

Computer Science 477/677 Spring 2019

University of Nevada, Las Vegas Computer Science 477/677 Spring 2019

Practice for Examination on February 13, 2019

Name: _____

No books, notes, scratch paper, or calculators. Use pen or pencil, any color. Use the rest of this page and the backs of the pages for scratch paper. If you need more scratch paper, it will be provided.

The entire test is 135 points.

1. True or False. [5 points each]

- (a) _____ Computers are so fast today that complexity theory is only of theoretical, but not practical, interest.
- (b) _____ If any problem can be precisely formulated in a mathematical way, there is an algorithm that solves it.
- (c) _____ Heapsort takes $\Theta(n \log n)$ time on an array of size n .

2. Fill in the blanks. [5 points each blank.]

- (a) What is the **only** difference between the abstract data types *queue* and *stack*?

- (b) Name a divide-and-conquer searching algorithm.

- (c) Name two divide-and-conquer sorting algorithms.

- (d) The following is pseudo-code for which sorting algorithm we've discussed?

```
int x[n];
for(int i = n-1; i > 0; i--)
    Find the largest element of x[0], ... x[i] and swap it with x[i]
```

3. Write the following asymptotic complexity classes in order, using “=” to mean that two classes are exactly the same, and “ \subset ” to mean that one class is a proper subset of the other; log means \log_2 .

$O(2^{\log n})$, $O(4n + 3)$, $O(2^n)$, $O(3^n)$, $O(F_n)$ (the n^{th} Fibonacci number), $O(n \log n)$, $O(\log^2 n)$, $O(\log n)$, $O(n^{1.1})$, $O(1.1^n)$, $O(n^3)$, $O(\log 2)$, $O(\frac{1}{n})$

4. Solve each of the following recurrences, giving the answer in terms of O , Θ , or Ω , whichever is most appropriate [10 points each].

(a) $T(n) < T(n - 2) + n^2$

(b) $F(n) \geq F(\sqrt{n}) + \lg n$

(c) $G(n) \geq G(n - 1) + n$

(d) $F(n) = 4F(n/2) + n^2$.

(e) $H(n) \leq 2H(\sqrt{n}) + O(\log n)$.

(f) $K(n) = K(n - \sqrt{n}) + 1$.

(g) $F(n) = 4F\left(\frac{3n}{4}\right) + n^5$ (No, you don't need a calculator.)

5. [15 points] Consider the following procedure:

```
void george(int n)
{
    int m = n;
    while (m > 1)
    {
        for (int i = 1; i < m; i++)
            cout << "I cannot tell a lie. I chopped down the cherry tree." << endl;
        m = m/2;
    }
}
```

Consider the question of how many lines of output the execution of `george(n)` would produce. Write down an appropriate recurrence for this question, and give an asymptotic solution in terms of n , using either O , Ω , or Θ , whichever is most appropriate.

6. Write correct pseudocode (or C++ code) for _____, which could be:
- (a) Bubblesort an array of size n .
 - (b) Selectionsort an array of size n .
 - (c) The partition loop of quicksort.