

University of Nevada, Las Vegas Computer Science 477/677 Fall 2023

Examination September 27, 2023

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. If you want anything on extra pages to be graded, staple those pages to your test and write, "Please grade this page."

The entire examination is 200 points.

1. [10 points] Simplify each expression.

(a) $\log_9 3$

(b) $2^{\log 5}$

2. Fill in the blanks.

(a) [10 points] Any comparison-based sorting algorithm on a file of size n must execute _____ comparisons in the worst case.

(b) [10 points] Name two divide-and-conquer sorting algorithms.

3. [20 points] The items in a priority queue, such as a stack, represent unfulfilled obligations. In class we discussed a stack algorithm for converting an infix expression to an equivalent postfix expression.

Each operator on the stack represents the unfulfilled obligation to _____

Each left parenthesis on the stack represents the unfulfilled obligation to _____

4. [10 points]

You have an array consisting of thousands of names in alphabetical order. What algorithm would you use to determine whether this array contains the name "Arthur Linkletter"? _____

5. Find the time complexity of each of these code fragments in terms of n , using Θ notation.

(a) [10 points]

```
for(int i = 0; i < n; i++)
    for(int j = i; j > 0; j=j/2);
```

(b) [10 points]

```
for(int i = 0; i < n; i++)
  for(int j = n; j > i; j=j/2);
```

(c) [10 points]

```
for(int i = 1; i < n*n; i = 2*i)
  for(int j = i; j > 0; j=j-1);
```

(d) [10 points]

```
for(int i = 1; i < n; i++)
  for(int j = 1; j < i*i; j++);
```

(e) [10 points]

```
for(int i = 1; i < n; i=2*i)
  for(int j = 2; j < i; j=j*j)
```

6. [20 points] Find the loop invariant of the following C++ function, which computes $\lfloor \log n \rfloor$.

```
int flooroflogarithm(int n)
{
  // input condition: n > 0
  int m = n;
  int rslt = 0;
  while(m > 1)
  {
    rslt++;
    m = m/2;
  }
  return rslt;
}
```

7. [20 points] Draw a circular queue with dummy node, holding items X, K, T, F, in that order from front to rear. Draw figures illustrating how the queue changes when you insert L.

8. [30 points] A stack of integers is implemented in C++ as an array follows.

```
struct stacknode
{
    int item;
    stacknode*link;
};
typedef stacknode*stack;
```

Write code for the operators push, pop, and empty.

9. [20 points] Walk through the steps of heapsort, sorting an array whose items are R,U,W,F,B,Y in that order. For ease of grading, use the matrix below. (You don't need all the rows.)
