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EXPLANATORY NOTE

In the information society the means for study and popularization of various knowledge, including artistic culture in common and certain types of arts in particular, are changing significantly.

The textbook is intended for training art history master students to use the modern information technologies in their professional career. The manual includes the training material on information technology tools, which, by the author's opinion, would be helpful for developing student's skills in investigating the art history field, generating the own ideas in the sphere of art and stimulating their creative thinking.

The purpose of the textbook "Information Technology in Art History" is to prepare students to use information technology as an effective means of organizing and providing research activities, implementing innovative ideas, and developing information resources for an expanding community of art professionals and amateurs.

The manual contains tutorials for text editing, images and music processing, statistical and dynamic graphics creating, etc.

The content of the textbook includes teaching units of theoretical material. Some units include practical sections. Practical sections consist of tasks. Practical tasks are aimed at the formation of universal competencies, skills in using information technology to solve research and innovation tasks, the ability to choose information and communication systems and technologies for solving professional tasks, the effective use of information resources in organizational and managerial activities, as well as stimulating creative thinking, generating your own ideas and developing tools to attract as many art connoisseurs as possible.

Tasks of the training manual:

– mastering methods and means of solving research problems in the field of culture and art using information technology;

– formatting the general ideas of how to apply information technologies in art history;

– studying the main computer instruments, which are the most relevant in the context of informatization, for developing digital resources on art history attracting art lovers;

– gaining the skills of creating a unique product via various information presentation techniques for expressiveness.

As a result of discipline study, the student should know:

– theoretical foundations of the functioning of art history information in society and the problems of informatization of culture and art;

– approaches to collecting and processing scientific data using information technology tools in the process of art research;

– modern achievements in the development and use of digital and communication technologies in the field of art history, both in theoretical and practical aspects;

– techniques of creating multimedia information products of the main of art.

Upon completion of the course, students will be able to:

– find and assess art history information on in the web-space and adapt it for further dissemination in the media environment;

– create multimedia information products of the main types of art;

– comprehensively use a variety of software tools to solve research and professional tasks on art history;

– use Internet media resources in the professional activity in art history;

– organize cultural institutions activities using cloud technologies;

– implement digital projects in the field of culture and art on the base of web platforms;

– create information resources in the media environment in accordance with modern standards.

The students should be experienced so that they can:

– apply approaches to design information tools for art and culture various areas;

– organize activities for implementation of art and culture project in a digital environment;

– develop media resources to attract art connoisseurs;

– design multimedia information products of spheres of art and culture.

The main forms of the educational process are lectures, seminars, laboratory work, an individual study of issues on information technology in art, the implementation of independent research based on modern information technologies. In the course of training, students must prepare a creative project (Appendix 1). The textbook includes recommendations for the presentation of creative tasks (Appendix 2).

The manual takes into account the structure of teaching. The lectures contain information on problematic theoretical issues of information modelling of objects, phenomena, processes and systems, the basics of designing information systems in various areas of art history and scientific research in the field of art history. The issues of information support of creative processes are considered. The practical sections of the textbook are aimed at developing the skills to use the tools of information technology in the development of creative projects.

UNIT 1. INFORMATIZATION OF SOCIETY

Main issues

1. Informatization of society. Advantages of informatization.
2. Main features of information society.
3. Information Society Challenges.
4. Synthesis of information technology and art.

Aim: to analyze the phenomenon of "informatization" and to investigate the main problem of informatization of society.

The information society is a new historical phase of the civilization development, whose main products are information and knowledge.

The information in the context of culture, on the one hand, is a source of its development, on the other hand, it is the channel of the culture transformation. Information is inherited in the form of social experience, contributing to the emergence of social and cultural memory. The place and the role of the information in the social and cultural memory structure is determined by the results of the interactions between traditions and innovations in the social evolutionary process. These days the humanity is living in the conditions of rapid information technology progress. New intellectual and humanitarian systems are being actively and constantly formed on the base of synergetic class information and communication resources. All the above phenomena have a significant impact on the development of contemporary art and culture contributing to the social transformation.

Let us consider three main directions in which the synthesis of information technology and art is currently developing:

– databases which are the cores of digital libraries and virtual museums;

– applications of computer technology in art design;

– information and communication technologies for the study of art.

These three directions are mainly put into practice through the media projects creating today. A media project is a type of media design being created and presented by the means of modern information and communication (or media) technologies and containing a video, audio, graphic and text content. The large part of media projects is carried out over the Internet. Successful media project maker is currently required to have

deep knowledge in the field of information technology and the skills of implementing various types of them for creating a media project or a part of it, if working in the group of specialists. However, not only the designer's proficiency in information technologies matters, the media project should be based on a creative idea and satisfy the laws of traditional art. So, one working in a media design sphere should cultivate both artistic abilities and a technological aptitude.

Nowadays, we come to the phenomena of media art which is considered being a unique medium of artistic expression that can amplify and integrate the traditional art forms by incorporating the technological advances of the contemporary world. The media artist utilizes a fundamental understanding of the mediums of analog and digital media to integrate digital technologies with traditional forms of artistic expression [1, p. 2].

Media art includes several ***directions*** that differ depending on the type of technologies used for the media product developing:

− video art, including VJing;
− sound art;
− media installation art, including media sculpture;
− media performance;
− computer animation;
− video games;
− robotics;
− cyborg art;
− 3D printing art;
− computer graphics;
− computer music;
− digital art;
− network art;
− Web art;
− virtual art.

However, the genres and forms of media art are not limited to enlisted above, since it is an extremely hybrid phenomenon in technical and methodological way, rapidly developing along with the evolution of technology.

Media art is a great example of information society development, but it is only the result of society's progress in the information technologies field. The emphasis on information and communication technologies provides an increasing efficiency in different spheres of society life, stimulating

innovations and also results in strengthening the competitiveness. The information became the product of mass consumption, which led to the formation of the information sector of the economy, growing much faster than other industries.

The informatization of society generates the following ***challenges*** and ***phenomena:***

− the digital technology spread;
− the information environment globalisation;
− the human intellectual capacity stimulation;
− the social systems complication;
− the challenges of information security;
− the challenges of social and psychological security.

Informatization has led to the expansion of information links between people, regions, countries, etc. So it is necessary to strive to use all the ***advantages of the informatization of society***, such as:

− high-quality and affordable services;
− high-speed implementing of innovations;
− increasing of labour efficiency;
− empowering the realisation of creative and cultural potential;
− making the lives of individuals and entire communities better.

The information society characteristics:

1) an increasing role of information and knowledge in the society;
2) an increasing information communications;
3) an increasing contribution of information products and services to the Gross Domestic Product;
4) developing the global information space that provides:
   − effective information interaction and coordination between people;
   − access to world information resources;
   − meeting the customer demand for information products and services.
5) changes in the social and professional society structure;
6) tranformation of moral values:
   − intellectual and moral capital is becoming one of the main types of social wealth;
   − high and increasing level of the cultural and spiritual values diffusion;
   − synthesis of the spiritual worlds of different nations.

7) changes in political relations: due to the world information systems creation the level of opinions, views, ideas exchanging between people is constantly increasing, so that ideological barriers are gradually being broken leading to the new political pardigms formed taking into account the sufficiently ucontrolled way of information circulation.

Informatization processes:

computerisation is an improvement of information retrieval and processing means;

mediatization is an improvement of collecting, distributing and storing information means;

intellectualization is a development of human abilities to perceive and generate information.

The positive side of informatization in the field of employment:

A. The transition to new forms of employment. For example, remote work, which erases the state borders when recruiting employees.

B. The rise in educational level of people in the world. The increasing number of contemporary job positions are focused on highly qualified specialists which are required to have not only university education but also to take permanently the educational courses for mastering their skills and gaining new knowledge.

C. Persons with disabilities and the elderly are able to continue working even after retirement.

Information Society Challenges:

1. The inequality in access to new information technologies at the international level and within each state.

2. The difficulties in the legislative regulation of the Internet.

3. The challenges of preventing the dissemination of terrorist, obscene, immoral and other materials, that pose a threat to the moral foundations of society.

Given the global nature of the Network, to cope with problems mentioned above is possible only through international cooperation.

There are two main ***theoretical*** and ***methodological approaches*** to the informatization of society:

The technocratic approach, which reduces the informatization of society to the technical and technological management and equipment of production processes. In this case, information technology is regarded as a means of increasing labour productivity.

The sociological approach considers informatization as a process covering all spheres of human activity, which affects the person in itellecual and morality fields, inflences the spiritual interests, personal development. In that context, the informatization of society is a combination of interrelated technical, economic, social, political, spiritual and cultural factors. This point of view considers the information expansion and large-scale information exchange in society as well one of the main factors of the further society development and improvement of its member's life quality.

The most notable technological transformation, which has fundamentally modified the human communication system is the widespread use of network technologies and the Internet. The communication capabilities of a person have changed due to quick connection to any group of Internet users, significant increase of the speed of receiving and transmitting information, enlarging the possibilities of information handling and opening the access to great variety of electronic archives and databases.

Conclusions

Informatization involves organizational, socio-economic, scientific and technical process for providing conditions for information sources creation.

Information technology is a set of methods and processes of creating, searching, receiving, transferring, collecting, processing, accumulating, storing, distributing, and handling information, including processes of information protection.

The global process of informatization of society is considered to be one of the general pattern of civilization evolution. This progress of society entails many scientific, technical, economic, and social developments. It significantly modifies the living conditions of people and their everyday life.

The informatization of society leads to progressive consequences but also brings challenges to modern society.

Key concepts: informatization of society, process of informatization, mediatization, intellectualization, information society challenges.

PRACTICE

Task 1. Terms of informatization processes

Match the terms of informatization processes with their definitions:

terms	definitions
1. Computerization	a) a development of human abilities to perceive and generate information.

2. Mediatization	b) an improvement of information retrieval and processing means
3. Intellectualization	c) an improvement of collecting, distributing and storing information means

1. ↔ ___ ; 2. ↔ ___; 3. ↔ ___.

Task 2. Media art genres

From the list below choose the genres which are related to the media art.

- ☐ ***VJing***
- ☐ ***robotics***
- ☐ ***sculpture***
- ☐ ***computer sound***
- ☐ ***web art***
- ☐ ***animation***
- ☐ ***cyber art***
- ☐ ***music***
- ☐ ***digital art***
- ☐ ***games***

Task 3. Informatization and information society

Consider the positive sides of informatization and information society challenges. Fill the following table using the statements bellow. Add your point of view to each column.

Information society challenges	***Positive sides of informatization***
1._____	1. _____
2._____	2._____
3._____	3. _____
4._____	4._____
_____	_____

A. The inequality in access to new information technologies at the international level and within each state.

B. The transition to new forms of employment. For example, remote work, which erases the state borders when recruiting employees.

C. The Challenges of preventing the dissemination of terrorist, obscene, immoral and other materials, that pose a threat to the moral foundations of society.

D. The increse in the educational level of people in the world.

E. The difficulties in the legislative regulation of the Internet.

F. Persons with disabilities and the elderly are able to continue working even after retirement.

Task 4. Information society caracteristics

Name the main information society caracteristics:

1) an increasing role of _____;

2) an increasing information _____;

3) an increasing contribution of _____ to the Gross Domestic Product;

4) developing the global _____ that provides:

− effective information _____;

− access to _____;

− meeting the customer demand for _____.

5) changes in the _____ structure;

6) tranformation of moral values:

− _____ capital is becoming one of the main types of social wealth;

− high and incresing level of _____ diffusion;

− synthesis of _____.

6) changes in _____ relations: due to the world information systems creation the level of _____ is constantly increasing, so that _____ are gradually being brocken leading to the new _____ formed taking into account the _____.

TALKING POINTS

Discuss the Internet resources for making cultural research.

Discuss the types of information technologies that are used in Arts and Culture fields.

Discuss the types of information technologies that are used in scientific research.

Speak on advantages and disadvantages of informatization for society, culture and art.

Give your opinion on informatization of society prospective in culture and art.

COMPUTER TRAINING

Training 1: Internet resources for Culture and Art Study

• Get to know the Internet resources presented in the ***Culture and Art Study*** list.

• Consider the three main directions of information technology and art sphere synthesis.

• Put the Internet recourses names you have just studded in the appropriate column of the table:

Databases which are the cores of digital libraries and virtual museums	**Applications of computer technology in art design**	**Information and communication technologies for art study services**
1. 2._____ …	1._____ 2._____ …	1._____ 2._____ …

• Explain your choice

CULTURE AND ART STUDY

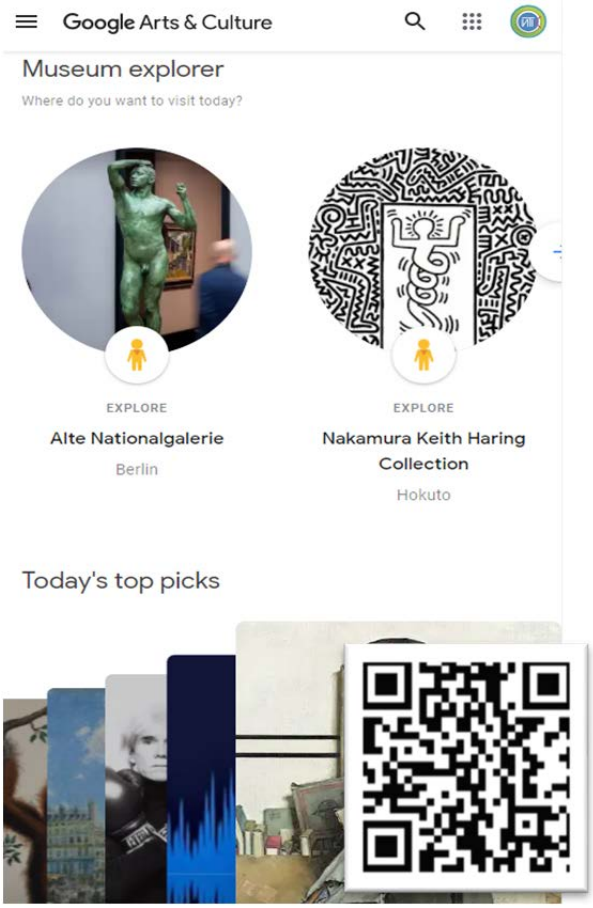
A: LearningApps

https://learningapps.org/



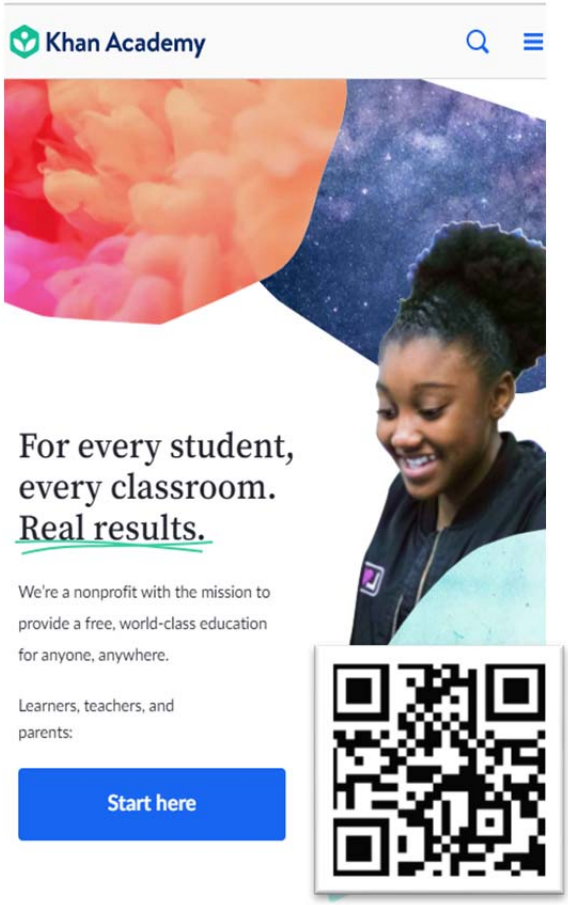
C: Google Arts and Culture

https://artsandculture.google.com/



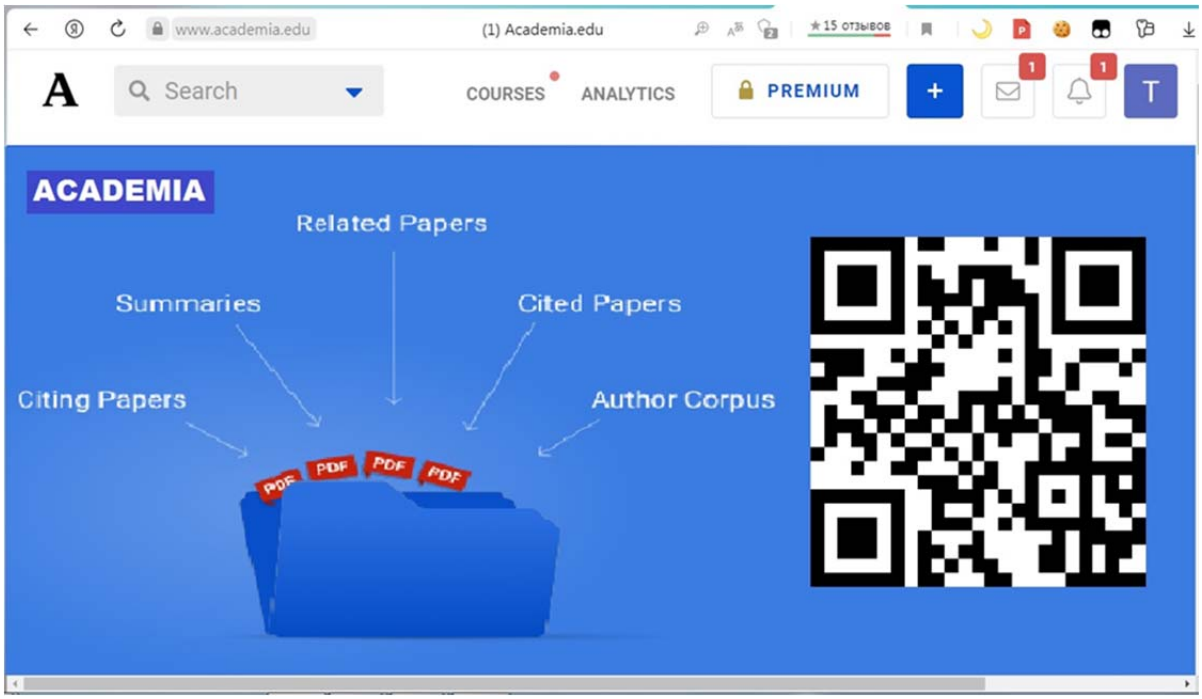
D: Khan Academy

https://www.khanacademy.org/



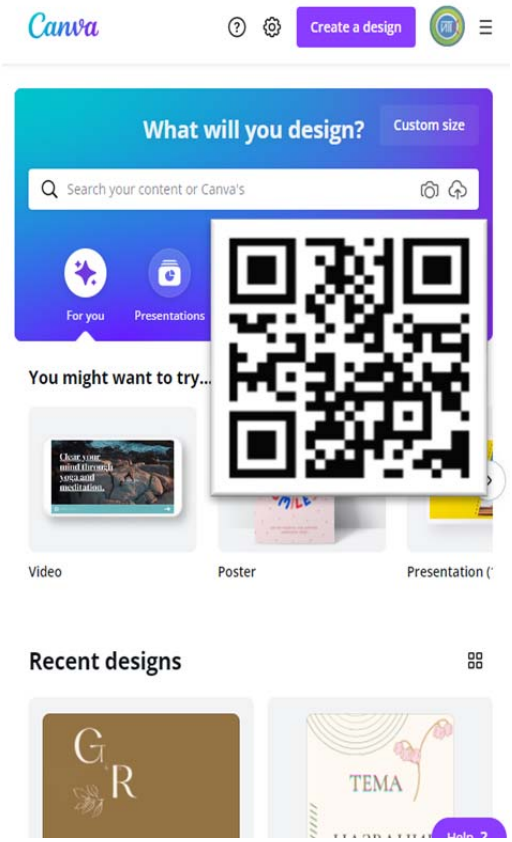
B: ACADEMIA

https://www.academia.edu/



E: CANVA

https://www.canva.com/



F: GRAVIT DESIGNER

https://www.designer.io/en/



Training 2: Information and communication technologies for art study services

• Access ***Khan Academy*** project via https://www.khanacademy.org/ . Observe the ***Khan Academy*** internet site. Give your opinion on Khan Academy site, it is intended for: 1)_____;
2)_____;
3)_____ ;
4)_____.

• Choose Art History course on Khan Academy site (Figure 1.1). Explore how the scientific information on Art History is presented for learners via video and text material (Figure 1.2). Pay attention, that some topics have Practice options, containing the quiz questions on significant theory points (Figure 1.3).

• Study one of the Art History topics. Watch one video and one article on the topic chosen, and then complete the Quiz. First, as an example, consider the topic: ***Europe1800-1900 | Romanticism | Romanticism in France*** (Figure 1.2–1.4).

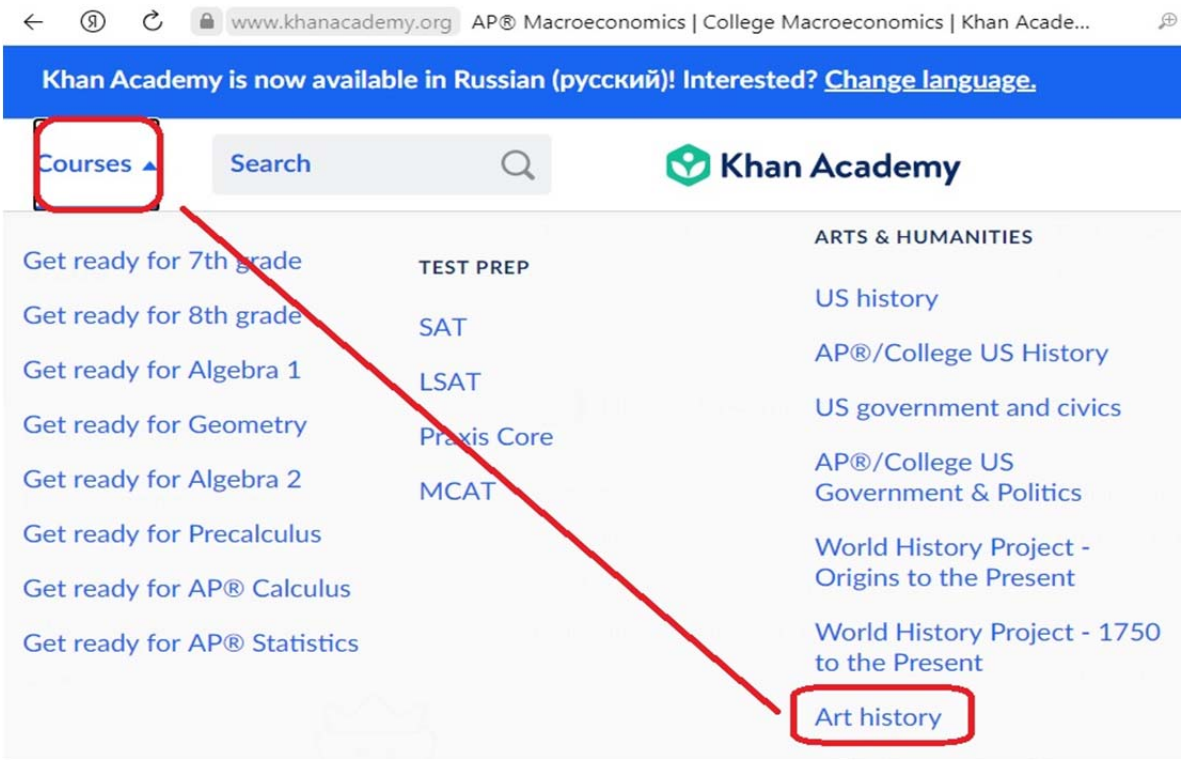


Figure 1.1 – Khan Academy | Arts & Humanities | Art History

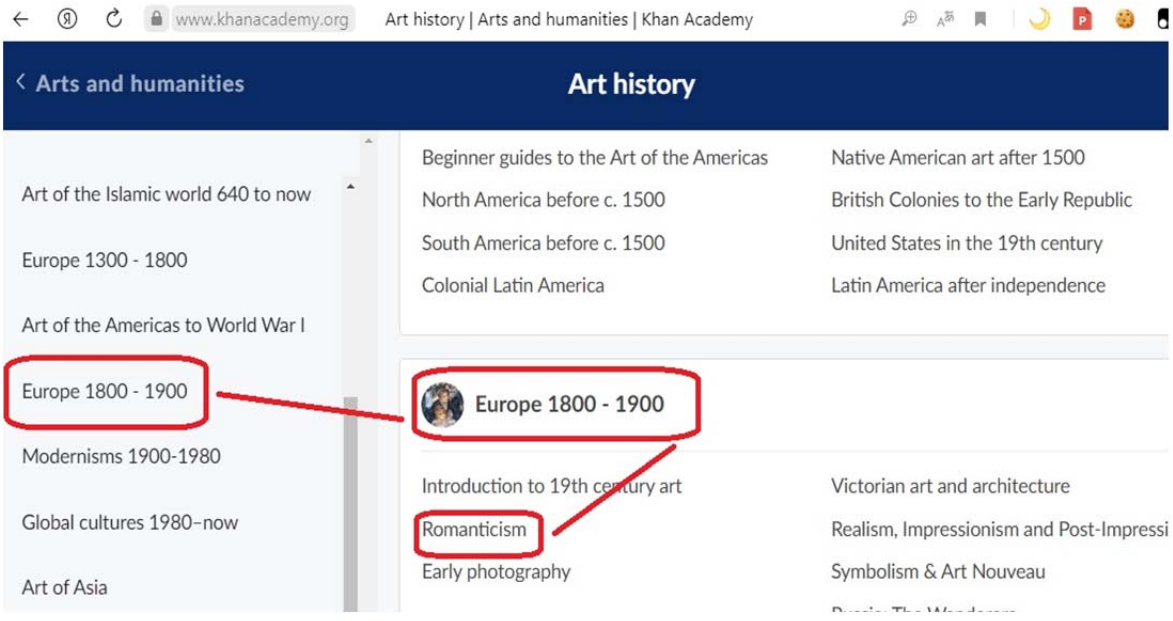


Figure 1.2 – Khan Academy |…| Art History | Europe1800–1900 | Romanticism

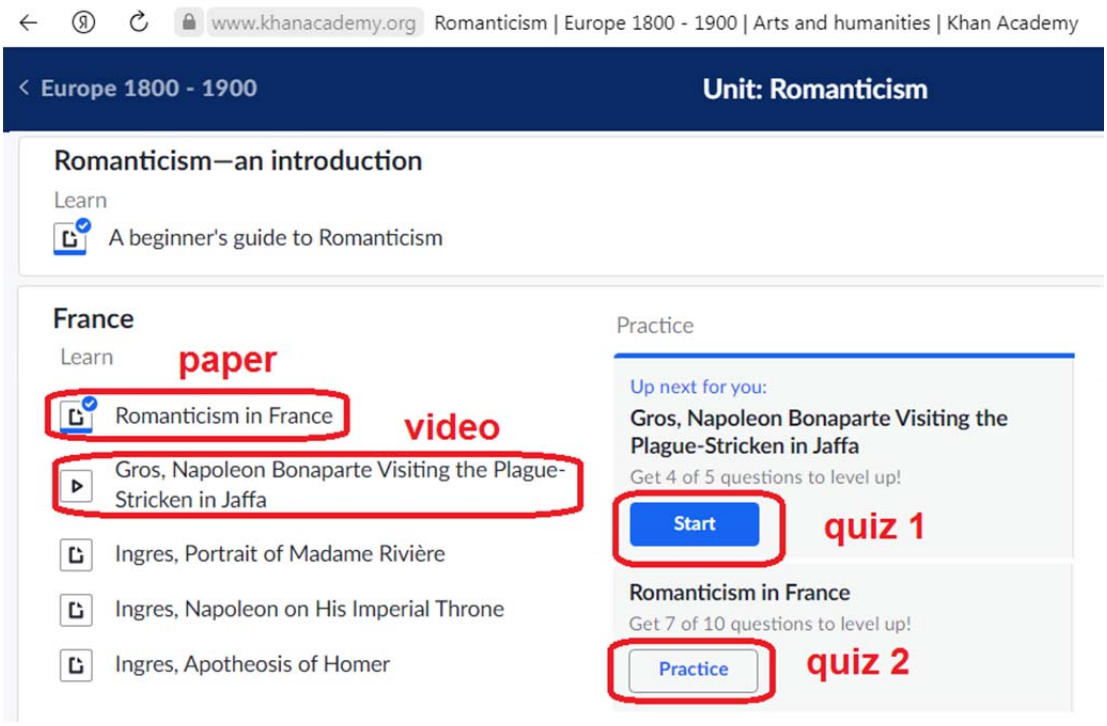


Figure 1.3 – Khan Academy |…| Europe1800–1900 |…| Romanticism in France

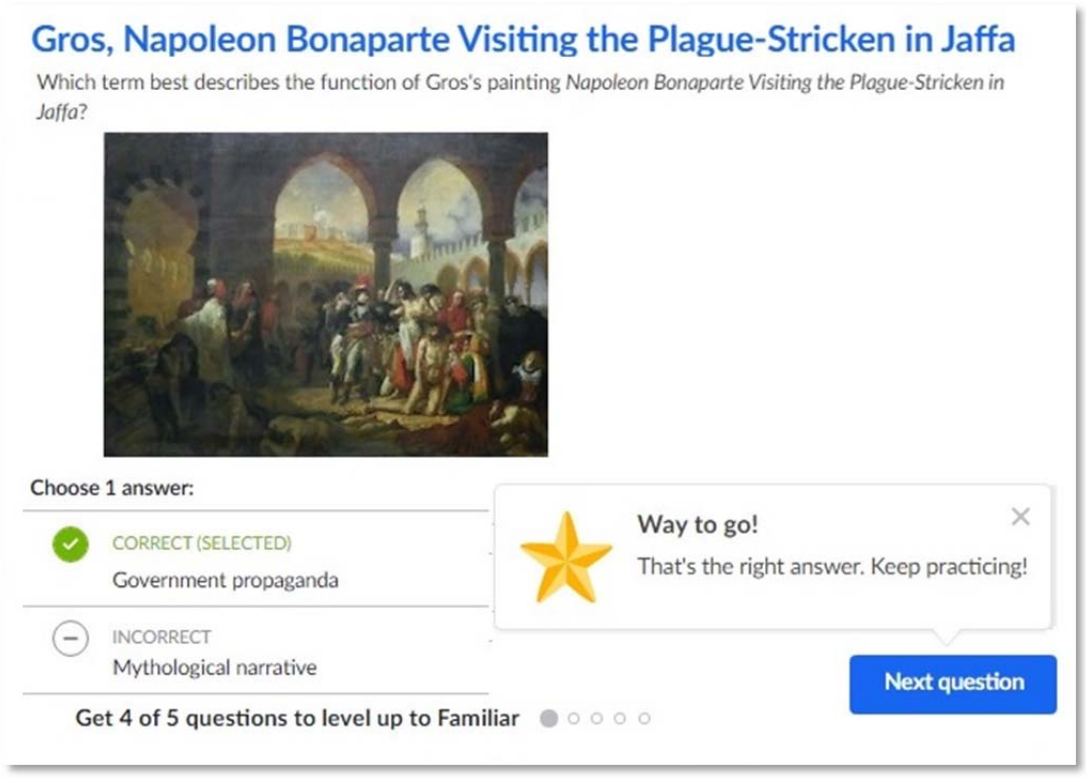


Figure 1.4 – Khan Academy |…|…|…| Romanticism in France | Practice

Note, that the quiz is developed in such a way that learners could memorize the important issues, thus each question has hint, reminding the essential point discussed in the text or video presentation.

INDIVIDUAL TRAINING

For individual training, choose one of the topics from the INDIVIDUAL TRAINING SECTION list. The topics deal with the synthesis of art and information technology, giving rise to new art genres and forms, in other words, genres of media art. Use the topic chosen to complete all the tasks from INDIVIDUAL TRAINING section. Later in the text, we will refer to the topic chosen as an ***Individual Topic***. In this manual the topic ***«3D Modeling and Sculpture»*** is used as the **Individual Topic** sample to demonstrate how to complete the tasks of the INDIVIDUAL TRAINING section.

Training 1: Navigating on Internet libraries

- Download three scientific papers on the *Individual Topic* from Internet libraries proposed below.

Library name	Link
SCIENCEDIRECT	https://www.sciencedirect.com/
JSTOR	https://www.jstor.org/
RESEARCHGATE	https://www.researchgate.net/about
ACADEMIA	https://www.academia.edu
GOOGLE SHOLAR	https://scholar.google.com/
ACM DIGITAL LIBRARY	https://dl.acm.org

- Make a bibliography list of five sources for the *Individual Topic* using the following digital library catalogues

Digital library catalogue name	Link
SCOPUS	https://www.scopus.com/
WEB OF SIENCE	http://webofknowledge.com
WORLDCAT	https://www.worldcat.org/

Put the bibliography sources according to the standard proposed bellow: *The first author second name, the first letter of the first name. Title / All the other authors. – Publisher, year. (– Volume for journals.) – Pages.*

Example:

Caterina, B. 3D printing: State of the art and future perspectives / Caterina Balletti, Martina Ballarin, Francesco Guerra. – Journal of Cultural Heritage, 2017. – Volume 26. – P. 172–182.

- Add to the completed bibliography list three scientific papers downloaded for *Individual Topic* from the first point of the training.

Training 2: Supporting research conclusions by Internet scientific papers statements

- Compose three perspectives of the development of media art, mentioned in **Individual Topic** and support your opinion by the citations from the papers downloaded in the **Training 1.**

Example: Topic: «3D Modeling and Sculpture»

Papers downloaded:

1. Hua, L. Research on Sculpture Art Based on 3D Printing Technology / Lei Hua & Tingzhou Tian // Proceedings of International Conference on Artificial Intelligence and Information Technology (ICAIIT 2020). – Journal of Physics: Conference Series, 2020. – 1533. – 6 p. – doi:10.1088/1742-6596/1533/2/022030.

2. Brans, K. 3D Printing, a Maturing Technology / Karel Brans // Proceedings of 11th IFAC Workshop on Intelligent Manufacturing Systems May 22–24, 2013. São Paulo, Brazil. – The International Federation of Automatic Control, 2013. – P. 469–472. – https://doi.org/10.3182/20130522-3-BR-4036.00112.

Prospective:

- In near future the decorations for the buildings will be modelled on the computer and printed via 3D printing. This supposition is supported by the research of Lei Hua and Tingzhou Tian where they confirm the progress in 3D printing technology: «In recent years, 3D printing technology has become more mature, the printing accuracy has gradually improved, and the size of printable components has also become larger and larger, and it has been able to meet the size requirements for printing proportional art sculpture components» [1].

- In the coming years consumers will be able to print 3D models as today one can use 2D printing, thus in his research Karel Brans state: «To support the revolution of 3D Printing for consumers, it is the vision of Materialize that 3D Printing should become as easy as 2D printing in the future…As in real manufacturing, consumers do not want to be overloaded with options and settings, they just want to get their part printed in the easiest, most automated way» [2, p.472].

UNIT 2. MULTIMEDIA IN ART HISTORY RESEARCH ORGANIZATION AND PRESENTATION OF THE STUDY RESULTS

Main issues

1. Multimedia
2. Digital communication
3. Net-Art
4. Virtual reality and augmented reality.

Aim: to explore and analyse advantages and prospective of multimedia for art history research organization and presentation of the study results.

«Multimedia», «media culture», and «media art» are modern concepts used in the information technology disciplines. These phenomena are not synonymous but do have some points in common.

The term «multimedia» is ambiguous. On the one hand, multimedia is considered to be a multimedia program, a product created on the basis of multimedia technology and computer equipment [8]. On the other hand, multimedia is treated as a special type of computer technology that combines both traditional static visual information (text, graphics) and dynamic speech, music, video fragments, animation, etc. This «technical and technological interpretation» of the concept of «multimedia» is most often used by specialists in the field of computer technology [8].

A multimedia «poly-environment» is a unified environment which provides a syncretic representation of different types and methods for text, graphics, sound and video information handling. However, it is too narrow to consider multimedia only as a type of computer technology or as a marketing tool. Currently, modern information and communication technologies (the Internet) are intensively developing and becoming a more effective tool for individual creativity and collective cooperation. Progress and innovation are inherent to the logic of the technological development. Common research interests of local and international communities, easily accessible and direct communication, as well as the freedom of access to information (cultural and art servers, mailing lists, videoconferences, etc.) stimulate the cultural and art development in a high degree.

Multimedia, as any progressive phenomenon, poses ***challenges to society***, for example, such as:

− the mosaic nature of culture, which influenced the educational models;

− eclecticism of the knowledge which is opposite to a systemic worldview based on a holistic approach paradigm;

− orientation towards reproduction instead of creativity;

− transmitting the culture of an art to «virtual environment» etc. [8].

Thus, the shift towards «virtual culture» poses new problems which include:

1) inaccessibility of certain information (information with limited access dependent on the status of the user);

2) imprecision of materials (errors in digital libraries, permitted by scanning materials);

3) abundance of advertising, resulting in the «information noise», etc.

Marshall McLuhan (Figure 2.1) was the first mass media theorist. In the 1970s, he predicted the onset of information technology era. He proposed a culturological concept which describes the sequential evolution of technical means producing a revolutionary convert of all practices and accompanying theory of interpersonal communication considering the different periods of history - from the wheels and the Gutenberg printing press to the supersonic aircraft, and colour television [9]. However, in this chain, computers and the global Internet are not mentioned. McLuhan died a year before the invention of a personal computer in 1980. But he managed to predict many changes in the field of communication technologies taking place in our lives.



Figure 2.1 − Marshall McLuhan

Digital or electronic communication creates new forms of social interaction without physical presence (physical communication). Digital communication is no longer subject to laws of any state and is not limited by

language or social barriers. New types of micro-communities emerge: small associations of people that are outside geographic and other boundaries. New forms of idea exchange, information control, and accounting appear and are implemented. Space «disappears», time «slips away». Multimedia computer equipment and media technology of the electro-digital communication era cease to be strictly separated and, to some extent merge, integrate (Figure 2.2). Multimedia becomes an advanced phase in the history of media that links the history and culture of communication [1].



Figure 2.2 − Multimedia means

Multimedia is a long history of images, therefore multimedia should be considered as an art, where a special place belongs to visual-spatial ways of transferring information such as computer graphics, animation, video, etc. Multimedia as a form of art with new means artistically expressed but also reflects the artistic content (Figure 2.3).



Figure 2.3 − The Multimedia Show «Van Gogh Alive»,
China tour, Beijing (2015) [China Daily Photo]

The new art, which did not find its prospects for implementation in the traditional framework of fine arts, was called «network art» (NetArt) or «cyberculture». NetArt includes works created on the Internet, for the Internet, that are exhibited, exist and function on the Web. It differs both from Web-design, artistic page design, and from traditional types of art presented on the Web (museum sites, paintings «posted» on the pages, photographs etc.). One of the main features of the NetArt is the proclaimed focus on communication rather than representation. That means that the artist's aim is not to impose his own personal vision, but communication – to communicate with the viewer, to involve him in a creative dialogue (Figure 2.4).

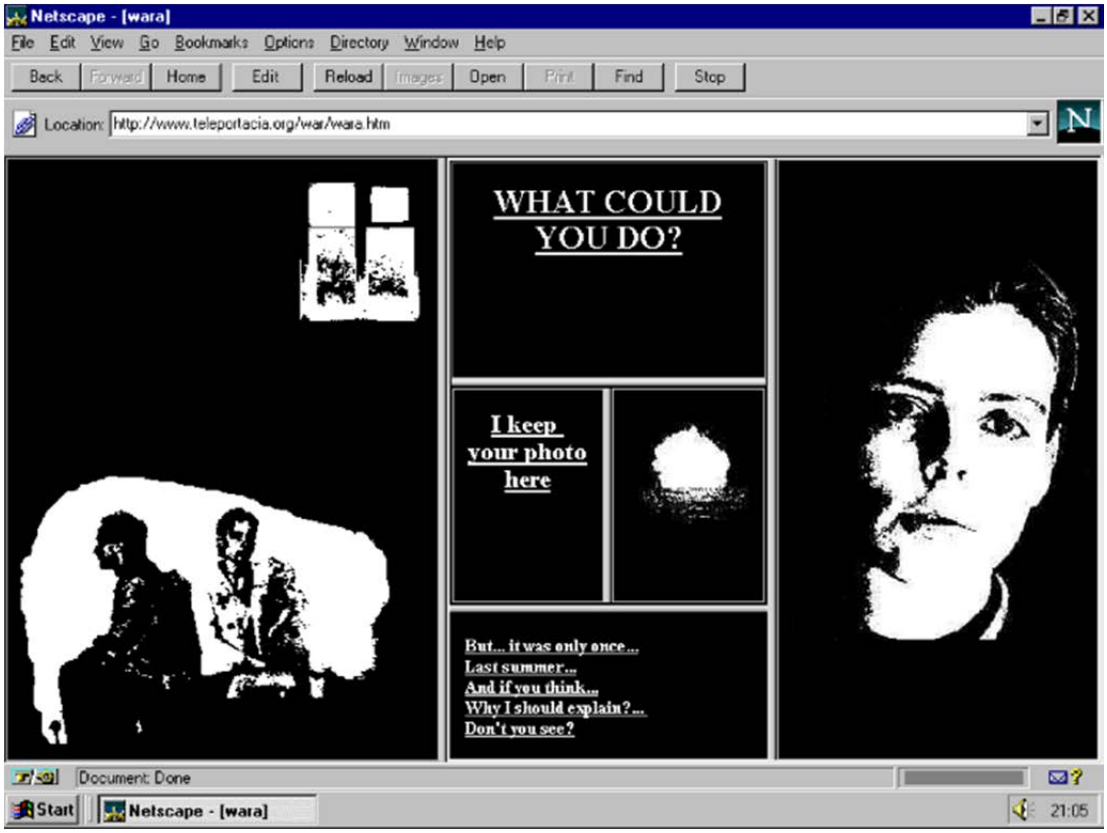


Figure 2.4 − Olia Lialina, My Boyfriend Came Back from the War, 1996. This internet-based work is interactive, having its windows split into more frames each time the user clicks on the image

Virtual reality is an artificial reality created using software and hardware (Figure 2.5). A two-way connection is formed between artificial reality and the person perceiving it. A dynamic model of reality is created by means of three-dimensional computer graphics and provides a user interaction with virtual objects in real time with the effect of his participation in the constructed scenes and events.

Augmented reality is a real-time environment that complements the physical world, as we see it, with digital data using any devices such as tablets, smartphones or others, and the software part. In augmented reality, virtual objects are projected onto a real environment (Figure 2.6). Virtual reality creates a world where a person can immerse himself, and augmented reality adds virtual elements to the real world. Mixed or hybrid reality combines both approaches.



Figure 2.5 −Virtual reality: project checking



Figure 2.6 − Augmented reality in Australian museum

Conclusions

One of the main features of informatization of culture is the widespread of multimedia, the use of virtual reality and digital or electronic

forms of communication in all spheres of society. To some extent multimedia could be considered as a form of art, where a special place belongs to visual-spatial ways of transferring information such as computer graphics, animation, video, etc. As a form of art multimedia art has its own innovative means of artistic expression and reflection of the artistic content.

Virtual reality is an artificial reality created using software and hardware. A dynamic model of reality is created by means of three-dimensional computer graphics and provides a user interaction with virtual objects in real time with the effect of his participation in the constructed scenes and events.

Key concepts: media environment, virtual reality, augmented reality, multimedia.

PRACTICE

Task 1

Marshall McLuhan was the first mass media theorist, who in the 1970s predicted the onset of information technology era. He proposed a culturological concept which describes the sequential evolution of technical means producing a revolutionary convert of all practices and accompanying theory of interpersonal communication. What technical means didn't Marshall McLuhan mention in his theory?

- ☐ Wheels
- ☐ Gutenberg printing press
- ☐ Supersonic aircraft
- ☐ Colour television
- ☐ Computer
- ☐ The Internet

Task 2

Name the Multimedia challenges referring to the text with empty spaces bellow. Multimedia, as any progressive phenomenon, brings challenges, such as:

− _____ nature of culture, which influenced the _____;

− _____of the knowledge which is opposite to a _____based on a _____;

− orientation towards _____ instead of _____;

− transmitting the culture an art to _____.

Task 3

Match the terms with their definitions:

terms	definitions
1. Multimedia	a) is the variety of works created on the Internet, for the Internet, that are exhibited, exist and function on the Web with proclaiming focus on communication rather than representation.
2. Multimedia poly-environment	b) is a real-time environment that complements the physical world, as we see it, with digital data and the software part by means of electronic devices (such as tablets, smartphones or others), virtual objects being projected onto a real environment.
3. Digital or electronic communication	c) is a special type of computer technology that combines both traditional static visual information (text, graphics) and dynamic speech, music, video fragments, animation, etc
4. Net-Art	d) is a new form of social interaction without physical presence which is not limited by language or social barriers.
5. Virtual reality	e) is a unified medium which provides syncretic representation of different types and methods for text, graphics, sound and video information handling.
6. Augmented reality	f) is an artificial environment created by means of software and hardware providing a user interaction with artificial objects in real time with the effect of his participation in the constructed scenes and events.

1. ↔ ___; 2. ↔ ___; 3. ↔ ___; 4. ↔ ___; 5. ↔ ___; 6. ↔ ___.

Task 4

Speak (in four groups) on the differences between:

− virtual reality and augmented reality;

− Net-Art and Web-design;

− digital or electronic communication and physical communication;

− reproduction instead of creativity;

− eclectic the knowledge and the knowledge based on a holistic approach paradigm.

TALKING POINTS

1. Speak on the advantages and disadvantages of multimedia presentations.

2. Describe the ways and means of using multimedia presentation in your professional activity.

3. Give the examples from the culture and art sphere where multimedia could be considerd as:

− means of communication;

− means of artistic creation;

− a type of computer technology.

COMPUTER TRAINING

Training 1: Interactivity with Google Forms

- Follow the ***Khan Academy*** link https://www.khanacademy.org.
- Choose the article from the *Art History*, which is interesting for you. See the Computer training of the Unit 1 for navigation on Khan Academy site.
- Create an educational QUIZ for the paper chosen.

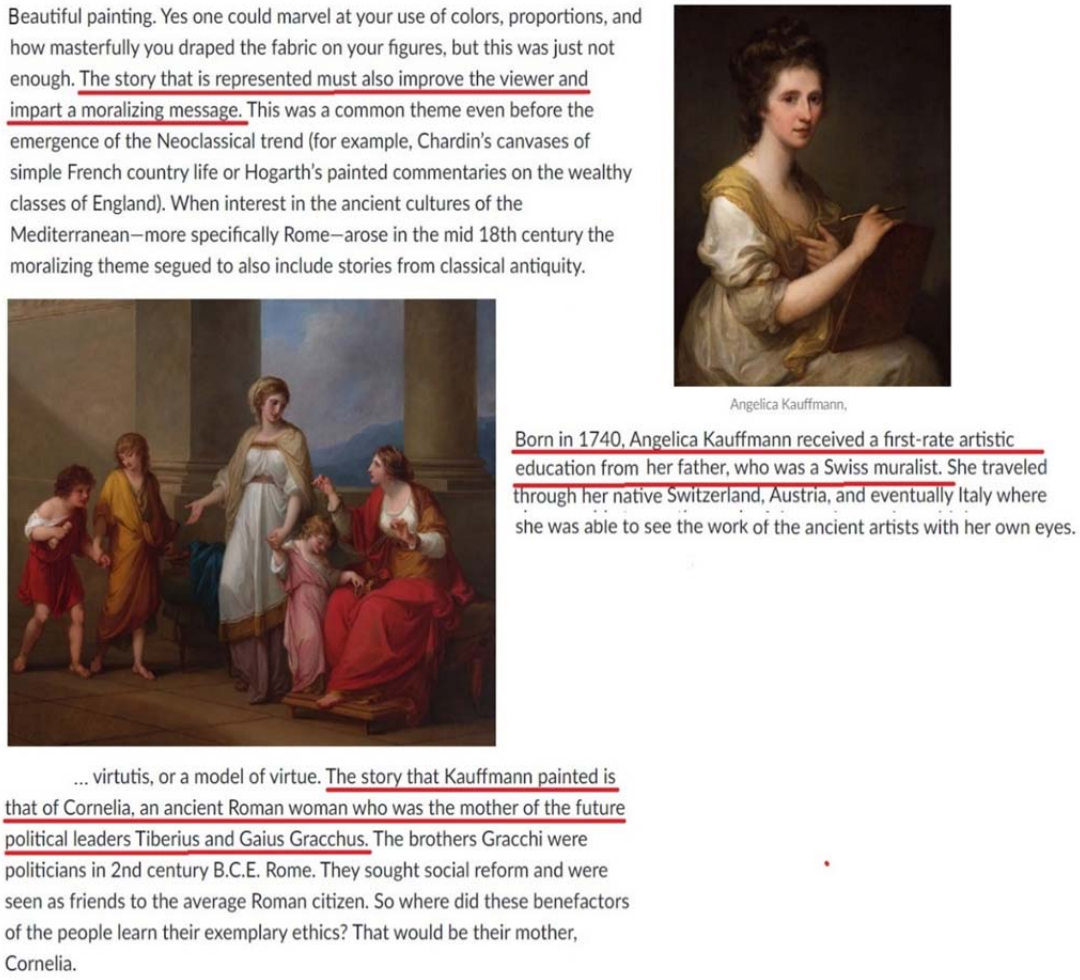


Figure 2.7 – Europe 1300-1800 | Rococo and Neoclassicism 18th century | Kauffmann, Cornelia Presenting Her Children as Her Treasures

EXAMPLE

For the training EXAMPLE, the article on analysis of A. Kauffmann painting «Cornelia, Mother of the Gracchi, Pointing to her Children as Her Treasures» is proposed (Figure 2.7).

First, it is necessary to design a Quiz, that is to choose the significant points of the article and develop questions. Mind to save the ***screenshots*** with information chosen for quiz to create hints after (Figure 2.8).


Beautiful painting. Yes one could marvel at your use of colors, proportions, and how masterfully you draped the fabric on your figures, but this was just not enough. The story that is represented must also improve the viewer and impart a moralizing message. This was a common theme even before the emergence of the Neoclassical trend (for example, Chardin's canvases of simple French country life or Hogarth's painted commentaries on the wealthy classes of England). When interest in the ancient cultures of the Mediterranean—more specifically Rome—arose in the mid 18th century the moralizing theme segued to also include stories from classical antiquity.

Angelica Kauffmann,

Born in 1740, Angelica Kauffmann received a first-rate artistic education from her father, who was a Swiss muralist. She traveled through her native Switzerland, Austria, and eventually Italy where she was able to see the work of the ancient artists with her own eyes.

... virtutis, or a model of virtue. The story that Kauffmann painted is that of Cornelia, an ancient Roman woman who was the mother of the future political leaders Tiberius and Gaius Gracchus. The brothers Gracchi were politicians in 2nd century B.C.E. Rome. They sought social reform and were seen as friends to the average Roman citizen. So where did these benefactors of the people learn their exemplary ethics? That would be their mother, Cornelia.

Figure 2.8 – Selecting the significant points from the article

Quiz design

Question 1

Initial message: «…The story presented should also enhance the viewer and convey a moral message. This was a common theme even before the emergence of the Neoclassical trend…»

Task 1: Choose one word answer for the following question:

What kind of the message, according the Neoclassical trend should any story convey?

a) advertising

b) moralising

c) entertaining

Question 2

Initial message: «… The story that Kauffmann painted is that of Cornelia, an ancient Roman woman, who was the mother of the future political leaders Tiberius and Gaius Gracchus.…»

Task 2: Choose all proper options.

Kauffmann painted an ancient Roman woman Cornelia, who was the mother of _____.

1. Roman political leader Tiberius
2. Roman philosopher Seneca
3. Roman philosopher Marcus Aurelius
4. Roman political leader Gaius Gracchus

Question 3

***Initial message*:** «… Born in 1740, Angelica Kauffmann received a first-rate artistic education from her father, who was a Swiss muralist.…»

Task 2: Choose all proper variants.

Angelica Kauffmann didn't receive a first-rate artistic education from the person, who was a _____.

1. Architect
2. Muralist
3. Painter
4. Sculptor

Creating Quiz with Google Forms

Having designed the quiz one needs to choose the Internet platform or program for creating the quiz interactive. The first platform we propose to get acquainted with interactive tools is ***Google Forms***. ***Google Forms*** are accessible on ***Google Drive*** for those who has ***Google Account (Figure 2.3)***.

Thus, the first step is to create ***Google Account*** or to access it in case one has it and go to ***Google Drive***. See Figure 2.9, step 1,2.

Then, it is necessary to ackees ***Blank Quiz*** on ***Google Forms***, see Figure 2.9, step 3-5.

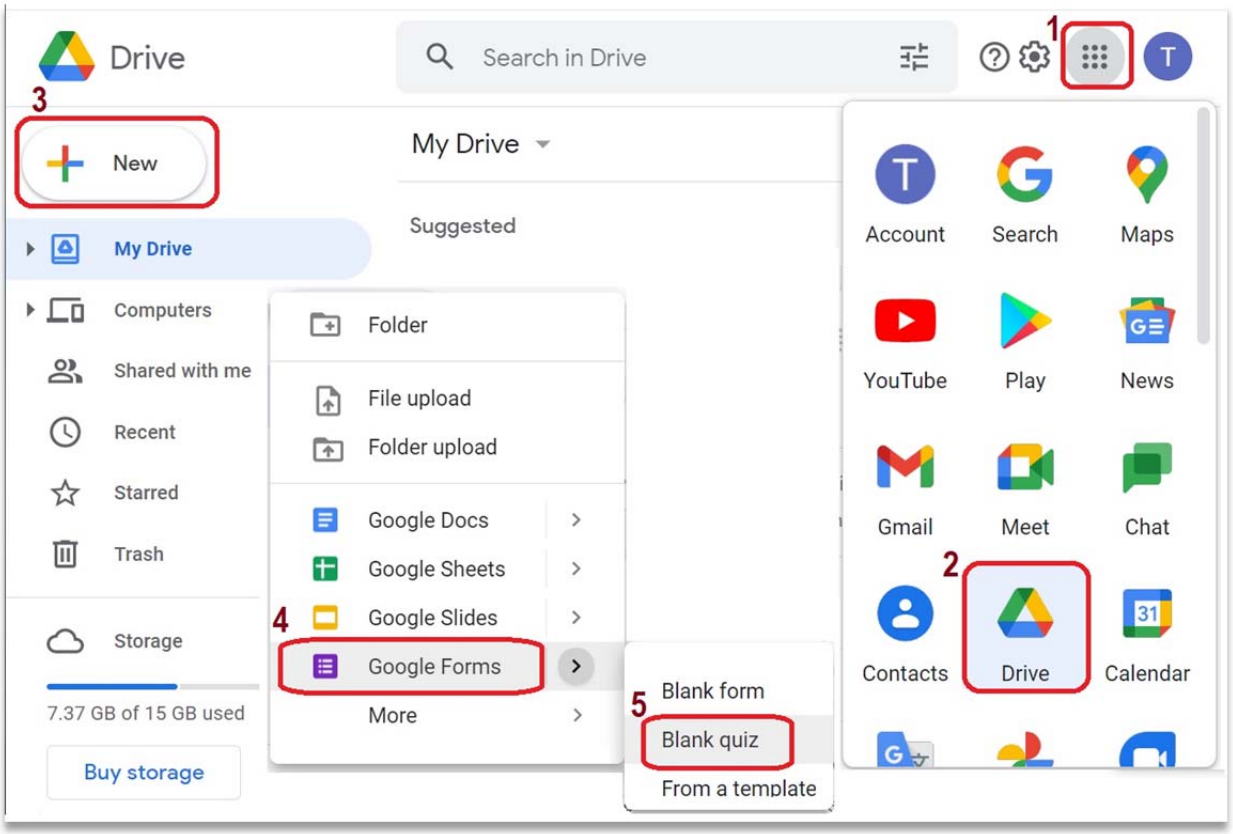


Figure 2.9 – Access to Blank Quiz on Google Forms

Next step is filling the fields of the ***Blank Quiz*** with the ***Quiz Name*** and ***Questions*** following the scene of the Figure 2.10



Figure 2.10 (a) – Quiz Name

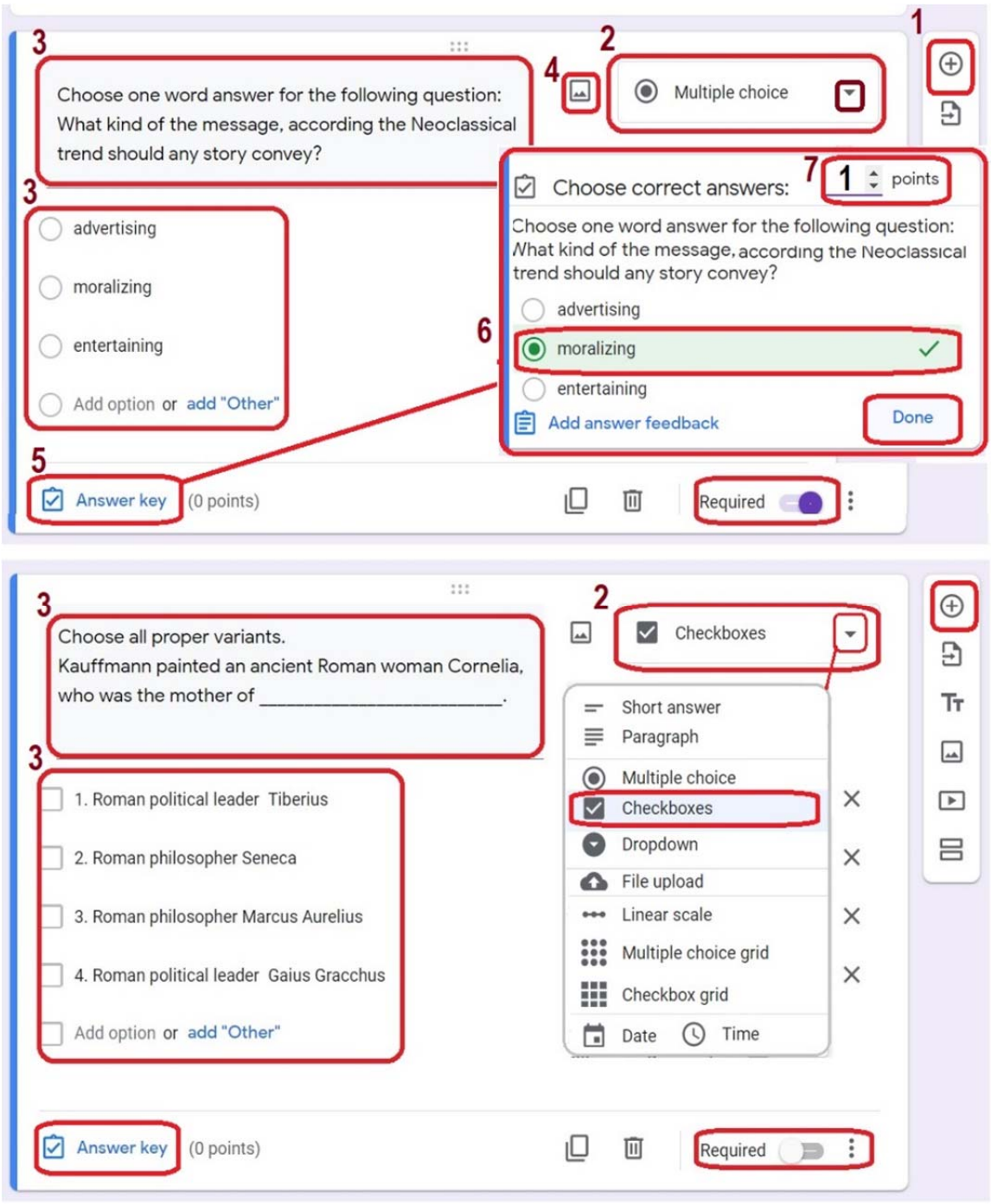


Figure 2.10 (b) – Quiz Questions

- Click the plus symbol to add a question to the quiz (Figure 2.10 (b) – 1).
- Use the dropdown menu to choose the type of question you're asking (short answer, multiple-choice, checkbox, dropdown, etc.) (Figure 2.10 (b) –2).
- Type in your question and, if applicable, any answer options (Figure 2.10 (b) – 3).
- Add images or videos to the question if needed for explanations or examples (Figure 2.10 (b) – 4).

• Add an answer key to your Google Forms quiz, cliking the Answer Key link below the question (Figure 2.10 (b) – 5).

• Choose the correct answer to the question (Figure 2.10 (b) – 6).

• Assign a point value for the question (Figure 2.10 (b) – 7).

• Click the Add Answer Feedback link if you want to provide students with feedback after answering a question. Enter the feedback you want to provide for correct and/or incorrect answers, and click Save (Figure 2.10 (c) – 8).

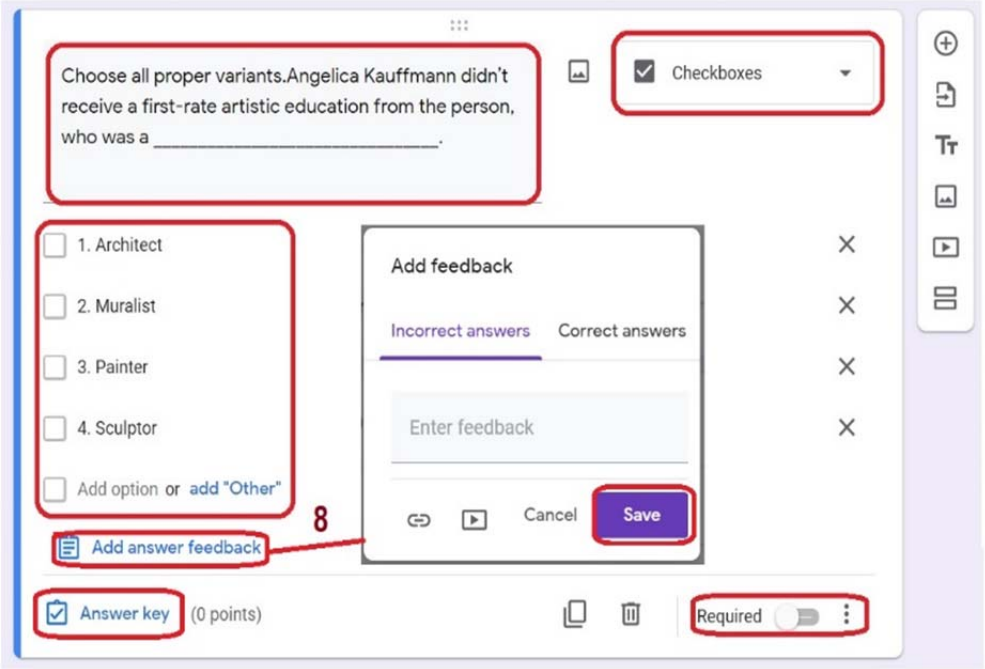


Figure 2.10 (c) – Feedback option

Repeat all of the steps above for each question you want to add to your quiz. And the last step of quiz creation is to adjust quiz settings (Figure 2.11).

•When you're finished, click the Send button, and adjust the sending settings (Figure 2.11 – 1).

• Choose theme options for quiz (Figure 2.11 – 2).

General Settings:

• Check the boxes next to Collect email addresses and Response receipts if you want respondents to turn in a printed confirmation that they completed the quiz (Figure 2.12 – 1,2).

• Check the box next to Limit to 1 response if you don't want respondents to be able to take the quiz more than once (Figure 2.12 – 3).

Presentation Settings:

• Check the box next to Show progress bar if you want respondents to see a visual indicator that shows how many more questions they have to answer (Figure 2.12 – 4).

• Check the box next to Shuffle question order if you want all of respondents to receive the questions in random order (Figure 2.12 – 5).

• Customize the text in the Confirmation message box. This is the text that displays when respondents complete the quiz and is a good place for reminders like «Make sure to print this page and turn it in tomorrow morning» (Figure 2.12 – 6).

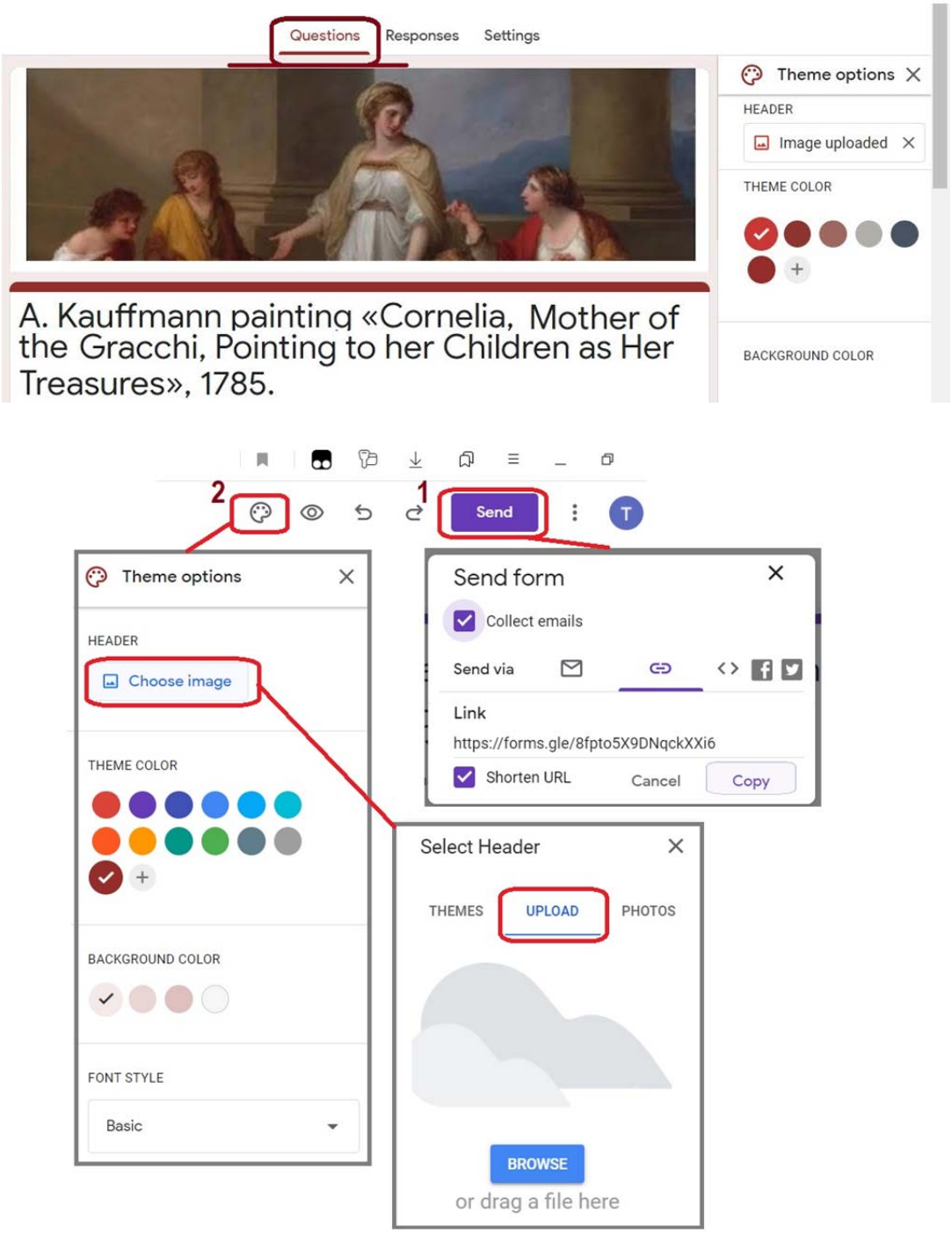


Figure 2.11 – Sending settings

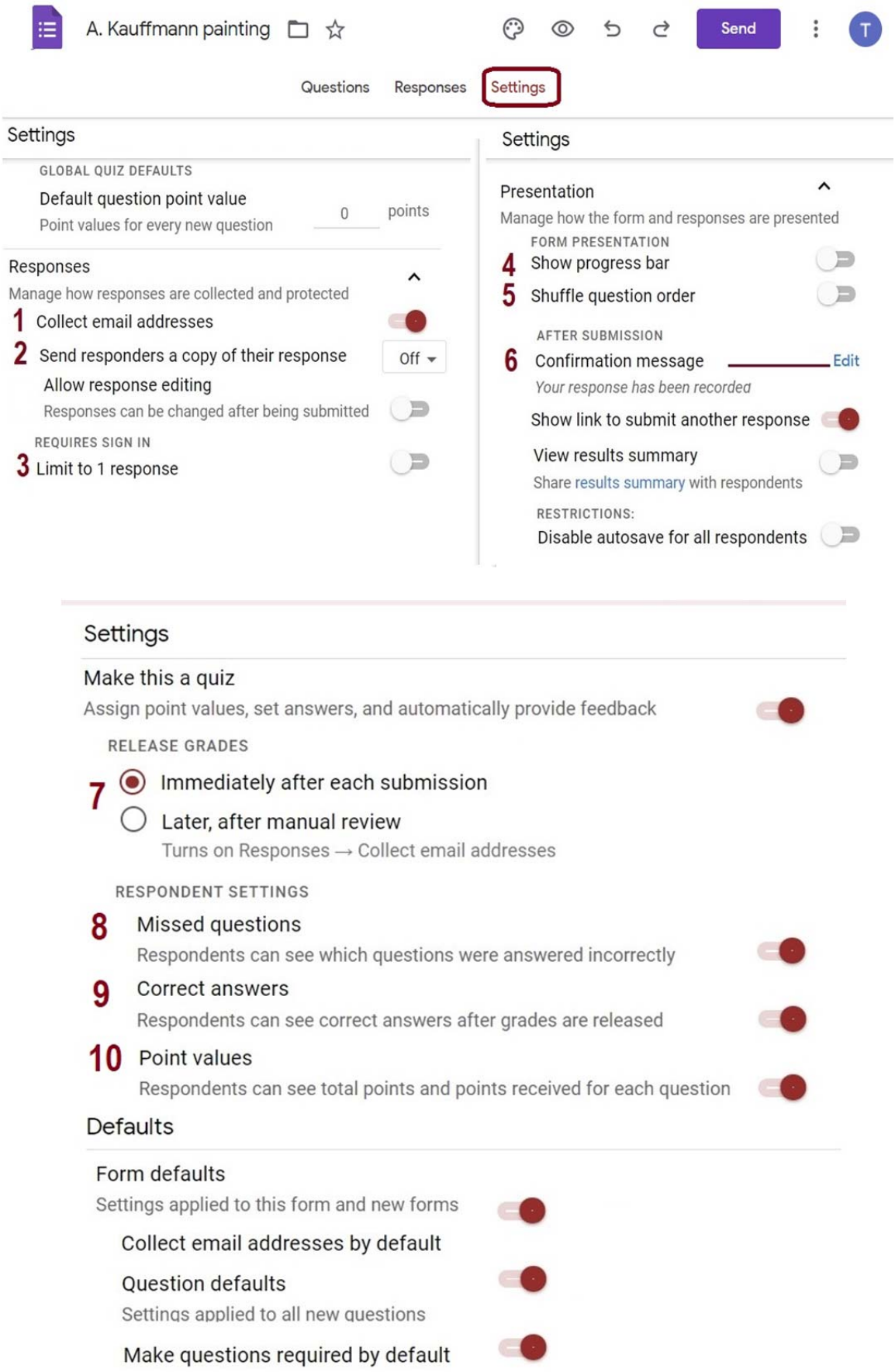


Figure 2.12 – General Settings

Quizzes Settings:

• Choose option when respondents should receive their grade by selecting the radio button next to either Immediately after each submission or Later, after manual review (Figure 2.12 – 7). • Check the box next to Missed questions if you want respondents to be able to see which questions they answered incorrectly (Figure 2.6 – 8). • Check the box next to Correct answer if you want respondents to be able to see the answer key after their quiz has been graded (Figure 2.12 – 9). • Check the box next to Point values if you want respondents to be able to see how many points each question is worth (Figure 2.12 – 10).

After saving your settings, click Send again (Figure 2.11 – 1). Choose how you want to send the quiz to respondents: You can send it by email, create a custom URL for the quiz, or embed the entire quiz on your website. If you're sending the quiz via email, enter the respondents' email addresses, and click Send.

After respondents have completed the test, return to the quiz to see the grades for each of respondents (Figure 2.13). Click the spreadsheet icon to send the quiz grades to a new or existing Google Sheets grade book.

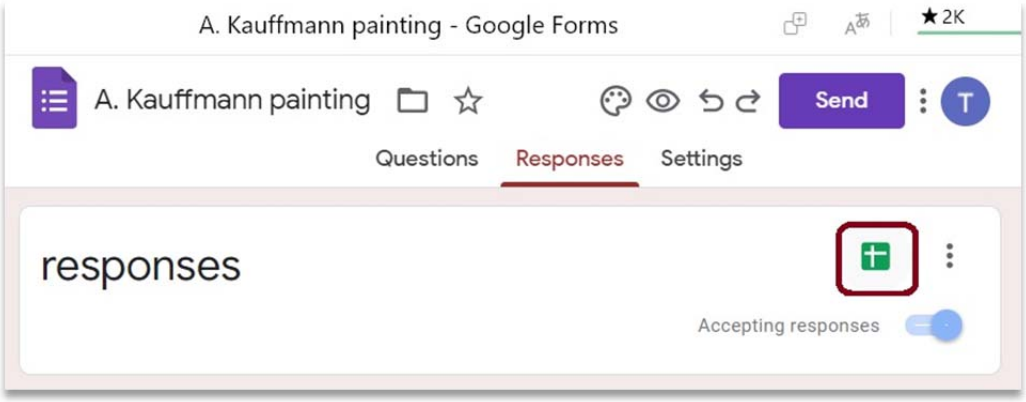


Figure 2.13 – Collecting results

INDIVIDUAL TRANING

Training 1: QUIZ

• On the base of the papers downloaded (see Unit 1, Individual Training, Training 1) write a short text of 300-350 words on the most important/interesting /promising facts of tendencies of the information technology (mentioned in ***Individual topic***) development and give brief analysis of its influence on media art.

• Consider «three perspectives» (see Unit 1, Individual Training, Training 2) and the text created in the previous point and make Google Form Quiz with three questions on key issues of ***Individual topic***.

UNIT 3. MEANS AND TECHNOLOGIES OF GRAPHIC INFORMATION PROCESSING

Main issues

1. Computer Graphics definition.
2. Computer Graphics classification
3. Computer Graphics applications
4. History of computer graphics development
5. Raster and Vector Computer graphics
6. Computer graphics file formats
7. Computer graphics colour models.

Aim: to study the basic issues of Computer Graphics and gain the skills of Computer Graphics implementation in the professional work of the researcher, such as presenting the research results, self-presentation, creation visual aids for scientific material as well as for scientific speech.

Topic 1: Computer Graphics and its classification

Computer graphics refers to the processes of generating, creating and manipulating the visual information such as pictures, images, photos, diagrams etc. with computer means.

But in general, the term Computer Graphics is used in **different contexts:**

– pictures and scenes generated by a computer;

– software tools used to work with visual information;

– science, which deals with the presentation of visual information digitally;

– art.

Computer Graphics is based on representation of visual information in the number of pixels. Pixel is the smallest unit represented on the computer screen having its definite position and colour.

The classification of Computer Graphics fields is vast and complicated. Thus, there are two types of computer graphics based on the interactivity characteristic:

Interactive Computer Graphics (Active) involves a two-way communication between computer and user. Here one is given some control over the image provided by an input device. For example, Computer Games equipped with video game controller.

Basic components of an interactive graphics system are:

− input such as mouse, stylus, multi-touch, in-air fingers, etc.;

− processing and storage of the graphics information according underlying representation or model;

− output or display such as screen or printer.

Non-Interactive Computer Graphics or passive computer graphics which presuppose the user not having any kind of control over the image. Here the image is totally under the control of program instructions not under the user, for example, screen savers, images.

The main areas of Computer Graphics applications:

− digitization of analogy visual information (Figure 3.1);



Figure 3.1 – Virtual Hermitage Museum

− data visualisation (Figure 3.2);



Figure 3.2 – Microsoft Power Bi

Today the data visualisation is used in diverse fields of human activity: scientific researches, engineering applications, medicine, business, industry, government, art, entertainment, education and other. It does enhance highly the data understanding and helps professionals to make their thinking points clear.

− creating and processing visual information (Figure 3.3).

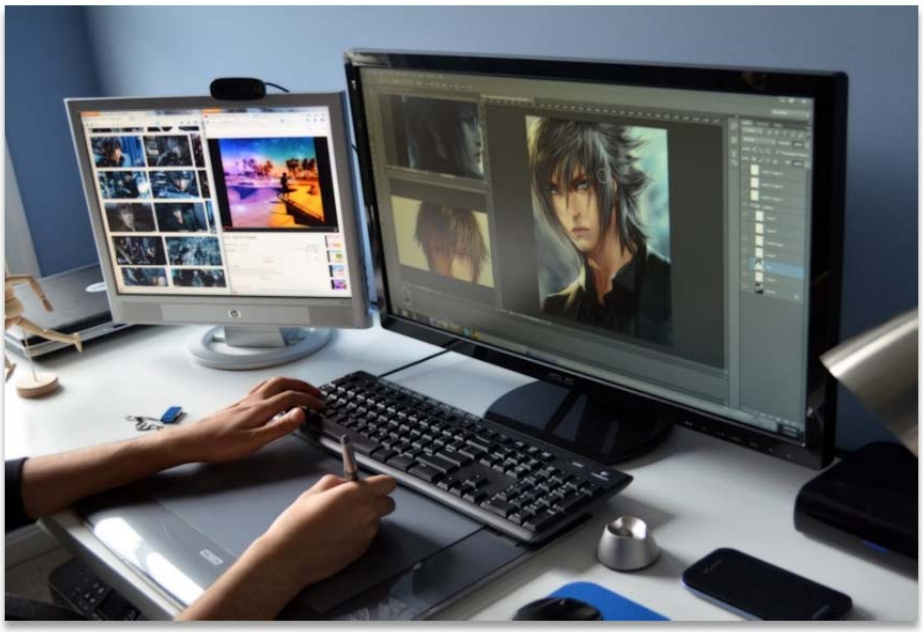


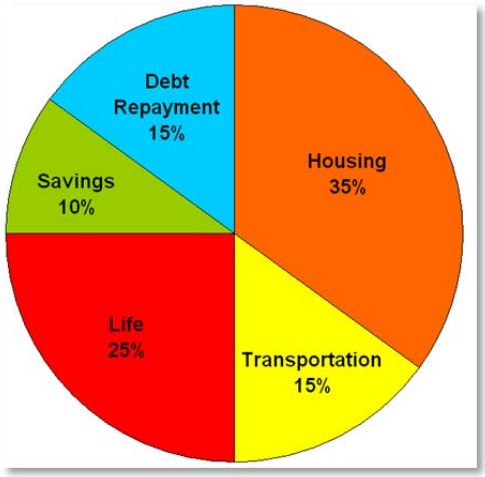
Figure 3.3 – Digital painting

Consider ***the classification of computer graphics*** based on its application fields:

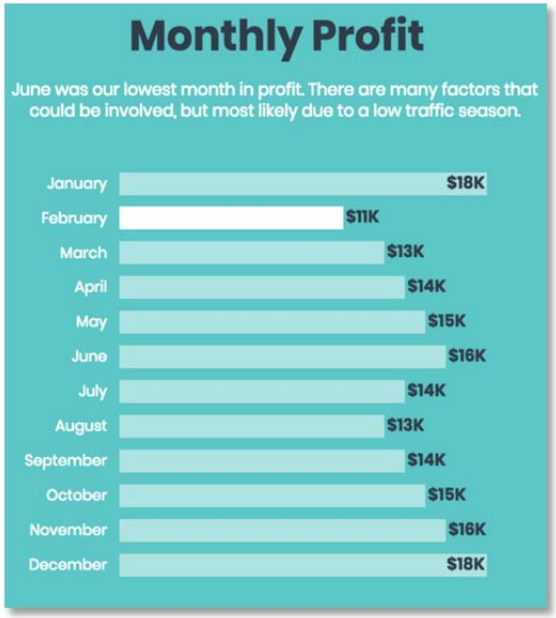
- Scientific Graphics
- Business Graphics
- Computer Graphic Design
- Computer-aided Design (CAD)
- Graphics Illustrations
- Computer Animation
- Web Graphics
- Computer Games
- Virtual and augmented Reality

Business Graphics is a field of computer graphics designed for visualising the various indicators and characteristics of business processes. To provide better understanding of business reports and statistical analytics, presentation requires graphics illustrative materials. While line charts, bar charts, and pie charts are common forms of business charts, there are dozens of other types of data representation. The business graphics tools are often included in spreadsheet and presentation programs (Figure 3.4).

Pie Chart



Bar Chart



Graph

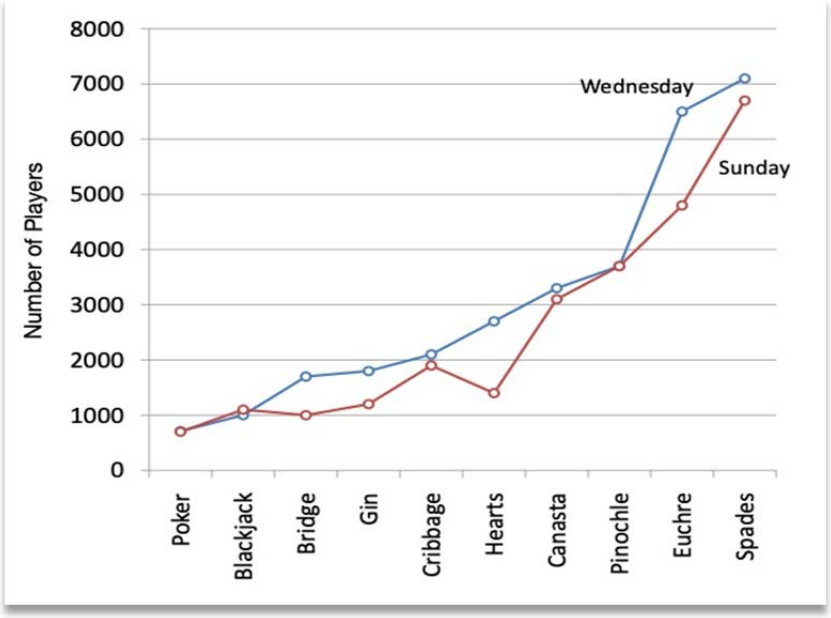


Figure 3.4 – Business graphics

Scientific Graphics is a field of computer graphics for visual representation of scientific research objects, calculation results and results of computational experiments.

Scientific graphics emerged in the beginning of the computer epoch, when computers were used only for solving scientific and industrial problems. The first graphic objects produced by machines appeared in the mode of symbolic printing (Figure 3.5).



Figure 3.5 – Symbolic Printing

Then special devices for drawing images with an ink pen on paper, named plotters, came into use (Figure 3.6).

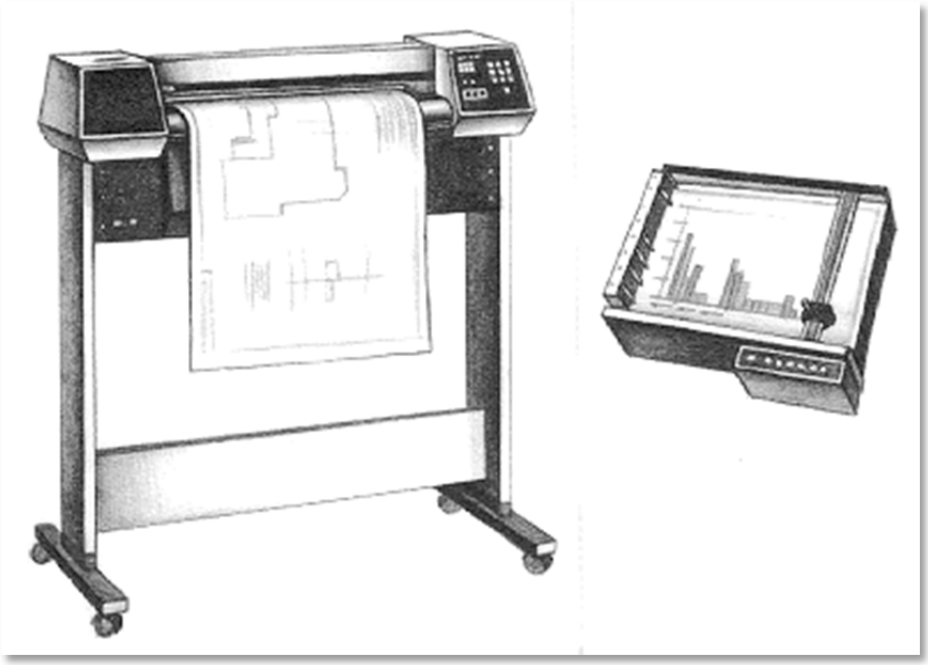


Figure 3.6 – Plotter

Modern scientific computer graphics makes it possible to carry out computational experiments with an immediate visualisation of their results (Figure 3.7).

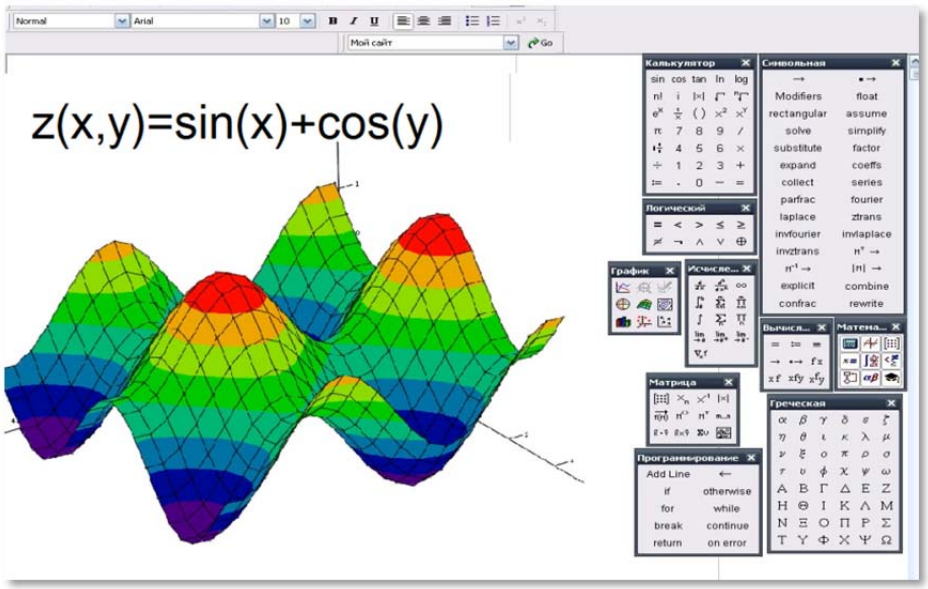


Figure 3.7 – MathCad Visualisation

Computer Graphic Design is a visualisation of ideas and creative templates for advertising and publicity. Computer graphic design combines skills in technology and art, using computer-generated images and words to create unique concepts and messages for publishing (Figure 3.8).



Figure 3.8 − Computer-generated Images and Words
to Create Unique Concepts

Computer-aided Design is a way to create 2D drawings and 3D models of real-world objects in digital mode before they are manufactured or built (Figure 3.9). Designers, engineers, architects, construction managers, inventors widely use it.



Figure 3.9 − Computer Architecture Model

Graphic Illustration is a kind of fine art for expression of visual ideas and conveys messages. It is also considered being a visual way to portray a written text, tell a story, or provide decoration (Figure 3.10). Illustrations come in both traditional and digital forms and can be found on flyers, fabrics, books, jackets, advertisements, packaging, posters, and websites.

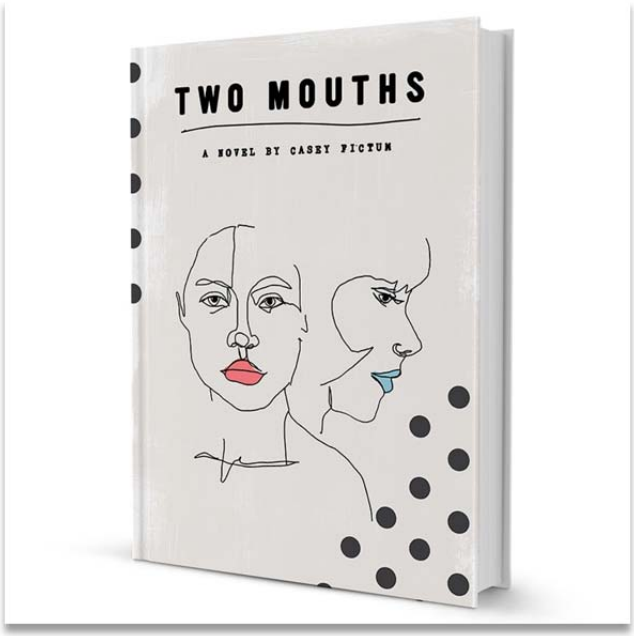


Figure 3.10 − An Evocative Book Cover Illustration by Fe Melo

Computer Animation is the process used for digitally generating animated images. The term «animation» comes from the Latin «animātiō» meaning «a bestowing of life». To create the illusion of movement, an image is displayed on the computer screen, then quickly replaced by a new image that is

similar to the previous image, but shifted slightly. This technique is identical to how the illusion of movement is achieved with television and motion pictures.

Today they differentiate between 3D animation and 2D computer animation:

• 3D animation is essentially a digital successor to the art of stop motion animation of 3D models. For 3D animations models are built on the computer monitor and 3D figures are rigged with a virtual skeleton (Figure 3.11).

• 2D computer animation is a successor to the frame-by-frame animation of 2D illustrations (Figure 3.12). For 2D figure animations, separate illustrations are placed on separate transparent layers, virtual skeleton being or not being used.

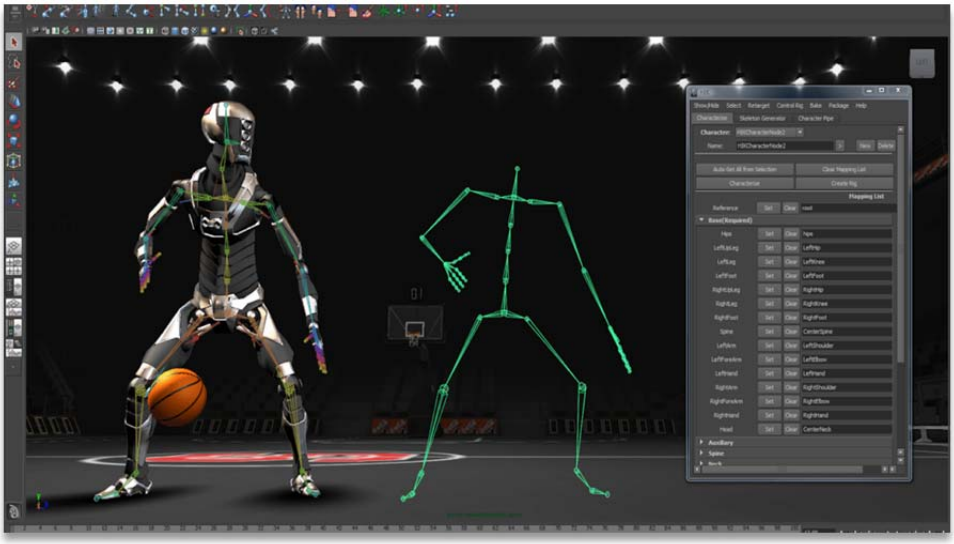


Figure 3.11 − 3D Figure Rigged with a Virtual Skeleton

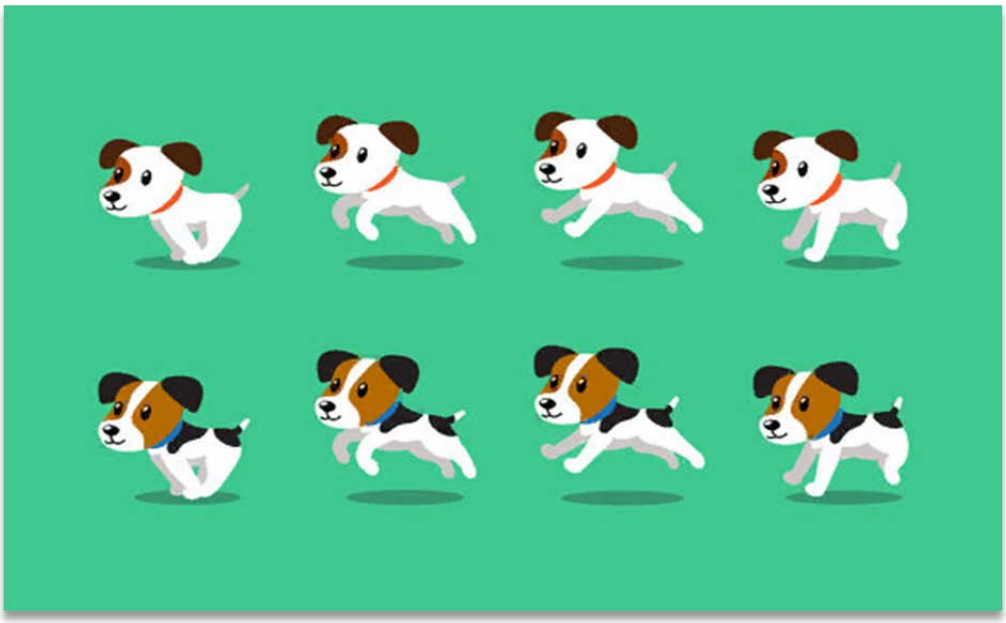


Figure 3.12 − Frame-by-frame Animation of 2D Illustrations

Web graphics is a visual representation of information on a website used to convey information and attract the attention of a website user.

Brief history of the computer graphics technology development

The period of the large computers is 1940-1970. Development of the Whirlwind computer (Figure 3.13) began in 1945 by the MIT Servomechanisms Laboratory for the U.S. Navy, and the system was first demonstrated on April 1951.



Figure 3.13 − Whirlwind computer:
The Mother of All Operating Systems, March 8, 1955

In 1962, Steve Russell in collaboration with Martin Graetz, Wayne Wiitanen, Bob Saunders completed the project of the first computer game «*Spacewar!*», being the first game with computer graphics. In 1966 a Group of MIT students developed the Spacewar! game on a mini-computer that used vector display. Some call this the first shooting game ever made (Figure 3.14).



Figure 3.14 – Spacewar!, computer game initially conceived by Steve Russell, Martin Graetz and Wayne Wiitanen in 1961

The first computer graphics design system was developed by Evan Sutherland as his PhD thesis at MIT in 1963. It was called Sketchpad. The application allowed a user to sketch a part on a computer screen. Sutherland

created also a device (Sketchpad) for drawing points, lines and the circumference with a digital pen, user controlling content, structure, and displayed images of via rapid visual feedback (Figure 3.15).

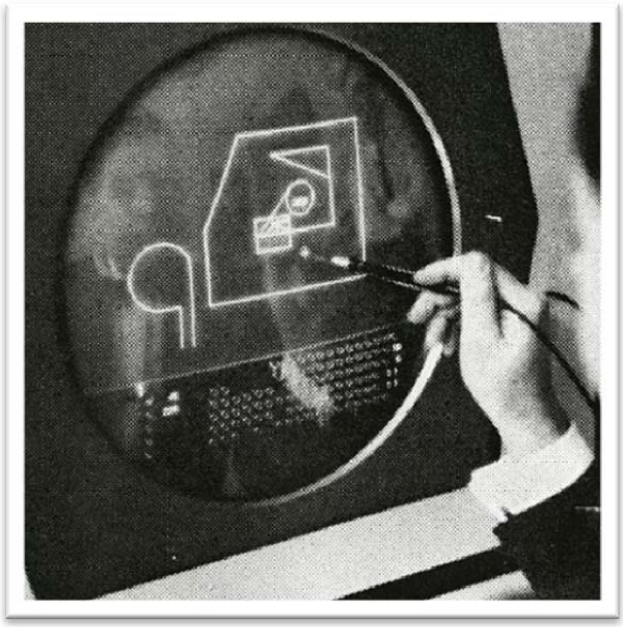
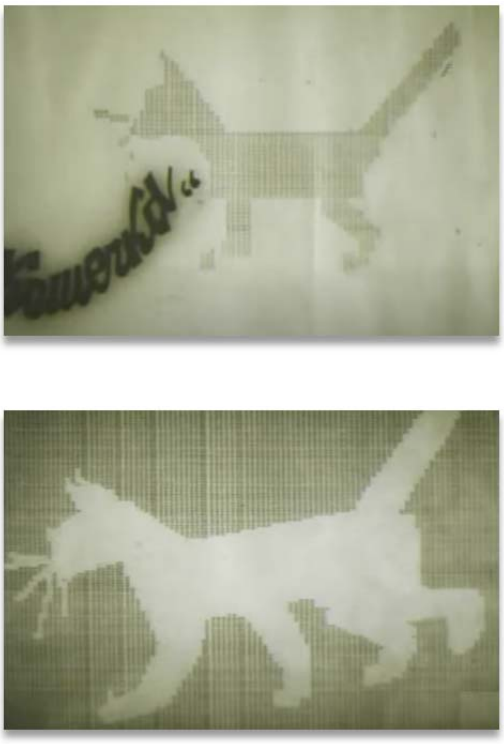
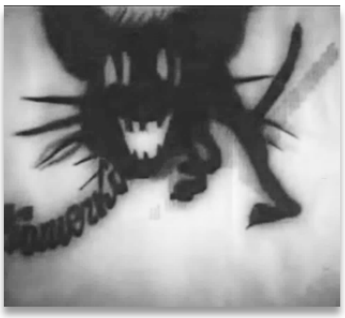


Figure 3.15 − Sketchpad

In 1968 N. Konstantinov with a group of soviet physicists and mathematicians created a mathematical model for the motion of a cat (Figure 3.16).





https://www.youtube.com/watch?v=OYrsjc9dz30&t=73s

Figure 3.16 − Kitty (1968). First computer animation

They elaborated on a computer programme solving the ordinary differential equations for cat moving.

It was displayed on the computer screen via printing hundreds of frames on paper with alphabet symbols and later filming these frames in a sequence. Thus, it was created the first realistic computer animation of a character, known as a walking cat.

Computers had no specific tools for working with graphics until 1971. Graphics images were created via programming, in other words, the images were programmed.

The period 1971–1985 is considered being the epoch of the fourth computer generation. It provided the thousands of Integrated Circuit to be embedded in a single silicon chip. This made it very easy to reduce the size of the machine. The use of microprocessor increased the efficiency of the computer even more. Thus, the first personal computers were invented (Figure 3.17). At this period, the user got the tools for display control. The colour computer models were elaborated and colour displays appeared.



Figure 3.17 – Apple personal computer

In 1986–1990 multimedia technology appeared. The term ***multimedia*** derived from the words «multi» and «media». Multimedia was considered as tools and delivery medium for mass communication which has all the functions of newspaper, magazine and TV. Modern multimedia goes further and absorbs much more tools and means (Figure 3.18).



Figure 3.18 – Modern multimedia means

In the late 1970s, the use of motion capture for computer character animation was invented. But it came widespread use only from 2000's. Motion capture is the recording of human body movement (or other movement) for immediate or delayed analysis and playback. The information captured can be as general as the simple position of the body in space or as complex as the deformations of the face and muscle masses. Motion capture for computer character animation involves the mapping of human motion onto the motion of a computer character. The mapping can be direct, such as human arm motion controlling a character's arm motion, or indirect, such as human hand and finger patterns controlling a character's skin colour or emotional state (Figure 3.19).



Figure 3.19 – Motion capture in «Avatar», 2009

Topic 2: Computer Graphics Types

Computer graphics is differentiated by the following types: ***raster, vector and fractal graphics***, basing on digital image representation and processing algorithms.

RASTER GRAPHICS

Raster graphics (also referred as bitmap graphics) is a type of digital representation of the image that uses tiny rectangular pixels arranged in a two-dimensional grid formation addressed by columns and rows (Figure 3.20). It has origin in television technology, with images constructed much like the pictures on a television screen. Each pixel contains one or more bits of information, depending on the degree of the image detalisation. For example, a black-and-white image contains only one bit per pixel: «1» means black and «0» means white. Images which one see on a computer screen are displayed on the base of raster graphics principles.

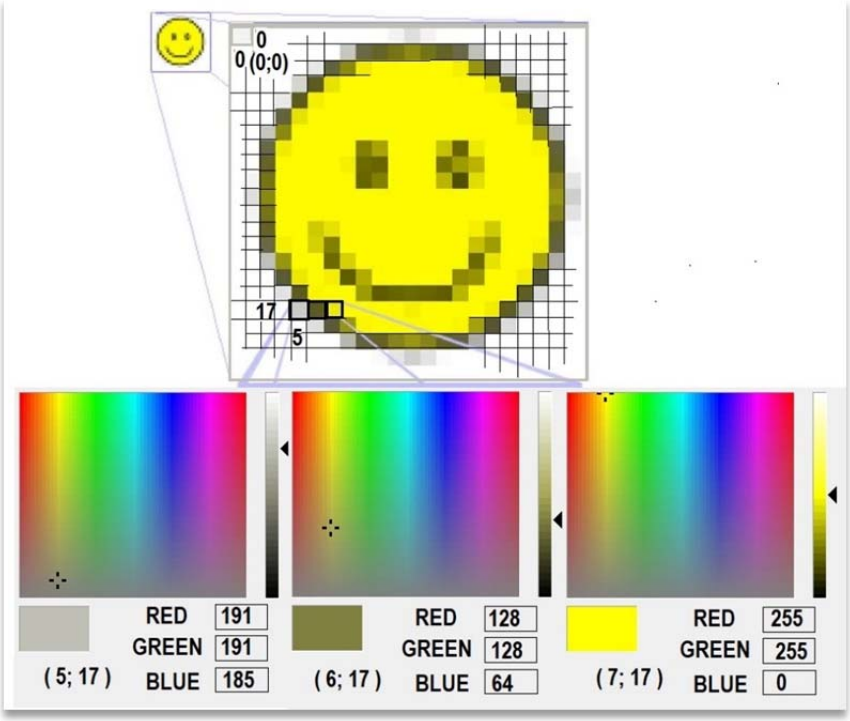


Figure 3.20 – Raster graphics image representation

They display images which one sees on a computer screen on the base of raster graphics principles (Figure 3.19, right side). Digital cameras pictures are generated and represented as raster graphics information. Normally the individual pixels are not seen unless the resolution is poor, or unless zooming in on a raster image (Figure 3.21, left side).

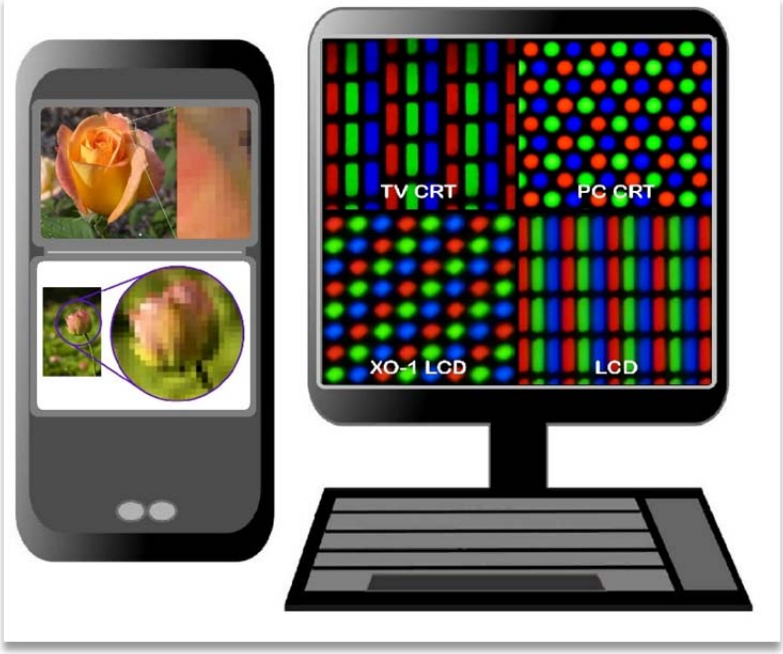


Figure 3.21 – Raster representation of images on a screen

Pictures are produced in the grid of pixels mode and are commonly referred to as a bitmap (byte-by-byte recording of a graphic image). The larger the image, the more space in the computer memory the graphic file takes up. Bitmap defines a space displayed on the screen and the colour for each pixel, or «bit». For example, on the Figure 3.18 the grey bit is placed in the 17^{th} row and 5^{th} column with RGB code [R-191; G-191; B-185]. Bitmap does not contain a bit of colour-coded information for each row pixel. It only contains indication of a new colour along a row. Thus, an image with solid colour requires a small bit map.

There are commonly used ***raster file formats:***

.bmp	.jpg	.psd – Adobe Photoshop program
.gif	.png	.psp – Corel Paint Shop Pro program
.tif	.tiff	.xcf – GIMP program

JPG/JPEG (Joint Photographic Experts Group) created with effective compression algorithms which enable to achieve a small file size without loss of quality or at a minimum with acceptable quality loss. Saving a JPG file, one can select a compression level by adjusting the file quality to file size ratio. JPG supports a full 24-bit palette with more than16.7 million colours.

GIF (Graphics Interchange Format) is rather focused on saving graphics/illustrations than photos. It has the limited number of colours, i.e. 256. The certain advantage of a GIF file is a possibility to include one of the transparent colours in the palette, that enables to see the background in

a selected rectangular graphic area. GIF format is also used for animated images, which combine numerous frames into a single file, frames being displayed in a sequence, generating an animated clip or a short video.

PNG (Portable Network Graphics) is the GIF format successor possessing intelligent transparency handling enables to round off the edges meeting the background and use some additional effects like shadows.

JPG, GIF and PNG files formats *are most commonly used on web pages*.

TIF/TIFF (Tagged Image File Format) format, used generally for printing, is based on lossless compression generating files normally of much larger sizes than JPG GIF and PNG formats. Thus, files contain much more additional information such as paths, alpha channels and comments used by printing devices. TIFF format also maintains transparent colours, but not all graphic programs have the possibility to save transparent colours in TIFF.

BMP (Bit Map) is the basic raster format created with minimum compression based on the list of pixels and their colours. BMP files have quite large sizes and *are not maintained by all Internet browsers*.

Raster graphics programs produce files that are also in raster formats. The most frequently used program for raster graphics handling is Adobe Photoshop, that saves files in PSD format. PSD contains much more data than just flat images and offers great edition possibilities. They are composed of layers which visibility can be switched on and off, providing only selected elements editing. Less used formats are XCF (GIMP program) and PSP (Corel Paint Shop Pro program) and some others.

Raster graphics advantages

Easy intuitive editing which is affordable by most users with common programs like Photoshop and Microsoft Paint.

Subtle gradations of colour reveals a multitude of colours in a single image and allow for more precise colour editing.

Finer nuances are showcased in shading and light at higher resolutions.

Perfect web browsers support due to the browsers focusing on maintaining raster graphics formats such as JPG, GIF and PNG.

Raster graphics disadvantage

Large size consuming for high-quality printing makes raster graphics not always usable for creating high-quality printed projects, especially for desired end product of a large-format.

Limit to scalability dealing with depicting pixels when the image is zoomed (Figure 3.19).

VECTOR GRAPHICS

Vector graphics is a type of computer graphics, which provides drawing lines and shapes in 2D or 3D space via series of mathematical formulas corresponding to the forms being depicted (Figure 3.22).

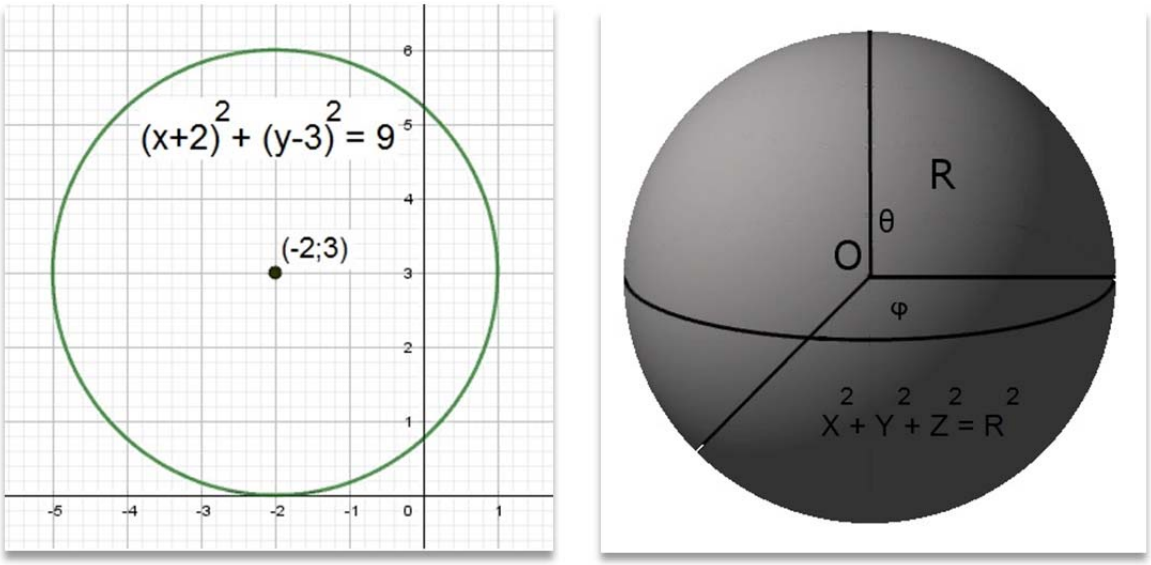


Figure 3.22 – Mathematical formulas of some geometrical lines and forms

There are several commonly used ***vector file formats***:

.ai Adobe Illustrator File	.eps Encapsulated PostScript File
.cdr CorelDRAW Image File	.svg Scalable Vector Graphics File
.dxf Drawing Exchange Format File	.wmf / .emf Windows Metafile

EPS (Encapsulated PostScript) is referred to as a universal format. It is supported by most vector graphics programs. It is recommended for saving visual identification elements, such as logos.

AI and CDR are files formats created for Adobe Illustrator and CorelDRAW, the most popular vector graphics programs, enabling files import to each other formats, in other words to the formats of their «competitor». The matter is the programs based on different principles of vector images handling, in this way Adobe Illustrator and CorelDRAW accomplish one another.

SVG (Scalable Vector Graphics) is a vector graphics format for the Internet. It is supported by Internet browsers, but some of them require an *add-on* to be installed. It is still not much popular.

WMF/EMF (Windows MetaFile/Enhanced MetaFile) created by Microsoft contains both bitmaps and vectors. It is used for vector graphics elements placed in Microsoft Office documents (Word, PowerPoint, etc.).

PDF (Portable Document Format) is a specific format, which is considered to be rather a document than graphic format, but it is very versatile and may include both vector and raster elements. It is often used for printing and especially for digital printing.

Advantages of vector graphics:

Scalability is provided by mathematical formulas of graphics data representation, which enable lines, curves, geometrical forms to appear smooth and of exact size at any scale, each image being calculated and drawn by the computer on the screen any time a user opens or modifies the vector graphics file.

Small file size, which is achieved through storing a small number of key points and the mathematical relationships between other pints of geometrical objects. For example, to store a circle it is necessary to know a centre point and radius defining the place of all the pints of the circle about its centre, thus, on the Figure 3.17 the circle is defined by its centre (-2;3) and distance form this point to all other, that is radius $\sqrt{9} = 3$. In computer memory mathematical relationships are expressed in a code.

Disadvantages of vector graphics:

- ***Limited detalisation.*** It is dealing with the mathematical complexity of realistic images representation (with shadows, light refraction, reflection etc.) and calculating all the images physical characteristics for rendering and building it in real time.

- ***Skill and time requirements***. Vector files can require more skill and time to create.

- ***Limited web browsers support.*** Modern browsers focus mainly on raster graphics.

- ***Incompatibility between vector graphics programs***. Vector graphics programs have different utilities for building and rendering vector images, among other factors.

Tips on using vector and raster graphics format	
LOGO	• Vector. • EPS: to be opened basically in any program and *imported in formats required* by end product.
Printing	• PDF, EPS or TIFF: most *frequently required by printing houses* formats for delivering materials. • For TIFF *high resolution (size in pixels) proportionality to the size of the printed area* are necessary.
Office files: Word documents and PowerPoint presentations	• Most often images placed in are bitmaps: JPG and GIF and sometimes PNG. GIF and PNG maintain transparencies, which may be helpful to better space arranging. • EMF is the best format *for documents preparing printing*, elements being able freely to scale, with *maximum printing quality* being ensured. •Vector formats can be also used when there are no any photos
Photographs	• Bitmaps only • The best format is JPG. It allows *to adjust the level of compression*, that means *the file quality to file size ratio*. • For printing photographs, it is best to have them in a format *not containing lossy compression*, e.g. TIF.
Projects (layouts)	• Should be saved in the *original format of the program*, in which they were created (e.g. PSD, PSP, AI or CDR), to enable editing them.
Graphics on WWW: files to be placed without processing on webpages	• Should be saved in formats *supported by all browsers*, such as JPG, GIF and PNG. • For pasting graphics into the e-mail contents, including footers, JPG, GIF and PNG formats are also applied.

► Mind that:

1. It is always possible to make a raster file of any resolution from a vector file and not possible to convert the raster file in vector file.

2. There are many more graphic raster, vector and mixed formats, the ones discussed above being just the most popular and most frequently used.

Topic 3: Fractal Graphics

The word fractal originates from mathematics and physics sciences, meaning a structure with an irregular or fragmented shape at all scales of measurement between a greatest and smallest scale such that certain mathematical or physical properties of the structure, behave as if the ***dimensions of the structure (fractal dimensions) are greater than the spatial dimensions***.

To explain the fractal phenomenon, consider a geometric fractal called the Koch Curve (Figure 3.23 and Figure 3.24) discovered in 1904 by Swedish mathematician Helge von Koch (Figure 3.25):

Koch Curve Creating

Step 0:

•Start with a straight line of length L=1m.

Step 1:

•Divide the line into 3 equal parts;

•Replace the middle section with triangular bump with sides of length L=1/3 m. New length L= 4/3 m.

Step 2 – Step N:

Recursively:

•Divide each ***SEGMENT*** of ***line attended in the previous step*** into 3 equal parts;

•Replace the middle section of each ***SEGMENT*** with triangular bump with sides of 1/3 of the ***SEGMENT length***.

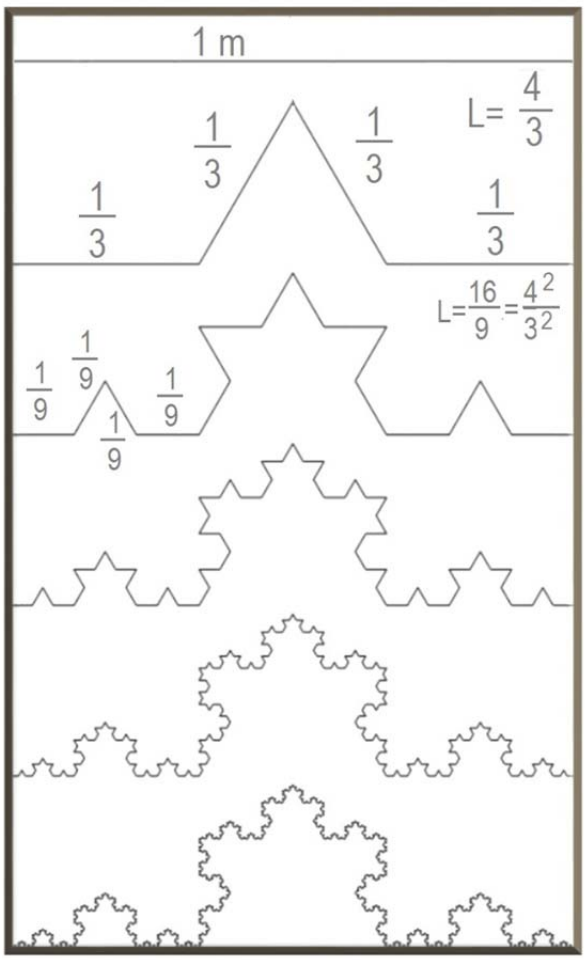


Figure 3.23 – Koch Curve

Thus, on each N-Step the length of the Koch line L is calculated by the formula:

$$L = \frac{4^N}{3^N},$$

and, while N tends to infinity ($N \to \infty$) length L tends to infinity ($L \to \infty$).

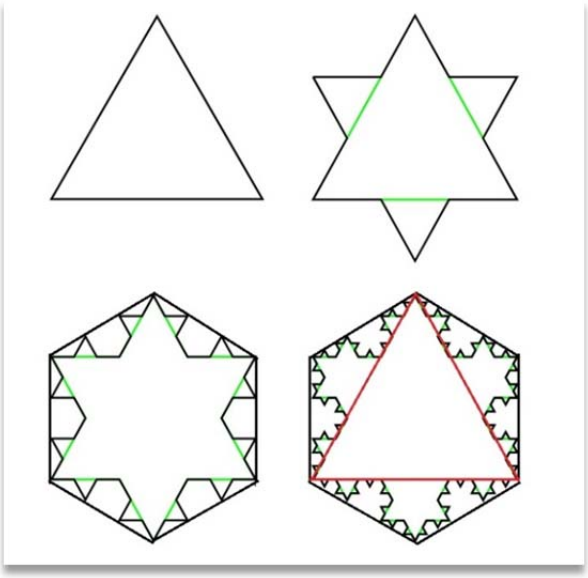


Figure 3.24 – Koch Snowflake



Figure 3.25 –Swedish mathematician Helge von Koch

Koch Snowflake is the geometrical figure consisting of three Koch curves, which form a triangle at the initial stage, and a snowflake in the result of curve creation (Figure 3.22). The phenomenon of a snowflake is that it has an infinite perimeter (which follows from the length of the Koch curve calculated above), limiting the finite area, which is less than the hexagon describing the Koch Snowflake and greater than the original triangle (Figure 3.22). This example demonstrates haw fractal dimensions works with fractional indicator, which are greater than the spatial dimensions. Thus, the normal cave or line «lives» in one-dimensional space but Koch Snowflake lives in space of dimensions equal to

$$\frac{\ln 4}{\ln 3} \approx 1,26,$$

Meaning, that some part of the dimension is «hidden». These «hidden dimensions» play an important role in fractal graphics applications such as, for example, image compression or damaged image recovery.

There are three common techniques for fractals generating.

1. ***Iterated function systems (IFS).*** IFS have a fixed geometric replacement rule: constructing deterministic fractals starts with a given geometric shape, called the ***initiator*** and the ***generator*** rule of replacing subparts of the initiator with pattern on each ***iteration***. The object created this way possesses ***self-similarity***. The example of deterministic fractal obtained with IFS is discussed above – Koch Curve and Koch Snowflake (Figure 3.23, 3.24). The other fractals, which are considered being IFS deterministic ones, are Sierpinski carpet (Figure – 3.26), Pythagoras Three (Figure – 3.27), Harter-Heighway Dragon Curve (Figure (3.28), T-Square, Menger sponge etc.

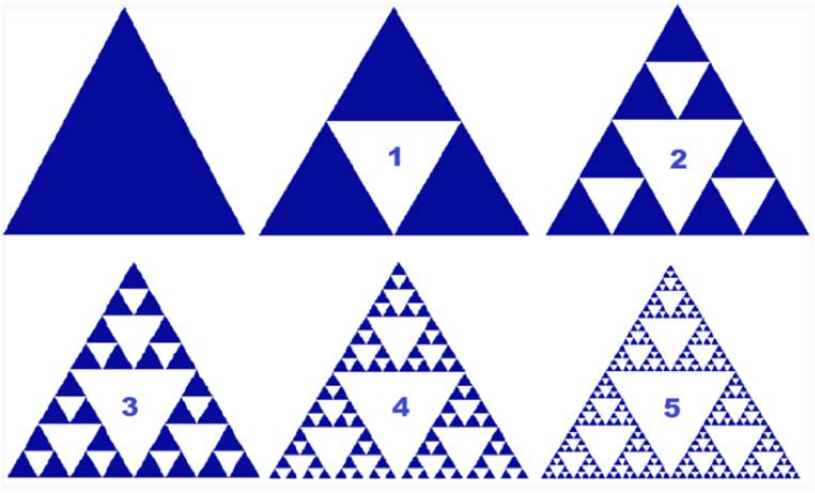


Figure 3.26 – Sierpinski Carpet (five iterations)

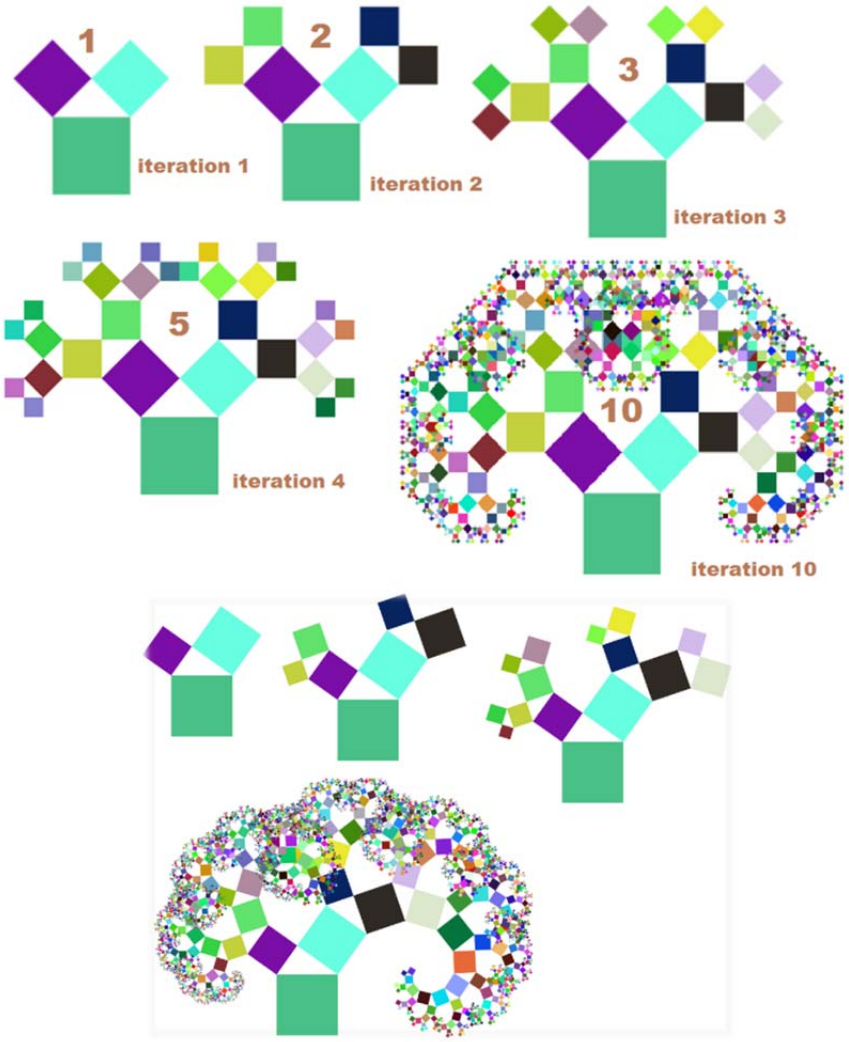


Figure 3.27 – Pythagoras Three with 45˚ angle (above) and 30˚ angle (on the right)

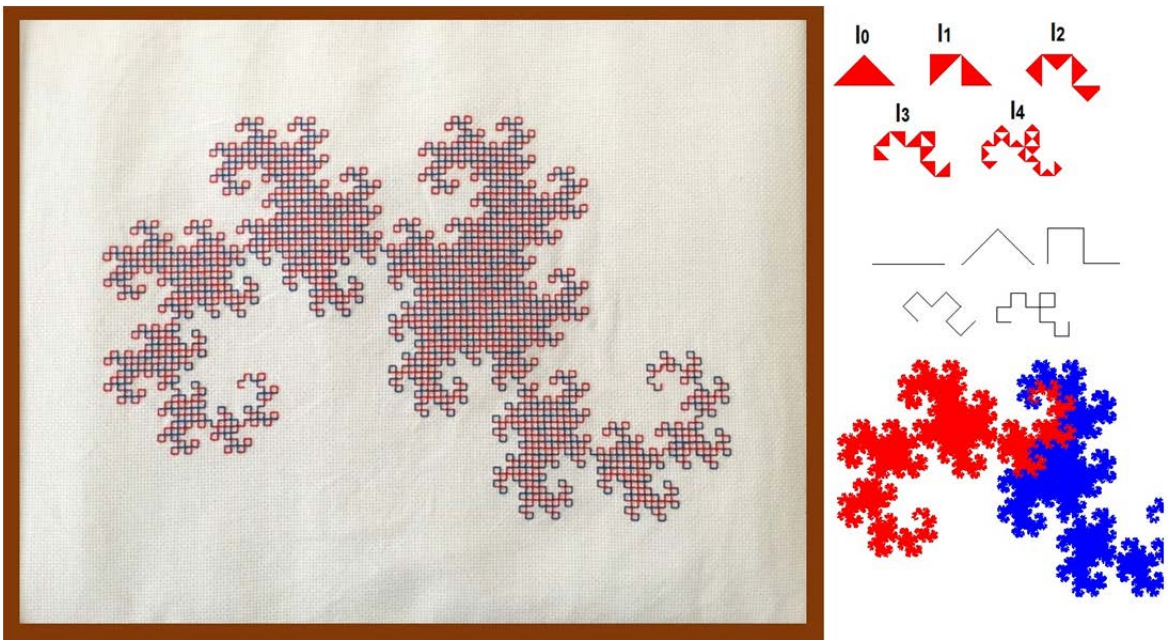


Figure 3.28 – Heighway Dragon Curve

2. *Escape-time fractals*

Escape-time fractals are dynamical fractals, defined by a recurrence mathematical formula / rule at each point in a space. The most famous among them is Mandelbrot set (Figure 3.29, 3.30), defined by the recursive relation of x and y: $x_{n+1} = x_n^2 - y_n^2 + x_0$,

$y_{n+1} = 2x_n y_n + y_0$.

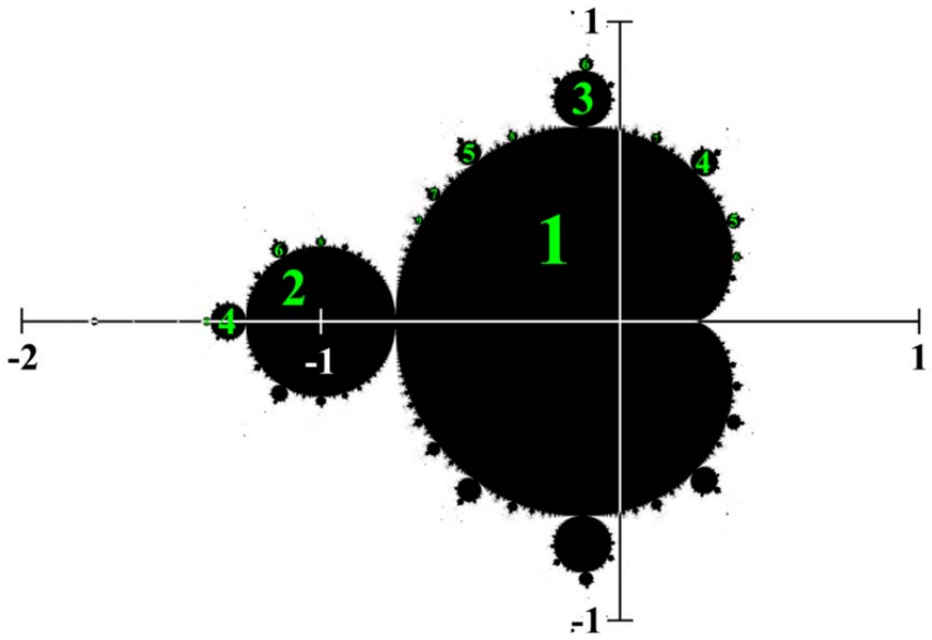
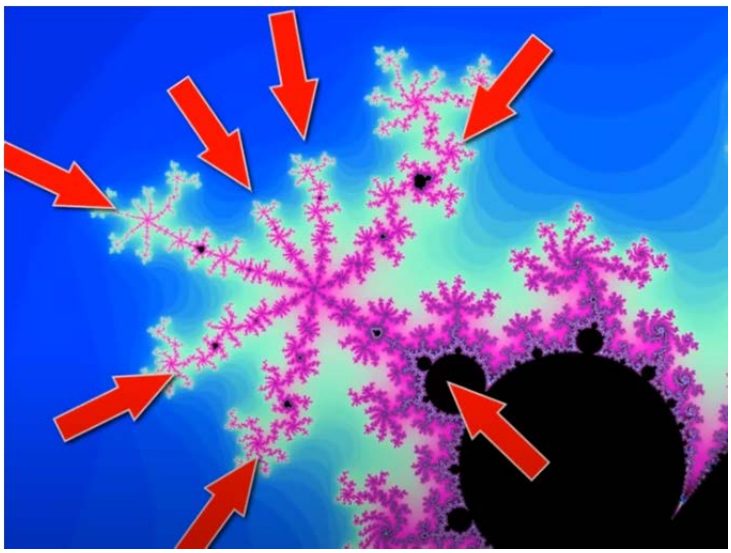


Figure 3.29 – Mandelbrot set

More precisely about Mandelbrot set creation see in the film «The Mandelbrot Set: How it Works and Why it's Amazing!» on **YouTube:**



https://www.youtube.com/watch?v=2JUAojvFpCo

Figure 3.30 – Mandelbrot set border

To obtain coloured Mandelbrot set (Figure 3.30) it is necessary to assign the colour to each point (x,y) of a 2-dimensional space, depending on how the sequence (x_n, y_n) with initial $(x_0 = x, y_0 = y)$ grows.

The other examples of dynamical escape-time fractals are the Burning Ship fractal (Figure 3.31) and the Lyapunov fractal.

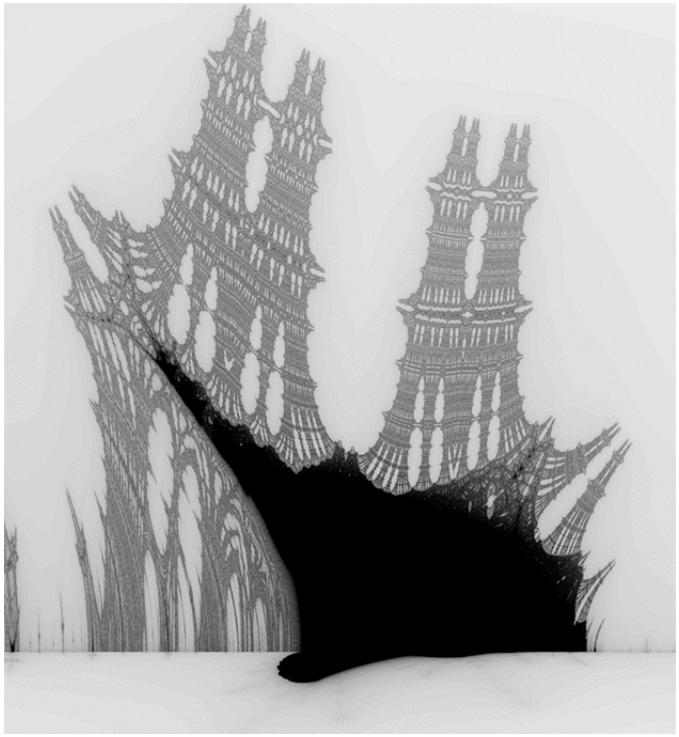


Figure 3.31 – Burning Ship fractal

The image on the right is generated by analysing the series

$$x_{n+1} = x_n^2 - y_n^2 - x_0,$$
$$y_{n+1} = 2|x_n y_n| - y_0.$$

for each point $(x_0 = x, y_0 = y)$ on the plane. The darkness of grey of (x, y) is fixed by how fast the series tends to infinity. Thus, the black points in the centre don't ever diverge to infinity; they either oscillate or converge to a single value.

The points shown in light grey diverge very quickly. This is exactly the same technique used to create the Mandelbrot set.

3. Random fractals

Random fractals generated by stochastic (random) processes (Figure 3.32). For example, fractal Landscapes (Figure 3.33) and the Brownian Tree (Figure 3.34).

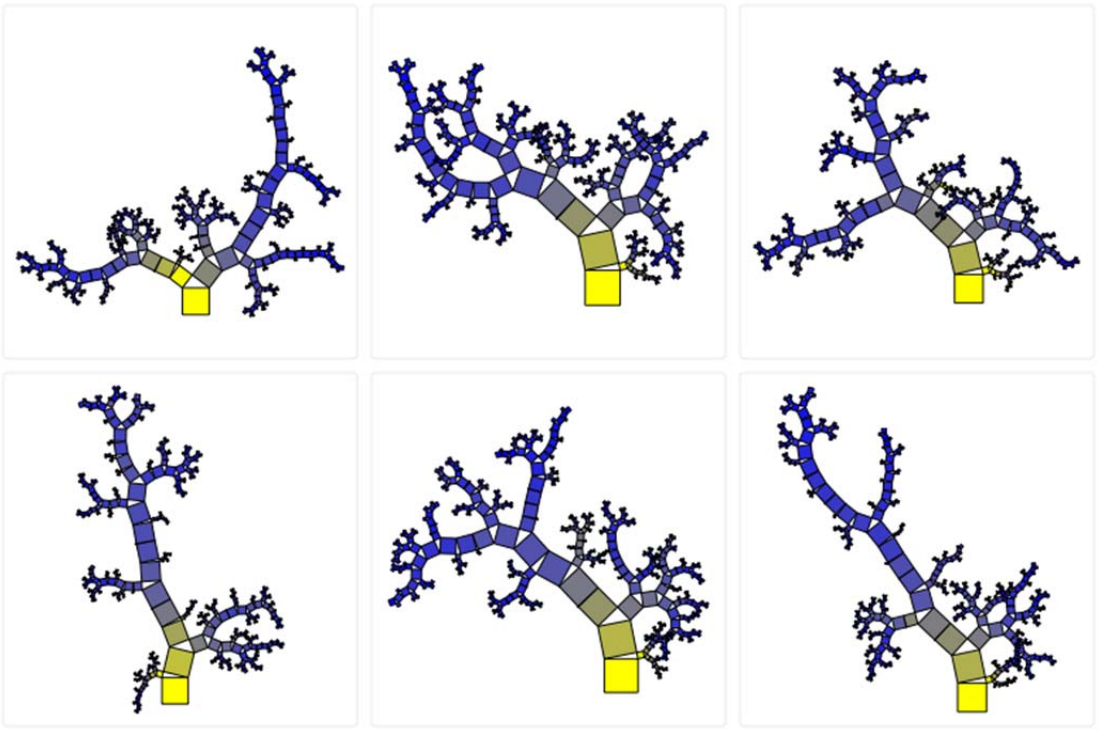


Figure 3.32 – Pythagoras Trees with random angles



Figure 3.33 – Fractal Landscape

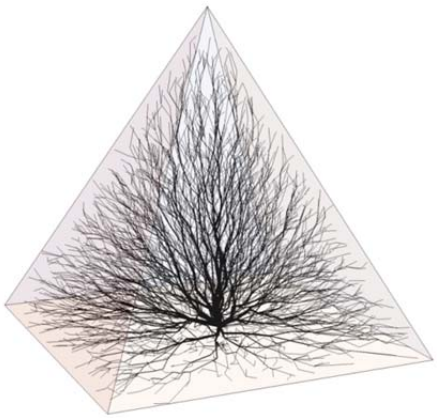


Figure 3.34 – Brownian Tree

The objects approximately looking like fractals or having fractal self-similar structure, but with finite scale, are easily found in nature, including plants (Figure 3.35), snowflakes, mountains, river networks, trees and systems of blood vessels. Such objects can be modelled on a computer via

recursive algorithms, like, for example, a fern (Figure 3.36) (a frond from a fern is a miniature replica of the whole: not identical, but similar in nature).



Figure 3.35 – Fractal-like plants



Figure 3.36 – The Fern Fractal with the QBasic code for its building

QBasic

```
SCREEN 12
WINDOW (-5, 0)-(5, 10)
RANDOMIZE TIMER
COLOR 10
DO
    SELECT CASE RND
        CASE IS < .01
            nextX = 0
            nextY = .16 * y
        CASE .01 TO .08
            nextX = .2 * x - .26 * y
            nextY = .23 * x + .22 * y + 1.6
        CASE .08 TO .15
            nextX = -.15 * x + .28 * y
            nextY = .26 * x + .24 * y + .44
        CASE ELSE
            nextX = .85 * x + .04 * y
            nextY = -.04 * x + .85 * y + 1.6
    END SELECT
    x = nextX
    y = nextY
    PSET (x, y)
LOOP UNTIL INKEY$ = CHR$(27)
```



Mountains can be modelled with a computer on the base of fractal geometry. Start with a triangle in 3D space and connect the central points of each side by line segments, resulting in 4 triangles (Figure 3.37). The central points are then randomly moved up or down, within a defined range. The procedure is repeated, decreasing at each iteration the range by half. The recursive nature of the algorithm guarantees that the whole is randomly similar to each detail.

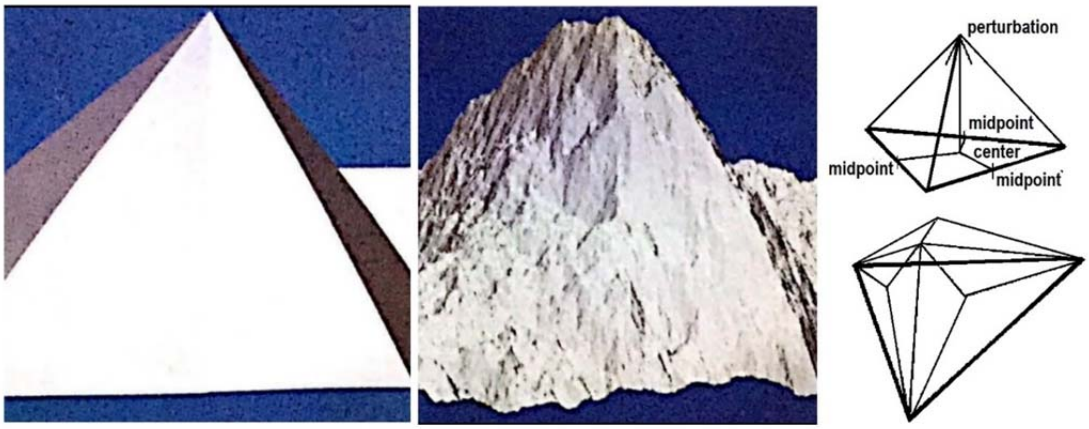
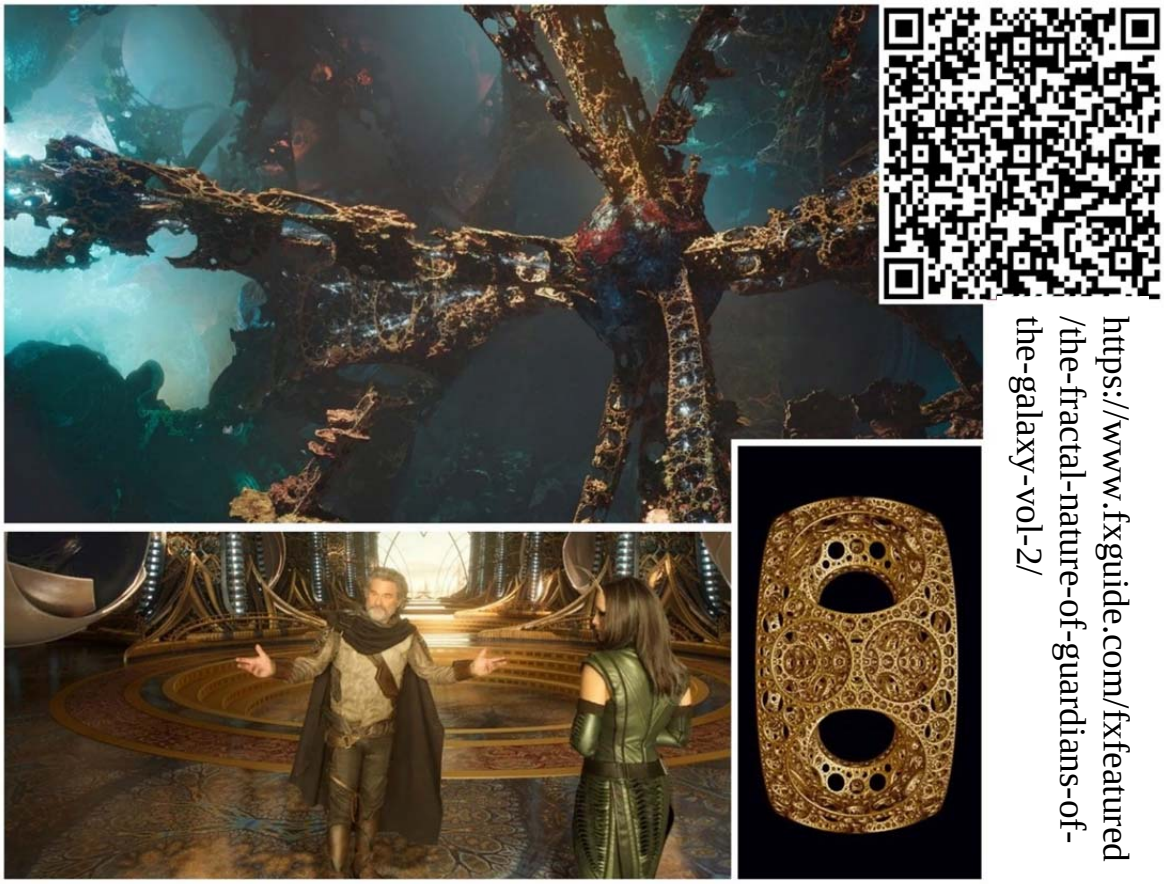


Figure 3.37 – Mountain modeled on a computer using a fractal



https://www.fxguide.com/fxfeatured/the-fractal-nature-of-guardians-of-the-galaxy-vol-2/

Figure 3.38 – Guardians of the Galaxy Vol. 2. For modeling fractal nature of Ego Planet Sierpinski gasket and Mandelbrot fractal were implemented

In Computer Graphics random or stochastic fractals are used for ***highly irregular real-world objects computer modelling***, such as clouds, water, fire, landscapes, organic environments. This very feature of fractals makes them vastly demanded in movie production and computer game design (Figure 3.38).

In Art fractals are applied for ***generating various art forms*** (Figure 3.39) or serve as the ***base for reflecting artistic ideas*** (Figure 3.40).



Figure 3.39 – Dynamic painting of San Base (http://www.sanbase.org/)

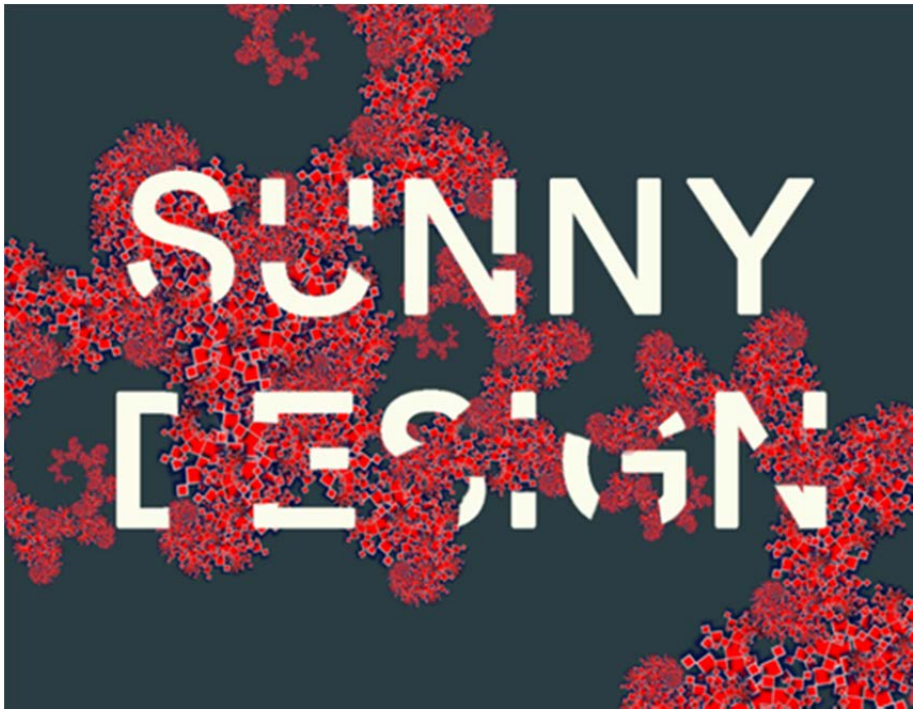


Figure 3.40 – SUNNY DESIGN by Zhang Meng Qi (2018, Minsk)

Fractals are also widely implemented in ***loss compression method for digital images.*** These methods work good for textures and natural objects images having the fractal-like structure (Figure 3.41). Fractal algorithms convert the fractal-like parts into mathematical fractal codes, which are used to recreate the encoded image.



Figure 3.41 – Natural objects images having the fractal-like structure (http://www.canadiannaturephotographer.com/ShellyPenner2.html)

Fractals are rendered with computers on the base of mathematical recursive algorithms which are programmed and need only the changing of parameters. There exists some software for rendering fractals and even generating new ones: ***Fractint***; ***Sterling Fractal*** – fractal-generating program written by Stephen Ferguson and ***Sterling2*** its free version; ***Ultra Fractal*** – a fractal image and animation generation program with its own programming language and an extensive set of features for composing, colouring, layering, masking, rendering, and more; XaoS – a fast interactive real-time fractal zoomed and morpher. One can try OnlineFractalTools (https://onlinefractaltools.com/) to generate some geometrical fractals changing parameters of samples which are coded on the base of fractal algorithms.

The film «Fractals – Hunting the Hidden Dimension» (www.youtube.com/watch?v=FKttSB4pzug) is recommended for knowing more about fractals creation and their applications.

Topic 4: Computer Graphics Colour Models

Colour Model is an abstract mathematical model providing the way of colours representation in digital way. Thus, the colours defined by tuples of numbers, commonly of three or four components. The resulting set of colours is called "colour space".

RGB colour model

RGB colour model is a model which is used by media (such as television) to transmit light and based on additive colour mixing with primary red, green, and blue colours, each stimulating one of the three types of the eye's colour receptors with as little stimulation as possible of the other two (Figure 3.42). In the computer each of red, green, and blue colour stimulation, as a rule, coded from 0 to 255 within ***8-bit colour depth***.

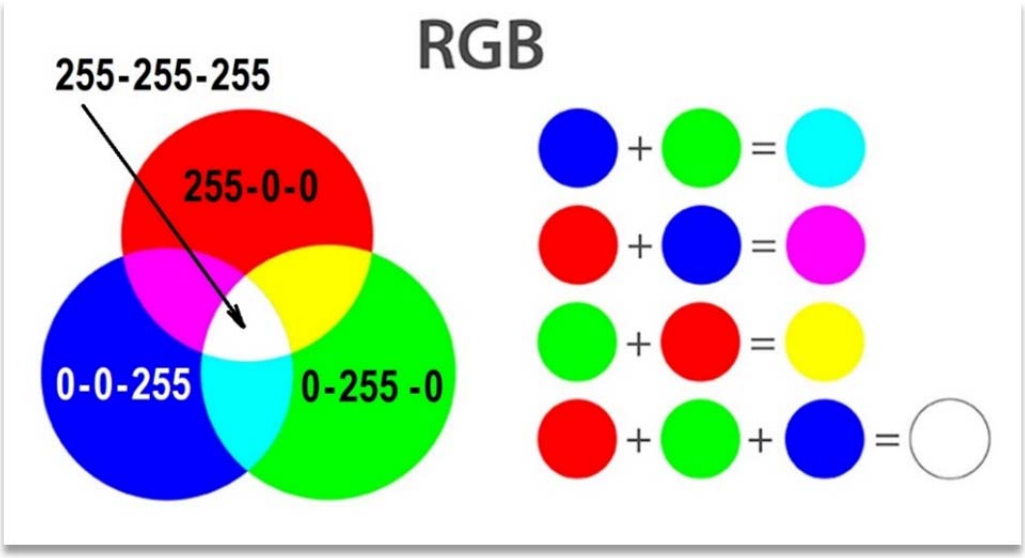


Figure 3.42 – RGB colour model

Mixtures of light of the primary colours cover a large part of the human colour space or, in other words, a large part of human colour experiences. This space is called "RGB" colour space (Figure 3.43). However, other primary colours could be also used, but the red, green and blue light mixtures capture the largest part of the human colour space.

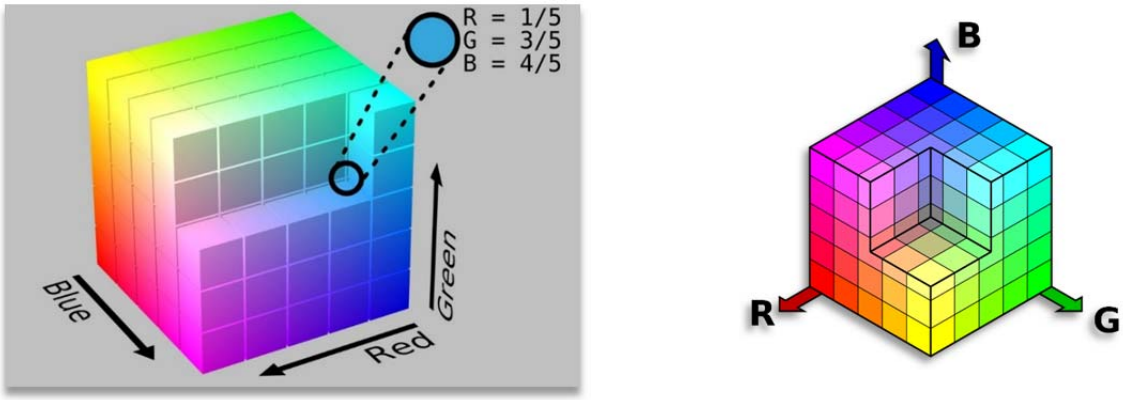


Figure 3.43 – RGB colour space, synthesized from the spectral hypercube

Screens and monitors are built from small dots or pixels with three primary colours, each tiny pixel consists of even smaller luminous dots of a specific colour. (Figure 3.44). These pixels are not seen with the naked eye. It should be mentioned that there is no any standard of what precisely loci in the chromaticity diagram correspond to the reference red, green, and blue colours, therefore the same RGB values give rise to slightly different colours on different screens.

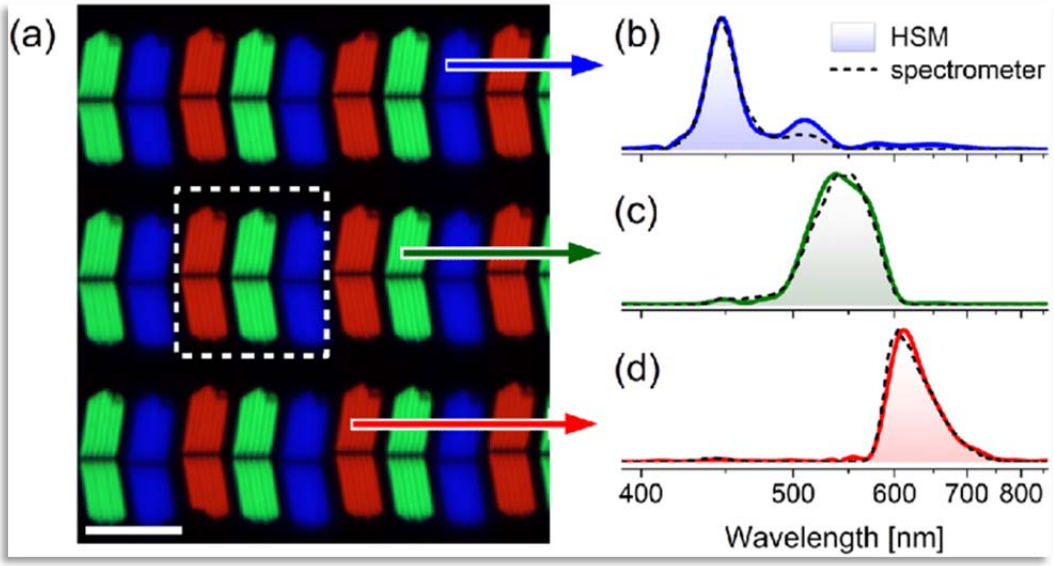
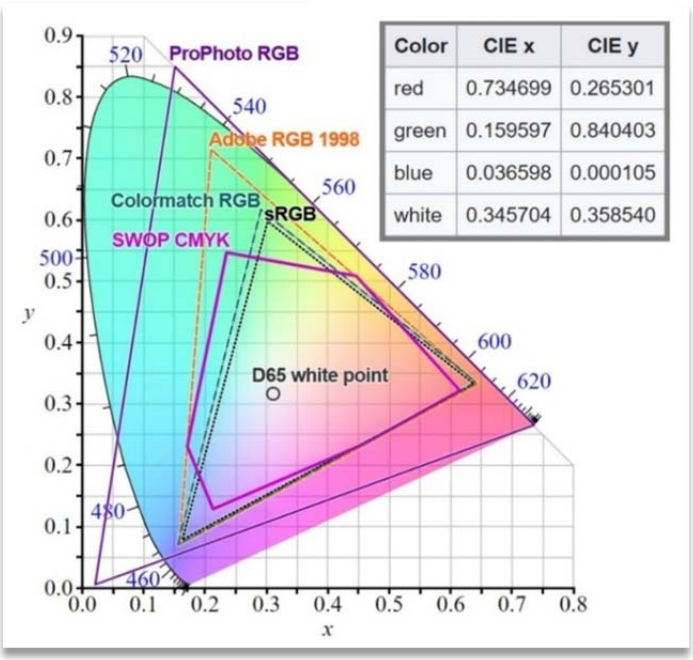


Figure 3.44 – RGB colour model HSM image of an RGB LCD screen:
(a) RGB image, synthesized from the spectral hypercube,
(b), (c) and (d) Normalized spectra of each individual emitter

Extended RGB colour model was developed by Kodak and named ***ProPhoto RGB***, also known as ROMM RGB (Reference Output Medium Metric).



Color	CIE x	CIE y
red	0.734699	0.265301
green	0.159597	0.840403
blue	0.036598	0.000105
white	0.345704	0.358540

Figure 3.45 – Comparison of some RGB and CMYK colour gamuts on the CIE 1931 XY chromaticity diagram

The ProPhoto RGB colour space encompasses over 90% of possible surface colours in the CIELAB colour space (Figure 3.45), and 100% of likely occurring real-world surface colours documented by Michael Pointer in 1980. However, approximately 13% of the representable with ProPhoto RGB colours are imaginary ones, which are not visible by human being (Figure 3.46).

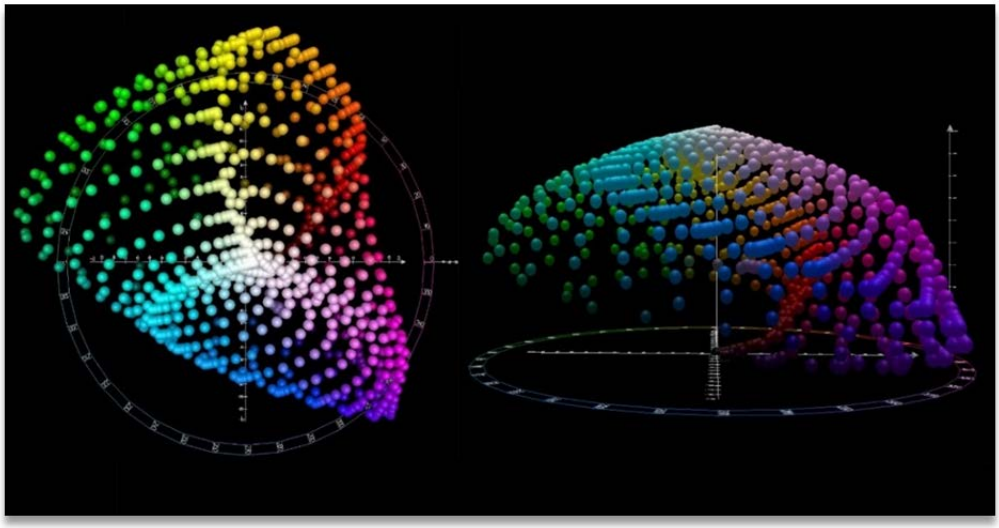


Figure 3.46 – CIELAB colour space top and front view

►Mind that:

1. Today, ProPhoto RGB is still considered more of a mathematical model than a real colour space. It is a kind of combination of the trichromatic

RGB model and human perception. ProPhoto RGB is mainly used when working on top quality printed layouts, as well as for especially deep retouching and colour correction of images (Figure 3.47).



Figure 3.47 – Photorealistic quality of image within RGB colour models

2. When working in colour spaces with such a large gamut, it is recommended to work in ***16-bit colour depth*** to have the smaller gradient steps for posterization effects avoiding.

3. The overwhelming majority of modern monitors, screens and other image output devices are not able to display all the colours of ProPhoto RGB space.

CMYK colour model

CMYK colour model is a colour model, based on mixtures of inks of four primary colours: cyan, magenta, yellow, and black (or key colour), focusing on colour printing (Figure 3.48). In the computer each of cyan, magenta, yellow, and black are coded from 0 to 100, key ink being prissily determined only wile printing for intensity of grey values and shadows to be specified.

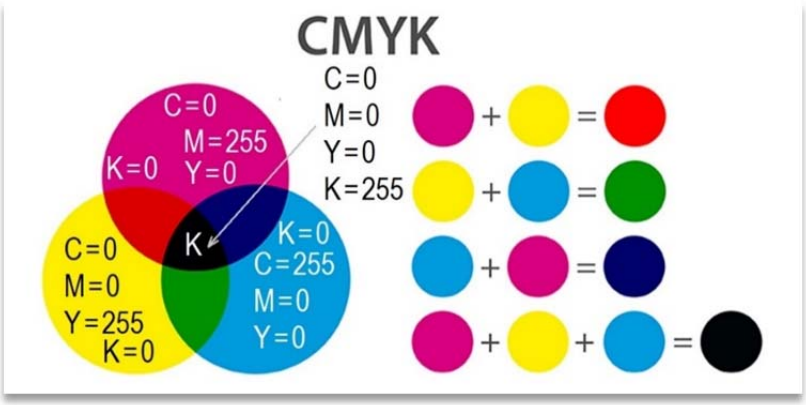


Figure 3.48 – CMYK colour model

Surfaces absorb and reflect light of certain wavelengths; thus, people see colours. Things that appear to be red reflect red light, objects that appear to be white reflects all wavelengths of light, and objects that appear black absorb all wavelengths. CMYK colour model is initiated by this very fact. The ink reduces the light that would otherwise be reflected, in other words "subtract" the colours red, green and blue from white light, therefore this model is considered to be subtractive.

For artistic intuitive understanding, the mixtures of cyan, magenta, yellow colours with key colour are represented in percentage proportion (Figure 3.49).

The mixture of 100% cyan, magenta and yellow should theoretically result in the colour black, but, in reality, only a very dark brown or dark grey arises. Therefore, the black key colour is added on the stage of printing an image. In this case, black does not equally black in printing. Its tint depends on the set of three primary colours represented in key black. This not only produces pure black, but influences intensity of grey values and shadows.



Figure 3.49 – Mixtures of cyan, magenta
and yellow in percentage proportion

In general, CMYK covers a smaller range of colours in the colour space (including those visible to humans) than RGB (Figure 3.50). The white colour within CMYK model is achieved by inks eliminating or with a special «white colour» in the so-called white printing.

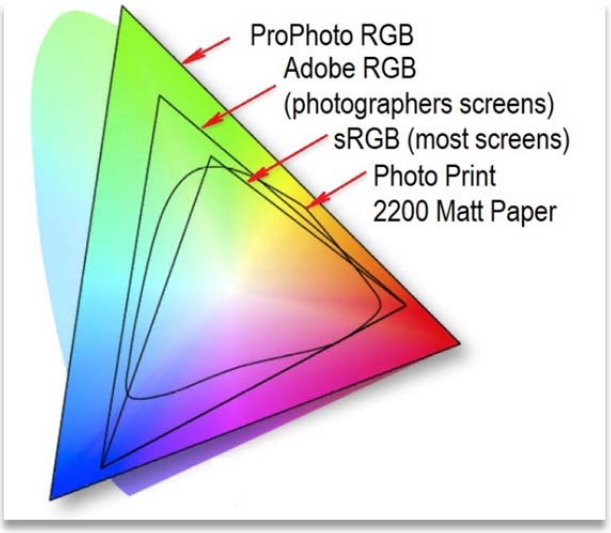


Figure 3.50 – Range of colours in the colour space within different colour models

► Mind that:

1. Covering smaller range of colours, in other words, smaller colour space doesn't mean that the CMYK model has fewer colours than RGB. The number of colures represented by the colour model depends on mathematical representation of colours each colour model based on.

2. CMYK is a prerequisite for four-colour printing and is used, for example, in offset printing (e.g. online printing industry). For printing projects, e.g. business cards, flyers, product packaging, T-shirts prints, the final image should be saved in PDF and EPS file formats.

HSV (HSB) and HSL colour models

HSV / HSB colour model is a cylindrical colour model with hue, saturation and (brightness) value dimensions, hue specifying the angle of the colour on the RGB colour circle, saturation – the amount of colour used and value – the brightness of the colour (Figure 3.51). For example, 0° angle in hue parameter results in red, 120° – in green, and 240° –in blue; a colour with 100% saturation is the purest colour possible, one with 0% saturation yields grayscale; a colour with 0% brightness value is pure black, one with 100% brightness value has no black mixed into the colour.

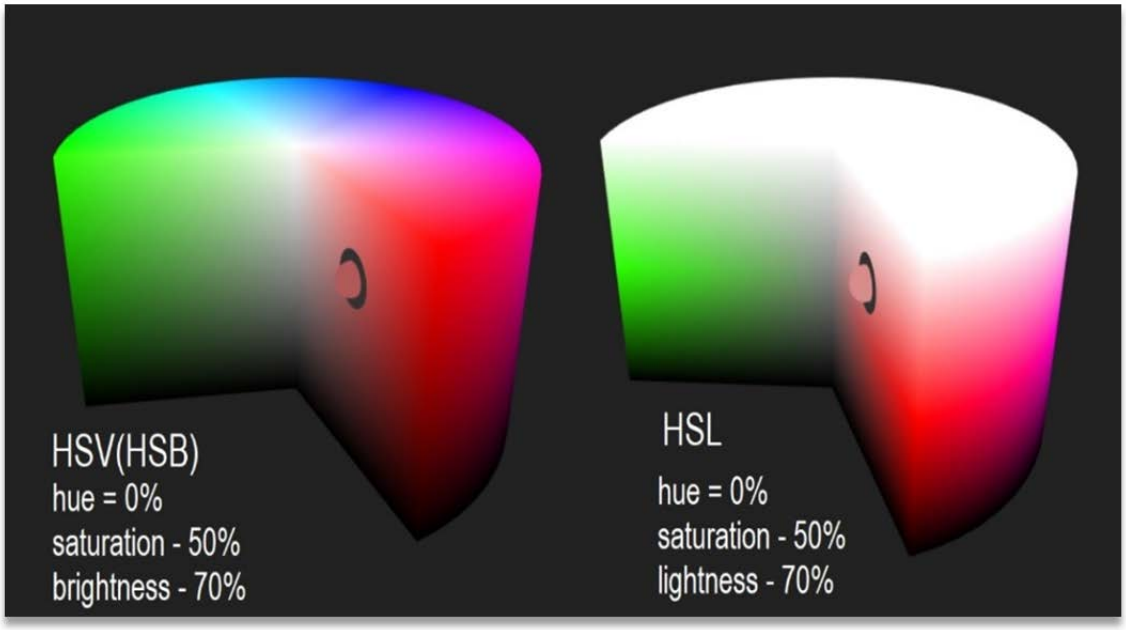


Figure 3.51 – HSV (HSB) and HSL colour models

HSL colour model is a cylindrical colour model with hue, saturation and lightness dimensions, hue specifying the angle of the colour on the RGB colour circle, saturation – the purity of the colour and lightness – the luminosity of the colour (Figure 3.51).

Lightness dimension is different from the HSV value dimension, and in this dimension the purest colour position in on the midway between black and white ends of the scale. Thus, colour with 0% lightness is black, 50% is the purest colour possible, and 100% is white.

► Mind that:

1. HSV (HSB) and HSL colour models are the models remapping RGB.

2. Even though the saturation dimension function is similar in HSV (HSB) and HSL colour models (specifying how much pure colour is used), the saturation controller provides different results within two models, caused by the brightness and lightness controllers (Figure 3.51).

3**.** There exist many other mathematical models for representing colour space, which are proved to be good in different fields of colour modelling including computer colour modelling (Figure 3.52).



Figure 3.52 – The Science of the Eye: The RGB Model

4. The conceptions of the colour models are based on science of the human eye, and when mastering the computer colour model one should take into account the peculiarities of colour perception by the human eye (Figure 3.53).



Figure 3.53 – Human eyes are there a source of colour modeling theory

Conclusions

Today we are witnessing the rapid development of computer technologies and computer graphics in particular. It is computer graphics that gives us the opportunity to make visual models of the reality around us, influencing all areas of human activity, such as business, science, medicine, education, and of course art and culture. Computer graphics technologies allow today to recreate the non-existent worlds of the past, visualize the events of the present and create the visual reality of the future, developing and improving new types of visual art.

***Key concepts*:** Computer Graphics classification, Computer Graphics colure models, Commuter graphics file formats, Commuter graphics software.

PRACTICE

Task 1. Rinds of graphics

What kinds of graphics are described by the following texts?

Computer graphics classification	Definition
	is the process used for digitally generating moving images. To create the illusion of movement, an image is displayed on the computer screen then quickly replaced by a new image that is similar to the previous image, but shifted slightly.
	is a way to create 2D drawings and 3D models of real-world objects in digital mode before they are manufactured or built. It is widely used by designers, engineers, architects, construction managers, inventors.
	is a field of computer graphics for visual representation of research objects, calculation results and results of computational experiments.
	is a visualization of ideas and creative templates for advertising and publicity. Its creation combines skills in technology and art, computer-generated images and words being used to create unique concepts and messages for publishing.
D. Web graphics	is a visual representation of information on Internet used to convey information and attract the attention of an Internet user.
	is a field of computer graphics designed for visualizing the various indicators and characteristics of production processes, giving better understanding of reports and statistical analytics through illustrative materials.
	is a kind of fine art for expression visual ideas and conveys messages considered to be a visual way to portray a written text, tell a story or provide decoration.

Consider the variants bellow:

A. Vector Graphics
B. Business Graphics
C. Scientific Graphics
D. Web graphics
E. Computer Animation
F. Fractal Graphics
G. Raster Graphics
H. Graphic Illustration
I. Interactive Graphics
J. Computer Graphic Design
K. Computer-aided Design

Task 2. File formats

What file formats correspond to the following characteristics:

1. Raster files, which maintain transparent colours are a) **PNG**; b)_____; c)_____; d)_____.

2. Basic raster format, which is created with minimum compression, is _____.

3. Raster file format, which allows selecting a compression level by adjusting the file quality to file size ratio, is _____.

4. Raster file format, which is based on lossless containing information such as paths, alpha channels and comments used by printing devices: _____.

5. Vector file format, which is referred to as a universal format supported by most vector graphics programs and recommended for saving visual identification elements, such as logos, is _____.

6. The file formats of two the most popular vector graphics programs, enabling files import to each other formats, in other words to the formats of their «competitor», are a)_____ and b)_____.

7. The file formats, which are the most frequently required by printing houses for delivering materials, are a) **PDF**; b) _____ and c) _____.

8. The best format for printing photographs are a) _____ and b) _____

9. Graphics files to be placed without processing on Web-pages and supported by all browsers are a) _____; b)_____ and c) _____.

10. Graphics file to be placed on Web-pages maintaining animation is: ___.

Consider the variants bellow:

BMP	JPG	PSP	AI	SVG
GIF	PNG	XCF	CDR	WMF / EMF
TIF / TIFF	PSD	PDF	DXF	

Task 3. Similarities and differences

Speak on similarities and differences between:

Business Graphics (BG) and Scientific Graphics (SG)

Similarities:

1. contain calculations

2.

Differences:

1. is used for presenting: BG – production data and SG – research data

_____

_____

2. _____

Graphic Illustration (GI) and Computer Graphic Design (CGD)

Similarities:

1. _____

2. _____

Differences:

1. _____

2. _____

Vector Graphics (VG) and Fractal Graphics (FG)

Similarities:

1. _____

2. _____

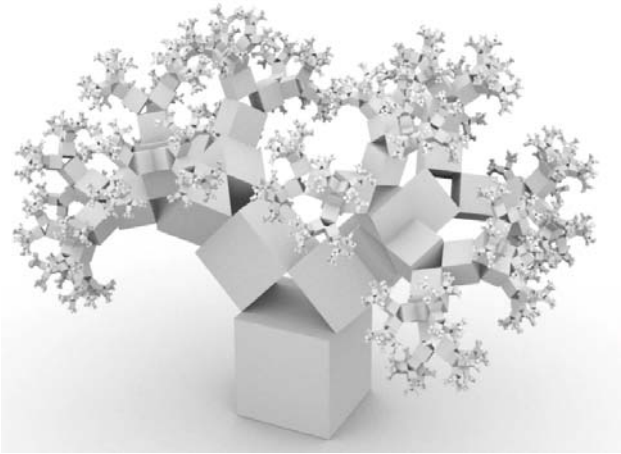
Differences:

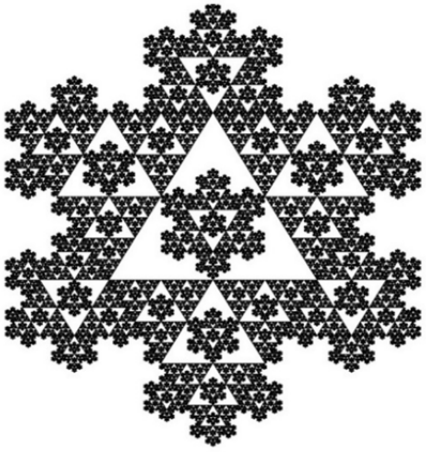
1. _____

2. _____

Task 4. Fractals

This fractal is based on





- _____
- _____
- _____

Consider Variants:

A. Mandelbrot set
B. Serpenski triangle
C. Koch Snowfall
D. Pythagoras tree
E. Dragon Curve

Task 4

Complete a Computer Graphics types analysis using the points, proposed in the table below. Fill the table with the analysis results.

	Raster Graphic	Vector Graphics	Fractal Graphic
Basic element of the image representation			pattern
Scaling			without loss of quality
Photorealism			mainly of a low level except objects of nature
Compression			without loss of quality
Graphic Programs			1) Apophysis,
File formats	1) JPG,		
Applications			1) Modeling nature objects with computer code; 2) 3)

Use the hints if necessary:

- pattern, line, pixel (dot);
- with loss of quality, without loss of quality;
- of a high level, of a quite low level mainly of a low level except objects of nature ;
- with loss of quality, with partial loss of quality, without loss of quality.

COMPUTER TRANING

Training 1: Raster Graphics Processing with Online Editor Photopia

Photopea.com is a free Photoshop double that runs in a browser (Figure 3.54), having identical to Photoshop interface. The program allows to create and edit images supporting most of the raster graphics file formats, including JPG, GIF and PSD and functions, such as layers, masks, artistic brushes etc (Figure 3.57).

• Create new Project (***File – New – New Project***) (Figure 3.55) and make a greeting card using Photopea samples.

Mind to choose Interface Language you need ***More – Language – English*** (Figure 3.56)



Figure 3.54 – Start window of the Photopea

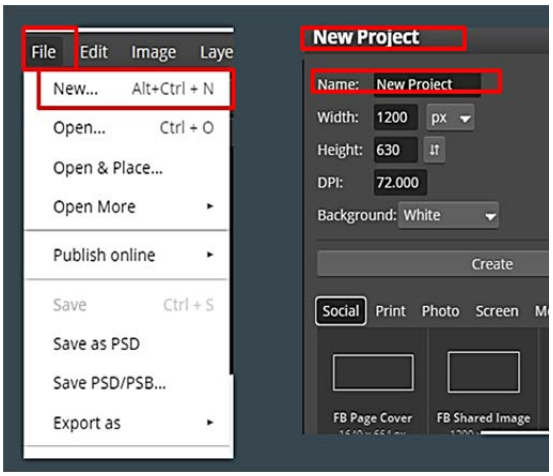


Figure 3.55 – Project Parameters

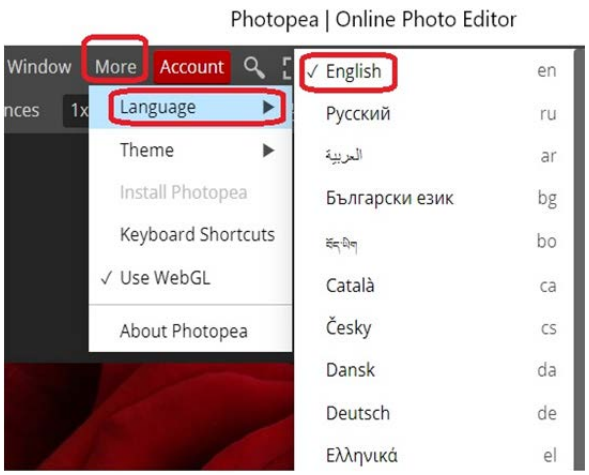


Figure 3.56 – Interface Language

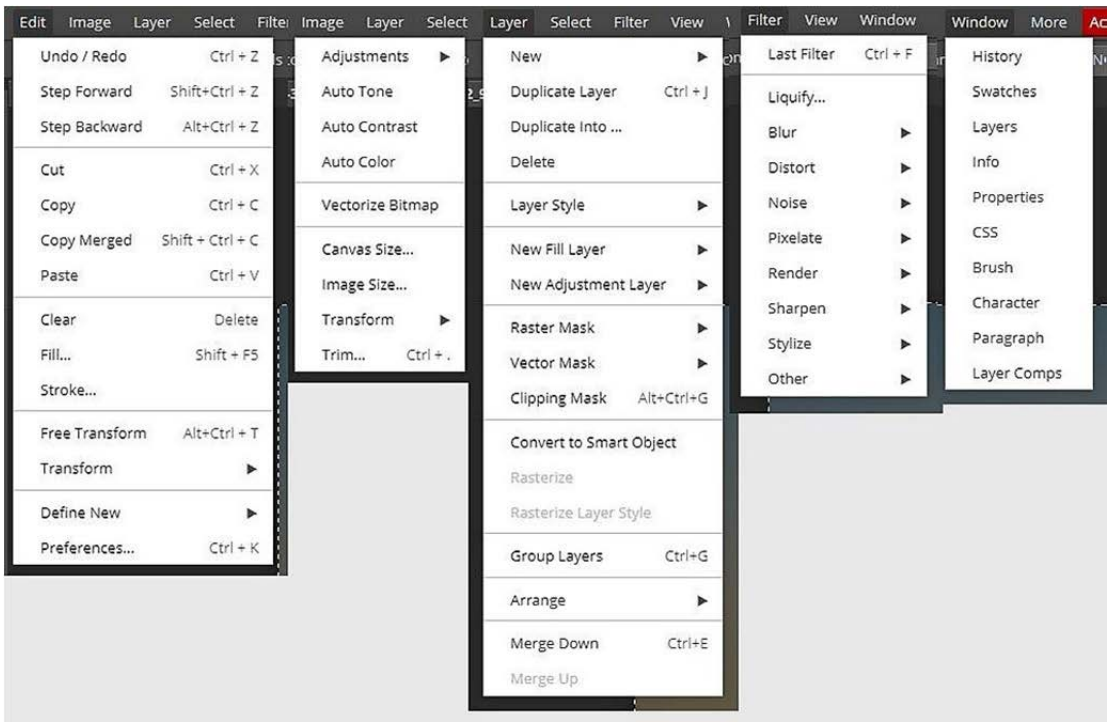


Figure 3.57 – Photopea Menu

EXAMPLE

1. Open new project (Figure 3.58).

2. Choose ***Template «Wake me up»***, ***B 5 size***, and then click ***Create*** button (Figure 3.14).

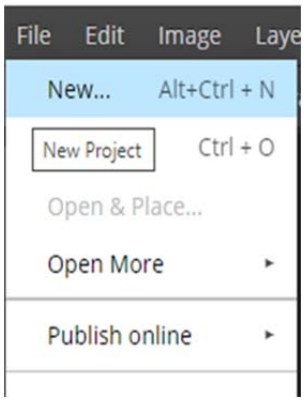


Figure 3.13 – New Project

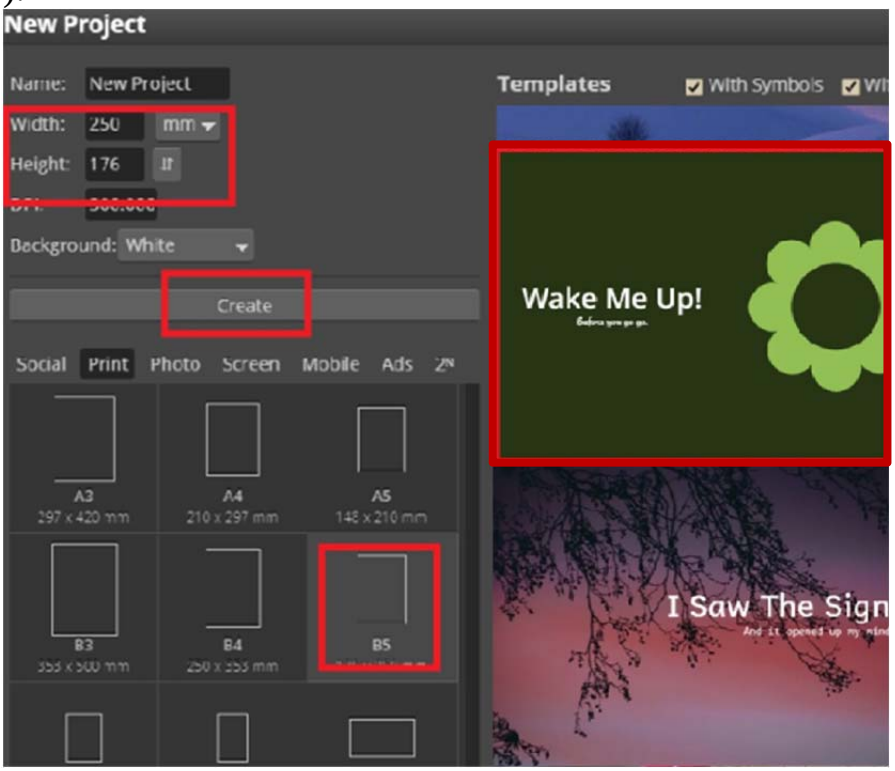


Figure 3.58 – Template

3. Open images ***Gallery***: ***Window – More – Gallery*** and choose image form it. (Figure 3.59).

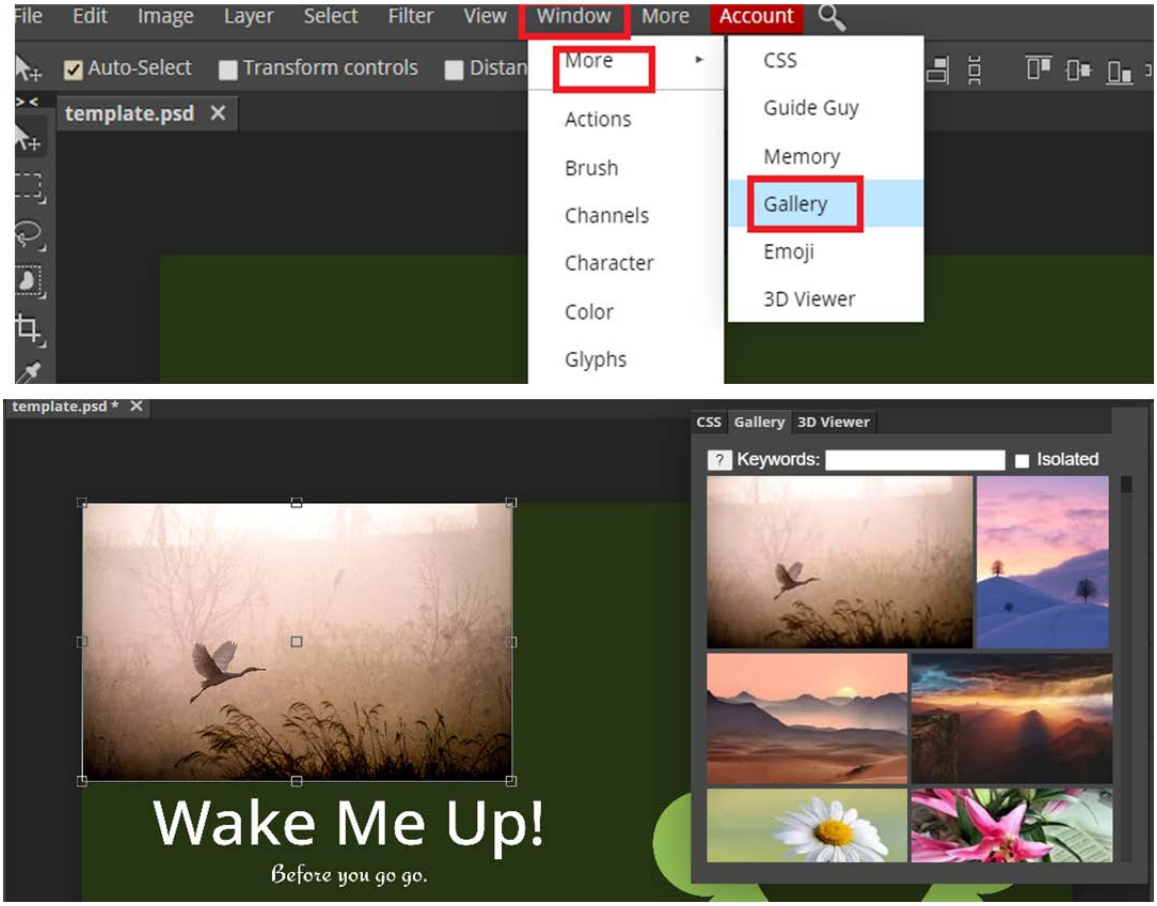


Figure 3.59 – Gallery of images

4. Rasterize layer with image (Figure 3.60).

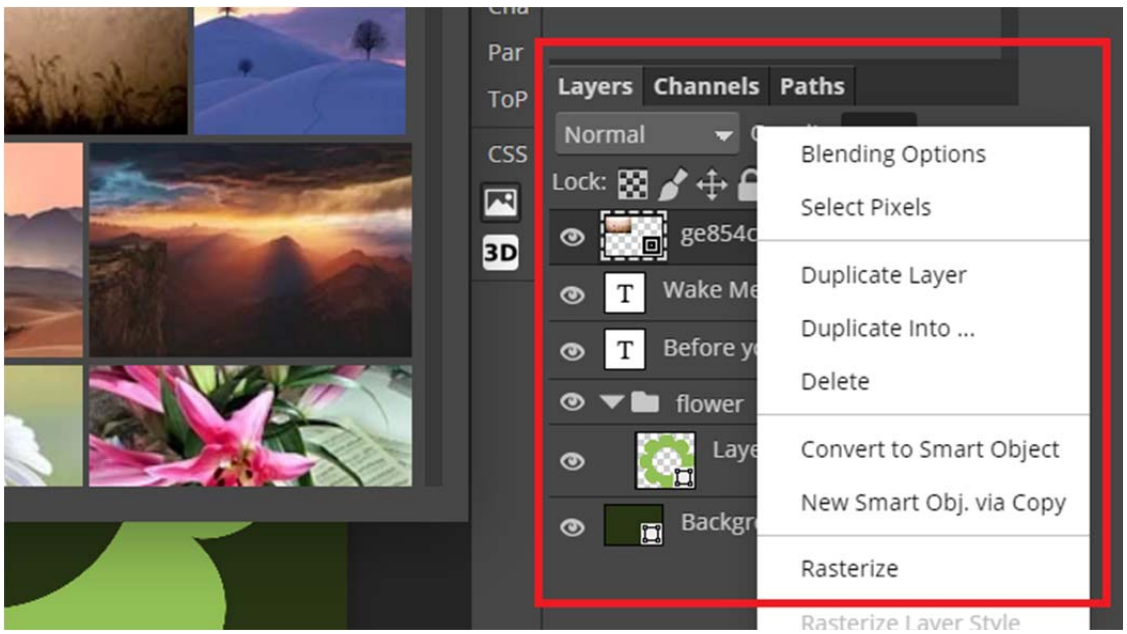


Figure 3.60 – Layers Palette

5. Move ***Layer with image chosen*** under the ***Layer with flower sample*** and put the image behind the flower (Figure 3.61).

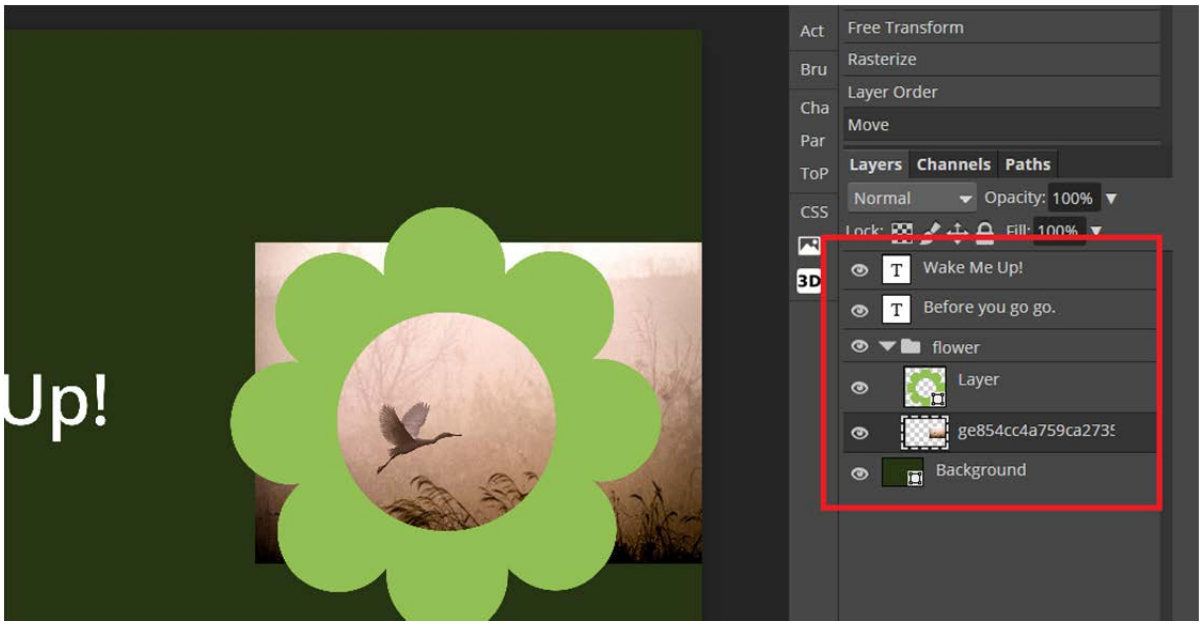
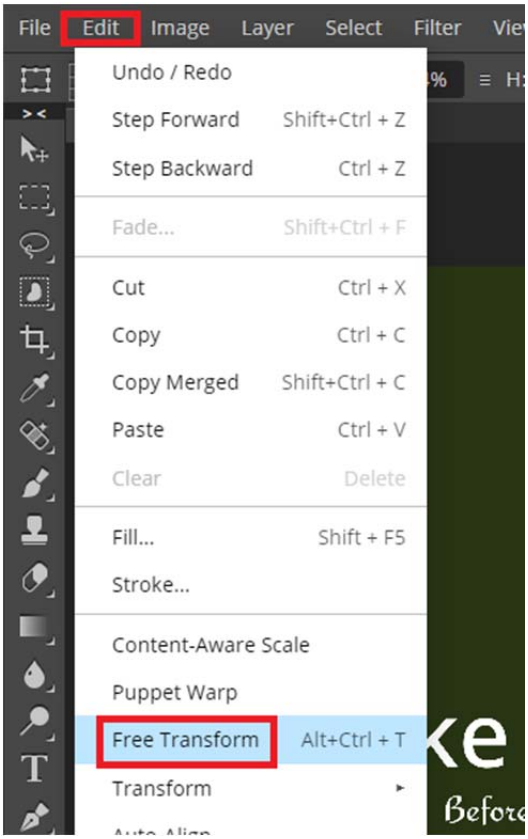


Figure 3.61 – Layers order

6. Choose ***Free Transform*** and fit ***the image*** to the ***flower frame*** (Figure 3.62). Then take Erase Tool and remove the part of the ***image,*** which does not fit the frame.



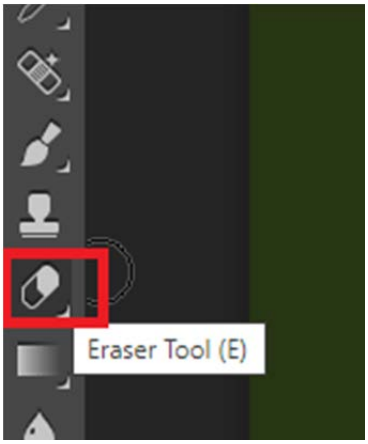


Figure 3.62 – Free Transform and Erase Tool

7. Select Background layer and adjust layer Hue/Saturation (Figure 3.63): ***(1) Background – (2) Layer settings – (3) Hue/Saturation – (4).***

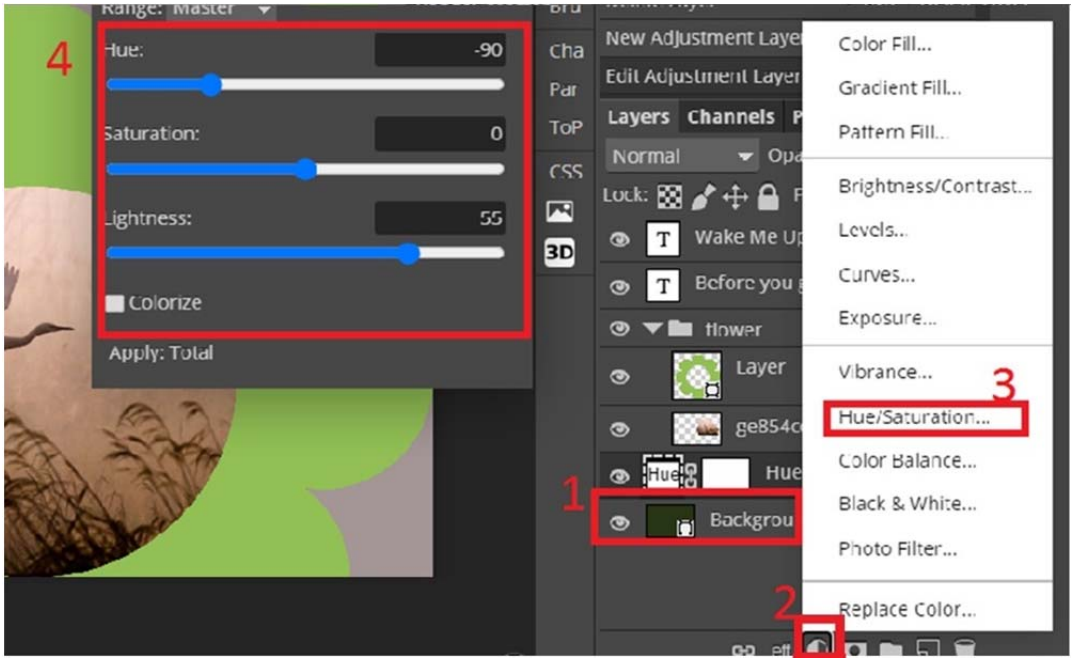


Figure 3.63 – Hue/Saturation

8. Do the same for ***layer with flower*** (click layer boundary with ALT button) (Figure 3.64).

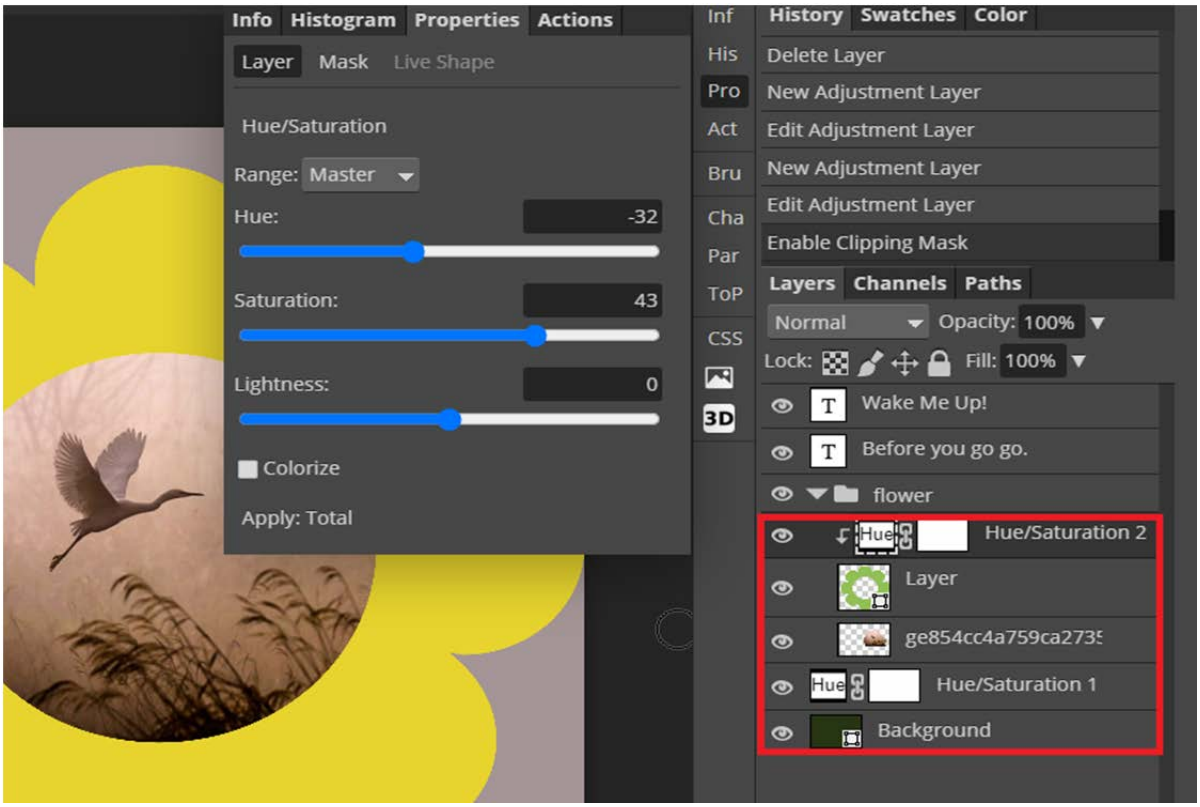


Figure 3.64 – Hue/Saturation applied only to the layer with flower

9. Take the ***Text Tool*** and put the ***Text*** on the greeting card. Pay attention that Text is on the special ***Text Layer***. Choose ***Text layer*** with Select Tool, select the text and put your «greetings». Change Character font, size and colour (Figure 3.65).

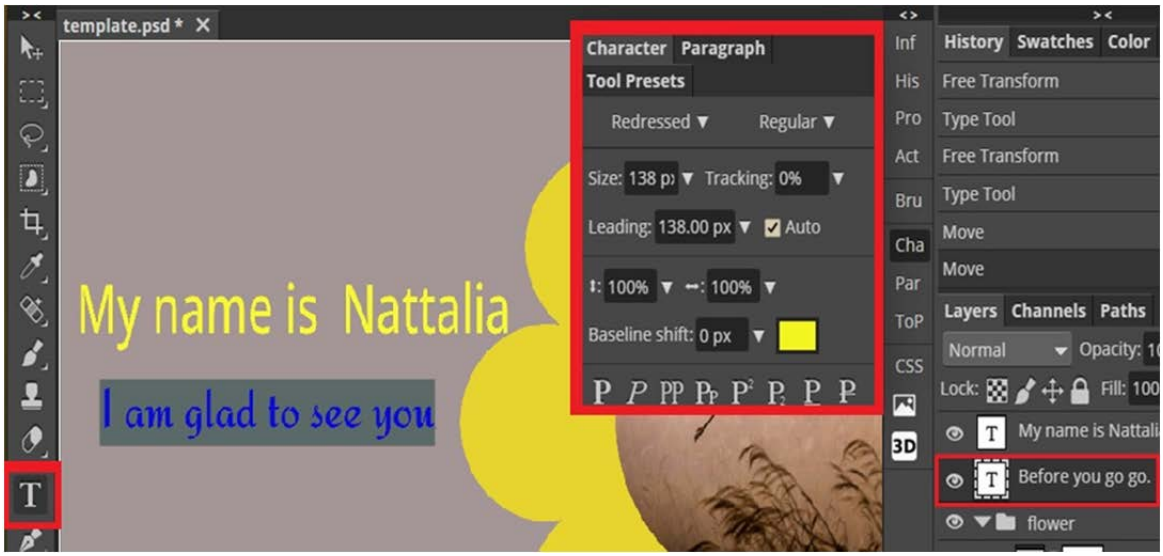


Figure 3.65 – Text Palette

10. Save image: Tile – Export as – JPG (Figure 3.66).

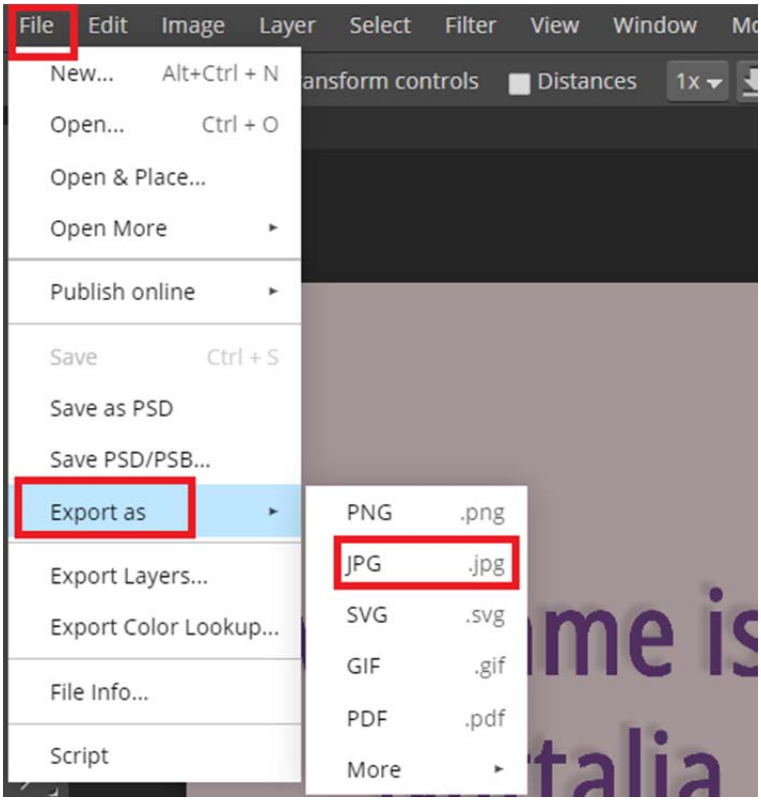


Figure 3.66 – Saving Image in JPG

Training 2: Collage creation with Online Editor Photopia

- Make a collage with your face on a famous portrait.

EXAMPLE

1. Find the ***Portrait*** on the Internet and save it on the computer.

2. Open the ***Portrait*** in Photopea (Figure 3.67). Pay attention that the ***Portrait*** is placed on the Background Layer



Figure 3.67 – Opening the Portrait in Photopea

3. Open your photo in a new file. Take ***Lasso*** and select the face (Figure 3.68).

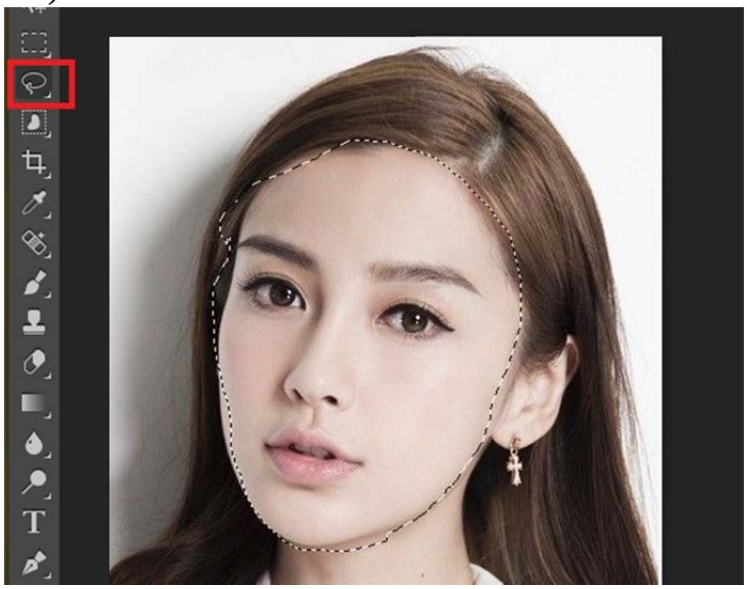


Figure 3.68 – Lasso Select in Photopea

4. Copy the selection to the clipboard: ***Edit – Copy*** (Figure 3.69).

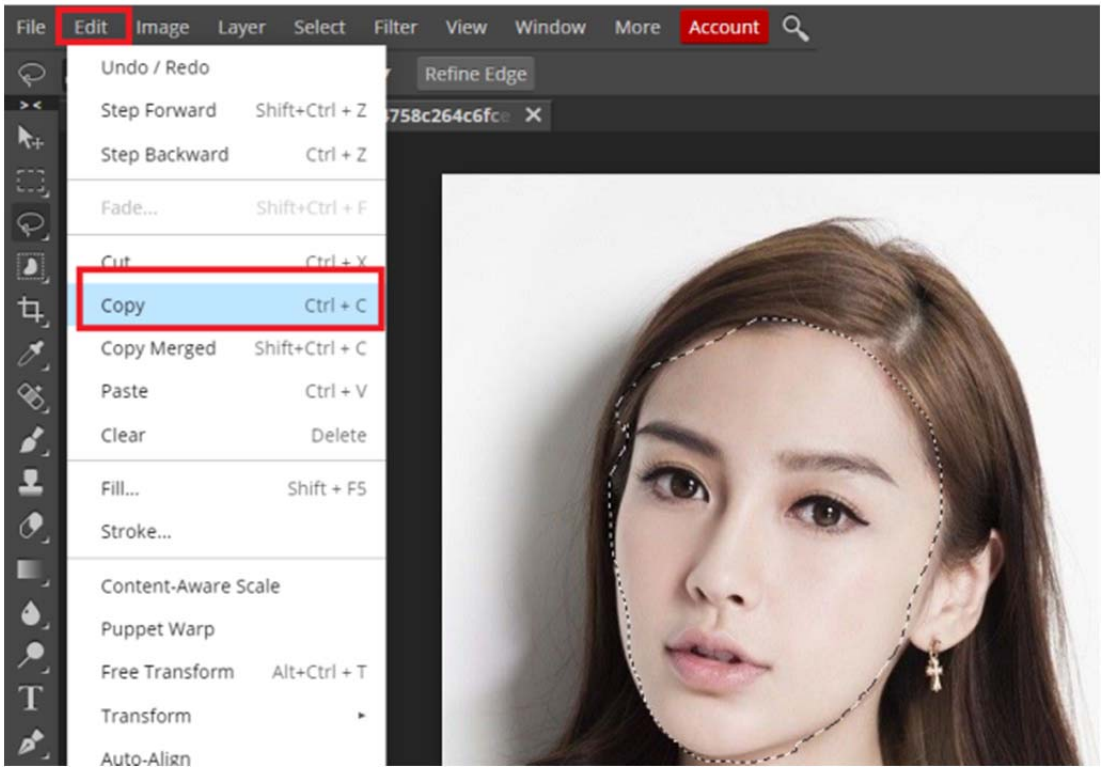


Figure 3.69 – Copy

5. Paste the face in the Portrait file on a new layer (Figure 3.70).

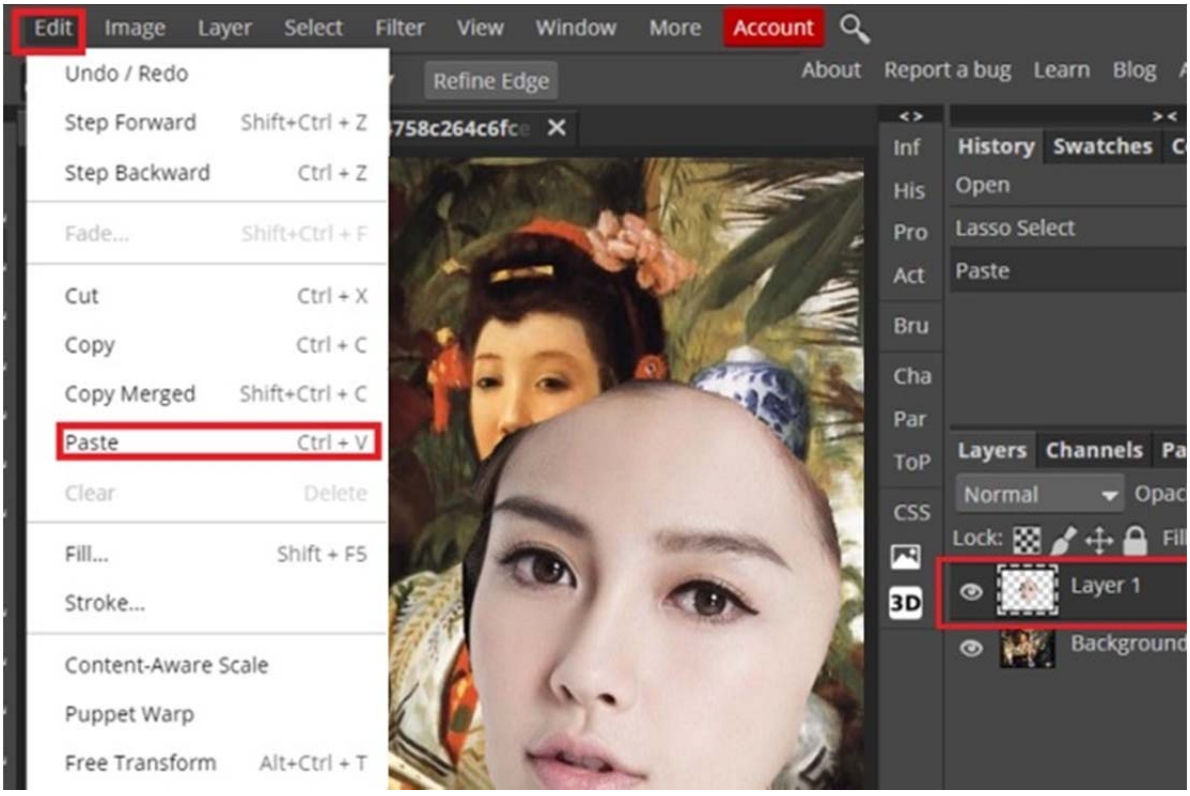


Figure 3.70 – Paste

6. Using Free Transform fit your photo to the ***Portrait*** face (Figure 3.71).

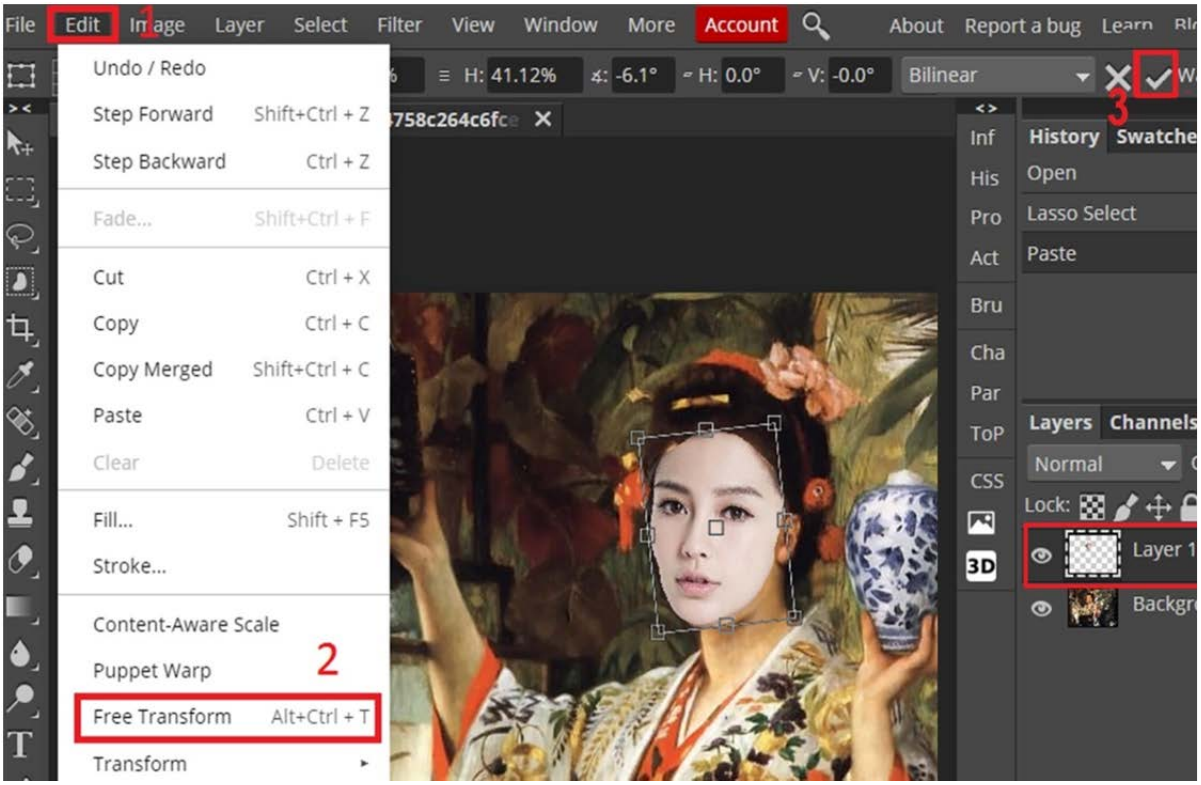


Figure 3.71 – Free Transform

7. Add mask to layer with your photo (Figure 3.72).



Figure 3.72 – Layer Mask

8. With ***Colour Balance*** tool (Image – Adjustment – Colour Balance) adjust the colours of the face to the colours of the ***Portrait*** (Figure 3.73).

9. Resize the canvas by adding ***space for caption*** at the bottom of the image, placing ***Anchor*** in ***the centre and up*** (Figures 3.74).

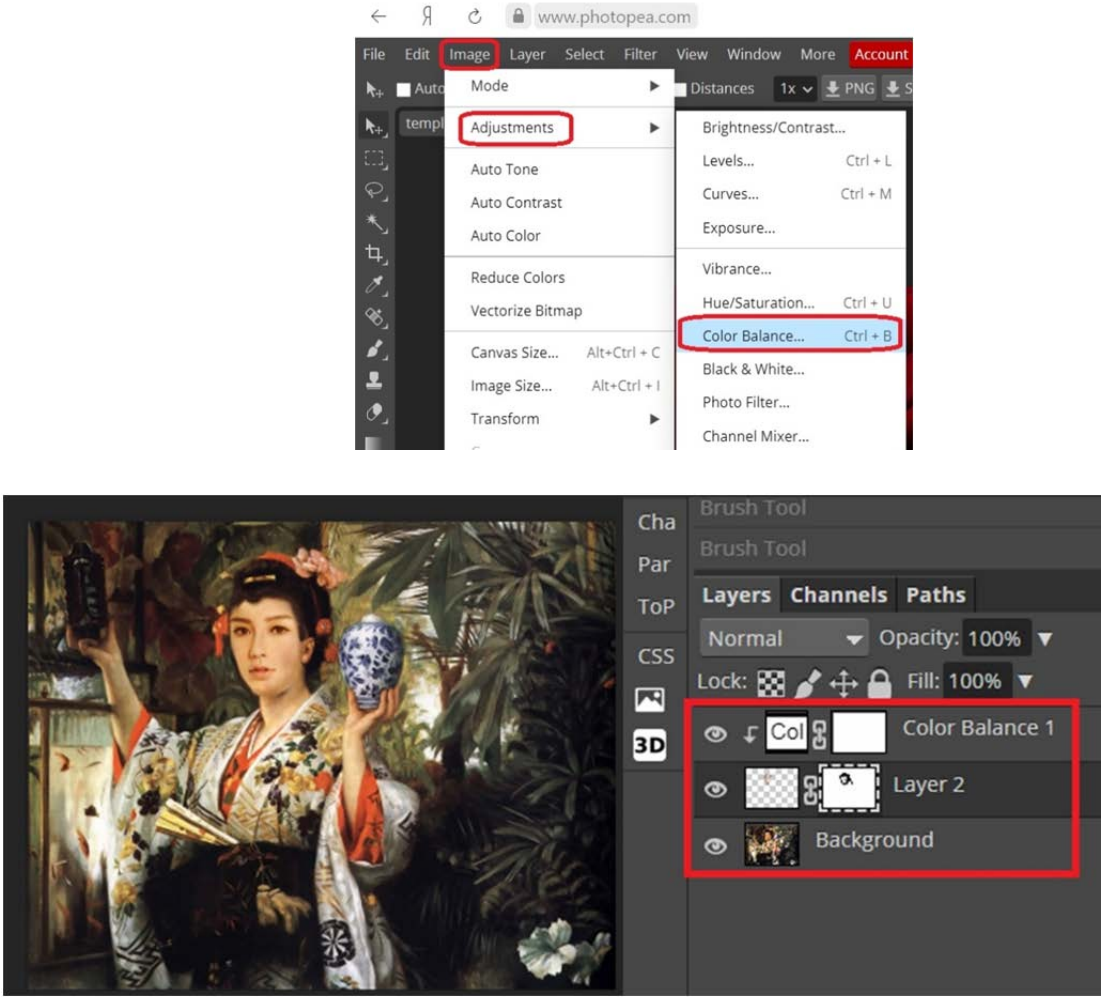


Figure 3.73 – Colour Balance Tool

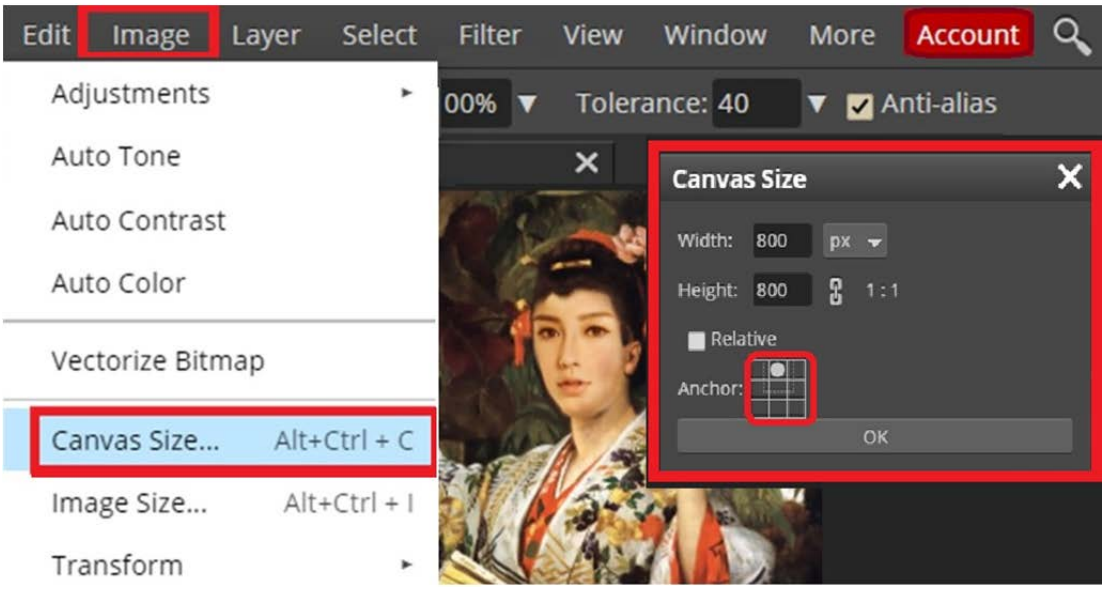


Figure 3.74 – Canvas Size tool

10. Use ***Eyedropper*** tool and ***Paint Bucket*** tools to add ***colour to caption space***. First, with Eyedropper click on the picture to choose appropriate colour and then with Paint Bucket click on the colouring space (Figure 3.75).



Figure 3.75 – Eyedropper tool and Paint Bucket Tools

11. Make a capture with your own name and the name of the ***Portrait*** author using ***Text*** tool (Figure 3.76). Save the final image in jpg file.

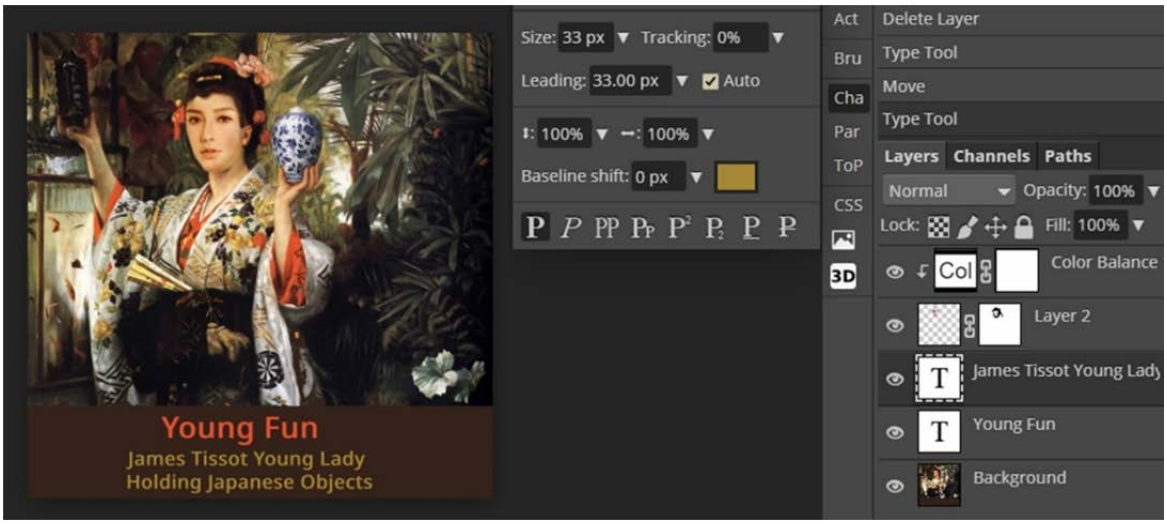


Figure 3.76 – Image Capture

Training 3: Business Card Design with online vector graphics editor Gravit Designer

- Create a ***Business Card*** with ***Gravit Designer***

Gravit Designer is a multi-purpose online tool for creating vector illustrations. Gravit interface was designed to be intuitive and simple. Gravit Designer is used by thousands of people not only for websites design but also to make illustrations and artworks even for games. Gravit's mission is to help designer to focus on the creative part of the design process. To access Gravit

Designer use the link https://designer.gravit.io/ (Figure 3.77). Before to start working mind to create a personal account.

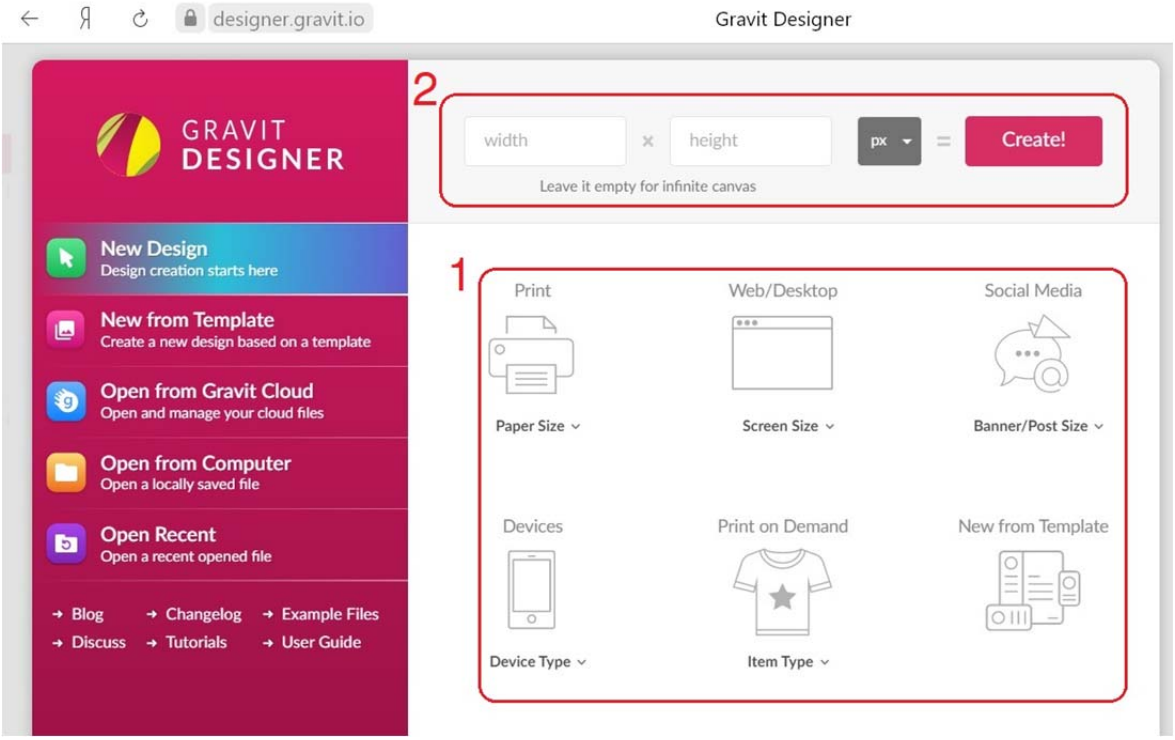


Figure 3.77 – Gravit Designer Start Screen

Gravit Designer has collected the most popular print and screen sizes (Figure 3.77 – (1), Figure 3.78), which one can choose directly on welcome screen, or start a project setting required values of width and high (Figure 3.78 – (2), Figure 3.79 – (1), (2)).

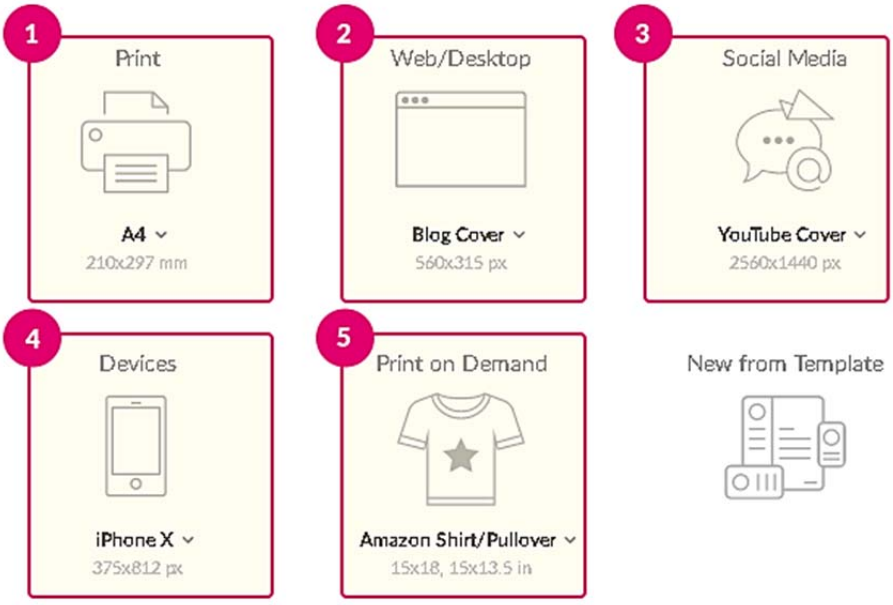


Figure 3.78 – Templates of canvas/page sizes



Figure 3.79 – Setting the required values of the page size

Gravit Designer has units suitable for print and screen design. For screen is better to use pixels (px), for designing print content millimetres (mm), centimetres (cm) or inches (in) are advisable to apply. (Figure 3.79 – (3)).

EXAMPLE

Creating geometrical forms

Gravit Designer allows to make several geometric shapes. Often such shapes are referred to as “primitives”. While these shapes may seem simple, they have hidden options built into them - for example, adding extra arms to a star or rounding the corners of a rectangle. Basic shapes include rectangles, ellipses, and polygons (and polygon variations such as triangles and stars).

To start training with geometrical forms, create first new file choosing the print form from collection of the standard print sizes (File New – Design – Print – Paper size – A4) (Figure 3.80).

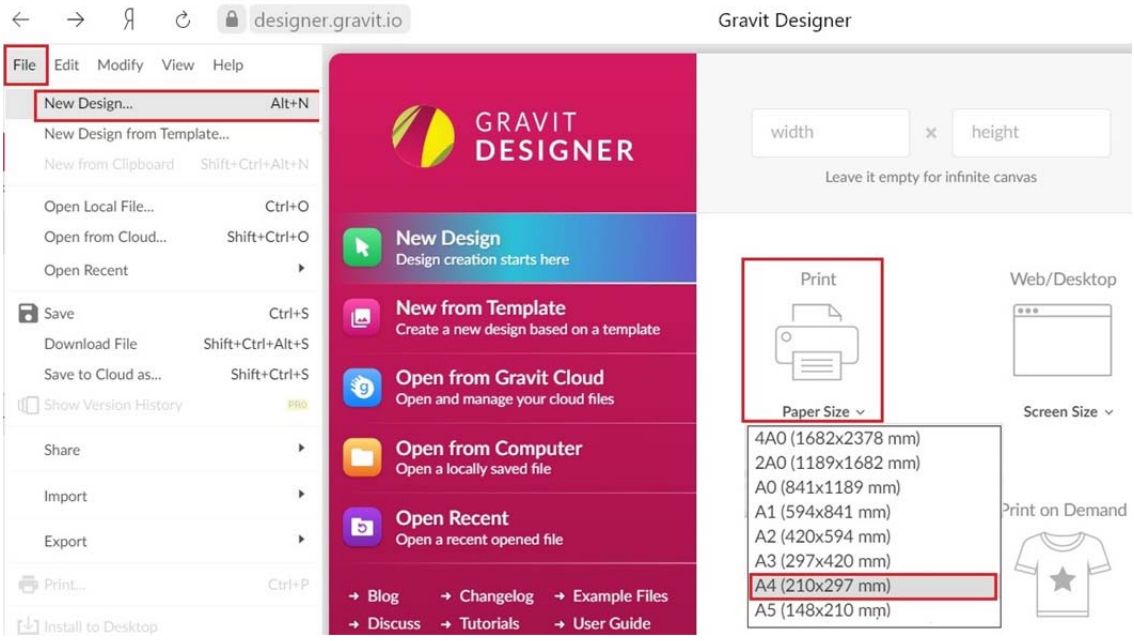


Figure 3.80 – Create new file

Rectangle (R)

To create a rectangle, click «+» and drag somewhere on the canvas. Release the mouse button when ready. To make a perfect square hold the SHIFT while dragging. By default, the rectangle will be drawn from the top left corner to the bottom right corner but to create rectangles from the centre it is necessary to hold the ALT key while dragging. To move the rectangle while creating it one needs to hold the «SPACE» key and move to the desired position.

Rectangles have hidden properties that can be controlled with subselect tool (D) – corners. To control how the corners of the rectangle look select the rectangle and hit the «ENTER» key, accessing the edit mode for manipulating the corner radius. For example, selecting one of the red control points and dragging it toward the centre of the rectangle provides rounded corners. Alternatively, changing the radius of the corners in the ***Inspector*** –> ***Appearance*** section by moving the ***Corner*** slider or by typing a value in the text field next to the slider gets the same result (Figure 3.81).

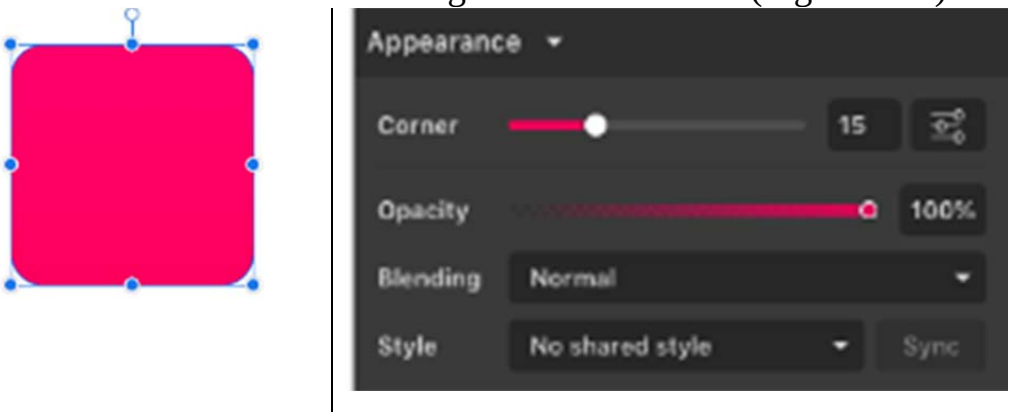


Figure 3.81 – Rectangle's controllers

Ellipse (E)

To create an Ellipse, click «+» and drag somewhere on the canvas. Release the mouse button when ready. To make a perfect circle hold the «SHIFT» while dragging. By default, the Ellipse will be drawn from the top left corner to the bottom right corner. To create Ellipse from the centre it is necessary to hold the «ALT» key while dragging. Ellipse tool allows to draw fully closed ellipses or circles, as well as truncated ellipses (2), arcs and pie shapes (3) (Figure 3.82).

If you press the Enter key (or double-click on an ellipse, or select the Subselect tool), two red control points that allow you to modify the open part of the ellipse contour become accessible. Alternatively, it is possible to use ***Angles*** fields in the ***Inspector*** panel to make more precise editing (Figure

3.83). Once the ellipse is open using the Shape buttons in the ***Inspecto***r panel allows to choose how the gap l behaviour. There are 3 options: ***Open***, ***Closed*** and ***Pie***.



1 2 3

Figure 3.82 – Ellipse Options

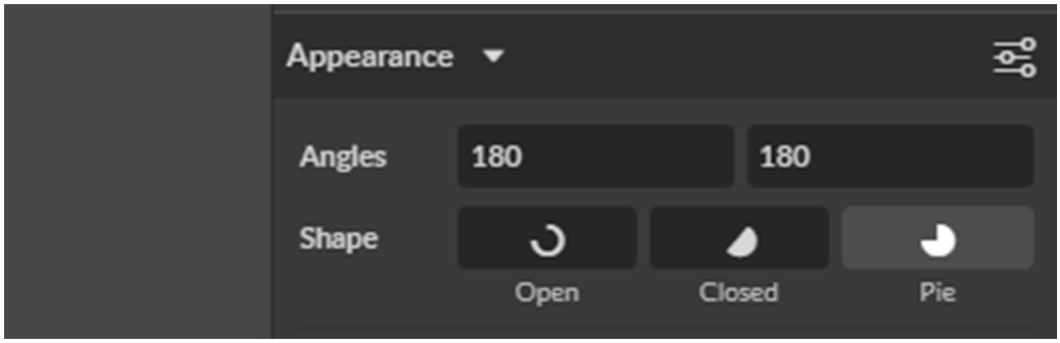


Figure 3.83 – Inspector panel

Polygons with 6 sides and 5 sides with shadow and reflection effects

To create a polygon, click «+» and drag somewhere on the canvas. Release the mouse button when ready. Hold «SHIFT» to constrain drawing to 15 degrees. A polygon is always drawn from the centre outwards. To move the polygon while creating it one needs to hold the «SPACE» key and move to the desired position. By default, Gravit Designer creates a polygon with 6 sides (hexagon). Once you create the shape you can change the number of sides in the ***Inspector*** panel.

Exercise. Practices in creating shapes as shown on the Figure 3.84.

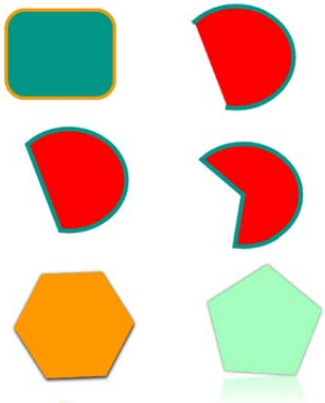


Figure 3.84 – Geometrical shapes

Compound shape.

Select 2 vector objects: Rectangle and Ellipse.

Use ***Modify*** –> ***Create Compound Shape*** (Alternatively: Create Compound Shape button in the main toolbar or in the context menu).

Choose from available *Boolean* operations (Union, Subtract, Intersect or Difference).

It is possible to split at any time Compound shape to its original parts using ungroup command «CTRL + SHIFT + G». All properties of the original objects will be restored.

A Compound Shapes are non-destructive and can be changed to a different merge operation at a later time using Compound options in the ***Inspector*** panel (Figure 3.85).

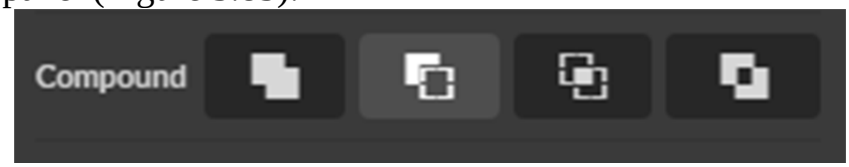


Figure 3.85 – Compound options in the Inspector panel

Create Compound Shape dropdown on the toolbar, or Compound options in the ***Inspector*** panel.

Compound shapes are cumulative you can have multiple ***Boolean*** operations (Union, Subtract, Intersect or Difference) in one Compound Shape (Figure 3.86).

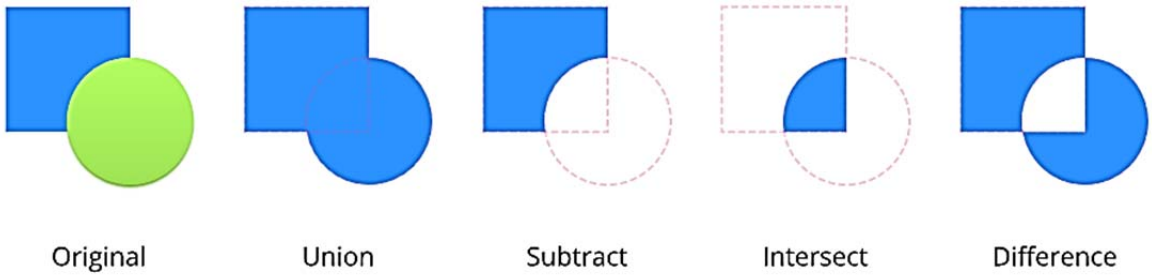


Figure 3.86 – Compound Shapes

Path (P) and transform Anchor points

Grab the Pen Tool from the Tool Bar or click Path on the keyboard. Click to set first anchor point that defines the start of the path (1), click to set second point (2), on bringing up more anchor points (Figure 3.87).

Transform type Anchor points (Figure 3.88) with Joint panel (Figure 3.89).

To create a curved line, it is necessary to click and hold down the left mouse button and drag to enter Bezier handles at the anchor point and form a curved line (Figure 3.90).

To create square 80x80. To select Path. You must click on first point. Then you must click on the second point, hold down the left mouse button and drag to enter Bezier handles at the anchor point. Repeat operations with point 3 and point 4 (Figure 3.91).

Close loop (Figure 3.58).

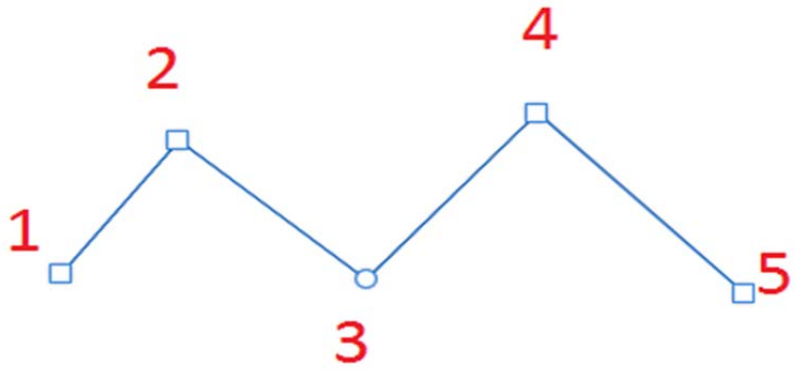


Figure 3.87 – Path

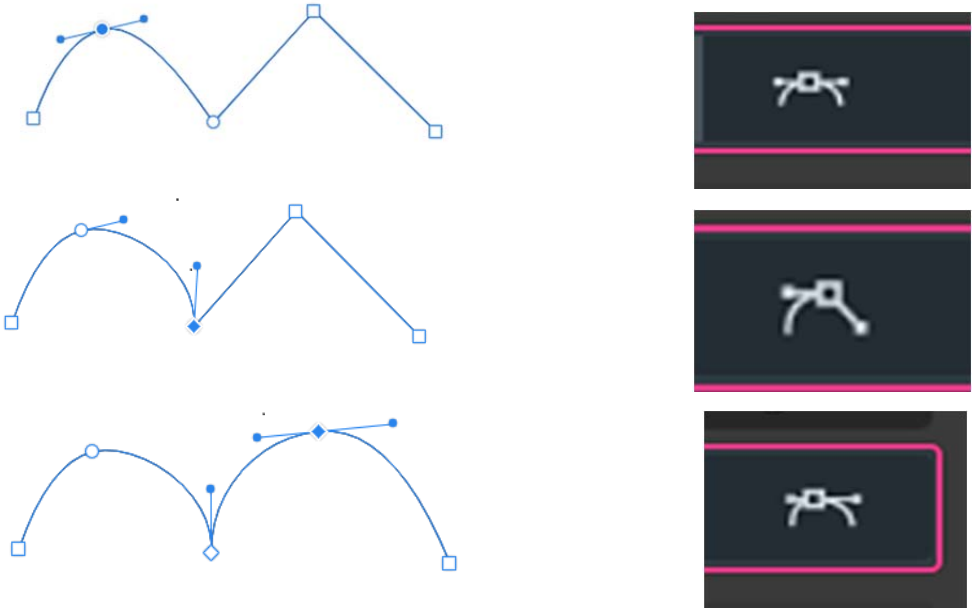


Figure 3.88 – Transform Anchor points

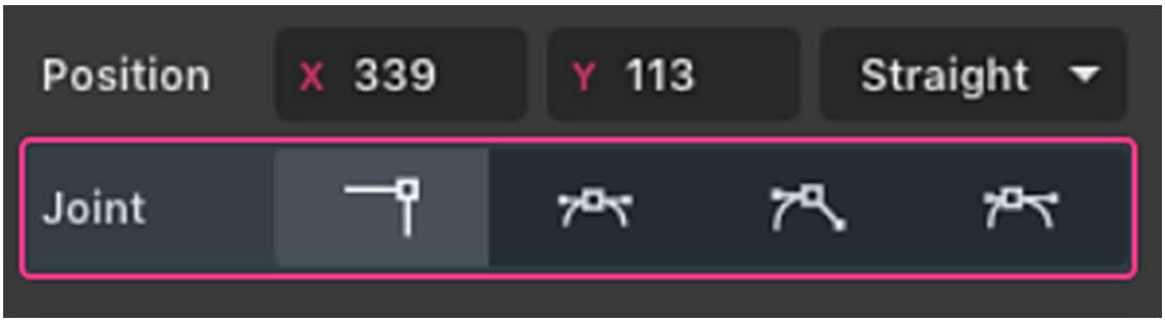


Figure 3.89 – Joint panel



Figure 3.90 – Curved line

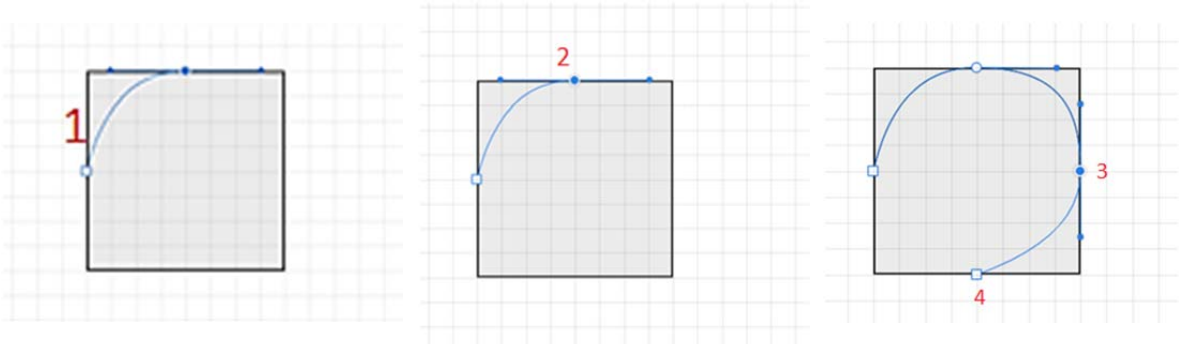


Figure 3.91 – Create Path with curved line

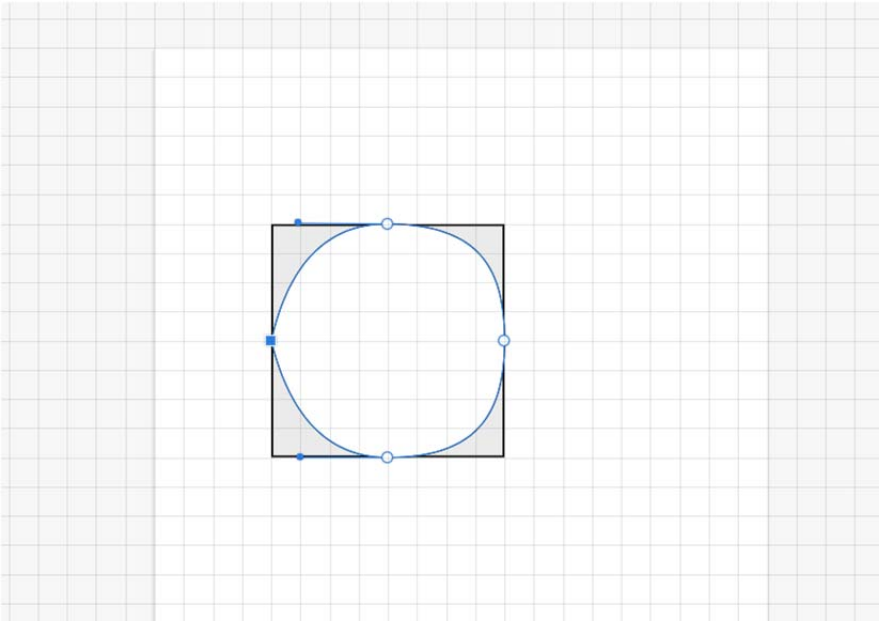


Figure 3.92 – Finished image

Business Card Creating

1. Load https://www.designer.io/en/ and create a personal account.

2. On the Print presets of the Welcome Screen, click the arrow next to A4 to show more file sizes and select Business Card (Figure 3.93) choosing ***Bisness Card (85x55)*** option.



Figure 3.93 – Business Card

3. Assign print areas (Figure 3.94 and 3.95):

Layout Safe Area

This is the safe area, which means that everything inside this area will appear on the final printed product. This is where all your important content will be.

Margin Area

The margins are defined as a safe zone for cutting. Be sure not to leave any important information on the margins and beyond it, because it might be cut out depending on the type of equipment that will be used.

Bleed Area

Each print shop uses different equipment and it's not safe to trust only the margins, so we also define a bleed area, which extends a little beyond the margin area. The bleed will be cut out on the final cutting process.

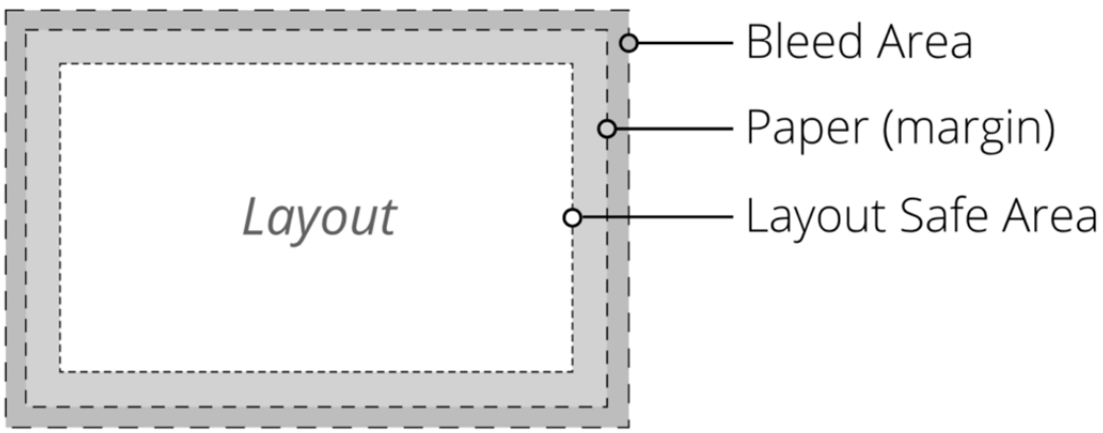


Figure 3.94 – Print Areas

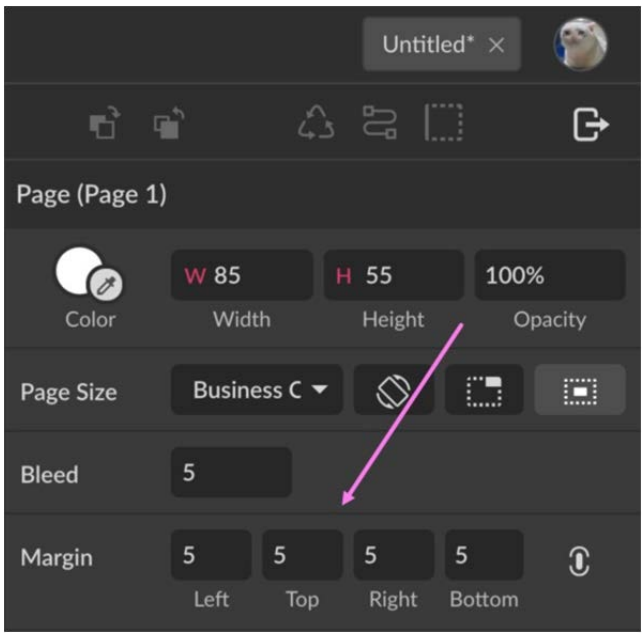


Figure 3.95 – Page Promoters

Rotating the canvas

The business card we are designing will be vertical, not horizontal, so let's rotate our canvas. This is done on the ***Inspector*** panel, under Page, by clicking the Rotate Canvas. Fill the page with background colour #CAF2F2.

4. Import university photo. Place it at the top centre. select the image of the university. Select the Subselect tool and pull the red handles to round the corners (Figure 3.96).



Figure 3.96 – Transform University photo



Figure 3.97 – Emblem of Business Card

5. Add Rectangle colour #CAF2F2 border size 2 px and colour #1C5E5E.

Move the rectangle layer under the image layer (Figure 3.97).

6. Add text. The business card should contain, in addition to the emblem or logo: your name, what you do, and ways of contacting you, for example, your email. Using the Type Tool (T), add three text boxes and fill them in with your name, status, and email address (Figure 3.98). To add text, simply click with the text tool on the canvas. You can change the size, colours, and fonts in the Inspector panel under Appearance. Add a line.



Figure 3.98 – Text boxes



Figure 3.99 –Business Card with deferent type text



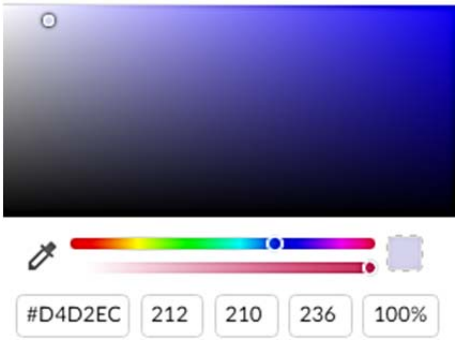


Figure 3.100 – Finished Business Card

Choosing fonts

Gravit Designer has an immense library of Web Fonts for you to choose from. Choose the Web Fonts tab on the fonts menu and navigate through all the fonts using up/down on your keyboard. All Web Fonts on Gravit Designer are free to be used commercially (Figure 3.99).

8. Define the colours.

Define a set of colours to be used in your design. If you already have a logo, make sure that the colours you choose for the card match this logo (Figure 3.100).

Training 4: Professional Logo Design with Gravit Designer

• Create a Professional Logo with Gravit Designer

EXAMPLE.

1. Begin your design creating a new project: ***File*** –> ***New Design*** or «CONTROL + N» to open the ***New Design***. Choose the preset option with 800 pixels wide by 600 pixels high (Figure 3.101).

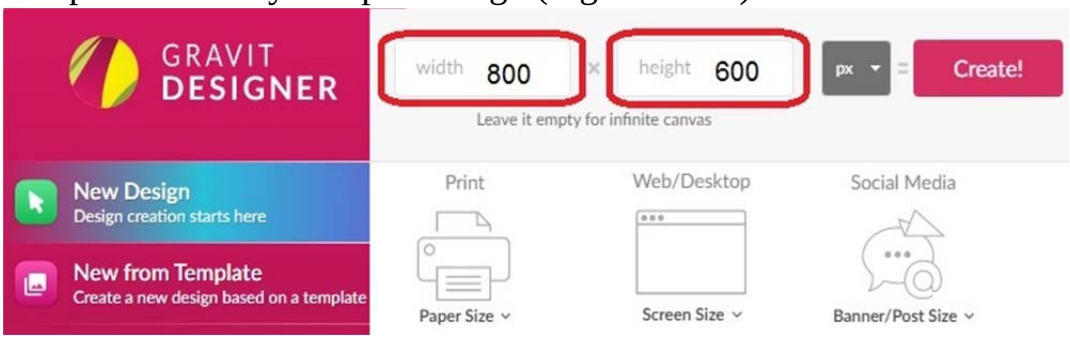


Figure 3.101– New Project

3. Choos colour for bagraund #E1E85E (Figure 3.102).

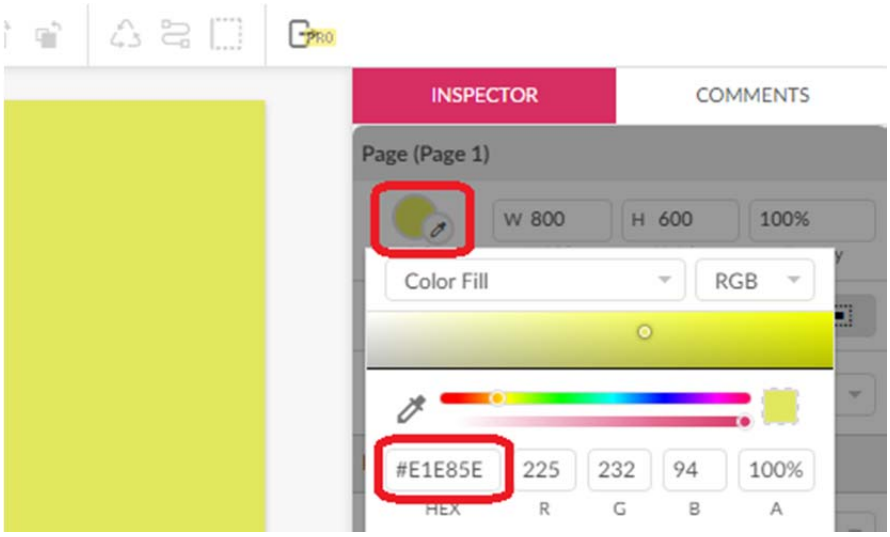


Figure 3.102 – Bagraund Colour

4. Create Rectangle. Select subselect tool (D) – corners. Select the rectangle and hit the «ENTER» key. Manipulate the corner radius. Select one of the red control points and drag it toward the centre of the rectangle. All the corners are now rounded. Alternatively, one can change the radius of the corners in the Appearance section of the Inspector panel by moving the Corner slider or by typing a value in the text field next to the slider. Choos colour for rectangle #980000. Then creit cope and rotet it. Then make a copy of the rectangle and rotate it 90 degrees move down to the start of the first rectangle and increase the length (Figure 3.103).

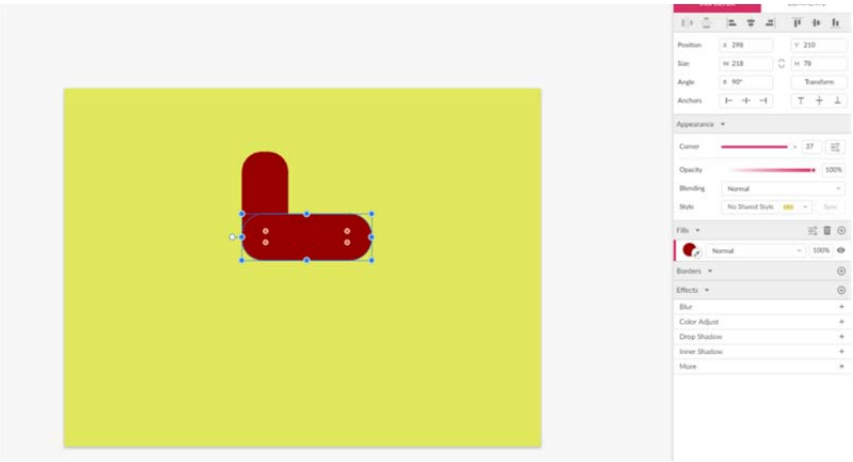


Figure 3.103 – Toucan body

5. Create a toucan eye using two gray and black ellipses (Figure 3.104).

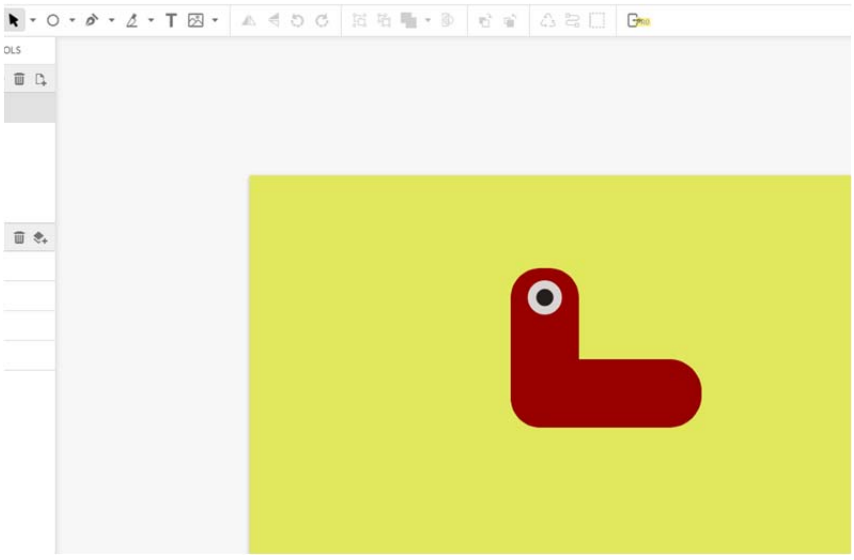


Figure 3.104 – Toucan body with eye

6. Create a toucan beak. To do this, create an orange rounded rectangle and a brown ellipse. Rotate ellipse. Select both shapes and create mask for an object. Clik twise to edit the clliped object. Move this layer down (Figure 3.105).

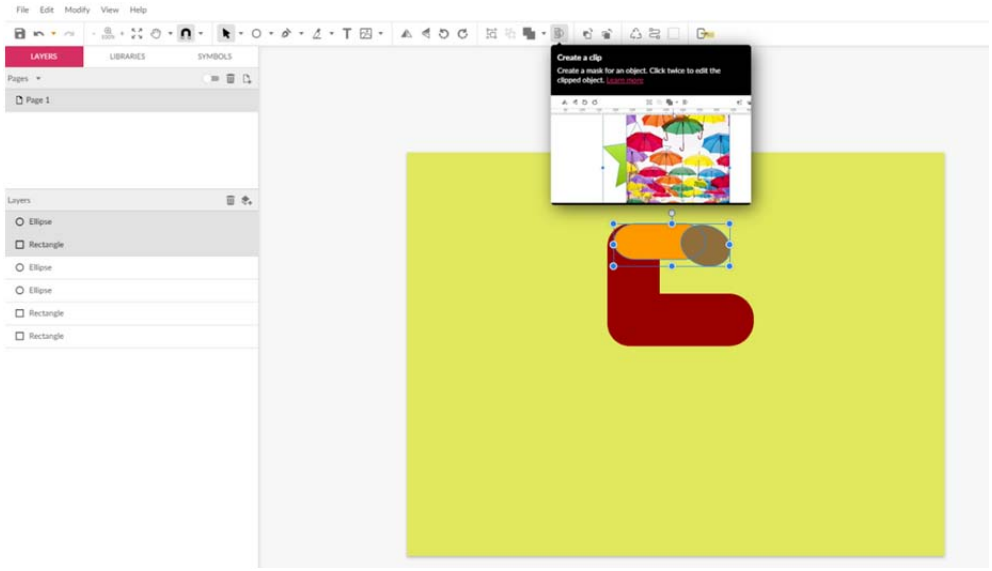


Figure 3.105 – Toucan body with beak

7. Create a line, select sudselect tool and round it. Apply a stroke, undo the fill. Move this layer up (Figure 3.106).

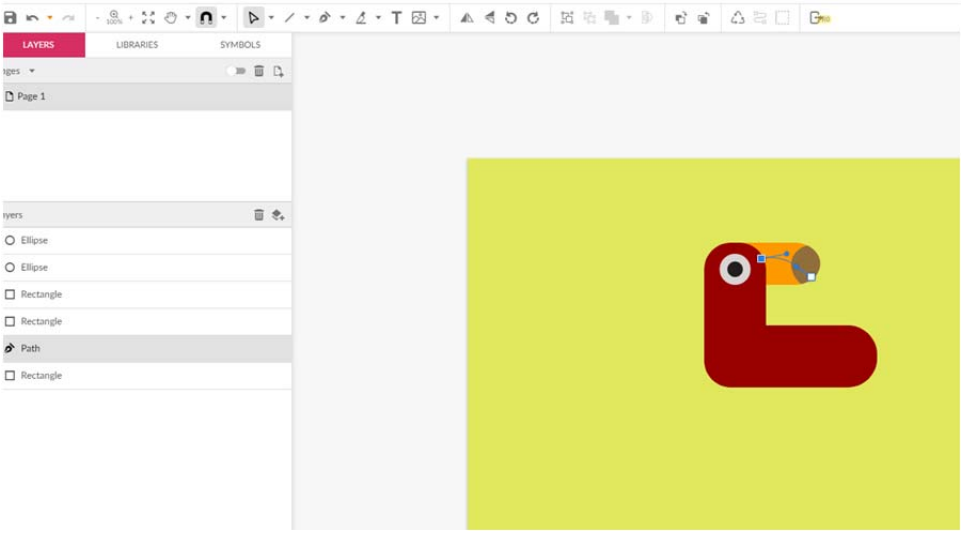


Figure 3.106 – Toucan body with beak

8. Create wing. To do this, create two rounded rectangles of different green colours. Select the second rectangle. In the Inspector, uncheck the Uniform Corners and make two of them straight (Figure 3.107). Create a rectangle overlaid on the previous ones. Apply the command Sabstract (Figure 3.108).

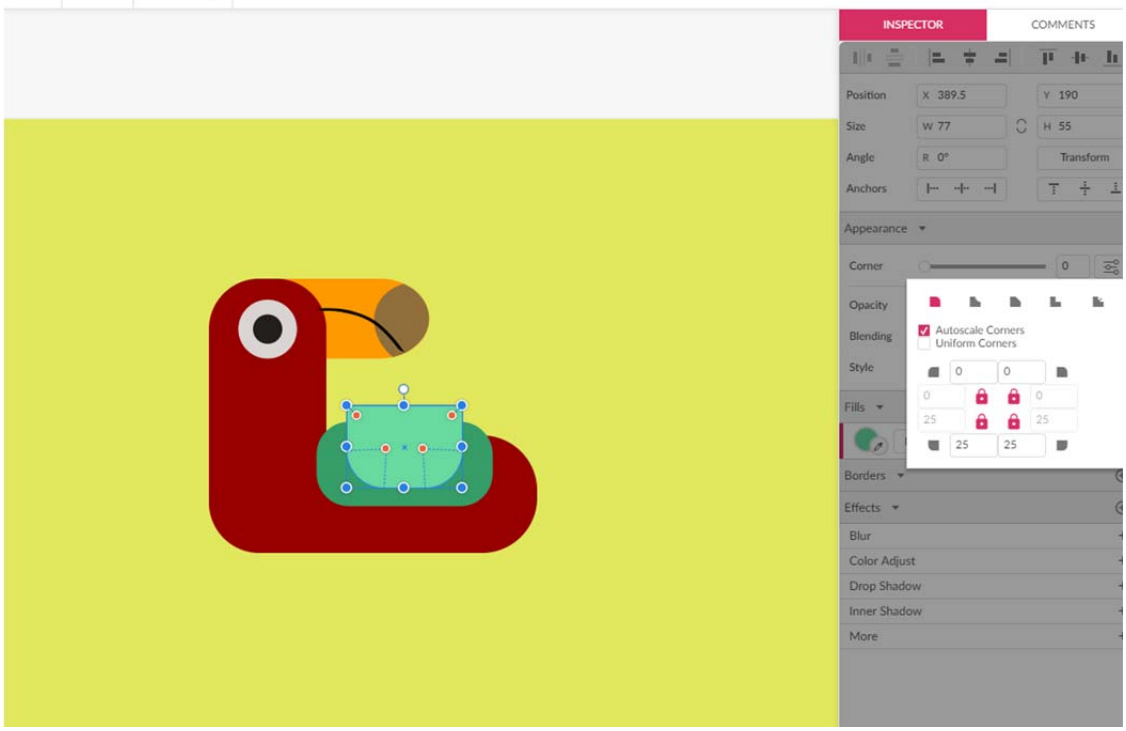


Figure 3.107 – Toucan body with wing

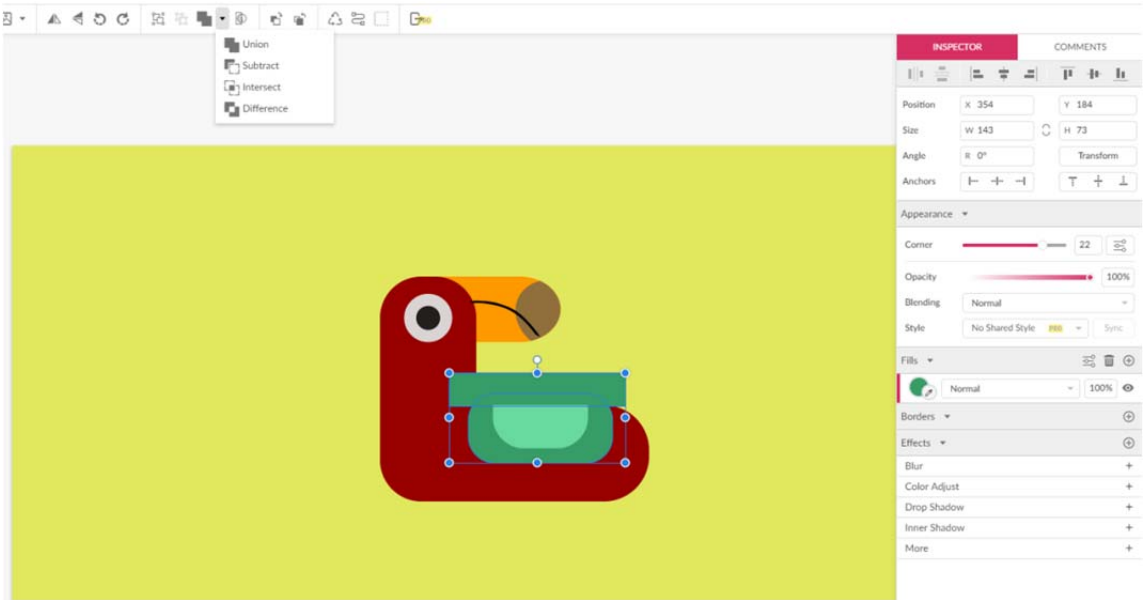


Figure 3.108 – Apply the command Sabstract

9. Add paws and rectangle. Add text. Using the Type Tool (T), add three text boxes and fill them. Select the Web Fonts tab from the fonts menu and navigate to the font type Palette Mosaic. The logo is finished (Figure 3.109).

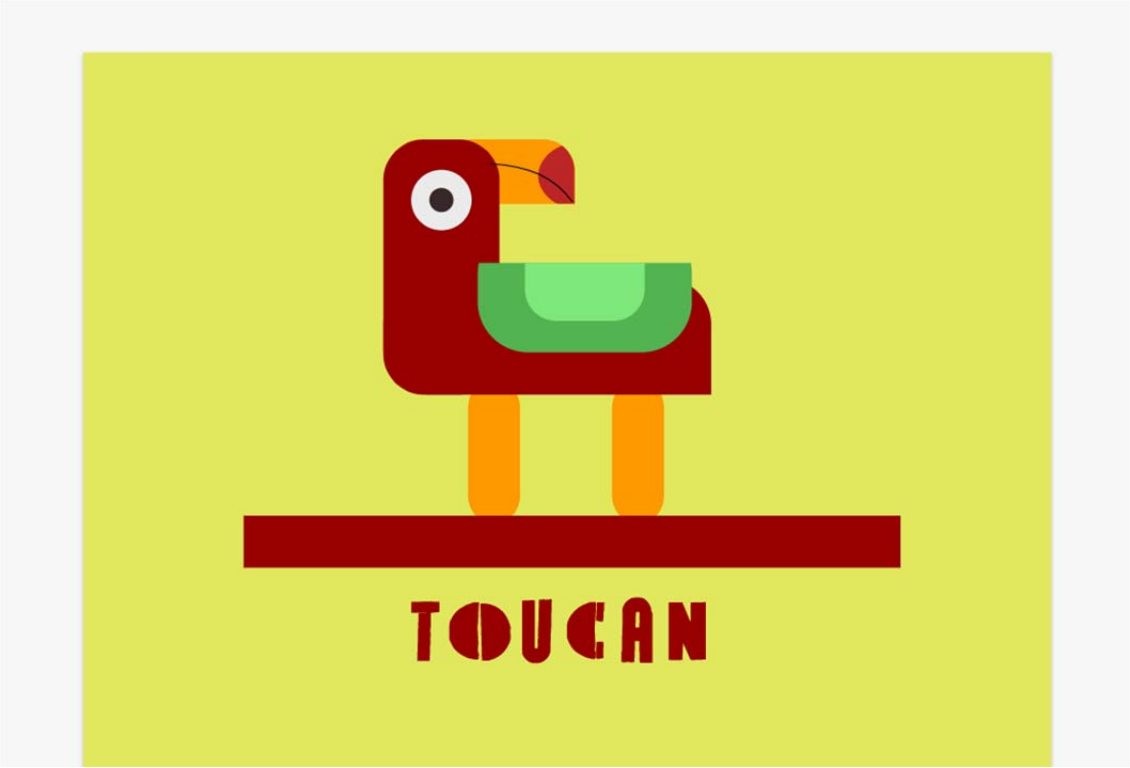


Figure 3.109 – The logo is finished

INDIVIDUAL TRANING

• Design and create LOGO using ***Gravit Designer*** program for presentation of your ***Individual topic***.

• With Gravit Designer design and create Bisness card wich you can give to your college on the conference or buisness meating as well as to send via sotial media.

UNIT 4. COMPUTER TECHNOLOGY IN MUSIC

Main issues

1. The main characteristics of sound
2. Analog and digital audio
3. Digital audio formats
4. Audio processing
5. Types of musical computer programs
6. The use of computer hardware and software in musical creativity
7. Music on the Internet. Streaming and static music
8. Internet audio file formats
9. Bitrate. Placement of audio files on the Internet.

Aim: Get acquainted with the basic concepts of audio information. Learn to work with sound using built-in computer resources and cloud services.

In physiology, sound occurs when the vibrations of an object pass through the medium until they hit the eardrum. In physics, the sound is created as a pressure wave. A sound is emitted when an object vibrates, creating a pressure wave. This pressure wave causes particles in the environment (air, water or solid) to oscillate. When particles vibrate, they move nearby particles, transmitting sound further through the medium. The human ear picks up sound waves when vibrating air particles cause small parts inside the ear to vibrate (Figure 4.1).

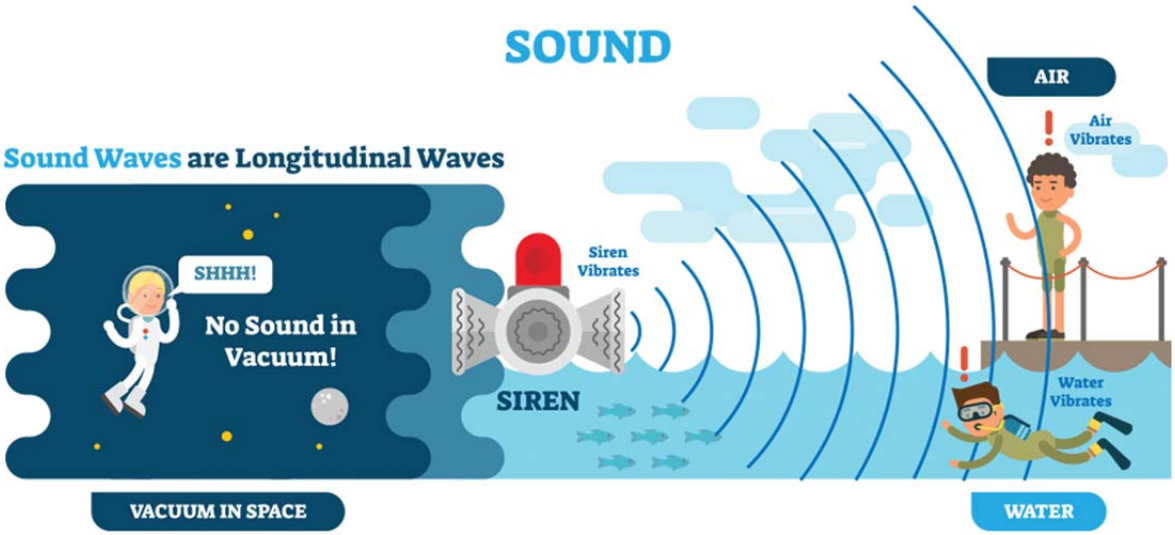


Figure 4.1 – Sound wave transmission

Thus, **sound** is a wave or audible physical phenomenon generated by the vibrational movements of particles in the air or other medium. There are many classifications of sound: audible, inaudible, unpleasant, pleasant, quiet, loud, etc.

Sound is a physical objective phenomenon. Its source is any elastic body capable of producing mechanical vibrations. There are three categories of sounds:

1. *Musical* – have a certain pitch, volume, timbre and other characteristics; are considered the most organized, are distinguished by a wealth of dynamic and timbre properties.

2. *Noisy* – sounds with an undefined pitch. These include sea noise, wind whistle, creaking, clicks and many others.

3. *Sounds without a focused pitch*.

To create compositions, only musical sounds are used, occasionally – noise ones. A sound wave is a rarefaction and thickening of sound in an elastic or sound-conducting medium.

The **sound wave** is invisible, but audible by a person since it affects his eardrums. It needs a medium to spread it. Scientists have proven that in a vacuum, that is, a space without air, a sound wave can form, but not propagate.

Sound receivers are devices that perceive sound energy, measure the characteristics of a sound wave (pressure, intensity, speed, etc.) and convert it into other energy. To receive sound in various environments, the following are used:

– microphones (for airspace);

– geophones (for the perception of the sounds of the earth's crust);

– hydrophones (to receive sound in the water).

There are natural receivers of sound (hearing aids for humans and animals) and technical ones.

Technical sound receivers convert an acoustic signal into an electrical one. Thanks to this, the sound is transmitted at different distances. It can be recorded, amplified, analysed, etc.

From an information technologies' point of view, main sound characteristics are amplitude and frequency.

The Frequency of sound is the frequency of the sounding body, the unit of measurement for pitch is hertz (Hz).

According to the frequency range, the sound is divided into:

– low frequency (bass) (up to 300 Hz);

– medium frequency (from 300 to 3000 Hz);
– high frequency (more than 3000 Hz).

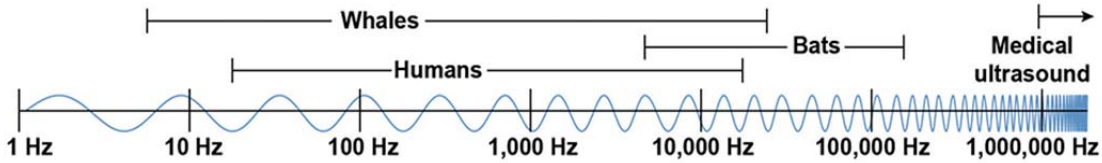


Figure 4.2 – Frequencies of sound and average range of hearing

The perceived sound frequency for the human ear is limited from 16 to 20,000 Hz. The human ear is incapable of perceiving ultrasound (frequencies above 20,000 Hz) or infrasound (with a frequency of less than 16 Hz) (Figure 4.2).

Infrasonic Waves (Infrasound). Infrasonic waves have frequencies below 20 Hz, which makes them inaudible to the human ear. Scientists use infrasound to detect earthquakes and volcanic eruptions, to map rock and petroleum formations underground, and to study activity in the human heart. Despite our inability to hear infrasound, many animals use infrasonic waves to communicate in nature. Whales, hippos, rhinos, giraffes, elephants, and alligators all use infrasound to communicate across impressive distances – sometimes hundreds of miles!

Ultrasonic Waves (Ultrasound). Sound waves that have frequencies higher than 20,000 Hz produce ultrasound. Because ultrasound occurs at frequencies outside the human hearing range, it is inaudible to the human ear. Ultrasound is most often used by medical specialists who use sonograms to examine their patients' internal organs. Some lesser-known applications of ultrasound include navigation, imaging, sample mixing, communication, and testing. In nature, bats emit ultrasonic waves to locate prey and avoid obstacles.

Amplitude of a sound wave determines its relative loudness (volume). In music, the volume of a note is called its dynamic level. In physics, we measure the amplitude of sound waves in decibels (dB) that do not correspond to dynamic levels. Higher amplitudes correspond to louder sounds, and shorter amplitudes correspond to quieter sounds. Despite this, studies have shown that people perceive sounds at very low and very high frequencies softer than sounds in the middle frequencies, even if they have the same amplitude.

Audio is sound transmitted in signal form. There are two types of audio: analogue and digital.

Analogue audio is sound recorded on a medium without digital transformation by electromechanical methods and reproduced in the same way. Analogue sources are vinyl and audiotapes.

The advantage of the analogue signal is that we perceive sound with our ears in the analogue form. Although our auditory system converts the perceived sound stream into digital form and transmits it in this form to the brain, science and technology have not yet reached the possibility of connecting players and other sound sources directly in this form.

The disadvantage of an analogue signal is the ability to store, transmit and replicate the signal. When recording to tape or vinyl, the signal quality will depend on the properties of the tape or vinyl. Over time, the tape will demagnetize and the quality of the recorded signal will deteriorate. Each read gradually destroys the medium, and rewriting introduces additional distortion, where additional deviations are added by the next medium (tape or vinyl) and device for reading, recording and transmitting a signal.

It is like taking another photograph to copy a photograph when we talk about making a copy of an analogue signal.

Digital audio is a set of coordinates describing a sound wave, and which we cannot directly hear without conversion into an analogue signal. Digital audio sources are CD-Audio, DVD-Audio, SA-CD, WAVE files and DSD (Direct Stream Digital) formats (such as Mp3, Flac, AAC, etc.).

The continuous audio signal must be converted to a digital discrete form in order for the computer to process it.

Audio adapter (sound card) is a device that converts electrical vibrations of an audio frequency into a numerical binary code and vice versa with help of digital-to-analogue converters (DAC) and analogue-to-digital converters (ADC) which are used to translate digital sound to analogue and vice versa. These converters are found in any modern device that can produce or record sound. Since all devices are digital now.

Sound recording for further digitization is done using a microphone or linear input from a vinyl or audio tape player. Microphones have a membrane that vibrates when exposed to sound waves. The coil attached to the membrane moves synchronously with the membrane in a magnetic field. An alternating electric current is generated in the coil then ADC transforms it into numbers. In the case of linear input from analogue player electric impulses go directly into ADC.

The electric signal on ADC input is subjected to time sampling and quantization. The parameters of the audio signal are not measured continuously, but at certain time intervals (sampling frequency);

measurement results are recorded in digital form with limited accuracy (quantization bit depth). The sampling frequency is measured in Hertz (Hz), quantisation - in bits.

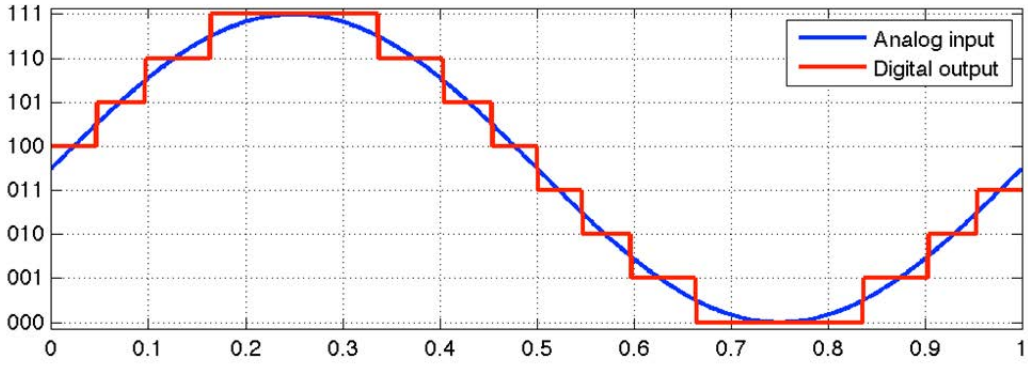


Figure 4.3 – Analog wave and digitized output comparison

The quality of the obtained digital sound depends on the number of measurements of the sound volume level per unit of time, i.e. the sampling frequency. The more measurements are made in 1 second (the higher the sampling rate), the more accurately the "ladder" of the digital audio signal repeats the analogy signal curve (Figure 4.3).

Digital signal coordinates along the horizontal axis are located at regular intervals, in accordance with the sampling frequency. In the common Audio-CD format, this is 44,100 dots per second (measured in Hertz (Hz)). Vertically, the accuracy of the coordinate height corresponds to the bit depth of the digital signal (quantization bit depth).

Quantization (in signal processing) is dividing the range of the signal readout values into a finite number of levels and rounding these values to one of the two levels closest to them), for 8 bits it is 256 levels, for 16 bits = 65536 and for 24 bits = 16777216 levels. The higher the bit depth (number of levels), the closer the vertical coordinates to the original wave.

The distortion of the stored signal occurs twice when digitizing sound: first, during sampling, information about the true change in sound between measurements is lost, and secondly, during quantization, not accurate, but close to the discrete values are saved.

Quantization bit depth and sampling frequency are often specified for various audio recording and playback devices as a digital audio representation format (24 bit/192 kHz; 16 bit/48 kHz).

The advantages of a digital signal include accuracy when copying and transmitting an audio stream, where the original is no different from the copy.

The main drawback is that digital signal is an intermediate stage, the accuracy of the final analogue signal will depend on how detailed, and accurately the coordinates describe the sound wave.

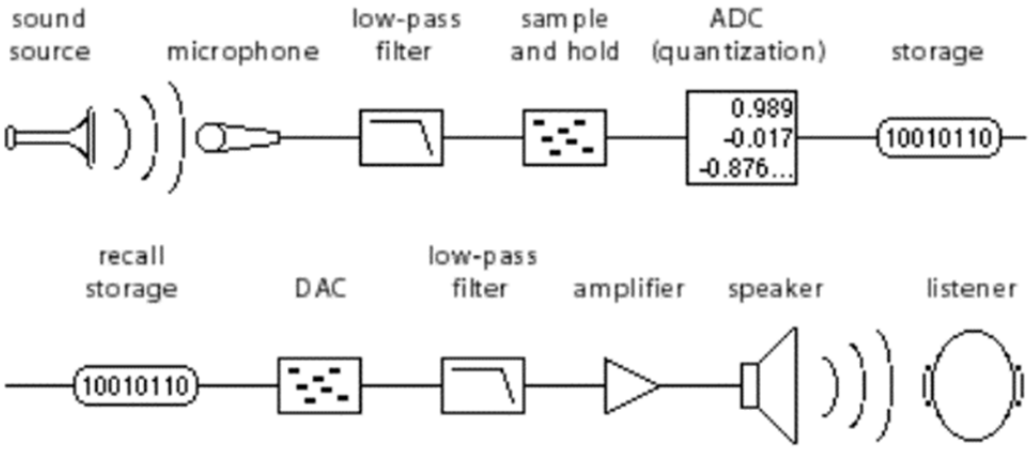


Figure 4.4 – Example of analog to digital
and vice versa audio conversion

Digital audio formats are a constant trade-off between coordinate accuracy versus file size, and any digital signal is only an approximation to the original analogue signal. However, at the same time, different levels of technologies for recording and reproducing a digital signal and storing on media for an analogue signal give more advantages to the digital representation of the signal, similar to a digital camera versus a film camera (Figure 4.4).

Digital audio format is a format for presenting audio data used in digital audio recording, as well as for further storage of the recorded material on a computer and other electronic media.

An audio file (a file containing a sound recording) is a computer file consisting of information about the amplitude and frequency of sound, saved for further playback. The file format determines the structure and presentation of audio data when stored on a PC storage device.

The audio codec is a computer program implementing an algorithm that compresses and decompresses digital audio data according to a given audio file or streaming media audio coding format. Audio codecs are used to eliminate the redundancy of audio data, with the help of which audio data is compressed.

There are three groups of audio file formats:

– uncompressed (WAV, AIFF);

– lossless compression (FLAC, APE (Monkey’s Audio));

– lossy compression (MP3, Ogg, AAC).

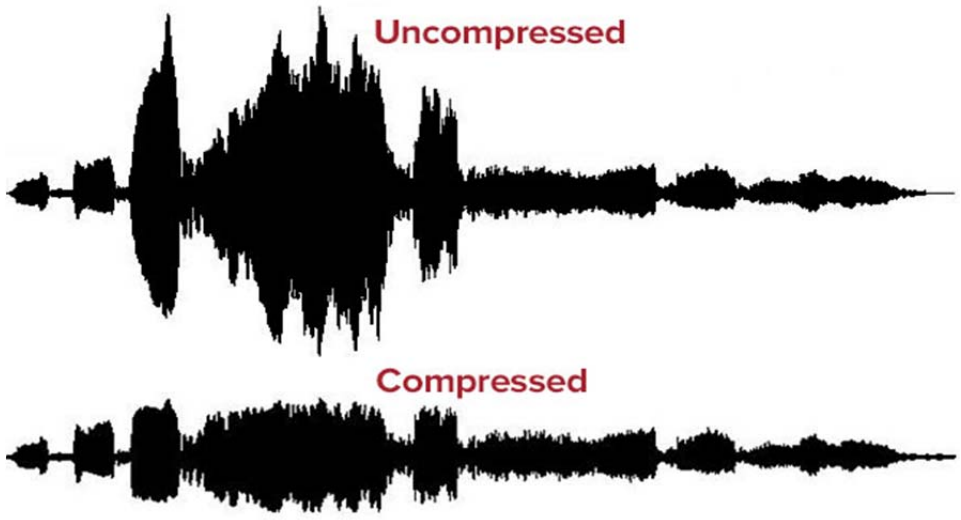


Figure 4.5 – Difference between compressed and uncompressed digital audio

Any digital audio format is characterized by a bitrate – the number of bits used for data transmission/processing per unit of time, i.e. the size of the audio file directly depends on the bitrate. The sound quality improves as the bit rate increases. Let's consider this using the MP3 format as an example:

– 32 kbps - generally acceptable for speech only;

– 96 kbps – typically used for low quality speech or streaming audio;

– 128 or 160 kbps – entry level music encoding;

– 192 kbps – acceptable quality music encoding;

– 256 kbps – high quality music encoding;

– 320 kbps – the highest quality encoding supported by the MP3 standard (Figure 4.5).

Sound is divided by the number of sound channels into

– single channel (mono);

– two-channel (stereo);

– multichannel (surround sound) (cinema formats Dolby Digital known as AC-3, Dolby Atmos, etc.).

Popular digital audio formats and codecs:

Microsoft Wave (WAV) is the first sound format for Windows that supports many different types of audio data, including 8- and 16-bit, mono and stereo. Wave is based on PCM (Pulse Code Modulation).

MPEG Audio Layer 3 (MP3) is the most popular way to present audio data. Allows compressing approximately 8-10 times, keeping the quality close to that of Audio CD. The compression ratio is variable and is set by the bit rate: 32, 64, 96, 112, 128, 160, 192, 224, 256, 320 Kbps.

Ogg Vorbis (OGG) offers superior audio quality at the same bitrate as MP3 and supports up to 255 channels, whereas MP3 is limited to just two (stereo).

Windows Media Audio (WMA, ASF) was developed by Microsoft as the answer to MP3.

Advanced Audio Coding (AAC) is one of the most advanced lossy audio compression tools and allows you to reduce the bitrate of mp3 while maintaining the same quality.

Free Lossless Audio Codec (FLAC) is a popular codec designed for free lossless audio data compression. Unlike audio codecs with lossy compression (MP3, AAC, WMA, OGG) FLAC, like any other lossless codec, does not remove any information from the audio stream and is suitable for listening to music on high-quality sound-reproducing equipment, as well as for archiving audio collection.

Monkey's Audio (APE) is a popular lossless audio coding format. The codec is distributed in the form of free software of the same name, as well as plugins for popular media players.

Audio processing

Since digital audio is information, it can be created and processed. Audio processing includes:

– *recording* from analogue sources;

– *editing* (the simplest type of processing, which is applied to almost all phonograms. At least, it is trimming at the beginning and at the end of the recording);

– *mixing* is the process by which multiple sounds are combined into one or more channels;

– *dynamic effects* (for example, distortion (imitation of the sound of a highly overdriven tube amplifier), which is widely used by guitarists in hard rock, metal, punk rock, etc.);

– *spectral transformations* that affect the timbre of the sound. (like equalizers);

– *delay effects*, which are based on the time delay of one copy of a signal relative to another. Such effects can create the illusion of space or room (echo, reverberation), the illusion of multiple sound sources (chorus), or the illusion of movement (phasers, flangers).

There are a huge number of both paid and free programs for audio creation and processing:

Steinberg Cubase is a digital audio workstation developed by Steinberg for music and MIDI recording, arranging and editing (Figure 4.6).



Figure 4.6 – Steinberg Cubase

Adobe Audition is a digital audio workstation developed by Adobe Inc. featuring both a multitrack, non-destructive mix/edit environment and a destructive-approach waveform editing view (Figure 4.7).

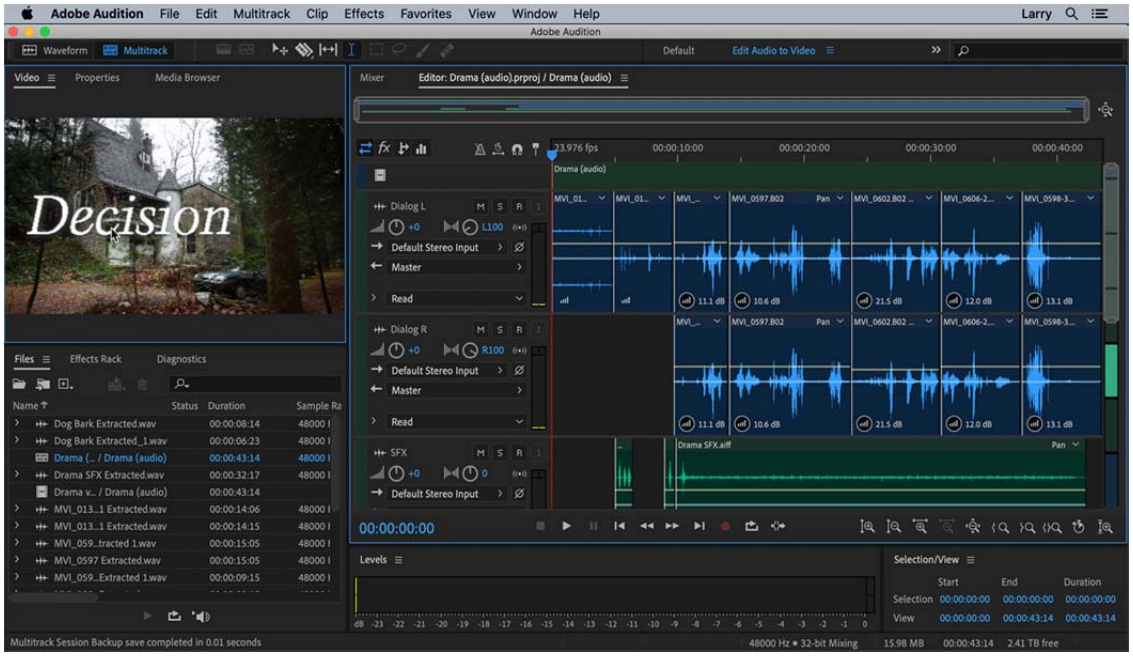


Figure 4.7 – Adobe Audition

Sound Forge (formerly known as Sonic Foundry Sound Forge, and later as Sony Sound Forge) is a digital audio editing suite by Magix Software GmbH offering such options as recording, audio editing, audio mastering and

processing. The program is aimed at the professional and semi-professional markets (Figure 4.8).



Figure 4.8 – Sound Forge



Figure 4.9 – Pro Tools

Pro Tools a digital is audio workstation developed and released by Avid Technology (formerly Digidesign) for Microsoft Windows and macOS. It is used for music creation and production, sound for picture (sound design, audio post-production and mixing) and, more generally, sound recording, editing, and mastering processes (Figure 4.9).

Pro Tools operates both as standalone software and in conjunction with a range of external analog-to-digital converters and PCIe cards with on-board digital signal processors. The digital signal processor is used to provide additional processing power to the host computer for processing real-time

effects, such as reverb, equalization, and compression and to obtain lower latency audio performance.

Ableton Live – is a digital audio workstation for macOS and Windows developed by the German company Ableton. In contrast to many other software sequencers, Ableton Live is designed to be an instrument for live performances as well as a tool for composing, recording, arranging, mixing, and mastering. It is also used by DJs (Figure 4.10), as it offers a suite of controls for beatmatching, crossfading, and other different effects used by turntablists, and was one of the first music applications to automatically beatmatch songs.

Cakewalk by BandLab is a full-featured Digital Audio Workstation software package for audio and MIDI composing, recording, arranging, editing, mixing and mastering. It is developed and published under a free subscription licensing model by BandLab Technologies of Singapore for the Microsoft Windows platform.



Figure 4.10 – DJ with Ableton Live

FL Studio (previously known as FruityLoops before 2003) is a digital audio workstation developed by the Belgian company Image-Line available in four different editions for Microsoft Windows and macOS. FL Studio features a graphical user interface with a pattern-based music sequencer (Figure 4.11).



Figure 4.11 – FL Studio

Logic Pro is a digital audio workstation and MIDI sequencer software application for the macOS platform. Logic Pro provides software instruments, audio effects and recording facilities for music synthesis. It also supports Apple Loops – royalty-free, professionally recorded instrument loops. Logic Pro can work with MIDI keyboards and control surfaces for input and processing, and for MIDI output. It features real-time scoring in musical notation, supporting guitar tablature, chord abbreviations and drum notation. Advanced MIDI editing is possible through Logic Pro's MIDI Transform Window, where velocity, pitch, pitch-bends, note length, humanize, and precise note positioning can be edited.



Figure 4.12 – Logic Pro

Main features of audio editors

– Opening and saving files in various formats (WAV, mp3, WMA, etc.)

– Work with the selected fragments and the clipboard (copy, delete, cut, paste, paste with mixing).

– Sound processing (recording from analogue inputs, changing the volume, panning, equalization, changing parameters (sampling frequency, bit depth, number of channels), noise removal).

– Overlay effects (echo, delay, chorus, flanger, change in pitch and duration, blur, distortion, reverb).

– Mixing sound from several tracks into one composition.

A headset can be an essential tool for communication, particularly when working from home, where you may need to block out surrounding noise just to get work done. Headsets are also particularly popular with gamers, who require the products to appreciate the atmosphere created by game developers and to speak to fellow teammates.

Conclusions

Modern Music and Audio Editors have turned the sphere of musical art, from simplification the set of notes writing to creating and arranging musical compositions. However, sound is not only music, today audio accompaniment is an integral part of any multimedia presentation, and it should be noted that any user can master creating simple audio tracks.

Key concepts: Audio classification, audio file formats, audio editors, audio compression

PRACTICE

Task 1

Complete the definitions of audio processing stages with the following terms:

mixing applying delay effects editing
applying dynamic effects recording

Since digital audio is information, it can be created and handled via the following processes:

The process of taking audio information from analogue sources is called _____.

The simplest type of processing audio information, which is applied for trimming at the beginning or at the end of the recording is called_____.

The process by which multiple sounds are combined into one or more channels is called _____.

The audio processing which allows to distort the sound or imitate of the sound of a highly overdriven tube amplifier etc. is called _____.

The audio processing which is based on the time delay of one copy of a signal relative to another, being able to create the illusion of space or room (echo, reverberation), the illusion of multiple sound sources (chorus), or the illusion of movement (phasers, flangers), is called _____.

Task 2. Audio file formats

There are three groups of audio file formats**.** Put each of the following formats in the proper group:

APE FLAC WAV AAC AIFF Ogg MP3

Uncompressed	**With lossless compression**	**With lossy compression**
WAV , _____.	_____, _____.	_____, _____, _____.

Task 3. Definition

Match the term and definition

1	**Digital audio**	**A**	is a format for presenting audio data used in digital audio recording, as well as for further storage of the recorded material on a computer and other electronic media.
2	**Audio codec**	**B**	is a sound recorded on a medium without digital transformation by electromechanical methods and reproduced in the same way.
3	**Quantization**	**C**	is a set of coordinates describing a sound wave, and which we cannot directly hear without conversion into an analogue signal.

4	**Digital audio format**	**D**	is a computer file consisting of information about the amplitude and frequency of sound, saved for further playback. The file format determines the structure and presentation of audio data when stored on a PC storage device.
5	**Audio file**	**E**	is a computer program implementing an algorithm that compresses and decompresses digital audio data according to a given audio file or streaming media audio coding format. Audio codecs are used to eliminate the redundancy of audio data, with the help of which audio data is compressed.
6	**Analogue audio**	**F**	is dividing the range of the signal readout values into a finite number of levels and rounding these values to one of the two levels closest to them.

1 ↔ C ; ___↔___; ___↔___; ___↔___; ___↔___; ___↔___.

Task 4

From the followin list eliminate the computer programs which don't deal with audio creation and processing

Sound Forge	Photoshop	Gravit Designer	Adobe Audition
Corel Draw	Pro Tools	Power Point	Logic Pro
Ms Word-	Ableton Live	Cubase	Paint

TALKING POINTS

• Discuss the advantages and disadvantagies of analog audio.

Analog audio

advantages	disadvantagies
1. 2. 3.	1. dependens on the properties of an analog medium 2. 3.

- Discuss the advantages and disadvantagies of didgital audio.

Digital audio

advantages	disadvantagies
1. 2. 3. 4.	1. losing of audio quolity for makin audio file smaller 2. 3. 4.

- Discuss the advantages and disadvantagies of compressed and uncompressed digital audio.

Compressed and uncompressed digital audio

	advantages	disadvantagies
Compressed		
Uncompressed		

COMPUTER TRAINING

We will make a multimedia presentation of the Robert Burns poem, accompanying the text with pictures and audio with reading the text. See the text of the poem at the end of this training module.

• Create a presentation of five slides, placing poem couplets on each slide. Select in Internet and add a picture of the English mountains by some famous English painter. Try to choose an image suitable to the content of the couplet on each slide.

• On the first slide place the Title of the poem, its author name and also the name of the performer and save the presentation (Figure 4.13).

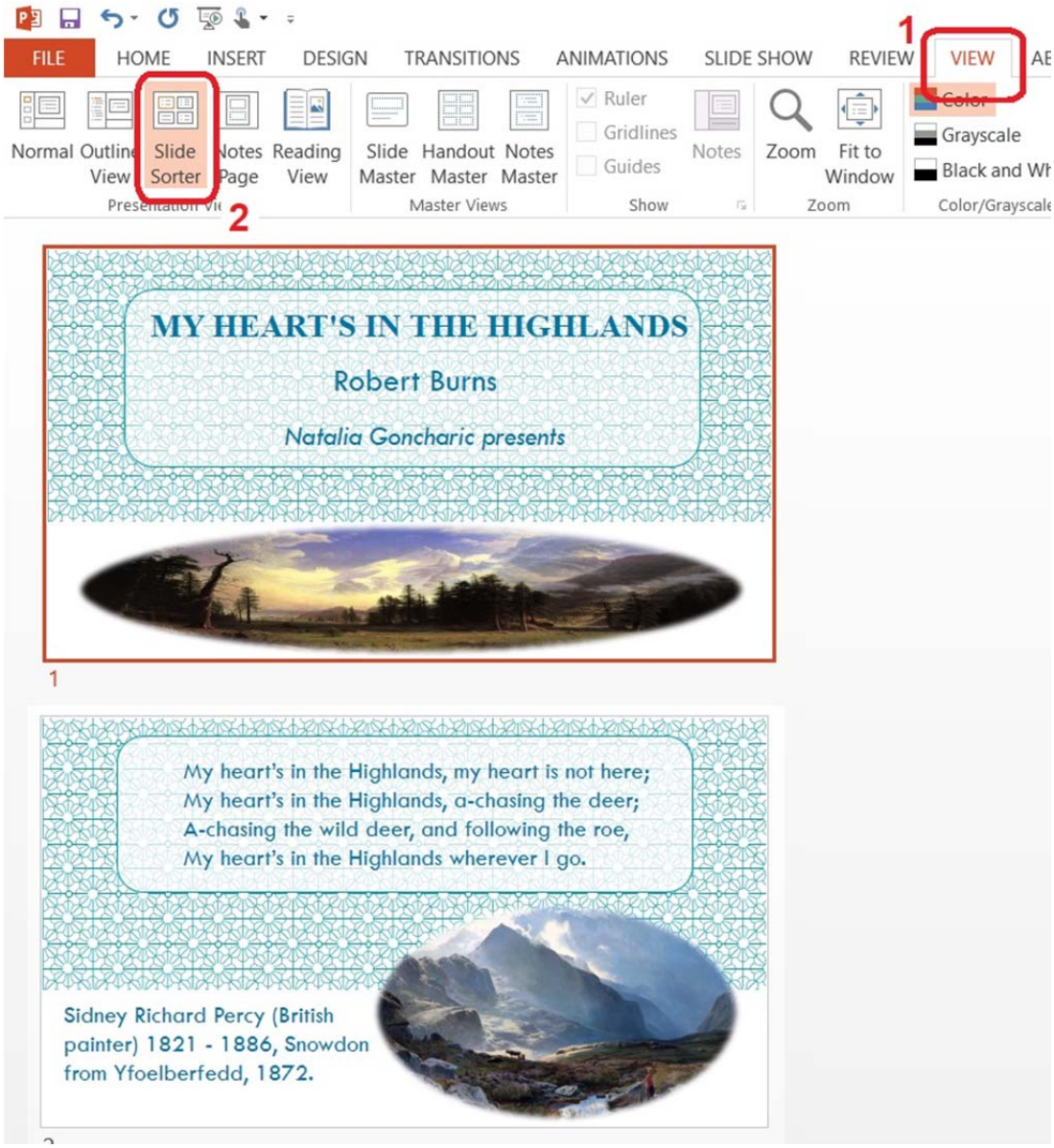


Figure 4.13 – Presentation of the poem

• Go to the View → Slide Sorter, choose the Title slide. Then select Slide Show → Record Slide Show → Start Recording from Current Slide. Voice the name of the poem, name of author and name of the presenter and click «Esc» button on the keyboard. Then voice the rest of the slides using the same method (Figure 4.14). Check the presentation voice accompaniment.



Figure 4.14 – Recording

• Go to the View → Slide Sorter, choose the Title slide. Then select Slide Show → Record Slide Show → Start Recording from Current Slide. Voice the name of the poem, name of author and name of the presenter and click «Esc» button on the keyboard. Then voice the rest of the slides using the same method (Figure 4.14). Check the presentation voice accompaniment.

MY HEART'S IN THE HIGHLANDS

My heart’s in the Highlands, my heart is not here;
My heart’s in the Highlands, a-chasing the deer;
A-chasing the wild deer, and following the roe,

My heart’s in the Highlands wherever I go.
Farewell to the Highlands, farewell to the North,
The birth-place of valour, the country of worth;
Wherever I wander, wherever I rove,
The hills of the Highlands for ever I love.

Farewell to the mountains high cover’d with snow;
Farewell to the straths and green valleys below;
Farewell to the forests and wild-hanging woods;
Farewell to the torrents and loud-pouring floods:

My heart’s in the Highlands, my heart is not here;
My heart’s in the Highlands, a-chasing the deer;
A-chasing the wild deer, and following the roe,
My heart’s in the Highlands wherever I go.

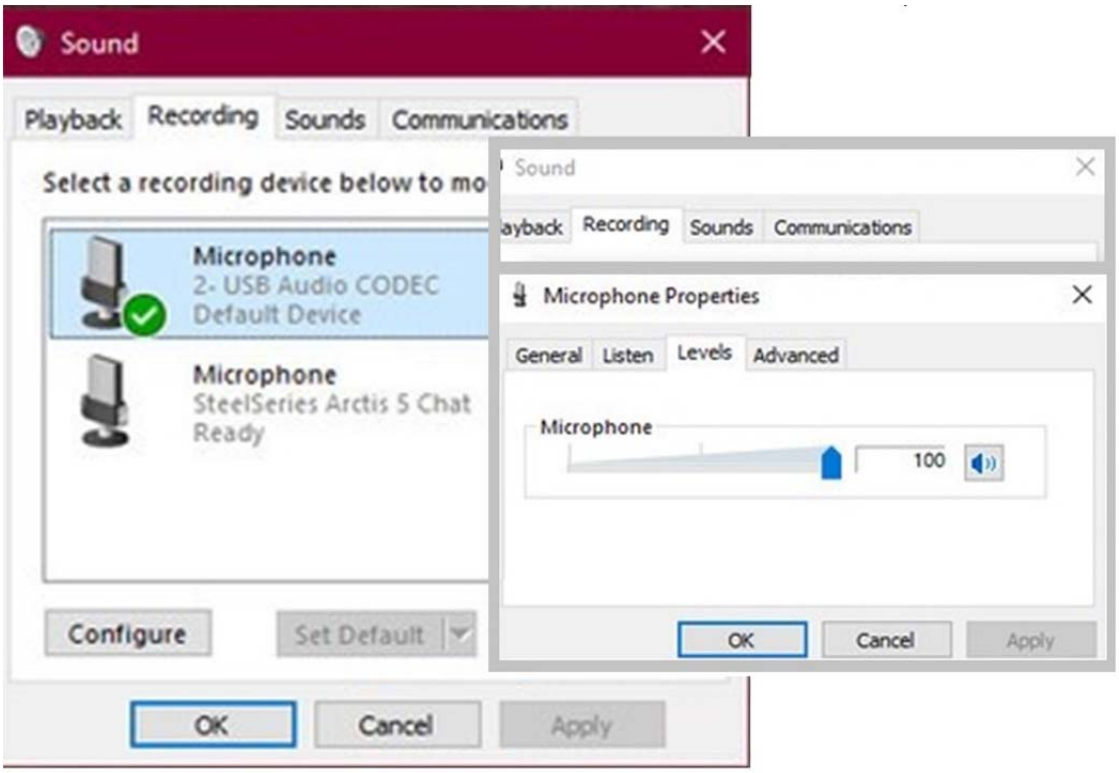


Figure 4.15 – Sound fixing

Set up audio recording

Set up audio recording, select the microphone as the default input device and make sure the volume is turned up. Right-click the «Sound» icon on the taskbar. 2. Select «Open Sound Settings». Go to the sound control panel on the right. Select «Entry». Select «Microphone». Choose «Set as default». Open the Properties window. Select the Levels tab. Adjust the volume accordingly (Figure 4.15).

Training 2: Sound editing using an online resources

Create the audio file voicing the poem «My heart's in the Highlands» by Robert Burns with music on the background.

Load https://online-voice-recorder.com/ and create a personal account. Choose Voice Recorder in Audio Tools. Record the poem (Figure 4.16). Open Audio Joiner. Add some music file and poem audio. Join the files (Figure 4.17). Save the audio file to the Cloud.

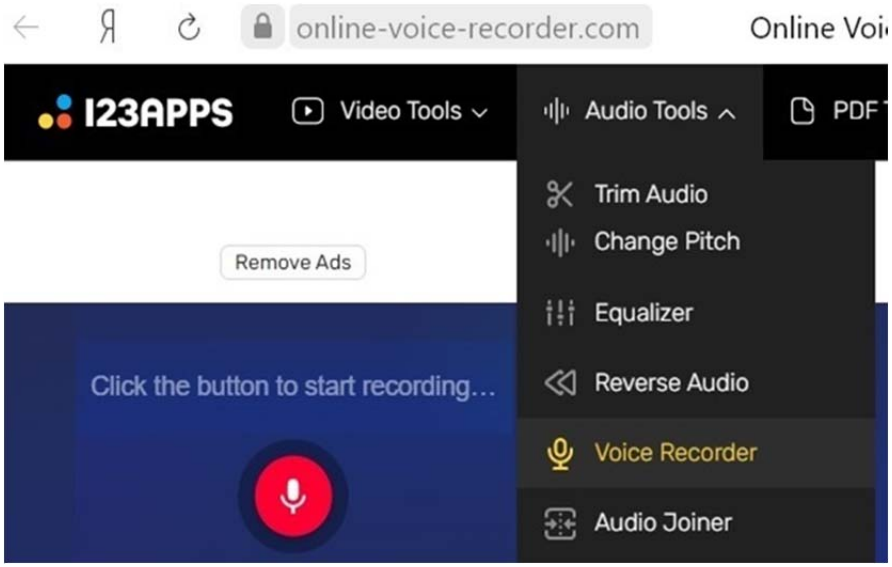


Figure 4.16 – Online-voice-recorder

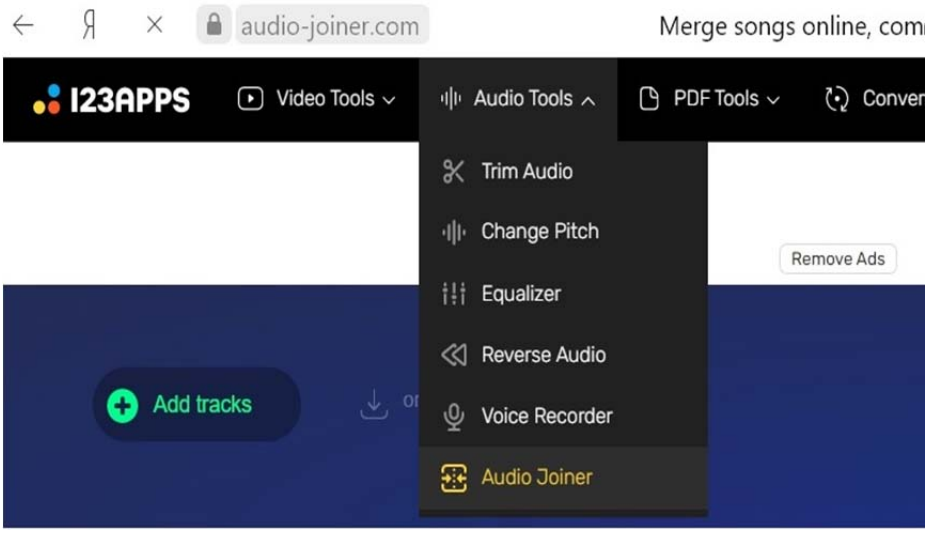


Figure 4.17 – Join the files

INDIVIDUAL TRAINING

- Make an analysis of 4 music services, for example, such as

Spotify
Apple Music
Google Play Music

YouTube Music
Deezer
Tidal
SoundCloud

making a comparative table with to the following criteria:

	1._____	2._____	3._____	4._____
interface simplicity				
speed of work, usability				
device compatibility				
download own music				
offline mode				
Songs texts (other)				
genres				
advantages				
disadvantages				

- Using computer means described above make some short funny sound for inviting listeners to the interactive game activity during the presentation of your ***Individual topic*.**

UNIT 5. TECHNOLOGIES OF DYNAMIC GRAPHICS: VIDEO PROCESSING

Main issues

1. Video types
2. Digital video main characteristics
3. Video compression basics
4. Codecs and containers
5. Video editing basics.

Aim: To get acquainted with basic concepts of video processing and its application in culture and art sphere.

Video information reflects the objects under study and their interaction most realistically. The advantages of video information are

– high reliability of transferring the properties of moving objects;

– creating the effect of presence.

The main terms related to the processing of video information are video and video recording.

By **video** (from Latin video – I look, I see) we mean electronic technology for the formation, recording, processing, transmission, storage and reproduction of a moving image, based on the principles of television, as well as an audiovisual work recorded on a physical medium (video cassette, video disc, solid-state drive, hard disk, memory card, etc.).

Video recording is an electronic technology for recording visual information, presented in the form of a video signal or a digital stream of video data on a physical medium in order to save this information and the possibility of its subsequent playback and display on an output device (monitor, screen or display).

Video types

Video, like audio, can be analogue and digital. Analogue video is barely used at the present moment (Figure 5.1). Currently, TV broadcasting is in digital format, and even old TVs require an external digital tuner with DVB-T format.

The most common representative is the VHS (Video Home System) standard, an analogue videotape format developed by JVC Corporation and introduced to the Japanese market in 1976. VHS was the dominant format for consumer playback until 2003 when DVD sales exceeded that of videotape.

The last major Hollywood film to be released on VHS was "A History of Violence" by director David Cronenberg in 2005.



Figure 5.1 – Analogue videotape

Analogue videotape format video has many problems associated with the analog information medium and its processing technology:

– signal distortion during transmission;

– rewrite loss;

– influence of the medium itself.

For example, let’s examine a filmstrip. The Film is a physical medium. Previously, it was used in cinemas, now all cinemas are converted to digital equipment since the use of digital video in cinemas is much cheaper. It is much cheaper to send a package of movie files to the cinema server than to make a multi-kilometre copy on film, plus the film wears out, it gets scratched, time destroys it.

Let’s talk about modern digital video.

Digital video is a set of technologies for recording, processing, transmitting and storing images and sound.

The following procedure is used to create a digital representation of a video image. Analogue signals from video sources, such as a camera, are converted to the YUV colour system before being digitized. The resulting video signal is then converted to digital form using a special device called an analogue-to-digital converter (ADC). The result of this transformation is a sequence of bytes that encode the colour of each pixel in the image frame. Combining information about each frame forms a data stream, that completely describes the video fragment. The video represented in such a way can be further processed, stored or transmitted in an almost unlimited number of times. However, the size of such a file turns out to be quite significant.

The main difference of digital video from the analogue one is that video and audio are encoded and transmitted not in their original form, but after ***analogue-to-digital conversion*** into video and audio data streams.

In most cases, digital video is compressed to reduce the amount of data for transmission and storage. Digital video can be distributed on various video mediums, through digital interfaces in the form of a stream (this is the process of continuous transmission of information to a user from a provider, for example, YouTube, IPTV and any video in a player embedded on a web page) or files.

Digital video main characteristics:

– Screen resolution;
– Aspect ratio;
– Frame rate;
– Bitrate;
– Scanning method;
– Colour depth.

Screen resolution is the number of dots (pixels) horizontally and vertically that make up the image (video frame) on the screen. For example, 720x576 pixels for DVD Video standard. Nowadays, there is usually a separate name for each resolution: **SD** (640x480), **HD** (1280x720), **Full HD** (1920x1080), **4K Ultra HD** (3840x2160), **8K Ultra HD** (7680x4320). There are intermediate formats, but they have not found widespread use, for example, **2K** (which is used by projectors in cinemas, but this is almost equivalent to Full HD), **6K**.

The aspect ratio of an image is the ratio of its width to its height and is expressed with two numbers separated by a colon. It is one of the main video characteristics.

Since the end of the 19th century silent films and, subsequently, films of the "classic" format, had an aspect ratio of 4:3 (in cinematography, it is recorded as 1.33:1). It was believed that a screen with this aspect ratio is close to the field of view of the human eye. The soon-to-be-launched television adopted this ratio and almost all analogue television systems (and therefore TV sets) had a 4:3 screen aspect ratio.

The first computer monitors also adopted the television aspect ratio standard. When choosing the aspect ratio of the HDTV screen, the 16:9 (1.78:1) standard was approved, which is closer to the mainstream cinema formats. Standard definition digital television has the same 16:9 ratio nowadays (Figure 5.2).

Today, the classic 1.33:1 format is not used at all in cinematography (they shoot movies in 4:3 format, but then crop to the current standard ratio). The exception is "Zack Snyder's Justice League", in which this ratio is

explained by the fact that Zach Snyder was interested in releasing the picture in IMAX theatres after the end of the coronavirus pandemic, and the aspect ratio in IMAX is 1.43:1, which is close to 1.33:1. Despite the "old" aspect ratio, the movie is available in 4K resolution.



Figure 5.2 – Aspect ratio comparison

It is only important to know one resolution parameter and aspect ratio in order to find out the second resolution parameter by making a simple proportion, for example, Full HD

$$\frac{1920}{1080} = \frac{16}{9}$$

Keep in mind that this does not apply to ultra-wide screens with a ratio of 21:9 or more. Typically, black stripes are added to the top and bottom to view an ultra-wide image on 16:9 screens.

Frame rate is the number of still images that alternate in one second of video recording and create the effect of moving objects on the screen. The higher the frame rate is, the smoother and more natural the movement will appear. The minimum frame rate at which the movement will be smooth is approximately 16 frames per second (this value is individual for each person).

Good quality digital video typically uses 30 frames per second.

The standard video playback speed is 30 frames/s (for cinema, this figure is 24 frames/s).

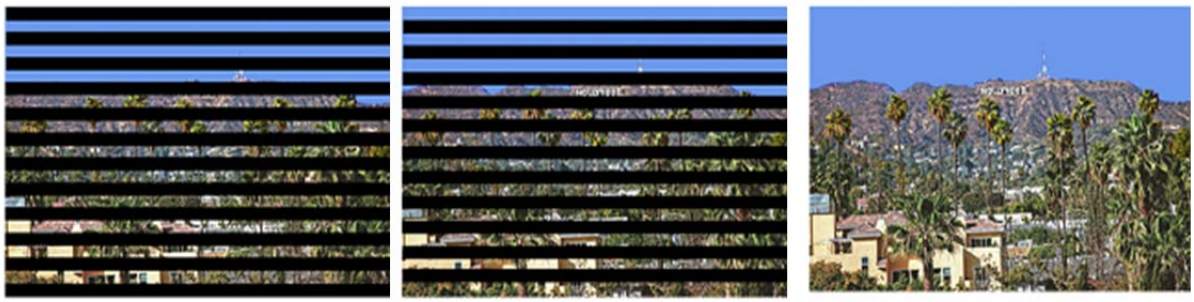
Colour depth is the number of colours (in bits) that can form a video image.

This metric is complex and measures the number of colours displayed simultaneously on the screen. Computers process colour in RGB (red-green-blue) format, while video uses other methods as well. One of the most common colour models for video formats is YUV. Each of the RGB and

YUV models can be represented by different levels of colour depth (maximum number of colours).

The RGB colour model typically has the following colour depth modes: 8 bits/pixel (256 colours), 16 bits/pixel (65,535 colours), and 24 bits/pixel (16.7 million colours). For the YUV model, the following modes are used: 7 bits/pixel (4:1:1 or 4:2:2, approximately 2 million colours), and 8 bits/pixel (4:4:4, approximately 16 million colours). **Bitrate** is the number of processed video bits per second of time, i.e., video stream speed (in Mbps). The higher it is, the better the quality.

The scanning method defines the parameters of a television scan used to convert a two-dimensional image into a one-dimensional video signal or data stream (Figure 5.3). Ultimately, the number of image elements and the frame rate depends on the scanning method. Scanning can be progressive or interlaced. For an interlaced stream, the notation "i" is applied along with the vertical resolution, for example, 576i, 1080i.



Even half-frame Odd half-fame Result

Figure 5.3 – Frame scan

In an interlaced scan, each frame consists of a certain number of lines, which are drawn not sequentially, but one after another, resulting in two half-frames, or so-called "fields". Therefore, each second of an analogue video signal consists of 60 fields (half-frames), while the flickering frequency of the kinescope increases above the physiological threshold of visibility. Also, this type of scan was used to reduce the channel bandwidth requirements (maximum transmission rate), since each half-frame takes up half the space, respectively than a frame with progressive scan. This does not affect the file size in any way, but it reduces the bitrate.

Meanwhile, a computer monitor uses a "progressive scan" method to draw the screen, in which the lines of the frame are formed sequentially, from top to bottom, and the full-frame is drawn 30 times every second. Of course, this method is called a non-interlaced video or progressive scan. This is the main difference between the computer and television methods of forming a video signal.

The interlaced scan was a compromise to be able to transmit over a bandwidth-limited image with a sufficiently high resolution. Despite its shortcomings, the interlaced scan is still used today in standard definition television due to the ubiquity of televisions supporting only such standards. The negative effect of interlaced video is the problem of displaying it on a progressive screen, which displays the entire frame. You have to pre-assemble one full-frame from two half-frames and only then display it. But, since the even and odd half-frames of such a frame refer to different moments in time, inconsistencies of even and odd lines will inevitably appear at the boundaries of moving objects, in the form visible of artefacts («comb effect») (Figure 5.4).

The figure shows the effect of a comb, which is sometimes visible in dynamic scenes, it is almost impossible to see it in smooth scenes.

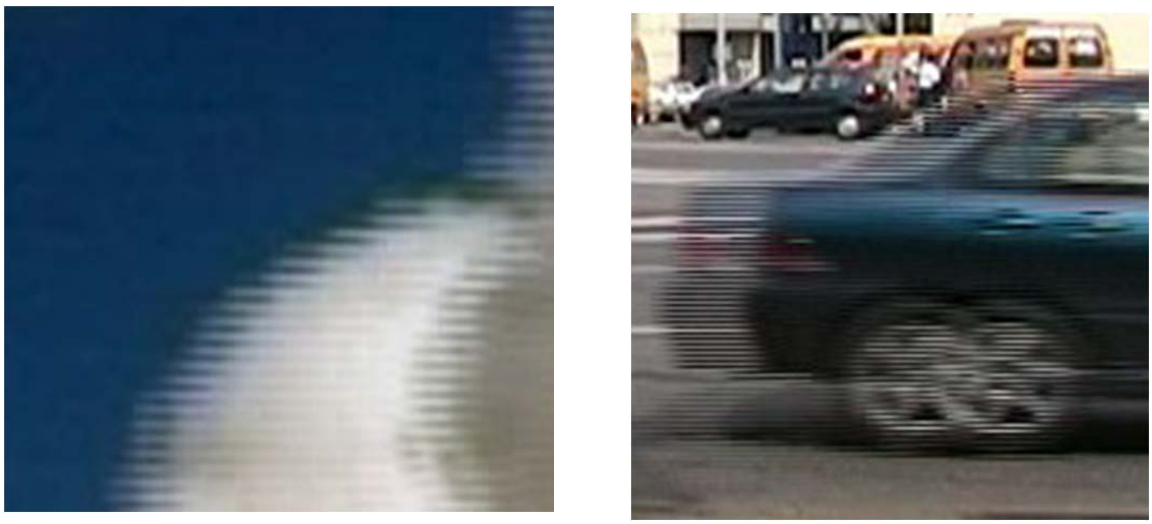


Figure 5.4 – Interlaced scan artifacts («comb effect»)

Video compression basics

Video stream is a time-coded sequence of frames of a certain format, a bit stream. The video stream can be saved as a file on various mediums (SSD/HDD, SD card, CD, DVD, Blu-ray).

A video file is a collection of static images that change each other at a certain frequency. Each still image is a separate video frame. This is true if we are talking about uncompressed videos. However, no one stores video uncompressed. For example, a 1920 x 1080 video frame with 8-bit colour takes up approximately 5.9 Mb. The second of uncompressed video with a frame rate of 30 will take up almost 177 Mb and one hour of such a video is about 622 Gb.

$$\frac{1920 \cdot 1080(\text{number of pixels in one frame}) \cdot 3(3 \text{ bytes for color})}{1024 \cdot 1024} \approx 5,9\text{Mb}$$

Thus, it is evident that the size must be reduced. It is not possible to use uncompressed video with the current storage capacities and data transfer rate, therefore, video compression is used to optimize the occupied space.

Video compression is technology of digital compression, which allows reducing the amount of data used for a video stream. Video compression allows to reduce effectively the stream required for video transmission over radio broadcasting channels, reduce the space required for storing data on the media.

The main idea of the compression algorithm is that several consecutive frames differ little from each other, so you can save a keyframe and frames that are different from the keyframe. For example, imagine that you were shooting a seascape for 5 minutes (Figure 5.5).



Figure 5.5 – Seascape

Every second the camera shoots 30 frames that are almost completely identical to each other. To record a landscape on video, it is enough to save one source frame (key frame), find all similar to it and remove duplicate parts of the image from similar frames (Figure 5.6). Then, when the video is played, the compression algorithm will overlay the changing parts on the original image (Figure 5.7). If something changes dramatically in the image, a new keyframe will be saved.

The described algorithm is called motion compensation and is considered one of the main methods of video data compression.

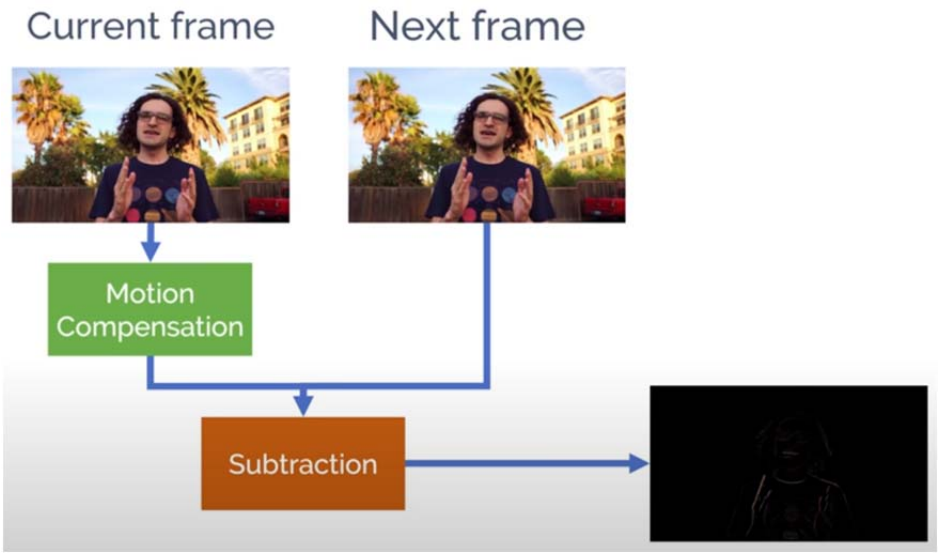


Figure 5.6 – Motion compensation. Subtraction

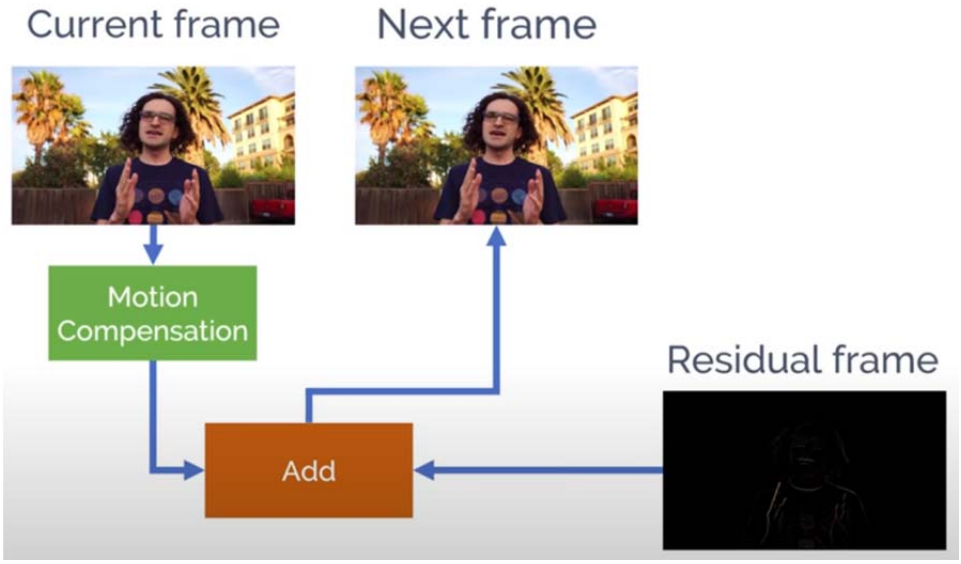


Figure 5.7 – Motion compensation. Overlay the changing parts

Digital video sequences are obtained from analog video using video capture – the process of hardware-software conversion of analog video into digital form with its subsequent storage on digital media. To put a video file recorded in real time into memory, it is necessary to compress it already during recording.

Video compression can be two types: without loss of quality (often briefly called "lossless") and with loss of quality ("lossy"). The difference between these types is clear from their name. Most lossless compression

methods do not take into account the visual similarity of adjacent frames in a video stream. In contrast, lossy compression techniques use this similarity in most cases. Because of this, the maximum compression ratio of an average video fragment achieved by lossless algorithms does not exceed 3 to 1, while algorithms that work with loss of quality can compress up to 100 to 1.

You should always consider whether there will be post-processing of the captured material with filters and non-linear video editing when capturing video. If so, it is recommended either not to use compression "on the fly" at all or to use not very strong compression based on a "separate" algorithm. The most popular type of such compression is Motion JPEG (MJPEG). Each frame is compressed by the well-known JPEG algorithm, which allows achieving compression ratios of 7:1 without noticeable image distortion. Such recommendations are due to the fact that strong compression and "recursive" algorithms introduce a very large number of "hidden" artefacts into the video fragment, which will immediately become noticeable when filtering or recompression performed after nonlinear video editing.

Codecs and containers

Compression of a video stream is carried out using a special program which is called **video codec. Codec** is an algorithm for compressing (reducing the size) of video data (video file, video stream) and recovering compressed data. **Codec** is file-formula for display.

There are the most well-known compression standards and their application (presented in chronological order).

MPEG-1 Part 2 is Video CD. This is an old video codec, usually, it took two discs for one movie (700 Mb/hour), the resolution was very low.

MPEG-2 Part 2/H.262 is DVD Video, Blu-ray, Digital Video Broadcasting (DVB).

MPEG-4 Part 2 is DivX, XviD. Now the most used is XviD, but since it violates some licensing agreements, it is prohibited in some countries.

H.264/MPEG-4 Part 10 / MPEG-4 AVC (Advanced Video Coding) is Blu-ray, DVB, Apple TV, Netflix, Amazon, Hulu, HBO Max, Disney+, HD DVD (Blu-ray's competitor, which lost the format war, and you probably will hardly find it at the present time, the HD DVD drive was installed in the very first version of the console Xbox One). This codec is most popular nowadays.

H.265/HEVC (High Efficiency Video Coding) is 4K, 8K video stream (practically not present on physical media, due to the large amount of information). The most recent codec, but not widely used yet, so not all TVs and stationary players support it yet.

HEVC/H.265 not only has better visual quality with little memory and low bandwidth but also has an advanced coding algorithm by coding motion vectors with much higher precision and minimal residual errors. In addition to the excellent method used for inter-prediction, this new codec also introduces an improved deblocking filter and adaptive sampling bias to reduce even more artefacts. However, it requires higher computing power than previous generation codecs.

Modern digital television broadcasting has become available precisely thanks to video compression. TV stations can broadcast not only high-definition video (HDTV) but also multiple TV channels in one physical TV channel (6 MHz). Although most video content today broadcasts using the MPEG-2 video compression standard, new and more efficient video compression standards are already being used in broadcast television, such as H.264.

The graph (Figure 5.11) shows a comparison of the compression efficiency for the same quality, the H.265 algorithm gives half the stream, which requires less bandwidth than the Internet channel.

H.265 has many advantages over H.264. For example, it supports up to 8K UHDTV (8192 × 4320 resolution), the data transfer rate is several Gb/s, and the file size is half the size, and this is with the best quality! H.265 has a big impact on the demand and sales of 4K screens, offering better video quality even on limited bandwidth networks (Figure 5.8).

But there is also a downside. HEVC takes longer to encode compared to AVC and has poor compatibility. The new format is nowhere near as popular as H.264 at present time. Modern devices and platforms that support the H.264 codec account for 99%. H.265 codec support, can be about 30–40%.



Figure 5.8 – H.265 (HEVC) and H.264 algorithm comparison

The second picture suggests that there is a big difference between the codecs in question. It lies in the quality of the video at the same bit rate.

In H.264 (AVC), block area boundaries are likely to be distorted because each macroblock is fixed and the data is independent of each other. H.265 provides sharper edge detail and smooth gradient areas with fewer

artifacts. Thus, H.265 is better than H.264 when it comes to compressing videos with better image quality.

Disadvantages of video compression: when using lossy compression sometimes clearly visible artefacts appear, for example, blocking (splitting the image into 8x8 pixel blocks), blurring (loss of fine image details), etc (Figure 5.9 and Figure 5.10).

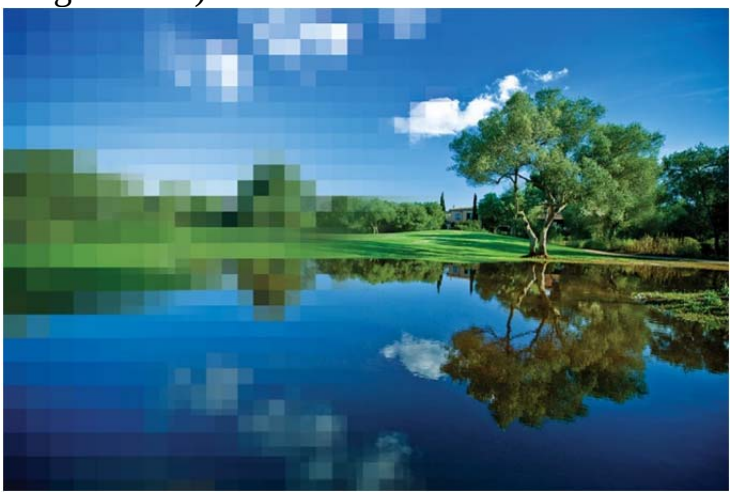


Figure 5.9 – Video compression artifacts: blocking



Figure 5.10 – Video compression artifacts: blurring

There are also lossless video compression methods, but today they do not reduce data enough.

Video compression algorithms are constantly improved. This is primarily due to the fact that with an increase in the image resolution of the video stream, the old algorithms turn out to be ineffective. For example,

4K H.264 (AVC) streaming requires 32 Mbps of bandwidth, while 4K HEVC video is only 15 Mbps for the same image quality (Figure 5.11).

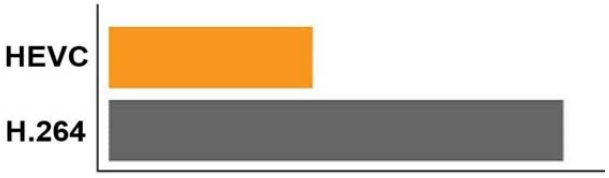


Figure 5.11 – H.265 (HEVC) and H.264 bandwidth usage comparison

The container is a file format that defines the distribution of audio, video, and in some cases text information within it. In most cases, the type of container does not account for the type of encoding (compression) of information within the file. And the container type itself is easily identified by the file extension.

AVI (Audio-Video Interleaved) is an old and still very popular type of container. Currently, it is starting to lose ground to more modern containers due to the lack of normal support for several audio tracks, subtitles and modern codecs (like H.264), nevertheless, it will still be popular for a long time due to the widest support by manufacturers of home electronics. This container is usually used in combination with MPEG4/DivX/Xvid codecs and MP3 compressed audio.

MKV (Matroska) is a modern container, developed as an open-source project and supports any modern video and audio codecs, multiple audio and subtitle tracks. Usually, but not at all, it is used in combination with modern H.264 / H.265 codecs, but no one bothers, for example, to put a video compressed by XviD inside an MKV container. Subjectively, it is the most popular for the online distribution and local storage of high-quality video.

MP4 is a fairly progressive container, supports video compression not only in MPEG4, as you might think from the name, but also using more modern methods, but is inferior to MKV in terms of supporting subtitles and audio formats.

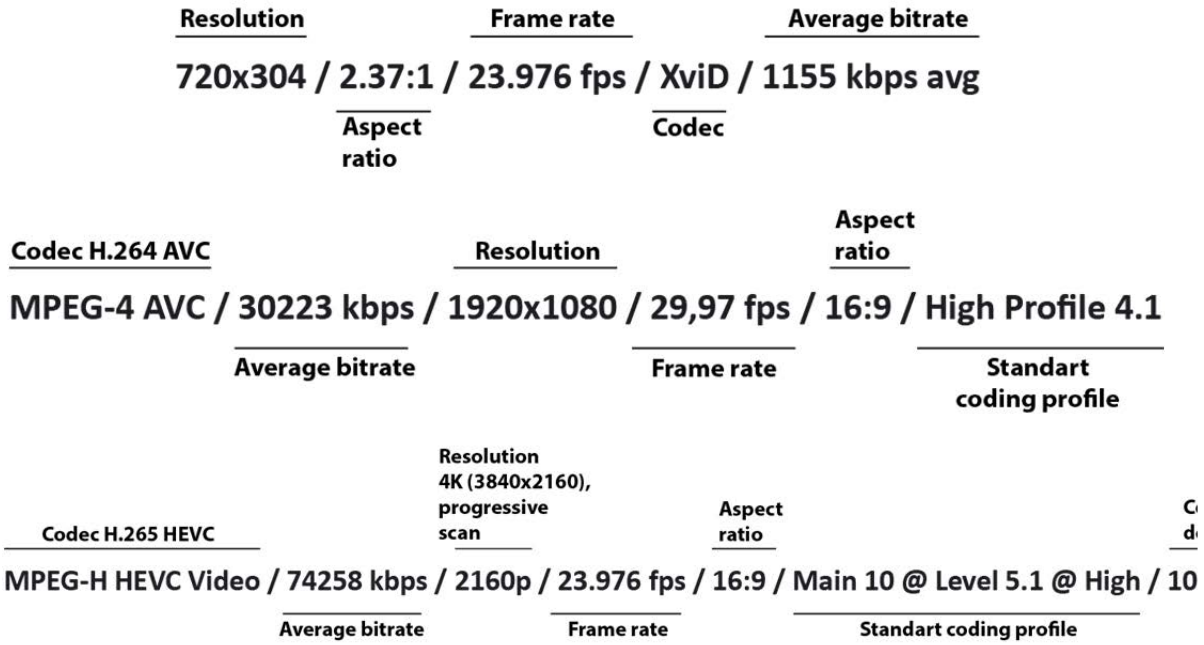
QuickTime (MOV or QT) is a fairly progressive container created by Apple supports almost all popular codecs and embedded subtitles, moreover, unlike MKV, it is much more suitable for editing video material recorded in such a container. However, its normal support is possible only with the Apple QuickTime package installed on the computer, third-party open-source reverse engineering software do not provide full functionality.

VOB (MPEG 2 Program Stream) is a DVD content. Supports only two video codecs, MPEG1 and MPEG2, otherwise, the standard of the era "before

HDTV", because there is support for subtitles, chapters (if you take the entire disc as a single container) and various audio formats, including very progressive.

.ts (MPEG 2 Transport stream) is popular due to satellite digital broadcasting, capable of using, despite the name, modern codecs and Full HD resolutions.

Let's see with examples what the container contains.



As you can see HEVC video stream has 4 times bigger resolution but only 2 times bigger bitrate which can be an example of its efficiency.

Video editing basics

Description of a typical technological video production process's components for multimedia products. There are several main stages in the process chain for preparing a video multimedia component:

– filming;

– digitization;

– editing;

– control review, elimination of errors and again a control review;

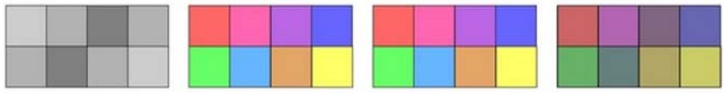
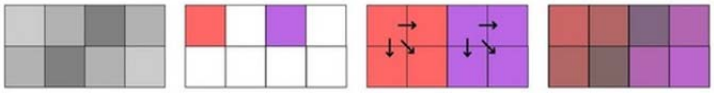
– compression with the required codec.

Today, video editing is very popular, and computer companies offer a wide variety of boards for nonlinear video editing, which differ in price and capabilities. The most common are relatively inexpensive cards with analog video inputs and hardware for digitizing and compressing video into the Motion JPEG format.

There are video inputs and equipment for digitizing and compressing video into Motion JPEG format. These are Miro Video DC10, DC30, Fast

AV Master, Matrox Marvel, etc. When digitizing video material using these cards, it is very important to choose the right compression level (there is a possibility of its adjustment within wide limits). The table below shows the chroma sub-sampling recommended compression levels depending on the quality of the output video file. If you choose a compression higher than the recommended one, then specific distortions associated with compression become noticeable – edging, block structure of the image, noise. In most cases, this is unacceptable. If you choose less than the recommended compression, then the consumption of disk space increases. In this case, the expected improvement in image quality does not occur, since, while decreasing, the distortions from compression are simply lost in the intrinsic noise and distortions of the video recording.

Table 5.1 – Chroma sub-sampling technique reducing file sizes by discarding some colour information while retaining luminance or brightness

Luma Chroma Luma + Chroma	
4:4:4 	a block of eight pixels (4x2), Luma (luminance) and Chroma (colour) information is retained for all pixels
4:2:2 	all pixels have Luma information but only 2 in the first row and 2 in the second retain Chroma information, which is then simply copied to the adjacent pixels
4:2:0 	2 pixels in the first row, but none in the second, have Chroma information, which is again copied to adjacent pixels (in this case on both rows)

Any filmed or digitized video material must be edited before being recorded into a video clip or video film. Remove "unnecessary" video clips, dock separate pieces of video material, make transitions between them, add special effects. This is what the devices that we will talk about are intended to do.

There are three types of video editing: linear, non-linear and hybrid.

Linear video implies dubbing of video material from two (or more) video sources to a video receiver (video recorder) with the accompanying cutting out unnecessary and "glueing" the necessary video scenes and adding the effects mentioned above. The disadvantage is the loss of quality (the only

exception is, perhaps, professional video signal presentation formats), high labour intensity and a large amount of video equipment.

Non-linear video is carried out based on specialized computer systems. At the same time, the raw video materials are first entered "into the computer", and then the editing procedures are performed. Advantages are practically no loss of quality, and with multiple "movements" of video clips, significant savings in video equipment.

Disadvantages – work not in real time, the long processing time of video material, high labour intensity (try to titrate half an hour of video material, which is necessary, for example, when creating educational films), a limited amount of video material entered into a computer.

Hybrid video is the view, that combines the advantages of the first two (non-linear video editing system acts as a video source). The disadvantage is usually the higher price.

The standard workflow of video editing begins with planning. Each step requires the use of skills and tools. In addition, the time spent on a particular stage will depend on the specific project. Includes the following actions:

1. Filming. This stage can record the initial video footage or collect the necessary source files for the project.

2. Capturing (transfer or import) video material to the hard drive.

3. Organizing clips. Projects these days can contain a huge variety of pieces of video material. Take the time you need to organize the clips used in your project.

4. Assembling video and audio fragments into a sequence and adding them to the timeline.

5. Creating transitions between clips, apply video effects, and performing compositing by placing clips on multiple layers (tracks).

6. Creating titles or images and adding them to your sequence. The technique is the same as for video clips.

7. Mixing multiple audio tracks to produce an acceptable volume level, and applying fades and special effects to audio clips to improve sound quality.

8. Exporting completed projects to a file on your computer's hard drive, to a streaming service like YouTube, to a mobile device, to DVD or Blu-ray discs.

Conclusions

Video is the best means of accompanying any presentation, it is especially important to accompany video presentations in the field of culture and art. Modern video editors are so simple that any user can work with

video, editing a movie, applying special effects, creating subtitles. Thus, the presentation of complex concepts from the world of culture and art becomes more accessible when it is possible to accompany scientific reflections with a bright, understandable video sequence.

Key concepts: Video classification, video file formats, video editors, video codecs

PRACTICE

Task 1. Digital video characteristics

- Select all digital video main characteristics.

☐ Screen resolution	☐ Brightness	☐ Frame rate
☐ Colour depth	☐ Aspect ratio	☐ Audio depth
☐ Saving project method	☐ Bitrate	☐ Screen frame
☐ Screen ratio	☐ Volume	☐ Scanning method

Task 2. Digital video formats

- Fill the table with video formats

AVI			

Task 3. Definitions

- Fill the sentences with proper terms

Digital video is a set of technologies for recording, processing, transmitting and storing images and sound.

The main difference of digital video from the analogue one is that video and audio are encoded and transmitted not in their original form, but after analogue-to-digital _____ into video and audio data streams.

_____ is a collection of static images that change each other at a certain frequency. Each still image is a separate video frame.

_____ is technology of digital compression, which allows reducing the amount of data used for a video stream. Video compression allows to _____effectively the stream required for video transmission over radio broadcasting channels, _____ the space required for storing data on the media.

Compression of a video stream is carried out using a special program, which is called _____. _____ is an algorithm for compressing (reducing the size) of video data (video file, video stream) and recovering compressed data. _____ is file-formula for display.

_____ is a file format that defines the distribution of audio, video, and in some cases text information within it. In most cases, the type of _____ does not account for the type of encoding (compression) of information within the file.

Task 4. Types of video editing

There are three types of video editing: linear, non-linear and hybrid. Put the proper type of the video in the cell aside its description.

video	Video of this type is carried out based on specialized computer systems. At the same time, the raw video materials are first entered "into the computer", and then the editing procedures are performed. Advantages are practically no loss of quality, and with multiple "movements" of video clips, significant savings in video equipment. Disadvantages – work not in real time, the long processing time of video material, high labour intensity (try to titrate half an hour of video material, which is necessary, for example, when creating educational films), a limited amount of video material entered into a computer.
video	Video of this type implies dubbing of video material from two (or more) video sources to a video receiver (video recorder) with the accompanying cutting out unnecessary and "glueing" the necessary video scenes and adding the effects mentioned above. The disadvantage is the loss of quality (the only exception is, perhaps, professional video signal presentation formats), high labour intensity and a large amount of video equipment.
video	Video of this type is the view combines the advantages of the first two (non-linear video editing system acts as a video source). The disadvantage is usually the higher price.

TALKING POINTS

- Discuss the advantages and disadvantagies of analog video.

Analog video

advantages	disadvantagies
1. When cine-film part is broken, the rest of the video can be recovered 2. 3.	1. 2. 3.

- Discuss the advantages and disadvantagies of digital video.

Digital video

advantages	disadvantagies
1. 2. 3.	1. If digital media is broken the video lost 2. 3.

- Speak on the following video characteristics which are the most important to know for video processing.

– Screen resolutions. Aspect ratio of the image. Aspect ratios of the video.

– Frame rate effect. Typical frame rate for digital video good quality.

– Determination of the smoothness and naturalness of the video. Minimum frame rate at which the movement will be smooth.

– The standard video playback speed for a movie theater. What affects the speed of the video stream (in Mbit/s).

– Colour depth. The most common colour model for video formats.

– Video compression effect. How is the video stream compressed. The most well-known compression standards and their application.

– Video container.

COMPUTER TRAINING

Training 1: Paste the Titles in MOVAVI

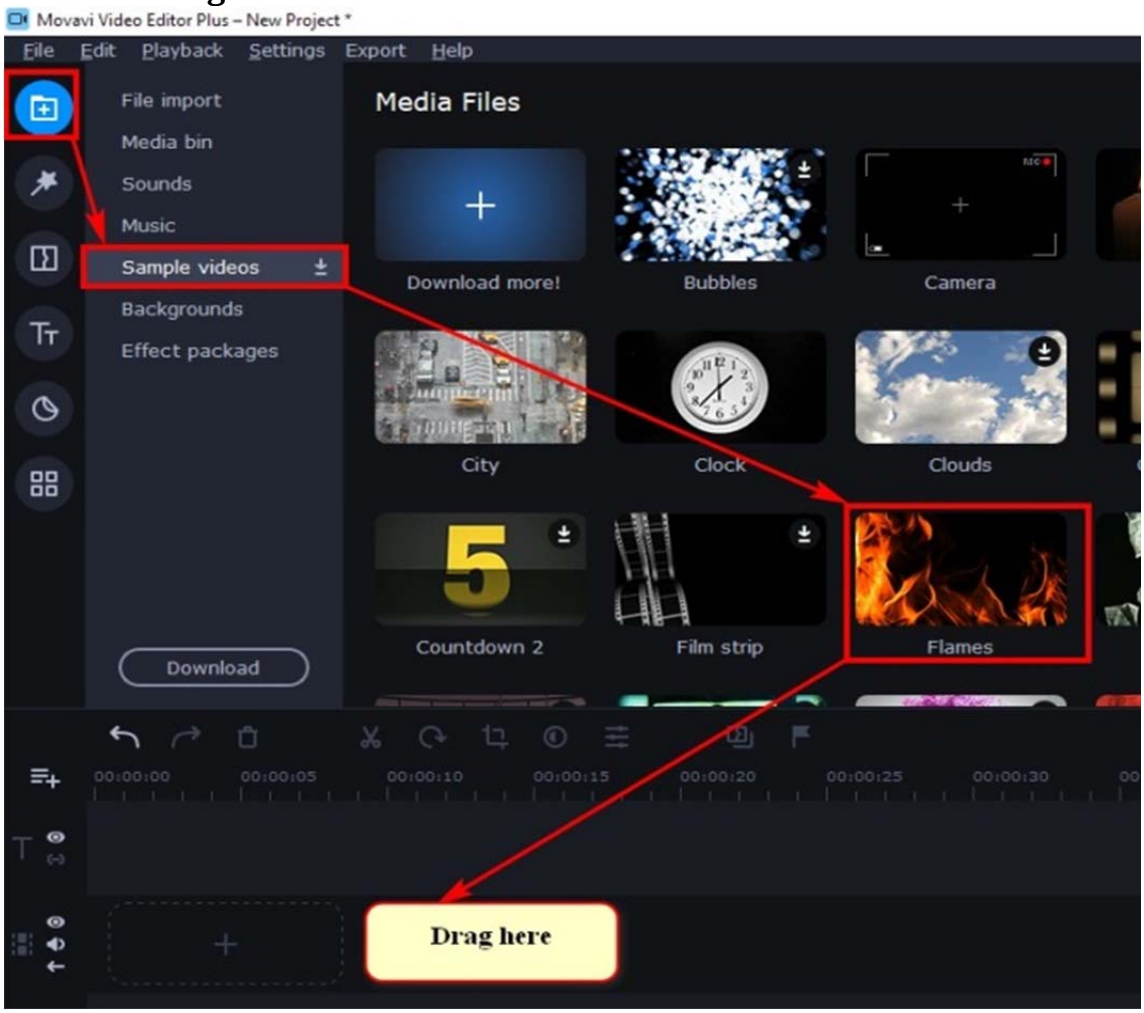


Figure 5.12 – Adding video

• Create a new project in **MOVAVI**. Add video being titled. To do this, go to **IMPORT → Sample videos**. Select the fragment you like and drag it to the video track (Figure 5.12). Add it several times if necessary.

• Add titles. Select **TITLES** on the toolbar. Drag the template you like onto the top track of the timeline (title track) (Figure 5.13).

• In order to make changes to the text, select the fragment needed on the title track (right-click on it, and it will be highlighted in yellow) and select on the toolbar the following button



Then make changes to texts (Figure 5.14).

Similarly add a few more premade fragments to the credits (Figure 5.15 and Figure 5.16).

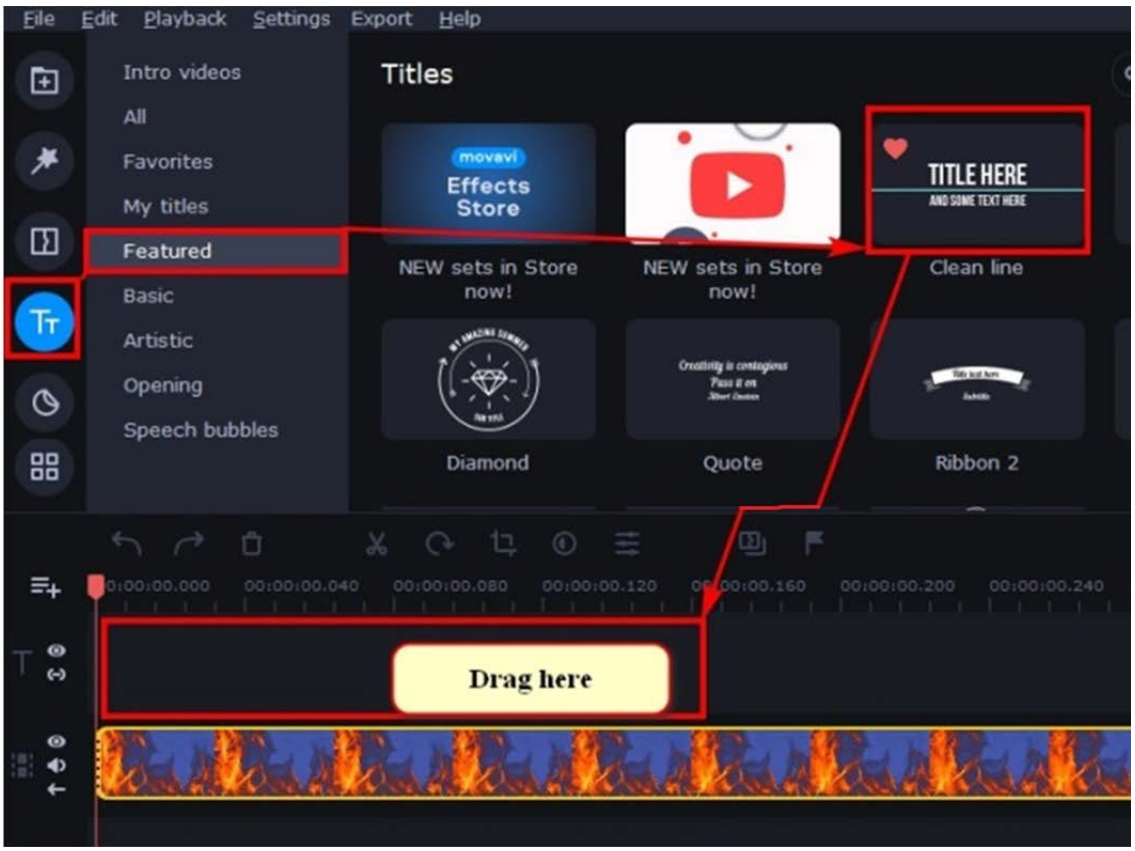


Figure 5.13 – Adding titles template

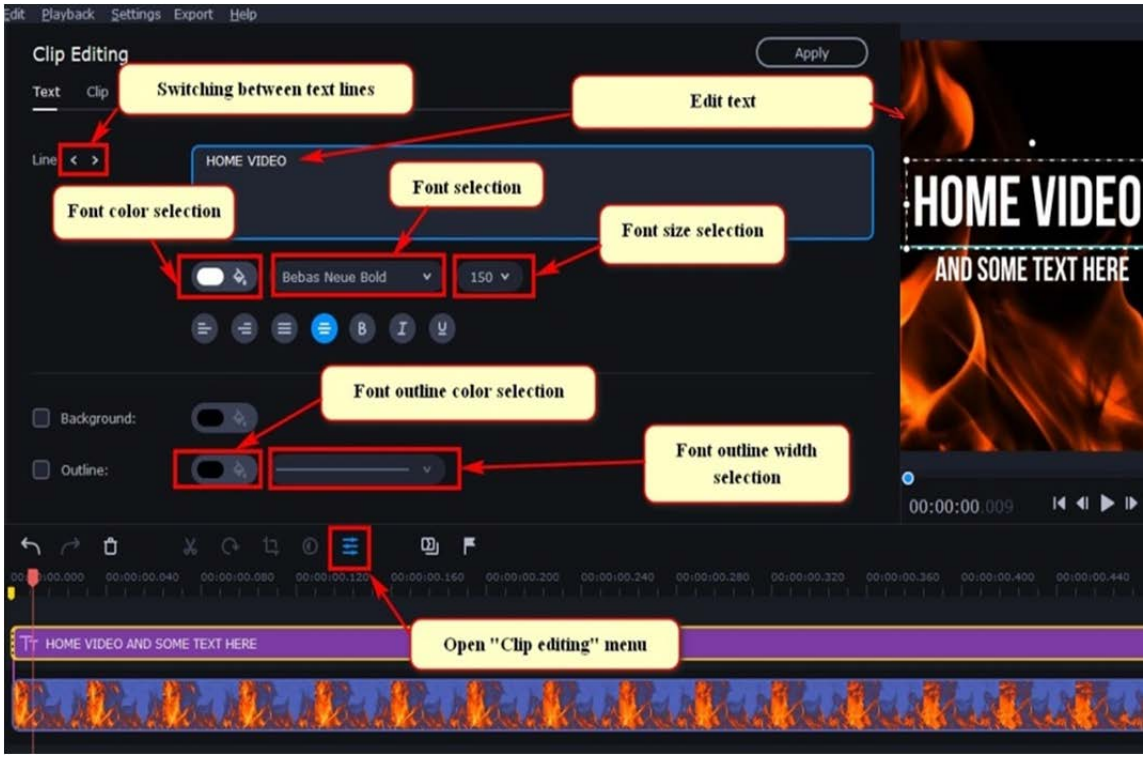


Figure 5.14 – Making text changes

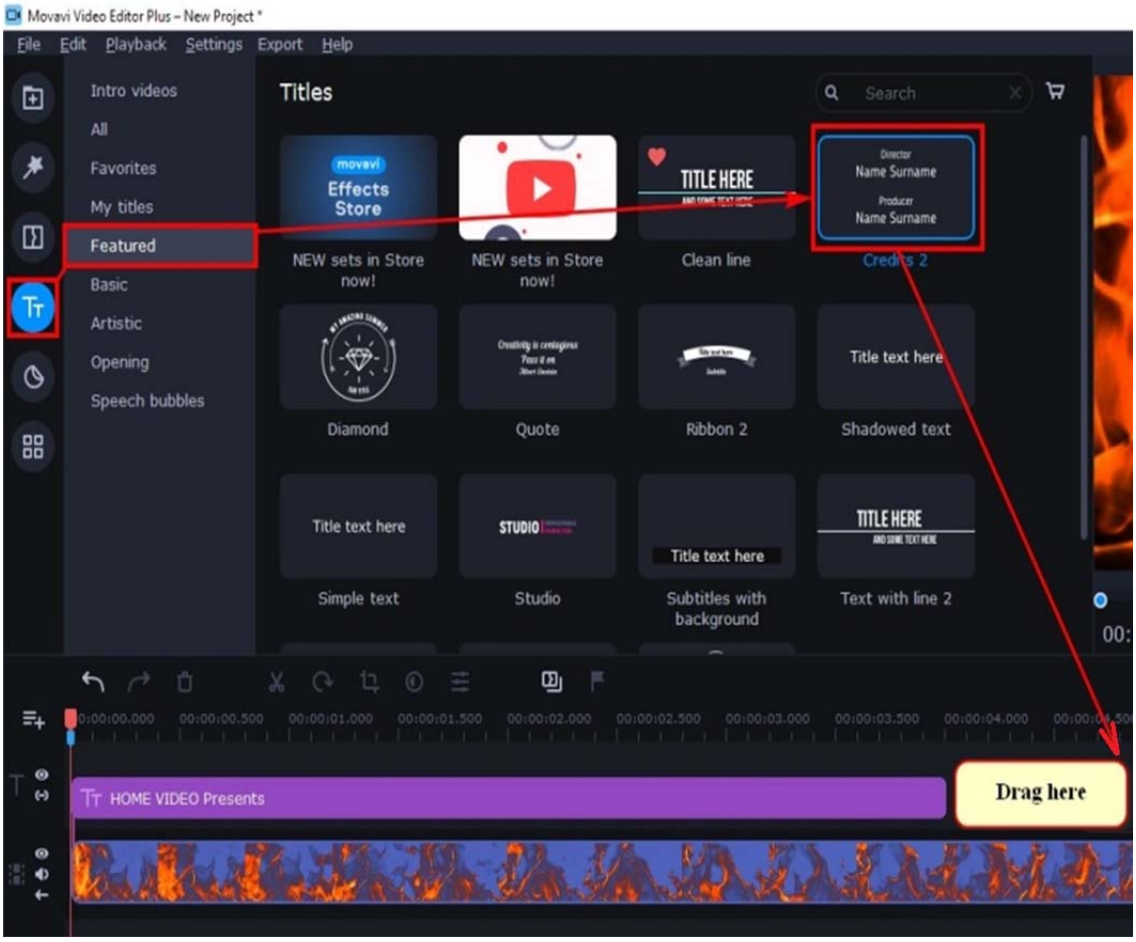


Figure 5.15 – Adding titles template

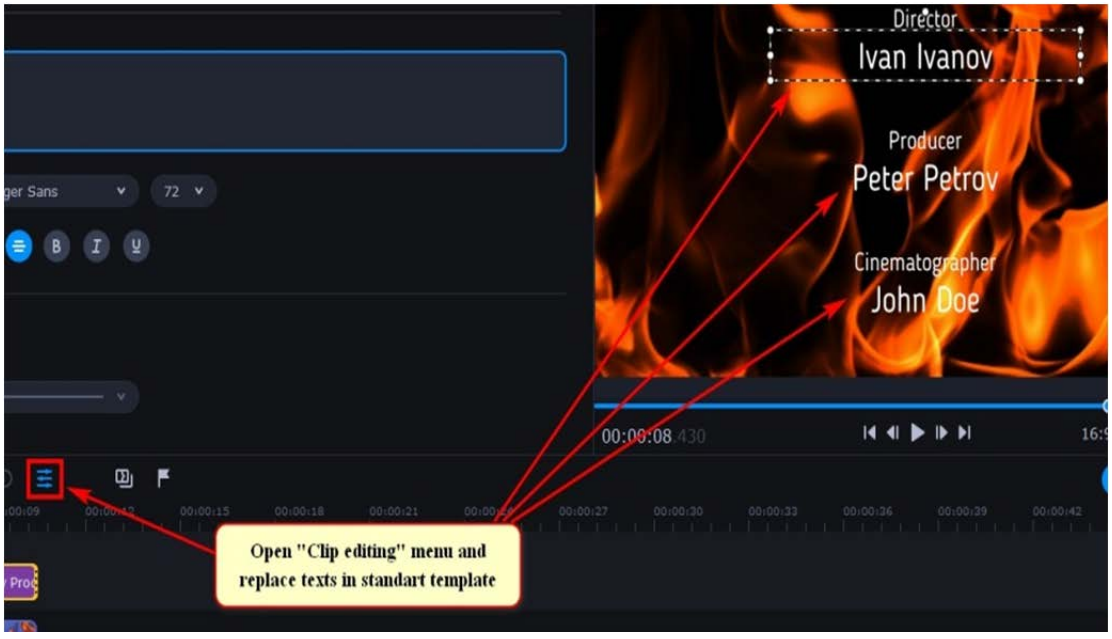


Figure 5.16 – Making text changes

Training 2: Adding a premade template

• Go to **IMPORT / Sample videos** (Figure 5.17). Select the fragment and drag it to the video track.

• In order to add self-made video material (video and audio) it is necessary to import it. To do this, click the **IMPORT** button on the toolbar, select **File import** and drag all the necessary files to the specified area (Figure 5.18). Files are automatically added to the Media bin once imported.

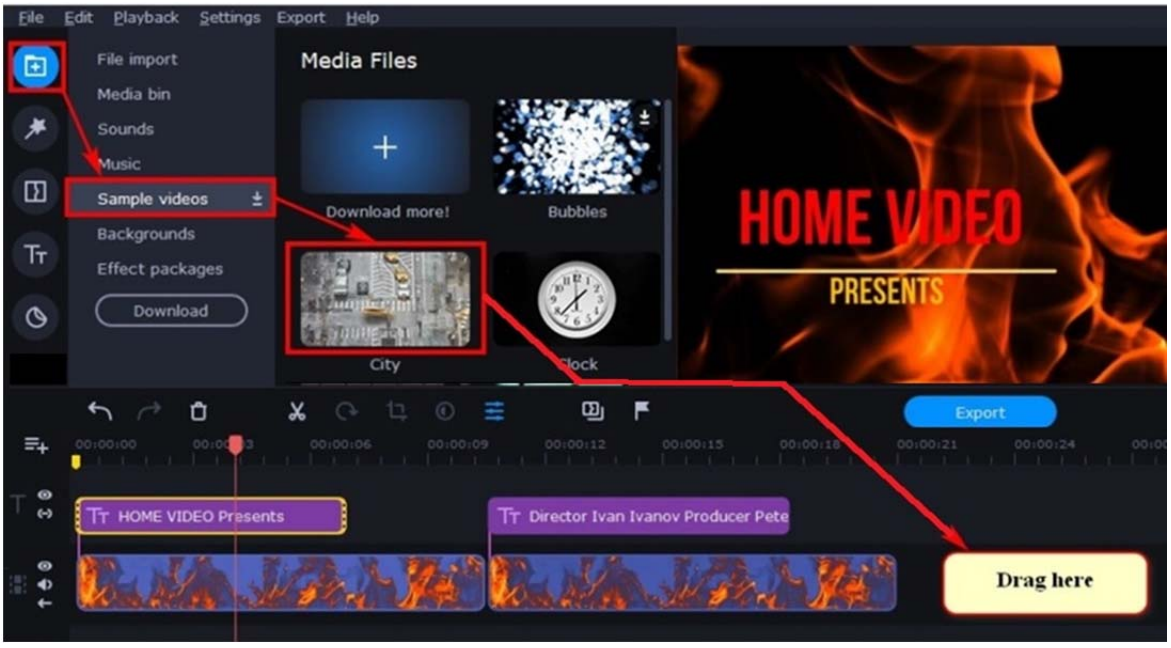


Figure 5.17 – Import sample videos

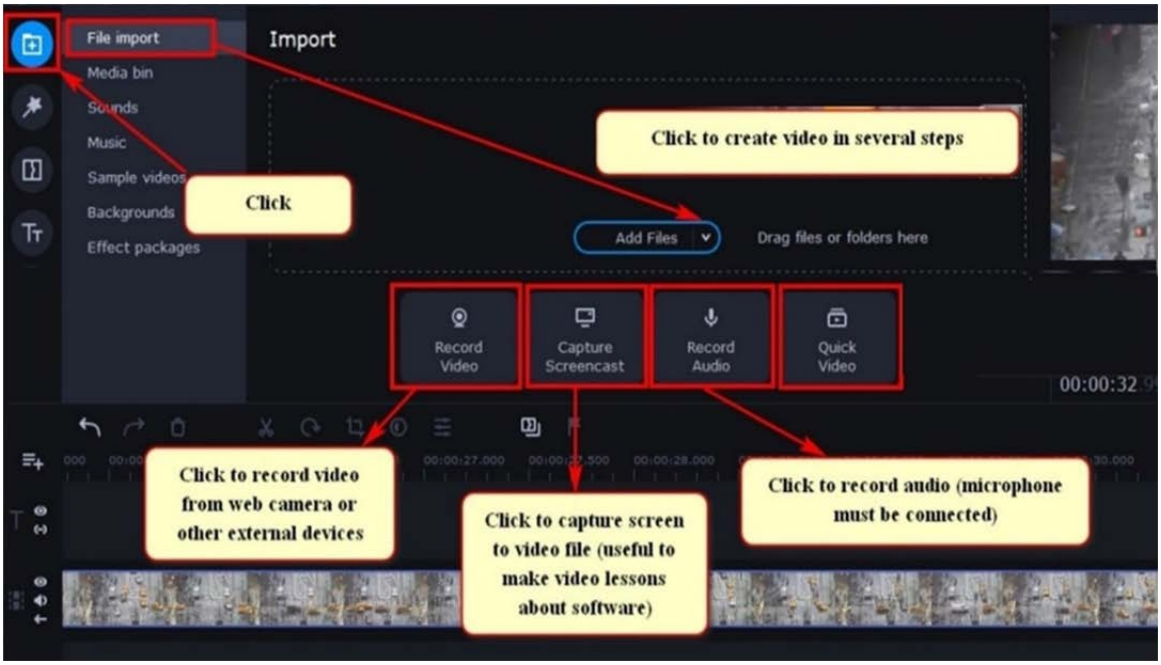


Figure 5.18 – File import

• To start processing the video, one needs to add r video clip to the video track (video line). To do this, click on the desired video file with the left mouse button and, while holding it, drag it to the desired track (Figure 5.19).

• Add titles to the end of the video. To do this, select **TITES / Artistic** from the toolbar (Figure 5.20). Drag the template to the top track of the timeline (title track) and make changes.



Figure 5.19 – Adding video clip

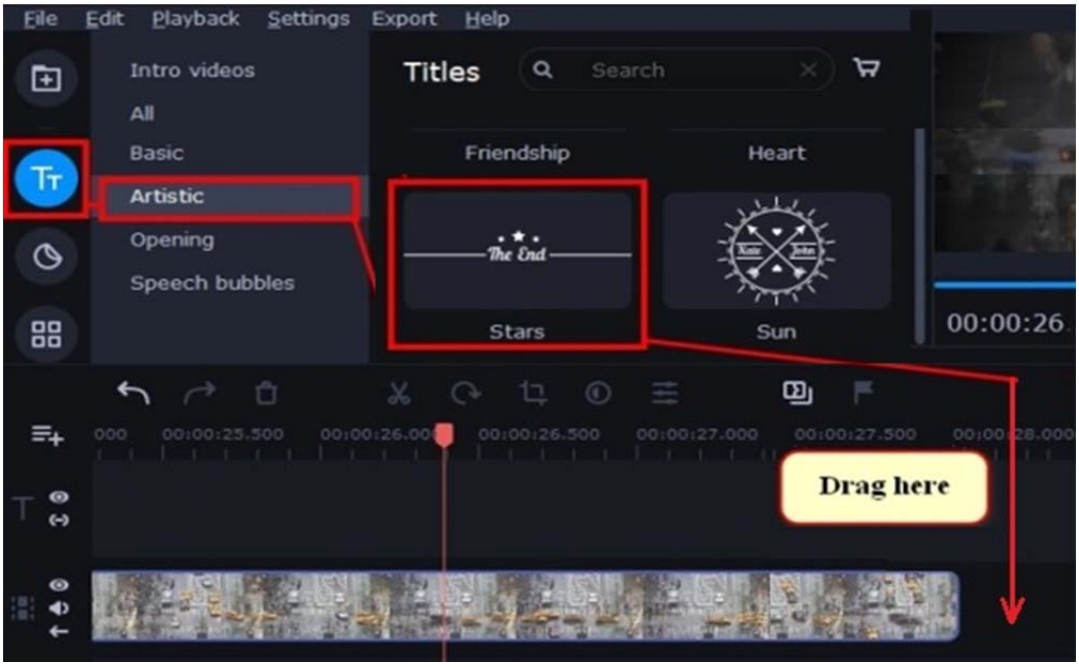


Figure 5.20 – Adding titles to the end of the video

Training 3: Processing video

Main tools for processing video are shown on the Figure 5.21.

• ***Old film video style.*** To make old film effect left-click FILTERS on the toolbar, select Vignettes and choose one you like (Figure 5.22). Then again left-click FILTERS, select Colour Filters and choose one you like (Figure 5.23).

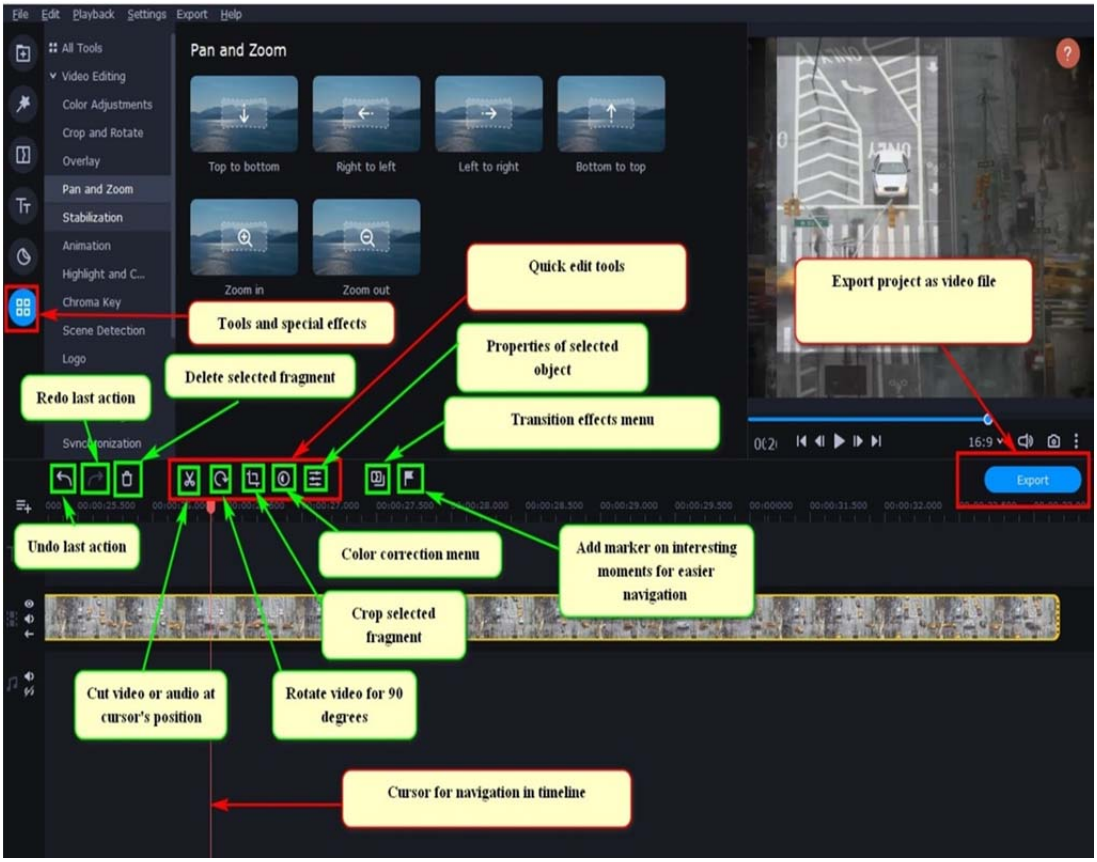


Figure 5.21 – Video tools

• ***Dividing video into several fragments.*** Place cursor where you want to cut fragment and click scisors on the quick editing panel (Figure 5.21 and Figure 5.24)

• ***Cropping video.*** Select the fragment being cropped and click **MORE TOOLS** on toolbar, then **Crop and rotate** and crop the desired area (Figure 5.25).

• ***Add transition effects between video fragments.*** Select **TRANSITIONS** on the toolbar, then choose **Circles** and drag the desired transition between the two clips to connect them using an animation effect (Figure 5.26). To set transition effects use the tool on the quick editing panel. Then make adjustments if necessary. It is better to add transition effects for each fragment separately (Figure 5.26).

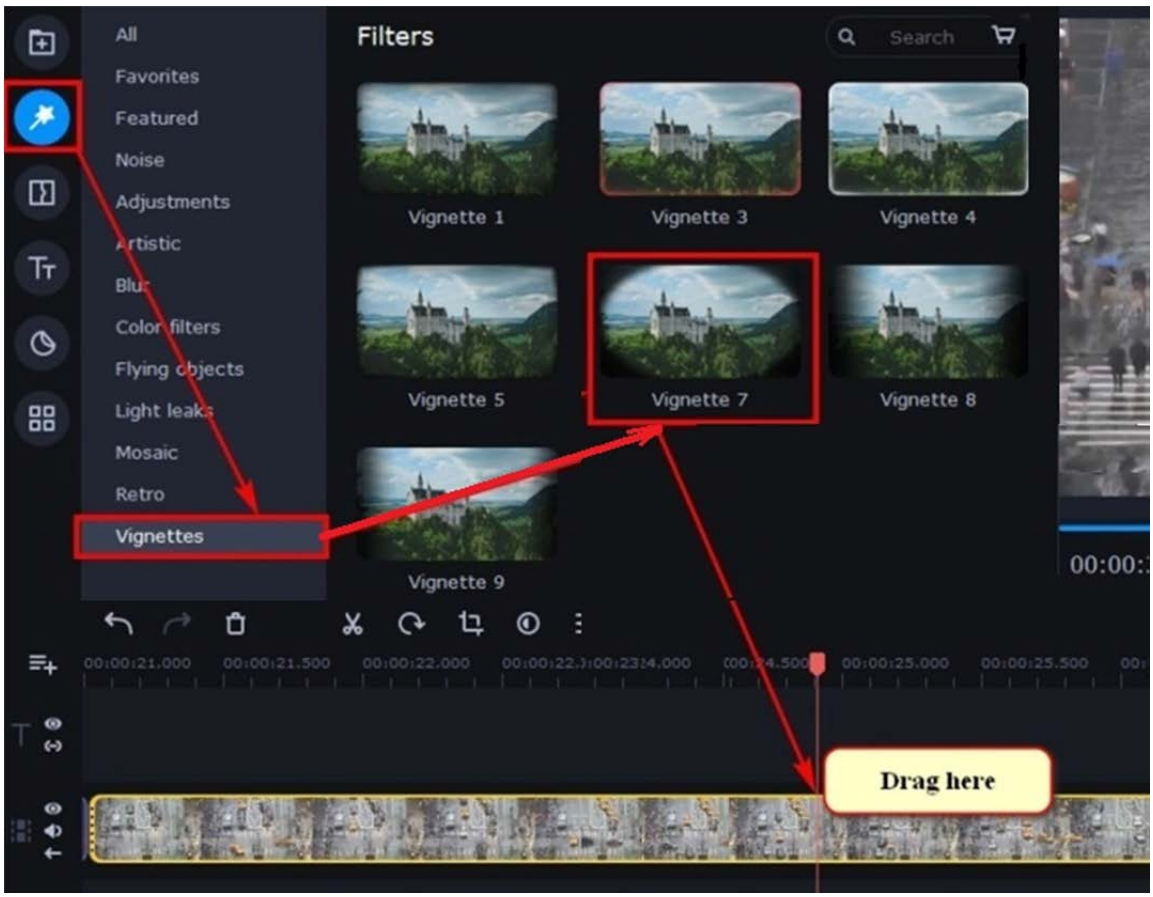


Figure 5.22 – Vignette filter

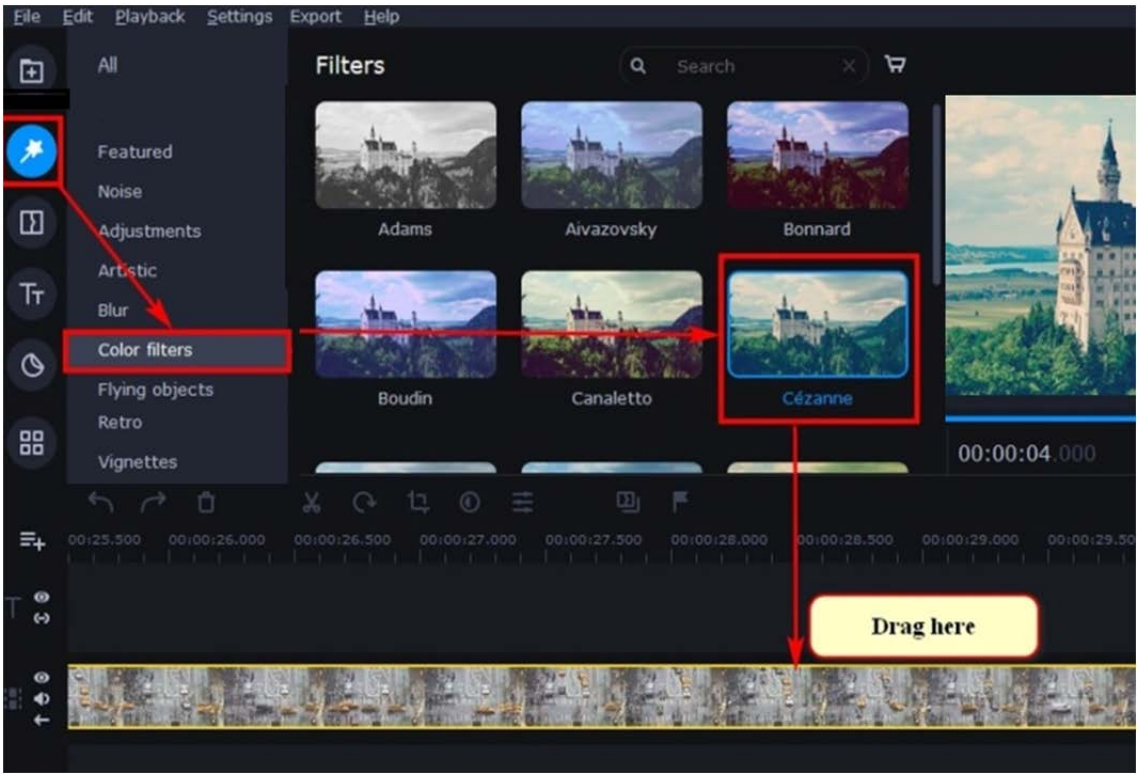


Figure 5.23 – Colour filters

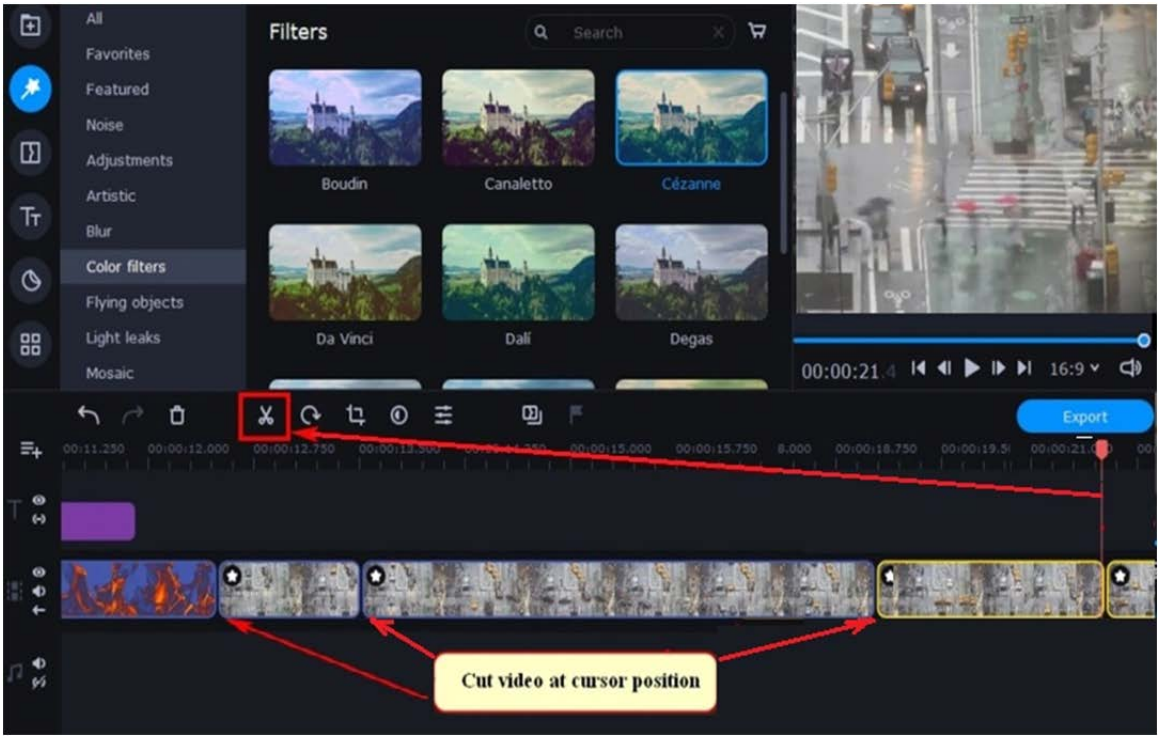


Figure 5.24 – Cutting video into fragments

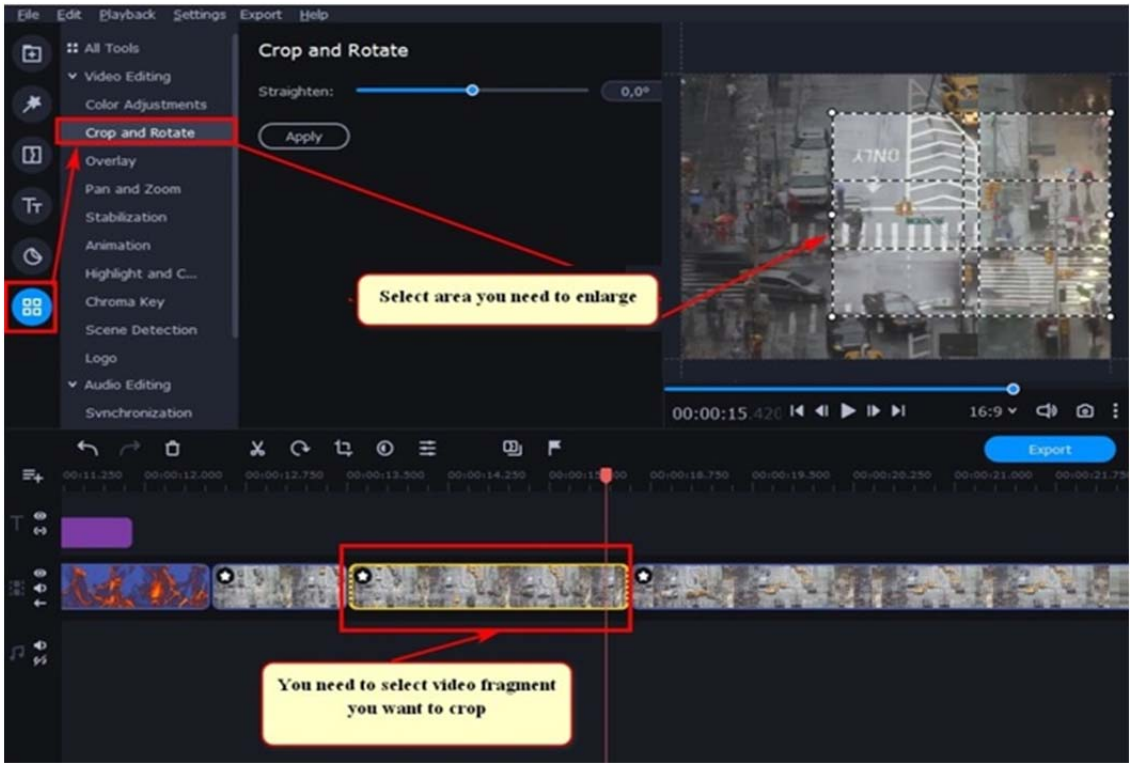


Figure 5.25 – Cropping video

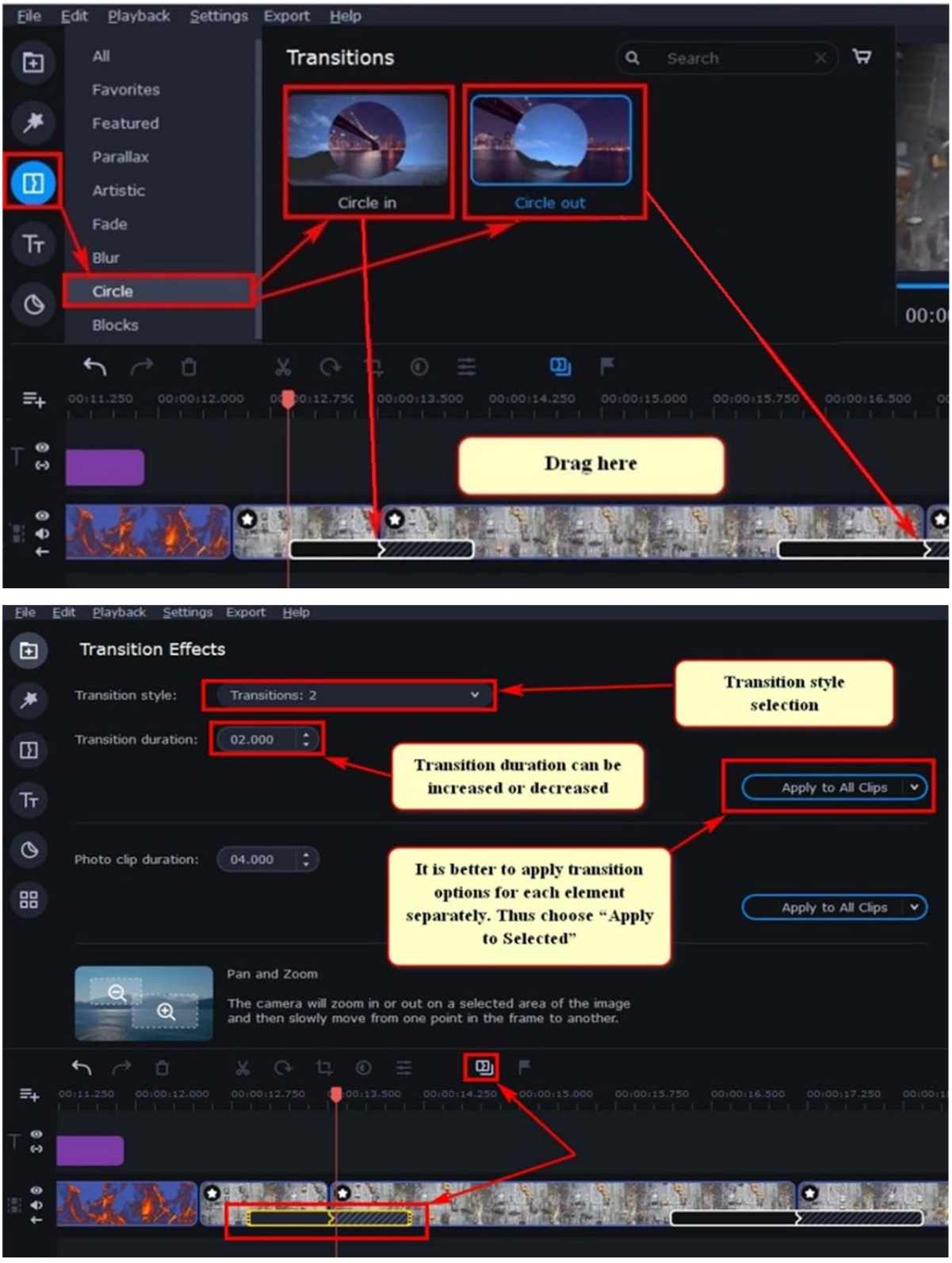


Figure 5.26 – Adding transition effects

• **Creating titles.** Select **TITLES / Artistic** from the toolbar. Drag the template you like to the top track of the timeline (title track) and make changes (Figure 5.27).

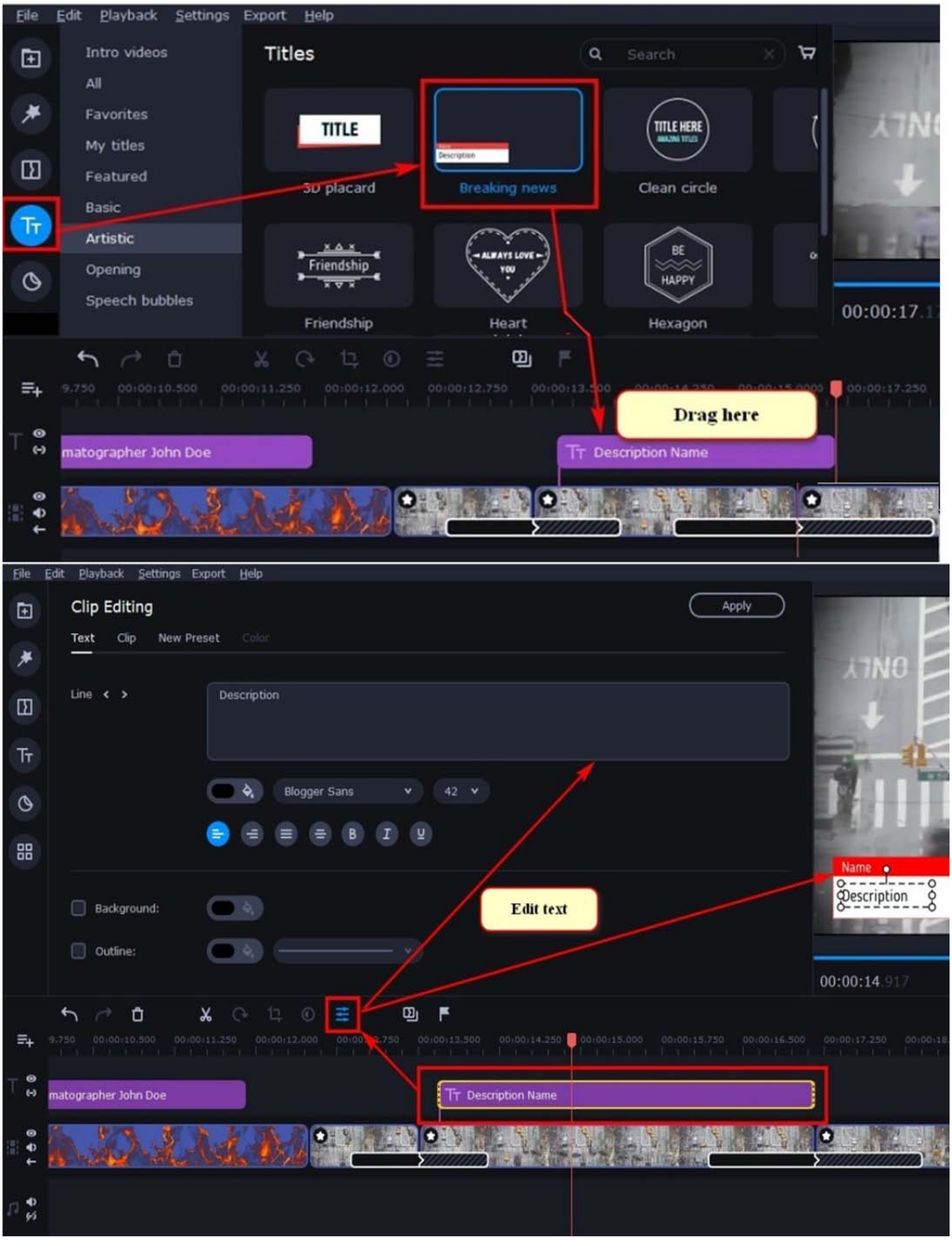


Figure 5.27 – Editing titles

• ***Adding logo to video.*** Select **MORE TOOLS** on the toolbar, then **Logo** and add a premade file (Figure 5.28). Choose the place on video to add logo, selecting MORE TOOLS on the toolbar, then Overlay and choose one. It is possible to adjust logo size if necessary (Figure 5.29).

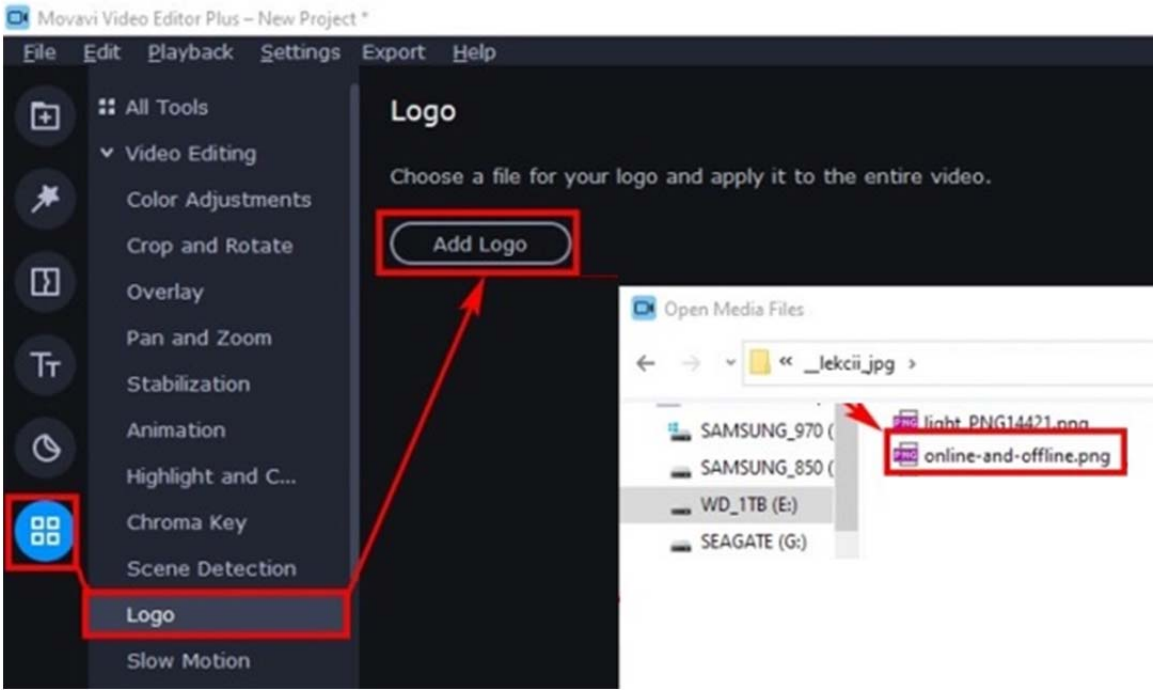


Figure 5.28 – Importing file with logo

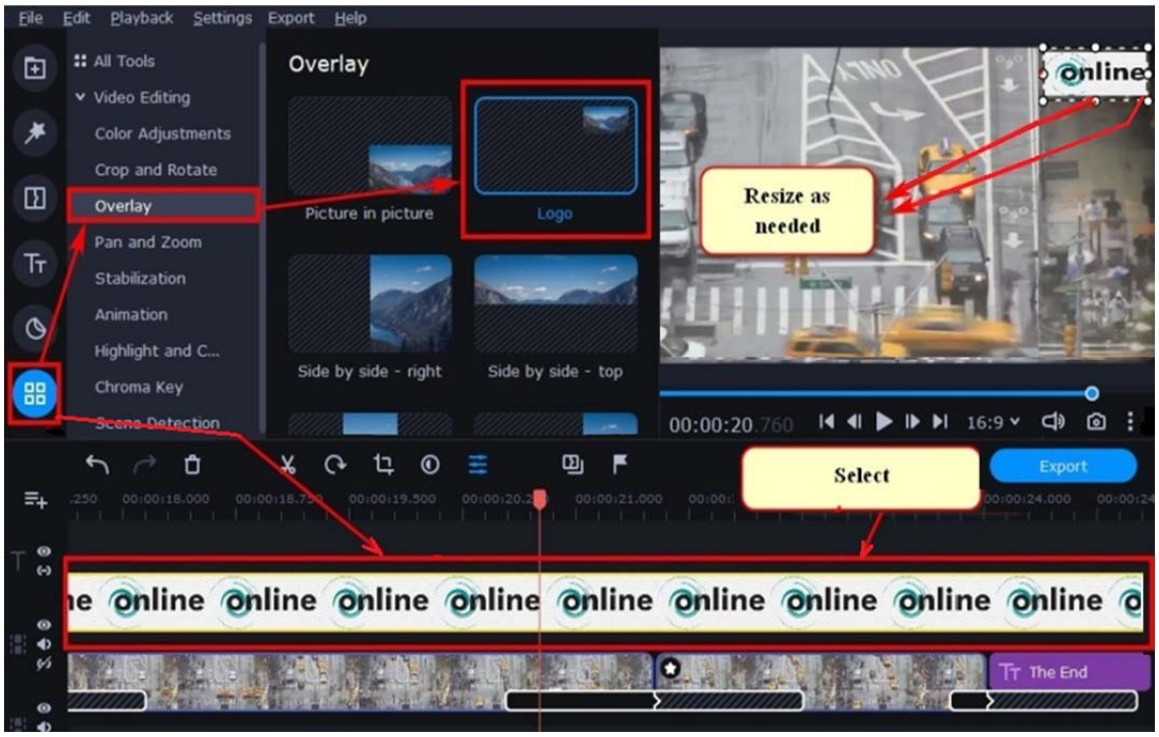


Figure 5.29 – Placing logo on video

- ***Adding audio to video***. Use a premade audio template. Go to **IMPORT / Music**. Select the fragment and drag it to the audio track (Figure 5.30). Then cut the part that is not needed. Use the tool scissors (Figure 5.31) to cut audio. Select the fragment to be eliminated and click basket on the editing panel (Figure 5.32).

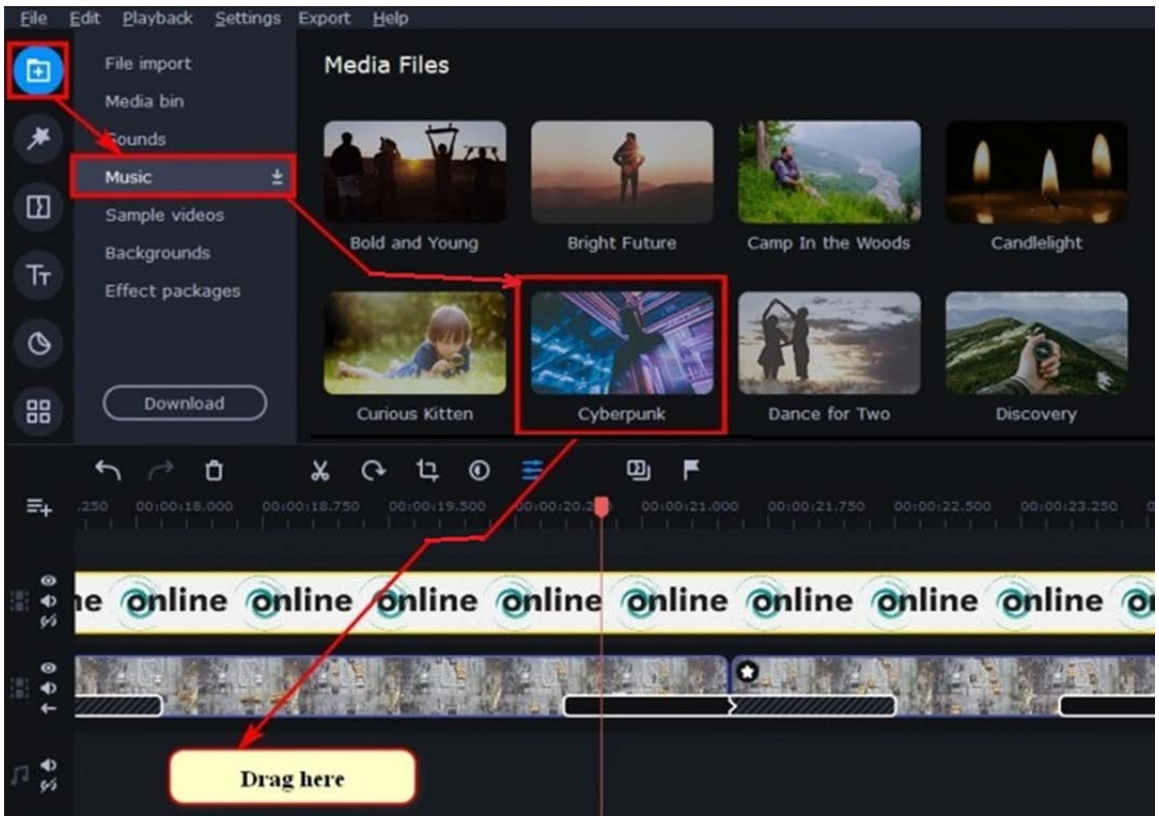


Figure 5.30 – Adding audio track

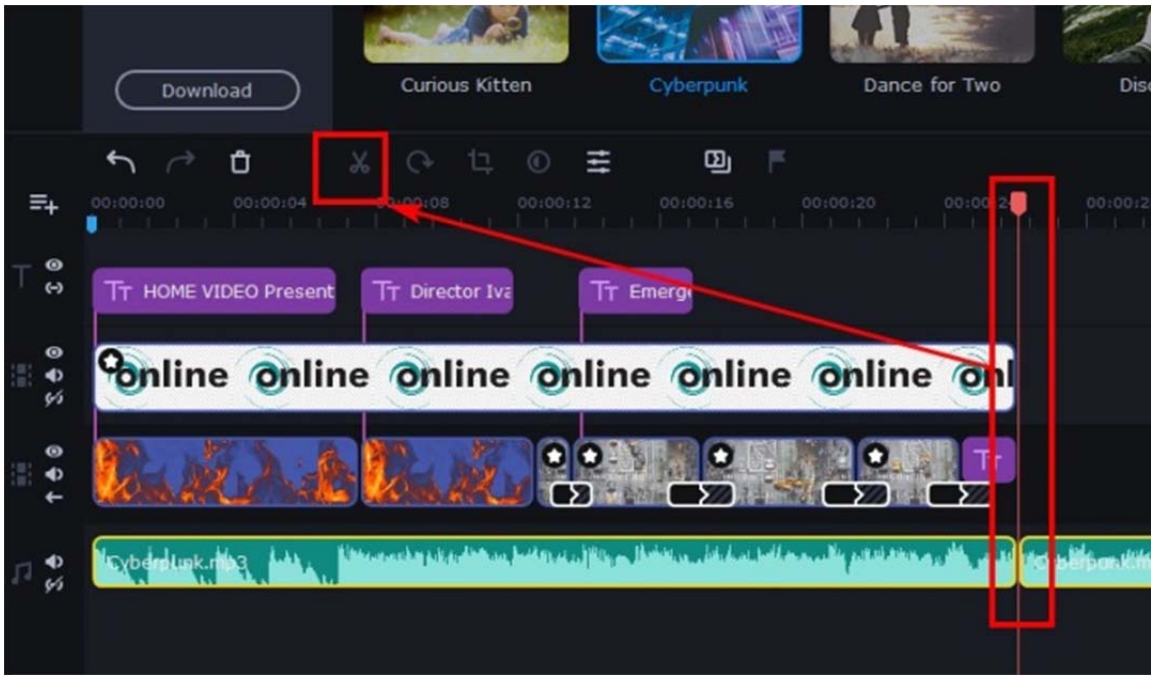


Figure 5.31 – Cutting video

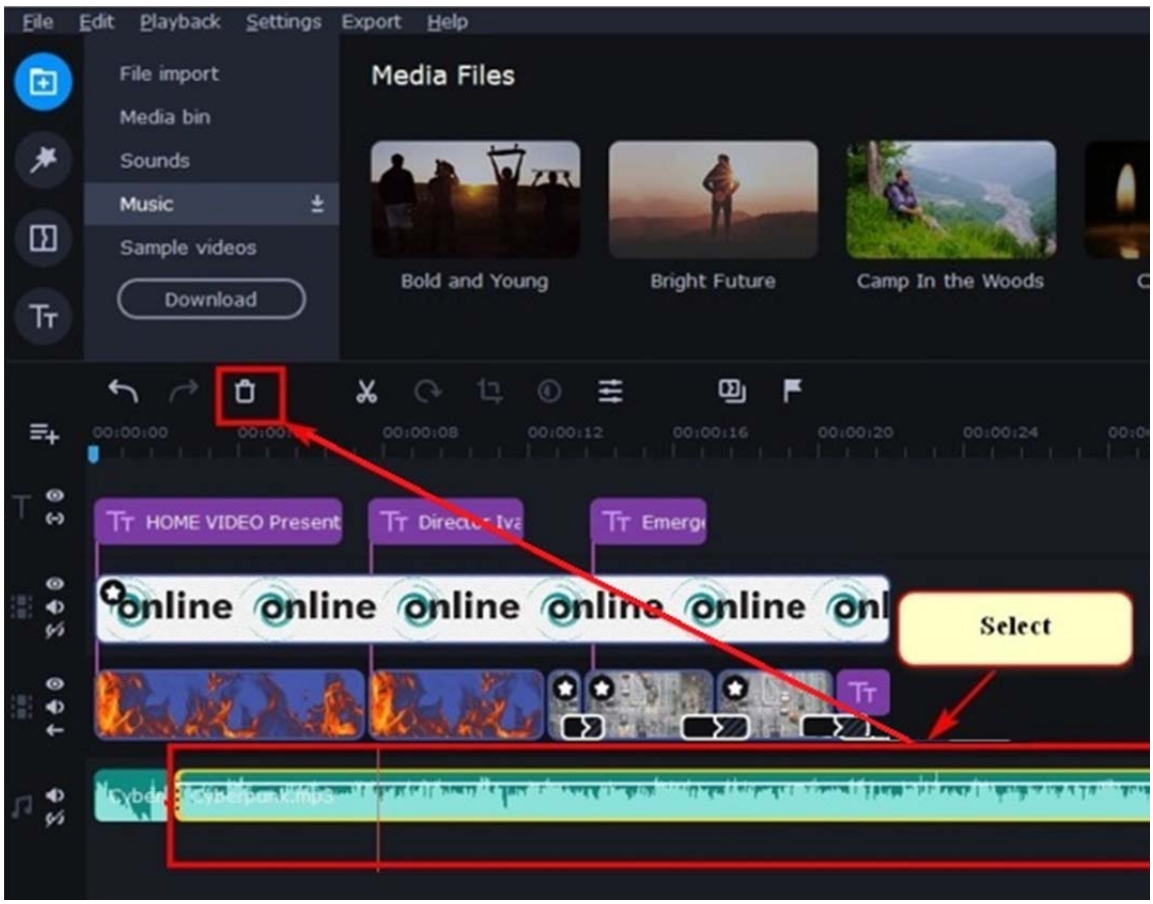


Figure 5.32 – Deleting video

To control the volume of the audio track, select the fragment in the audio track, the white horizontal bar that appears is the default volume level of 100%. To add sound attenuation or volume control at a specific place in the audio track, double-click the left mouse button to add nodes on the white line and move them (Figure 5.33).

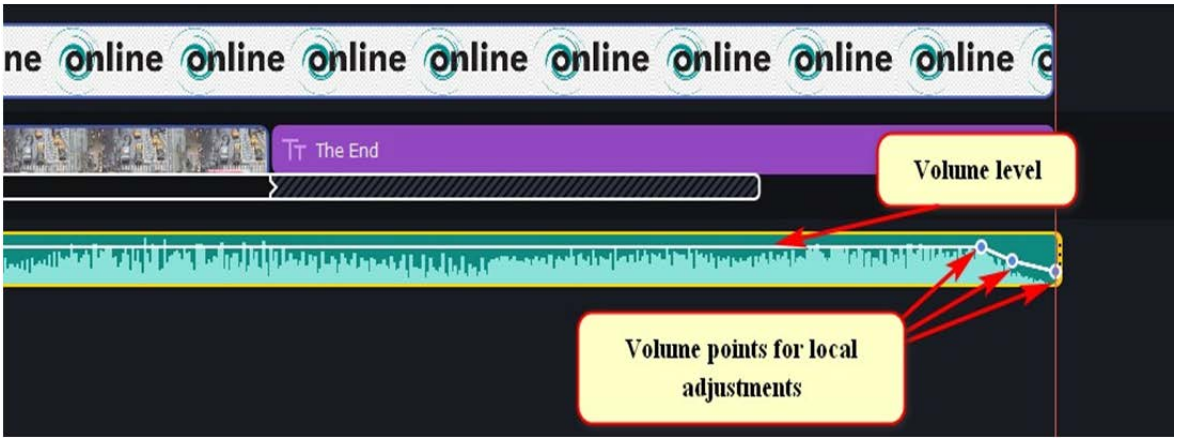


Figure 5.33 – Audio track volume controls

• ***Saving project***

In order to save the project for further editing select **FILE / Save project as…** and choose location.

Export the project in one of the standard video formats clicking on the **FILE/Save movie as** a media file menu. In this window select the path to save. See the total duration of the video and the approximate size of the resulting file (a range of values is given, since the video is encoded with a variable bitrate – the amount of information required to save one second of video – and the program can't predict exactly how the video will be compressed). To change the format, quality and resolution, click the «**Advanced**» button. For this work under consideration the following settings are recommended: the MP4 format, the "good" quality option and the resolution no more than 1280x720, the rest of the parameters are default (Figure 5.34).

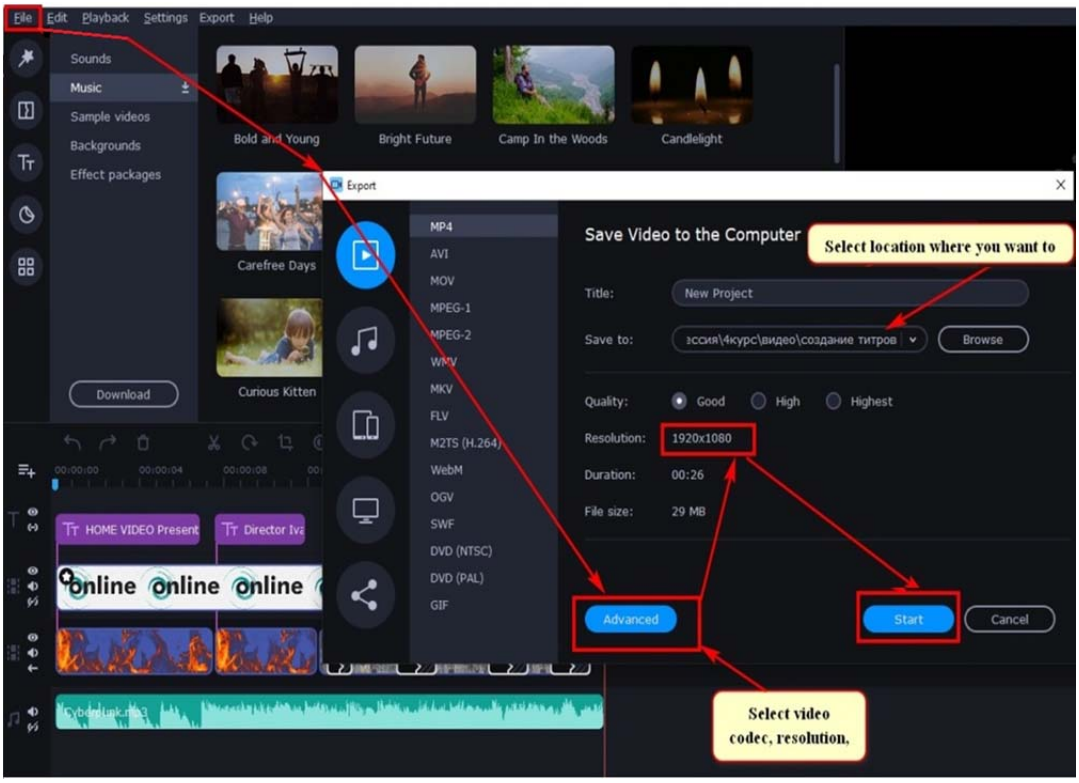


Figure 5.34 – Exporting project

INDIVIDUAL WORK

• Create a video on ***Individual Topic*** using online video editor servicehttps://clipchamp.com/en/.

RECOMENDATIONS

Open in browser https://clipchamp.com/en/, use a Google account or register (Figure 5.35) or open https://123apps.com/ (Figure 5.36).

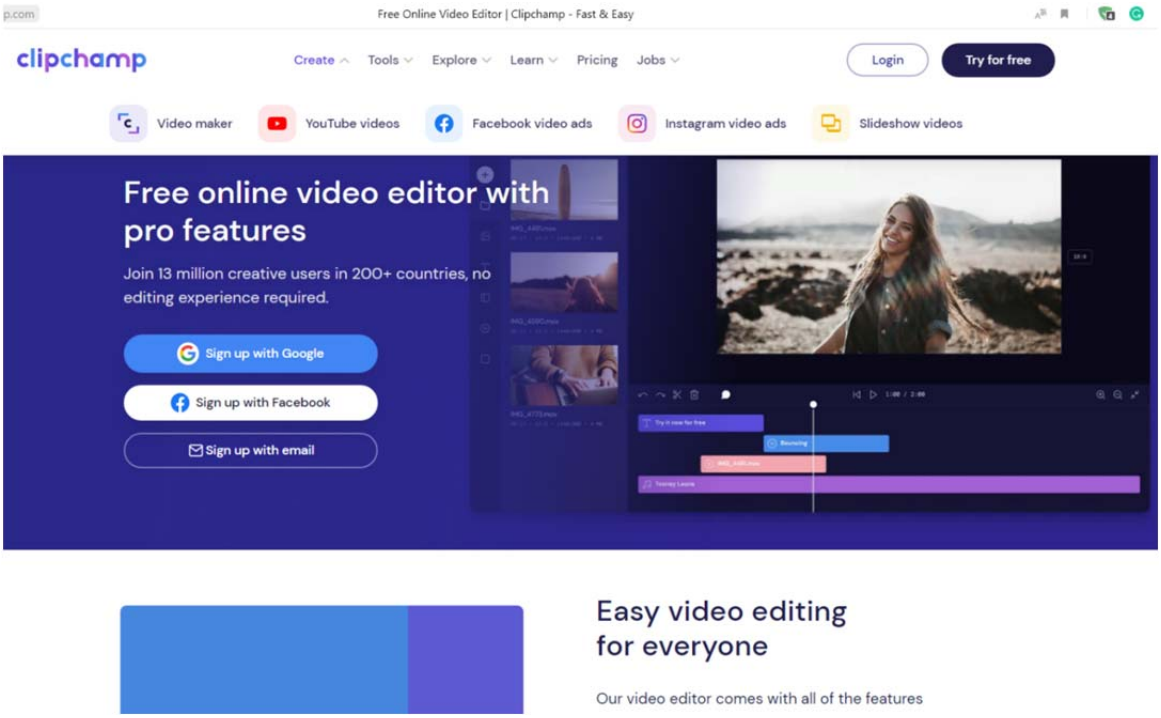


Figure 5.35 – Online resource Clipchamp

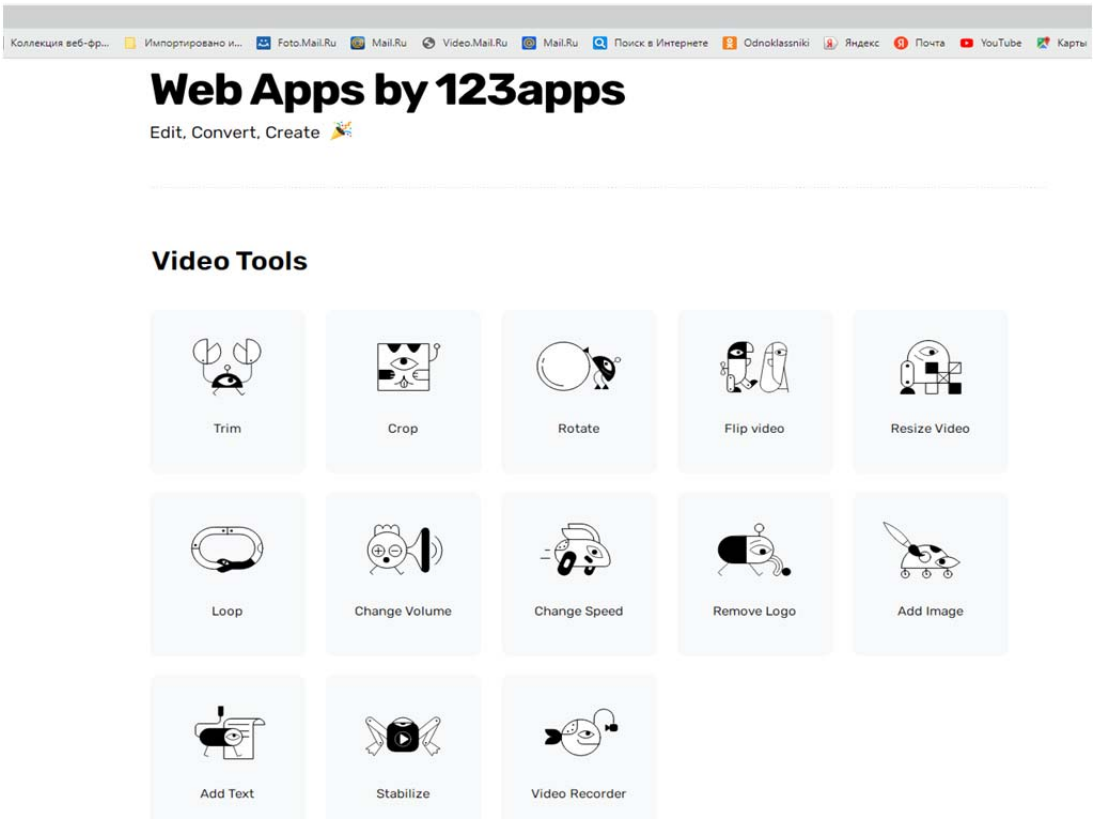


Figure 5.36 – Web Apps by 123apps

Get started with these slideshow video essentials. Start a slideshow by uploading your media.

Open up Clipchamp and start by selecting from the available video templates or by creating a new video project from scratch. Once inside the editor, browse through files and add photos and clips to the media library.

Add a music track to slideshow.

In addition to visuals, upload audio files to the editor and drag and drop it to timeline, right below the images and clips. There are extra tracks on the timeline for audio, so there's ample space for both background music and voice over.

Apply filters to create movement.

Give slideshow a cinematic feel by applying dynamic moving filters. Simply select an image from timeline, browse through the available filters and select favourite to use the effect.

Trim and sync visuals and audio together.

Set the slides to the tune of your background music by aligning them on the timeline. The preview area on the right-hand side shows the playback timing of slideshow video.

INDIVIDUAL TRAINING

Download from Internet videos on your **Individual topic**. Make 2-3 minutes video which will support your ***Individual topic*** speech.

UNIT 6. SEACHING SCIENTIFIC INFORMATION ON THE INTERNET

Main issues

1. Internet basics
2. Internet services
3. Internet protocols
4. Internet search engines. Basic search rules
5. Internet scientific libraries.

Aim: to master the basic approaches to finding scientific information on the Internet.

Topic 1: Internet basics. Main Services and Protocols

The Internet is a globally connected network system facilitating worldwide communication and access to data resources through a vast collection of private, public, business, academic and government networks. The system of computers, which are logically connected, is using a global unique address space, based on the Internet protocol suite, commonly known as TCP/IP. The current foundational protocols in the suite are the ***Transmission Control Protocol*** (TCP) and the ***Internet Protocol*** (IP), as well as the User Datagram Protocol (UDP). In networking, a ***Protocol*** is a standardized way of doing certain actions and formatting data so that two or more devices are able to communicate with and understand each other. TCP is a protocol, which determines how information should be split into packets and sent over communication channels. IP is an address protocol providing each data packet to contain a computer-sender and the computer-recipient addresses.

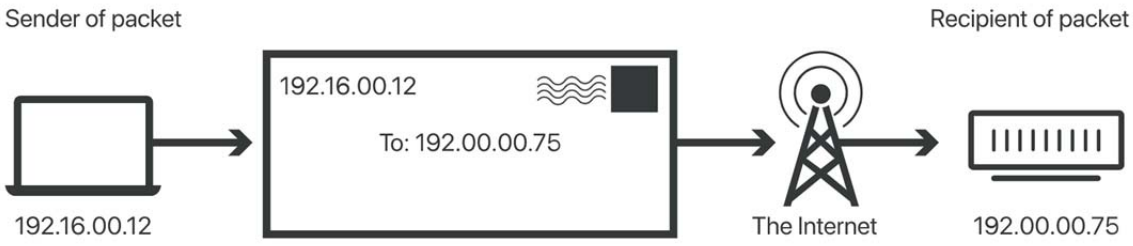


Figure 6.1 – IP addressing

An **IP *address*** is a unique identifier assigned to a device or domain that connects to the Internet. Each IP address is a series of characters, such as

«192.168.1.1». Via DNS resolvers, which translate human-readable domain names into IP addresses, users are able to access websites without memorizing this complex series of characters. Each IP packet will contain both the IP address of the device or domain sending the packet and the IP address of the intended recipient, much like how both the destination address and the return address are included on a piece of mail (Figure 6.1).

IP *packets* are created by adding an IP header to each packet of data before it is sent on its way. An IP header is just a series of bits (ones and zeros), and it records several pieces of information about the packet, including the sending and receiving IP address. IP headers also report:

- Header length
- Packet length
- Time To Live (TTL), or the number of network hops a packet can make before it is discarded
- Which transport protocol is being used (TCP, UDP, etc.)

In total there are 14 fields for information in IPv4 headers, although one of them is optional.

Consider the first remarkable steps of Internet development, which completely changed the way of communication in the world:

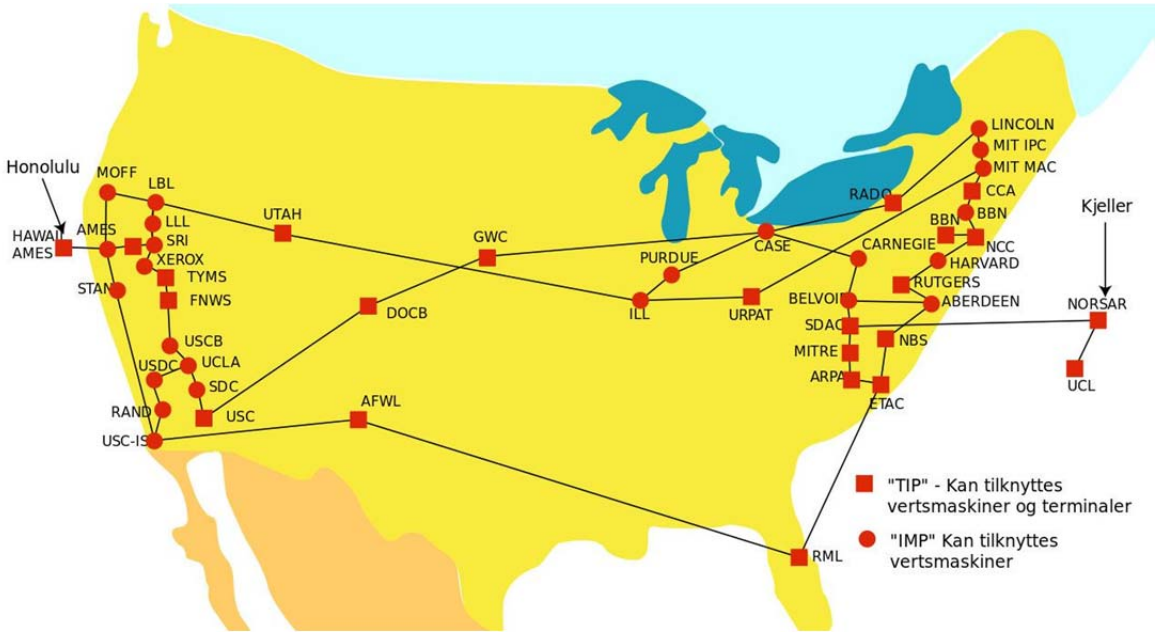


Figure 6.2 – Spread of ARPANET as of September 1974

1969 – the first long-distance (640 km) computer communication between the University of California Los Angeles (UCLA) and the Stanford Research Institute (SRI). Both nodes were connected via ARPANET network (Figure 6.2);

1971 – the first e-mail program for the ARPANET was developed and implemented by the computer programmer Ray Tomlinson (Figure 6.3);

1974 – Internet Protocol or IP, the connectionless datagram service in the original Transmission Control Program, was introduced by Vint Cerf and Bob Kahn (Figure 6.4);

1983 – ARPANET switched from NCP protocol to TCP / IP, and got the term «Internet»;

1988 – the Internet Relay Chat (IRC) protocol was developed providing the real time message exchange in chat;

1989 – the concept of the World Wide Web first elaborated. Tim Berners-Lee (Figure 6.5), a British scientist, developed the HTTP protocol, HTML language and URI (Uniform Resource Identifier);



Figure 6.3 – Ray Tomlinson implemented the first email program on the ARPANET

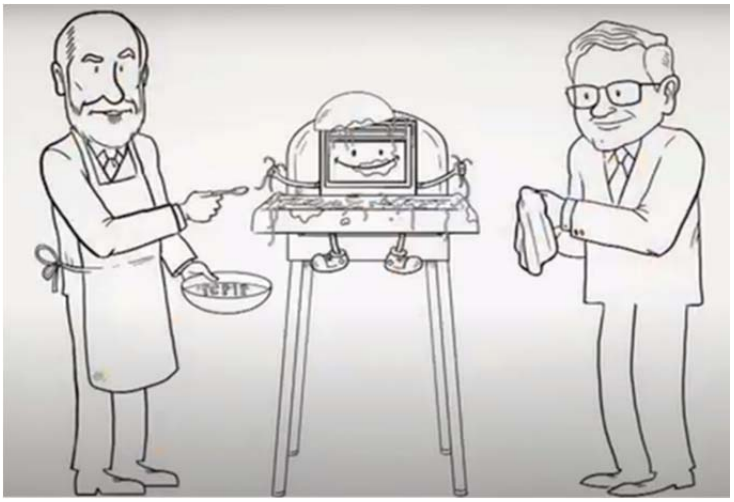


Figure 6.4 – Vint Cerf and Bob Kahn (https://www.youtube.com/watch?v=vd3dH90tdhk)

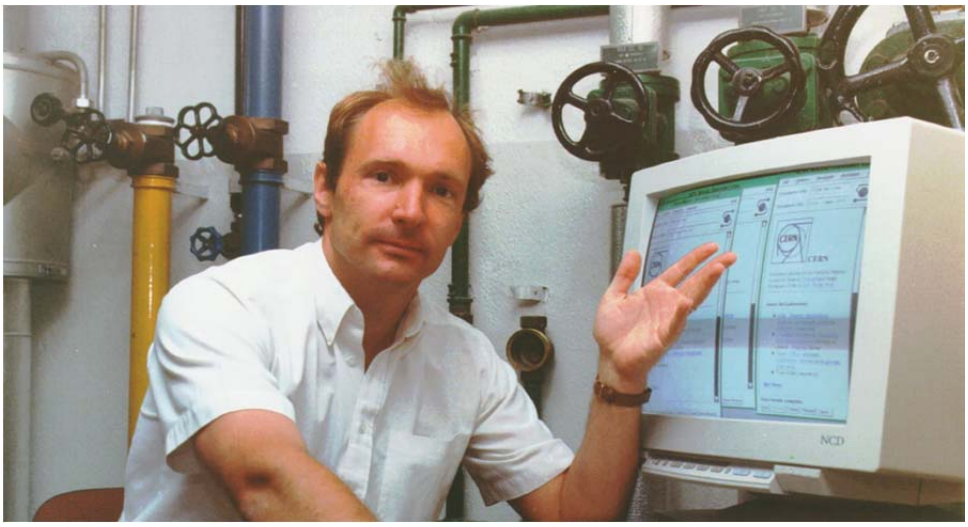


Figure 6.5 – Tim Berners-Lee, the man who created the World Wide Web

1990 – the first dial-up Internet connection;

1991 – NCSA Mosaic, the first Internet browser.

Through these steps, researchers from all over the world got powerful tools to keep in touch and share scientific information. Such tools were unimaginable 75 years ago and have come a long way to being invented and implemented (Figure 6.6).

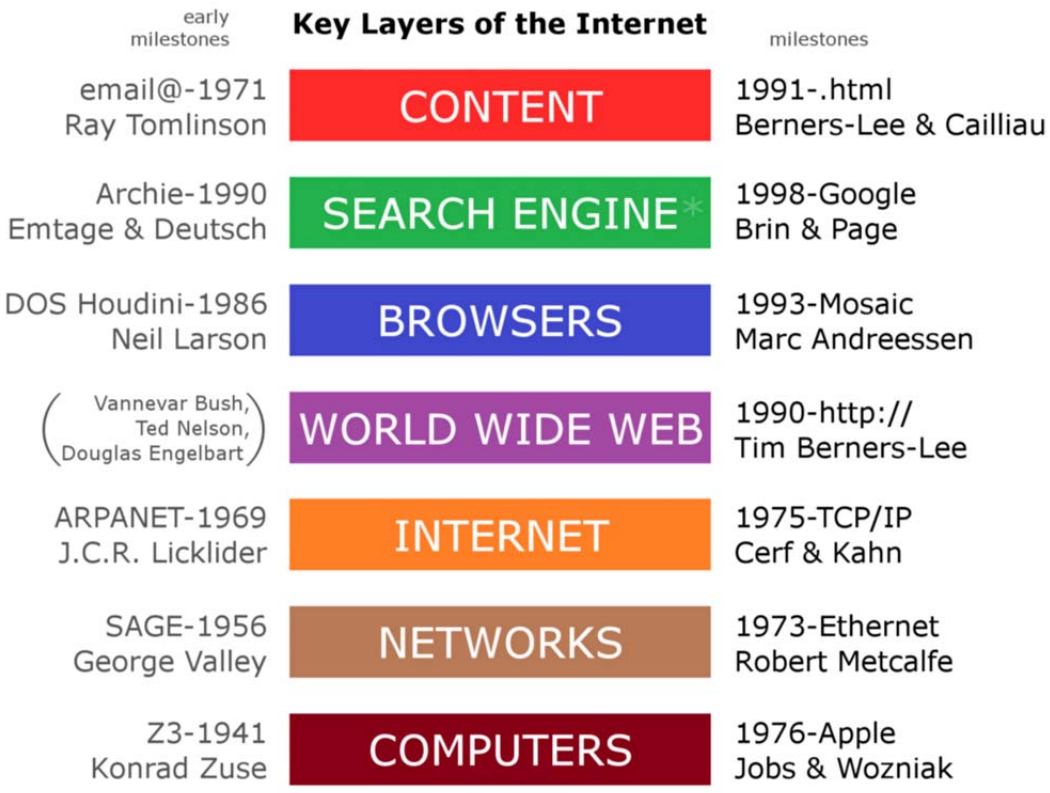


Figure 6.6 – Milestones of Internet Invention

Today the internet services offer scientists and researchers a vast variety of tools to access and exchange a large amount of data such as software, audio clips, video clips, text files, other documents, etc. Some of the commonly used internet services are:

1. Communication Services are intended for data/information exchange among individuals or organizations:

• ***IRC* (*Internet Relay Chat*)** provides possibility for subscribers to communicate in real-time by connecting numerous computers in public spaces called channels.

• ***VoIP* (*Voice over Internet Protocol*)** is a technique for making voice calls via the Internet rather than over a traditional (or analog) phone line.

• ***List Server* (*LISTSERV*)** delivers a group of email recipient's content-specific emails.

• ***E-Mail*** is Used to send electronic mail via the internet.

• ***User Network* (*USENET*)** hosts newsgroups and message boards on certain topics, it is mostly run by volunteers.

• ***Video Conferencing Systems*** allow two or more people who are generally in different locations to connect live and visually. Live video conferencing services are necessary for simulating face-to-face talks over the internet. Tools available for this purpose are Zoom, FreeConference, Google Hangouts, Skype, etc.

2. Information Retrieval Services provide the procedure for gaining access to information/data stored on the Internet. Net surfing or browsing is the process of discovering and obtaining information from the Internet.

• ***www.geeksforgeeks.org*** collects free tutorials, millions of articles, live, online, and classroom courses, frequent coding competitions, industry expert webinars, internships, and job possibilities are all available. A computer-based system for searching and locating data in a file, database, or another source.

• ***www.khanacademy.org*** aims to provide a free personalized learning experience, that are built on the texts and videos, hosted on YouTube. It also includes features such as progress tracking, practice exercises and teaching tools.

3. File Transfer uses the network or internet connection for transferring or shifting a file from one computer to another. Data files include documents, multimedia, pictures, text, and PDFs and they can be shared by uploading or downloading them.

• ***Gopher*** is a file retrieval application based on hierarchical, distributed menus that is simple to use.

• ***FTP (File Transfer Protocol)*** is intended for sharing, transferring or sending a file or logical data item across several users and/or machines, both locally and remotely.

• ***Archie*** is a file and directory information retrieval system that may be linked to FTP.

4. Web Services are software that uses defined messaging protocols and is made accessible for usage by a client or other web-based programs through an application service provider's web server. Web services allow information to be exchanged across web-based applications. Using Utility Computing, web services can be provided.

5. World Wide Web is a vast network of interconnected computers. Using this network, one can connect to the world wide web abbreviated as 'www' or 'web', which is a collection of webpages.

6. Directory Services are a set of software that keeps track of information about a company, customers or both. Network resource names are mapped to network addresses by directory services. A directory service provides users and administrators with full transparent access to printers, servers and other network devices.

• ***DNS* (*Domain Name System*)** stores the mappings of computer hostnames and other types of domain names to IP addresses.

• ***LDAP* (*Lightweight Directory Access Protocol*)** is a set of open protocols that are used for obtaining network access to stored data centrally. It allows users to interact with other directory services servers.

7. Automatic Network Address Configuration assigns a unique IP address to every system in a network. A DHCP (Dynamic Host Configuration Protocol) Server is a network server that is used to assign IP addresses, gateways, and other network information to client devices.

8. Network Management Services are beneficial to network administrators. Network management services aid in the prevention, analysis, diagnosis and resolution of connection problems.

9. Time Services provide facilities included in the operating system; for example, one may set a computer clock via the Internet.

• ***Network Time Protocol* (*NTP*)** is a widely used internet time service that allows to accurately synchronize and adjust computer clock.

• **The Simple Network Time Protocol (*SNTP*)** is a time-keeping protocol that is used to synchronize network hardware. When a full implementation of NTP is not required, then this simplified form of NTP is typically utilized.

10. USENET is a network of online discussion groups. It's one of the first networks where users may upload files to news servers and others can view them.

• ***News Group*** is a live Online Discussion Forum that is easily accessible via Usenet. Each newsgroup contains conversations on a certain topic, as indicated by the newsgroup name. Users can use newsreader software to browse and follow the newsgroups as well as comment on the posts. It uses Network News Transfer Protocol (NNTP).

11. E-commerce is a business concept that allows businesses and individuals to buy and sell goods through the internet. Example: Amazon, Flipkart, etc.

Almost all Internet services are built on the client-server principle. A server is a computer or program capable of providing some network services to clients upon requests. Client programs include:

• ***Browsers*** are programs for viewing Web-servers;

• ***FTP client*** is an application on your computer that connects you to remote servers through FTP and other protocols;

• ***Telnet client*** enables a TCP/IP user to sign on and use applications on a remote system by using a Telnet server application. Telnet allows you to log on to the remote computer and use it as if you were connected directly to it;

• **WAIS *clients*** are available separately for people who only want to retrieve data;

• ***E-mail*** *and* ***mail-clients***.

All services provided by the Internet can be grouped into two categories:

I – the exchange of information between network subscribers;

II – the use of a network databases.

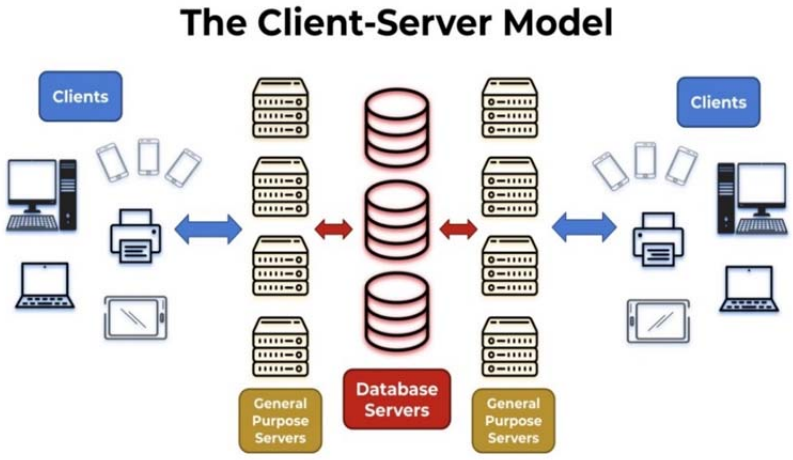


Figure 6.7 – The client-server model
(designed by S. Ingalls, Server Watch)

An operational client-server architecture (Figure 6.7) facilitates the following process:

- the client submits a request through a network-enabled device;
- the network server receives and processes the request;
- the server delivers a response to the client.

Word Wide Web (WWW) is the most popular service of the Internet. It is a hypermedia/hypertext distribution system that stores data on Internet servers, where documents are connected together by links. Hypertext is a term coined by Ted Nelson in 1965 to mean «branching and responding text». Hypertext document contains links to other documents in the form of a network-address of these documents. The standard of hypertext documents allows you to use links to other texts, images, audio and video materials, in other words, to any information that can be represented in electronic form.

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Document</title>
</head>
<body>
    <h1>Interneting Is Easy!</h1>
    <p>First, we need to learn some basic HTML.</p>

    <h2>Headings</h2>
    <p>
        Headings define the outline of your site. There are six levels of headings.
    </p>
</body>
</html>
```

Figure 6.8 – HTML tags and the web page view in the browser



Figure 6.9 – Web page corrisponding to the tags of Figure 6.8

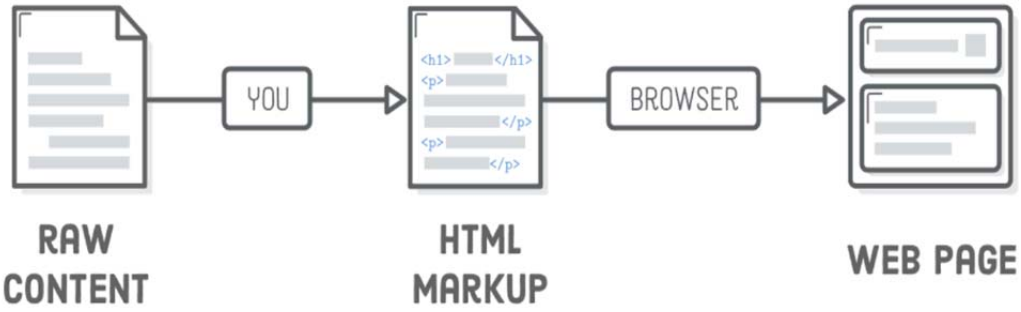


Figure 6.10 – Browser: from HTML tags to web page view

In Internet the hypertext is maintained by Hyper Text Markup Language (HTML) (Figure 6.8). Markup is defined by tags. Tags provide page formatting elements and allow to place headlines, graphics, pictures, hyperlinks, etc. on a webpage (Figure 6.9). For viewing (browsing) web-sites on the Internet the programs which called Browsers are used. Browser reads the code of a webpage and renders it (Figure 6.10).

The Internet services are maintained by the Internet protocols. The most famous of them are:

– ***Hyper Text Transfer Protocol*** (HTTP) is used to transfer Web pages from one computer to another.

– ***File Transfer Protocol*** (FTP) is used to transfer files from a dedicated file server to a user's computer.

– ***Post Office Protocol*** (POP) is used for handling incoming mail.

– ***Simple Mail Transfer Protocol*** (SMTP) is a protocol that defines a set of rules for sending mail. It has three responding ways:

- a receive acknowledgment;
- an error message;
- an additional information request.

– ***Telnet*** is a remote access protocol. It allows subscribers to work on any computer connected to the Internet running programs, changing an operating mode, and so on.

– ***Uniform Resource Identifier*** (URI) is a string of characters that uniquely identify a name or a resource on the internet.

– ***Uniform Resource Locator*** (URL) is a specific type of URI that identifies a resource by its retrieving mechanism.

– ***Uniform Resource Name*** (URN) is a specific type of URI that uses the urn-scheme. URN identifiers are assigned within defined namespaces to be available for a long period of time, even after the resource which they identify ceases to exist or becomes unavailable.

Topic 2: Internet Search Engines

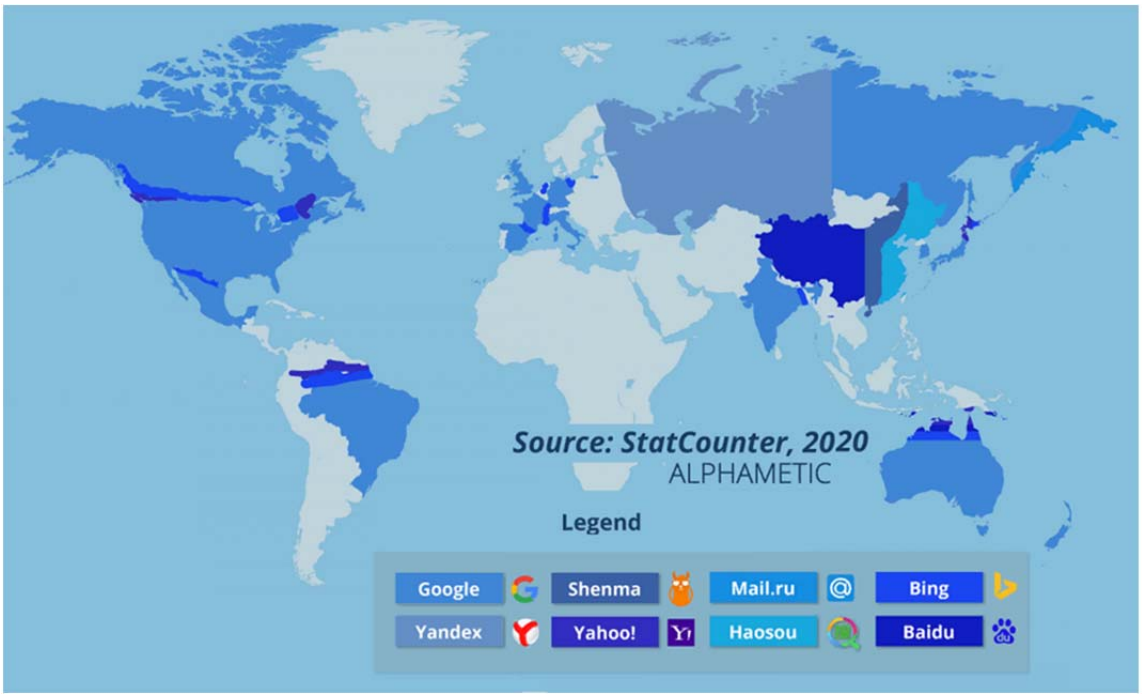
To find the information and websites and to direct the Internet user to required information the Internet systems called ***Internet search engines*** are applied. Internet search engine is a complex of algorithms or suite of algorithms and computer software that provides search and selection of the data requested by researcher in Internet databases according to preset criteria, specifically the key word or phrase. They do not use Human editors to vet sources (as do Library Databases), and are limited to material found on the Open Web.

The search results are generally presented in a line of results, often referred to as search engine results pages (SERPs). The information may be a mix of links to web pages, images, videos, infographics, articles, research papers, and other types of files. Some search engines also mine data available in databases or open directories. Unlike web directories, which are maintained only by human editors, search engines also maintain real-time information by running an algorithm on a web crawler. Internet content that is not capable of being searched by a web search engine is generally described as the deep web.



Figure 6.11 – Internet search engines specialized
in particular types of information

All search engines are similar in a way that they are located on special powerful servers and connected to effective communication channels. However, at the same time Internet search engines are different specialized in particular types of information (Figure 6.11) or developed for certain country, language or geographical region (Figure 6.12).



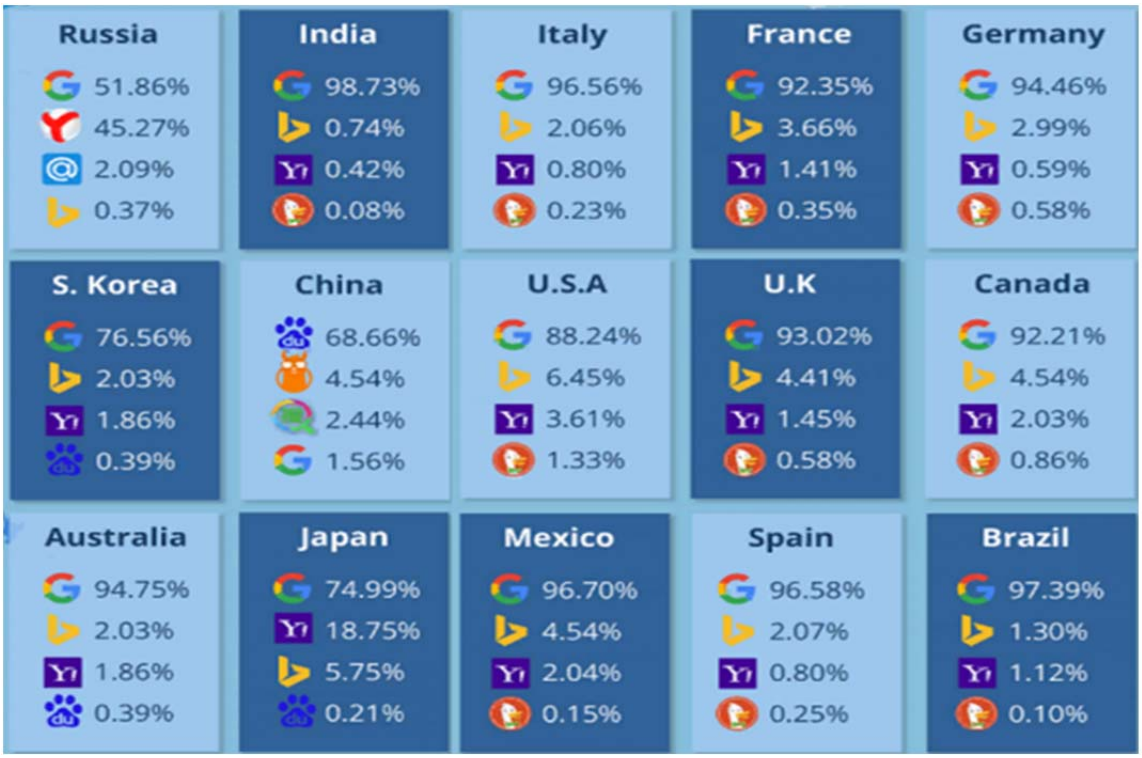


Figure 6.12 – Geographical spread of some Internet search engines

When searching scientific literature in certain language one needs to take into account that using special Internet search engines oriented on the language or geographical region can give more efficient results (Figure 6.12).

A search engine maintains the following processes in near real time:

- Web crawling
- Indexing
- Searching

Web search engines obtain their information by web crawling from site to site. The "spider" checks for the standard filename robots.txt, addressed to it. The robots.txt file contains directives for search spiders, telling it which pages to crawl and which pages not to crawl. After checking for robots.txt and either finding it or not, the spider sends certain information back to be indexed depending on many factors, such as the titles, page content, JavaScript, Cascading Style Sheets (CSS), headings, or its metadata in HTML meta tags. After a certain number of pages crawled, amount of data indexed, or time spent on the website, the spider stops crawling and moves on. No web crawler may actually crawl the entire reachable web. Due to infinite websites, spider traps, spam, and other exigencies of the real web, crawlers instead apply a crawl policy to determine when the crawling of a site should be deemed sufficient. Some websites are crawled exhaustively, while others are crawled only partially (Figure 6.13).

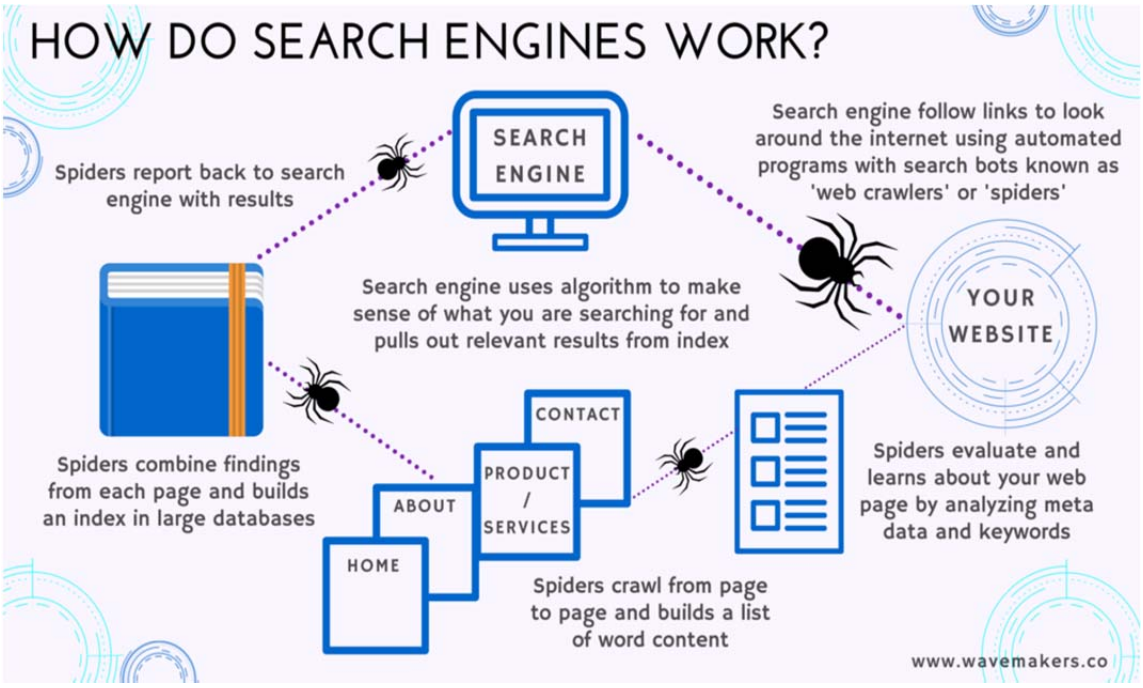


Figure 6.13 – Search engines work

Library Systems

A Library Database is an electronic collection of information, organized to allow users to get that information by searching in various ways. As a rule, Library Database information contains articles from magazines, newspapers, peer-reviewed journals and more; books; images, audio and video; radio interview transcripts; general reference information such as encyclopedia.

Research databases are organized for managing collections of digital information or data such as journal articles, books, images and multimedia that can be searched to retrieve information. They can be general or subject oriented with bibliographic citations, abstracts, and/or full text.

A Search engine and a Library system have the following differences:

Table Search engine vs Library systems

	Search engine	**Library systems**
Authority	A Search engine searches the open Web giving information from numerous sources as from expert so as from amateurs.	A Library contains curated collections of materials, which reflect information quality better.
Access	Searching only the open Web, Search engines cover the broad range of information, but Web Crawlers are excluded from indexing proprietary, Deep Web sources.	Library databases have deep level of searching material, which is accessible by payment or subscription.
Best to use	Web Search engines are better for less expert, but more up-to-date materials, which reflect current practices.	Library databases are best to use for looking special, peer-reviewed, scholarly information.
		Search by author, topic year

Topic 3: Basic Approaches to Searching Scientific Information

Information is knowledge about a particular subject, issue, event or process. Information can be obtained from various sources. It is important to differentiate between various types of information for choosing the right one for

scientific work. Consider Table 6.1 and 6.2 paying attention to Scholarly and Non-scholarly information classification as well as Primary and Secondary one.

Table 6.1 – Scholarly Information vs. Non-scholarly Information

	Scholarly	**Non-scholarly**
Creating points	Scholarly sources have been created as a result of a rigorous research process and then reviewed by other scholars before they are published.	Non-scholarly sources written or created for an audience outside the academic community such as the general public.
Useful for	– university assignments; – academic or other kinds of research.	– general knowledge; – everyday purposes; – as data for analysis.
Sources	– peer-reviewed journal articles; – scholarly books; – academic conference papers; – published research data sets; – academic book reviews.	– news; – general websites and blogs; – Social Media posts; – fiction books; – popular non-fiction books; – government documents and publications.

Table 6.2 – Primary Information vs. Secondary Information

	Primary	**Secondary**
Creating points	These are sources where the author has witnessed first-hand the events they are writing about.	These are sources where the author is reporting on something that someone else saw and has written about.
Useful for	– scientific, historical or social research; – data analysis.	– understanding how people interpreted the event; – understanding the different issues that are relevant in the study of the event.
Sources	– research reports; – personal journals, letters, etc.; – public speeches; – audio / video recordings; – photographs / artworks; – literary works, novels, plays; – artefacts; – statistical record.	– journal articles; – academic books such as – history books, textbooks, etc.; encyclopaedias.

Boolean Search Operators

Most databases use similar search syntax and ***Boolean operators***: AND, OR, NOT (Figure 6.14).

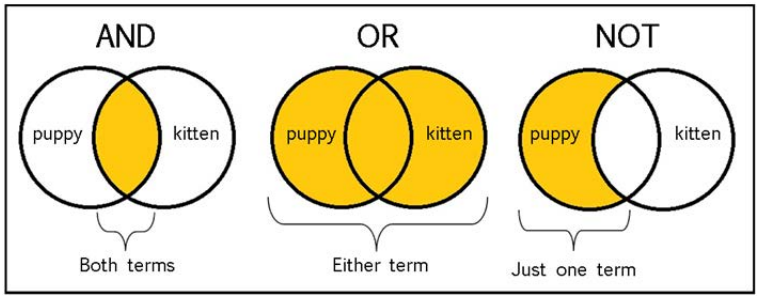


Figure 6.14 – Boolean operators

Let us consider the example of using Boolean operators for constructing the search query for the following task.

Outline the career of a musical group from the "British Invasion" in relation to music style, using seminal recordings and other historical information.

The first steps before to start the search are to identify the key phrases and make the search words constriction:

1) key phrases

musical group | *"British Invasion"* | *music style*

2) search words constriction

I		II		III
Musical group	**AND**	*"British Invasion"*	**AND**	*Music* **AND** *Style*
OR		**OR**		**OR**
Musician		1960-1970		Genre
OR				**OR**
(*Rock* **OR** *Pop*) **AND** *Group*				Composition

However, different Search engines offer different options, and may use different symbols for the same functions. For example, Google Search engine uses the symbols represented in the Table 6.3 for making the search more precise.

Table 6.3 – Search Query Symbols and Shortcuts for Google search engine

Search Query Symbols	
– Dash or Minus	Minus symbol is used to remove specific words from Google search results. **(*Keyword to search*) - (*Keyword to exclude*)** When the words are connected with dash symbols as a phrase, Google will consider it as normal search query and ignore considering it as a dash symbol as such. ***Examples*** Search query «**news -site:cnn.com**» will exclude CNN from the search results and show all other relevant results. Search query «**LG -tv**» will show the results of all LG products except TVs. Search query «**free ebooks -site:ebay.com**» searches for the free ebook sites excluding ebay.com. Searching «**do-it-yourself scientist»** will not restrict any words in the results.
+ Plus	Plus symbol is used to search Google+ pages. For example, searching for «**+bguki**» will return the Google+ pages, website and all other social profiles belongs to this site.
_Underscore	Underscore is used to connect two words. Having search «**get start**» Google will return related pages having either “get start” as it is or connected as “getstart” without the underscore.
” ” Double Quotes	Double quotes are used to force Google searching the exact words or phrase mentioned within the quotes. Example. «**“fox and crane”**» will results all pages containing this phrase. Google also uses synonyms of the words within the quotes as “fox and stork”.
(..) Range	It is used as a range operator to find all relevant results within the specified range. For example, «1990..2022».
~ Tilde	The tilde symbol informs Google to search similar keywords with the same synonyms. For example, «**”Math ~tutorial”**» also display results for the synonyms like Math guide, Math manual etc.
$ Dollar	Dollar symbol in Google search is used for searching products with the price in $.

	Example. Search «LG $1000» will give all products from LG with the having price tag of $1000.
@	The @ symbol is used to find relevant social tags mainly from Twitter and other social platforms having usernames starting with @.
# Hashtag	Hashtag is mainly used by social media sites to group together all relevant posts containing a particular word prefixed by #.
Search Shortcuts	
define: <keyword> «**define: tech savvy**» will show you the definition of the keyword tech savvy.	
keyword filetype:document extension Searching «**Linux introduction filetype:ppt**» will results only PowerPoint presentations including keywords “Linux introduction”. In the same way, one can search for the docx, doc, xls, xlsx, pdf and other file types.	
site:yoursite.com The search query “webmasters site:webnots.com” will show results with the keyword “webmasters” from the site “webnots.com”.	
related: search operator This will show all related pages matching the site in your search query. For example, the search query «**related:cnn.com**» will show all other news sites similar to CNN.	

Evaluating information

Once search results are obtained, the researcher must evaluate their relevance to the study. The following five steps are disable for checking the quality of information.

Currency: The timeliness of the information

- When was the information published or posted?
- Has it been revised or updated?
- Are the links functional?

Relevance: ***The importance of the information for a topic under research***

- Does the information directly relate to a topic under research?
- Does it help to solve the research problems?

- Who is the intended audience of this information (scientists, amateurs)?
- Are there other sources to find the best one?

Authority: ***The source of the information***

- Who is the author or publisher?
- Are they qualified to write about the topic? “Peer reviewed” is a good indicator for this
- Is there any contact information, such as a publisher or email address?
- If it’s a website, does the URL say anything about the source? (.com .gov .edu .org?)

Accuracy: ***The reliability and correctness of the information***

- Is the information supported by evidence?
- Can the information be verified with another source?
- Has the information been reviewed or refereed?
- Does the language seem unbiased and free of emotion?
- Are there any spelling, grammar or typographical errors?

Purpose: The reason the information exists

- What is the purpose of the information?
- Does the point of view appear objective and impartial?
- Is the information fact, opinion or propaganda?
- Are there political, ideological, cultural, religious, institutional or personal biases?

Conclusions

In the modern world, searching for information on the Internet has become one of the most favorite activities of a person. However, a large amount of information data requires a critical analysis of the information received, especially in the scientific field, where expert assessments are most important. Thus, acquiring the skills to work with electronic search engines and library resources becomes one of the most important goals of the researcher.

Key concepts: Database, Web Search Engine, Electronic Library, Search Query Symbols and operators.

PRACTICE

Task 1. Database and Web Search Engine

Library Database or Web Search Engine?

I.

_____ introduce you to good quality friends at a small party, _____ allow you to speak to anyone off the street. This does not mean you cannot find good quality friends off the street, but you're more likely to find good conversation at a party!

II.

_____ would be best to find news on a political party, but for discussion of their political theories, a _____ would be better.

Task 2. Information search approaches

1. What best describes a Library database?
   - ☐ Contains scholarly and peer-reviewed articles.
   - ☐ Organised collections of digital information or data.
   - ☐ Can be subject-specific or general.
   - ☐ All of these options.

2. What are the elements of a question you need to consider when analyzing your topic for making a query?
   - ☐ Content words, strong or weak words.
   - ☐ Analysis words, focus limiting words.
   - ☐ Content words, focus or limiting words.
   - ☐ Analysis words, policy words, focus or limiting words.

3. What is the best way to find a government document or report?
   - ☐ A library database.
   - ☐ A search engine i.e. Google.
   - ☐ All of these options.

Task 3. Information relevance

1. What is meant by credible information?
   - ☐ Evidence-based, relevant, and recent
   - ☐ Evidence-based, lengthy, and contemporary
   - ☐ Evidence-based, easy to download, and extant
   - ☐ Recent, lengthy, and extant

2. You are required to use primary sources of information for your research. Which of the following can you use? You can choose more than one.
   - ☐ Scientific research report
   - ☐ Journal article
   - ☐ Public speech
   - ☐ Encyclopaedia

3. Select the answer which best defines "credible information" for academic assignments or researches.

- ☐ Evidence-based (includes citations or references).
- ☐ Peer-reviewed (written and checked by experts in the field).
- ☐ Free from bias.
- ☐ All of these options.

Task 4. Fake information

1. Fake news is information that is:

- ☐ Used to manipulate people by passing incorrect information as real.
- ☐ Based on facts.
- ☐ Based on current events.
- ☐ Used to make people upset.

2. You see an image that you want to use in your assignment but you're not sure if it has been photoshopped. What can you do?

- ☐ Check the references.
- ☐ Check the date.
- ☐ Do a Google reverse image search.
- ☐ Look at the author.

3. Why is fake news dangerous?

- ☐ It uses emotions instead of facts.
- ☐ It combines facts will feelings.
- ☐ It is appealing and catches our attention.
- ☐ All these options.

4. How can you spot fake news? You can choose more than one answer.

- ☐ Look at the spelling and grammar.
- ☐ Ask the experts.
- ☐ Check your own beliefs and biases.
- ☐ Click on the links and see if the information actually supports the story.

COMPUTER TRANING

Task 1

Assess the relevance of the research topic by analysing the Internet documents.

Using the resources for searching scientific publications presented in Table 6.4 fulfil the form of Table 6.5 for quantitative documentary analysis dealt with the preliminary research topic defined preliminary in ***UNIT 1, INDIVIDUAL TRAINIG*** part.

Table 6.4 – Recourses for searching scientific publications

BOOKS AND PAPERS	
SPRINGER	https://link.springer.com/
SCIENCEDIRECT	https://www.sciencedirect.com
JSTOR	https://www.jstor.org/
RESEARCHGATE	https://www.researchgate.net/about
ACADEMIA	https://www.academia.edu/
PAPERITY	https://paperity.org/
JURN	http://www.jurn.org/#gsc.tab=0
GOOGLE SCHOLAR	https://scholar.google.com/
DISSERTATIONS	
DART-EUROPE	https://www.dart-europe.org/basic-search.php
HAL	https://www.dart-europe.org/basic-search.php
OATD (Open Access Theses and Dissertations)	https://oatd.org/
NDLTD	https://ndltd.org
REFERENCES	
SCOPUS	https://www.scopus.com/
WEB OF SIENCE	http://webofknowledge.com/
WORLDCAT	https://www.worldcat.org/

- Assess the relevance of the preliminary research topic by analysing the results obtained in the filled-in form of the Table 6.5.
- Answer the question: Is it possible to assess the relevance of the research topic relying only on quantitative analysis.
- Make changes in research topic defined preliminary, improving it according to the conclusions of the quantitative analysis and the analysis of

the content of the Internet documents obtained in ***UNIT 1, INDIVIDUAL TRAINIG*** part.

Table 6.5 – Form for quantitative documentary analysis

	published during the period of last five years		published during the period of last 5 and 20 years ago		published during the period more than 20 years ago	
	in free access	in paid editions	in free access	in paid editions	in free access	in paid editions
Number of units related to the research topic expressly	Books__ Papers_ Total__	Books__ Papers_ Total__	Books__ Papers_ Total__	Books__ Papers_ Total__	Books__ Papers_ Total__	Books__ Papers_ Total__
	Totally Books__ Papers__ Total__		Totally Books__ Papers__ Total__		Totally Books__ Papers__ Total__	
Number of units related to the research topic implicitly	Books__ Papers__ Total__	Books__ Papers__ Total__	Books__ Papers_ _ Total__	Books__ Papers_ _ Total__	Books__ Papers_ _ Total__	Books__ Papers_ _ Total__
	Totally Books__ Papers__ Total__		Totally Books__ Papers__ Total__		Totally Books__ Papers__ Total__	
Dissertations						
Diploma works						

INDIVIDUAL TRAINIG

• Find some recent information on your ***Individual topic*** in Internet**.** Evaluate it following the points enlisted on the page 168.

UNIT 7. CLOUD SERVICES FOR INNOVATIVE ACTIVITIES IN THE FIELD OF ART AND CULTURE

Main issues

1. Cloud computing
2. Claude services
3. Network services based on cloud technologies

2. Services for innovative activities in the field of art and culture.

Aim: To get acquainted with cloud technologies and network services basing on them for innovative activities in the field of art and culture.

Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations.

Cloud Computing

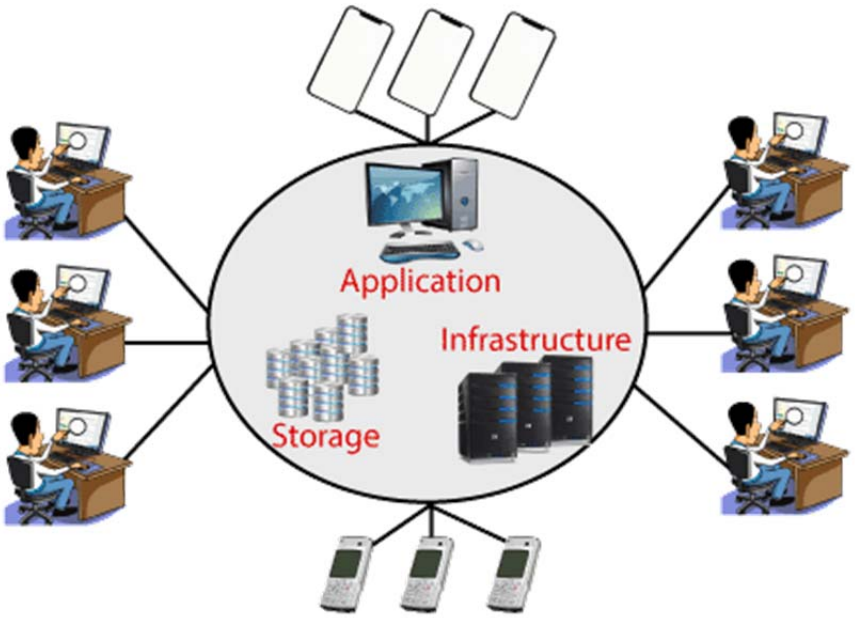


Figure 7.1 – Cloud computing conception

Cloud Computing is the delivery of computing services such as servers, storage, databases, networking, software, analytics, intelligence, and more, over the Cloud (Internet) (Figure 7.1). The cloud environment provides an easily accessible online portal that makes handy for the user to manage the compute, storage, network, and application resources (Figure 7.2). For example, Dropbox, Google Drive, OneDriveare used to store and share information (text, images, audio, etc.)

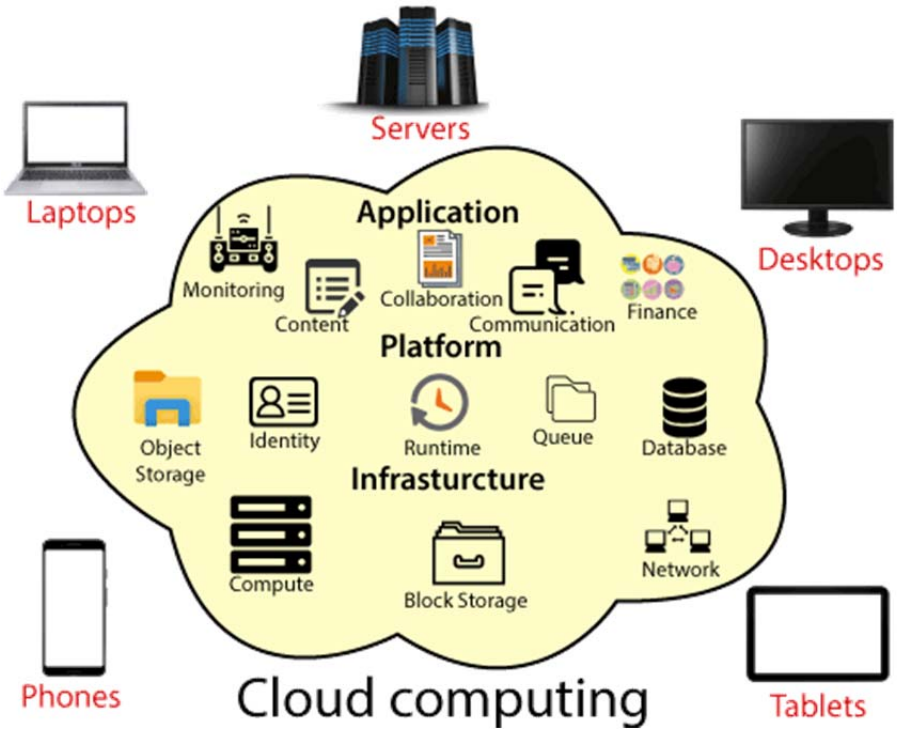


Figure 7.2 – Cloud environment

Cloud computing services have three main types (Figure 7.3):

- Software as a service (SaaS)
- Platform as a service (PaaS)
- Infrastructure as a service (IaaS)

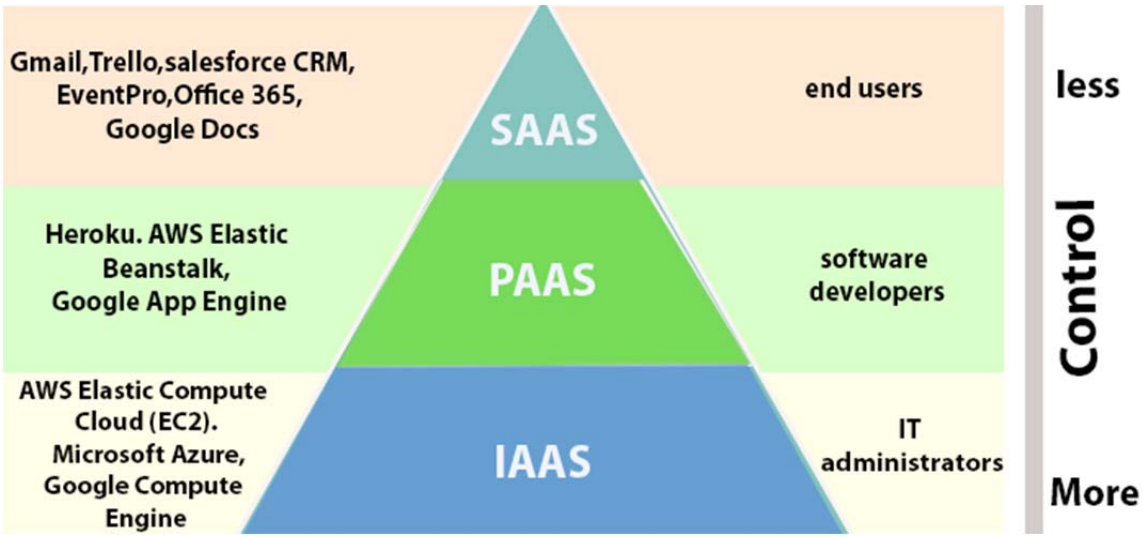


Figure 7.3 – Cloud computing services

Software as a Service (SaaS) is a way of delivering services and applications over the Internet. It removes the need to install and run applications on private computers and let user to access application via the Internet.

Platform as a Service **(**PaaS) is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet. PaaS services are hosted in the cloud and accessed by users simply via their web browser.

A PaaS provider hosts the hardware and software on its own infrastructure. As a result, PaaS frees users from having to install in-house hardware and software to develop or run a new application. Thus, the development and deployment of the application take place independent of the hardware. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment (Figure 7.4)

Infrastructure as a service (IaaS) is a service model that delivers computer infrastructure on an outsourced basis to support various operations. Typically, IaaS is a service where infrastructure is provided as outsourcing to enterprises such as networking equipment, devices, database, and web servers. It is also known as Hardware as a Service (HaaS). It simply provides the underlying operating systems, security, networking, and servers for developing such applications and services, and deploying development tools, databases, etc (Figure 7.4)

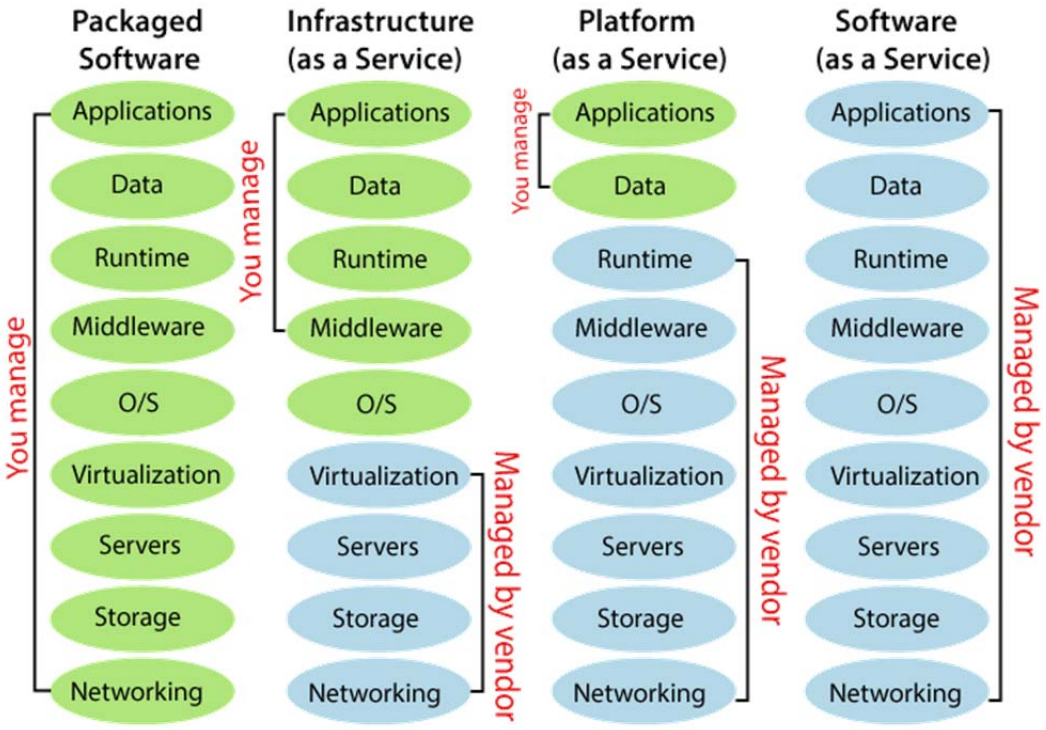


Figure 7.4 – Cloud computing services user control

Today the activity of world museums is impossible without cloud computing services. The main trend of the contemporary museums is to stare the heritage in s digital form and grant an access to their digital collections. Museum digital asset management system ensures the storage, access, delivery, and preservation of the museum digital media, and provide integration with other systems in the digital ecosystem. One of the most famous examples of performing museum collections is Google Art & Culture. To grant an access to the painting in such great resolutions as Google Art & Culture does the storage and calculating resources are required. Therefore, the Google cloud technologies ensure the functioning of the project.

Google Claude services

Google Arts & Culture provides free access to high-resolution images of works of art and information about them. It's a place where people can study the intellectual and cultural heritage of humanity. The user's curiosity becomes the guide. Thanks to the search, you can find a specific museum, exhibition or exhibit. Everything is provided with stories about the historical past. Individual masterpieces are signed with miniature descriptions of distinctive elements. The physical exhibits are complemented by historical events, presenting them in the context of the realities and characters of that time. The project is not just an online gallery, but also a set of useful tools that allow users to dive into the collection of each museum in detail, sort works of art by type, period of creation, author's name and other criteria.

On the Google Arts & Culture platform there is a variety of educational interactive games about art and history, with which users will be able to test their knowledge in the field of art, get acquainted with the culture of different countries, solve puzzles, and also engage in creativity (Figure 7.5).

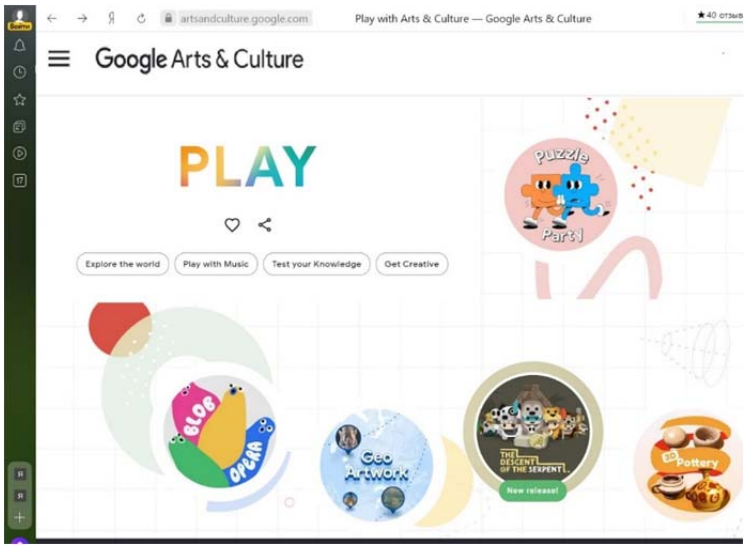


Figure 7.5 – Google Arts & Culture games

Google Docs, the most known document collaboration platform, provide collaborative work with documents on the Web, that is jointly and simultaneously create, view and edit text, tables and multimedia documents with the display of all changes in real time. It is very useful for organizing independent collective project activities.

Google Books is a service that searches the full text of books and magazines that Google has scanned, converted to text using optical character recognition, and stored in its digital database. Books are provided either by publishers and authors through the Google Books Partner Program, or by Google's library partners through the Library Project.

Google Sites is a structured wiki and web page creation tool. The application allows users to create and edit files online while collaborating with other users in real-time.

Video and audio broadcasting cloud services. It is convenient to organize consultations, seminars, group projects in the form of web conferences. In addition to the ability to see and hear the conference participants, there is a possibility to organize collaborative work with the various types of materials. There are plenty of services in Internet based on cloud technologies performing different options for broad casting, for example, YouTube, Cisco WebEx, GoToMeeting, Zoom etc. Today video conferences can be held using messengers such as Viber, Telegram.

Social media repository. Such services are used to share images and videos making own galleries, showcasing and discovering creative works, for example, Behance, Pinterest, Instagram.

Services for graphic and media design. As a rule, these are cross-platform services, which allow creating images, presentations, videos on the base of professional templates by dragging and dropping ready-made elements and changing ready samples. One of the most popular free graphic editor is ***Canva***, having a built-in template library, access to stock objects such as illustrations, photos, fonts. It allows creating presentations, logos, images for publication on the Internet, and layouts for printing products. Canva also allows to process video files: to put subtitles, trim and crop. The Canva tools allows making scientific and business presentations with infographics and multimedia material.

Services for creating information resources such as blogs and sites. The most famous of them are Wix, Sites.Google, Tilda, LiveJournal, Blogger, Wordpress, etc. Blog is the simplest Internet website to be created. The user regularly adds its main content: text, images and multimedia. Blogs

allow publishing visitor reviews and comments. This makes blog a network communication environment.

Routes drawing and organization of virtual excursions. As the rule ***to organize virtual excursions*** such map tools as WikiMapia, Google Maps, etc. are used. Related skillset includes finding and marking locations on a map and provide photographs, comment to them.

Network cloud services are developing rapidly. The services proposed above are ones that can be successfully used in culture and art activities.

***Conclusions*:** Cloud services can be used to organize professional or research activities in the sphere of culture and art. They allow to work in collaborative groups, to search and store information, create and use media materials, edit and use maps and diagrams; organize collective work on projects, etc.

***Key concepts*:**

Innovative activities, cloud technologies, cloud computing

PRACTICE

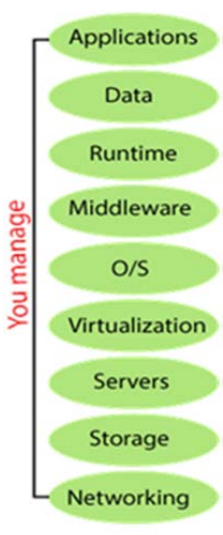
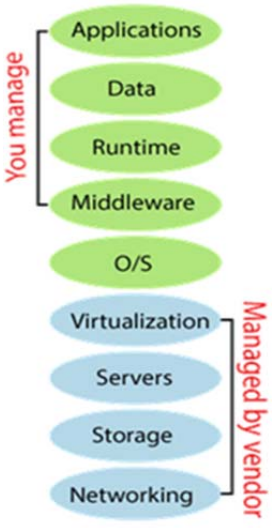
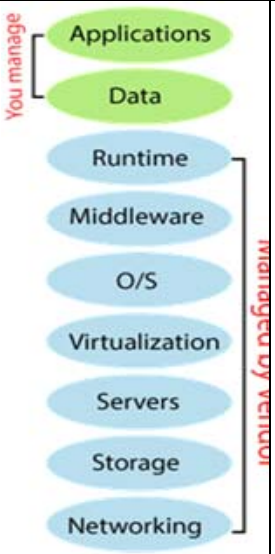
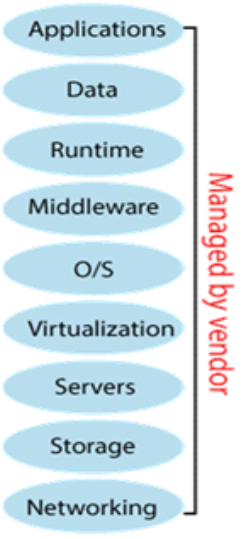
Task 1. Cloud computing services

- Put the cloud computing service or computer software

Platform as a Service (PaaS)
Infrastructure as a Service (IaaS)
Package Software (PS)
Software as a Service (SaaS)

on the proper place in the Table according to management rights of the user.

Table. Claude computing services management

	IaaS		
			

Task 2. Advantages and disadvantages of Cloud computing services

• Give 4 advantages and 4 disadvantages of cloud computing services.

Advantages of cloud computing services:

1._____

2._____

3._____

4_____

Disadvantages of cloud computing services

1._____

2._____

3._____

4_____

Task 3. Claude software service or package software

• The following software

Adobe Photoshop Canva Photopia MOVAVI
CorelDraw Adobe Illustrator Gravit Designer LerningApps

should be properly distributed in the Table

Table. Claude software service or package software

Claude software service	**Package software**
LearningApps	

TALKING POINTS

• Compare Claude services and Package software: 1) discussing Claude services and Package software advantages and disadvantages; 2) defining the prospective of Claude services and Package software development; 3) sharing with interlocutors your preferences of Claude services and Package software use.

• Discuss what is the best use of cloud technologies in the culture and art sphere. Substantiate your reasoning by examples.

COMPUTER TRAINING

Traning 1. Create an invitation for your colleagues and friends to attend your speech or performance

Canva is a graphic design platform, used to create social media graphics, presentations, posters, documents and other visual content. The app already includes templates for users to use. The platform is free to use and offers paid subscriptions like Canva Pro and Canva for Enterprise for additional functionality. Users can also pay for physical products to be printed and shipped**.**

EXAMPLE

Load https://www.canva.com/ and create a personal account. Choose a template (for example, **Instagram Posts)** (Figure 7.6).

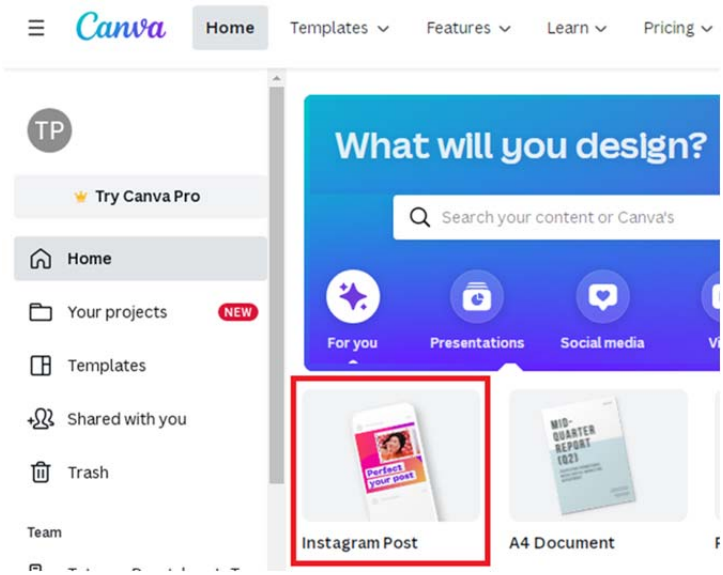


Figure 7.6 – Create a design

Search Pictures on the topic to be announced (for example, MUSIC) and select template (Figure 7.7).

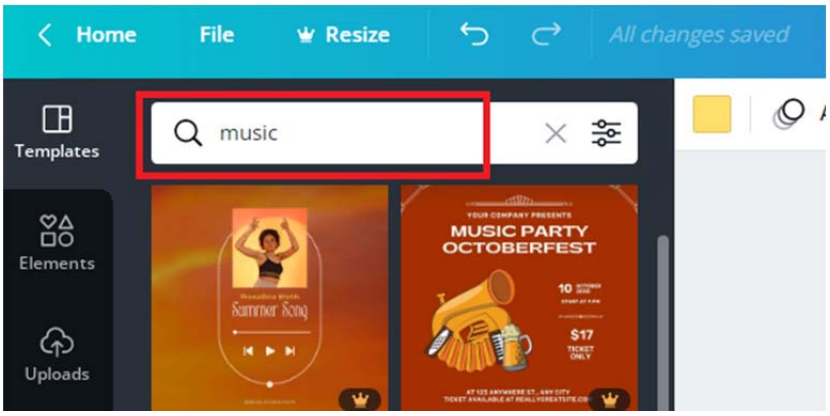


Figure 7.7 – Templates of Music

Choose Text box and create an invitation title “Dear colleagues!” (Figure 7.8). Add Text box with the text “I would like to invite you to attend my presentation!” and Change the text parameters (Figure 7.9).

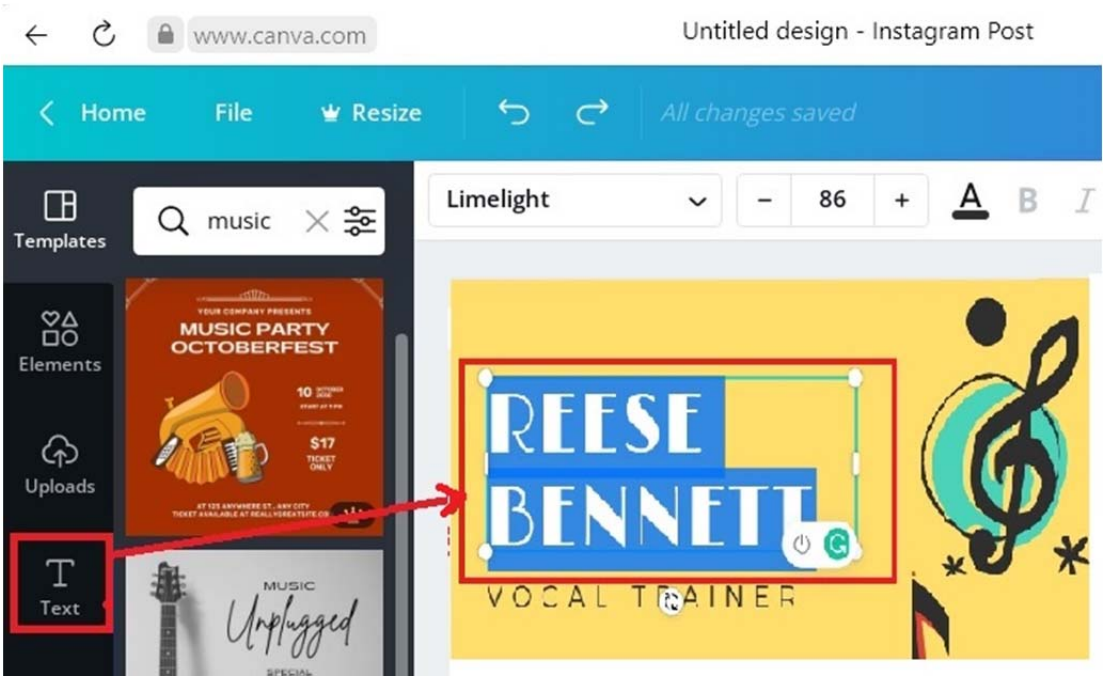


Figure 7.8 – Changing the text

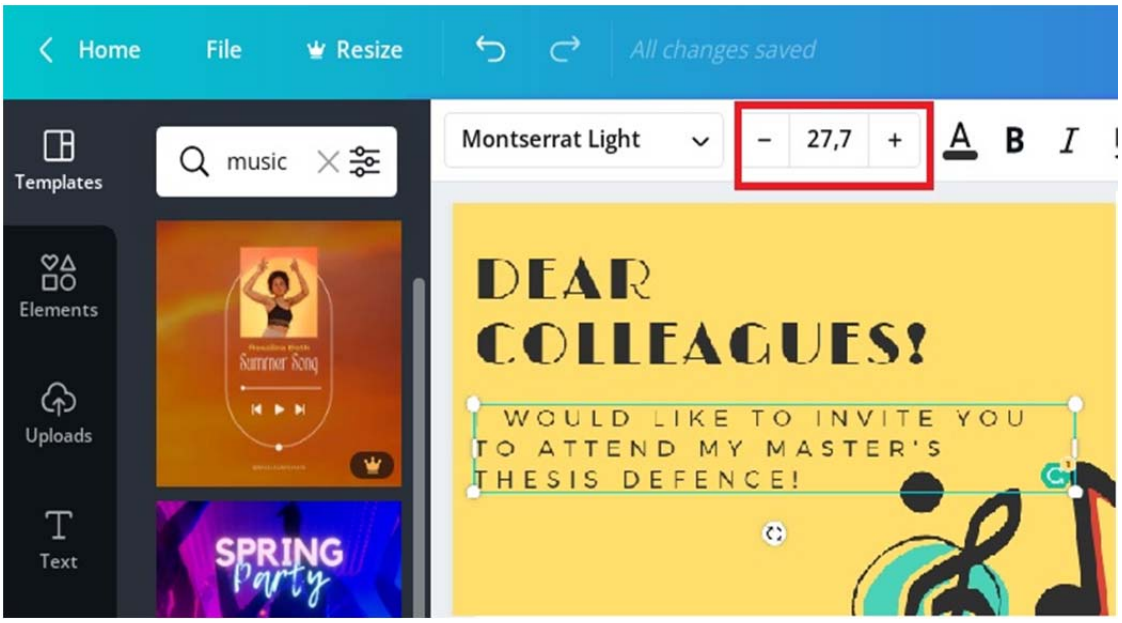


Figure 7.9 – Change the text parameters

Choose your photo and upload it (Figure 7.10).

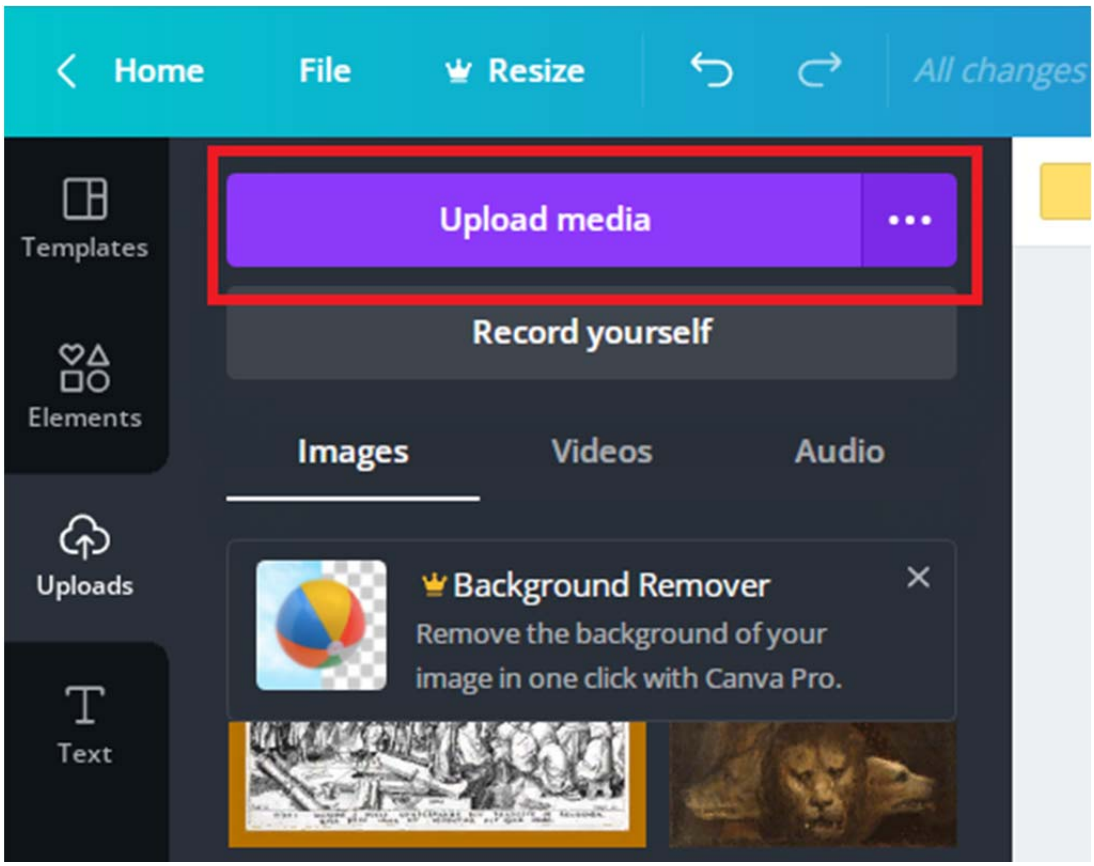


Figure 7.10 – Upload media

Choose **Elements – Graphics** and select shape (Figure 7.11). Choose Uploads, click on your photo and place your photo on the shape (Figure 7.12). Choose **Edit image** add to your photo some effects (Figure 7.13).

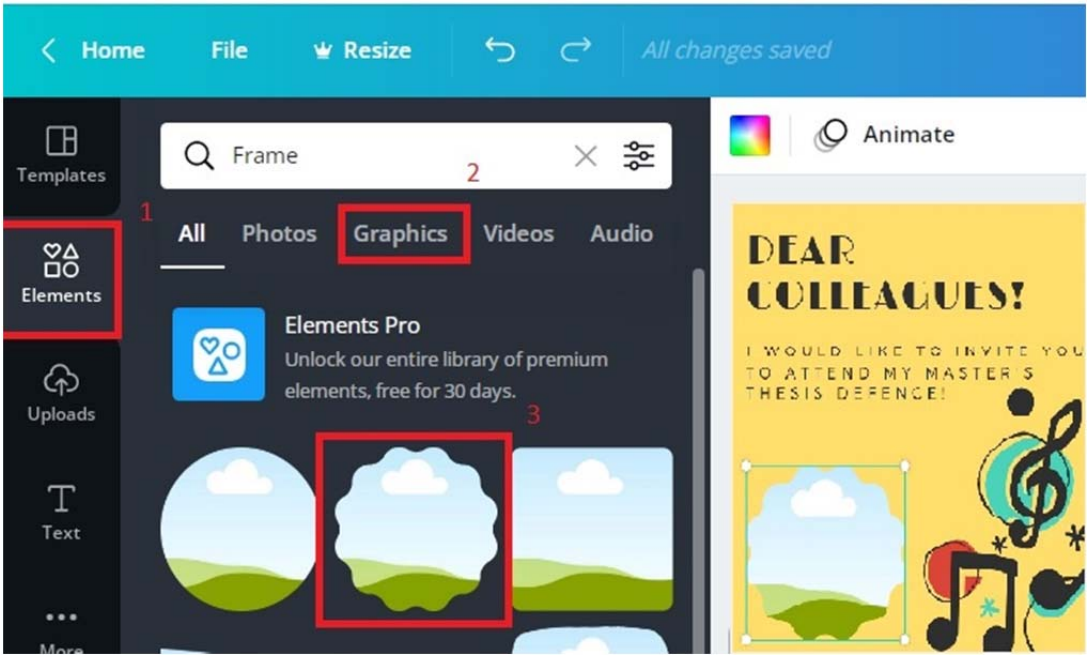


Figure 7.11 – Elements of Canva

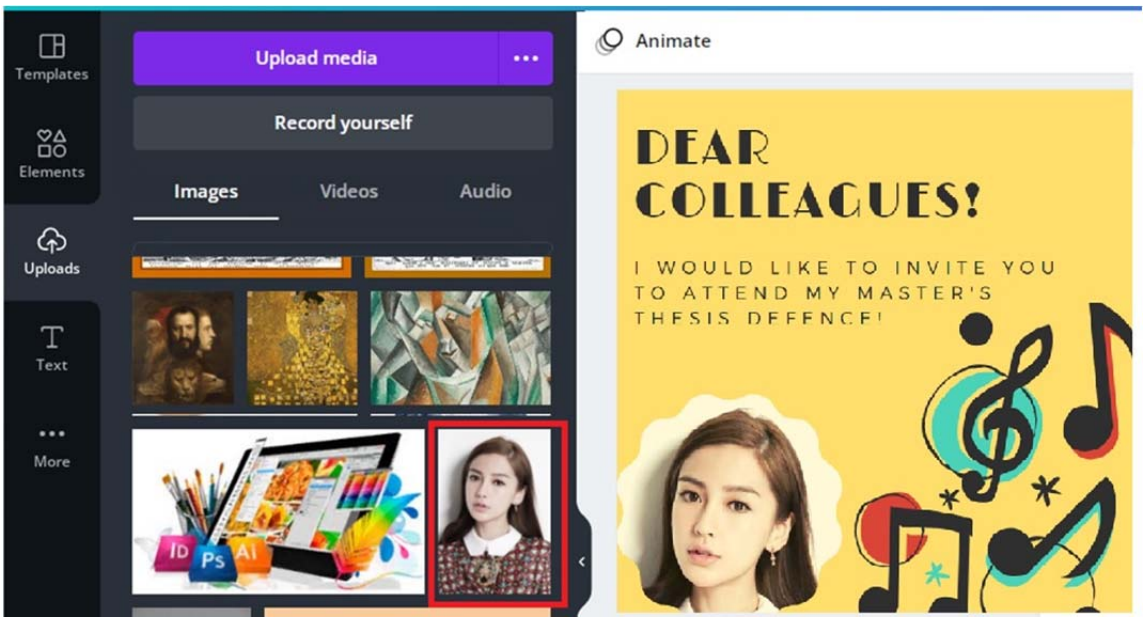


Figure 7.12 – Past photo

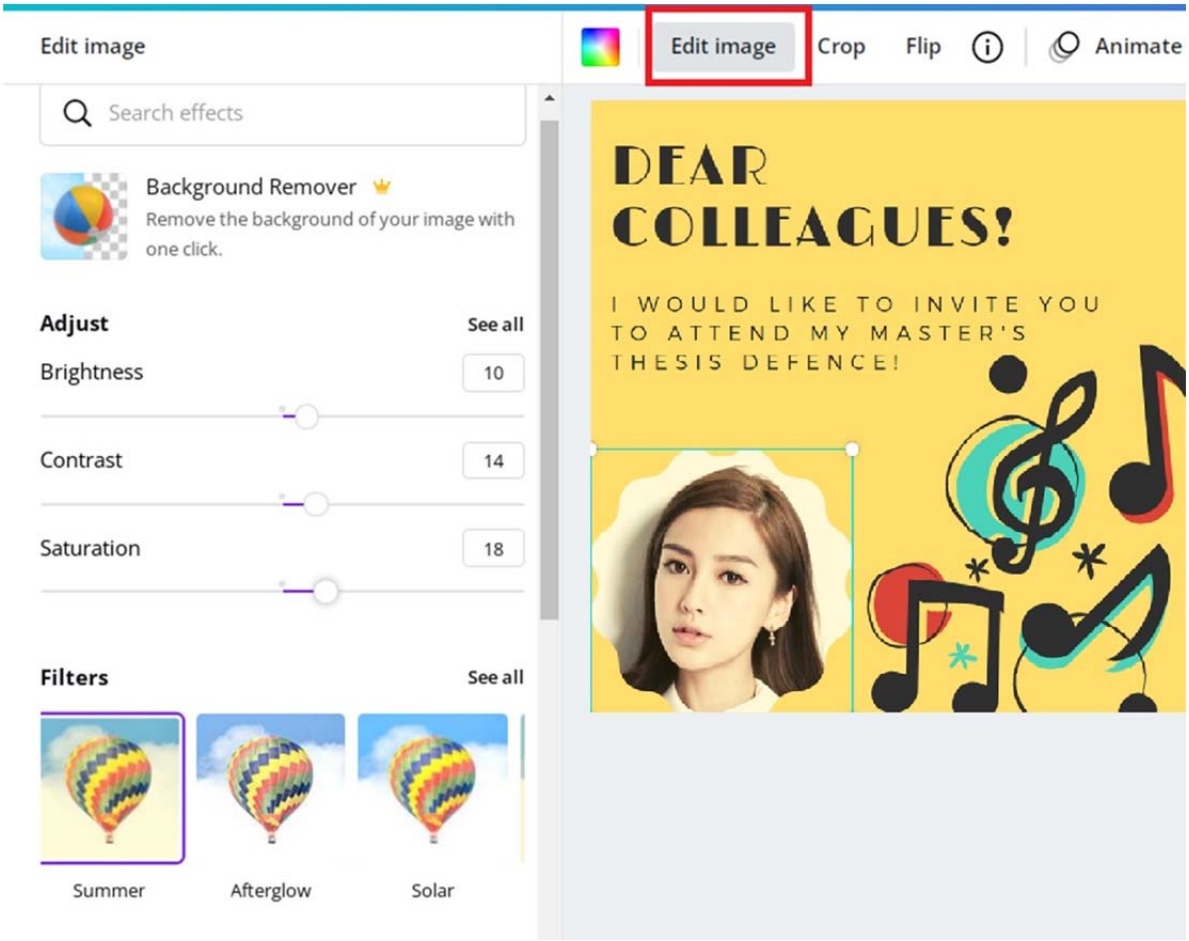


Figure 7.13 – Edit image

Add Text box with time of presentation (Figure 7.14). Select the image blocks and swap it (Figure 7.14).



Figure 7.14 – Changes in the position of the blocks

Try other instruments.

Save the final **INVITATION** in jpg (pdf, gif, png) file, for example, INVITATION_ **Lucy Liu**.jpg (Figure 7.15).

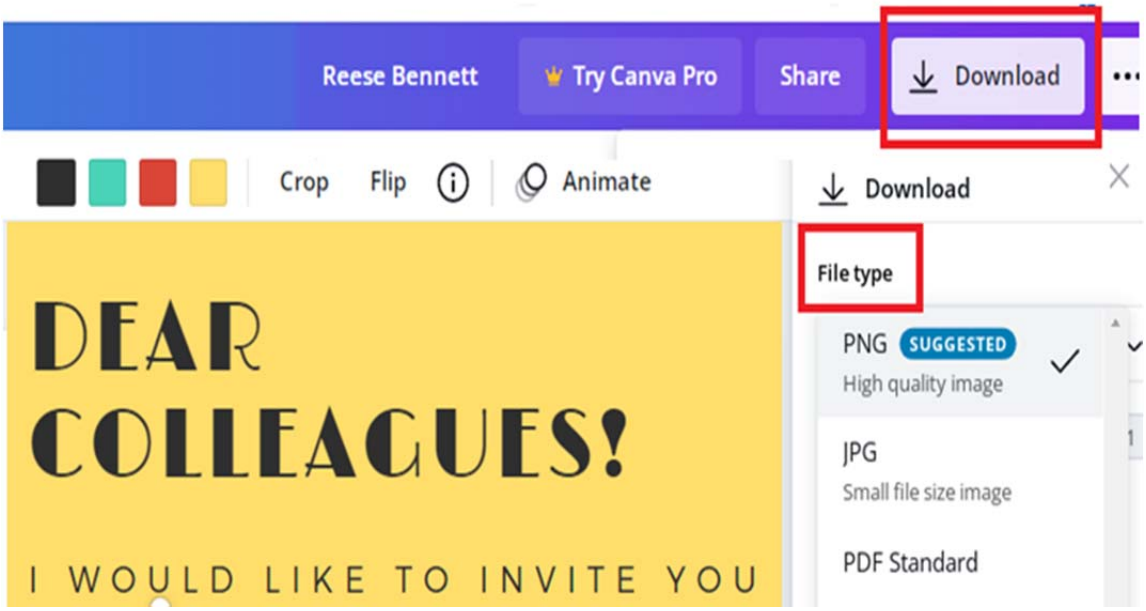


Figure 7.15 – Save the final Invitation

Traning 2: Creating games with learning apps

- Create Pair game with lerningApps

Prepare the game material with pictures and the painters. As an example, we propose to use Khan Academy materials.

Go to educational site Khan Academy and choose Art History course (Figure 7.16).

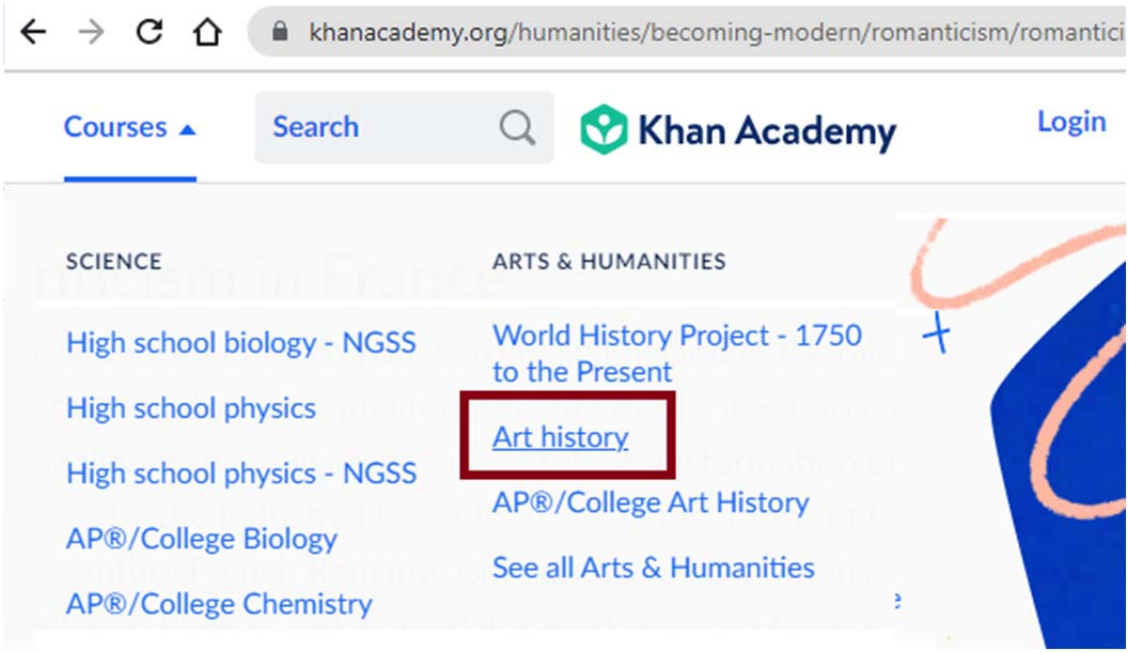


Figure 7.16 – Khan Academy: Art History course

Take Unit Europe 1800-1900 - Romanticism – Romantism in France (Figure 7.17)

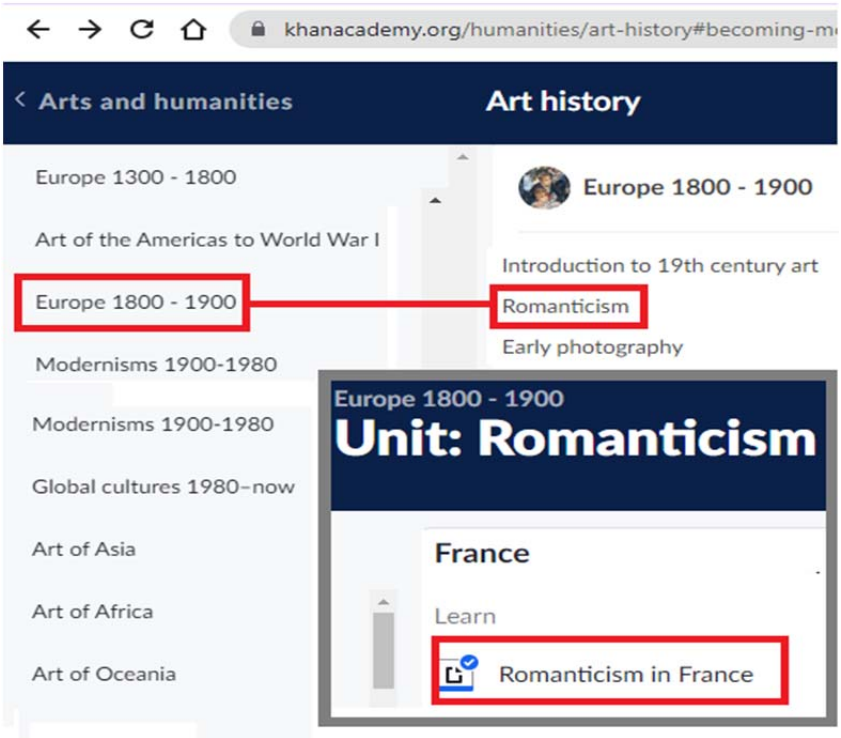


Figure 7.17 – Art History course: Romanticism

Save 7 pictures with names of the painter and picture (Figure) on the computer (Figure 7.18–7.19)

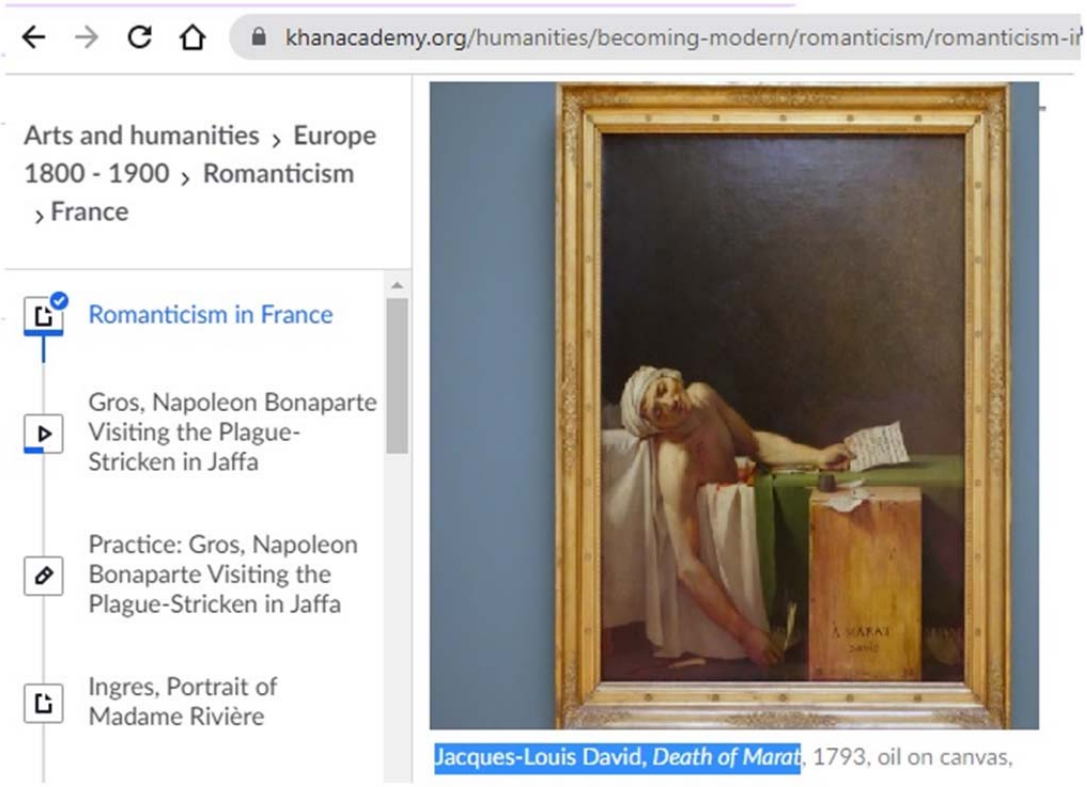


Figure 7.18 – Saving pictures: copy the names of the painter and author



Figure 7.19 – Saving pictures:
put the names of the painter and painting in the file caption

On this point the preparation part is finished.

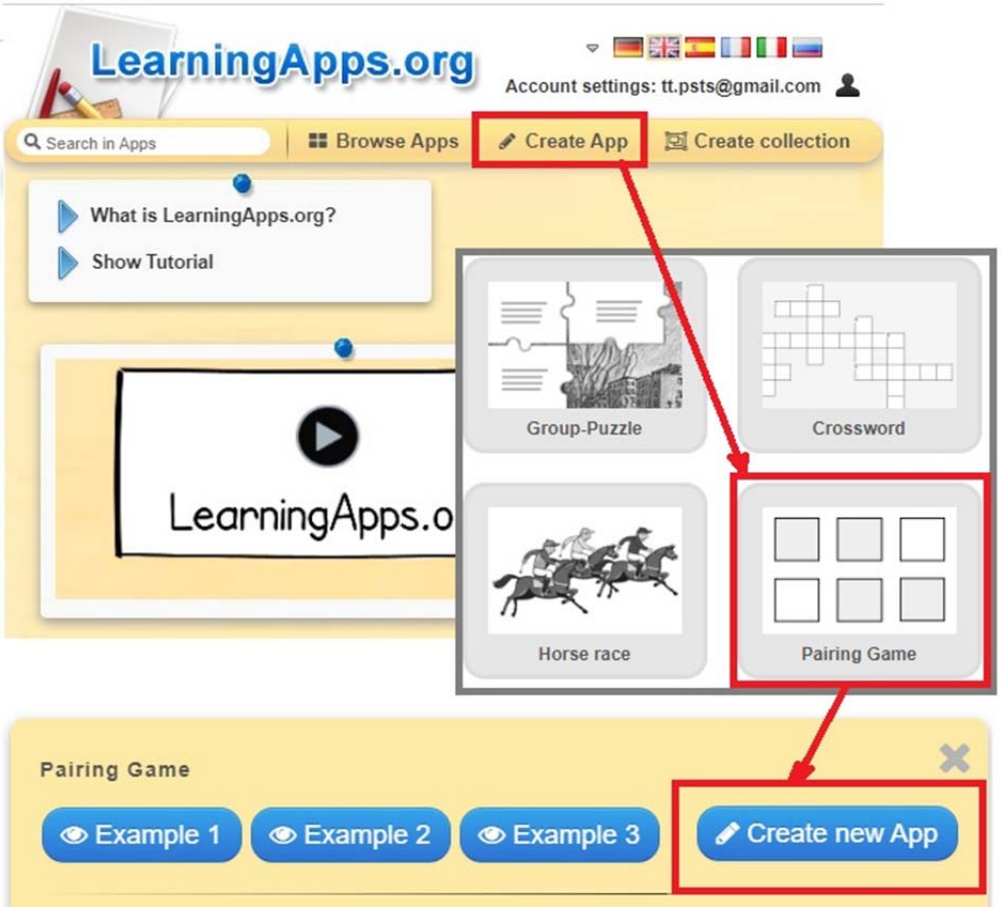


Figure 7.20 – LearningApps: Create new Application

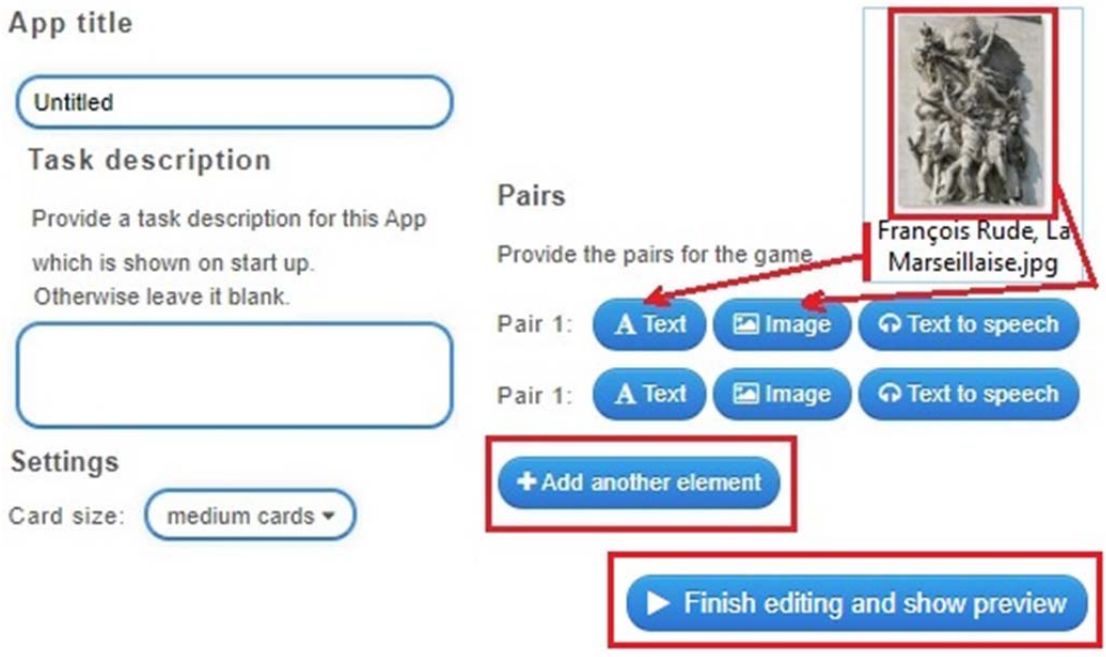


Figure 7.21 – LearningApps: Creating the game

Go to learningapps.org and choose CREATE APPLICATION option. Then find and click Pairing Games option. Explore the examples proposed here paling one or two games.

Then click on Create new Application (Figure 7.20) and fill the form fields. Attach to the Image field the picture saved before and in the text field put the name of the picture and its painter. Then click on Add another element and attach other pictures (Figure 7.21).

Press the ***Finish editing and show preview***. Try the game and then create qr code to acsess the game (Figure 7.21).

INDIVIDUAL TRANING

- Plan to report your ***Individual topic*** via Zoom.
- Make a poster to announce your presentation for sotial media in Canva.
- Create interactive activity game for your presentation in LearningApps.

UNIT 8. INFORMATION TECHNOLOGIES IN CONDUCTING SCIENTIFIC RESEARCHES ON ART AND CULTURE

Main issues

1. Heuristic function of digital research methods
2. Application of statistical analysis software
3. Intelligence maps.

Aim: to define the heuristic function of digital research methods and study information technologies means for research scientific researches in art and culture.

The heuristic function of digital research methods in humanities is mainly focused on finding patterns, dynamics and relationships in data analysis. Researches in art and culture sphere should not try to discover rigid laws, but study patterns and build mathematical models to analyse and predict these patterns. Thus, informational methods in art history include:

– large data analysis;
– digital modelling and visualization of processes and phenomena;
– statistical forecasting of art and culture processes;
– systematization and classification of data using information database systems.

One of the significant problems to use digital research methods in art and culture field is formalization of the research sphere content in data structures and application of algorithms and ways to analyse data make a proper interpretation of obtained results. The universality and objectivity of mathematical theory lead to the mechanization of cognition and its reduction to a predefined set of rules. However, in the analysis of art and culture objects, objectivity and universalism can only lead to distortions of the obtained data. For example, quantitative analysis is more easily perceived as “evidence”, while rhetoric and cultural differences remain at the “argumentation” level.

The comparative method is effectively used when objects (at least two) are studied simultaneously and the comparison with the aim of detecting similarities and differences becomes the main method of analysis. In this case the number of objects studied is small (two or three), and each of them is

studied comprehensively. For the comparing the use of spreadsheets is recommended to systemize the information.

It is necessary to find the most convenient form of presentation data for analysis. The main technique to do this is schematization. A scheme always simplifies real relationships, coarsens the true picture. Therefore, schematization of relations is the compression of information. But it also presupposes the search of a visual and easily visible form of presenting the information. For this purpose, the data can be summarized in tables or charts.

A table's convenience is in the inclusion of both quantitative and qualitative data. The purpose of a table is a quick data evaluation. Usually, a row corresponds to a case, and columns represent its various aspects (features).

A diagram is another technique for concise visual presentation of information. There are different types of diagrams. In structural diagrams, elements are depicted with conventional shapes (rectangles or ovals), and the links between them are represented by lines or arrows, that identify the logical structure of events or text. In this case, a semantic analysis is first carried out and nodal events or components are outlined, and then they are presented in a graphical form so that the connection between them becomes as clear as possible.

Methods of quantitative analysis are usually divided into two groups. First, statistical description methods are used to quantify the data obtained in a specific study. Second, statistical inference methods are used to extend the results obtained in a particular study to the entire phenomenon as such, to draw general conclusions. Statistical methods, in general, are used to identify stable patterns and design theories to explain them.

Statistical inference is the process of hypothesis testing. Initially, it is always assumed that the observed differences are random, that is, the sample belongs to the same general population. In statistics, this assumption is called the null hypothesis.

Methods for finding out texts authorship (attribution) are the base of software systems for determining the author's style. When solving the problem of determining the texts authorship, the analysis of the syntactic, lexico-phraseological and stylistic levels of the text is of the greatest interest and the greatest complexity. Expert analysis of the author's style is a labor-intensive process; therefore, the work focuses on the formal methods of identifying the author of the text. At present, for text attribution, approaches from the theory of pattern recognition, mathematical statistics and probability theory, algorithms of neural networks, cluster analysis, etc. are used. Among the problems that complicate research in the field of attribution, one can single out

the problem of choosing linguo-stylistic parameters of the text and compiling a sample of reference texts. It is necessary to conduct further research aimed at finding new or improving existing methods of attributing texts, searching for characteristics that make it possible to clearly distinguish between the styles of authors, including in short texts and in small sample sizes.

Statistical analysis software

Microsoft Excel is a program designed to work with spreadsheets.

SPSS Statistics (Statistical Package for the Social Sciences) is a computer program for statistical data processing, one of the market leaders in the field of commercial statistical applications intended for applied research in the social sciences. Its capabilities include:

– data entry and storage;

– use of different variable types;

– frequency distribution of features, tables, graphs, contingency tables, diagrams;

– primary descriptive statistics;

– marketing research;

– analysis of marketing research data.

STATISTICA is a comprehensive statistical analysis package developed by StatSoft. The STATISTICA package implements procedures for data analysis, data management, data mining and data visualization. It includes many statistical analysis methods (more than 250 built-in functions) that are combined in specialized statistical modules.

STATA – professional statistical software package. It is the most popular among the US educational and scientific institutions along with SPSS.

STATGRAPHICS PLUS is a powerful statistics program. Contains over 250 statistical functions, generates clear and customizable report functions.

The use of cloud technologies for planing scientific research makes it possible to expand the possibilities of preparing the schedule, communications, cooperation, by considering the individual characteristics of the researcher. Ability to cooperate also improving the planning and management of the research as a whole.

In art and culture research, the services for creating intelligence maps can be successfully used. The programs Draw.io, Simple Mind, Mindmeister, Story Map JS are good instruments to create intelligence maps. Mental maps, associative maps, intelligence maps, a mind maps are a tools for systematization of information in visual form according to the methodology

of Tony Buzen, author of books and consultant on intelligence and psychology of learning.

Timeline services are usfull for study the history of culture and art. Such servicies as Sutori and Tiki-Toki allow to organize information in chronological order. Events are plotted on the timeline in chronological order in the form of not only text but also images, video and sound. In addition, a fragment of text or an image can be designed as a hyperlink to a third-party resource on the Internet, in which the event is disclosed in more detail. Geoservices are of interest, with the help of which one can organize a geographical scheme for the reseach if it is needed.

Conclusions

Today we are faced with the phenomenon of the formation of new methods of culture and art studies using digital technologies and algorithms. These methods require an interdisciplinary approach in the study of visual art and culture and the analysis of large arrays of data in the field of culture and art. Thus, we can say that the problematic field of application of new information methods in the academic tradition of understanding culture and art is being updated.

Key concepts: digital research methods, methods of statistics in culture and art sphere, intelligence maps, Timeline services

PRACTICE

Task 1. Informational methods in art history

• List informational methods in art history:

1._____

2._____

3._____

4._____

Task 2. Problems of digital research methods use in art and culture field

• Fill in the missing words.

One of the significant problems to use digital research methods in art and culture field is _____ of the research sphere content in data structures and application of _____ and ways to analyze data make a proper _____ of obtained results. The universalism and objectivity of mathematical theory lead to the _____ of the process of knowledge and its reduction to

a set of rules. However, in the analysis of art and culture objects, objectivity and universalism can only lead to _____ of the obtained data. For example, quantitative analysis is more easily perceived as «_____», while rhetoric and cultural differences remain at the «_____» level.

TALKING POINTS

- Discuss the advantages and digadvantages of digital research methods use in art and culture field.
- Remind or find in internet examples of statistical method use in difrent spheres of culture and art reseach. For example, methods of finding out texts authorship.
- Consider whether we should believe the computer's conclusions about the authorship of a text, a music or a painting.
- Computer algorithms for determining the art work authorship are not perfect today. More advanced algorithms may in the future prove the fallacy of the original authorship hypotheses. Won't suspicions on authorship deceit, based on the findings of the computer, be devastating to the author career and life?

COMPUTER TRAINING

Traning 1: Making survey and processing the survey results

Take a picture from Google Art&Culture Galary.

Designe survey questions for making reseach on emotional influence of the picture on an obsever.

Question 1: Use the folowing shceme to create a question.



Question 2: Choose on the picture 4–5 of the most emotionally significant objects by your opinion. Make a question which of them make the most strong emotional influence on the observer.

Question 3: If in your city the exibition of this artist take place will you visit it?

3.1 For free

1. Shurely yes
2. More likely yes
3. Most likely no
4. Absolutely not

3.2 For ten dollars

1. Shurely yes
2. More likely yes
3. Most likely no
4. Absolutely not

Question 4:

If you were given this painting, would you hang it:

1) in the most visible place to look often?
2) somewhere the glimps will only sometimes fall, but you can show it to your friends?
3) in hidden place becouse the picture is valuable, but from emotional point it dosnt worth to be visible?

You may add your questions to survey.

Create a survey form in Google Forms and send it to your frends. Make suvrvey asking no less then 20 people.

Analyze the answers using Google Forms Statistical Tools.

INDIVIDUAL TRANING

- Create a survey in Google Forms to collect the feedback from listners on your presentation. Analyze the results with Google Statistics.
- Make conclusions what points you can improve next time.

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APPENDIX 1
INDIVIDUAL TRAINING

Individual training is aimed to deep knowledge of the educational material by systematization, planning and control of their own activities.

Prepare a multimedia interactive presentation on one of the following topics

1. 3D modeling in art	adv: _____ da: _____
2. Digital technologies in animation	adv: _____ da: _____
3. 2D animation art	adv: _____ da: _____
4. 3D animation art	adv: _____ da: _____
5. Motion capture technologies in movie	adv: _____ da: _____
6. Computer-generated imagery in movie	adv: _____ da: _____
7. 3D mapping art	adv: _____ da: _____
8. Art of digital holograms	adv: _____ da: _____
9. Holograms in theatre	adv: _____ da: _____
10. Holograms in dance art	adv: _____ da: _____
11. 3D printing in art and design	adv: _____ da: _____
12. 3D Computer Graphics Art	adv: _____ da: _____
13. Mixed Media and Hybrid Painting	adv: _____ da: _____
14. Augmented reality for architecture	adv: _____ da: _____
15. Augmented reality in visual art	adv: _____ da: _____
16. Artificial intelligence in art	adv: _____ da: _____

17. Virtual reality for art exhibitions
adv: _____
da: _____

18. Digital sculpture
adv: _____
da: _____

19. Digital painting
adv: _____
da: _____

20. 2D Digital Painting
adv: _____
da: _____

21. 3D Digital Painting
adv: _____
da: _____

22. Digital Photography
adv: _____
da: _____

23. Phenomenon of Vocaloid
adv: _____
da: _____

24. Virtual reality in art
adv: _____
da: _____

25. Virtual reality in Movie
adv: _____
da: _____

26. Virtual reality painting
adv: _____
da: _____

27. The Art of video games
adv: _____
da: _____

28. Robots in music art
adv: _____
da: _____

29. Fractal art
adv: _____
da: _____

30. Fractal music
adv: _____
da: _____

31. ANSI art
adv: _____
da: _____

32. Pixel Art
adv: _____
da: _____

33. Digital Collage
adv: _____
da: _____

34. Drones in art show
adv: _____
da: _____

35. Digital photo art
adv: _____
da: _____

APPENDIX 2
RECOMMENDATIONS FOR POWER POINT PRESENTATION

PowerPoint computer program is recommended to prepare multimedia presentation on Individual work topic.

PowerPoint allows to create and show slides to support a presentation. One can combine text, graphics and multi-media content to create professional presentations. PowerPoint can improve the clarity of the presentations and help to illustrate message of the speaker and engage an audience. Presentation need to be carefully planned and structured in order to achieve its objectives.

As **a presentation tool** PowerPoint can be used to:

- organise and structure presentation;
- create a professional and consistent format;
- provide an illustrative backdrop for the content of presentation;
- animate slides to give them greater visual impact.

1. Designing PowerPoint slides using colour

- Ensure that all slides have the same or similar background images and colour schemes. PowerPoint's design templates can be used for this.
- Prepare slides that use a bold colour contrast, e.g. black or deep blue text on a cream background (black and white can be too glaring for the audience).
- Avoid using red or green for text or highlighting as it can be difficult to read.

2. Designing PowerPoint slides Using text

- Avoid using too much text (slides should have no more than six bullet points and each bullet point should be no more than six words long).
- Create bullet points which are clear summaries of key points. It is not necessary for bullet points to be complete sentences.
- Too many variations in font size and type can be visually confusing.
- Ensure that text is at least **24pt otherwise** it may be difficult to read on screen.
- Choose left align for all text to make it easier to read.

- Avoid multiple columns of text on a single slide as they can be difficult to follow on screen.
- Use bold for a clear and simple form of emphasis and headings rather than UPPER CASE, italics or underlining.
- Set clear hierarchies for type size to help your audience distinguish between headings, main text and other types of text.

3. Making the most of graphics

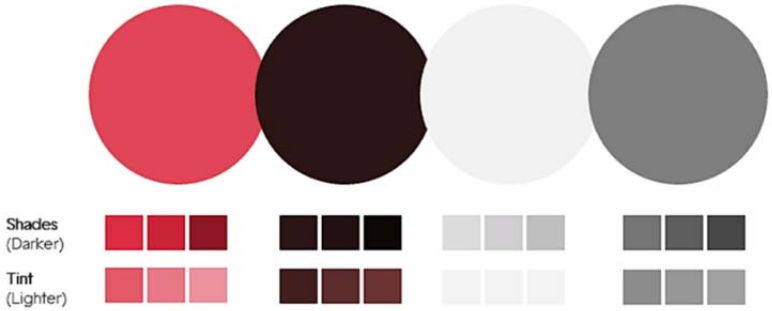
- Make sure graphics are relevant to your text and not just decorative.
- Consider using graphics to replace text where you think an image would be easier to understand.

4. Use harmonious colour palettes for your slide designs

Colour Palette #1- Powerfully Memorable (Red and Grey)

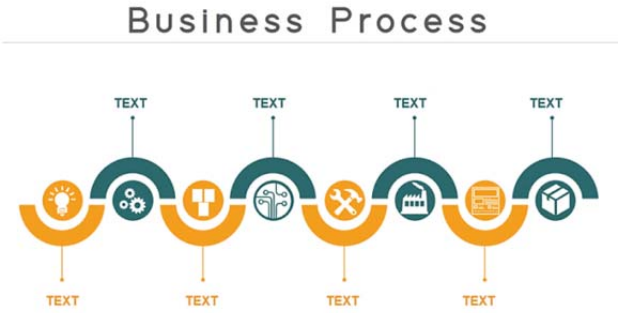
This colour palette comprises basically 2 colours: red and grey and shades of them. This high contrast colour scheme is applicable to all types of presentations, especially where you need to pitch your products or services.

Red adds energy to the content and the slide, while grey grounds the slide, makes it look professional and lets red be the centre of attraction.



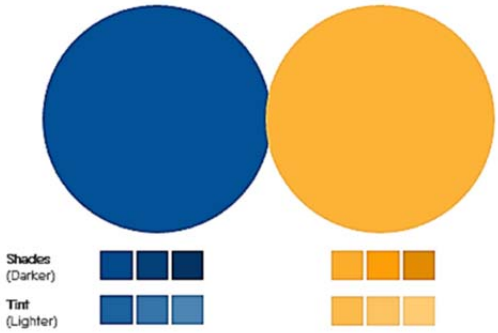
Colour Palette #2 – Vibrant and Young (Plum, Orange, Teal & Grey)

If you feel combining these colours is creating a colour riot, just choose any 2 contrasting colours from this palette and make your slides.



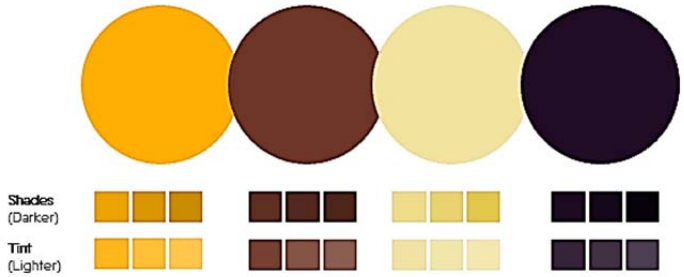
Colour Palette #3 – Opposite Attraction (Blue & Yellow)

One that represents summer and the other winter. Yellow and blue. A warm and cool colour in one single slide gives you the perfect balance- the youthful energy and the professional touch.



Colour Palette #4 – Down to Earth vs. Royal
(Brown & Gold vs. Dark Purple)

Earth tone colour schemes include combination of browns and tans. The soil, clay, dirt and rocks give us neutral colours that can be used to give a down-to-earth look to our presentation. Here's such a scheme that contains all the neutral colours except one- dark purple that is a colour of royalty.



5. Making the most of animations

- Animating elements of slides and using Slide Transition are two of the most powerful features that PowerPoint offers.
- It is very easy to overdo your use of these features and create a presentation where the animation distracts your audience from the content of your presentation.
- Use animations to show progression. Animation is very effective at revealing a process one stage at a time.
- Be conservative. Make sure that any animation you use serves a clear purpose (e.g. to introduce a new piece of information at an appropriate point). If you cannot think of a reason to animate your slide – don't do it!

• Be consistent. Try to ensure that you use similar types of animation for similar functions. For example, if your text always drives in from the left it will be distracting if it suddenly appears from another direction or uses another animation technique.

Requirements for the design of slides

Style	Unified slide design style. Avoid styles that distract from the presentation itself. Auxiliary information (control buttons) should not prevail over the main information (text, Figures).
Background	The background should not be too bright or colourful.
Use of colour	Contrasting colours are used for the background and text.
Animation effect	You can't overload slides with animation effects. To change slides, you must use the same animation effect.

Requirements for submitting information

Information content	The text on the slides should be readable. Each slide must contain a title. Don't put a dot at the end of titles. Headlines should attract the audience's attention.
Location of information on the page	Preferably, the information should be placed horizontally. The most important information should be located in the centre of the screen. If the slide contains an image, the label must be located below it. The space of the slide (screen) should be used as much as possible.
Fonts	For titles – at least 24. for information-at least 18. for text, it is best to use the following fonts: Arial, Tahoma, Verdana, Times New Roman, Courier New. You can't mix different font types in the same presentation. Use bold, italics, or underscores to highlight information. Capital letters should not be used too often.
Ways to highlight information	You should use: borders, borders, fill, hatching, arrows, drawings, diagrams, diagrams to illustrate the most important facts.
Quantity of information	Do not fill one slide with too much information: no more than three facts, conclusions, and definitions; no more than 7 elements per slide.
Types of slides	To ensure diversity, you should use different types of slides: with text, with tables, and with diagrams.

Учебное издание

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ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ В ИСКУССТВОВЕДЕНИИ

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