NE 255 Fall 2016
Homework #6 Due December 1, 2016

On homework:

- If you work with anyone else, document what you worked on together.
- Show your work.
- Always clearly label plots (axis labels, a title, and a legend if applicable).
- Homework should be done "by hand" (i.e. not with a numerical program such as MATLAB, Python, or Wolfram Alpha) unless otherwise specified. You may use a numerical program to check your work.
- If you use a numerical program to solve a problem, submit the associated code, input, and output (email submission is fine).
- If using Python, be aware of `copy` vs. `deep copy`:
  https://docs.python.org/2/library/copy.html

1. (30 points) Using the direct inversion of CDF sampling method, derive sampling algorithms for
   (a) The neutron direction in 3D if the neutron source is isotropic.
   (b) The distance to the next collision in the direction of neutron motion if the neutron is in the center of the spherical volume that consists of three concentric layers with radii R_1, R_2, and R_3, each made of different materials with total cross sections Σ_{t1}, Σ_{t2}, and Σ_{t3}, respectively.
   (c) The typoe of collision if it is assumed that the neutron can have both elastic and inelastic scattering, and can be absorbed in fission or (n,gamma) capture interactions. Assume monoenergetic neutron transport.

2. (20 points) Use a rejection Monte Carlo method to evaluate $\pi = 3.14159$:
   - from $\pi = 4 \int_0^1 \sqrt{1 - x^2} dx$
   - from $\pi = 4 \int_0^1 \frac{1}{1+x^2} 1 dx$
   - Assuming that $\pi = 3.14159$ is exact, calculate the relative error for 10, 100, 1 000, and 10 000 samples.
   - What do you notice about the behavior of error as a function of number of trials?