RTU Course "Fundamentals of Computer Graphics and Image Processing"

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General data

Code	DAA300
Course title	Fundamentals of Computer Graphics and Image Processing
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Katrīna Šmite
Academic staff	Mihails Kovaļovs Olga Krutikova Evija Cibuļska
Volume of the course: parts and credits points	1 part, 3.0 credits
Language of instruction	LV, EN
Annotation	Computer graphics and image processing are the two important Computer Science fields where we work with visual information in a digital format. The computer graphics field is responsible for creating, transforming or animating two-dimensional (2D) and three-dimensional (3D) graphical objects to be able to display the acquired image, object, or animation on the screen of any device. Image processing is responsible for modifying, improving, and transforming the digital image that has been already acquired. The study course will study different, simple computer graphics algorithms for drawing and converting 2D graphic objects. A theoretical insight into the visualization and use of the 3D graphics will be provided as well. Students will be able to learn the basics of image processing - how to open a picture on the computer and how to modify it. The study course is not just a theoretical insight into computer graphics and image processing algorithms, as algorithms viewed during the study course will also be realized in practice. During practical sessions students will program a digital imaging application with the ability to modify and customize the image and will implement and modify the algorithms that we look at during the study course to draw different 2D objects on the screen. Programming knowledge is optional because during the study course each algorithm will be explained gradually by looking in depth at both the features and syntax of the programming language used during the study course and the steps of the algorithm itself.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide fundamental theoretical knowledge and practical skills in the fields of computer graphics and image processing. The tasks of the study course are: 1. To provide theoretical knowledge of raster graphics algorithms, visualization and transformation of 2D/3D objects, imaging and image processing techniques. 2. To develop practical skills to implement the explored algorithms and methods in practice using the programming environment offered in the study course. 3. To develop the skills to use the acquired theoretical knowledge and practical skills independently and creatively to address computer graphics and image processing tasks.
Structure and tasks of independent studies	Independent studies are integrated with the learning of theoretical material and the realization of practical tasks. As part of the course, students develop computer programs under the supervision of the instructors, according to learned computer graphics or imaging algorithms. During practical sessions, students receive an independent task for improving the developed computer programs based on theoretical material explained during the lecture. The independent task must be completed by the next practice session. As part of their own work, students also develop a course work, which includes an in-depth analysis of theoretical material, independent searching for additional information, and independent realization of algorithms. The task of independent work is to develop the skills of students to analyze theoretical information and to improve the realized computer graphics and imaging algorithms.
Recommended literature	Obligātā. / Obligatory: Korites, B. J.. Python graphics : a reference for creating 2D and 3D images /B.J. Korites., xiii, 363 lpp. : ilustrācijas ; 26 cm. Chityala, Ravishankar. Image processing and acquisition using Python / Ravishankar Chityala, Sridevi Pudipeddi. Boca Raton : CRC Press, ©2014., xxxv, 354 lpp. : il. Papidu. / Additional: Alasdair McAndrew . A Computational Introduction to Digital Image Processing Routledge, 2021 Steve Marschner, Peter Shirley. Fundamentals of Computer Graphics (5th edition) A K Peters/CRC Press, 2021 John F. Hughes. Computer Graphics: Principles and Practice (3rd Edition) PEARSON INDIA, 2019 Rafael C. Gonzalez, Richard E. Woods. Digital Image Processing (4th edition) Pearson, 2017
Course prerequisites	Basic knowledge of Mathematics and Informatics (secondary education).

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work

Introduction to Computer Graphics and Image Processing.	4	4	0	0
Graphical primitives. Straight line generation algorithm.	4	4	0	0
Graphical primitives. Circle line generation algorithm.	4	4	0	0
Graphical primitives. Ellipse line generation algorithm.	4	4	0	0
Curve generation algorithms. Interpolation and approximation. Bezier curves.	4	4	0	0
2D object visualization. Geometrical transformation of 2D objects.	4	4	0	0
3D objects visualization. Projections.	4	4	0	0
Fundamentals of image processing. Basic principles for image analysis.	6	6	0	0
Simple processing of digital images. Image blending modes and transition effects.	6	6	0	0
Total:	40	40	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Knows and understands the basic principles, benefits and limitations of computer graphics and image processing,	Exam, test.
Knows different computer graphics algorithms and image processing methods.	Exam, test.
Is able to create computer programs that implement the creation, transformation, visualization, and image processing of graphic objects, using the programming environment provided in the study course.	Practical works.
Is able to expand and enhance the created computer programs independently to solve more sophisticated practical tasks in computer graphics and image processing.	Course work.

Evaluation criteria of study results

Criterion	%
Practical works	40
Exam	30
Course work	20
Test	10
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	1.0	0.0	1.0		*	