



## Assignment 6

### 1 Summary

This is the second non-programming assignment . There are four questions below. The detailed instructions explain where you'll answer them and how you'll submit the answers.

### 2 Questions

1. (25%) Let  $M$  be a 3-dimensional mesh with  $n$  nodes in each dimension. Let  $s$  and  $t$  be any pair of diagonally opposite corner nodes in this mesh, meaning two corners that are not on the same face of the mesh. How many distinct *shortest* paths are there between  $s$  and  $t$  as a function of  $n$ ?
2. (25%) Suppose that the best possible sequential algorithm for a problem of size  $n$  solve it in time proportional to  $n^3$ , and that a problem of size  $n$  requires memory proportional to  $n^2$ . If a given parallel algorithm has an overhead proportional to  $n \log p$ , what is the scalability function of this parallel algorithm in terms of  $n$  and  $p$ , ignoring any constant factor?
3. (25%) A random number generator (RNG) is defined by the following formula:

$$u_{i+1} = (19u_i + 61) \text{ mod } 127$$

and  $u_0 = 5$ . What is the period of this RNG?

4. (25%) Suppose that a particular parallel program solves a problem of size  $n$  in  $t$  seconds using  $p$  processors. Suppose that  $0.2$  is the fraction of the parallel program's total execution time spent executing inherently sequential code. Suppose also that the number of processors  $p$  and the problem size  $n$  are increased together so that the ratio  $n/p$  remains constant. As a function of  $p$  what is the scaled speedup of this program?

### Detailed Instructions

1. Using any *ssh client* on your computing device, remotely login to `eniac.cs.hunter.cuny.edu`.
2. After you login successfully, ssh to **any cslab host**. For example, to ssh to `cslab12` you would type:

```
$ ssh cslab12
```

3. The remaining instructions assume that you have logged into some `cslab` host.
4. Copy the file `/data/biocs/b/student.accounts/cs493.65/hwks/hwk6_answers` to your home directory using the command

```
$ cp /data/biocs/b/student.accounts/cs493.65/hwks/hwk6_answers ~/
```

5. Answer the above questions by putting the answers immediately after the colon ":" on each line corresponding to the question number. You will need to use a text editor to do this. **Do not use a word processor to do this.** If you do, the file will not be readable and you will get a zero on the assignment. Instead, if you edit it on Linux, use an editor such as `vim`, `emacs`, `pico`, `nano`, `gedit`, or `geany`. Make sure that you follow the instructions for how to write the answers in order to receive full credit.



6. Save your file and make sure that you **do not add an extension to its name**. It can be named anything, but do not add an extension such as “.txt”.
7. Assuming the file is named `my_hwk6_answers`, to submit it, run the command

```
submithwk_cs49365 -t 6 my_hwk6_answers
```

The program will copy your file into the directory

```
/data/biocs/b/student.accounts/cs493.65/hwks/hwk6/
```

and if it is successful, it will display the message, “File `hwk6_username` successfully submitted.” where `username` is your username. You will not be able to read this file, nor will anyone else except for me.

8. **You can do step 7 as many times as you want. Newer versions of the file will overwrite older ones.**

## Grading Rubric and Deadline

This assignment is 10% of your final grade. Each question is 20% of the grade for the assignment. Partial credit may be given, at my discretion, for partially correct answers. Again, the deadline is **Thursday, May 9 at 7:00 PM**.