

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Računalniška grafika
Course title:	Computer Graphics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Izobraževalno računalništvo 1. stopnja UN Educational computer science 1 st cycle Academic undergraduate		3.	zimski Autumn

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30		30			120	6

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	slovenski / Slovene
	Vaje / Tutorial:	slovenski / Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Znanje, ki je vključeno v predmetih Programiranje I in II, Matematika I in II

Prerequisites:

Knowledge included in the courses Programming I and II, Mathematics I and II.

Vsebina:

- Uvod: definicija računalniške grafike, definicija obdelave in analize slik, zgodovinski oris, uporaba računalniške grafike, viri v računalniški grafiki.
- Osnove OpenGL: grafični cevovod, senčilniki.
- Geometrijske transformacije: 2D geometrijske transformacije, homogene koordinate, kompozicija 2D transformacij, 3D geometrijske transformacije, kompozicija 3D transformacij, inverzne transformacije.
- Projekcije: perspektivne projekcije, vzporedne projekcije.

Content (Syllabus outline):

- Introduction: computer graphics definition, definition of image processing and analysis, history, computer graphics application, references in computer graphics.
- OpenGL basics: graphics pipeline, shaders.
- Geometrical transformations: 2D geometrical transformations, homogeneous coordinates, composition of 2D transformations, 3D geometrical transformations, composition of 3D transformations, inverse transformations.
- Projections: perspective projections, parallel projections.
- Hidden surface removal.

- Odstranjevanje zakritih ploskev.
- Rasterizacija: prebirna pretvorba daljic in krožnic, antialias.
- Lokalni osvetlitveni modeli: Gouraudovo senčenje, Phongovo senčenje.
- Teksture: preslikava tekstur, preslikava izboklin, preslikava odmikov, preslikava okolja, sence.
- Globalni osvetlitveni modeli: algoritem sledenja žarku, tehnike in strukture delitve prostora.
- Krivulje: želene lastnosti krivulj, krivulje B-zlepkov, Bézierove krivulje, krivulje NURBS.
- Ploskve: ploskve B-zlepkov, Bézierove ploskve, ploskve NURBS.
- Barve: človeški vid, določevanje barv in barvni modeli, uporaba barv.
- Grafična strojna oprema: arhitektura grafičnega procesorja, splošnonamensko računanje na grafičnih procesorjih, CUDA, OpenCL.

- Rasterization: scanline conversion of lines and circles, antialiasing.
- Local shading models: Gouraud shading, Phong shading.
- Textures: texture mapping, bump mapping, displacement mapping, environment mapping, shadows.
- Global illumination models: ray-tracing algorithm, space subdivision techniques and structures.
- Curves: desired curve properties, B-spline curves, Bézier curves, NURBS curves.
- Surfaces: B-spline surfaces, Bézier surfaces, NURBS surfaces.
- Colours: human vision, colour determination and colour models, use of colours.
- Graphical hardware: graphics processor architecture, general purpose computation on graphics processors, CUDA, OpenCL.

Temeljni literatura in viri / Readings:

- N. Guid: *Računalniška grafika*, učbenik, Univerza v Mariboru, Fakulteta za elektrotehniko, računalništvo in informatiko, Maribor, 2001.
- D. Hearn, M. P. Baker, W. Carithers: *Computer graphics with Open GL*, Prentice Hall, Upper Saddle River, 2010.
- R. S. Wright, B. Lipchak: *OpenGL Superbible*, 3. izdaja, Sams Publishing, Indianapolis, 2005.

Cilji in kompetence:

Cilj predmeta je seznaniti študente z osnovami računalniške grafike.

Objectives and competences:

The objective of this course is to acquaint students with fundamentals of computer graphics.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben

- razumeti temeljne koncepte prebirne pretvorbe grafičnih gradnikov, 2D in 3D geometrijskih transformacij, projekcij, tvorbo krivulj in ploskev, odstranjevanja zakritih ploskev, lokalnih in globalnih osvetlitvenih modelov in barvnih modelov,
- načrtovati preproste grafične aplikacije,
- zgraditi preprosti osvetlitveni model.

Prenosljive/ključne spretnosti in drugi atributi:

- *Spretnosti komuniciranja:* ustni zagovor laboratorijskih vaj, pisno izražanje pri projektu.
- *Uporaba informacijske tehnologije:* pisanje računalniških programov, uporaba programskih orodij za grafične aplikacije.
- *Spretnosti računanja:* reševanje računskih problemov pri domačih nalogah.
- *Reševanje problemov:* izvedba preprostih grafičnih aplikacij.

Intended learning outcomes:

Knowledge and understanding:

On completion of this course the student will be able to

- understand basic concepts of scan conversion graphical primitives, 2D and 3D geometrical transformations, projections, curve and surface creation, hidden-surface removal, local and global illumination models, and colour models,
- design simple graphical applications,
- construct a simple illumination model.

Transferable/Key skills and other attributes:

- *Communication skills:* oral lab work defence, manner of expression at project.
- *Use of information technology:* writing computer programs, use of software tools for graphical applications.
- *Calculation skills:* solving calculating problems in homework assignments.
- *Problem solving:* construction of simple graphical applications.

Metode poučevanja in učenja:

Learning and teaching methods:

- predavanja,
- seminarske vaje,
- laboratorijske vaje,
- projekt.

- lectures,
- tutorials,
- lab work,
- project.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) /

Assessment:

• laboratorijske vaje,	30 %	• lab work,
• opravljen projekt,	20 %	• completed project,
• 1. vmesni pisni izpit,	16 %	• 1st midterm written exam,
• 2. vmesni pisni izpit,	17 %	• 2nd midterm written exam,
• 3. vmesni pisni izpit.	17 %	• 3rd midterm written exam.

Opomba:

Če študent ni uspešno opravil vseh treh vmesnih izpitov, jih nadomesti s pisnim izpitom v deležu 50 %.

Note:

If a student has not completed all three midterm exams, he replaces them with a written exam in the weight of 50 %.

Reference nosilca / Lecturer's references:

- STRNAD, Damjan, GUID, Nikola. A fuzzy-genetic decision support system for project team formation. Applied soft computing, ISSN 1568-4946, Sep. 2010, vol. 10, iss. 4, str. 1178-1187.
- STRNAD, Damjan. Parallel terrain visibility calculation on the graphics processing unit. Concurrency and computation, ISSN 1532-0634, 2011, vol. 23, iss. 8, str. 2452-2462.
- KOHEK, Štefan, STRNAD, Damjan. Interactive synthesis of self-organizing tree models on the GPU. Computing, ISSN 0010-485X, Feb. 2015, vol. 97, iss. 2, str. 145-169.
- STRNAD, Damjan, GUID, Nikola. Parallel alpha-beta algorithm on the GPU. V: 33rd International Conference on Information Technology Interfaces [also] ITI 2011, June 27-30, 2011, Cavtat / Dubrovnik, Croatia. LUŽAR - STIFFLER, Vesna (ur.), JAREC, Iva (ur.), BEKIĆ, Zoran (ur.). Proceedings of the ITI 2010, (ITI ... (Tisak), ISSN 1330-1012). Zagreb: University of Zagreb: University Computing Centre, cop. 2010, str. 571-576.
- FISTER, Iztok, STRNAD, Damjan, YANG, Xin-She, FISTER, Iztok. Adaptation and hybridization in nature-inspired algorithms. V: FISTER, Iztok (ur.), FISTER, Iztok (ur.). Adaptation and Hybridization in Computational Intelligence, (Adaptation, learning, and optimization, ISSN 1867-4534, Vol. 18). Cham ... [et al.]: Springer, 2015, str. 3-50.