ODESSA I.I. MECHNYKOV NATIONAL UNIVERSITY
FACULTY OF MATHEMATICS, PHYSICS AND INFORMATION TECHNOLOGIES
DEPARTMENT OF MATHEMATICAL SUPPORT OF COMPUTER SYSTEMS

Syllabus of the course "*Still Image Compression Methods*"

Amount	the total number of: credits – 4; hours – 120; content modules - 2
Semester	autumn
Days, Time, Place	according to the class schedule
Teacher(s)	Tatiana Petrushina, Ph.D. (physics and mathematics), Associate Professor of the Department of Mathematical Support of Computer Systems
Contact phone number	(067) 4860042
E-mail	Tatyana.Petrushina@gmail.com
Workplace	department of mathematical support of computer systems
Consultations	face-to-face consultations: according to the class schedule online consultations: ZOOM (link is generated at the beginning of classes)

COMMUNICATION

Communication with students will be carried out by e-mail, in the classroom or via ZOOM.

COURSE ABSTRACT

Subject of the study of the course is the main types of tasks that arise in the context of the application of video compression methods in archivers.

Course prerequisites

The course material is based on previously acquired knowledge, practical skills and skills of topics and areas related to algorithms, data structures and discrete mathematics. The corresponding courses are taught within the educational program of the first (bachelor) level of higher education in specialty 126 "Information systems and technologies".

Post-requisites of the course

According to the used theoretical approaches and models, this course complements the discipline "Image processing methods and algorithms and computer vision" in the field of data analysis and processing and is the basis for mastering the following disciplines of the educational and professional master's training program in the specialty 126 "Information systems and technologies": "Professional research practice", "Execution of master's qualification work".

Purpose of the course is the study of the basic concepts and principles of image compression, the study of image compression methods and algorithms and their use in modern archivers.

Course content

Considered:

— General concepts of image compression algorithms. General characteristics of lossless archiving algorithms. Difference between algorithm and format.

— RLE algorithm. Possible modifications. Characteristics of the algorithm.

— LZW algorithm. Possible modifications. Characteristics of the algorithm. Possible ways of organizing the chain table.

— Huffman coding algorithm. The concept of a prefix code. Code presentation problem. The concept and properties of an optimal prefix code. The concept of "greedy" algorithms. Proof of the optimality of the Huffman algorithm. Estimation of the number of operations.

— Lossy archiving algorithms. Main advantages and disadvantages. Loss estimation problems. Use of various measures. PSNR.

— JPEG algorithm. Different systems of color representation. Transition to the YUV system. The essence of DKP. Quantization. Operations pipeline. Stages of image compression and recovery. Characteristics of the algorithm. Characteristic artifacts.

— Recursive (wave) algorithm. The idea of the method. Presence of artifacts. Characteristics of the algorithm.

— Fractal algorithm. Photocopier Barnsley. The concept of IFS. Fixed point theorem. Theorem on compressive transformation. The main stages of the algorithm execution. Characteristics of the algorithm.

EXPECTED RESULTS

As a result of studying the course, the student must

know: *methods and algorithms of information compression and archiving; main directions of development and methods of archiving and storing information; methods of calculating the characteristics and coding of random discrete and continuous systems.*

be able: *choose the optimal and effective method of information compression, taking into account the specifics of the task; programmatically implement information compression algorithms using programming languages and environments; determine the structure of optimal models and evaluate their quality taking into account compression; use the selected programming environment to develop procedures for integrating software modules.*

Competencies that the student receives as a result of studying the course:

- *the ability to develop mathematical, information and computer models of objects and informatization processes.*
- *the ability to use modern data analysis technologies to optimize processes in information systems.*
- *the ability to mathematically model digital data and use effective algorithms for the analysis and transformation of multimedia data in modern information systems.*
- *the ability to conduct information analysis and create multidimensional models of subject areas.*

Learning outcomes: upon completion of the course, the student will have skills

- *develop and use data repositories, perform data analysis to support decision-making.*
- *to present research results, conduct discussions, and publish research results.*
- *to develop mathematical models and software and information systems for solving current problems of analysis and processing of multimedia information.*
- *create optimized pipelines for preparing data for further storage and processing.*

FORMS AND METHODS OF TEACHING

The course will be taught in the form of lectures (18 hours) and laboratory classes (18 hours), organization of students' independent work (84 hours).

The basic training of students is carried out in lectures and laboratory classes.

During the teaching of the course, the following teaching methods are used: verbal (lecture, explanation); face-to-face (Power Point presentation); practical (laboratory works); work with literary sources (independent work of students).