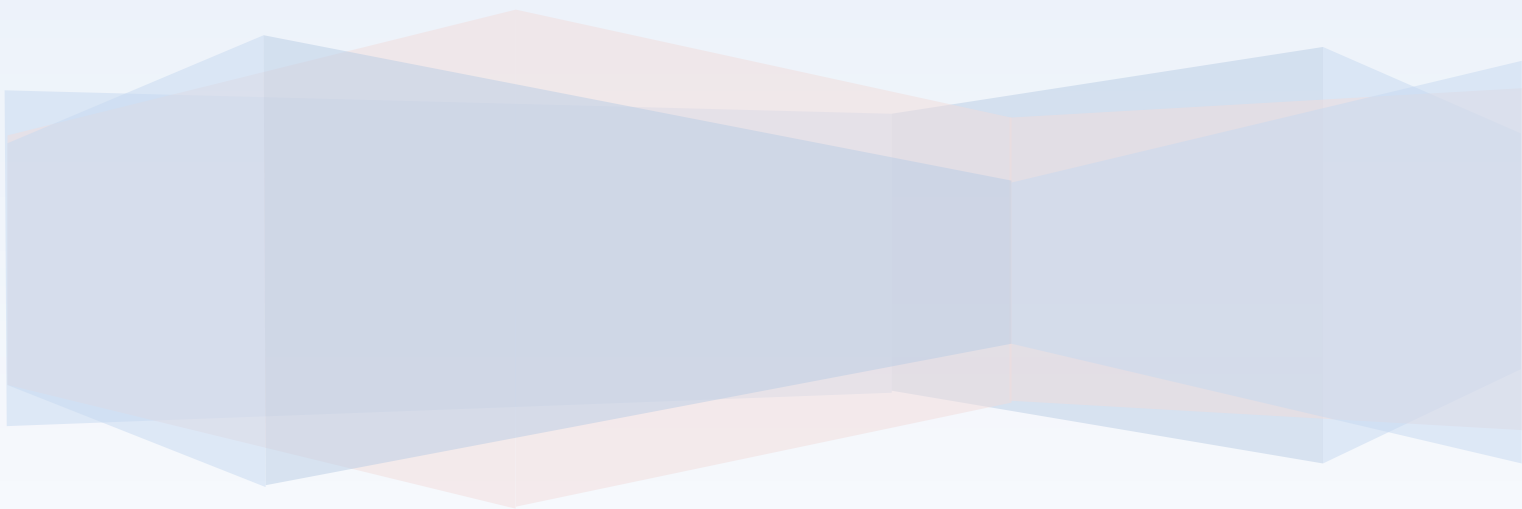# COS30002 Artificial Intelligence for Games

Semester 1, 2023
Learning Summary Report

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Declaration

I declare that this portfolio is my individual work. I have not copied from any other student's work or from any other source except where due acknowledgment is made explicitly in the text, nor has any part of this submission been written for me by another person or software service.

Signature: Adonias Pedro

Self-Assessment Details

The following checklists provide an overview of my self-assessment for this unit.

	Pass (P)	Credit (C)	Distinction (D)	High Distinction (Low HD)	(High HD)
Self-Assessment (please tick)	✓				

Self-assessment Statement

	Included? (tick)
Learning Summary Report	✓
Complete Pass ("core") task work, approved in Canvas	✓

Minimum Pass Checklist

	Included? (tick)
Additional non-core task work (or equivalent) in a private repository and accessible to staff account.	
Spike Extension Report (for spike extensions) in Canvas	
Custom Project plan (for D and/or low HD), and/or High HD Research Plan document in Canvas (optional)	

Credit Checklist, in addition to Pass Checklist

	Included? (tick)
Custom Project Distinction Plan document, approved in Canvas	
All associated work (code, data etc.) available to staff (private repository), for non-trivial custom program(s) of own design	
Custom Project "D" level documents in Canvas, to document the program(s) (structure chart etc) including links to repository areas	

Distinction Checklist, in addition to Credit Checklist

	Included? (tick)
Custom Project "HD" level documents in Canvas, to document the program(s) (structure chart etc) including links to repository areas	

Low High Distinction Checklist, in addition to Distinction Checklist

	Included? (tick)
High Distinction Plan document, approved in Canvas	
High Distinction Report document, in Canvas, which includes links to repository assets	
All associated work (code, data etc.) available to staff (private repository) for your research work	

High High Distinction (Research) Checklist, in addition to D/Low HD Checklist

Introduction

This report summarises what I learnt in COS30002 AI for games. It includes a self-assessment against the criteria described in the unit outline, a justification of the pieces included, details of the coverage of the unit intended learning outcomes, and a reflection on my learning.

Overview of Pieces Included

This section outlines the pieces that I have included in my portfolio…

The pieces that are included in this portfolio are:

- FSM Lab because it gives a structured and efficient way to model complex behaviours and decision-making processes in software systems.
- Tic Tac Toe Lab because a simple yet effective way to practice fundamental programming concepts like logic, loops, and conditions.
- Tic Tac Toe Graphs, Search, Rules because it combines the simplicity of the original with advanced techniques like graph theory and search algorithms, providing a deeper understanding of both game development and problem-solving strategies.
- Navigation with Graphs because it enables efficient traversal and manipulation of complex relational data structures, facilitating tasks such as pathfinding, network analysis, and optimization algorithms.
- PlanetWars because its good for practicing various AI techniques, such as heuristic search algorithms and strategic decision-making.
- Tactical Analysis with PlanetWars because it's good for strategic decision-making and optimization in competitive gameplay scenarios.
- Steering with Seek, Arrive, Flee, Wander, Path and Hide because it allows for the implementation of sophisticated autonomous agent behaviours, enabling the creation of dynamic and realistic simulations
- Agent Marksmanship because it allows for the implementation of precise and strategic decision-making within virtual environments, enhancing the realism and effectiveness of simulated agents.
- Soldier on Patrol because it gives out a practical implementation of autonomous agent behaviour, allowing for the simulation and study of patrol strategies.

Coverage of the Intended Learning Outcomes

This section outlines how the pieces I have included demonstrate the depth of my understanding in relation to each of the unit's intended learning outcomes.

ILO 1: Software Development for Game AI

"Discuss and implement software development techniques to support the creation of AI behaviour in games"

- In lab 7 the techniques to support the creation of the AI behaviour were covered in dictionaries of having goals and action for the AI. It also having 3 functions to help the AI to have a behaviour of applying all its action it's been assigned to and choosing any random action.
- In spike 8 the techniques to support the creation of the AI behaviour in games were covered were mainly defined in 1 class. Which is the class made for the GOAPAgent, which updates the states of the agent, it increases its time, plans for illustration, executes the plan and then checks all its preconditions that it may be assigned to.

ILO 2: Graphs and Path Planning

"Understand and utilise a variety of graph and path planning techniques."

I have utilised the variety of graph and path planning technique in the Spike 6 task. In the box world there is the method called 'plan_path' which does the main thing for planning the paths between starting position and the end position by taking the name of the search algorithm and a limit on the number of iterations. And the utilisation of variety of graphs was done by constructing a navigation graph using the 'SparseGraph' class for each box in the grid is represented as a node, and the connections between these boxes are represented as edges. The edges have varying costs based on the type of terrain, reflecting a weighted graph. All 4 agents in the program were guided through all the planning and graph methods that's been covered.

ILO 3: Force-based Agent Movement

"Create realistic movement for agents using steering force models."

Creating realistic movement for agents using steering forces was demonstrated in my lab 11, 12 and spike 13 tasks. For task 11 and 12 the steering forces were initialised in a dictionary. Seek which demonstrates making the agent to move an entity towards the target. Arrive which demonstrates moving towards a target, aiming to arrive with zero velocity by adjusting its speed based on the distance to the target and a deceleration rate. Flee which does the opposite by moving away from a hunter position by calculating a desired velocity that directs it in the opposite direction. If the hunter is within a panic range. The Wander demonstrates generating random wandering behaviour by using a projected jitter circle. And for spike 13 the hide steering force was created for 1 or more agents in the program to behind a circle object in the program selecting the one closest to the agent's current position. If a suitable hiding spot is found, the agent will move towards it using the arrive method that's been implemented. Otherwise, it will evade the hunter.

ILO 4: Goals and Planning Actions

"Create agents that are capable of planning actions in order to achieve goals."

Creating agents that are capable of planning actions in order to achieve goals was demonstrated in Spike 15 where the attacking agent is programmed to plan which weapon or projectile it will utilise in the program. This was done by creating a projectile class that class initializes with speed, accuracy, position, and direction, and creates a visual representation using a circle shape. It then adjusts the projectile's position over time. And also creating a weapon class that initializes with a specified type of weapon for the agent to use for its actions and creates a `Projectile` object based on the weapon type. Each type (rifle, rocket, handgun, grenade) sets specific speed and accuracy values for the projectile, determined by the weapon's characteristics.

ILO 5: Combine AI Techniques

"Combine AI techniques to create more advanced game AI."

Combining AI techniques to make a more advanced game of ai is demonstrated in task 16 using the FSM technique from task 2, shooting and attack technique from task 9, 10 and 15. This was done by having a

hunter class for inheriting and focusing on a single behaviour, mainly wander, and is designed to represent a chasing entity in the environment. Both classes include methods for calculating forces, updating positions, and rendering the agent's representation on the screen. The attacks happen with a pursuit method that chases and attacks using the FSM ai technique.

Reflection

The most important things I leant:

> The most important things I learnt were:

- FSM because the key learning points for me were the concept of states and transitions and application in problem solving. I learnt what I excepted due to learning about knowing what states that should be used in the program and implementing and identifying the actions in the program.
- Graphs, Search & Rules because the key learning to me were modifying state of doing tic tac toe with an ai, improving the ai's movement and using it to search a graph implanted in the program. I learnt what I wanted which were improving the AI's effectiveness and improving its efficiency which will help for great software development for the future.
- Planet Wars because the key learning points for me were detecting for collision, inputs, controls and designing the environment. I leant what I expected which was getting familiar with playing on planet wars, creating a bot, and making bots battle each other.

The things that helped me most were:

- Lecture Slide because when coding the program, the lecture would have methods and classes as examples on knowing to get a whole program working properly which was like a life saver basically and helped me gained knowledge how to code various methods like a flee method, seek method, hide method etc.
- Asking peers helped a lot because I would ask my classmates or friends on how to get a class or method made to perform a task in a program.
- The tutor was mainly the biggest helper of them all as the tutor was always confident on knowing how to fix a error that would be occurred in a program and that helped in understand how to read and fix an error way better than my previous years of coding.

I found the following topics particularly challenging:

- Agent marksmanship was challenging because I thought referring to planet wars would help a lot by making a agent shoot but it was completely different. Figuring out on how to make an agent pick what weapon and projectile was hardest part of the whole topic.
- Tactical Steering (Hide!) was another challenging tasks mainly because trying to code out on how to make not only but multiple agents hide behind a circle object felt nearly impossible as it was so tactical to code out in the program.
- Soldier on Patrol was challenging because it uses other ai techniques to make this ai more complex than the previous one. It was hard because trying to implement FSM and a bunch of modes in one object-oriented language felt too technical at one point.

I found the following topics particularly interesting:

- Tic Tac Toe was interesting mainly because it was something I already one before. But it became more interesting when it came to making the ai scan the gameboard and make a move based on graphs which was something I never done before.
- FSM was also particularly interesting because it was something new to me. I enjoyed making a bunch of states for the machine and creating variables to causes state changes in the program.
- Planet Wars was challenging but still very interesting due to learning how to make ships shoot out of planets. And planet wars were very fresh to me as I never did it before. It was also interesting because testing each bot in different kind of maps.

I feel I learnt these topics, concepts, and/or tools really well:

- I feel like I learnt the tool of hiding agents behind a object very well by analysing how the agents will find a object near them very well. It did not only enhance my grasp of spatial reasoning but also deepened my insight into the intricate strategies employed by autonomous entities within simulated environments.

- I feel like I leant the concept of having an ai agent scan a game board very well by implementing a method to scan it simply. Mastering the concept of board scanning has empowered me to create more sophisticated and strategic AI systems in various gaming scenarios.
- I feel like I learnt the topic Finite State machine very because of the state transitions, grasped the concept of state hierarchies, and applied FSMs to model complex behaviours efficiently. This comprehensive exploration not only solidified my understanding of FSMs but also equipped me with a versatile tool for designing intelligent systems with clear, structured decision-making processes.

I still need to work on the following areas:

- Drawing graphical things on a GUI e.g. Bullets. When making the program, coding on how a particular shape should look is not as challenging but when to appending it drawing in the program it's a bit challenging and its something I still need to work on.
- Understanding errors more would be better as well. Especially if I'm coding by myself and I would get an error, I would usually understand it, but if it's a very complex error it can be very hard to understand the wrong in the whole program.
- Navigating with graphs is another one because trying to code out a search algorithm for the AI to look for a path can be really harsh at times and also something I need to work on. Overall, working with graph navigation has provided valuable insights into the intricacies of AI pathfinding, underscoring its significance in creating immersive and dynamic game experiences.
- Assigning a object to a method e.g. accidently assigning an agent to work as a bullet. At times I wouldn't know to assign an agent to do a certain task. Through this exploration, I gained valuable insights into the nuances of agent behaviour implementation and the critical role of method allocation in maintaining simulation integrity and functionality.

My progress in this unit was …:

Constantly submitting and engaging with the tutor was always a priority for this unit. The tutor would always tell me what needed to be fixed weather it'll be in the code or a spike report. My rate of progress affections overall for learning and final grade seems more than I could expected they were certain that I didn't I could complete but I did end doing it with extra assistance. The things I've learnt like making tactical methods, classes, AI and agents could take me into units that are related to either AI or machine learning that I would want to learn.

This unit will help me in the future:

It will relate to the rest of my studies and career with versatile skills applicable across various domains, enhancing my problem-solving abilities and strategic thinking, which are vital not only in game development but also in other fields such as robotics and finance.

And the things I've learnt like navigation with search algorithms, modifying AI, steering agents will definitely provide a solid foundation for understanding complex systems, decision-making processes, and optimization algorithms, empowering me to tackle real-world challenges and contribute effectively to innovative projects in my future career endeavours.

If I did this unit again I would do the following things differently:

I would try to get more assistance from the tutor as I didn't ask for to much assistance unit the middle of the semester. I would also start the tasks from the first week mainly I started ab bit later on. I would manage to navigate through the unit independently for a significant portion of the semester, I now realize the value of seeking clarification and guidance early on. By engaging with the tutor sooner, I can ensure a clearer understanding of the course material from the beginning, laying a stronger foundation for subsequent topics.

Other…:

I also intend to engage more actively with supplementary learning resources such as online forums, tutorials, and academic papers. By expanding my sources of information beyond the course materials. By taking a more holistic approach to learning, encompassing both formal instruction and independent exploration, I know I can maximize my learning outcomes and become proficient in AI for Games.

Conclusion

In summary, I believe that I have clearly demonstrate that my portfolio is sufficient to be awarded a Pass grade.