<table>
<tr><td>Subject code:
F.2(4)</td><td colspan="3">Subject name: Computer Vision</td></tr>
<tr><td>Study load:
2 ECTS</td><td>Load of contact hours: 26</td><td>Study semester:
Spring</td><td>Assessment:
Credit / No credit</td></tr>
<tr><td>Objectives:</td><td colspan="3">The course discusses the basic concepts of computer vision, the principles of machine learning in the field of computer vision, algorithms for solving the problems of classifying and segmenting images, detecting objects in images, tracking objects in video, processing three-dimensional scenes and generating images.

The purpose of the course is to study the basics and methods of computer vision and image processing, including the extraction of semantic and metric information from images.</td></tr>
<tr><td>Course outline:</td><td colspan="3">Topics covered:
1. Computer Vision Overview
2. Basic image processing algorithms.
3. Simple methods of image analysis.
4. Representation of images.
5. Estimation of model parameters.
6. Image filtering.
7. Basic segmentation.
8. Machine learning in computer vision.
9. Image classification.
10. Methods for searching and localizing objects.
11. Convolutional neural networks.
12. Example TensorFlow MNIST. Standard datasets and models in TensorFlow using the Transfer Learning approach as an example.
13. Machine learning in OpenCV.
14. Face Detection and Image Processing using OpenCV and Python.
15. Template Matching
16. Feature Detection
17. contour analysis
18. Tracking moving objects in time and optical flow analysis.
19. Real-time computer vision.
20. Image generation.</td></tr>
<tr><td>Learning Outcomes:</td><td colspan="3">By the end of the course students (in the terms of knowledge, skills, and attitudes) should be able to:
1 – solve applied problems of analysis and image processing based on computer vision technologies;
2 – critically evaluate what computer vision is and its goals;</td></tr>
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<tr><td></td><td>3 – identifying some of the key application areas of computer vision;
4 – critically evaluate the digital imaging process;
5 – applying mathematical techniques to complete computer vision tasks.</td></tr>
<tr><td>Assessment Methods:</td><td>Assessment is split into two parts: individual tasks and group project in the end of the course.</td></tr>
<tr><td>Teacher(s):</td><td>Svetlana Bolotova</td></tr>
<tr><td>Prerequisite subject(s):</td><td>None</td></tr>
<tr><td>Compulsory Literature:</td><td>Steve Holden, Computer Vision: Advanced Techniques and Applications Hardcover. Clanrye International. 2019.</td></tr>
<tr><td>Replacement Literature:</td><td>Sunila Gollapudi, Learn Computer Vision Using OpenCV. Apress; 1st ed. Edition. 2019.

Benjamin Planche, Eliot Andres. Hands-On Computer Vision with TensorFlow 2. Packt Publishing. 2019.</td></tr>
<tr><td>Participation requirements:</td><td>Lower limit of lectures attendance is 80%, each task and group project must be presented by end of the course.</td></tr>
<tr><td>Independent work:</td><td>1. A human visual system model
2. Spatial filtering problem
3. Frequency Filtering problem
4. Object Detection task
5. Segmentation by watershed methods
6. The task of recognizing objects in the image
7. Tasks on large image collections
8. Face Recognition in Videos
9. Image overlay
10. Final group project</td></tr>
<tr><td>Grading criteria scale or the minimal level necessary for passing the subject:</td><td><table><tr><td>Failed</td><td>< 50 points</td></tr><tr><td>Passed</td><td>> =50 points</td></tr></table>Points distribution:

Ongoing assessment:
Individual Tasks: 30 points
Homework reports: 40 points

Final Group Project: 30 points</td></tr>
<tr><td>Information about the course:</td><td>Room ___, on ___ at ___</td></tr>
<tr><td>1) Date 1</td><td>Lecture 1</td></tr>
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	Classroom presentation: Computer Vision Overview Classroom presentation: Basic image processing algorithms Homework: About human visual system model (5 points)
2) Date 2	**Workshop 1** Students presentations: Simple methods of image analysis
3) Date 3	**Lecture 2** Classroom presentation: Representation of images Classroom presentation: Estimation of model parameters Homework: About spatial and frequency filtering problems (5 points)
4) Date 4	**Workshop 2** Students presentation: Image filtering. Basic segmentation. Segmentation by watershed methods.
5) Date 5	**Lecture 3** Classroom presentation: Machine learning in computer vision Homework: Image classification overview (5 points)
6) Date 6	**Workshop 3** Students presentation: Introduction in convolutional neural networks
7) Date 7	**Lecture 4** Classroom presentation: Methods for searching and localizing objects. Classroom presentation: Template Matching. Feature Detection. Contour analysis. Image generation Homework: Object Detection task (10 points)
8) Date 8	**Workshop 4** Classroom individual tasks: The task of recognizing objects in the image (15 points)
9) Date 9	**Lecture 5** Classroom presentation: Standard datasets and models in TensorFlow using the Transfer Learning approach as an example Homework: Example TensorFlow MNIST (5 points)
10) Date 10	**Workshop 5** Classroom individual tasks: Tasks on large image collections (15 points)
11) Date 11	**Lecture 6** Classroom presentation: Machine learning in OpenCV Classroom presentation: Face Detection and Image Processing using OpenCV and Python Homework: Tracking moving objects in time and optical flow analysis (10 points)
12) Date 12	**Workshop 6** Students presentations: Real-time computer vision. Face Recognition in Videos. Image overlay
36) Date 13	**Workshop 7** Students presentations: Group projects demonstration (30 points)