CSCE 350 Spring 2005
HOMEWORK 4
Tuesday 2005-02-22

This is a special homework assignment that allows you to make up 20 of the points lost in the first midterm exam (5 per question). You must turn in your handwritten answer on these two sheets, using the back if necessary. No additional pages will be allowed. You must turn in your work at the beginning of class on Thursday. On an exceptional basis, you may discuss these problems with other students in the class.

1 Correctness of a recursive program–10 points

Prove by induction that the following recursive procedure computes $n!$, for $n \geq 0$. In other words, the following specification is satisfied by the procedure Power:
(* Precondition: $n \geq 0$ *)
f = Factorial(n);
(* Postcondition: $f = n!$ *)

```
procedure Factorial(n: integer);
begin
        if n=0 then 1
        else return n * Factorial (n-1);
        end; (* else *)
end Factorial;
```

Hint: Use simple induction.

2 Complexity of a recursive program–10 points

Set up a recurrence relation for the number of multiplications in the Factorial program of the previous question. Solve the recurrence relation. If you guess the solution, verify it for full credit.

3 Complexity of an iterative program–10 points

Consider the version of the bubblesort sorting algorithm given below.

```
Algorithm BubbleSort(A[0..n-1])
```

```
// Input: an array A[0..n-1] of orderable elements
// Output: the array with the elements sorted in ascending order

for i = 0 to n-2 do
  for j = 0 to n-2-i do
if A[j+1] < A[j] swap A[j] and A[j+1]
```

Use comparison of keys as a characteristic operation.

1. Set up a sum to count the number of characteristic operations
2. Solve the sum

4 Complexity of an iterative program–10 points

Consider the version of the selection sorting algorithm given below.

```
Algorithm SelectionSort(A[0..n-1])
// Input: an array A[0..n-1] of orderable elements
// Output: the array with the elements sorted in ascending order

for i = 0 to n-2 do
  min := i
  for j = i+1 to n-1 do
    if A[j] < A[min] min := j
    swap A[i] and A[min]
```

Use comparison of keys as a characteristic operation. What is the asymptotic complexity of SelectionSort in the worst, best, and average case? (Use the Θ notation.)