COSC 3304 – Algorithms Design and Analysis

Assignment 1

Due: 23:59:00pm, Jan. 24, 2024 (Wednesday)

1. Why is the worst case very useful for algorithm efficiency analysis? (30 points)

2. When all elements in the input array ***A*** are the same, is it the best case or worst case for the INSERTION-SORT function below? Why? (35 points)

```
INSERTION-SORT(A)
1  for j = 2 to A.length
2      key = A[j]
3      // Insert A[j] into the sorted
           sequence A[1 .. j − 1].
4      i = j − 1
5      while i > 0 and A[i] > key
6          A[i + 1] = A[i]
7          i = i − 1
8      A[i + 1] = key
```

3. Between the following two input arrays, A=[1, 2, 3, 4, 5, 6, 7, 8] and A=[8, 7, 6, 5, 4, 3, 2, 1], which requires more steps to run the MERGE-SORT function below? Why? (35 points)

```
MERGE-SORT(A, p, r)
1  if p < r
2      q = ⌊(p + r)/2⌋
3      MERGE-SORT(A, p, q)
4      MERGE-SORT(A, q + 1, r)
5      MERGE(A, p, q, r)
```

4. What is the time complexity of the following program by assuming $N=2^k$ (please show detailed steps for full credits):

```
int sum=0;
for (int j=1; j<=N; j=j*2)
    for (int i=j; i>0; i=i/2)
         sum++;
```

(30 points)