NE 155 - Introduction to Numerical Simulations in Radiation Transport
Final Project
Due May 12, 2015

Below is a list of possible term projects (there are Monte Carlo and deterministic options). If you intend to share a project amongst a team of students (maximum 3 students per team), check to ensure that the project has sufficient scope. The project is 30% of your grade and is due on May 12. The following schedule will be imposed:

April 8: Decide which project to work on; turn in list of team members (if applicable) and a 1-page abstract of project, including:

- what you plan to do
- major steps to execute the project
- deadlines associated with each step
- what you need to do to accomplish each step (laying out a path to success)
- if in a team, the division of work

April 20 : Submit written report (4 pages maximum) explaining your project, including any associated background; preliminary results; and plans for completion.

May 12: Presentations (between 5 and 15 minutes, depending on project and team size) containing

- a project description,
- approach taken / methods used, and
- results and conclusions

(what exactly is included will vary by project).

May 12: Final written reports (6-7 pages/team member as rule of thumb) are due.

Your report grade will be based on the quality of your written report and oral presentation (rubric provided).

Potential project topics:

There are two main project types: **code** and **analysis**. They have different scoring criteria for the reports and presentations.

Code topics:

If you are comfortable writing your project in Python, I encourage you to consider using PyNE (http://pyne.io) to facilitate your project. Depending on what you do, we might be able to contribute your project back to the PyNE code base over the summer.

1. Write a 2D diffusion solver that has vacuum boundaries on the bottom and left faces and reflecting boundaries on the top and right boundaries. I have more detailed specifications and some helpful tasks to facilitate completion if you choose this project.

2. Write a 2D transport solver that has vacuum boundaries on the bottom and left faces and reflecting boundaries on the top and right boundaries. I have more detailed specifications and some helpful tasks to facilitate completion if you choose this project.

3. Propose your own project to write a method for deterministic or Monte Carlo code.

Analysis topics:

You may need software that requires a license (MCNP, Serpent, SCALE). If you do not have the appropriate license already, it may not be a good idea to do one of those projects - though Serpent is pretty easy to obtain quickly.

1. Propose your own project for doing analysis with an existing deterministic or Monte Carlo code.

2. There was a reactor in Baghdad that was used to measure a some nuclear data. We would like to model this experiment in MCNP to try to reproduce the inelastic neutron scattering data. This project involves creating a model based on two publications with information about the experiment, running the model, and comparing to the results. I can give you some source materials, and Lee Bernstein and I will help you get started. This one has no guarantee of success.

3. Some interesting problems in computational radiation dosimetry were posed by the European Commission; they can be modeled with MCNP A full description of the problems can be found at: http://www.nea.fr/download/quados/quados.html

   The eight problems are:

   - Brachytherapy (photons)
   - Endovascular (electrons)
   - proton eye treatment (protons)
   - TLD-albedo dosimeter response function (neutrons)
   - ISO phantom backscatter (photons)
   - Environmental scatter (neutrons)

- Simulation of response of germanium detector (photons)
- detection sensitivity to the position of an Am-Be source (neutrons)

4. Nuclear material control and accountability is an important topic. Model a spent fuel cask and perform some analysis calculations with either Serpent, MCNP, or MAVRIC (a Monte Carlo code accelerated by deterministicly-created weight windows; it is part of the SCALE package). After you build the model you can do some comparison calculations. E.g. what happens if you remove some of the fuel or change the fuel composition?