CS 302 Introduction to Data Structures
University of Nevada, Las Vegas
Spring 18

Assignment 4
Due: Saturday, February 17, 2018, by email

1. In a sorted array containing $1,000,000,000$ entries you search for a specific key. In the worst case how many comparisons will this take?

2. How many moves are made by the Towers of Hanoi program for 30 disks? $2^{30}-1$

3. (a) Algorithm A has a running time of $10n$, whereas Algorithm B has running time $n \log n$. Up to roughly which n will algorithm B perform better than A?
   (b) Algorithm A has a running time of 2^n, whereas Algorithm B has running time $10n^2$. Up to roughly which n will algorithm A perform better than B?

4. (a) The complete and balanced binary tree of height 30 has how many nodes?
   (b) A complete and balanced binary tree with no fewer than $1,000,000$ leaves has at least what height?

5. Give the Θ-order of the following code segments written in pseudocode:

   (a)
```
mystery(n: integer)
  { for ( int i = n-2; i <= n; i++ )
      for ( int j = 1; j <= n; i++ )
                    write * ;
  }
```

   (b)
```
example(n: integer);
 { for (int i=1; i<= n; i++)
   for (int j=1; j<= n; j++)
     for (int k=1; k<=n; k++)
           if ((k=j) && (j=i))
                    some code requiring Θ(n^5) time
  }
```

6. Assume that the array A was initialized in the following way:

```
for (int i = 0; i<  N; i++) a[i] = i - 2*(i % 4) + 4
```

   (a) What is the Θ-order run-time of Selection Sort?
   (b) What is the Θ-order run-time of Insertion Sort?

7. How many multiplications are necessary to compute 2^{1000}?

8. Solve the following recursion by back-substitution: $t(n) = 3t(n-1)$; $t(0) = 1$.

9. Using the master theorem read off the Θ order of the following recurrences.

   (a) $T(n) = 2T(n/2) + n$
   (b) $T(n) = 4T(n/2) + n$
   (c) $T(n) = T(n/4) + 1$

How to submit. Create one PDF file with your solutions. Email this file as an attachment to the TA, Mr. Kaushik Deshmukh, deshmk1@unlv.nevada.edu. Subject of your email must be "Assignment 4", <your name>, <your student ID number>.