CS4386: AI GAME PROGRAMMING

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
AI Game Programming

Subject Code
CS - Computer Science

Course Number
4386

Academic Unit
Computer Science (CS)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CS2310 Computer Programming or
CS2311 Computer Programming or
CS2312 Problem Solving and Programming or
CS2313 Computer Programming or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This aim of this course is to provide in-depth coverage of Game AI, which is a collection of AI techniques relevant to computer games, and its applications to modern computer game programming. The main objective is to ensure students have a firm and clear understanding of the common AI techniques that are applicable to computer game development. In particular, a main emphasis of this course is to equip students with hands-on practical on Game AI when students design and develop advanced computer games.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify, explore and describe the key technologies and development environments of game programming.	15	x		
2	Demonstrate working knowledge of common Game AI.	20		x	
3	Adopt and implement different Game AI in computer games.	25		x	
4	Compare different Game AI and justify their applications under different scenarios.	25		x	
5	Develop comprehensive and robust computer games with sophisticated Game AI.	15			x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Concept and general knowledge of Game AI and game programming are explained and discussed.	1, 2, 3, 4, 5	3 hours per week

| 2 | Tutorial | Designed cases/questions are discussed with students so that the taught material could be recalled and applied.

Open-ended questions will be presented that encourage students to exercise critical thinking on a designed problem and pursue its solution.

Students will have hand-on practices on Game AI and game programming to deepen their understanding on the related subjects. | 1, 2, 3, 4, 5 | 8 hours per semester |
| 3 | Assignment | Students are required to develop a computer game. Students will be encouraged to discover the Game AI used in computer games and develop their own application for their game. | 1, 2, 3, 4, 5 | After class |

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment	1, 2, 3, 4, 5	35	
2	Quiz	1, 2, 3, 4, 5	15	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

Assignment

Criterion

1.1 ABILITY to discover the technologies/approaches in Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Assignment

Criterion

1.2 ABILITY to provide quality evaluation on Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Programming Assignment

Criterion

2.1 ABILITY to demonstrate working knowledge of Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Programming Assignment

Criterion
2.2 ABILITY to implement appropriate Game AI and provide justification on their choice

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Programming Assignment

Criterion
2.3 ABILITY to write comprehensive and robust code

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Programming Assignment

Criterion

2.4 ABILITY to design game with high quality Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Quiz/Exam

Criterion

3.1 ABILITY to describe and identify the characteristics and application of various Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Quiz/Exam

Criterion

3.2 ABILITY to demonstrate working knowledge of common Game AI

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Quiz/Exam

Criterion
3.3 ABILITY to provide quality evaluation on various Game AI

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Board Games, Decision Making, Learning, Movement, Pathfinding, Tactical AI, Procedural Content Generation.

Syllabus

· Board Games
  Game Tree. Minimax, Negamax, Alpha-Beta Pruning, Transposition Table, Zobrist Hashing, Variable Depth Approaches, Monte Carlo Tree Search.
· Decision Making
  Decision Tree, Finite State Machine, Hierarchical State Machine, Behavior Tree, Fuzzy Logic, Goal-Oriented Behavior
· Learning
  Action Prediction, N-grams, Naïve Bayes Classifier, Decision Tree Learning, Reinforcement Learning, Artificial Neural Network
· Movement
  Kinematic Movement Algorithms, Steering Behaviors, Predicting Physics, Jumping, Coordinated Movement
· Pathfinding
  Dijkstra, A*, Hierarchical Pathfinding, Continuous Time Pathfinding
· Tactical AI
  Waypoint Tactics, Tactical Analyses, Influence Map, Tactical Pathfinding
· Procedural Content Generation

Pseudorandom Numbers, Lindenmayer Systems, Landscape Generation, Dungeons and Maze Generation, Shape Grammars

Reading List

Compulsory Readings

	Title
1	Ian Millington (2019). Artificial Intelligence for Games (Third Edition), CRC Press. (ISBN-13: 978-1-138-48397-2)

Additional Readings

	Title
1	Georgios N. Yannakakis and Julian Togelius (2018). Artificial Intelligence and Games, Springer. (ISBN-13: 978-3-319-63519-4)