INTEGRATIVE PROJECT IN COMPUTER SCIENCE AND MATHEMATIC

420-204-RE

PROJECT

DELIVERABLE-1-

Team

Anthony Monaco

Mark Antoun

M-Amar Kseibi

Youssif Khalifa

Team Name

The Scientist's Lab

List of Program Courses and Concepts

List all the program courses that you have already token or are currently taking and list their key concepts.

If there is a discrepancy between team members where a team member did not take a certain course, mention it.

Course	Concepts
Calculus 1(all team members took the class)	Limits
Calculus 2(all team members took the class)	Integration

Mechanics(all teams members took the class)	laws of motion
General Chemistry(all teams members took the class)	General chemistry concepts
Waves, Optics, and Modern Physics(Anthony, youssif and amar took the class)	Simple harmonic motion, lenses, and time relativity
Electricity and Magnetism (no one took the class yet)	Forces due to charges and electric fields

Project Idea

Each team member must think of and choose a project idea then work with their teammate to select the more convenient ones.

Team Name:	The Scientist's Lab
Team Member's name and Project Idea 1:	M-Amar Kseibi Idea: Physics simulation hub which includes the idea of charges and shows the details of the charge transfer and imbalance in objects. It can also include other physics concepts, such as: projectile motion and simple harmonic motion.

	Idea: Chemistry-related idea, show the concept of pressure through a container simulation, in which the user can tweak certain variables (number of particles, volume of container, temperature, and speed of particles) to understand what affects the pressure in a container.
Team Member's name and Project Idea 2:	Youssif Khalifa Idea: An application that could help in drawing any function on a graph. As an input we could take the equation of a function f(x) and draw a point on $\forall x$ where f(x) is continuous on a line graph on a stage. We could also make a feature that helps the user to draw the derivative and the antiderivative of the given function. The derivatives could also be drawn on top of the initial function so that the user could compare both of them. Another feature we could include is a program that takes as input a specific matrix and gives its reduced row echelon form or it could also give its inverse.
Team Member's name and Project Idea 3:	Mark Antoun Idea1:A program in which when entering a simple function, and entering the parameters, the program will draw the function on a graph and use riemann sum(a finite number of rectangles) to have an underestimate or overestimate of the area under the graph of the entered function and also showing the rectangles drawn on the graph. Idea2:a simulation in which 2 cars are shown and you can set their position and speed. The simulation will make a visualization of the

	faster car catching up and how long it took for it to catch up.
Team Member's name and Project Idea 4:	Anthony Monaco Idea: Mechanics related program to demonstrate a ball in free fall. The ball will roll off of an incline to show its projectile motion. Things like gravity and the effects of objects can be visualized. Also an added minigame where players can try to move obstacles so that the ball can successfully fall into a targeted area (like a garbage can at the bottom).
Selected Project Ideas and why:	The idea that we chose to work on is based on kinematics. Our project will be helpful to students that are learning mechanics and specifically kinematics. The project will be considered a laboratory and once entered will have 4 different simulations that are based on kinematics formulas. The idea behind the project is to help students understand the concept of kinematics by making them visualize it. First simulation will be Mark's idea #2. Second simulation is Anthony's idea. Third simulation is youssif's idea. Fourth simulation is Amar's idea.

Project Description

Describe you project idea, in brief, all while addressing the following points:

Concept

- Describe the physical and/or mathematical concept(s) behind the project.

Our project will be mostly based on the kinematics formulas that were learnt in our mechanics class. These formulas are: $\Delta x = v_i\Delta t + 1/2\ a(\Delta t)^2$, $v_f = v_i + a\Delta t$,

$\Delta x = ((v_i+v_f)/2)\Delta t$ and $v_f^2 = v_i^2+2a\Delta x$. These formulas are going to be used to calculate unknown variables in our simulations such as: displacement, initial velocity, final velocity, time and acceleration of different objects.

Concept Aspects

- Identify and list the main aspects of the concept such as the problem it addresses, the proposed solution, the solution category among other approaches' categories.

This concept helps describe the movement of objects when certain information(variables) is missing. For example, if we have a car that has an initial velocity, acceleration, and a period of time during which it is in motion, we will be able to find its final velocity using kinematics.

- The possible variable parameters that would control the user interface animating the concept.

There are many variables that could be controlled by the user such as: displacement, initial velocity, final velocity, time and acceleration.

Typical Input

- Describe the typical input for the solution of the applied concept to work.

The input of the simulations we are creating will vary between displacement, initial velocity, final velocity, time and acceleration. The specific input will depend on the specific simulation out of the four.

Expected Output

- Describe the expected output and how the user interface would look like and what it would allow the user to do.

The expected output is a visualization of the applied formulas on different types of simulations. This is to help the user better understand concepts and see how different variables in the different equations change the movement of projectile objects. In some sub projects, the user will be able to play a mini game to better understand the concept.

Feasibility

- List the JavaFX, or similar technology, elements, and implementation components that you expect to use to implement the project.

- org.apache.commons.lang3.time.StopWatch,
- javafx.util.Duration,java.util.concurrent.TimeUnit
- JavaFx.Controls
- Fxml Scene Builder
- JavaFx.scene.shape
- JavaFx.animation
- Javafx.scene.layout
- javafx.fxml.FXML

- Justify the feasibility in terms of timeline and team tasks assignment.

By dividing the main physics idea into 4 people, we believe we will be able to fully demonstrate this concept through these 4 simulations. By working on the project regularly throughout the semester will be key to keep the feasibility reachable.

Individual part

- For each team member, describe their individual part and how it would integrate with the whole project with other team members parts.

Mark Antoun:

My simulation will be based on two cars that have parameters such as acceleration, initial and final velocity, and displacement. These variables will be chosen by the user before the start of the animation. During the animation, the cars will be shown moving with all their variables being updated instantly which should help the user understand the relationship between the variables better. In addition, if a car starts before another and is going slower, the faster car will catch up. In this case, the time until the second car catches up will be calculated and shown during the simulation.

Anthony Monaco:

My part of the project will demonstrate projectile motion based on the initial quantities. This program will show the motion of the ball that will happen based on the physics laws, giving a visualization of the physics laws. A mini game will be added where a final position is randomly generated, and the goal of the user is to make the ball land in this designated area. This can be used as a test to see if they properly understood the concept.

Youssif Khalifa

My simulation will consist of a simple pendulum animation. The scene where the animation will be displayed will be contain three nodes: One node is for the animation itself (A canvas and a pane of top of it), the other node is placed just under the animation pane and it will contain the play, pause and stop buttons and finally the last node will contain the settings. The settings will contain many features such as changing the length of the string, the damping, the color of the bob.

Another idea I thought of is doing a simulation of two circles departing from random positions and colliding together. Each will end up with a different momentum than the one it started with. I could allow the user to change the mass and initial speed of the circles by using the settings.

M-Amar Kseibi

The simulation that I will be doing for this project explores the idea of free fall of objects. There will be different parameters that the user can modify to their own interest in order to understand this concept of kinematics. These include variables such as height of dropping the object, initial velocity of the drop, and the planet where the drop takes place (different gravitational force variable). There will also be a timer in the simulation, which will show the user the effects of modifying the variables on the time. Additionally, there might be an extra feature that asks the user to find the time, as a quiz question, that the object needs to reach a rest position. Finally, changing the planet that the object is being dropped from will also change the background accordingly.