Project Description

The project is going to be a physics learning program which allows the user to simulate different scenarios with realistic physics and watching the results in real time. The program is going to simulate 3 different physics phenomena: how the pressure exerted on the container by the particles changes when factors such as temperature, size of particles, pressure and concentration of particles changes; it will also have a rates of reaction simulator which enables the user to change the factors of rates of reactions which are the concentration of the particles, the temperature of the particles, the activation energy, and whether a catalyst is present. The rates of reaction simulator is going to have a set of known reactions the user can use which are scientifically realistic, i.e the reaction between those two compounds can actually take place, and the activation energy will be well known. The user can then change the factors that can be changed like the temperature, concentration and adding, removing a catalyst. If a change made by the user causes the reaction to stop i.e having the kinetic energy of the particles be lower than the activation energy by decreasing the temperature, the reaction is going to stop and inform the user exactly what caused the reaction to stop. Finally, the last physics simulation in the program is going to be projectile motion simulation which takes in inputs from the user about the angle at which the projectile is going to be launched, the initial velocity of the projectile, and adding to that, the user will have to option of picking between different “planets” which have different gravitational forces and see how that affects the trajectory of the projectile; so the user can see how a projectile launched in Jupiter would look like compared to if it were launched here on Earth.

The libraries I am going to use are: Tkinter to implement my user interface, Math to make all my calculations, Projectile for the projectile motion simulator, Pymunk which is also for the projectile motion simulator and it allows me to simulate different environments such as the gravity which would be needed for launching projectiles in different “planets”, and Collisions which will allow me to simulate collisions between the particles and make them have realistic physics.

When the user first launches the program, he/she will be greeted by the home screen page which has 3 buttons: one for each simulator. In the pressure simulator, the user will be able to enter the values for the factors that affect the pressure and then click on “start simulation” which will open a new window and simulate the movement of the particles in the container while displaying the result of the pressure being exerted on the container on the side of the screen. The factors the user added will also be present at the side of the screen and at any time, the user will be able to change the factors by typing in new values and then clicking on “start simulation” again which will close the current simulation and start a new one with the new factors.

The second simulation, which is the rates of reaction simulation, will give the user the option of picking between 3-4 preset reactions, and these preset reactions are going to be realistic in every possible way. They are going to have the right activation energy, which is the minimum energy required to start the reaction, they are going to have the right chemical equations which determines which element is the limiting factor in the reaction. For example, the reaction between Magnesium (Mg) and hydrochloric acid (HCl) is has the chemical equation Mg(s) + 2 HCl(aq) 🡪 MgCl2(aq) + H2(g). The equation shows that for every Mg that reacts, there are two HCls that react, so if we had 2 Mgs and only 3 HCls, only 1MgCl2 would be produced and the limiting factor in this case is HCl. Each compound/ element is going to have a unique color, and the key of colors will be on the side of the screen so the user can know what compounds/elements he/she is looking at. If the user were to simulate the aforementioned reaction and inputs, he/she will be able to see 1 MgCl2 compound, 1 Mg particle and 1 HCl particle floating around, so the user will know how many particles reacted exactly based on the chemical equations. If, for any reason, the reaction fails; for example, not enough kinetic energy, or not enough particles, a message will pop up telling the user exactly why the reaction cannot happen.

Finally, the collisions simulator. The user will be able to choose the initial velocity, angle and the “planet” the projectile is being launched in. He/she will then click on “simulate” and will see a live simulation of the projectile being launched and the path will be plotted which shows the trajectory. This will allow the user to see how the trajectory of the projectile changes under different circumstances, and when the projectile lands, the user will get how long the projectile lasted in the air, and its final velocity as it hits the ground.

By the first milestone, when I show a small demo to my CA, I aim to have two simulations working, the projectile simulation and the pressure simulator.