- Show your work.
- Please submit your assignment online via github classroom at `https://classroom.github.com/a/c4VDIT86`
- All code must be version controlled with git.
- You may discuss your process with your peers, but your implementation and code should stand alone. This assignment is individual work.

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1. (30 points) Select[1] and implement a neutron transport method. Report on your results with sufficient clarity to reproduce your work. This should include a clear README describing how your instructor can replicate your work. A report document (in `.pdf` format) should include a 4 (or more) page description of your method and results. Scanned handwritten documents will not be accepted. The report must be generated by a typesetting program (Markdown or LaTeX generated documents are preferred but Word, Open Office, Google Docs are allowed).
   (a) Consider finding a straightforward paper concerning a simple geometry and replicating its results.
   (b) Include references to primary sources (journal articles).
   (c) Clearly explain in your report what approximations your method makes (energy, angle, space).
   (d) Summarize the current use of this method.
   (e) Describe the strengths and weaknesses of the method as well as the kinds of problems for which it is and is not appropriate.
2. (20 points) Solve for the flux in a basic problem see Section 1.
3. (30 points) Go further. Select two challenge problems from Section 2.
4. (20 points) Prepare a 10 minute presentation and present to the class at 8am May 7th. Include a `.pdf` of the presentation in the repository.

[1] In order to select Monte Carlo, P_N or S_n you must add advanced features (e.g. coarse mesh rebalancing) and address an additional challenging problem (e.g. 3-D cylinder).

1 Basic Problems

1.1 Slab Scalar Flux

Solve for the scalar flux as a function of space in an infinite slab with two regions in Figure 1. There are vacuum boundary conditions on both sides of the slab. Scattering is isotropic in the lab system. In region 1:

- Width is $2cm$.
- $\Sigma_t = \frac{1}{cm}$.
- $\Sigma_a = \frac{0.5}{cm}$.
- There is a uniformly distributed isotropic unit source $\left(1\left[\frac{n}{cm}\right]\right)$.

In region 2:

- Width is $4cm$.
- $\Sigma_t = \frac{1.5}{cm}$.
- $\Sigma_a = \frac{1.2}{cm}$.
- There is no source.

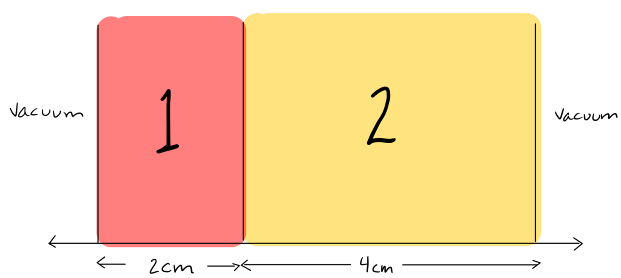

Figure 1: Infinite slab with two regions.

1.2 Slab Angular Flux

Consider a slab

- $\Sigma_t = \frac{1}{cm}$.
- $\Sigma_a = \frac{0.5}{cm}$.
- There is a uniformly distributed isotropic unit source $\left(S_0\left[\frac{n}{cm}\right]\right)$.
- The slab has length L
- The slab has vacuum boundaries.

Find the rightward angular flux ψ_+, leftward angular flux ψ_-, the scalar flux $\phi(x)$
Plot the angular flux from $0 \leq x \leq L$ for values of μ corresponding to $\theta = \frac{\pi}{4}$, $\theta = \frac{3\pi}{8}$, $\theta = \frac{3\pi}{4}$, $\theta = \frac{5\pi}{8}$. The plot should contain 4 lines on a single graph. If it is helpful, feel free to choose an explicit length for L.

1.3 Detector Response

1.4 Eigenvalue Calculation

1.5 Others

Other basic problems that have been solved with other methods in our homework or in class can be selected. For example, a criticality problem or detector response problem could be approached. Define it clearly with a diagram, explicitly state boundary conditions and cross sections, etc.

2 Challenge Problems

2.1 Spherical Problem

Solve for the flux in a $10cm$ sphere inside a vaccuum. Scattering is isotropic and there is a uniform, isotropic source of volumetric strength $S_0 \left[\frac{n}{cm^3}\right]$. $\Sigma_t = \frac{1}{cm}$ and $\Sigma_a = \frac{0.5}{cm}$.

2.2 Spatial Convergence

Refine the spatial resolution of the mesh to demonstrate spatial convergence of the method.

2.3 Order of Accuracy Convergence

Increase the order of accuracy of the method and demonstrate convergence of the method due to increasing order of accuracy.

2.4 Advanced Features

Implement an advanced feature, such as coarse mesh rebalancing, acceleration with the adjoint, contributon or similar. Be creative.