Istanbul Bilgi University

CMPE 211 Data Structure and Algorithms
2017-2018 Fall Preperation For Midterm

Name	:	Department	: .....
Student No	:	Date	: .....
		Grade	: .....

[5P] Q.1 Explain the following sentence "*Algorithms are opinions embedded in code*". Give a concrete example.

[5P] Q.2 What is the difference between traditional algorithms and machine learning algorithms?

[10P] Q.3 Compare the running times for two algorithms running on different computers over input size $N = 10^7$. What is your conclusion?

	Computer Power	Algorithm Time
A	10^{10} instructions per sec.	$T_A(N) = N^2$
B	10^7 instructions per sec.	$T_B(N) = Nlog_2(N)$

[20P] Q.4 Compare time complexity of the following three algorithms.

- $T_1(N) = 1 + T_1(N/2)$ with base case: $T_1(1) = 1$
- $T_2(N) = 2T_2(N/2)$ with base case: $T_2(1) = 1$
- $T_3(N) = 1 + T_3(N-1)$ with base case: $T_3(0) = 1$
- $T_4(N) = N + T_4(N/2)$ with base case: $T_4(1) = 1$

[5P] Q.5 Define and explain the use of $\Theta()$ notation.

[5P] Q.6 Compare arrays and linked lists.

	advantages	disadvantages
Array	.....	.....
Linked List	.....	.....

[10P] Q.7 Why insertion sort is a better algorithm than selection sort? What are their time complexity?

[10P] Q.8 How much time is required to check if an array is sorted? Give pseudo code or java code.

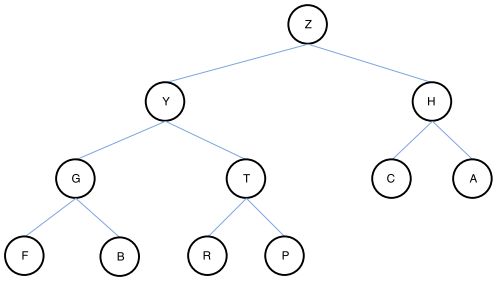
[10P] Q.9 How much time is required to merge two sorted sub-arrays?Give pseudo code or java code.

[5P] Q.10 What is the main advantage of quick sort over merge sort?

[10P] Q.11 Suppose you have a doubly-linked list with two references to the begininig of the list and end of the list. Write the worst-case running time of each operation below.

add(item)	prepend item to the beginning	.....
get(i)	return item with position i	.....
set(i, item)	put item to the position i	.....
remove()	remove last item	.....
exists(item)	does item exist?	.....

[10P] Q.12 Max-Heap. 1- Give the array representation of the heap. 2-Insert item Q to the binary heap. Indicate any entries that changed. 3- Remove max and show resulting tree. 4- Again remove max and show resulting tree.



[10P] Q.13 Binary Search. Fill the code.

```
1   public class search {
2       public static int binarySearch(Integer[] a, Integer k){
3           int mid, start = 0, end = a.length-1;
4           while(start <= end){
5
6
7
8
9           }
10          return -1;
11      }
12  }
```

[5P] Q.14 Draw the array content for some intermediate steps during selection the sort.

12	9	0	1	5	8	4	6	19	3	7	2	11

[5P] Q.15 Draw the array content for some intermediate steps during insertion sort.

12	9	0	1	5	8	4	6	19	3	7	2	11

[5P] Q.16 Draw the array content for some intermediate steps during merge sort.

M	E	R	G	E	S	O	R	T	E	X	A	M	P	L	E

[5P] Q.17 Draw the array content for some intermediate steps during quick sort.

Q	U	I	C	K	S	O	R	T	E	X	A	M	P	L	E
K	R	A	T	E	L	E	P	U	I	M	Q	C	X	O	S

[15P] Q.18 Propose a better algorithm for the following code. Compare their running times.

```
1  public class twoSumProblem {
2      public static int bruteForce(Integer[] a) {
3          int count  = 0;
4          for (int i = 0; i < a.length; i++)
5              for (int j = i+1; j < a.length; j++)
6                  if (a[i] + a[j] == 0) count++;
7          return count;
8      }
9  }
```

[10P] Q.19 Write two different arbitrary java programs which run in $O(N^2 log(N))$ time.

[10P] Q.20 We want to generate 2 *distinct* random integers between $[0, N-1]$. Propose an algorithm which does not generate 2 duplicate integers.

[10P] Q.21 Suppose you are given a shuffled array of integers from 1 to N. But one integer is missing. Propose an efficient algorithm to find it.