Advanced Topics in Games Development

Module Information

2022.01, Approved

Summary Information

Module Code	6207COMP
Formal Module Title	Advanced Topics in Games Development
Owning School	Computer Science and Mathematics
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 6
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
Computer Science and Mathematics

Learning Methods

Learning Method Type	Hours
Lecture	22
Practical	22

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
JAN-CTY	CTY	January	12 Weeks

Aims and Outcomes

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

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Review and critically evaluate an advanced topic in games development.
MLO2	2	Apply suitable mathematical models and software development techniques to analyse and solve advanced games development problems.
MLO3	3	Use a high-level language and appropriate middleware to integrate a relevant programming techniques and algorithms into an interactive 3D game application.

Module Content

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 Behaviours, 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: PartialObservability, 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
Module Overview	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 â€“ 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 how specific algorithms and technologies in each field are applied to dynamically control both characters and the environment of a game application. You will learn how to model AI in a game environment using discretisation techniques and how to model physics in a game engine environment using Numerical Solver-based techniques.
Additional Information	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.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Portfolio	Critical review	40	0	MLO1
Practice	Implementation	60	0	MLO2, MLO3

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Abdennour El Rhalibi	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings