| UČNI NAČRT PREDMETA / COURSE SYLLABUS | |
|---|---|
| **Predmet:** | Razvoj pogona za videoigre |
| **Course title:** | Game Engine Development |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|---|---|---|
| Razvoj videoiger in razširjenih resničnosti, visokošolski strokovni študijski program prve stopnje | - | Drugi | Četrti |
| Game and Extended Reality Development, first cycle Professional Study Programme | - | Second | Fourth |

| | |
|---|---|
| **Vrsta predmeta / Course type** | Izbirni / Elective |
| **Univerzitetna koda predmeta / University course code:** | 4-RVRR-VS-IP-RPV-2026-09-29 |

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorials | Klinične vaje<br>Clinical tutorials | Druge oblike študija<br>Other forms of study | Samost. delo<br>Individ. work | ECTS |
|---|---|---|---|---|---|---|
| 30 | - | 45 | - | - | 105 | 6 |

| | |
|---|---|
| **Nosilec predmeta / Lecturer:** | Doc. dr. Kenny Bešter Štorgel |

| | | |
|---|---|---|
| **Jeziki / Languages:** | **Predavanja / Lectures:** | Slovenščina, angleščina / Slovene, English |
| | **Vaje / Tutorial:** | Slovenščina, angleščina / Slovene, English |

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisites:** |
|---|---|
| Pogoj za vključitev v delo je poznavanje vsebin predmeta Programiranje 2. | To enroll in the course, familiarity with the contents of Programming 2 is required. |

| **Vsebina:** | **Content (Syllabus outline):** |
|---|---|

- Osnove grafične knjižnice SFML.Net (ustvarjanje okna, osnovni izrisi, teksture, zvok, obravnava uporabniškega vnosa in dogodkov).
- Arhitektura igralnega pogona (igralna zanka, upravljanje časa in frekvenca posodabljanja, stanje igre, organizacija podsistemov).
- ECS arhitektura (entitete, komponente, sistemi, kompozicijsko načrtovanje, upravljanje entitet in komponent).
- Geometrija 2D prostora (vektorji, osnovne geometrijske operacije, razdalje, koti, premice, presečišča).
- Fizika in gibanje (položaj, hitrost, pospešek, rotacija, gravitacija, masa, vztrajnostni moment).
- Zaznavanje in reševanje trkov (omejevalni pravokotniki, AABB).
- Osnove 2D grafike (liki, animacije, osnovni senčilniki).
- Upravljanje sveta (nalaganje, ustvarjanje in odstranjevanje scen, prehajanje med scenami).
- Metanje žarkov in kamere (pogledi, vidno okno, transformacije).
- Umetna inteligenca (osnovno vedenje NPC-jev, krmiljenje, iskanje poti).
- Shranjevanje in nalaganje stanja igre (serializacija, konfiguracijske datoteke).
- Uporabniški vmesniki (osnovni sistemi za menije, povleci in spusti sistem).
- Napredna igralna zanka
- Napredni sistemi igralnega pogona (sistemi delcev, akcije in ponovitve).

- Fundamentals of the SFML.Net graphics library (window creation, basic rendering, textures, sounds, and handling user input and events).
- Game engine architecture (game loop, time management and update rate, game states, and subsystem organization).
- ECS architecture (entities, components, systems, composition-based design, and entity and component management).
- 2D geometry (vectors, basic geometric operations, distances, angles, lines, and intersections).
- Physics and motion (position, velocity, acceleration, rotation, gravity, mass, and moment of inertia).
- Collision detection and resolution (bounding rectangles, AABBs – axis-aligned bounding boxes).
- Fundamentals of 2D graphics (sprites, animations, and basic shaders).
- World management (loading, creating, and removing scenes, changing between scenes).
- Ray casting, and cameras (views, viewports, and transformations).
- Artificial intelligence (basic NPC behavior, steering, and pathfinding).
- Saving and loading game states (serialization and configuration files).
- User interfaces (basic menu systems and drag-and-drop system).
- Advanced game loop.
- Advanced game engine systems (particle systems, actions, and replays).

**Temeljni literatura in viri / Readings:**


- R. Pupius. (2015). SFML Game Development By Example, 1. izdaja, Packt Publishing.
- R. Nystrom. (2014). Game Programming Patterns, Genever Benning.
- R. B. Whitaker. (2021). The C# Player's Guide, 5. izdaja, Starbound Software.

| **Cilji in kompetence:** | **Objectives and competences:** |
|---|---|
| Cilj učne enote je študente seznaniti z osnovnimi koncepti, načeli in tehnikami razvoja igralnih pogonov in jih usposobiti za njihovo uporabo pri razvoju računalniških iger.<br><br>Učna enota prispeva k razvoju naslednjih splošnih in predmetno-specifičnih kompetenc:<br><br>*Splošne kompetence:*<br>• Usposobljenost za izvajanje vseh faz razvoja programskih rešitev: načrtovanje, razvoj, testiranje, implementacija in vzdrževanje.<br>• Sposobnost učinkovitega ustvarjanja projektne dokumentacije, shem, diagramov poteka in oblikovnih rešitev, primernih za razvoj in produkcijo videoiger in razširjenih resničnosti.<br>• Usposobljenost za skupinsko delo v vseh fazah razvoja in oblikovanja programske opreme.<br><br>*Predmetno-specifične kompetence:*<br>• Poznavanje osnovnih principov in arhitekture igralnih pogonov.<br>• Poznavanje osnovnih gradnikov in podsistemov igralnih pogonov.<br>• Poznavanje principov igralne zanke, obravnave dogodkov, upravljanja časa in izrisovanja.<br>• Razumevanje osnovnih principov objektno usmerjenega in podatkovno usmerjenega razvoja igralnih pogonov.<br>• Poznavanje osnovnih tehnik optimizacije in učinkovitega upravljanja podatkov. | The aim of the instructional unit is to familiarize students with the basic concepts, principles, and techniques of game engine development and to equip them with the skills to apply them in the development of computer games.<br><br>The instructional unit contributes to the development of the following general and subject-specific competences:<br><br>*General competencies:*<br>• Ability to perform all phases of software development: design, development, testing, implementation and maintenance.<br>• Ability to effectively produce project documentation, flowcharts, diagrams and design solutions suitable for the development and production of video games and extended reality.<br>• Ability to work as part of a team at all phases of software development and design.<br><br>*Subject-specific competencies:*<br>• Knowledge of the basic principles and architecture of game engines.<br>• Knowledge of the basic building blocks and subsystems of game engines.<br>• Knowledge of the principles of the game loop, event handling, time management, and rendering.<br>• Understanding of the basic principles of object-oriented and data-oriented game engine development.<br>• Knowledge of basic optimization techniques and efficient data management. |
| **Predvideni študijski rezultati:** | **Intended learning outcomes:** |

| Znanje in razumevanje: | Knowledge and understanding: |
|---|---|
| *Študent/študentka:*<br>• Razume osnovne koncepte in arhitekturo igralnih pogonov.<br>• Pozna glavne gradnike in podsisteme igralnega pogona.<br>• Razume principe upravljanja igralnih objektov, komponent, dogodkov in časa.<br>• Razume osnovne principe izrisovanja in organizacije podatkov.<br>• Pozna osnovne pristope k optimizaciji in učinkovitemu upravljanju podatkov.<br>• Zna uporabiti ustrezne podatkovne strukture za učinkovito upravljanje igralnih objektov.<br>• Zna uporabiti pristope objektno usmerjenega in podatkovno usmerjenega programiranja pri razvoju igralnih pogonov.<br>• Zna analizirati in izboljšati učinkovitost implementiranih rešitev.<br>• Zna razviti, testirati in dokumentirati manjši igralni pogon. | *The student:*<br>• Understands the basic concepts and architecture of game engines.<br>• Knows the main building blocks and subsystems of a game engine.<br>• Understands the principles of managing game objects, components, events, and time.<br>• Understands the basic principles of rendering and data organization.<br>• Knows the basic approaches to optimization and efficient data management.<br>• Can use appropriate data structures for the efficient management of game objects.<br>• Can apply object-oriented and data-oriented programming approaches in game engine development.<br>• Can analyze and improve the efficiency of implemented solutions.<br>• Can develop, test, and document a small game engine. |

| **Metode poučevanja in učenja:** | **Learning and teaching methods:** |
|---|---|
| • predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri),<br>• konzultacije,<br>• vaje,<br>• skupinsko delo na projektni nalogi. | • lectures with active student participation (explanation, discussion, questions, examples)<br>• consultations,<br>• tutorials,<br>• group work on project assignment. |

| **Načini ocenjevanja:** | **Delež (v %) / Weight (in %)** | **Assessment:** |
|---|---|---|
| Način (pisni izpit, ustno izpraševanje, naloge, projekt)<br><br>Študenti bodo ocenjeni na podlagi samostojnega ali skupinskega dela pri projektni nalogi. | | Type (examination, oral, coursework, project):<br><br>Students will be assessed on their individual or group work on project assignment. |

| | | |
|---|---|---|
| • Projektna naloga | 100 % | • Project assignment |

**Reference nosilca / Lecturer's references:**

- C. J. Dallard, M. Milanič, K. Štorgel, Treewidth versus clique number. II. Tree-independence number, Journal of Combinatorial Theory. Series B. 164 (2024), 404-442.
- C. J. Dallard, M. Milanič, K. Štorgel, Treewidth versus clique number. III. Tree-independence number of graphs with a forbidden structure, Journal of Combinatorial Theory. Series B., 167 (2024), 338-391.
- C. J. Dallard, V. V. Lozin, M. Milanič, K. Štorgel, V. Zamaraev, Functionality of box intersection graphs, Results in Mathematics, 79 (2024), 1-17.
- B. Lužar, M. Maceková, S. Rindošová, R. Soták, K. Sroková, K. Štorgel, Locally irregular edge-coloring of subcubic graphs, Discrete Applied Mathematics, 339 (2023), 136–148.
- H. La, B. Lužar, K. Štorgel, Further extensions of the Grötzsch Theorem, Discrete mathematics, 345 (2022), 1-12.
- C. J. Dallard, M. Milanič, K. Štorgel, Treewidth versus Clique Number. I. Graph Classes with a Forbidden Structure, SIAM Journal on Discrete Math., 35 (2021), 2618-2646.