## Criterion A: Planning

## Defining the problem

My client is Ms. Alveena Naizam, a physics teacher at my school. In her teaching career, she often encounters topics that would be better taught if they were visualized and are difficult to visualize otherwise. She would like to be able to have a simulation on the computer to help students visualize these concepts and interact with the physics to improve their learning.

Some of the topics that Ms. Naizam mentioned would be useful to visualize are ones which “involve many small particles” – such as fluid dynamics, electrics (circuits) and rigid body mechanics. Ms. Naizam has asked me to make a simulation of a projectile motion scenario, a visual demonstration of a particle, a “ball” moving in a gravitational field. The ball can be “shot”, given some initial velocity, and its motion will be modeled. To study the motion of the ball, the program will also include a timer and a ruler to measure various aspects of the ball’s motion.

I will provide a computer-based solution to this problem. My client and I agreed that the solution would be a web application, which can be accessed from many devices.

## Rationale

My client mentioned: “I don’t care how the application is accessed, as long as it’s available easily on all devices”, which led me to consider creating a web application. Additionally, although most students in the school use iPads as devices for learning, creating an iPad app has several difficulties, as my client said, “with an iPad app, we’d need to run that through administration to have it verified for installation on the iPads.

The web app will be created using JavaScript for the animations of the simulations, with HTML and CSS used for displaying the webpage. JavaScript was chosen as it has the best integration for web-based applications as well a large variety of available libraries for a variety of purposes, including modelling physical processes.

## Success criteria

1. The system will display a space in which the simulation will take place. In here the user will be able to drag-n-drop the ball to set up the simulation which can then be executed.
2. The user will be able to create multiple balls and control them individually.
3. The space will have a grid overlaid so the user can visualize the distances covered by the ball.
4. The user will be able to see displayed in text the following properties of the ball and be able to edit it them to precise values:
   1. x-y coordinates
   2. Vertical velocity
   3. Horizontal velocity
   4. Net velocity
   5. Angle of velocity
5. The position of the ball will be displayed visually.
6. A trail of the ball’s position over time will be able to be turned on and off by the user.
7. Arrows centered on the ball showing its velocity
8. The system will have the following preset layouts for the simulation, allowing for common experiments to be done:
   1. Ball being fired from the ground at an angle.
   2. Ball being fired off a cliff.
9. The user will be able to create graphs of the various properties of the ball, which will be displayed on the page.
10. The system will display a play button, which will start time in the simulation once pressed.
11. The program must be available on Windows, MacOS, iOS.
12. The program must have an interface appropriate for high school students (ages 15+).