Project Ideas for End Term Examination

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Contents

1 Instructions for the End-Term Examination

1. All students must form groups of five.
2. As a group, propose a topic of your choice that involves solving a real-world problem using Python programming.
3. A list of suggested project ideas relevant to your field is provided for reference, though you are not limited to selecting a project within your field.
4. Your group must prepare a report in LaTeX, ensuring proper formatting, inclusion of a table of contents, figures, and references.
5. The report should clearly specify each member's contribution.
6. Prior to the final exam, you will present your project. Each group will have 10 minutes (2 minutes per student), followed by a 5-minute viva.
7. The marking scheme is as follows: 20 marks for the project, 20 marks for the report, and 10 marks for the viva.

2 Proposed projects

2.1 Physics Projects

2.1.1 Simple Harmonic Motion Simulator

Python Task: Simulate the oscillation of a pendulum or spring and plot position, velocity, and energy graphs over time.
LaTeX Report: Include the mathematical model of SHM, a description of the simulation, plots of motion, and a discussion of energy conservation.

2.1.2 Projectile Motion Calculator and Plotter

Python Task: Take initial velocity and launch angle as inputs to calculate and plot the trajectory of a projectile.
LaTeX Report: Present the equations of motion, include trajectory graphs for different angles, and discuss how varying initial conditions affect the range and height.

2.1.3 Ohm's Law Calculator

Python Task: Create a tool to calculate current, voltage, or resistance when given any two values.
LaTeX Report: Provide a short theoretical background on Ohm's law, example calculations, and discuss how the program helps verify basic circuit properties.

2.1.4 Kinematic Equations Solver

Python Task: Create a tool that solves the kinematic equations for different variables like velocity, acceleration, and time.
LaTeX Report: Explain the equations, include example scenarios, and provide detailed solutions calculated by the program.

2.1.5 Simple Circuit Simulator

Python Task: Simulate a basic DC circuit and calculate current, voltage drop, and power dissipation across resistors.
LaTeX Report: Illustrate the circuit, explain the calculations, and include tables and graphs of current or voltage distributions.

2.2 Mathematics Projects

2.2.1 Prime Number Finder

Python Task: Create a program that checks if a number is prime and generates a list of primes up to a user-defined limit.
LaTeX Report: Include a brief theory of prime numbers, a list of found primes, and discuss patterns or distributions.

2.2.2 Fibonacci Sequence Generator

Python Task: Generate the Fibonacci sequence up to a given number of terms and visualize it.
LaTeX Report: Discuss the Fibonacci sequence, include generated sequences, and visualize the Fibonacci spiral using matplotlib in Python.

2.2.3 Pythagorean Theorem Visualizer

Python Task: Take the lengths of two sides of a right-angled triangle and calculate the hypotenuse, displaying a visual representation.
LaTeX Report: Present the theorem, provide calculations for sample inputs, and include graphical representations of triangles with calculated sides.

2.2.4 Algebra Solver

Python Task: Solve linear equations of the form ax + b = c.
LaTeX Report: Discuss how linear equations work, provide examples of input/output from the program, and explain step-by-step solutions.

2.2.5 Factorial Calculator

Python Task: Write a program to calculate the factorial of a given number using loops or recursion.
LaTeX Report: Explain the concept of factorial, show results for different numbers, and discuss the computational efficiency of recursive vs loop-based solutions.

2.3 Chemistry Projects

2.3.1 Periodic Table Lookup

Python Task: Create a tool that lets the user search for an element by symbol or atomic number and displays its properties.
LaTeX Report: Include a brief introduction to the periodic table, a few example element lookups, and a discussion of trends in element properties.

2.3.2 Chemical Equation Balancer

Python Task: Create a program to balance simple chemical reactions by taking reactants and products as input.
LaTeX Report: Explain the importance of balancing equations, show examples of input/output, and discuss the rules of balancing.

2.3.3 Molar Mass Calculator

Python Task: Implement a program that calculates the molar mass of a compound based on its chemical formula.
LaTeX Report: Include a table of molar masses calculated for common compounds, explain the process, and discuss how to use molar mass in chemical calculations.

2.3.4 Gas Law Simulator

Python Task: Simulate the relationships between pressure, volume, and temperature using the ideal gas law.
LaTeX Report: Present the ideal gas law, include graphs showing the relationships between variables, and discuss real-world applications.

2.3.5 pH Calculator

Python Task: Write a program to calculate the pH of a solution based on the concentration of hydrogen ions.
LaTeX Report: Provide background on the pH scale, show calculated pH values for different concentrations, and discuss how pH is used in chemistry.

2.4 Geology Projects

2.4.1 Rock Type Classifier

Python Task: Classify rocks based on characteristics like hardness and texture, and assign them as igneous, sedimentary, or metamorphic.
LaTeX Report: Include a table of classified rocks, a brief explanation of each rock type, and discuss the decision-making process in the program.

2.4.2 Earthquake Intensity Simulator

Python Task: Simulate the intensity of an earthquake over time, visualizing seismic wave propagation.
LaTeX Report: Discuss how earthquake intensity is measured, include simulated data, and explain how the program mimics real seismic events.

2.4.3 Plate Tectonics Visualizer

Python Task: Create a visualization of tectonic plate movements and the resulting geological features.
LaTeX Report: Include a brief overview of plate tectonics theory, a visual representation of tectonic movements, and explain how the program models this process.

2.4.4 Mineral Property Lookup

Python Task: Implement a tool where users can input a mineral's name to look up properties like hardness, streak, and color.
LaTeX Report: Provide a summary of different minerals, show example lookups, and discuss the importance of mineral identification in geology.

2.4.5 Volcano Eruption Probability

Python Task: Build a program that estimates the likelihood of a volcanic eruption based on historical data and certain geophysical indicators.
LaTeX Report: Explain the factors that influence volcanic eruptions, include program outputs for different volcanoes, and discuss the implications of such predictions.