**Your Name:** Angikar Ghosal

**Your Net-ID:** ag520

Copy/Paste from running PercolationStats with these grid sizes:

grid sizes of 100, 200, 400, 800, 1600, and 3200

and using 20 trials

**PercolationDFSFast**

simulation data for 20 trials

grid mean stddev total time

100 0.593 0.014 0.234

200 0.591 0.010 0.292

400 0.590 0.006 1.942

800 0.594 0.004 10.773

There is a stackoverflow error for grid values more than 800.

**PercolationBF**

simulation data for 20 trials

grid mean stddev total time

100 0.593 0.014 0.240

200 0.591 0.010 0.270

400 0.590 0.006 1.552

800 0.594 0.004 6.627

1600 0.592 0.002 51.046

3200 0.593 0.001 290.038

**PercolationUF with QuickUWPC**

simulation data for 20 trials

grid mean stddev total time

100 0.593 0.014 0.286

200 0.591 0.010 0.435

400 0.590 0.006 1.574

800 0.594 0.004 5.155

1600 0.592 0.002 23.996

3200 0.593 0.001 181.974

**Answer these questions for PercolateUF with a QuickUWPC union-find object**

**How does doubling the grid size affect running time (keeping # trials fixed)**

Based on the data, we see that doubling the grid affects the running time by a margin between 4 and 5. We suspect that if the grid size is N, the run time is O(N^2 log N). Thus depending on the initial grid size, the runtime is affected differently on doubling grid size, as log (2N)/ log (N) depends on N. However for the values of grid size here, it is roughly around 1.1 and 1.2. This also agrees with the fact that union find algorithm takes place in logarithmic time O(N). Since number of squares needed to percolate is O(N^2), where N is grid size, total runtime is O(N^2 log N), agreeing with experimental data.

**How does doubling the number of trials affect running time.**

For 10 trials, we get:

simulation data for 10 trials

grid mean stddev total time

100 0.593 0.019 0.112

200 0.596 0.006 0.179

400 0.592 0.006 0.597

800 0.592 0.003 3.002

1600 0.594 0.002 12.974

3200 0.593 0.001 57.771

For 40 trials, we get:

simulation data for 40 trials

grid mean stddev total time

100 0.594 0.015 0.487

200 0.591 0.009 0.951

400 0.591 0.005 4.547

800 0.593 0.004 14.580

1600 0.593 0.002 77.712

Based on the data for 10, 20 and 40 trials,

The running time approximately doubles with doubling the number of trials. If the number of trials is N, running time is O(N).

**Estimate the largest grid size you can run in 24 hours with 20 trials. Explain your reasoning.**

24 hrs = 86400 seconds

24 seconds was the rough time for grid size = 1600.

86400/24 = 3600

Therefore, if grid size is 1600k,

3600 = k^2 \* log (k)/log 1600

k^2 \* log (k) = 11534.8319,

Log (k) is roughly 1.3 (base 10 taken)

k=82(roughly)

Therefore, the largest grid size is about **132000.**

**Answer) 132000**