Liverpool John Moores University

Title:	Advanced Topics in Games Development
Status:	Definitive
Code:	**6207COMP** (128007)
Version Start Date:	01-08-2021
Owning School/Faculty:	Computer Science and Mathematics
Teaching School/Faculty:	Computer Science and Mathematics

Team	Leader
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Academic Level:	FHEQ6	**Credit Value:**	20	**Total Delivered Hours:**	44
Total Learning Hours:	200	**Private Study:**	156		

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Lecture	22
Practical	22

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	AS1	Critical review and comparisons of techniques used in advanced games development in AI or Physics	40	
Artefacts	AS2	Implementation of an advanced topic in a games development application involving Game AI and Physics	60	

Aims

The aims of this module involve introducing theoretical concepts on advanced topics

in games development in the areas of Game Artificial Intelligence and Games Physics. In particular we will aim:
-To explain the logical foundations and graph and tree-based approaches representing decisions and paths in games.
-To present knowledge of mathematically modelling characters and the environment, using intelligent agent and multi-agent systems.
-To explain and describe the role of mathematical principles such as numerical analysis and solvers underpinning physical simulation and dynamics.
-To apply game-industry standard middleware for the implementation of both domains

Learning Outcomes

After completing the module the student should be able to:

1	Review and critically evaluate an advanced topic in games development.
2	Apply suitable mathematical models and software development techniques to analyze and solve advanced games development problems.
3	Use a high-level language and appropriate middleware to integrate a relevant programming techniques and algorithms into an interactive 3D game application.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Critical review	1	
Implementation	2	3

Outline Syllabus

Artificial Intelligence:
- What is AI?
- Agents and Environments
- Search Strategies.
- Tree and Graph-Based AI Nodes for Virtual Environments.
- Heuristic and Cost Functions.
- Key Algorithms: Best Frist, Dijkstra, A etc.*
- Scripted vs. Procedural AI.
- Controlling entities in games, Pattern Movements, Steering Behaviors, Decision making.
- Logic: Predicates, First-Order Logic, Syntax and Semantics, Truth Tables, Axioms, Associativity, Commutativity, Modus Ponens etc.
- Specifying the Task Environment. Classifying Virtual Environments: Partial Observability, Stochastic, Episodic, Discrete/Continuous etc.
- Finite State Machines and Extensions (Stack, Message, Concurrent etc).
- Agent Coordination: Multiple Autonomous Agents vs Centralized Control (e.g. Swarm).
- AI Game Architecture: Messaging Systems, Hierarchical AI.

- Machine Learning

Rigid Body Dynamics:
- Rigid Body Simulation:
-Inertia and Momentum.
-Linear and Angular Momentum.
-Newtonian Mechanics.
-Equations of Motion.
-Differential and Integral Calculus.
-Kinetics, Kinematics and Energy.
-Numerical Analysis and Approximation techniques.
- Physics Engine and Middleware Concepts:
-Volume Approximation: Collision Primitives, AABB, OBB, k-Dop, Digital Content Creation Generated.
-Kinematic Controllers (Character and Vehicle)
-Impulses, Forces, Inertia.
-Programmatic control of linear and angular momentum.
-Collision Filtering (Broadphase)
-Composition of Primitive Volumes (Broadphase)
-Articulations/Ragdolls

Learning Activities

Lectures – to deliver the theoretical concepts on advanced topics in games development.
Practical – Tutor-led practical session in the computer laboratory.
Further exercises – additional exercises for students to work on in their own time.
Directed learning – provides additional reading to enable practical work to be completed.
Learning materials can be accessed digitally via University Virtual Learning Environment (VLE).

Notes

This module covers the two major sub-disciplines of advanced topics in games development which are used to convert real-time rendered 3D graphics into game applications – Artificial Intelligence and Rigid Body Dynamics (Game Physics). The module will begin with an overview of the underpinning theories of both fields and will focus on specific algorithms and technologies in each field and how they are applied to dynamically control both characters and the environment of a game application. Students will learn how to model AI in a game environment using discretization techniques and how to model physics in a game engine environment using Numerical Solver-based techniques.