SET09119 Physics-Based Animation

Assessment 2: Final Assessment

Learning Outcomes Covered:	L01, L02, L03, L04
Assessment Type:	Practical Assessment / Demonstration
Overall module assessment	40% Assessment 1, 60% Assessment 2
For this assessment:	60%
Assessment Limits:	40 hours
Submission Date:	Monday, 29 April 2024
Submission Time:	17:00
Submission Method:	Via Moodle
Turnitin:	Not Applicable
Module leader:	Babis Koniaris
Tutor with Direct Responsibility:	

- You are advised to keep a copy of your assessment solutions.
- Please note regulation Section B5.3.b regards component weighting.
- Late submissions will be penalised following the University guidelines as follows: Choose an item.
- Extensions to the submission date may only be given by the Module Leader for exceptional circumstances. – by submitting appropriate request form from Extenuating circumstances.
- Feedback on submissions will normally be provided within three working weeks from the submission date.

The University rules on Academic Integrity will apply to all submissions. The student academic integrity regulations contain a detailed definition of academic integrity breaches which includes use of commissioned material; knowingly permitting another student to copy all or part of his/her own work

You must not share your work with other students - this includes posting any of your work in any repository that is accessible to others (such as GitHub) and applies also after you have completed the course. You must not ask coursework-related questions in online for a (such as Stackoverflow) and you must not use ChatGPT or other generative AI tools – this would constitute academic misconduct as it would be commissioning material.

By submitting the report, you are confirming that:

- It is your own work except where explicit reference is made to the contribution of others.
- It has not been submitted for any module or programme degree at Edinburgh Napier University or any other institution.
- It has not been made with the assistance of Artificial Intelligence (AI) tools.

Physics-based Animation - SET09119

Babis Koniaris

1 Introduction

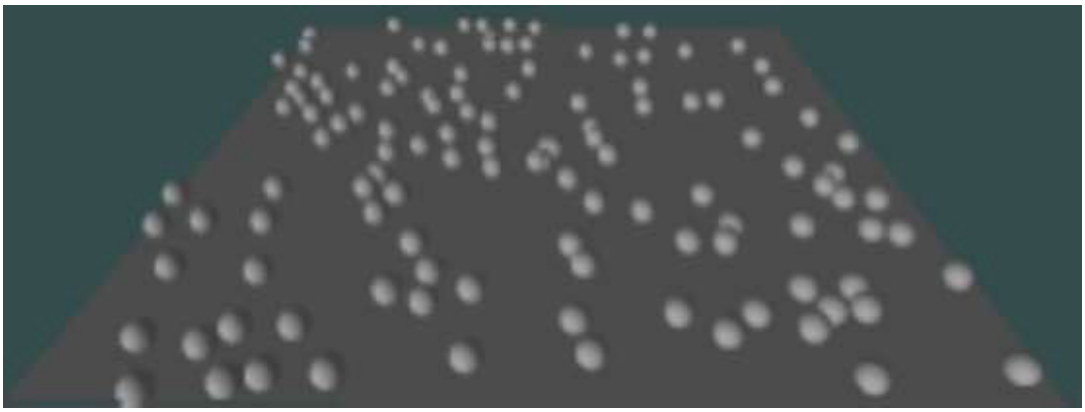
The goal of this project is to enable you to expand your practical understanding of physics-based animation techniques. The emphasis of this assignment is on the following topics:

- Collision detection
- Rigid bodies

2 Brief

This assessment can give you a total of 35 marks, distributed as 25 marks for the implementation and 10 marks for the report.

2.1 Spheres on the plane



In this project, you will create a simulation with interacting spheres moving on a table surface. The requirements are as follows:

- There are three types of spheres: red, green and blue, and their masses are 1kg, 2kg and 3kg respectively. All spheres have a radius of 1m. When creating spheres, pick randomly from these three types.

- The spheres use the model file resources/models/sphere.obj, which is centered at the origin and has a radius of 1.
- Simulate a number of spheres, between 10 and 30 (hint: everything can test against everything and still get smooth framerate)
- The table has dimensions of 30m x 30m.
- The table uses the model file resources/models/cube.obj, which is centered at the origin and the length of its sides is 1.
- The spheres start at random positions, as long as they are within the table's limits and on the table, and do not intersect with each other at their initial positions.
- There is an invisible wall surrounding the table, that the spheres can bounce off.
- The spheres start at random initial velocities, between -20 and 20 m/sec for each of the x and z axes.
- By pressing R, your simulation should restart with the same random seed. By pressing U, your simulation should restart with a different random seed (e.g. seed = seed+1)
- The delta time is 1/60 of a second
- There is no friction between the spheres and the table, and there is no friction between the spheres and the wall either.
- For this basic implementation, only simulate positions (no rotations)
- **Extension 1** Increase the number of spheres to at least 100, and increase the size of the table up to 10 times. Implement a broad phase collision detection algorithm so that your program can efficiently handle all collision pairs. Investigate approaches, choose one, implement it and explain your choice in the report.
- **Extension 2** Add support for rotations using what you have learnt in rigid body dynamics. You don't have to add friction, but you need to implement a believable form of energy loss, so that spheres don't bounce forever. Investigate approaches, choose one, implement it and explain your choice in the report. Energy loss should be toggled on and off with E.

2.1.1 Marking scheme

- The setup is correct: table and spheres with correct starting position and velocity [2 marks]
- Spheres collide correctly with wall [3 marks]
- Spheres collide correctly with each other [4 marks]
- Extension 1 Broad phase algorithm is simulated correctly [8 marks]

- Extension 2 Rotations are simulated correctly, and energy loss looks realistic [8 marks]

2.2 Report

All the work you will complete for this project may not be apparent by running your submitted executable, and the techniques you have used won't be either. You are therefore required to document your project appropriately: present the research you have conducted and the approach(es) you have considered, chosen and implemented. Many experiments you have undertaken won't be visible in your final simulation, so make sure your report does justice to all the work you've done behind the scenes. Your report should also demonstrate your ability to reflect on your achievement in relation to concepts and techniques covered in lectures and/or researched independently.

Your report can get you a maximum of 10 marks, out of the total of 35.

3 Collaboration and Plagiarism

This is an individual piece of assessment and the work submitted should be entirely your own. You are not allowed to collaborate with other people or to copy the work of other people.

Your coursework will be electronically checked against all other submissions. If any plagiarism is detected your coursework will not be marked. In the event of any doubt about authorship, you will be interviewed by the School of Computing Academic Conduct Officer and may be asked questions about any aspect of the work.

4 Submission

Your work will be assessed based on the following deliverables:

- Working executables
- Source code of your project
- Report

You should submit your assignment via Moodle. The assignment deliverable needs to contain the source code and everything else needed (e.g. CMakeLists. txt file) to build the project and generate an executable, including the executable. Please name your files as SET09119_<your-matric-number>.zip (rar/7z are also fine). The report should be similarly named and submitted to Turnitin separately.