PHY407: Lab 7

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Work Distribution: We worked on this assignment together in-person, so it was split quite evenly. We brainstormed pseudocodes, and then the base code for each question was collaborated upon. We reused the code we wrote as necessary to answer all of the questions. We alternated between parts for these questions, and then switched and checked each other's work at the end.

*All Python code and outputs are included in the Quercus submission as .py files.

## Question 1: Space Garbage

a) Code, plot, and description
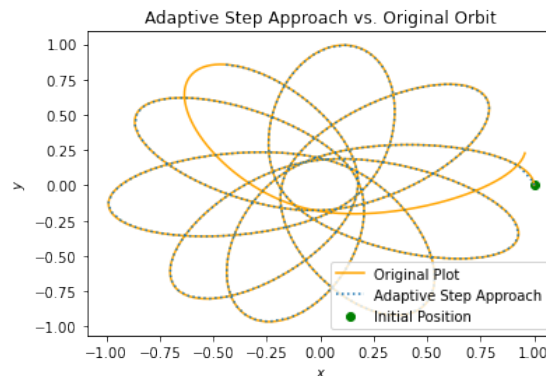
Notice that the adaptive step size approach does follow the original plot, and therefore we do see the effect of the adaptive step size approach. We see changes in step size based on different parts of the plot. For example, we see increases in step size further away from the centre of the orbit, and decreases in step size when the orbit reaches the centre. When there is a decrease in kinetic energy (and therefore, velocity), we see a smaller step size.

b) Printed output

The adaptive step approach is much faster as it only took about 0.2 seconds to execute, whereas the non-adaptive code took about 1.28 seconds to run.

c) Code, plots, and written answers
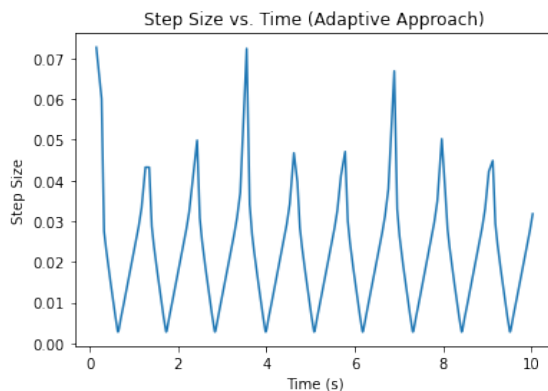
The time steps tend to be relatively short around the center of the orbit. This is likely due to the conservation of energy. Since potential energy is high in these regions, kinetic energy must be low and so the velocity is also low, causing the time steps to be closer together.

Question 2: Hydrogen Atom

a) Code submitted in .py file

b) Written Answers

Increasing l decreases the energy slightly, while increasing n increases the energy by a large margin. This makes sense because the larger the value of n, the further away from the center the electron gets, causing the potential energy to increase.

c) Code and plots