

# 2022 Subject & Assessment Guide

Physics for Games

10702NAT

Advanced Diploma of Professional  
Game Development

Programming

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# Physics for Games

## Units of Competency

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

[ICTGAM556](#) – Develop and implement physics in 3-D digital games

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

- Demonstrate an understanding of physics formulas
- Apply a knowledge of real-time physics techniques
- Integrate third-party physics libraries

### Subject Description

This subject is designed to teach you the **techniques** and **algorithms** used in **modern physics simulations**. Game developers are always trying to push the boundaries of realistic simulations. Realistic physical modelling can dramatically increase the immersion of the player within the game world. When physical simulations are integrated into game mechanics, players can use their real-world intuition to solve problems the game presents. This subject introduces you to both the theory and the practice of implementing your own physics engine. Theoretical content discussing the relationships between position, velocity, acceleration, force, mass, momentum, angular momentum, torque, and moments of inertia are discussed. Practical demonstrations showing how to implement the theoretical concepts into a real-time physics simulation are also given.

You will learn how to implement their own physics from the ground up and will gain experience using a commercial implementation with third-party software.

### Industry Relevance

Many games incorporate physics simulations – some use physics as a central mechanic, while others use it as a way to add depth and realism to their worlds. Many engines such as Unity3D and Unreal Engine 4 come with physics simulations as a standard feature. Understanding the theory and practice behind

these engines empowers students to both use them more effectively, as well as implement their own customised simulations, to the project at hand.

## 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:

- Millington, I., 2017. ***Game Physics Engine Development: How to Build a Robust Commercial-Grade Physics Engine for your Game***. 2nd ed. New York: CRC Press.
- Ericson, C, ***Real Time Collision Detection***, CRC Press (2005)
- Eberly, D, ***Game Physics***, Morgan Kaufmann Publishers (2004)

# Assessment Criteria

## Assessment Description

### Assessment Milestones

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

### General Description

For this assessment you are required to create a custom physics simulation and demonstrate its successful implementation within a real-time application. You may not use any third-party physics libraries in the creation of this simulation. The simulation must demonstrate:

- Static and Dynamic Rigid Bodies
- Forces being applied to Dynamic Rigid Bodies
- Static and Dynamic Rigid Bodies interacting with each other as expected

You must visually display the simulation in a meaningful way.

Once you have created your simulation you will need to create documentation that includes:

- Class diagrams for your custom physics systems
- List of references and research material used for creating the custom physics simulation
- Any third-party non-physics libraries used
- What improvements could be made to the simulation

Finally, you are tasked with demonstrating advanced physics interactions using a third-party physics system within a second non-trivial, real-time application or game. This application must demonstrate:

- Joints and Ragdoll Physics

- Trigger systems that use call-backs to influence the simulation when collisions occur
- Use of a complex Character Controller that uses Dynamic and Kinematic systems
- Demonstration of ray-casting in the simulation environment

### 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 what you need to produce as evidence of competency:

Assessment Tasks & Evidence Descriptions
<p><b>1 Custom Physics Simulation</b></p> <p>Evidence that includes:</p> <ul style="list-style-type: none"> <li>• Implementation and demonstration of custom physics systems implemented within a real-time application that includes: <ul style="list-style-type: none"> <li>○ Implementation of static and dynamic rigid body physics that interact together</li> <li>○ Forces applied to physics bodies</li> <li>○ Visualisation of physics bodies</li> <li>○ Physics simulations run as expected without physical errors</li> </ul> </li> <li>• Application executable submitted that runs external from IDE without error</li> <li>• Source code and assets for the application submitted for review without any compile or link error</li> </ul>
<p><b>2 Custom Physics Documentation</b></p> <p>Evidence that includes:</p> <ul style="list-style-type: none"> <li>• Creation of class diagrams for the Custom Physics Simulation that include: <ul style="list-style-type: none"> <li>○ Physics System's classes, their properties, relationships and how they interact together</li> </ul> </li> <li>• Creation of a written document that includes: <ul style="list-style-type: none"> <li>○ References and research material used to influence the creation of the Custom Physics Simulation</li> <li>○ What the Custom Physics Simulation is demonstrating and how the physical bodies are interacting together</li> <li>○ Third-party libraries used to create the Custom Physics Simulation, if any</li> <li>○ What improvements could be made to the Custom Physics Simulation to</li> </ul> </li> </ul>

<p>support further features and more accurate simulations</p> <ul style="list-style-type: none"> <li>Respond to any feedback given by amending documentation or projects as requested.</li> </ul>
<p><b>3 Advanced Physics Implemented</b></p> <p>Evidence that includes:</p> <ul style="list-style-type: none"> <li>Use of advanced physics systems within a non-trivial, real-time application, including evidence of: <ul style="list-style-type: none"> <li>Physics Joints</li> <li>Ragdoll Physics</li> <li>Raycast into simulation's scene for picking purposes</li> <li>Trigger systems with callback functions that impact the simulation in a meaningful way</li> <li>Use of Character Controller physics bodies supporting dynamic and kinematic rigid bodies</li> </ul> </li> <li>Application executable submitted that can run external from any IDE without error</li> <li>Source code and assets for the application also submitted for review that does not include any compile or link errors</li> </ul>

## 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

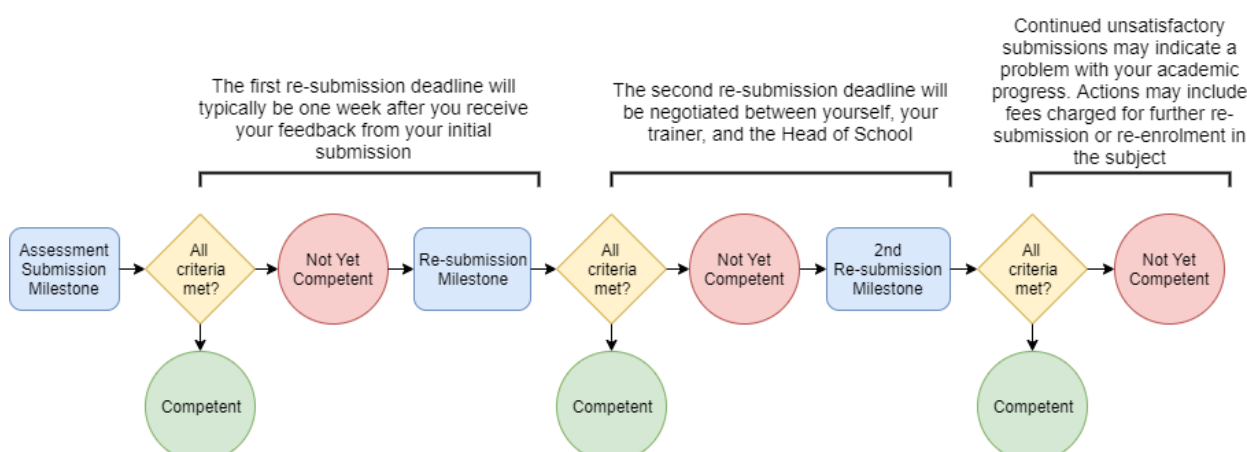
Formative assessment takes place as your teacher observes the development of your work throughout the subject and, although the assessor is likely to be aware of the evidence you are submitting, it is your responsibility to be prepared for the interview where a competency judgement is made (summative 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/vs/>

### *Unity3D / Unreal Engine 4*

Projects need to be done in a game engine of choice. Learners can use the engine of their choice, no restrictions.

Unity3D is a widely used 3D game engine. It has powered many financially and critically successful games. It has a wide array of features that aid with development, especially for a small team. Games made with Unity can be built to a large array of devices.

- <http://www.unity3d.com>

Unreal Engine 4 is a complete suite of game development tools used to make games from 2D mobile games to console blockbusters and VR. Unreal 4 is a 3rd party development tool used in many game studios and offers professional development experience.

- <https://www.unrealengine.com/>