# Computational Science 1

http://www.tu-chemnitz.de/physik/THUS/de/lehre/CSM_WS1819.php

Seminar
Exercises

**Prof. M. Schreiber**
schreiber@physik.tu-chemnitz.de
Room 2/P302, Phone 21910

**Dr. P. Cain**
cain@physik.tu-chemnitz.de
Room 2/P310, Phone 33144

Exercise 3 (2.11.2018):

## Planet Motion

from ***An Introduction to Computer Simulation Methods***,
Chapter 5, Problem 5.10-11

a) Use `Planet2` (`Planet2.java` and `Planet2App.java` from `org.opensourcephysics.sip.ch05`) with the initial conditions given in the program. For illustrative purposes, we have adopted the numerial values $m_1/M = 10^{-3}$ and $m_2/M = 4 \times 10^{-2}$ and hence GM1 = $(m2/M)$GM and GM2 = $(m1/M)$GM. What would be the shape of the orbits and the periods of the two planets if they did not mutually interact? What is the qualitative effect of their mutual interaction? Describe the shape of the two orbits. Why is one planet affected more by their mutual interaction than the other? Is the angular momentum and the total energy of planet one conserved? Is the total energy and total angular momentum of the two planets conserved?

b) An interesting dynamical system consists of one planet orbiting about two fixed stars of equal mass. In this case there are no closed orbits, but the orbits can be classified as either stable or unstable. Stable orbits may be open loops that encircle both stars, figure eights, or orbits that encircle only one star. Unstable orbits will eventually collide with one of the stars. Modify `Planet2` to simulate the double star system, with the first star located at $(-1, 0)$ and the second star of equal mass located at $(1, 0)$. Place the planet at $(0.1, 1)$ and systematically vary the $x$ and $y$ components of the velocity to obtain different types of orbits. Then try other initial positions.