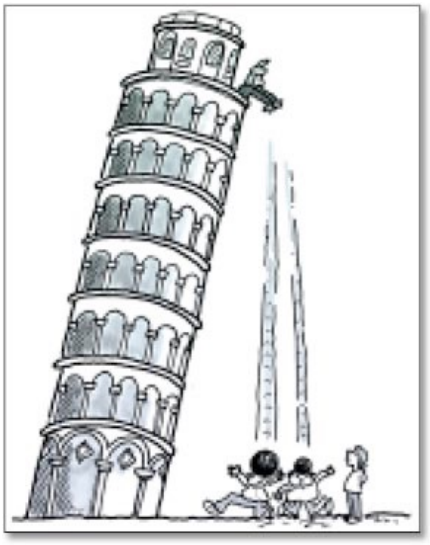
Project 2: Galileo's Experiment

Due: Feb 12, 2018, 11:55PM



You are standing at the top of the Leaning Toward of Pisa. Just like Galileo, you are trying to convince people that your numerical integrator is accurate by dropping two balls with equal mass from the tower. One ball follows the analytical equation of free-fall motion while the other one is simulated by your particle system. Your goal is to show that they reach the ground at the same time.

In your program, you will implement two numerical integration methods: Explicit Euler and Midpoint. Show that one of them yields the same motion as the analytical solution, while the other one does not.

In your executable, show three particles side-by-side falling from the same height at the same time with zero initial velocity. Render the particle that follows the analytical solution red and the other two blue.

Skeleton code

Once you build and run the skeleton code, you will see three balls (one red and two blue) on the screen. Hit the space bar to start the simulation. In the skeleton code, you will see that the three balls move downward with the same constant speed. Your goal is to make the red ball follow the analytical equation of free-fall motion and the blue balls follow the two integration methods you implement. You can easily check whether or not the blue balls are moving in the same way as the red ball by pausing the simulation (hit the space bar) and comparing their positions using the checkerboard background.

You should first examine the source code in the particle and simulator classes. Clearly, the major effort of this project will be completing the function, simulator::simulate(). You can change the skeleton code as you see fit.

Extra points:

1. Add a functionality to input initial vertical velocity via keyboard and show that the simulation yields the same result with nonzero initial velocity (2 point).
2. Implement the third numerical integrator that uses first-order semi-implicit Euler (2 points).