Seat No. [ ]

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King Mongkut's University of Technology Thonburi
Final Examination of the 2nd Semester, Academic Year 2559

CPE 213 Algorithm Design — **Automation Engineering 2nd Yr.**
Tue. May 9, 2017 — 13:00 – 16:00

Instructions:

1. This exam has 2 parts, 45 points, 8 pages, (including the cover page).
2. This exam is closed-book, closed-note.
3. A calculator is not allowed.
4. Write your solution in the provided space and the back of pages if necessary.
5. If you believe some question is unclear or assumptions are needed to be made, state your assumptions at the beginning of your solution.

Students must raise their hand to inform to the proctor upon their completion of the examination, to ask for permission to leave the examination room.

Students must not take the examination and the answers out of the examination room.
Students will be punished if they violate any examination rules. The highest punishment is dismissal.

This examination is designed by
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This examination is approved by the Department of Computer Engineering.

Assc.Prof.Dr. Natasha Dejdumrong
(Head of Curriculum)

Part I: (6 points) For each item below, select one choice from (a), (b), ..., to match and mark × for your solution in the answer sheet.

1. An algorithm to find shortest paths from a given vertex to all the other vertices.
2. An algorithm to solve a stable matching problem.
3. A binary tree with all its levels are full except possibly the last level, where only some rightmost keys may be missing.
4. Algorithm design technique that stores additional information by input preprocessing to accelerate solving the problem afterward.
5. The next empty cell is linearly probed for insertion of a hash key.
6. A largest subset of edges in a bipartite graph such that no two edges share the same vertex.
7. An algorithm to solve a minimum spanning tree problem.
8. An algorithm to solve a string matching problem.
9. Algorithm design technique that creates an access structure for faster or flexible data access.
10. A binary tree with the key value at each node is at least those of its children.
11. Difference of heights between left subtree and right subtree
12. A matrix that tells if one vertex is reachable from another.

Choices

(a) Kruskal's algorithm
(b) Open hashing
(c) Node balance factor
(d) AVL tree
(e) Gale-Shapley algorithm
(f) Stable marriage output
(g) Augmenting path
(h) Closed hashing
(i) Prim-Dijkstra's algorithm
(j) Transitive closure
(k) Prestructuring
(l) Comparison-count sorting algorithm
(m) Dynamic programming
(n) Input enhancement
(o) Horspool's algorithm
(p) Dijkstra's algorithm
(q) Loading factor
(r) Parental dominance property
(s) Maximum matching
(t) Essentially complete binary tree

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Part I Answer Sheet

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

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Part II: Answer the following questions in the provided space (and back page if necessary). Show details of how you work out the solutions.

1. (10 points) Consider the following list {1,6,2,5,8,3}

   (a) (5 points) Apply the bottom-up heap construction to create a heap from the given list. Show how the heap is updated in each step from an essentially complete binary tree.

   (b) (5 points) From the heap you have created in (a), apply the maximum deletion to obtain a sorted list. Show how the heap is updated in each step.

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2. (6 points) Given a list {1,6,2,5,8,3}, apply the comparison-counting sort algorithm to obtain a sorted list and appropriately fill in values in the count table.

Initially	count[]						
After pass $i = 0$	count[]						
After pass $i = 1$	count[]						
After pass $i = 2$	count[]						
After pass $i = 3$	count[]						
After pass $i = 4$	count[]						
Final state	count[]						
Sorted array							

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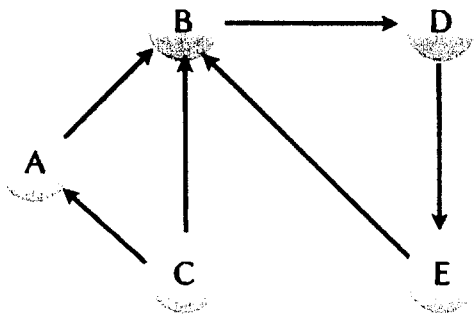
3. (7 points) Consider a directed graph below:



(a) (1 points) Write down the adjacency matrix of the graph.

(b) (6 points) Determine the transitive closure by successively determining $\boldsymbol{R}^{(k)}$. Show the matrix $\boldsymbol{R}^{(k)}$ in each step and circle entries in the matrix that are changed from the previous step.

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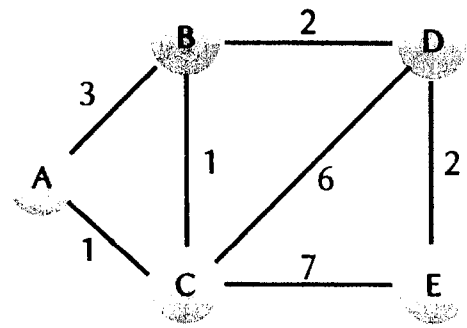
4. (8 points) A road network in a certain country is modelled by a weighted undirected graph shown in the figure below. The vertices represent the city center and weights are proportional to travel distances between two city centers.



(a) (1 points) Write down the weight matrix of the graph.

(b) (7 points) Determine the closest distance of all city pairs by using Floyd's algorithm. Show the matrix $D^{(k)}$ in each step and circle entries in the matrix that are changed from the previous step.

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5. (8 points) Consider a set of 3 men (M_1, M_2, M_3) and 3 women (W_1, W_2, W_3) where each man and woman has preferences regarding who he/she wants to go out for a date with below:

$$M_1 = \{W_2, W_1, W_3\}$$
$$M_2 = \{W_3, W_1, W_2\}$$
$$M_3 = \{W_3, W_2, W_1\}$$
$$W_1 = \{M_2, M_3, M_1\}$$
$$W_2 = \{M_3, M_1, M_2\}$$
$$W_3 = \{M_2, M_3, M_1\}$$

(a) (2 points) Show the ranking matrix for this problem.

(b) (6 points) Determine a stable matching for this input where each man gets the highest rank woman in his list. In each step, show the free men, which man proposes, and whether the proposed woman accepts or rejects the proposal.