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SPECIALIST EDUCATORS IN GAMES, ANIMATION & FILM VFX

2021 Subject & Assessment Guide

Artificial Intelligence for Games

ICT50120 Diploma of Information Technology (Game Programming)

CUA51015 Diploma of Screen and Media

academy of interactive entertainment
Sydney Melbourne Canberra Adelaide Lafayette Seattle Online

Table of Contents

Artificial Intelligence for Games

Units of Competency

The units of competency that are covered in this subject are as follows:

ICTGAM423 – Apply artificial intelligence in game development

ICTICT435 – Create technical documentation

BSBDES402 – Interpret and respond to a design brief

CUADIG507 – Design digital simulations

Assessment processes and competency evidence requirements are described in the *Assessment Criteria* section below. If you have prior or other evidence against competency you should discuss this with your teacher.

Subject Overview

Overall Learning Outcomes

- Develop and apply an understanding of modern A.I. techniques for games
- Implement pathfinding algorithms
- Implement decision making techniques

Subject Description

Artificial Intelligence (A.I.) in games is a broad topic. A.I. covers a range of techniques that allow the computer to think and act based on a set of rules. The aim of most A.I. is to succeed at whatever its goal is. In the case of game A.I. its goal is actually to lose, but to lose convincingly and encourage the player to overcome a challenge.

Brian Schwab, author of "**AI Game Engine Programming**", says the aim of game A.I. is "to be a good dad". Imagine an A.I. entity playing a game with their kid. A bad dad would defeat their kid as quick as possible. A good dad would encourage their kid to rise to the challenge and overcome it, adapting the difficulty to meet the skills of their child.

This subject will teach you various decision-making algorithms and techniques used in games, along with locomotion techniques to move entities around your game worlds. You will also learn pathfinding algorithms that help A.I. find their way to a goal, be that a location within the level or a certain goal state such as world domination!

Industry Relevance

Artificial intelligence is a big part of modern video games that need competitive opponents and various non-player characters. Games are full of little smart agents making all kinds of decisions, from humanoids to little rodents that need to scamper around environments realistically. Simulation industries also require A.I. as does film. The Lord of the Rings movie franchise made heavy use of A.I. techniques for their hordes of orcs and humans battling it out on the big screen.

Assumed Knowledge

- Knowledge of C++ programming sufficient to create complex real-time applications
- Knowledge of basic vector and matrix mathematics for 3-D coordinate systems

Subject Textbooks

Although not required, the following textbooks are recommended to aid in the completion of this subject:

- Funge, J, Millington, I, ***Artificial Intelligence for Games***, 2nd Edition, CRC Press (2009)
- Mark, D, ***Behavioral Mathematics for Game AI***, Charles River Media (2009)
- Buckland, M, ***Programming Game AI by Example***, Wordware Publishing Inc (2005)
- Schwab, B, ***AI Game Engine Programming***, 2nd Edition, Cengage Learning (2008)

Assessment Criteria

Assessment Description

Assessment Milestones

Please refer to your Class Schedule for actual dates on your campus

General Description

This subject will teach you various aspects of artificial intelligence for games. To be assessed as competent you will need to demonstrate a real-time simulation, which may or may not be interactive, but which demonstrates a few key assessable elements in game A.I.

The application you develop for your assessment may be a game, or an extension to a previous assessment, but it must implement the following required assessable elements:

- Entities using decision making techniques
- Entities using suitable pathfinding algorithms

Examples of decision-making techniques that are acceptable include state machines, blackboards, decision trees, behaviour trees, and planning algorithms. Suitable pathfinding algorithms include Dijkstra's algorithm, A-Star pathfinding, and navigation meshes. Other algorithms also exist and you are free to use another or a combination of algorithms to implement your simulation or game.

The project involves several stages of development, outlined below. Each stage consists of separate deliverables and it is recommended you schedule your work so that each deliverable can be assessed in turn.

Stage 1: Research

For this stage of development, you will need to do some preliminary research that will assist you in the planning and design of your simulation.

A workbook has been created for you to help you prepare the specific pieces of information you will need to collate.

You will need to research and identify the following:

- AI path-finding strategies for the genre and environment detailed in your selected brief, and how they influence design and development
- AI strategies
- Industry standards applicable to using AI strategies in game development
- Technical documentation requirements
- Industry standards relating to technical documentation
- Potential pre-existing components (assets, libraries, and algorithms) available for use, including an evaluation of each component's functionality, suitability, and technical impact on the project
- Licensing issues and copyright restrictions for potential pre-existing components
- The target audience, format and delivery platform of the simulation
- The real-world environment to be simulated, including the required depth of physical and functional fidelity required
- The simulation complexity
- Any additional information that will aid in the design of the simulation
- Any authoring tools that will aid in the implementation of the simulation

Stage 2: Design

During the planning phase you will write a Technical Design Document.

This document can take any form and need not be a traditional document. For example, you may wish to assemble all planning information within a OneNote, Wiki, HacknPlan project site, or another flexible format.

If you use a non-traditional document format, you must ensure that when submitting your assessment all documentation is submitted in either MS Word or PDF format.

A Technical Design Document template can be downloaded from the AIE Learning Management System (Canvas), and must contain the following information:

- The pathfinding algorithm you will implement
- AI strategies for NPCs for the game design that are technically feasible, respond to the brief, and provide creative solutions to all design issues
- The scope of work to be produced
- The system features, functionality, and constraints of the target platform
- A description of your simulation or game, including the behaviour of all actors

- A description of the state machine (or other NPC decision algorithm) used. This may take the form of a diagram (in a format appropriate to the algorithm described)
- The user interface controls
- Positive and negative feedback to user interaction
- Sequencing of difficulty levels, if required
- Schedule of major milestones, including communication process and frequency of communication with client
- Assessment of production risks
- Pre-existing components (assets, libraries, and algorithms) to be used, including an evaluation of each component's functionality, suitability, and technical impact on the project

Stage 3: Design Handover

Present your final design to the client (or your trainer) for validation and confirmation that the design meets the requirements of the brief.

The client (or your trainer) may provide feedback and require adjustment of your design before your design is approved.

Stage 4: Implementation

You will develop your project, implementing the core simulation using an accelerated development schedule.

Requirements for this phase are:

- Implement an NPC AI strategy
- Implement a path-finding algorithm
- Evaluate your prototype against the design brief

It is recommended that your solution is developed in C++ using the RayLib or AIEBootstrap framework, or another C++ graphics framework. While you are encouraged to write or use your own maths library, use of an alternative maths library (such as glm) is acceptable.

Use of alternative programming languages or full-featured game engines is strongly discouraged as it will generally be much more difficult to prove competency in writing the required algorithms. All classes and tutorials for this subject will be taught in C++ using the RayLib or AIEBootstrap framework.

Stage 5: Review

Once you have implemented your simulation or game, you are to create a short, written document that includes:

- A description of how easy or difficult it was for you to implement your planned techniques.
- What the computational performance of your techniques were and how they could have been improved?
- An evaluation of the usefulness of the technical documentation created.

Evidence Specifications

This is the specific evidence you must prepare for and present by your assessment milestone to demonstrate you have competency in the above knowledge and skills. The evidence must conform to all the specific requirements listed in the table below. You may present additional, or other evidence of competency, but this should be as a result of individual negotiation with your teacher.

Your Roles and Responsibilities as a Candidate

- Understand and feel comfortable with the assessment process.
- Know what evidence you must provide to demonstrate competency.
- Take an active part in the assessment process.
- Collect all competency evidence for presentation when required.

This table defines the individual requirements for each part of the assessment criteria. Listed here are the cumulative requirements for all assessment items. The evidence requirements for specific assessment items can be seen by referring to the table listed for that assessment item in the following sections.

Assessment and Competency Requirements
1. Research Evidence that includes: • Completed Project Research Workbook that sufficiently answers all questions listed. Where no guidance is given, at least one- to two-paragraph answer are expected.
2. Design Evidence that includes: • A Technical Design Document containing the following information: o The pathfinding algorithm you will implement o AI strategies for NPCs for the game design that are technically feasible, respond to the brief, and provide creative solutions to all design issues o The scope of work to be produced o The system features, functionality, and constraints of the target platform o A description of your simulation or game, including the behaviour of all actors o A description of the state machine (or other NPC decision algorithm) used. This may take the form of a diagram (in a format appropriate to the algorithm described) o The user interface controls o Positive and negative feedback to user interaction (If the simulation is non-interactive, a description of all feedback generated) o Sequencing of difficulty levels, if required o Schedule of major milestones, including communication process and frequency of communication with client o Assessment of production risks o Pre-existing components (assets, libraries, and algorithms) to be used, including an

evaluation of each component's functionality, suitability, and technical impact on the project
3. Design Handover Evidence that includes: • Presentation of your final design to the client for validation and approval • Adjustments made to your design, in negotiation with the client, and in accordance with any feedback given

4. Implementation
Evidence that includes:
• Implementation of the simulation described in your *Technical Design Document*, including:
  ○ Implementation of an NPC AI strategy
  ○ Implementation of a path-finding algorithm
• The final simulation matches the approved design

5. Review
Evidence that includes:
• A short, written project review, that includes:
  ○ A description of how easy or difficult it was for you to implement your planned techniques.
  ○ What the computational performance of your techniques were and how they could have been improved?
  ○ An evaluation of the usefulness of the technical documentation created.

Assessment Instructions for Candidate

METHOD OF ASSESSMENT

Assessment is a cumulative process which takes place throughout a subject. A 'competent' or 'not yet competent' decision is generally made at the end of a subject. Your assessment will be conducted by an official AIE qualified assessor. This may be someone other than your teacher. The evidence you must prepare and present is described

above in this assessment criteria document. This evidence has been mapped to the units of competency listed at the beginning of this document. Assessments will be conducted on a specific milestone recorded above in this assessment guide document.

ASSESSMENT CONDITIONS

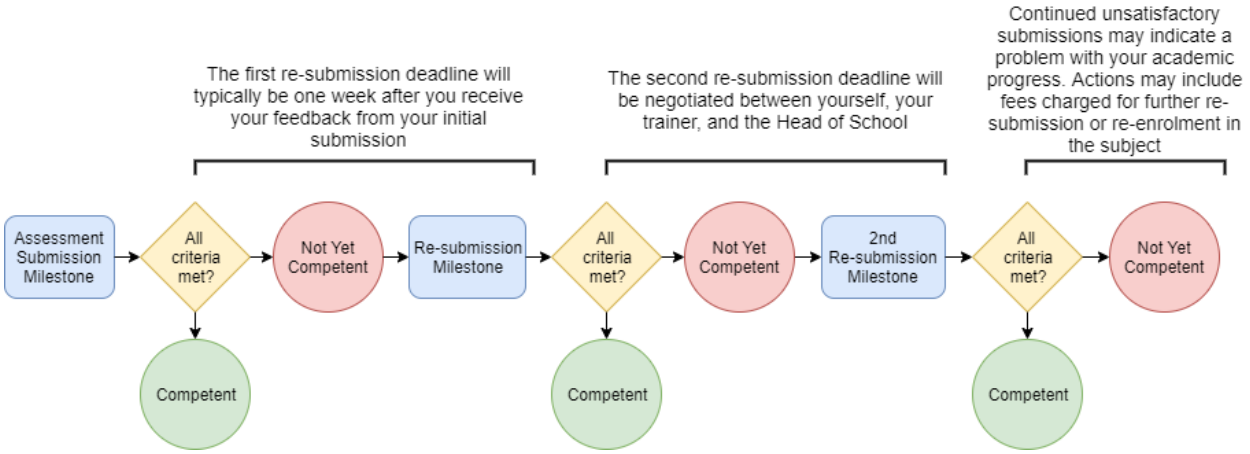
Formative assessment takes place as your teacher observes the development of your work throughout the subject and, although the assessor is likely to be aware of the evidence you are submitting, it is your responsibility to be prepared for the interview where a competency judgement is made (summative assessment). Forgetting something, or making a small mistake at the time of the milestone assessment, can be corrected. However, the assessor may choose to assess other candidates who are better prepared and return to you if time permits.

Upon completion of the assessment you will be issued with feedback and a record of the summative assessment and acknowledge that you have received the result. If you are absent for the nominated assessment milestone (without prior agreement or a sufficiently documented reason) you will be assessed as not yet competent.

GRADING

The assessment you are undertaking will be graded as either *competent* or *not yet competent*.

REASSESSMENT PROCESS



If you are assessed as being not yet competent you will receive clear, written and oral feedback on what you will need to do to achieve competence. Failing to submit an assessment will result in you being assessed as not yet competent. You will be given a reassessment milestone no more than one (1) week later to prepare your evidence. If you are unsuccessful after your reassessment, you may be asked to attend a meeting with your Head of School to discuss your progress or any support you may need and further opportunities to gain competency.

REASONABLE ADJUSTMENTS

We recognise the need to make reasonable adjustments within our assessment and learning environments to meet your individual needs. If you need to speak confidentially to someone about your individual needs, please contact your teacher.

FURTHER INFORMATION

For further information about assessment and support at AIE, please refer to the assessment and course progress sections of your student handbook.

Software

Core

Microsoft Visual Studio

Microsoft's Visual Studio is the recommended IDE for this subject. Other IDEs may be employed if desired as the content of this subject is designed to be cross-platform and IDE agnostic, however we cannot guarantee that all subject material will operate as intended on other IDEs and platforms.

- https://www.visualstudio.com/

Microsoft Word

Microsoft Word is industry standard word processing software, development by Microsoft and used throughout the course for creating documents and reports. Microsoft Word allows documents to be saved in *word* format, as well as several other standard document formats including *pdf*.

Learners will have access to Microsoft Word on campus but may also use alternate word processing software capable of loading and saving documents in *word* or *pdf* format.

- https://www.microsoft.com/en-us/education/products/office/default.aspx
- https://www.openoffice.org/
- https://www.google.com.au/docs/about/

7zip

7-Zip is a free and open-source file archiver, a utility used to place groups of files within compressed containers known as "archives". This utility program will be necessary to package your assessment files for submission.

- https://www.7-zip.org/download.html

Suggested

Photoshop / Krita

Whether it is for textures, level design or other art related topics, usually Adobe Photoshop is the software of choice for creating graphic content.
Krita is a free and open-source image editing program, offering functionality comparable to Photoshop.

- https://www.adobe.com/products/photoshop.html
- https://krita.org/en/

References and additional material

Artificial Intelligence for Games

- https://en.wikipedia.org/wiki/Artificial_intelligence_in_video_games

- http://aigamedev.com/
- http://www.gameai.com/
- An Intro to Video Game AI for Beginners and Young Programmers (youtube)

