PHYS516 Final Project—Anything Related to What You Have Learned in the Class
Due: May 13 (Wed), 2020 (email to anakano@usc.edu)

Submit the following project by May 13 (Wed). In addition, each student is required to make a brief (~2 minutes) presentation about his/her project at one of the last three classes—April 27 (Mon), April 29 (Wed) or May 1 (Fri). Please discuss your potential project with me by April 17 (Fri), so as to agree on your topic.

Project: Choose one of the following three options. (The subject can be anything related to simulations such as molecular dynamics, Monte Carlo, quantum dynamics, or eigenvalue problems.)

1. Write a program that is related to one of the subjects covered in the class. The following is a list of possible topics (note that this list will expand as we learn more simulation methods in the class):
   - Change the integration algorithm in the molecular dynamics (MD) program, `md.c`, to a higher-order Trotter expansion method,[1] and compare its energy conservation property with that of the velocity Verlet algorithm.
   - Ising-model simulation, using one of advanced Monte Carlo (MC) algorithms, *e.g.*, Wolff's cluster MC, multigrid MC (MGMC), replica exchange MC.
   - Hybrid MC simulation of particles on a disk.
   - Write a program for MGMC simulation of particles.

2. Read a research paper on computational physics and write a report summarizing the techniques used in the paper and its results. Potential topics include: MD, MC, quantum dynamics, and eigenvalue problems. Possible sources of papers include: *Computer Physics Communications* (http://www.sciencedirect.com/science/journal/00104655) and *Journal of Computational Physics* (http://www.sciencedirect.com/science/journal/00219991).

3. Write a research proposal containing novel extensions of any of the techniques you have learned in the class. The proposal should contain: Goal, specific objectives, current state of the knowledge/previous work, techniques to be used, and expected results.

[1] H. Yoshida, "Construction of higher order symplectic integrators," *Phys. Lett. A* **150**, 262 (1990).