Lab 9 - OpenMP
NERS/ENGR 570 Fall 2020

Oct. 30th, 2020

Before we begin

- Find a partner to pair up with
- Start a terminal session on Great Lakes
- Clone this repository: https://github.com/bkochuna/OpenMP_Examples
- Also open a web browser to https://github.com/bkochuna/OpenMP_Examples
- Next we'll go into breakout groups and determine how to start an interactive job with multiple cores for threading.

Exercise 1 - Simulated Annealing

For this exercise we will use a short program that solves a simulated annealing problem for a plate with a fixed boundary condition. This constitutes solving Laplace's equation given by:

$$\nabla^2 T = 0$$

Note that this is similar to Poisson's equation. Similar to Poisson's equation, we discretize with finite difference creating a 5-point stencil. In this problem the solution is obtained via Gauss-Seidel iteration, so the resulting fixed point iteration scheme is given by:

$$T_{i,j}^{(k+1)} = \frac{1}{4}\left(T_{i-1,j}^{(k+1)} + T_{i+1,j}^{(k)} + T_{i,j-1}^{(k+1)} + T_{i,j+1}^{(k)}\right)$$

The convergence criteria used in this problem is based on the infinity norm of the difference between consecutive iterates or:

$$\varepsilon = max \left| T_{i,j}^{(k+1)} - T_{i,j}^{(k)} \right|$$

The goal of this exercise is to modify the existing `SimulatedAnnealing` program to use OpenMP to solve the equations in parallel.

During lab, we will examine the program and decide how to parallelize. This procedure will generally follow:

1. Test the environment for OpenMP and write some basic info about number of threads
2. Decide which loops to parallelize
3. Implement OpenMP parallelism and debug
4. Test speedup
5. Repeat steps 2 through 4 and try to modify the algorithm to achieve better speedup.