CS 581 Homework 1

January 12, 2018

Problem 1.
Answer true or false:

1) Any problem has a general algorithm that can solve it.

2) An algorithm must terminate.

Problem 2.
Use induction to prove that for all $n \in \mathbb{N}$,

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \tag{1}$$

Specify your base case, induction hypothesis, induction step, and how you tie them all together.

Problem 3.
Other than speed, name two other measures of efficiency might one use in a real-world setting.

Problem 4.
Define what it means for a sorting algorithm to be "in-place" and "stable" respectively.

Problem 5.
Sort array {4, 2, 6, 1, 8, 3, 5, 7} using insertion sort. Show each step.

Problem 6.
Sort array {4, 2, 6, 1, 8, 3, 5, 7} using merge sort. Show each step.

Problem 7.
We can express insertion sort as a recursive procedure as follows. In order to sort $A[1..n]$, we recursively sort $A[1..n-1]$ and then insert $A[n]$ into the sorted array $A[1..n-1]$. Write a recurrence for the running time of this recursive version of insertion sort.