Introduction to Computer Simulation
Term: Spring 2019
Instructor: Charles S. Peskin (peskin@cims.nyu.edu)
TA: Rohit Nandwani (rhn235@nyu.edu)
Grader: Priyank Pathak (pp1953@nyu.edu)

Prerequisite: Calculus I and Physics I; Co-requisite: Calculus II

Description:
In this course, students learn how to do computer simulations of such phenomena as orbits (Kepler problem and N-body problem), epidemic and endemic disease (including evolution in response to the selective pressure of a malaria), musical stringed instruments (piano, guitar, and violin), and traffic flow in a city (with lights, breakdowns, and gridlock at corners). The simulations are based on mathematical models, numerical methods, and Matlab programming techniques that are taught in class. The use of animations (and sound where appropriate) to present the results of simulations is emphasized. The course is organized around student projects, which may be done individually or in teams. The main course requirement is to do three projects during the semester. Each project involves a written proposal, an in-class presentation, and a written report. The Recitation for this class is a Computer Lab, in which the students learn the details of computing in Matlab. This is also a place for students to work together on their projects and to get immediate help from the TA.

Text (recommended, not required):
Hunt BR, et al., A Guide to Matlab for Beginners and Experienced Users, Third Edition. Cambridge University Press, 2014

Syllabus
Week 1: Course Introduction; Newton's laws and Euler's method.
Week 2: Orbit of a single body around a fixed center.
Week 3: N-body problem.
Week 4: Mechanics with other forces besides gravity.
Written Proposal for Project 1 is due at end of week.
Week 5: Deterministic and stochastic models of epidemics.
Week 6: Student presentations of Project 1.
Written Report on Project 1 is due at end of week.
Week 7: Endemic disease. Malaria and the evolution of the sickle-cell gene.
Written Proposal for Project 2 is due at end of week.
Week 8: Mathematics of music. Equations of a vibrating string.
Week 9: Student presentations of Project 2.
Written Report on Project 2 is due at end of week.
Week 10: Piano, guitar, and violin simulation.
Week 11: Traffic in a single lane with lights.
Written Proposal for Project 3 is due at end of week.
Week 12: Traffic on a grid with lights, breakdowns, and gridlock.
Week 13: Bonus topic(s) and/or student presentations.
Week 14: Student presentations of Project 3.
Written Report on Project 3 is due at end of week.
Grading:
25% of course grade is based on active participation in the Friday Recitation. This is an individual grade, assigned by the TA, based on the TA's impression of the contribution of each individual student to the projects on which that student is working and also to the work of the class as a whole.

75% of the course grade is based on the three projects, with equal weight, so that each project contributes 25% to the final grade.

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Within any one project, 8 points will be based on the written proposal, 8 points on the in-class presentation, and 9 points on the written report, for a maximum total of 25 points. The proposal and written report grades are assigned by the grader. The presentation grade is assigned by the professor, and includes his impression of the overall project quality, not just how it was presented.

Projects may be done individually or in teams, but the maximum team size is three students. Teams form by mutual agreement to do a specific project together, not for the entire semester. In fact, to avoid excessive reliance of one student on another, no two students are allowed to be members of the same team on all three projects. On any one project, all team members receive the same grade.

Office Hours (Peskin, 917 Warren Weaver Hall):
  Thursday: 2-4pm

Office Hours (TA, Rohit Nandwani, 524 Warren Weaver Hall):
  Monday: 3:00-4:30pm