Name:_____ Student Number:_____

CSE191 Midterm II Spring 2017

Plagiarism will earn you an F in the course and a recommendation of expulsion from the university.

(1 pt each) For Questions 1-5, when asked for a running time or the result of a summation, you must choose from the following:

a. $\Theta(n \log n)$
b. $\Theta(n^2)$
c. $\Theta(n)$
d. $\Theta(\log n)$
e. $\Theta(1)$

1. Given an unordered array of *n* items on a sequential computer (*i.e.*, a RAM), what is the worst-case running time to determine whether or not a given element is present? _____
2. Why?_____

3. Given *an unordered* list of *n* items on a sequential computer, what is the running time to sort the list using Merge Sort? ____

4. Given an array of *n* sorted items on a sequential computer, how long does it take to find the largest item? ____

5. $\sum_{i=0}^{n} \frac{1}{2^i}$ = ____

(1 pt each) For problems 6-8, give the **best** asymptotic description of the function.

6. $12n^5 + 4n^3 + 17n + 123$ = _____
7. $1234n + 1100$ = _____
8. $1/n + 12345$ = _____

(1 pt each) For problems 9-10, give the **best** asymptotic relationship between the two functions.

9. n^2 and $n \log^2 n$ _____
10. $n \log n$ and n^2 _____

(1 pt each) Questions 11-15.

11. What is the (best) asymptotic lower bound on sorting *n* items distributed one per processor on a mesh of size *n*? _____ Why (a brief explanation in the space provided)?

12. What is the (best) asymptotic lower bound on sorting *n* items distributed one per processor on a hypercube of size *n*? _____ Why (a brief explanation in the space provided)?

13. Given an array with *n* data items, what is the optimal asymptotic running time of parallel prefix on a sequential computer? _____ Briefly describe your algorithm below.

14. Given *n* data items, distributed one per processor on a mesh of size *n,* what is the asymptotic running time of an optimal parallel prefix algorithm? _____

15. Given one piece of data per processor on a linear array of size *n,* what is the asymptotic running time of an optimal sorting algorithm? _____

16. (3 pts) Draw and label a hypercube of size 16. Use binary numbers as labels.

17. (3 pts) Given *n* integers stored in the first *n* positions of global memory on a PRAM of your choosing (please state), give an efficient algorithm to determine the number of those integers that are equal to 17. An English description is fine – no code is necessary. State and justify the asymptotic running time of your algorithm. (You will earn more points for a better solution, less points for a poor solution, and no points for an incorrect solution.)

18. (4 pts) Given *n* integers distributed one per base processor on a tree of base size *n*, give an algorithm that will result in all base processors knowing the sum of these *n* integers. An English description is fine – no code is necessary. State and justify the asymptotic running time of your algorithm. (You will earn more points for a better solution, less points for a poor solution, and no points for an incorrect solution.)

Extra Credit (1 pt each) Circle the correct answer.

19. How many books has Dr. Miller co-authored?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

20. What is the name of a famous algorithm to determine molecular crystal structures that was co-developed by Dr. Miller?
    a. Stop-and-Drop
    b. Hit-and-Run
    c. Barnum-and-Bailey
    d. Turn-and-Burn
    e. Shake-and-Bake