Ninth problem set for Physics 5300 - Theoretical Mechanics

Prof. Dick Furnstahl

Due date: Wednesday, March 27, 2019 in class

Important dates: No class Mar 22

The problems on this set add up to 72 points. In order to receive full credit you have to obtain 64 points.

Converting pendulum notebook to Hamilton's equations

- [12 points] The notebook Lagrangian_pendulum.ipynb has a simplified version of our former Pendulum class, now called LagrangianPendulum, that defines and solves a *simple* pendulum (no damping or driving) based on the Euler-Lagrange equation. Simple plots of the time dependence of the angle and angular velocity are given, plus a state-space plot. **Your task is to add a new HamiltonianPendulum class that solves Hamilton's equations to make plots of the angle and the generalized momentum versus time, plus a phase-space plot. Turn in the plots, a print-out of the new class, and comment on the differences of the code to the Lagrangian method for this problem.**

Chapter 13

- 13.6** [8 points] Bonus [another 4 points]: Verify the result for the frequency by adapting your HamiltonianPendulum notebook to this problem.
- 13.12* [8 points] Example showing that the Hamiltonian is not always equal to the sum of kinetic and potential energies (cf. 13.11 from class).
- 13.18*** [12 points] Charge in an electromagnetic field.
- 13.21** [8 points]
- 13.25*** [12 points] An example of a "canonical transformation" (cf. 13.24 from class).
- 13.26* [8 points] Adapt the HamiltonianPendulum notebook and turn in a plot of the phase space trajectory.