

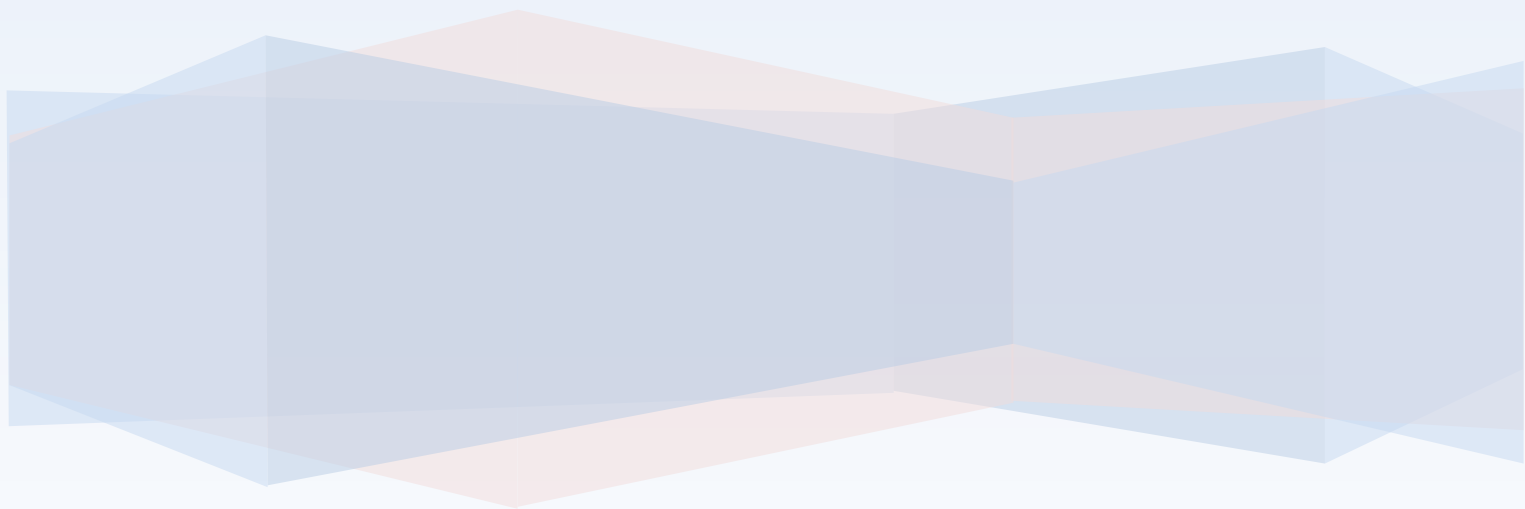
# COS30002 AI for Games

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*Semester 1, 2019*

*Learning Summary Report*

Sam Huffer (101633177)

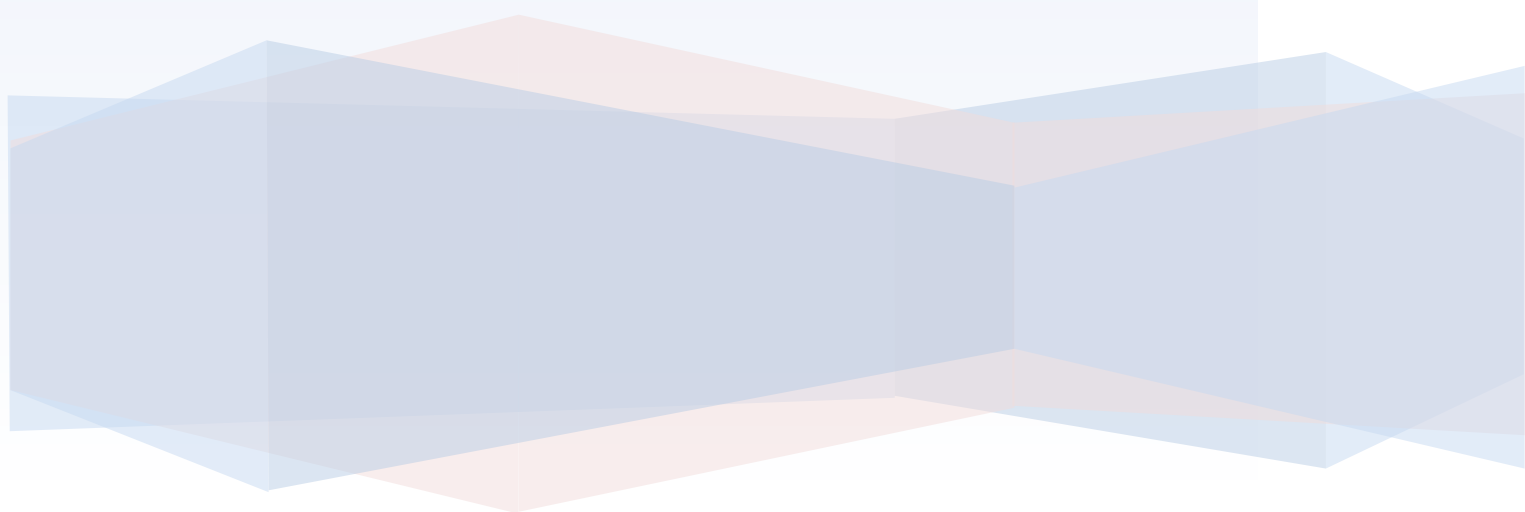


# COS30002 AI for Games

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*Learning Summary Report*

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## 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	✓
Time-boxed Demonstration Activity (Lab Test) in Doubtfire	✓
Complete Pass ("core") task work, approved in Doubtfire	✓

### 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 Doubtfire	✓
Custom Project plan (for D and/or low HD), and/or High HD Research Plan document in Doubtfire (optional)	✓

### Credit Checklist, in addition to Pass Checklist

	Included? (tick)
Custom Project Distinction Plan document, approved in Doubtfire	✓
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 Doubtfire, 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 Doubtfire, 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 Doubtfire	
High Distinction Report document, in Doubtfire, 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

Task	Included?	Justification
Task 1: Bitbucket Setup	Y	Illustrates competence with tools used in software and game development, and therefore somewhat related to ILO 1.
Task 2: FSM and Python	Y	Illustrates learning regarding FSMs and state diagrams, which relate to ILO 1.
Task 3: Tic Tac Toe	Y	Illustrates learning regarding FSMs, state diagrams, and competing game AIs, which relate to ILO 1.
Task 4 (Spike): Goal-Oriented Behaviour	Y	Illustrates learning regarding GOB and SGI, which relate to ILO 4.
Task 5: PlanetWars Bots	Y	Illustrates learning regarding GOB, which relates to ILO 4.
Task 6: Graphs, Search and Rules	Y	Illustrates learning regarding graphs, searches, and path planning, which relate to ILO 2; with GOB, which relates to ILO 4; and regarding combining the above, relating to ILO 5.
Task 7 (Spike): Tactical Analysis with PlanetWars	Y	Illustrates learning regarding tactical analysis for GOB, which relates to ILO 4.
Task 8: Autonomous Steering: Seek, Arrive, Flee	Y	Illustrates learning regarding force-based agent movement (ILO 3).
Task 9: Autonomous Steering: Wander and Paths	Y	Illustrates learning regarding force-based agent movement (ILO 3) and combining AI techniques for more complex behaviour (ILO 5).
Task 10 (Spike): Tactical Steering	Y	Illustrates learning with force-based agent movement (ILO 3), tactical analysis for GOB, which relates to ILO 4, and combining AI techniques for more complex behaviour (ILO 5).
Task 11 (Spike): Emergent Group Behaviour	Y	Illustrates learning with force-based agent movement (ILO 3), tactical analysis for GOB, which relates to ILO 4, and combining AI techniques for more complex behaviour (ILO 5).
Task 12: Test	Y	Answered questions 2 and 6, which illustrate learning regarding the concepts of game balance, bias, strategy and tactics, which relate to ILOs 1 and 4.
Task 13: Test Response	N	Not attempted; consulted with Tien, who figured my test responses were sufficient, and suggested I only do it if I had time, which I ran out of.
Task 14 (Spike): Agent Marksmanship	Y	Illustrates learning with software development for game AI (ILO 1), goals and planning actions (ILO 4) and combining AI techniques (ILO 5).
Task 15 (Spike): Soldier on Patrol	Y	Illustrates proficiency regarding FSMs, which relate to ILO 1, with force-based agent movement (ILO 3), with GOB and tactical analysis, which relate to ILO 4, and combining AI techniques (ILO 5).
Task 16 (Spike): Goal-Oriented Action Planning	Y	Illustrates learning regarding GOB and planning actions (ILO 4), as well as proficiency regarding FSMs, which relate to ILO 1, tactical analysis, which relates to ILO 4, and combining AI techniques (ILO 5).
Task 17: Graphs, Paths and Search	Y	Illustrates learning regarding graphs and path planning (ILO 2), GOB (ILO 4) and combining AI techniques (ILO 5).

Task 18 (Spike): Navigation with Graphs	Y	Illustrates learning regarding graphs and path planning (ILO 2), GOB and tactical analysis (ILO 4) and combining AI techniques (ILO 5).
Task 19 (Credit): Spike Extension Report	Y	Illustrates understanding and reiterates learning and proficiency regarding all outcomes.
Task 20 (Credit): Custom Project Plan	Y	Illustrates understanding regarding FSMs, which relate to ILO 1, graphs, searches and path planning (ILO 2), GOB and tactical analysis, which relate to ILO 4, and combining AI techniques (ILO 5).
Task 21 (Distinction): Distinction-Level Custom Project	Y	Illustrates proficiency regarding FSMs and software development for game AI, which relate to ILO 1, graphs, searches and path planning (ILO 2), GOB and tactical analysis, which relate to ILO 4, and combining AI techniques (ILO 5).
Task 22 (Credit): Research Plan	Y	Illustrates understanding regarding software development for game AI (ILO 1); findings might have furthered learning regarding ILOs 2 through 5.
Task 23 (High Distinction): High Distinction-Level Custom Project	N	Not attempted; not going for HD.
Task 24 (High Distinction): Research Report	N	Not attempted; not going for HD.
Task 25: Portfolio	Y	Illustrates understanding and reiterates learning and proficiency regarding all outcomes.

## 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."*

To demonstrate my pass-level learning, proficiency and achievement regarding ILO 1: Software Development for Game AI, I have included in my portfolio the following tasks:

- Task 1: Bitbucket Setup. The Task Summary PDF on Canvas lists this task – setting up a Bitbucket repository to store all work done for this unit – as pertaining to this outcome at a pass level; I suppose setting up a repository demonstrates familiarity with the tools required for game development, and allows for the examination of other tasks by assessors. Beyond that, it doesn't particularly relate to AI for games specifically.
- Task 2: FSM and Python. In this task's pass-level content, I demonstrate my learning regarding AI states, basic finite state machines (FSMs), and state diagrams outlining the states and state transitions of FSMs, by drawing up a state diagram for a simple FSM, and implementing that FSM.
- Task 3: Tic Tac Toe. In this task's pass-level content, I demonstrate my learning regarding basic FSMs, state diagrams, and competing game AIs pitted against one another by creating several bots to play games of Tic Tac Toe.
- Task 12: Test. In this task's pass-level content, I demonstrate my learning and understanding regarding the concepts of game balance and player bias, answering question 2 and outlining the aforementioned concepts and discussing the suitability of different levels of game balance and AI bias for different players. I also demonstrate my learning regarding the concepts of strategy and tactics, answering question 6 and outlining the difference between the two, and providing examples of each in existing games.
- Task 14 (Spike): Agent Marksmanship. In this task's pass-level content, I demonstrate my learning and proficiency regarding the application of game and software development techniques by implementing predictive targeting and object pooling in a games AI context.
- Task 15 (Spike): Soldier on Patrol. In this task's pass-level content, I demonstrate my learning and proficiency regarding FSMs by implementing multi-level FSMs, with high-level states encapsulating low-level behaviours and the decision-making code to utilise them.
- Task 16 (Spike): Goal-Oriented Action Planning. In this task's pass-level content, I demonstrate proficiency regarding FSMs by adding further states and the requisite code to the agent class, and allowing the agent to plan to return to previous tasks if conditions permit.
- Task 25: Learning Summary Report. In this task's pass-level content, I demonstrate my learning and understanding and highlight my proficiency regarding software and game development techniques for game AI by summarising and highlighting how each task that relates to this outcome does so, and how my achievements in that task demonstrate my learning and proficiency.

To demonstrate my credit-level learning, proficiency and achievement with ILO 1: Software Development for Game AI, I have included in my portfolio the following tasks:

- Task 14 (Spike): Agent Marksmanship. In this task's credit-level content, I demonstrate my learning and proficiency regarding FSMs and the application of game and software development techniques by using states to simulate explosive projectiles and the rate of fire of weapons in a gamic environment.
- Task 16 (Spike): Goal-Oriented Action Planning. In this task's pass-level content, I implement further agent states and tactical analysis-based decision making that could have been completed as an extension to Task 15 (Spike): Soldier on Patrol, thereby demonstrating credit-level understanding and proficiency regarding multi-level FSMs.
- Task 19 (Credit): Spike Extension Report. In this task's credit-level content, I demonstrate my learning and understanding and highlight my proficiency regarding software and game development techniques for game AI by summarising and highlighting extensions completed for each spike, including extensions that relate to this learning outcome.
- Task 20 (Credit): Custom Project Plan. In this task's credit-level content, I demonstrate my understanding regarding FSMs by designing and drawing up state diagrams for FSMs for my custom project.
- Task 22 (Credit): Research Plan. In this task's credit-level content, I demonstrate my understanding and curiosity regarding software development for game AI by devising a research project that would

investigate and compare game AI tools and methods used in two RPGs, which would provide opportunity to further my learning in regards to ILOs 2 through 5.

To demonstrate my distinction-level learning, proficiency and achievement regarding ILO 1: Software Development for Game AI, I have included in my portfolio the following tasks:

- Task 21 (Distinction): Custom Project. In this task's distinction-level content, I demonstrate my proficiency regarding FSMs by implementing the agents designed for Task 20 (Credit): Custom Project Plan and editing the state diagram for the project based on the final implementation and any refinements over the original design, as well as regarding software development for game AI generally by producing a UML class diagram of the finished project.

## ILO 2: Graphs and Path Planning

*"Understand and utilize a variety of graph and path planning techniques."*

To demonstrate my pass-level learning, proficiency and achievement regarding ILO 2: Graphs and Path Planning, I have included in my portfolio the following tasks:

- Task 6: Graphs, Search and Rules. In this task's pass-level content, I demonstrate my learning regarding graphs, searches and path planning by completing and running simulations of the Towers of Hanoi and Water Jugs problems, broadening my understanding of how searches can be applied to graphs to plan sequences of actions.
- Task 17: Graphs, Paths, and Searches. In this task's pass-level content, I demonstrate my learning regarding graphs, searches and path planning by completing the required changes and discussing the merits of different search behaviours and graph properties and their implications for planning paths.
- Task 18 (Spike): Navigation with Graphs. In this task's pass-level content, I demonstrate my learning and proficiency regarding graphs, searches and path planning by implementing multiple types of agents that move around using searches to plan paths along the network that comprises the box world.
- Task 25: Learning Summary Report. In this task's pass-level content, I demonstrate my learning and understanding and highlight my proficiency regarding graphs, searches and path planning by summarising and highlighting how each task that relates to this outcome does so, and how my achievements in that task demonstrate my learning and proficiency.

To demonstrate my credit-level learning, proficiency and achievement regarding ILO 2: Graphs and Path Planning, I have included in my portfolio the following tasks:

- Task 18 (Spike): Navigation with Graphs. In this task's credit-level content, I demonstrate my learning and proficiency regarding graphs, searches and path planning by implementing predictive shooting that uses the box world's network and agents' planned paths to predict their future position.
- Task 19 (Credit): Spike Extension Report. In this task's credit-level content, I demonstrate my learning and understanding and highlight my proficiency regarding graphs, searches and path planning by summarising and highlighting extensions completed for each spike, including extensions that relate to this learning outcome.
- Task 20 (Credit): Custom Project Plan. In this task's credit-level content, I demonstrate my understanding regarding graphs, searches and path planning by outlining how I plan to use them in my custom project to constitute graph-based patrolling, attacking, scouting and fleeing movement behaviours.

To demonstrate my distinction-level learning, proficiency and achievement regarding ILO 2: Graphs and Path Planning, I have included in my portfolio the following tasks:

- Task 21 (Distinction): Custom Project. In this task's distinction-level content, I demonstrate my proficiency regarding graphs, searches and path planning by implementing the graph-based movement behaviours (patrolling, attacking, scouting and fleeing) designed for Task 20 (Credit): Custom Project Plan, and using graphs, searches and path planning to inform agents' decision making and to update the current waypoint on the lead soldier's death.

## ILO 3: Force-Based Agent Movement

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

To demonstrate my pass-level learning, proficiency and achievement regarding ILO 3: Force-Based Agent Movement, I have included in my portfolio the following tasks:

- Task 8: Autonomous Steering: Seek, Arrive, Flee. In this task's pass-level content, I demonstrate my learning and proficiency regarding force-based agent movement by drawing a UML class diagram of the existing classes provided for this task, and fully implementing basic force-based seeking, arriving and fleeing behaviours, and then developing pursuit behaviour, varying the shapes of agents, and attempting to limit different steering forces separately.
- Task 9: Autonomous Steering: Wander and Paths. In this task's pass-level content, I demonstrate my learning and proficiency regarding force-based agent movement by implementing further basic force-based behaviours of wandering and following a path.
- Task 10 (Spike): Tactical Steering. In this task's pass-level content, I demonstrate my learning and proficiency regarding force-based movement by implementing hiding behaviour for prey agents.
- Task 11 (Spike): Emergent Group Behaviour. In this task's pass-level content, I demonstrate my learning and proficiency regarding force-based movement by implementing cohesion, separation and alignment steering behaviours.
- Task 15 (Spike): Soldier on Patrol. In this task's pass-level content, I demonstrate my learning and proficiency regarding force-based movement by implementing and adapting movement behaviours for use by high-level attacking and patrolling states.
- Task 25: Learning Summary Report: In this task's pass-level content, I demonstrate my learning and understanding and highlight my proficiency regarding force-based agent movement by summarising and highlighting how each task that relates to this outcome does so, and how my achievements in that task demonstrate my learning and proficiency.

To demonstrate my credit-level learning, proficiency and achievement regarding ILO 3: Force-Based Agent Movement, I have included in my portfolio the following tasks:

- Task 10 (Spike): Tactical Steering. In this task's credit-level content, I demonstrate my learning and proficiency regarding force-based movement by implementing the ability for agents to avoid obstacles.
- Task 11 (Spike): Emergent Group Behaviour. In this task's credit-level content, I demonstrate my learning and proficiency regarding force-based movement by implementing walls, agent- and wall-avoidance behaviours, and attempting to balance group movement behaviours to get aesthetically-pleasing group movement amongst the prey agents.
- Task 19 (Credit): Spike Extension Report. In this task's credit-level content, I demonstrate my learning and understanding and highlight my proficiency regarding force-based agent movement by summarising and highlighting extensions completed for each spike, including extensions that relate to this learning outcome.

## ILO 4: Goals and Planning Actions

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

To demonstrate my pass-level learning, proficiency and achievement regarding ILO 4: Goals and Planning Actions, I have included in my portfolio the following tasks:

- Task 4 (Spike): Goal-Oriented Behaviour. In this spike's pass-level content, I demonstrate my learning regarding goal-oriented behaviour (GOB) achieved through simple goal insistence (SGI) by implementing basic GOB and SGI, and discussing some limits of SGI.
- Task 5: PlanetWars Bots. In this task's pass-level content, I demonstrate my learning and growing proficiency regarding GOB, writing pseudocode for and implementing several simple bots to compete in PlanetWars simulations.
- Task 6: Graphs, Search and Rules. In this task's pass-level content, I demonstrate my learning regarding GOB by completing and running simulations of the Towers of Hanoi and Water Jugs problems, searching graphs to plan a sequence of actions to achieve a desired goal.
- Task 7 (Spike): Tactical Analysis with PlanetWars. In this task's pass-level content, I demonstrate my learning and proficiency with GOB achieved through tactical analysis, by developing GOB bots for the PlanetWars simulation, that use simple and complex tactical analysis to inform their decisions, and comparing their success rates across a number of PlanetWars maps.
- Task 10 (Spike): Tactical Steering. In this task's pass-level content, I demonstrate my learning and proficiency regarding GOB by having prey agents use tactical analysis to further their goal of evading the predator agent.
- Task 11 (Spike): Emergent Group Behaviour. In this task's pass-level content, I demonstrate my learning and proficiency regarding GOB by implementing force-based movement behaviours that facilitate



the goal of agents moving in groups, and using tactical analysis while prioritising and weighting those movement behaviours to best address the agent's (prioritised) goals.

- Task 14 (Spike): Agent Marksmanship. In this task's pass-level content, I demonstrate my learning and proficiency regarding GOB, tactical analysis and planning by implementing weapons and predictive targeting to further agents' goals of attacking and accurately shooting enemy agents.
- Task 15 (Spike): Soldier on Patrol. In this task's pass-level content, I demonstrate my learning and proficiency regarding GOB and tactical analysis by using tactical analysis to inform agents' switches between states that control low-level behaviours to pursue various goals.
- Task 16 (Spike): Goal-Oriented Action Planning. In this task's pass-level content, I demonstrate learning regarding GOB and planning actions by having agents, under certain conditions, record that they observed something or were doing something, and planning to return to it, barring any timeouts. I also demonstrate proficiency regarding tactical analysis, as it is used to inform the decisions and planning mentioned above.
- Task 17: Graphs, Paths, and Searches. In this task's pass-level content, I demonstrate my learning and understanding regarding GOB by applying graphs, searches and path planning to achieve specified goals, and discussing the merits of particular configurations in relation to achieving those goals.
- Task 18 (Spike): Navigation with Graphs. In this task's pass-level content, I demonstrate my learning and proficiency regarding GOB and tactical analysis by implementing multiple agents of varying types that analyse the network that comprises the box world to inform decision making for furthering agents' goals.
- Task 25: Learning Summary Report. In this task's pass-level content, I demonstrate my learning and understanding and highlight my proficiency regarding GOB, tactical analysis and action planning by summarising and highlighting how each task that relates to this outcome does so, and how my achievements in that task demonstrate my learning and proficiency.

To demonstrate my credit-level learning, proficiency and achievement regarding ILO 4: Goals and Planning Actions, I have included in my portfolio the following tasks:

- Task 4 (Spike): Goal-Oriented Behaviour. In this spike's credit-level content, I demonstrate my learning regarding GOB and SGI by converting the procedural, pass-level version of this program into an object-oriented (OO) version, and discussing the pros and cons OO programming affords in this context.
- Task 7 (Spike): Tactical Analysis with PlanetWars. In this task's credit-level content, I demonstrate my learning and understanding regarding GOB and tactical analysis by discussing further information that could be used for tactical analysis in the simulation, and the implications of PlanetWars' fog of war regarding tactical analysis, and of symmetrical versus asymmetrical maps regarding game bias and balance.
- Task 10 (Spike): Tactical Steering. In this task's credit-level content, I demonstrate my learning and proficiency regarding GOB by having prey agents use tactical analysis to choose hiding spots from multiple predator agents intelligently, furthering their goal of evading the predator agents and not being eaten.
- Task 11 (Spike): Emergent Group Behaviour. In this task's credit-level content, I demonstrate my learning and proficiency regarding GOB by implementing force-based movement behaviour that facilitate the goals of agents not overlapping and avoiding walls, and regarding tactical analysis by adding a predator agent that prey agents have to use tactical analysis to evade.
- Task 12: Test. In this task's pass-level content, I demonstrate my learning and understanding regarding GOB by discussing the concepts of game balance and player bias, answering question 2 and discussing biases players will have for particular strategies in pursuit of in-game goals. I also discuss the concepts of strategy and tactics, answering question 6 and outlining the difference between the two, providing examples of each in existing games of how tactics are used to meet the underlying goals of a strategy in a given environment.
- Task 14 (Spike): Agent Marksmanship. In this task's credit-level content, I demonstrate my learning and proficiency regarding GOB and tactical analysis by implementing weapons that force agents to account for their range, and adapting object-avoidance behaviour to help agents evade nearby, slow projectiles.
- Task 16 (Spike): Goal-Oriented Action Planning. In this task's pass-level content, I implement further agent states and tactical analysis-based decision making that could have been completed as an extension to Task 15 (Spike): Soldier on Patrol, thereby demonstrating credit-level understanding and proficiency regarding GOB and tactical analysis.

- Task 18 (Spike): Navigation with Graphs. In this task's credit-level content, I demonstrate my learning and proficiency regarding tactical by implementing predictive shooting that uses tactical analysis of the box world's network and agents' planned paths to predict agents' future positions.
- Task 19 (Credit): Spike Extension Report. In this task's credit-level content, I demonstrate my learning and understanding and highlight my proficiency regarding GOB, tactical analysis and action planning by summarising and highlighting extensions completed for each spike, including extensions that relate to this learning outcome.
- Task 20 (Credit): Custom Project Plan. In this task's credit-level content, I demonstrate my understanding regarding GOB and tactical analysis by outlining the GOB the agents in my custom project will display and the tactical analysis required for much of the involved decision making.

To demonstrate my distinction-level learning, proficiency and achievement regarding ILO 4: Goals and Planning Actions, I have included in my portfolio the following tasks:

- Task 21 (Distinction): Custom Project. In this task's distinction-level content, I demonstrate my proficiency regarding GOB and tactical analysis by implementing tactical analysis informed by graphs, searches and paths as outlined in Task 20 (Credit): Custom Project Plan to achieve agents' goals.

## ILO 5: Combine AI Techniques

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

To demonstrate my pass-level learning, proficiency and achievement regarding ILO 5: Combine AI Techniques, I have included in my portfolio the following tasks:

- Task 6: Graphs, Search and Rules. In this task's pass-level content, I demonstrate my learning regarding combining AI techniques by completing and running simulations of the Towers of Hanoi and Water Jugs problems, using graphs and searching to plan the sequence of actions necessary to achieve a particular goal, combining graphs, searching and path planning with GOB.
- Task 9: Autonomous Steering: Wander and Paths. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by applying force-based movement to following the nodes of a path.
- Task 10 (Spike): Tactical Steering. In this task's pass-level content, I demonstrate my learning and proficiency combining AI techniques by having prey agents use tactical analysis to further their goal of evading the predator agent using force-based movement behaviours.
- Task 11 (Spike): Emergent Group Behaviour. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by combining cohesion, separation and alignment movement behaviours to generate emergent group behaviours amongst prey agents, and tactical analysis while prioritising and weighting agents' goals.
- Task 14 (Spike): Agent Marksmanship. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by implementing and using tactical analysis to inform predictive targeting of enemy agents, furthering agents' goals of attacking and shooting enemy agents.
- Task 14 (Spike): Agent Marksmanship. In this task's credit-level content, I demonstrate my learning and proficiency regarding FSMs and the application of game and software development techniques by using states to simulate explosive projectiles and the rate of fire of weapons in a gamic environment.
- Task 15 (Spike): Soldier on Patrol. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by using tactical analysis to inform agents' switches between high level states that control low-level force-based movement behaviours to pursue various goals.
- Task 17: Graphs, Paths, and Searches. In this task's pass-level content, I demonstrate my learning, understanding and proficiency regarding combining AI techniques by applying graphs, searches and path planning to achieve specified goals, and discussing the merits of particular configurations in relation to achieving those goals.
- Task 18 (Spike): Navigation with Graphs. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by implementing multiple agents of varying types that apply tactical analysis to the network that comprises the box world to inform decision making and select targets for path planning, allowing agent movement and furthering their goals.
- Task 25: Learning Summary Report: In this task's pass-level content, I demonstrate my learning and understanding and highlight my proficiency regarding combining AI techniques by summarising and highlighting how each task that relates to this outcome does so, and how my achievements in that task demonstrate my learning and proficiency.

To demonstrate my credit-level learning, proficiency and achievement regarding ILO 5: Combine AI Techniques, I have included in my portfolio the following tasks:

- Task 10 (Spike): Tactical Steering. In this task's credit-level content, I demonstrate my learning and proficiency combining AI techniques by having prey agents use force-based obstacle avoidance to further the goal of not colliding with obstacles, balanced against the use of other force-based movement behaviours to move to locations to hide from multiple predators, locations chosen using tactical analysis.
- Task 11 (Spike): Emergent Group Behaviour. In this task's pass-level content, I demonstrate my learning and proficiency regarding combining AI techniques by modifying and comparing weightings of cohesion, separation and alignment steering behaviours to generate different emergent behaviours, while investigating circling behaviour, and using force-based movement to further the agents' goals of avoiding walls and each other.
- Task 14 (Spike): Agent Marksmanship. In this task's credit-level content, I demonstrate my learning and proficiency regarding combining AI techniques by adapting force-based object avoidance and tactical analysis to enable agents to avoid nearby slow-moving projectiles, and by combining tactical analysis-informed predictive targeting of enemy agents with states for explosive projectiles and weapons' rate of fire to simulate realistic weapons in a gamified environment.
- Task 16 (Spike): Goal-Oriented Action Planning. In this task's pass-level content, I implement further agent states and tactical analysis-based decision making that could have been completed as an extension to Task 15 (Spike): Soldier on Patrol, thereby demonstrating credit-level understanding and proficiency regarding combining AI techniques for more complex behaviour.
- Task 18 (Spike): Navigation with Graphs. In this task's credit-level content, I demonstrate my learning and proficiency regarding combining AI techniques by implementing predictive shooting that uses tactical analysis of the box world's network and agents' planned paths to predict agents' future positions.
- Task 19 (Credit): Spike Extension Report. In this task's credit-level content, I demonstrate my learning and understanding and highlight my proficiency regarding combining AI techniques by summarising and highlighting extensions completed for each spike, including extensions that relate to this learning outcome.
- Task 20 (Credit): Custom Project Plan. In this task's credit-level content, I demonstrate my understanding regarding combining AI techniques by outlining how I will use graph-based movement behaviours to fulfil agents' goals, using tactical analysis to inform switches between high-level states that will control low-level behaviours.

To demonstrate my distinction-level learning, proficiency and achievement regarding ILO 5: Combine AI Techniques, I have included in my portfolio the following tasks:

- Task 21 (Distinction): Custom Project. In this task's distinction-level content, I demonstrate my proficiency regarding combining AI techniques by implementing the behaviours and functionality outlined in Task 20 (Credit): Custom Project Plan, using graphs, searches and path planning to facilitate graph-based movement and the tactical analysis required to inform state switches to pursue agents' goals, as outlined in the updated state diagram produced for my custom project report.

## Reflection

### The most important things I learnt:

- The underlying logic behind a number of force-based AI movement behaviours that can be combined and modified to form more complex behaviours (i.e. alignment, cohesion and separation).
- How search algorithms and networks can be applied in AI movement to make decisions about where to go, and follow paths to get to one's destination in a graph-based world.
- Pros and cons of different ways of having AIs move in a boxed, graph-based environment in relation to customizability of the simulation space by the user.

### The things that helped me most were:

- The lecture notes that outlined the logic required for particular movement behaviours, as they gave me a basis for the implementation of those behaviours and gave me ideas to work with in case that implementation ran into issues and I needed to devise an alternative.
- The lab and spike work, as it allowed me to explore the topic and build my understanding of it and competencies it required by working through each requirement of the task.
- Google search results for specific questions related to programming in python.

### I found the following topics particularly challenging:

None of the topics were especially challenging conceptually; I found they were all reasonably straightforward. The challenges came from the implementation, such as:

- Implementing the detection of objects using feelers as outlined in the lecture slides: there were one or two aspects of how to implement it that didn't click in my mind until after the submission of the task, resulting in me improvising an alternative obstacle-avoidance method using two detection circles.
- Balancing the group steering behaviours in Task 11 to create functional and nice-looking steering behaviours: getting the magnitudes of the different forces and combining them all was tricky to do. I managed it somewhat, but not to the point of replicating the smoothness of the behaviours as demonstrated in the lecture, nor to the point of getting the prey agents circling around the simulation space.

### I found the following topics particularly interesting:

- Force-based steering behaviours and emergent group behaviour (including patrolling): these behaviours appear to form the basis of how enemy AIs move in, for example, first- and third-person shooters and adventure games, and thus struck me as being of particular practical value.
- Predicting the location of a target an AI is shooting at, another fundamental behaviour required of any game involving AIs shooting each other or the player.
- Graph-based locations and movement: this seemed an interesting alternative means of moving around a virtual space besides force-based steering.

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

- Finite state machines, both with regard to designing them and drawing them up in state diagrams, as well as implementing them. For evidence, see Tasks 15 and 16 and my custom project, as well as my comments regarding them above, under ILO 1L Software Development for Game AI.
- Graphs, searches, and path planning, and their applicability for graph-based movement and informing tactical analysis. For evidence, see Tasks 17 and 18 and my custom project, as well as my comments regarding them above, under ILO 2: Graphs and Path Planning.
- Force-based movement behaviours. For evidence, see Tasks 8 through 11 and 15, as well as my comments regarding them above, under ILO 3: Force-Based Agent Movement.

### I still need to work on the following areas:

- Emergent group behaviour. My ability to weight cohesion, separation and alignment behaviours to generate elegant and sophisticated emergent behaviour could use some work, as I discuss in my spike report for Task 11.

- Planning actions. I feel I could learn and demonstrate more regarding goal-oriented action planning than I demonstrated in Task 16, particularly with where the line is between reactive goal-oriented behaviour and goal-oriented action planning.

### My progress in this unit was . . . :

During the semester, I worked consistently on my tasks, handing almost all of the lab and spike work in on time. The only gaps in my progress during the semester according to the burndown chart were during the mid-semester break, when there were no tasks due and I elected to focus on work for my concurrent capstone project, and while I was working on upcoming assignments from other units while waiting for the release of the instructions of Task 18: Navigation with Graphs and the credit tasks. Otherwise, I have worked consistently on each week's tasks from that week's tutorial until the tasks' completion.

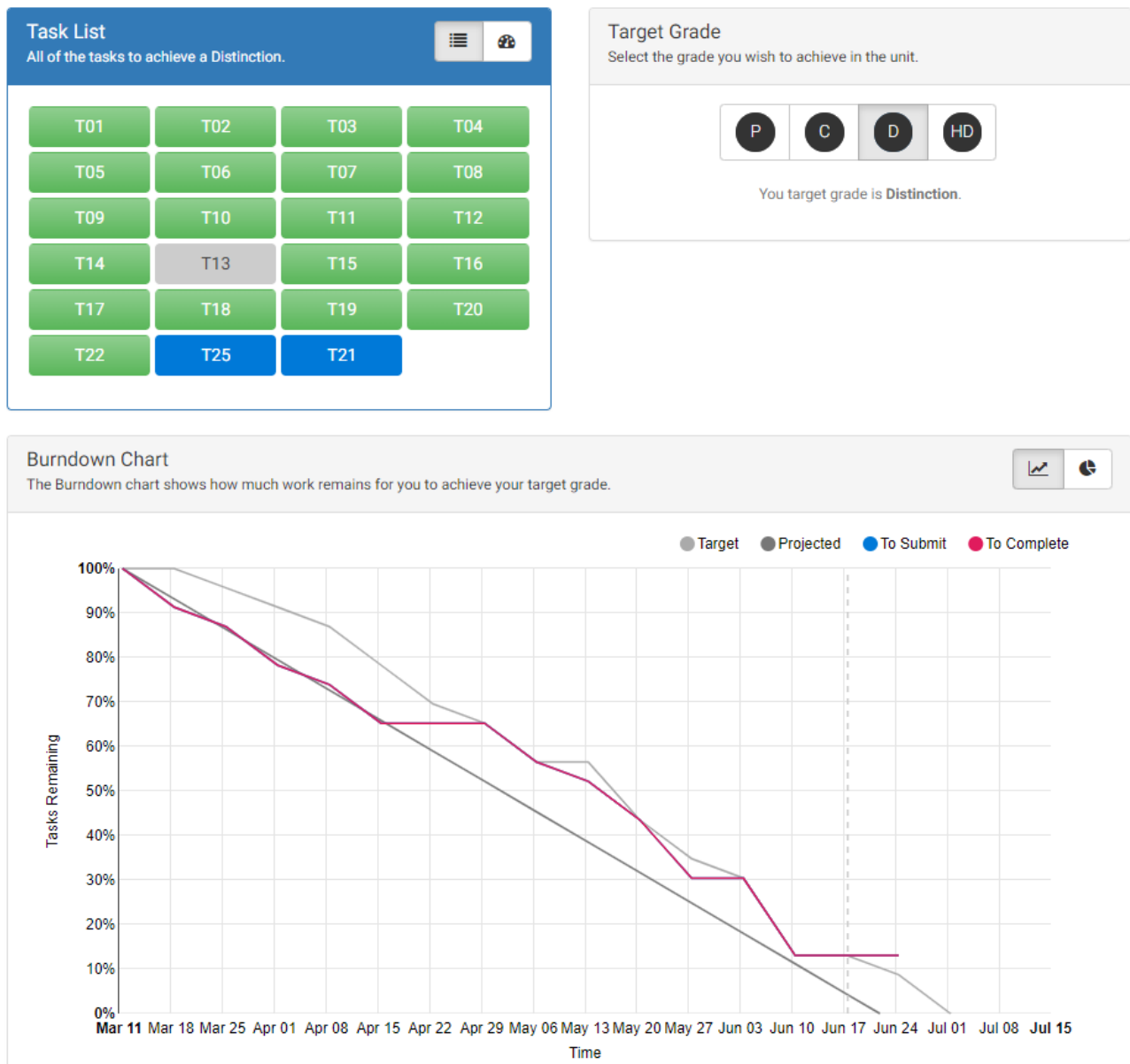


Figure 1: My burndown chart and completed tasks for AI for Games.

### This unit will help me in the future:

This unit has given me a firm basis in the logic and implementation of force- and graph-based AI movement, fundamental types of game AIs, the uses of graphs and searches in games, and AI action planning to achieve goals, all of which are practical and applicable beyond just this unit. Certainly, I'll be able to take the concepts

and logic behind various features and adapt them for future projects in university, and in game development projects generally, particularly since this unit has furthered my desire to specialise in game AI programming.

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

- Assuming assignments and deadlines from other units permitted, if I did this unit again, I would like to begin working on the designs and implementation for my custom project earlier in the semester. That would ensure I had more time to complete the custom project if I needed it, and would likely allow me to finish and submit it earlier than I achieved this time around.
- If I had sufficient time while redoing this unit, I wouldn't mind attempting a HD research report; after doing the research plan credit task, I was genuinely curious about my chosen research matter and wouldn't have minded looking into it.

## **Conclusion**

In summary, I believe that I have clearly demonstrate that my portfolio is sufficient to be awarded a distinction grade. I completed all of the core work and credit tasks, and have submitted a distinction-level custom project that combines and extends core concepts in a manner I believe sufficiently demonstrates my learning and proficiency with the unit's content – sufficient to warrant a distinction grade.