Team Principia

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Period 5

Physics Interpreter and Visualizer

The goal of this project is to create a computer program that can interpret, solve, and visually represent various concepts in the field of physics.

User Experience

- The user should be able to interact with this program either directly from the terminal or from an interface constructed using Processing. A basic example of using this program is as follows:
    - The user wishes to calculate the gravitational force on an object. To do so, first navigate to this topic (e.g. Menu > Forces > Gravity > On object by Earth).
    - The user is then prompted to enter appropriate inputs in order to solve the problem—the object's mass, in this case.
    - A solution is then returned and a visual representation will be shown.
- The user should be able to provide input and receive output in any applicable unit.
- The user will be prompted to fix errors such as not providing enough information or having inconsistencies in input syntax.

Topics and Concepts

- Trees will be used in constructing the various menus in the program. This helps to organize the various concepts in physics, allowing for categorization and easy searching by the user.
- Use of enum types: planetary data, atomic elements, subatomic particles, electromagnetic spectrum.
- Encapsulation: mainly for a Vector class and a Unit class.

- Stacks will be used to perform calculations when solving a given problem. This is especially important because there will be operations beyond basic arithmetic such as unit conversion, vector addition, dot products, cross products, equation rearrangement, substitutions, etc.
- Queues may be useful in creating a looping animation. Operations that are dequeued and processed can be immediately enqueued.

Minimum Viable Product

- For a user, the first working version will have navigation, input, output, and visualization.
- The first priority is to get a functioning program with only the most basic concepts of physics. This will most likely be the topic of kinematics, which has very simple equations. In addition, it is easy to visually model the equations of motion within the x,y coordinate system of Processing.
    - This does not even need to work with vectors but instead with magnitudes.

Potential Difficulties

- Making sure that user input is correctly interpreted (units, significant figures, direction of vectors).
- Visual representations of more complex concepts (3-space, waves, field lines).
- Integrating terminal and graphical interfaces.