

University of Nevada, Las Vegas Computer Science 477/677 Fall 2020

Assignment 3: Due Monday September 14, 2020

Name: _____

Write your answers into a pdf file and email it to the graduate assistant, Miss Chua, on Monday, September 14, before midnight.

1. Work problem 2.4 in your textbook. Suppose you are choosing between the following three algorithms:

- Algorithm A solves problems by dividing them into five subproblems of half the size, recursively solving each subproblem, and then combining the solutions in constant time.

- Algorithm B solves problems of size n by recursively solving two subproblems of size $n - 1$ and then combining the solutions in constant time.

- Algorithm C solves problems of size n by dividing them into nine subproblems of size $n/3$, recursively solving each subproblem, and then combining the solutions in $O(n^2)$ time.

What are the running times of each of these algorithms (in O notation), and which would you choose?

2. Work problem 2.5 in your textbook. Do not replace any transcendental constant with a decimal. For example “ $\log_2 3$ ” should be left as is, but “ $\log_2 4$ ” should be written as 2.

(a) $T(n) = 2T(n/3) + 1$

(b) $T(n) = 5T(n/4) + n$

(c) $T(n) = 7T(n/7) + n$

(d) $T(n) = 9T(n/3) + n^2$

(e) $T(n) = 8T(n/2) + n^3$

(f) $T(n) = 49T(n/25) + n^{3/2} \log n$

(g) $T(n) = T(n - 1) + 2$

(h) $T(n) = T(n - 1) + n^c$ where $c \geq 1$ is a constant.

(i) $T(n) = T(n - 1) + c^n$ where $c > 1$ is a constant.

(j) $T(n) = 2T(n - 1) + 1$ Work this one by substitution. Let $n = \log_2 m$, and let $F(m) = T(2^n)$.
Substituting, we have $F(m) = 2F(m/2) + 1$.

(k) $T(n) = T(\sqrt{n}) + 1$ Use substitution: $m = \log_2 n$.

3. Work problem 2.12 in your textbook. How many lines, as a function of n , does the following program print? Write a recurrence and solve it. You may assume n is a power of 2.

```
function f(n)
  if n > 1:
    print_line('still going')
    f(n/2)
    f(n/2)
```

4. Walk through the steps of mergesort for the following input file:

LBGSMKUJ

5. Walk through the steps of polyphase mergesort for the following input file:

LBGSMKUJ

6. What does the following program do? What is the loop invariant of its main loop?

```
int f(int n)
{
    assert(n >= 0);
    int m = n;
    int d = 0;
    while(m > 0)
    {
        m = m-1;
        d = d+2;
    }
    return d;
}
```