CSE 5311
Test 2 - Closed Book
Spring 2018

Name Key 1
Last name, then first name as on your UTA ID card

Multiple Choice:

1. Write the letter of your answer on the line (_____) to the LEFT of each problem.
2. CIRCLED ANSWERS DO NOT COUNT.
3. 3 points each

1. The worst-case input sequence when constructing a suffix array using `qsort` is:

A A. A long string over a single-character alphabet
B. A long random string over a large alphabet
C. Any worst-case string for the Manber-Myers construction
D. A Fibonacci string

2. The length of the TSP tour found by the triangle inequality technique achieves what minimization ratio?

D A. 0.5 B. $1 + \in$ (e.g. a PTAS) C. 1.5 D. 2

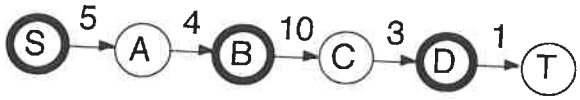
3. Which of the following is helpful if you wish to know the farthest pair in a set of points in 2D?

D A. Delaunay triangulation
B. Euclidean minimum spanning tree
C. Voronoi diagram
D. Convex hull

4. Which is not true regarding the first-fit decreasing method for bin packing?

C A. Each object is placed by going left-to-right until it fits in a bin or a new bin is allocated.
B. Objects placed in bins beyond the optimal number have sizes no larger than ½.
C. The number of objects placed in bins beyond the optimal number is arbitrary.
D. The number of objects with sizes larger than ½ is a lower bound on the optimal number of bins.

5. The capacity of the following cut is _____. (S vertices are bold.)



C A. 1 B. 10 C. 16 D. 23

6. Under what condition does an instance of stable marriages have only one solution?

A A. The male-optimal solution and female-optimal solution are the same
B. There is only one rotation
C. Every male preference list is identical to some female preference list
D. No female appears at the beginning of multiple male preference lists

7. What is the minimum increase in the tail's distance from the source between the first and second times that an edge becomes critical in the Edmonds-Karp method?

B A. 1 B. 2 C. (V-2)/2 D. VE

8. Capacity scaling is a reasonable substitute for:

C A. Edmonds-Karp B. Ford-Fulkerson
C. Maximum capacity paths D. Push-relabel

9. The reduction from 3-sat to 3-colorability will give a graph requiring four colors when:

B A. Removing one clause from the 3-sat instance will leave a satisifiable set of clauses.
B. The 3-sat instance is unsatisfiable.
C. The 3-sat instance is satisfiable.
D. The 3-sat instance is a tautology.

10. Which of the following is not true regarding Strassen's algorithm?

A A. It is not possible to have an asymptotically faster algorithm.
B. It requires more space than the everyday method.
C. It uses $\Theta\left(n^{\lg 7}\right)$ scalar additions when multiplying two n x n matrices.
D. It uses $\Theta\left(n^{\lg 7}\right)$ scalar multiplications when multiplying two n x n matrices.

11. Top-trading cycles is the solution approach for which problem?

B A. Stable roommates B. House allocation
C. Stable marriages D. Stable marriages with incomplete preference lists

12. The most general approximation result that can be achieved for an NP-hard problem is:

C A. Approximation Algorithm
B. Approximation Scheme
C. Fully Polynomial-time Approximation Scheme
D. Polynomial-time Approximation Scheme

13. In a maximum flow problem, the number of augmenting paths in a flow decomposition is bounded by:

A A. E B. $O(VE)$ C. f D. V

14. Which of the following is not represented in a DCEL?

C A. Edges B. Faces C. Sweep-line D. Vertices

15. The technique for approximating a subset cover proceeds by:

D A. Choosing the subset with the smallest fraction of its elements uncovered
B. Choosing the subset with the smallest number of uncovered elements
C. Choosing the subset with the largest fraction of its elements uncovered
D. Choosing the subset with the largest number of uncovered elements

16. Explain how the scaling parameter Δ is initialized and how it changes. (5 points)

Initialize:
Set Δ to largest 2^K that does not exceed the largest capacity of an edge leaving the source

Change:
If no AP exists for Δ, then $\Delta = \Delta/2$

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Test 2 - Open Book
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1. Fill in the blanks in the following instance of a suffix array with lcp values and ranks. As usual, s[21] is NULL ('\0'). (15 points)

i	sa	suffix	lcp	s	rank	lcp[rank]
0	21		-1	a	2	1
1	2	aabcbadababcdeabcde	0	b	8	0
2	0	abaabcbadababcdeabcde	1	a	1	0
3	9	ababcdeabcde	3	a	4	2
4	3	abcbadababcdeabcde	2	b	11	1
5	16	abcde	3	c	14	0
6	11	abcdeabcde	5	b	10	2
7	7	adababcdeabcde	1	a	7	1
8	1	baabcbadababcdeabcde	0	d	17	0
9	10	babcdeabcde	2	a	3	3
10	6	badababcdeabcde	2	b	9	2
11	4	bcbadababcdeabcde	1	a	6	5
12	17	bcde	2	b	13	4
13	12	bcdeabcde	4	c	16	3
14	5	cbadababcdeabcde	0	d	19	2
15	18	cde	1	e	21	1
16	13	cdeabcde	3	a	5	3
17	8	dababcdeabcde	0	b	12	2
18	19	de	1	c	15	1
19	14	deabcde	2	d	18	1
20	20	e	0	e	20	0
21	15	eabcde	1		0	-1

2. Use the Gale-Shapley algorithm to determine the male-optimal solution for the following instance of the stable marriages problem. In addition, show the preference lists at termination, i.e. you are to use the MEGS technique. Note that the preference lists are given left-to-right. (10 points)

male preference lists are:

1: 1 2 3 4 5

2: 2 3 4 5 1

3: 3 4 2 5 1

4: 1 3 2 5 4

5: 3 5 4 2 1

female preference lists are:

1: 4 3 5 2 1

2: 2 3 5 4 1

3: 1 2 5 4 3

4: 3 2 4 5 1

5: 2 4 3 1 5

(spare, same as above) male preference lists are:

1: 1 2 3 4 5

2: 2 3 4 5 1

3: 3 4 2 5 1

4: 1 3 2 5 4

5: 3 5 4 2 1

(spare, same as above) female preference lists are:

1: 4 3 5 2 1

2: 2 3 5 4 1

3: 1 2 5 4 3

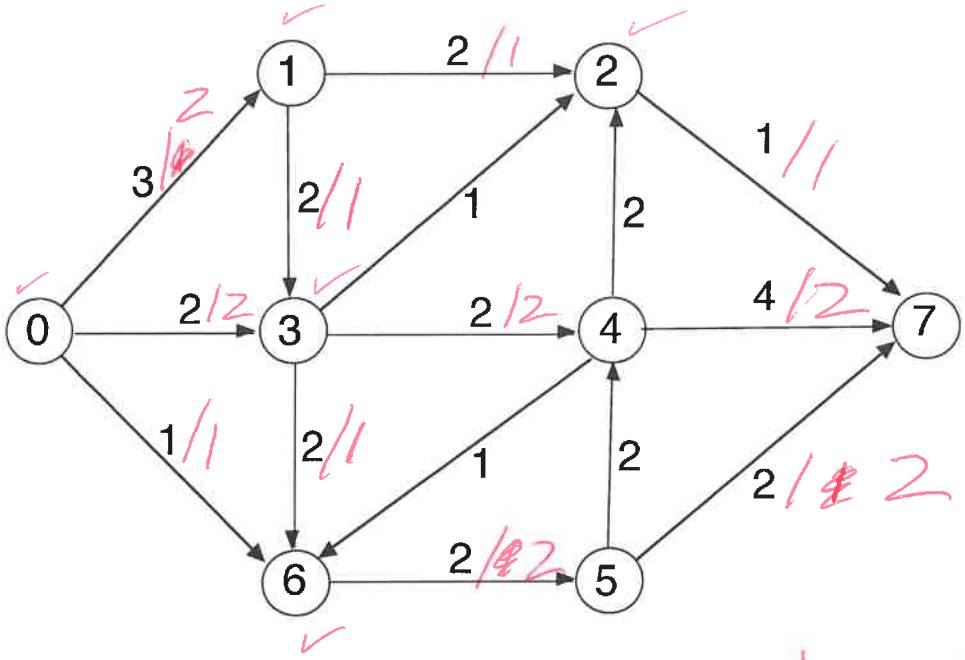
4: 3 2 4 5 1

5: 2 4 3 1 5

3. Give both types of KMP failure link tables for the following pattern: (10 points)

		1	2
0	C	-1	-1
1	A	0	0
2	B	0	0
3	A	0	0
4	B	0	0
5	C	0	-1
6	C	1	1
7	A	1	0
8	B	2	0
9	C	3	3
10	A	1	0
11	B	2	0
12	A	3	0
13	B	4	0
14	C	5	-1

4. Give augmenting paths for determining a maximum flow and give a minimum cut for the following network. 0 is the source and 7 is the sink. 15 points.



Minimum Cut:

S vertices: 0, 1, 2, 3, 6

T vertices: 4, 5, 7

Augmenting Paths and Contribution to Flow:

0, 1, 2, 7 / 1

0, 3, 4, 7 / 2

0, 6, 5, 7 / 1

0, 1, 3, 6, 5, 7 / 1

$\Sigma = 5$