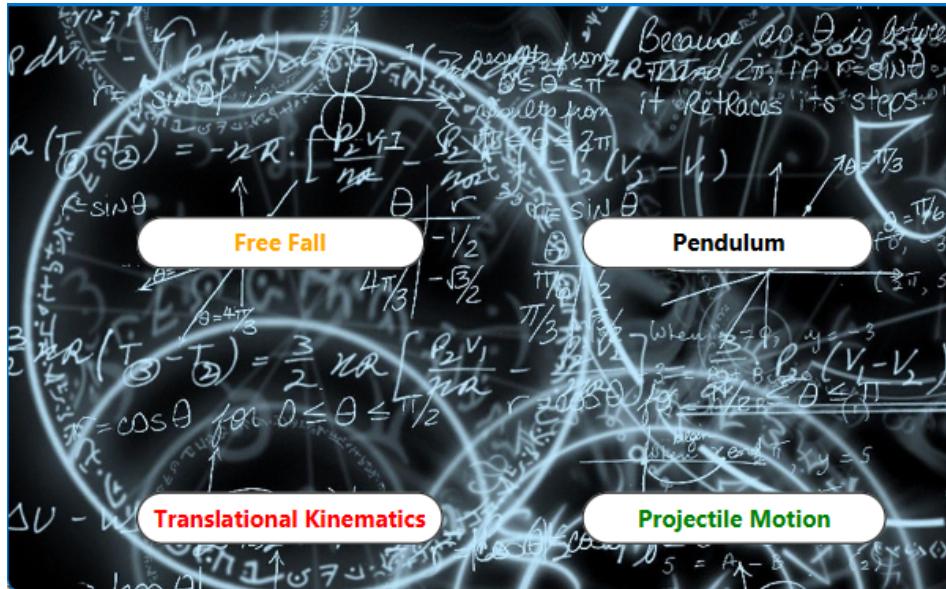


Projectile Motion User Guide

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Main Window Guide

Upon opening the application, the user is faced with 4 different simulations related to kinematics.



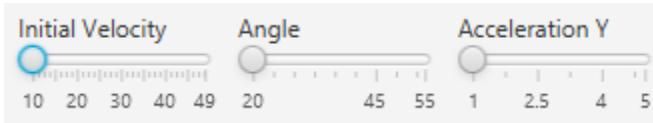
The user can choose whichever one they want by clicking on the button and can understand how it works with the guides below.

Projectile Motion Guide

Objective : To land the ball from the cannon inside the basket at the bottom of the screen.

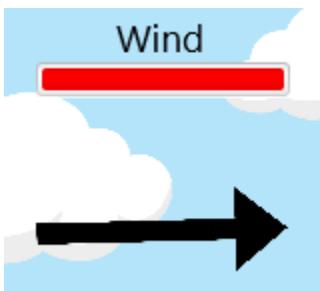
Start-Up: When opening up the window, the application is set in its default state. A basket  will spawn randomly at the bottom of the screen, being the spot you want the ball to land in. All sliders are set to their lowest settings, and the application is waiting for you to interact with it.

Play: Three sliders at the bottom, Initial Velocity, Angle and acceleration Y



are there for the user to change. The initial velocity slider will change the speed of the ball as it exits the cannon, the angle will change the angle of the cannon which shoots the ball, and lastly the acceleration Y will be the gravity force which pulls the ball down.

After choosing these values, the user has the option to enable wind. When the wind checkbox is enabled, the wind will be randomly generated and indicated at the top right.



The wind will have a direction and a strength (red being the strongest and green being the weakest). This wind will affect the trajectory of the ball since it will be adding another force onto it.



Once Ready, press the begin button which will start the animation.

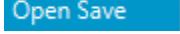
Animation Ends : Once the animation is over, the user is required to press the reset button once they are ready, and reapply the steps in **PLAY**.

Saving : After the user has a simulation run which they are satisfied with, they are able to hit the file drop down from the menu and then press “Save last run”

 . This will open a file explorer where the user is able to choose a

location to save their run. Saving a run will remember all of the simulation settings, including the wind, initial velocity, angle, acceleration y and the landing area's location into a CSV file.

Opening a Save: Once the user has a simulation saved in the generated CSV file, they must go into the file menu drop down and now select “Open Save”

 . The user must then choose the file of their previous save and open it with the file explorer. Once selected, the application will reload the save.

Edit: In the edit menu drop down, gives the user the ability to personalize the simulation by editing the image of the background and of the ball. If the user chooses the “Change Ball” menu , the user will then have a new window opened, where they can select one of the options of an image for the ball, and then press done. The same applies for the background.



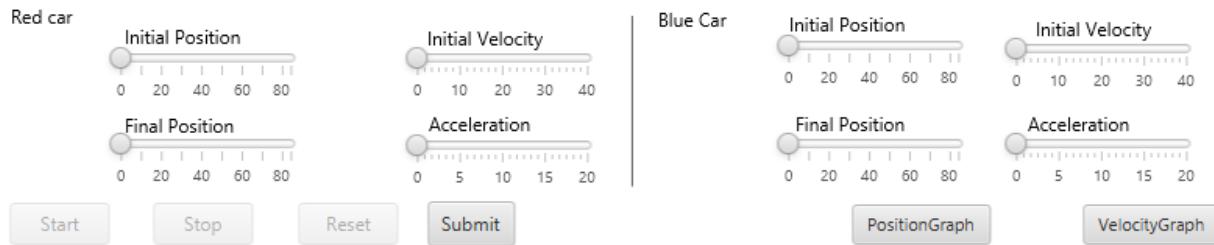
Home Button: When the user presses  , the projectile motion simulation closes, and the user is brought back to the main window where they can choose another simulation.



Info: Hovering over the blue info icon  next to “Projectile Motion” will pop up a brief description of the **Start-Up** guide.

Translational Kinematics Guide

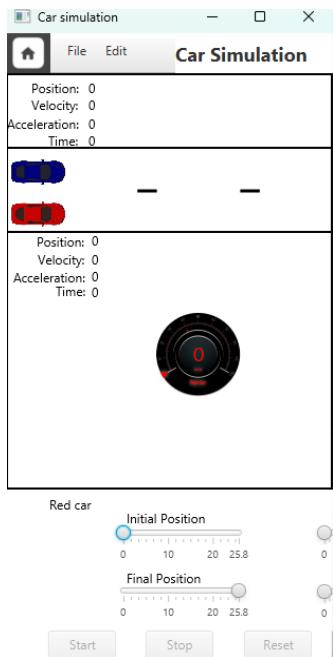
Objective : to give values and make the cars move creating an animation to explain the concept of kinematics



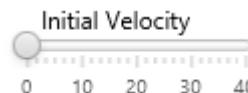
Initial Position and Final Position will determine where the car will start and finish its animation. Please note that the final position cannot be smaller than the initial position which is why when the initial position is moved, the minimum value of the final position slider will change and become the initial position chosen.

ex:

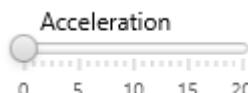
In addition, the final position slider's maximum value can change depending on the width of the window. In other words, if the width of the window gets smaller, the max final position value will get smaller and the opposite is true too.



Ex:



Now for the initial velocity slider , its value will indicate at what speed the car will start moving and the acceleration slider will indicate if the car

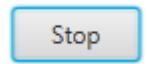


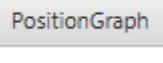
accelerates and at which rate .

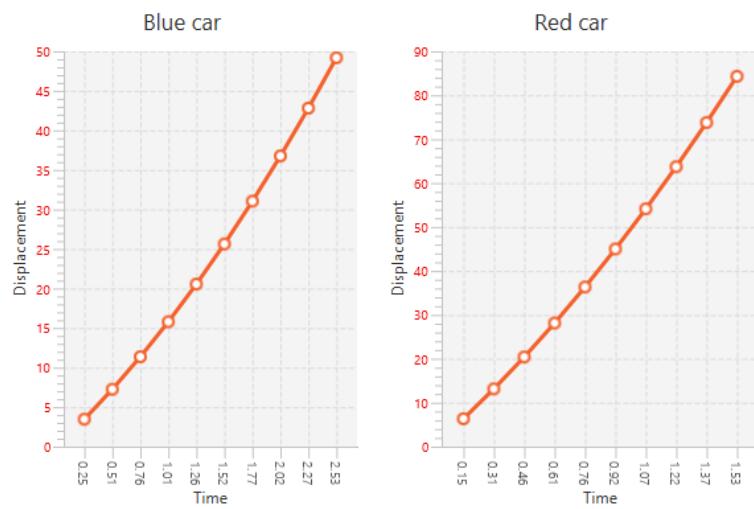
After selecting all values, pressing submit will read all the values and store them in the program. Also, pressing submit will disable all buttons except start and all sliders.

pressing Start will disable the button and cause the animation to start and enable the Stop button which can be pressed at any moment during the animation to pause it.

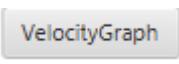
If  is pressed, the button will be disabled and the animation will pause and the button start will be enabled. Pressing  will continue the animation from where it was paused, disable the button start, and enable the button stop again.

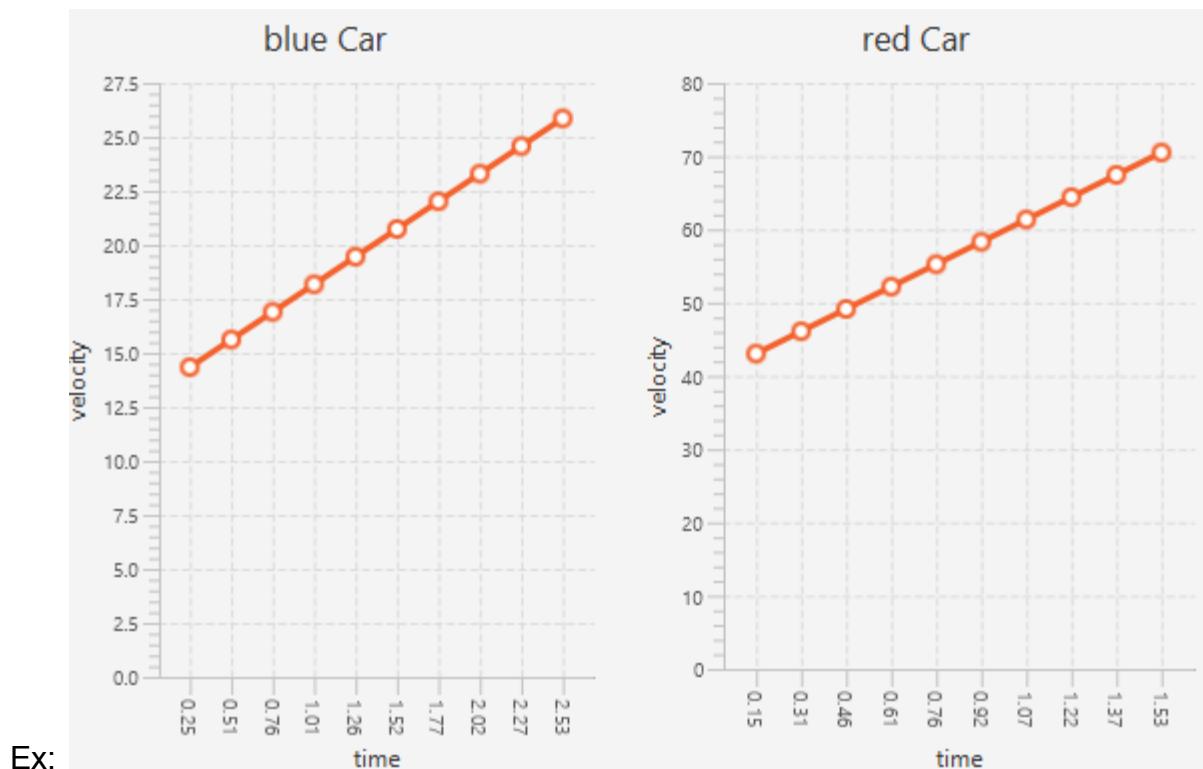
In addition, if  is pressed, the reset button  will be enabled and if pressed, the submit button will be enabled along with all sliders for the user to choose new values for the next animation. After this process, when the submit button is pressed, the start button will be enabled as mentioned at the start.

It is important to know that after hitting start, a position vs time and velocity vs time graphs will be drawn and available to the user. Pressing , will open a window displaying the graph of the animation that has been recently played



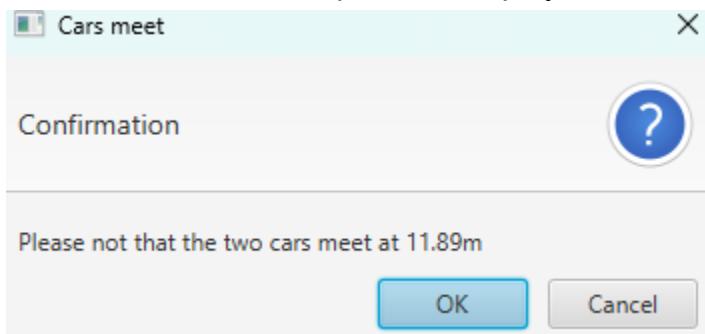
ex:

Similarly, pressing  will open the velocity graph of the animation most recently played.

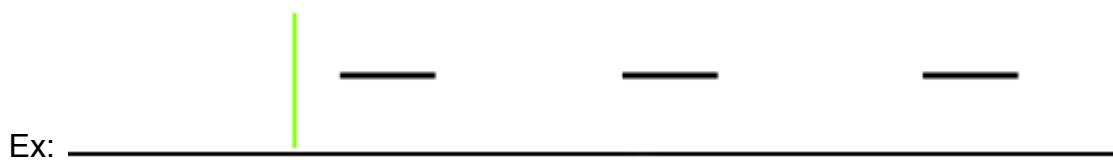


Please note that after the two cars reach their final position, the button submit along with all sliders will be enabled automatically for the user to enter the values for the next animation.

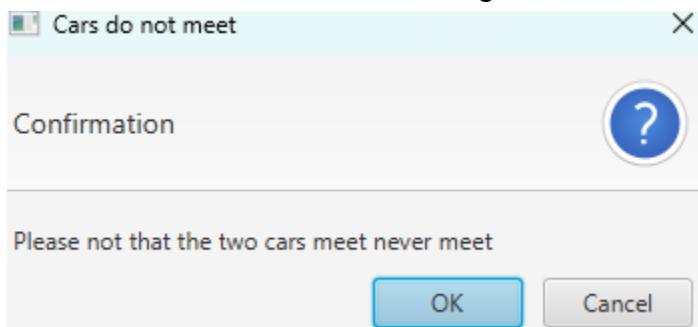
In addition, after the two cars reach their final positions, a window with a message will pop up stating if the cars meet during the animation or not. If yes, then the position at which both cars catch up will be displayed. ex:



In addition, a green line will be drawn at the position during which the two cars met.



If the cars do not meet the message will be :



Please note that the two speedometers display the current velocity of both cars

Ex:

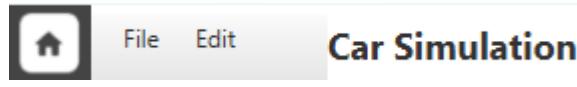


In addition, all values of both cars are calculated and displayed as text during the animation.

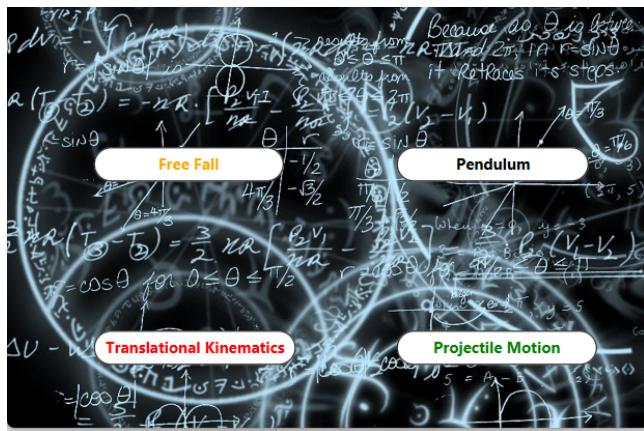
Position: 84.41
 Velocity: 12.11
 Acceleration: 0.00
Time: 6.97

Position: 84.68
 Velocity: 58.26
 Acceleration: 20.00
 ex: Time: 2.78

Now to discuss the top part of the window,



The house image acts as a home button. In other words, when pressed , the simulation window will be closed and the user will return to the main menu:



For the menuBar , pressing on the File option, the user will see

[Save Last Run](#)

[Open](#) [Save](#). “Save last run” will allow the user to save the values entered for the last simulation played by loading them into a CSV file that will be saved on the computer wherever the user pleases.

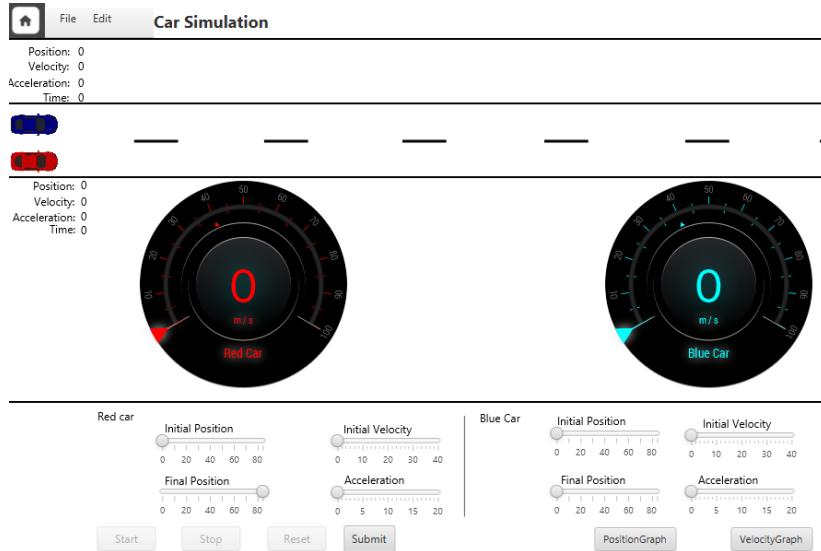
Pressing “Open save”, the user will have the option to find and select the CSV file that has been saved previously which will load up the values and apply them to the sliders of the application.

Now talking about the Edit button  , when pressed the user will see these two

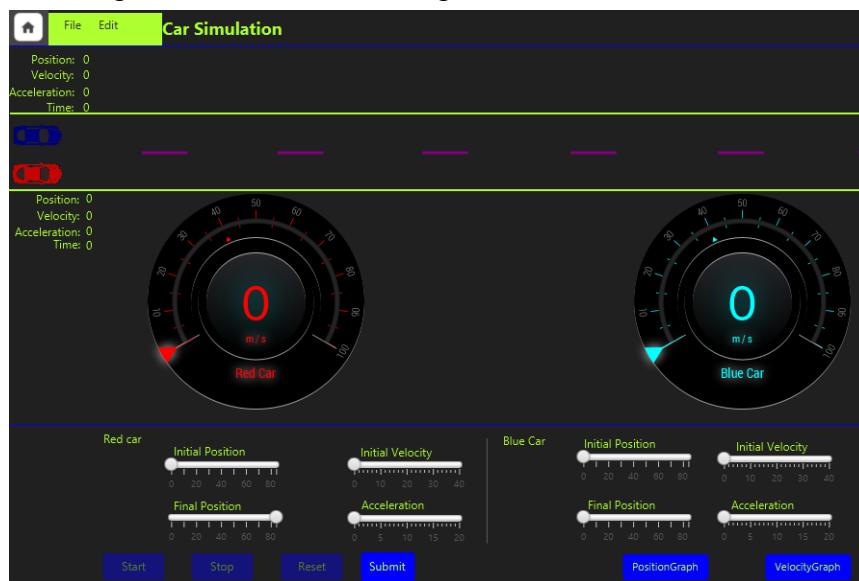
Dark mode

light mode

buttons . Pressing on light mode which is the mode the window opens with initially will cause the window to look like this:



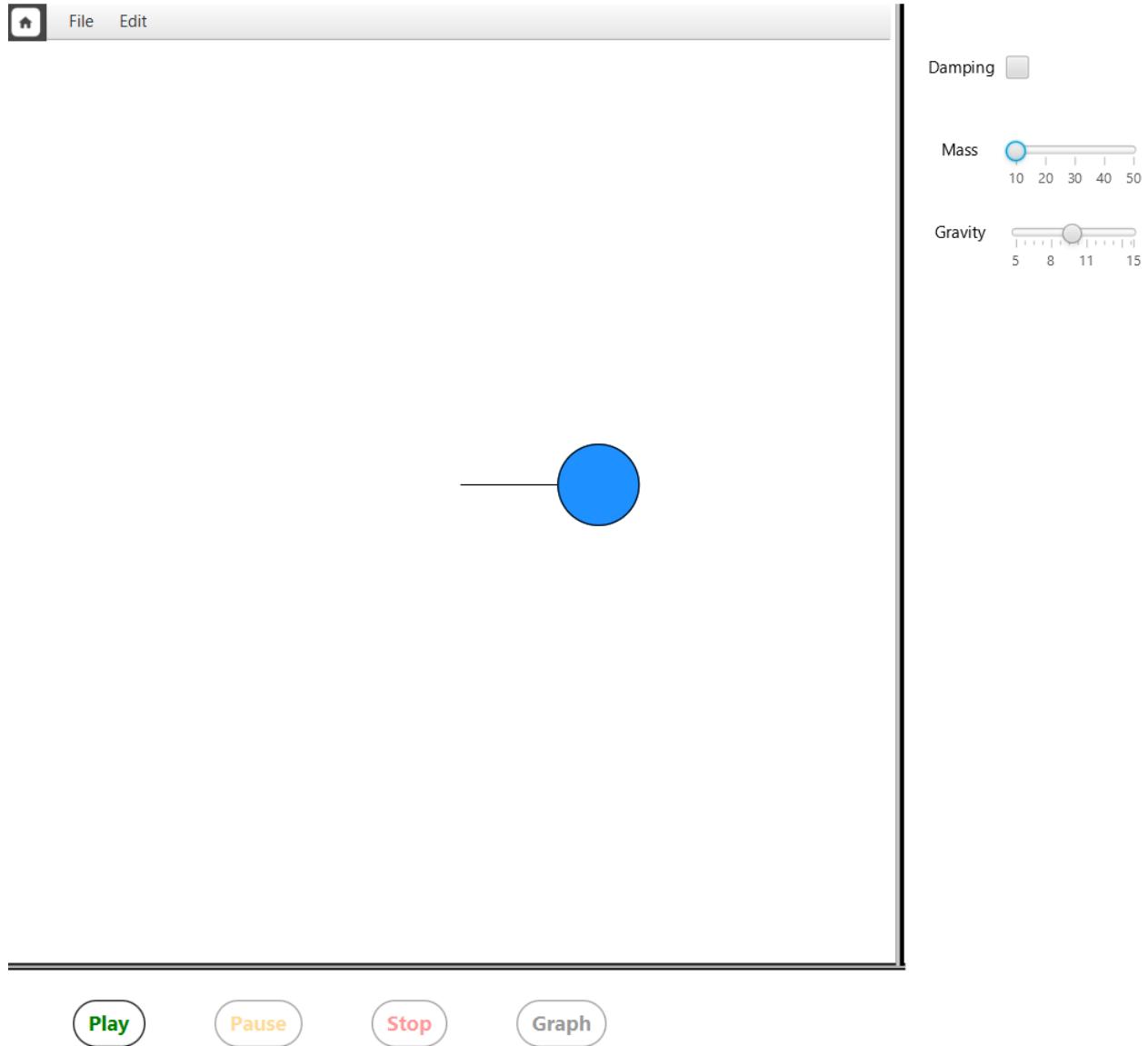
Pressing Dark mode, will change the window to this:



Pendulum Guide

Objective: understand how simple harmonic motions such as the pendulum works and how some factors such as the mass, gravity, length of the string and the damping affect them.

When we first open the stage we see:

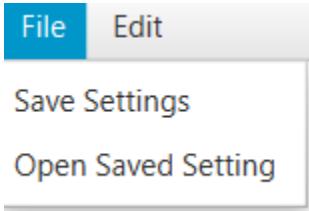


At the top there is a menu bar, at the right we see the settings, in the middle we see the animation being displayed and finally at the bottom we see the control buttons.

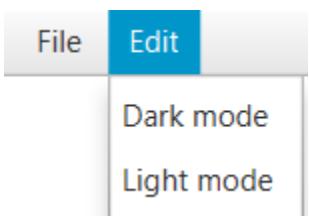
If we start with the menu bar, we can see one image view and two menu bars.



The image view is treated like a home button, every time it is pressed, it closes the stage.

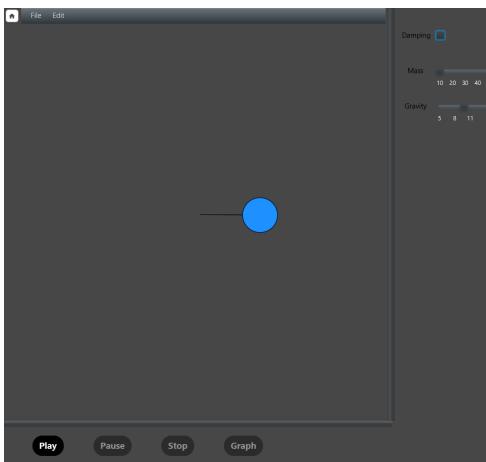


The first menu bar gives us two options: "Save Settings" and "Open Saved Settings." The first menu item saves the value that the user put in the sliders and the check box. The user clicks on it and chooses a file where he will store the data in a CSV file. He can later access this data and even put the value back again on the controllers by pressing on the second item. Note that these features are disabled during the running of the animation.



The second menu bar just helps the user to activate dark or light mode. These features are on all the time.

Example of dark mode:



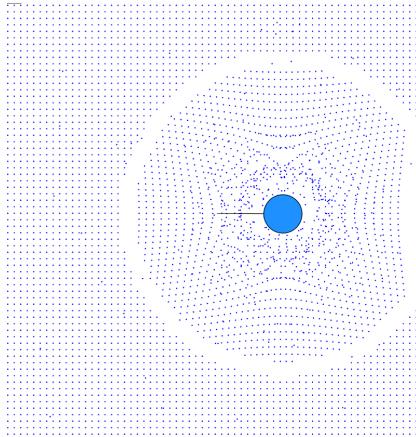
Damping

Mass  A horizontal slider with a blue circular handle at position 10. The scale has tick marks at 10, 20, 30, 40, and 50.

Gravity  A horizontal slider with a grey circular handle at position 11. The scale has tick marks at 5, 8, 11, and 15.

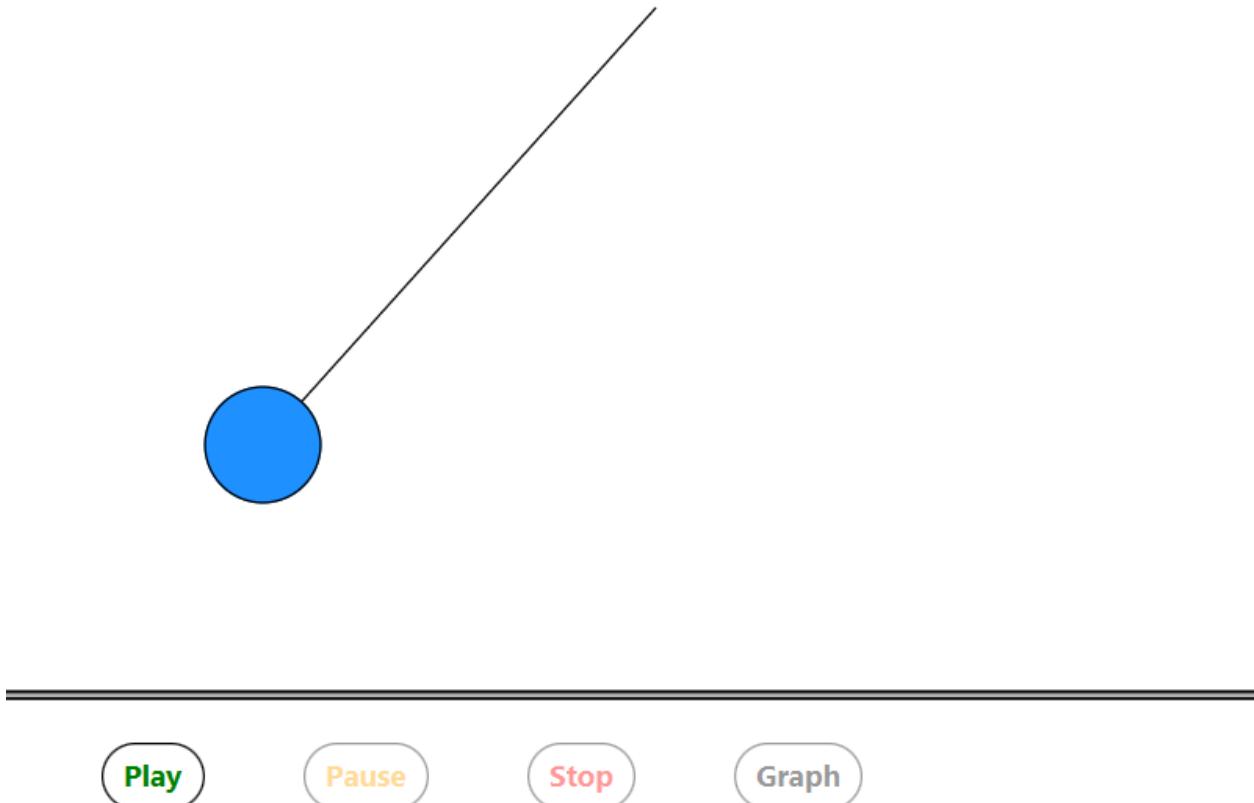
Here we explore the three settings that could affect the pendulum animation.

The first is the damping and when activated it draws particles all around the pendulum like this:



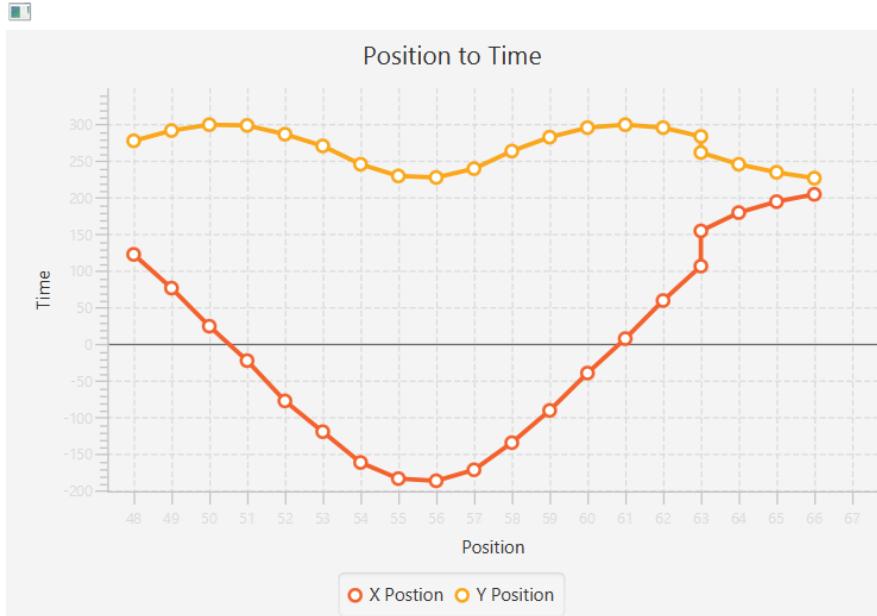
We can see these particles as wind particles that prevent the pendulum from oscillating smoothly.

The other sliders that are displayed allow the user to change the mass and the gravity of the pendulum which will change the duration of the animation.



In the middle and bottom part of the stage we see the animation and the buttons. When the animation is stopped the user can use his mouse to drag the ball wherever he wants as long as the length of the string does not exceed 300 pixels. However, as soon as the play button is pressed this feature is removed and the user would have to click on the stop button to drag the ball again. Notice that when the play button is not disabled the pause and stop and pause buttons are. However once the play button is pressed they are enabled to allow the user to either pause or replay the animation. So if an animation is playing and the user stops it and plays it again it will play from duration one meaning that its current position is the initial one.

On the other hand at the bottom right there is a graph button that allows the user to see the x and y position of the ball. When pressed it creates a new window with a graph such as this one:

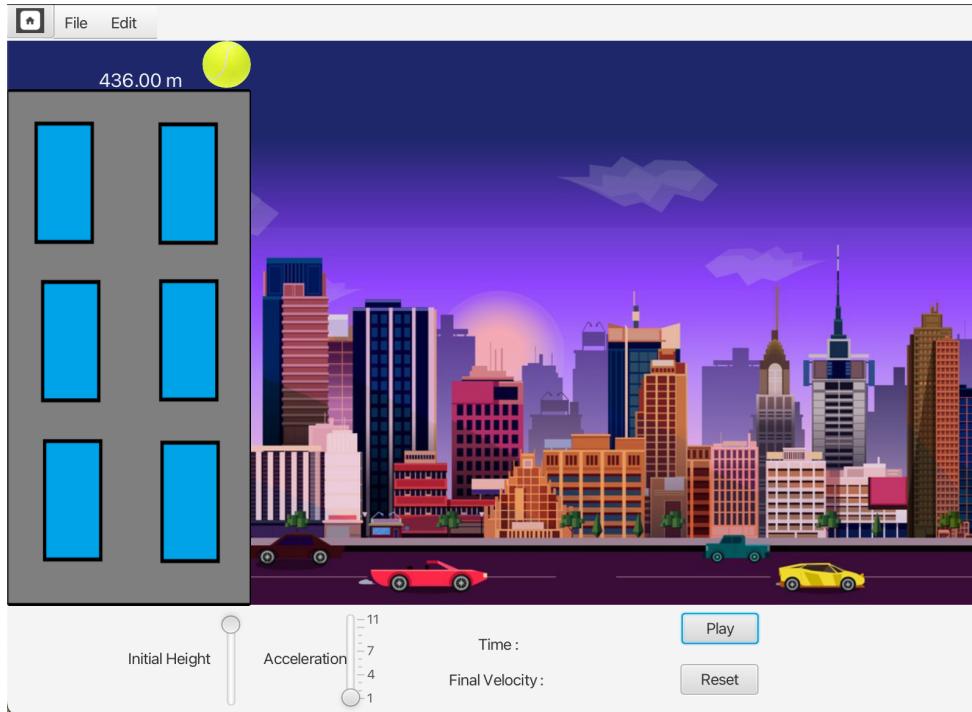


The orange line is the x position and the yellow one is the y of the ball. The x axis is the time and it is in seconds and the y axis is the position in pixels. The data is recorded each second. This graph allows the user to see how a position graph of a simple harmonic motion would look like in real life.

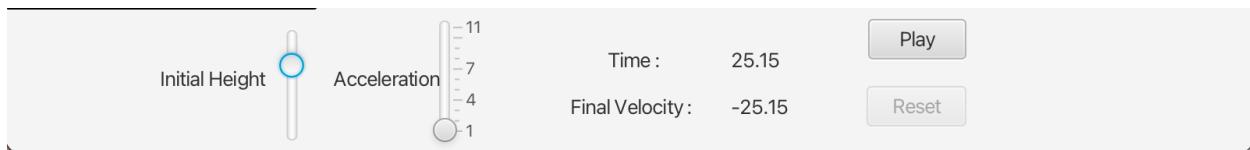
Free Fall Guide

Objective: This simulation is designed for students exploring the concept of free fall motion, in mechanics, through modifying different settings and experimenting with different values related to this idea.

When the user clicks on the “Free Fall” button on the main window, the main simulation window is displayed on the screen as follows:



Additionally, the bottom space of the window is responsible for the core concept of free fall. It is there that the user is able to experiment and modify essential values, the initial height and acceleration, that change the outcome of the free fall of the ball, which are the time and final velocity of the ball.



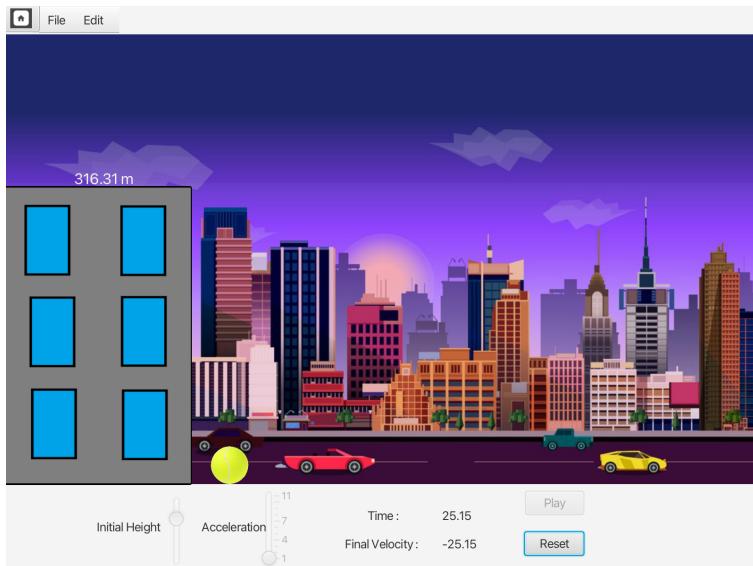
Firstly, the user must choose an initial height for the ball. Then, they must modify the acceleration of the ball, which is a very important aspect in free fall because with the ability to change acceleration, the user of this program can modify this value depending on where the ball is being dropped. For example, on earth the value of acceleration is

different from that on the moon. Therefore, the user has the freedom to adjust the value depending on their needs.

Upon the modification of these values, the user must press on the play button in order to:

- Launch the animation
- Receive the values of time and final velocity of the ball

Upon the completion of this step, the window will now look like this:



then , the user can reset and re-use the program by clicking on the reset button. This allows the user to choose new settings and start a new simulation.

Also, the top bar of the window allows the user to first

- Save runs
- Edit
- Return to menu

The home button returns the user back to the main menu of the simulation where they are able to open another simulation.

When pressing the file menu drop down, the user is able to choose to either save the previous simulation that was played or open one that was already saved.

In the edit submenu, the user has the option to have a dark mode, or light mode which only inverts the white to black or black to white.