Phys 102, Kintner, Fall 2019

Final Project Guidelines

Dates:
Presentations will be in class: Dec 2 and Dec 6
Written reports due Dec 9 (The final exam is also Mon, Dec 9.)
First topic request to me by Mon, Nov 11. (Email would be good.)

Description:
For the final project in this class, use computational physics/programming to explore something you would like to learn more about. You will report your findings to the class in a short presentation, and you will turn in working code and a written report.

There are lots of projects I can imagine, but I am also very open to an idea of your own. Ideally you can choose something you are interested in. Here are some ideas:

Simulation ideas:

- Muon decay as a function of altitude (imagine they were created in the upper atmosphere.) Include time dilation.
- Create the double slit pattern for single photons (or single electrons)—even more fun would be to watch it build up over time
- Simulate some aspect of a game you enjoy (dice games and card games work well, but we can probably simplify any game with a random element.)
- Your own idea

Numerical solution ideas:

- The three-body problem (did you know that you cannot solve for the positions of just three masses exerting gravitational forces on each other?) (This can be done with Phys 1 level Newton's Laws.)
- The double pendulum (easier with a Lagrangian).
- Any chaotic system (easier with a Lagrangian).
- Spring pendulum (easier with a Lagrangian).
- Your own idea

It does not have to be a simulation or numerical solution, though those are some of the most powerful ways to use a computer in physics and engineering. If there's something you would like to explore, ask me to see if we can fit it into the scope of the class.

Requirements:
You must include a clear statement of the problem you are investigating, the derivation of any relevant equations, an explanation of your computational method and how you implement it, graph(s) of your results, and a discussion of your results.

Grades will be assigned based on the requirements listed above, with consideration for the difficulty of the problem, the accuracy of the method, and the clarity of your explanation.

A suggestion of a way to test your code is to find a case where you know the outcome and see if you get it. Then also investigate more than one set of initial conditions or input variables as appropriate for your problem. Play with your code! Once it's written you've done the hard part.

Another really fun thing to include is an animation of the motion if there is any, but that is not required.

Final Projects should be entirely your own work! Of course you can ask me for help, but you may not get a solution from another source. (You may look up experimental results or other solutions to compare to, but you should not look up code.) Also, no two people should work on the same problem. So check with me. (There are usually variations if two people want to do the same kind of problem.)

Presentations:
About 10 minutes. You may use Powerpoint (or presentation software of your choice), but you don't have to. I would probably prefer any physics/algebra to be done on the board and explained as you go. Be sure to include all the requirements listed above—with the possible exception of code. There might be pieces of code worth showing, but mostly showing code itself is difficult in a presentation. But you should definitely show graphs (and animations if you have them).

Written report:
Must be typed in some format, with the exception of any algebra. You may write that by hand and either include is as figures in the text, or just attach it.

Script files: Turn in working code to me by email. (Don't forget we have a sheet with instructions for things like choosing good variable names and leaving white space and comments.)