CMSC 651, Spring 2018, University of Maryland
HW4, due as PDF to the address *cmsc651.umd@gmail.com* by 11:59PM on April 18, 2018

Notes: (i) Please work on this with your group (one writeup per group). Consulting other sources (including the Web) is not allowed. (ii) Write your solutions neatly and *include your names*; if you are able to make partial progress by making some additional assumptions, then **state these assumptions clearly and submit your partial solution**. (iii) **Please make the subject line of your email** "*651 HW4*" followed by your full name, and email a PDF to *cmsc651.umd@gmail.com*: PDF generated from Word or LaTeX strongly encouraged.

1. Complete the quick proof we showed in class that the sum of the elements of an n-element array can be computed using n processors and in $O(\log n)$ time on an EREW PRAM. **(12 points)**

2. In studying how to do processor emulation with fewer processors, we considered the following algorithm A on a DAG $G = (V, E)$:

```
i = 0;
while (G is not empty) {
   i = i + 1;
   L(i) = current set of sources (nodes with no incoming edges) in G;
   Remove L(i) (and all edges incident on vertices in L(i)) from G;
}
```

Suppose A partitions V into $L(1), L(2), \ldots, L(\ell)$. We used the following fact without proof, in proving that our processor assignment led to a 2-approximation of the maximum completion time: *ℓ equals the number of vertices in a longest (directed) path in G.* Prove this fact. **(15 points)**

3. Problem 5.3 from the Lau-Ravi-Singh book that is posted under "Resources". **(10 + 8 points)**

4. Problem 5.6 from the Lau-Ravi-Singh book that is posted under "Resources". (The notation "$X - Y$ paths" does not mean "X minus Y", but refers to "from X to Y".) **(15 points)**