Final Exam Section 1 Fall 2015, Part A
Computer Science Department, SJSU
CS146: Data Structures and Algorithms
Instructor: Katerina Potika

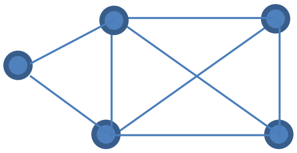
NAME_________________________________SID__________________

Section	Points
Section I Multiple Choice 10 questions (2 points each)	______Out of 20
Section II Short Answer Question 1	______Out of 14
Section II Short Answer Question 2	______Out of 12
Section II Short Answer Question 3	______Out of 15
Section II Short Answer Extra Question	______Out of 10
Total	______ Out of 61

Duration 50 min. Closed books. Good Luck!

SECTION I Multiple Choice [2 points each] Choose the best answer for each question.

1. For the following graph what is true:

a. It has a Hamiltonian cycle b. It has an Euler cycle c. a and b d. None	

2. What do you know about P=NP
a. It is true
b. It is false
c. It is open
d. a and c

3. Which of the following is not true
a. activity selection is solved by a greedy algorithm
b. Matrix Multiplication is solved by divide and conquer algorithm
c. 0-1 Knapsack is solved by a greedy algorithm
d. 0-1 Knapsack is solved by a dynamic programming algorithm

4. Which problem can be solved optimally in polynomial time
a. 3SAT
b. Euler Cycle

c. Hamilton Cycle
d. Clique

5. If you want to prove that problem A is NP-hard which of the following is the correct way to prove it
a. $Sorting \leq_p A$
b. $\underline{\boldsymbol{Graph\ Coloring \leq_p A}}$
c. $A \leq_p 3 - SAT$
d. None of the above

6. The distance matrix of a (directed) graph with vertices P,Q, R and S is given by the shortest path from Q to S consists of edges

	P	Q	R	S
P	0	1	∞	4
Q	-2	0	2	5
R	3	∞	0	1
S	1	∞	∞	0

a. QR and RS
b. QS
c. **QP and PS**
d. there is no path

7. state whether the following statement is true or false for a NP-Complete

i. if the Hamiltonian Cycle problem has an efficient algorithm then P=NP is true
ii. To prove NP-completeness of a problem you can only start from any NP-complete problem.

a. i: true, ii: false

b. i: **true, ii: true**

c. i: false, ii: false

d. i: false, ii: true

8. Consider the 0-1 knapsack problem. What is the best solution, with 4 items and W=6, such that w=(5, 2, 4, 1) –*weights*- and b=($25, $12, $20, $18) -*values*
a. 45
b. **43**
c. 32
d. none

9. state whether the following statement is true or false for Single Source Shortest Paths

i. The problem is to determine the shortest paths between every pair of vertices of G.

ii. The way to generate the shortest paths from s to the remaining vertices is to use relaxation.

iii. If edge weights are positive and negative then there might be a negative weighted cycle.

a. i:True, ii: true, iii: true

b. i:True, ii: false, iii: true

c. i:True, ii: true, iii: false

d. <u>i:False, ii: true, iii: true</u>

10. When you want to avoid duplicates in search results when web crawling, which is the best data structure to use:

a. array

b. red black tree

c. <u>hash table</u>

d. linked list

Extra question

Consider an undirected graph G = (V, E). Definition: A matching, M, of G is a subset of the edges E, such that no vertex in V is incident to more than one edge in M. Intuitively we can say that no two edges in M have a common vertex. Maximum is the matching that contains the maximum number of edges. Consider a graph that is a path, (v0,v1) in E, (v1,v2) in E, etc. (|E|=|V|-1). What is the size of a maximum matching, if

a) |V|=30

b) |V|=55

Answer: a=15, b=22

SECTION II – Short Answer– Write a short answer to each question.

Question 1

Match the algorithms. Consider the following algorithms and data structures.
In the blank to the left of each problem below, fill in the letter of the most appropriate algorithm or data structure from the list above. “Most appropriate” means the algorithm or data structure that is a better choice.

______ Sort a list of keys which are already nearly in sorted order. ______ Sort a large list of keys in roughly random order. ______ Find a shortest path in an edge-weighted digraph with some negative edge weights but no negative cycles. ______ Find a shortest path in an edge-weighted digraph with no negative edge weights. ______ Compress an input stream, using a symbol table. ______ Maintain a symbol table that supports insert, search, sort and select operations with comparable keys.	A. Bellman-Ford B. BST C. Dijkstra D. Hashing E. Insertion sort F. Quicksort

Answer:

___E___ Sort a list of keys which are already nearly in sorted order. ____F__ Sort a large list of keys in roughly random order. ____A__ Find a shortest path in an edge-weighted digraph with some negative edge weights but no negative cycles. ___C__ Find a shortest path in an edge-weighted digraph with no negative edge weights. ___D__ Compress an input stream, using a symbol table. ___B__ Maintain a symbol table that supports insert, search, sort and select operations with comparable keys.	A. Bellman-Ford B. Red Black Tree C. Dijkstra D. Hashing E. Insertion sort F. Quicksort

Question 2

For each function on the left, give the best matching order of growth of the running time on the right. *Hint: fi are known methods (covered in class)*

_____	

```
public static int f1(int n) {
  int x = 0;
  for (int i = 0; i < n; i++)
          x++;
  return x;
}
_____
public static int f2(int n) {
    if (n == 0) return 0;
    return f2(n/2) + f1(n) + f2(n/2);
}
_____
public static int f3(int n) {
   if (n == 0) return 1;
   return f3(n-1) + f3(n-2);
}
_____

public static int f4(int n) {
   if (n == 1) return 0;
   return 1 + f4(n/2);
}
_____
```

A. O(log n)
B. O(n)
C. O(n log n)
D. O(n^2)
E. O(2^ n)
F. O(n!)

Answer:

B D F C B E A

Question 3

[15pts] Consider the following 36-character text string:
a b a a b a c a b a a b a c d a b a a b a c a b a a b a c d e.
Find the frequency of each letter and then compute the Huffman codes.

SCRATCH PAPER