GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Computers Graphics, PG_00047811		
Field of study	Informatics		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2021/2022
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Part-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Intelligent Interactive Systems -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Jacek Lebiedź	
	Teachers	dr inż. Maciej Smiatacz mgr inż. Jerzy Redlarski dr inż. Jacek Lebiedź	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
	Adresy na platformie eNauczanie:						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	5.0	65.0	100

Subject objectives	The purpose of education is to acquire the ability to create images using standard graphics APIs (libraries Allegro, GDI, Xlib, OpenGL i DirectX) and to implement transformation of 2D and 3D images.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W42] Knows and understands, to an advanced extent, architecture, design principles and methods of hardware and software support for local and distributed information systems, including computing systems, databases, computer networks and information applications, as well as the principles of human cooperation with computers and computer-aided teamwork	Student is aware of the hardware support of the rendering pipeline in graphic units and understands what programming of shaders is.	[SW1] Assessment of factual knowledge
	[K6_U07] can apply methods of process and function support, specific to the field of study	Student understands the rendering pipeline and is able to modify its steps.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K6_U43] can analyse date and formulate, apply and assess appropriate formal models and algorithms for solving problems in the field of information systems and applications	Student is able to implement basic graphic algorithms.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn	Student analyzes the problems and develop appropriate models, data structures and numerical and heuristic algorithms for graphics applications.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K6_W01] Knows and understands, to an advanced extent, mathematics necessary to formulate and solve simple issues related to the field of study	Student uses mathematical models to define the image,	[SW1] Assessment of factual knowledge
Subject contents	1. Rules of credit for a course, bibliography 2. Concept of computer graphics, image processing and pattern recognition 3. Applications of computer graphics, image processing and pattern recognition 4. Basic techniques in computer graphics – image generating with use of standard graphical API 5. Implementation of basic transformations (scaling, rotation, translation) by mechanism of standard graphical API 6. Graphical environments: MS Windows, X Window; graphics systems: standard API, DirectX, OpenGL; graphics engines 7. Visual perception, human eye, receptors: rods and cones 8. Color – trichromacy theory, metamerism 9. Theoretical and technical color models 10. CIE XYZ color model 11. CIE LUV, CIE LAB, TekHVC color models 12. RGB color model 13. CMY, CMYK color models 14. HSV, HLS color models 15. YUV, YIQ, YCbCr color models 16. Raster graphics – concept, forms of images and representation methods 17. Vector graphics – concept, forms of images and representation methods 18. Comparison of raster and vector graphics, vector graphics emulation for raster graphics devices 19. Digital geometry – concept of pixel, pixel neighborhood 20. Image digitization – sampling, condition of compatibility of region with sampling grid 21. Image digitization – quantization, dithering, error diffusion 22. Lossless image compression: Huffman coding, arithmetic coding, dictionary coding (LZW), run length encoding (RLE) 23. Lossy image compression: BTC, DPCM, wavelet compression (JPEG2000), discrete cosine transform compression (JPEG), fractal compression 24. Fractals – concept, examples, applications, drawing methods, collage theorem 25. Scan-conversion algorithms for straight line segments: numerical, conditional (Bresenham"s algorithm, midpoint algorithm), structural 26. Aliasing and antialiasing – scan-conversion algorithms for antialiased straight line segments: Gupta-Sproull algorithm, Wu's algorithm 27. Scan-conversion algorithms for circular arcs and other conics: numerical, conditional (Bresenham"s algorithm, midpoint algorithm) 28. Bézier curves – definition and features, de Casteljau's algorithm for point of Bézier curve 29. B-splines – definition and features, de Boor-Cox algorithm for point of B-splines 30. Scan-conversion algorithms for Bézier curves and B-splines: parametric (iterative and recursive), midpoint 31. Image processing – contour tracing: all contours tracing algorithm, single contour tracing algorithm 32. Image processing – contour filling: contour filling by parity check, contour filling by connectivity 33. Image processing – thinning: concept of skeleton, basic thinning algorithm, classical thinning algorithm 34. Image processing – filtering: linear and non-linear filters, low-pass and high-pass filters 35. Image processing – morphological operations: erosion, dilation, opening, closing 36. Image transformations: geometrical, in color space, histogram 37. 3D graphics – principles, rendering pipeline 38. Geometric solid modeling: boundary representation, spatial-partitioning representation (concept of voxel), constructive solid geometry 39. Surface modeling, tessellation, Bézier and B-splines surfaces 40. Visible-surface determination: image-precision algorithms (z-buffer) and object-precision algorithms, generation of shadows 41. Texturing: concept of texel, texture mapping, bump mapping 42. Illumination modeling – Phong illumination model 43. Gouraud shading – color interpolation 44. Phong shading – normal-vector interpolation 45. Global illumination methods: ray tracing, radiosity		
Prerequisites and co-requisites	No requirements		

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Practical exercise</td><td>60.0%</td><td>50.0%</td></tr>
<tr><td>Written exam</td><td>53.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Angel E.: Interactive Computer Graphics. A Top-Down Approach Using OpenGL (3rd Edition). Addison Wesley 2003. 2. Foley J. D., van Dam A., Feiner S. K., Hughes J. F.: Computer Graphics: Principles and Practice, (2nd Edition). Addison-Wesley, Reading 1990. 3. Hill F. S. jr., Kelley S. M.: Computer Graphics using OpenGL (3rd Edition). Pearson Education 2007. 4. Pharr M., Humphreys G.: Physically Based Rendering. From Theory to Implementation (2nd Edition). Morgan Kaufmann 2010. 5. Schneider Ph. J., Eberly D. H.: Geometric Tools for Computer Graphics. Morgan Kaufmann 2003.</td></tr>
<tr><td>Supplementary literature</td><td>1. Shreiner D., Sellers G., Kessenich J., Licea-Kane B.: OpenGL Programming Guide. The Official Guide to Learning OpenGL, Version 4.3 (8th Edition). Addison-Wesley 2013. 2. Varcholik P.: Real-Time 3D Rendering with DirectX and HLSL: A Practical Guide to Graphics Programming (Game Design). Addison-Wesley 2014.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Application for drawing of given solid using a particular graphics API.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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