LAB 4: A COMPUTER SIMULATION OF THE SOLAR SYSTEM

1. Introduction

The general topic of this lab is to create a computer simulation of the orbiting planets of our solar system.

We'll explore some of the graphing and animation features of Maple and apply our knowledge of parametric equations. It is often the case that we use technology to demonstrate some concept or physical application. Here we will attempt to construct an animated simulation of the planets in our Solar System as they orbit the sun.

The purpose of this lab is not only to explore more of Maple's features, but also take on a slightly larger project so that you can focus a bit more on the write up.

You will notice two due dates for this lab (from the syllabus). The first due date will be on Monday, November 6th (for both lab sections). I will return these labs to you at the beginning of class on November 8th or 9th (for the Wed, Thur sections, respectively). At that point, you may choose to make any revisions and re-submit the labs by Monday, November 13th (there will not be anything new for you to do on the 8th/9th lab session).

Because of this short turn around time, I will not accept any late labs. If you're late, you will not have a chance to do any revisions.

2. Details of the Lab

(1) Copy `AnimationExample.mw` from the class web page to your working directory and load it into Maple. Look over the code, run it, play with it and modify it so that you understand how it works.
(2) Go to the internet and find the information we'll need to create a computer model for the first three planets. One such web link is on our class website. For an initial model, you may assume that the orbits are circular (estimate a reasonable radius based on the web information).
(3) There is a lot of folklore about planetary alignments. One possibility for a model extension would be to discuss the issue of

planetary alignment (or conjunction). In particular, there was a "great conjunction" back in the year 2000.

(4) Is it possible to add all the remaining planets to your animation? If so, do it. If not, why not? You might think about your answer to the previous question.
(5) See if you can incorporate the orbit of the Moon into your animation. Think about what we did in the "Spirograph" lab.
(6) See if you can find out why the planets move in an elliptical path, and why they move in a plane (Hint: Kepler's Laws, Sect 13.4 in Stewart)

Write up your results. Include an introduction that explains what you will do, a body that addresses the issues raised above, and you can include a brief sequence of frames (at most 4) of your animation.

When we write up a mathematical model or simulation, it is important to discuss the model assumptions. For example, in a solar system simulation, what are the model assumptions?

In a simulation, we have to decide on numerical values for the model, so you should also think about those and discuss how you chose the parameter values.

At the end, discuss what kinds of things might be done to make the simulation more realistic.