PHYS405 - Advanced Computational Physics
Assignment #8
Due: Friday, November 20

Purpose: Learn how to solve PDEs using parallel computers.
Note: Please identify all your work.

Solving Poisson Equation

You are to solve Poisson equation in a parallel code. This elliptic PDE is typicaly used in demonstrating how to numerically solve PDEs. It has the advantage of being time independent. In 2D, it takes the form of

$$\frac{\partial u(x,y)}{\partial x^2} + \frac{\partial u(x,y)}{\partial y^2} = S(x,y) \tag{1}$$

where the field $u(x,y)$ is solved for in a domain in x and y with specified boundary conditions and source term $S(x,y)$.

Steps

- Use finite difference approach on an equally spaced square lattice to solve the PDE.
- Start with the serial 2D Poisson solver code (*poisson_2d.c*) in the course web pages. Use the physical set-up as in this code, namely use the domain, the gaussian source, and the Dirichlet boundary conditions as specified in this code.
- Parallelize the code.
- Use the parallel *Game of Life* (*parallel_life_game.c*) and the 1D Poisson equation solver (*poisson_parallel_1d.c*) codes as guides.
- Use MPE or a pipe in the Python graphic code (*plot_image.py*) to display the solution.
- Compare your solution (map image of $u(x,y)$) to the serial code solution as a rough check of the code.
- Replace the solution back in the Poisson equation as a further (MORE PRECISE) check of the solution (as is done in the serial code).
- Make sure your code works for arbitrary lattice size and number of processors.