Course Outline	
COMP7126 Artificial Intelligence in Games (2/2)	**Study Program** Computer Science
Effective Date 01 September 2016	**Revision** 0

1. Course Description

Artificial Intelligence in Games is one subject which learns how is Artificial Intelligence (AI) used in games. This course provides students with the techniques, pathfinding, decision making, tactical and strategic AI, how learning works in games and finally how can we design AI-based game. By completing this course, students can explain AI works in games and describe how to implement techniques to embed AI in a game. To understand this course appropriately, students need to pass Artificial Intelligence course.

2. Graduate Competency

Each course in the study program contributes to the graduate competencies that are divided into employability and entrepreneurial skills and study program specific outcomes, in which students need to have demonstrated by the time they complete their course.

BINUS University employability and entrepreneurial skills consist of planning and organizing, problem solving and decision making, self management, team work, communication, and initiative and enterprise.

2.1. Employability and Entrepreneurial Skills

Aspect	Key Behaviour

2.2. Study Program Specific Outcomes

Study Program Specific Outcomes
Able to classify problems and to apply design and development principles for specific problems
Able to classify criteria and specifications appropriate to specific problems, plan strategies for their solution and construct appropriate software systems.
Able to construct a solution by applying current technologies

3. Topics

- Introduction
- Game AI
- Movement: Steering Behaviors
- Movement: Predicting Physics & Jumping
- Movement: Coordinated Movement, Motor Control & Movement in the Third Dimension
- Pathfinding: Djikstra & A*
- Pathfinding: Hierarchical & Continuous Time Pathfinding
- Decision Making: Decision Tree & State Machines
- Decision Making: Behavior Tree, Fuzzy Logic & Markov Systems
- Decision Making: Goal-Oriented Behavior & Rule-Based System
- Learning: Parameter Modification & Action Prediction
- Learning: Decision Learning
- Project Presentation

4. Learning Outcomes

On successful completion of this course, student will be able to:

- LO 1: Describe how Artificial Intelligence works in Games
- LO 2: Explain concepts of AI Techniques in Games
- LO 3: Apply AI Techniques in building Games
- LO 4: Construct AI-based Games

5. Teaching And Learning Strategies

In this course, the lecturers might deploy several teaching learning strategies, including Project Work, Group Presentation, Lecture, and Self-Assessment.

6. Textbooks and Other Resources

6.1 Textbooks

1. Ian Millington. (2009). ***Artificial intelligence for games***. 02. Morgan Kaufmann Publishers. Burlington. ISBN: 9780123747310.
2. Steven Halim, Felix Halim. (2013). ***Competitive Programming*** 3. 03. Lulu. ISBN: B00FG8MNN8.
3. Y. Daniel Liang. (2015). ***Introduction to Java Programming***. 10. Pearson Education. Essex. ISBN: 9781292070018.

The book in the first list is a must to have for each student.

6.2 Other Resources

1. http://www.youtube.com/watch?v=wsmMOJj6ETo

7. Schedule

Theory

Session/ Mode	Related LO	Topics	References
1 F2F	LO 1	Introduction - What is AI - Model of Game AI - Algorithms, Data Structures, and Representations - On the Website	- Introduction - Artificial intelligence for games, Chapter 1 - An Intro to Video Game AI for Beginners and Young Programmers, http://www.youtube.com/watch?v=wsmMOJj6ETo
2 F2F	LO 1	Game AI - The Complexity Fallacy - The Kind of AI in Games - Speed and Memory - The AI Engine	- Game AI - Artificial intelligence for games, Chapter 2
3 GSLC	LO 1 LO 2	Movement: Steering Behaviors - The Basics of Movement Algorithms - Kinematic Movement Algorithms - Steering Behaviors - Combining Steering Behaviors	- Movement: Steering Behaviors - Artificial intelligence for games, Chapter 3
4 F2F	LO 1 LO 2	Movement: Predicting Physics & Jumping - Aiming and Shooting - Projectile Trajectory - The Firing Solution - Projectiles with Drag - Iterative Targeting - Jump Points - Landing Pads - Hole Fillers	- Movement: Predicting Physics & Jumping - Artificial intelligence for games, Chapter 3
5 F2F	LO 2 LO 3	Movement: Coordinated Movement, Motor Control & Movement in the Third Dimension - Formations - Slot	- Movement: Coordinated Movement, Motor Control & Movement in the Third Dimension

		- Output Filtering - Capability-Sensitive Steering - Rotation in Three Dimensions - Align - Face	- Artificial intelligence for games, Chapter 3
6 GSLC	LO 2 LO 3	Pathfinding: Djikstra & A* - The Pathfinding Graph - Dijkstra - A*	- Pathfinding: Djikstra & A* - Artificial intelligence for games, Chapter 4
7 F2F	LO 2 LO 3	Pathfinding: Hierarchical & Continuous Time Pathfinding - The Hierarchical Pathfinding Graph - Pathfinding on the Hierarchical Graph - Hierarchical Pathfinding on Exclusions - Continuous Time Pathfinding - Movement Planning	- Pathfinding: Hierarchical & Continuous Time Pathfinding - Artificial intelligence for games, Chapter 4
8 F2F	LO 2 LO 3	Decision Making: Decision Tree & State Machines - Overview of Decision Making - Decision Trees - Random Decision Trees - State Machines - Hard-Coded FSM - Hierarchical State Machines - Combining Decision Trees and State Machines	- Decision Making: Decision Tree & State Machines - Artificial intelligence for games, Chapter 5
9 F2F	LO 2 LO 3	Decision Making: Behavior Tree, Fuzzy Logic & Markov Systems - Implementing Behavior Trees - Decorators - Concurrency and Timing - Fuzzy Logic Decision Making - Fuzzy State Machines - Markov Processes - Markov State Machine	- Decision Making: Behavior Tree, Fuzzy Logic & Markov Systems - Artificial intelligence for games, Chapter 5
10 F2F	LO 2 LO 3	Decision Making: Goal-Oriented Behavior & Rule-Based System - Goal-Oriented Behavior - Simple Selection - Overall Utility - Timing - Rule-Based Systems - Rule Arbitration - Unification - Rete - Extensions	- Decision Making: Goal-Oriented Behavior & Rule-Based System - Artificial intelligence for games, Chapter 5
11 GSLC	LO 3 LO 4	Learning: Parameter Modification & Action Prediction - Learning Basics - Parameter Modification - Action Prediction	- Learning: Parameter Modification & Action Prediction - Artificial intelligence for games, Chapter 7
12 F2F	LO 3 LO 4	Learning: Decision Learning - Naive Bayes Classifiers - Decision Tree Learning - Reinforcement Learning - Artificial Neural Networks	- Learning: Decision Learning - Artificial intelligence for games, Chapter 7
13 F2F	LO 4	Project Presentation - Project Presentation	- Project Presentation - Artificial intelligence for games, Chapter 1, 2, 3, 4, 5, 7

Practicum

Session/ Mode	Related LO	Topics	References
1 F2F	LO 1	Review Java Fundamental - Input and Output - Collection (Array, Array List, Vector, Hash Map) - Class and Object - Constructor	- Review Java Fundamental - Introduction to Java Programming, Chapter 1, 2, 7, 8, 9
2 F2F	LO 1 LO 2	Recursive, Memoization, Bot Movement - Recursive - Memoization - Bot Movement	- Recursive, Memoization, Bot Movement - Competitive Programming 3, Chapter 3 - Introduction to Java Programming, Chapter 6
3 F2F	LO 2	Dynamic Programming I - Coin Change Problem - Travelling Salesman Problem (TSP)	- Dynamic Programming I - Artificial intelligence for games, Chapter 3 - Competitive Programming 3, Chapter 3
4 F2F	LO 2	Dynamic Programming II - Greedy Algorithm - Anagram - Permutation and Combination	- Dynamic Programming II - Artificial intelligence for games, Chapter 3 - Competitive Programming 3, Chapter 3
5 F2F	LO 2	Graph Theory I - Prim - Kruskal	- Graph Theory I - Artificial intelligence for games, Chapter 4 - Competitive Programming 3, Chapter 4, 8
6 F2F	LO 2	Graph Theory II - Dijkstra - A*	- Graph Theory II - Artificial intelligence for games, Chapter 4 - Competitive Programming 3, Chapter 3, 4, 8
7 F2F	LO 2 LO 3	Decision Making - Minimax Tree - Alpha Beta Pruning	- Decision Making - Artificial intelligence for games, Chapter 8 - Competitive Programming 3, Chapter 3,4, 8
8 F2F	LO 2 LO 3	Quiz - Quiz	- Quiz - Artificial intelligence for games, Chapter 4, 8 - Competitive Programming 3, Chapter 3, 4, 8 - Introduction to Java Programming, 1, 2, 6, 7, 8, 9
9 F2F	LO 3	Introduction to 2D Graphics I - Draw Shape - Game Loop - Input System (Mouse and Keyboard) - Collision	- Introduction to 2D Graphics I - Artificial intelligence for games, Chapter 3 - Introduction to Java Programming, Chapter 15
10 F2F	LO 3	Introduction to 2D Graphics II - Draw Shape - Game Loop - Input System (Mouse and Keyboard) - Collision	- Introduction to 2D Graphics II - Artificial intelligence for games, Chapter 3 - Introduction to Java Programming, Chapter 15
11 F2F	LO 3 LO 4	Steering Behaviors - Vector 2D - Seek and Flee	- Steering Behaviors - Artificial intelligence for games, Chapter 3

		- Gravity	
12 F2F	LO 4	Project Collection - Project Collection	- Project Collection - Artificial intelligence for games, Chapter 3, 4, 8 - Competitive Programming 3, Chapter 3, 4, 8 - Introduction to Java Programming, Chapter 1, 2, 6, 7, 8, 9, 15

8. Evaluation

Theory

Assessment Activity	Weight	Learning Outcomes			
		1	2	3	4
Assignment	25%	√	√	√	√
Mid Exam	35%	√	√		
Final Exam	40%		√	√	√

Practicum

Assessment Activity	Weight	Learning Outcomes			
		1	2	3	4
Project	60%	√	√	√	√
Worksheet	40%	√	√	√	√

Final Evaluation Score

Aspects	Weight
Theory	80%
Practicum	20%

9. A. Assessment Rubric (Study Program Specific Outcomes)

LO	Indicators	Proficiency Level			
		Excellent (85 – 100)	**Good (75 – 84)**	**Average (65 – 74)**	**Poor (<= 64)**
LO 1	1.1. Ability to identify fundamental issues occur in implementing AI in Games	Fundamental issues occur in implementing AI in Games are clearly identified	Fundamental issues occur in implementing AI in Games are identified	Fundamental issues occur in implementing AI in Games are not well identified	Fundamental issues occur implementing AI in Games are not identified
	1.2. Ability to explain utilization of AI techniques in Games	Utilization of AI techniques in Games is totally mastered	Utilization of AI techniques in Games is affordable	Utilization of AI techniques in Games is not really realized	Utilization of AI techniques in Games is unknown
LO 2	2.1. Ability to explain fundamental concepts of AI techniques in Games	fundamental concepts of AI techniques in Games are totally mastered	fundamental concepts of AI techniques in Games are affordable	fundamental concepts of AI techniques in Games are not really realized	fundamental concepts of AI techniques in Games are unknown
	2.2. Ability to relate one concept to another	Relationship one concept to another is clearly identified	Relationship one concept to another is identified	Relationship one concept to another is not well defined	Relationship one concept to another is not defined
LO 3	3.1. Ability to build games from AI techniques	Solutions from AI concepts are very well constructed	Solutions from AI concepts are constructed	Solutions from AI concepts are incompleted	Solutions from AI concepts are not defined
	3.2. Ability to extract some functionality from AI techniques in Games	Some functionality from AI techniques are extracted	Some functionality from AI techniques are partly extracted	Some functionality from AI techniques are unconvincing	Some functionality from AI techniques are not extracted
LO 4	4.1. Ability to build AI-based Games	AI-based Games are well built without any mistakes	AI-based Games are well built	AI-based Games are built but still have many mistakes	AI-based Games are not able to be built
	4.2. Ability to evaluate AI-based Games	AI-based Games are very well evaluated	AI-based Games are appropriately evaluated	AI-based Games are little bit evaluated	AI-based Games are not able to be evaluated

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