

# ASTRONOMY 9602

Computer Project #1

Due: October 26, 2011

This project requires you to use a computer program to calculate three-body motion. This deceptively simple problem is actually characterized by a huge variety of complex solutions, most of which are *not* periodic, in contrast to the two body problem.

An exceptional case in the three body problem is the so called “figure-8” solution, in which three bodies of equal mass do trace out a periodic pattern in the shape of the number eight.

1. Download the N-body program (see attached sheet) and set it up in a directory you have created (e.g., on one of the Astronomy computers). Compile the code and run it using the example input given in the README file that accompanies the code.

The given initial conditions should lead to the figure-8 motion. Learn how the positions of the objects are written in the output file. Use the output data, and plotting software (e.g., GNUPLOT, IDL, MATLAB), to make one or more plots that illustrate the figure-8 motion. You need to turn in one or more plots that *clearly* illustrate the motion of each of the three objects. Much of this project actually involves figuring out how to visualize the data output from the program.

2. Perform the following computational experiments and present the results as you did in the previous question. Make a small change to the input file and see what happens to the motion of the three objects. Does the motion resemble the figure-8 pattern? Next make a bigger change to the input positions and/or masses of the three objects and present an example where one object is flung outward to a large distance. Finally, calculate the evolution of a case with more than three objects; you choose the number of objects and initial condition. Present figures illustrating the outcome for each of the above cases.

Please provide a copy of any computer programs you write to read in the program output and display the results. Any computing language is acceptable. Write some text summarizing what you did, and also describe the input you gave to the program in each case.

This project can be carried out on the Linux workstation 'sedna' located in the Astronomy computer room 320. You will need to use the gcc compiler to compile the program. MATLAB and GNUPLOT are available on sedna.

The additional sheets handed out in class can be found at the following websites:

<http://www.sns.ias.edu/piet/act/comp/algorithms/starter/index.html>

<http://www.sns.ias.edu/piet/act/comp/algorithms/starter/readme.html>

<http://faculty.ifmo.ru/butikov/Projects/Collection3.html>