

# CS 1050: Constructing Proofs

## Problem Set 4

Due on Wed, Nov 8

### Problem 1 (10 points)

Demonstrate the MERGE SORT algorithm on the following list (you need not count the number of comparisons):

2, 20, 6, 4, 17, 12, 9, 11, 3, 10, 5, 18, 7, 13, 1, 8

### Problem 2 (10 points)

Demonstrate the BUBBLE SORT algorithm on the following list (you need not count the number of comparisons):

9, 5, 10, 7, 4, 2

### Problem 3 (10 points)

Demonstrate the INSERTION SORT algorithm on the following list (you need not count the number of comparisons):

20, 6, 4, 17, 12, 9, 11, 3

### Problem 4 (10 points)

1. Given a sorted list of  $m$  integers, and an additional integer  $b$ , show how binary search can be used to insert  $b$  into the sorted list so that the augmented list is also sorted. How many comparisons are needed? Give a reasonable upper bound.
2. Given a list of  $n$  integers, we run the INSERTION SORT algorithm with the following modification: when we insert an element in the new list, we use binary search instead of a linear search. What is the number of comparisons used by this algorithm? Give a reasonable upper bound.

### Problem 5 (25 points)

For each of the following statements, answer whether it is TRUE or FALSE, with proper justification.

1.  $n^3 + 7n^2 + 5n + 2$  is  $O(n^3)$ .
2.  $2^n + 20n^3$  is  $O(2^n)$ .
3.  $3^n$  is  $O(2^n)$ .
4.  $17\sqrt{n}$  is  $O(n)$ .
5.  $n^2$  is  $O(n \log_2 n)$ .