***Documentation***

This document will cover what the Custom Physics Simulation is demonstrating, as well as what improvements could be made to it in the future.

There are three simulations included in the application (pinball, a physics demo, and newtons cradle), so we will start with explaining what pinball is demonstrating. The pinball demo illustrates most aspects of the physics engine, including collisions between objects (as the ball hits both planes and boxes), collisions between static and kinetic objects (the ball is the only rigidbody in the scene with isKinematic set to false), and it shows forces being applied to the ball as it moves around the game space. The ball can have force applied to it directly by the player as they force it out of the starting box, and when it hits any of the purple bumpers the high elasticity causes them to bounce off with more force than they initially came in with. To prevent this added force causing the ball to gain too much energy and leave the viewable area, the velocity is clamped down to (150, 150).

In the physics demo, the player can create balls to see how they interact with the objects already placed into the scene. The softbody shows that the springs work without much numerical instability, and the balls that can be spawned in can show the player how sphere/sphere collisions work, as well as show that the springs holding the bridge together will keep it in the air even if more mass is applied. As well as spawning in objects, the player can also delete them by hitting the “R” key at any time to clear the screen back to the start conditions. Newtons cradle is mainly there to demonstrate conservation of energy, as if the simulation didn’t calculate this correctly the balls wouldn’t come to a full stop after being hit.

Improvements that could be made to this simulation would be, in the pinball game, to add a scoring mechanism that checks if the ball has collided with any of the bumpers and if so it adds to the total score, or more adjustments to the gravity and drag variables to get a more accurate simulation of a real pinball machine. Another improvement would be a different method of preventing the ball from gaining too much speed, as clamping the velocity down could lead to instability should it get too large before the clamp occurs. In the physics demo, a way for the player to destroy an object by left clicking it would be a good feature to add, as right now you can only delete all the created spheres at once. Also more objects in this demo would lead to more interesting interactions for the player to see, so adding some rotating boxes or kinetic objects would improve it as well.

***References***

Third party libraries are:

* Glm
* Gizmos
* Bootstrap

All reference and research material sourced from AIE lectures.