Description of Courses of MCV programme

BASIC BLOCK

Mathematics for computer vision (1 year, 1 module)

This course is devoted to the systematization of the mathematical background that is necessary for you to master prior to entering the field of computer vision. The course includes sections of mathematical analysis, probability theory, and linear algebra.

PROGRAMMING BLOCK

Object-oriented programming (1 year, 1 module)

The ability to write programs using object-oriented programming languages is an important skill for engineers working with computer vision. The course will cover two object-oriented languages: **Python and C ++.** These object-oriented languages are most often used when working on projects in the field of computer vision.

Architecture of computing systems (1 year, 4 module)

This course focuses on the architecture of modern computers. We'll cover the evolution of computer architecture and the factors influencing the design of hardware and software elements of computer systems. We'll also discuss the processor micro-architecture and pipelining, memory organization, and various types of the modern hardware architecture.

Software engineering of computer vision projects (2 year, 4 module)

The success of a computer vision project depends not only on the algorithms and models, but also on the solution architecture, performance, and robustness. Thus software engineering is an important skill for engineers working with computer vision. The course will cover best engineering practices for large-scale projects that heavily rely on deep learning and computer vision.

PROFESSIONAL BLOCK

2D image processing (1 year, 2 module)

This course is devoted to the usage of computer vision libraries like OpenCV in 2D image processing. The course includes sections of image filtering and thresholding, edge/corner/interest point detection, local and global descriptors, and video tracking.

Data analysis and machine learning (1 year, 2 module)

This course is devoted to the presentation of modern data analysis and machine learning methods that are widely used computer vision. The main emphasis is placed on such sections as:

- Learning and inference in vision, where you'll study a taxonomy of models that relate the measured image data to the actual scene content.
- Generative and discriminative models Classification, regression, and clustering methods.

Modern operation research methods (1 year, 3 module)

The discipline is designed to develop skills in working with information about open and recently-solved problems from various fields of operations research and computer science, as well as develop approaches to these problems.

Deep learning in computer vision (1 year, 4 module)

The goal of this course is to introduce you to deep learning algorithms for computer vision, starting from basics and then turning to more modern deep learning models. The course will cover image classification, object detection, and semantic segmentation algorithms. You'll learn how to build accurate algorithms for a given task using state-of-the-art algorithms and tools.

Visual geometry and 3D image processing (2 year, 1 module)

The course is focused on geometry models used for understanding of 3D scenes. The main emphasis is placed on such sections as: projective pinhole camera model, 2D/3D image transformation models, multiple cameras, and multi-view reconstruction.

Applied tasks of computer vision research seminar (2 year, 1 module)

Computer vision technologies are used in various fields of human activity. They are medicine, automotive technologies, the creation of video surveillance systems, the entertainment industry, etc. The problems that arise attract the attention of a large number of researchers and practitioners. This research seminar is focused on analysis of new research papers on the topic of computer vision.

Modern tools for solving computer vision problems (2 year, 2 module)

Many sophisticated Computer Vision and Deep Learning tools are emerging nowadays. You'll become familiarized with state-of-the-art libraries and tools for:

- model training;
- efficient inference, including inference on edge devices;
- and working with 2Dimages, videos, and 3D data.

Deep generative models (2 year, 3 module)

The course covers the key techniques that have dominated the generative modeling of images. The course includes sections of variational autoencoders, generative adversarial networks, and style transfer.

“Computer vision of mobile devices” project seminar (2 year, 3 module)

The project seminar is devoted to the usage of either traditional image processing or deep learning models in Android mobile devices. The course includes sections of modern tools for mobile programming, implementation of computer vision algorithms in mobile applications, and transformation and optimization of deep learning models for mobile devices. The submission of the material is organized in a step-by-step format from the analysis of the idea to the implementation of the application on a mobile device.

PROJECT BLOCK

Machine learning in computer vision project (1 year, 3 module)

The project will be considered in the first semester after you study the basic adaptation disciplines of mathematics and programming blocks, as well as studying the professional course “Data analysis and machine learning”. The goal of this project is to solve an applied problem for the analysis of two-dimensional images using machine learning technology.

Project “Deep learning in computer vision” coursework (2 year, 2 module)

In this coursework you'll analyze the benefits of deep learning approaches over traditional machine learning technologies and complete an applied project that demonstrates the identified benefits.

Final project (2 year, 4 module)

Master degree thesis – scientific paper