Algorithmics and complexity

MCQ 2 – TD 7 – monday 14/01/2019

CentraleSupélec

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First and Last Name :

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Duration: 10 minutes.
No document is allowed. Using a calculator or a phone is forbidden.
Questions with the symbol ♣ accept one or many correct answers you must all tick. Other questions only accept one correct answer.
Warning: tick the boxes properly, without scratch, and do not use correctors. Check in dark color like here: ☒

Question 1 ♣ Among the following arrays, select those that are valid binary min-heaps:

- ☐ `A = [ 2, 4, 15, 6, 11, 60 ]`
- ☐ `A = [ 2, 11, 15, 6, 4, 60 ]`
- ☐ `A = [ 2, 4, 6, 11, 60, 15 ]`
- ☐ `A = [ 15, 60, 4, 6, 2, 11 ]`

Question 2 ♣ To implement a graph $G = (V, E)$ and make a traversal in $\mathcal{O}(|E|)$, we need:

- ☐ A priority queue whose keys are the degrees of the nodes
- ☐ An adjacency matrix
- ☐ An adjacency list
- ☐ None of these

Question 3 ♣ In the shortest-path problem, at the end of the execution of the Bellman-Ford algorithm, we get the following matrix M of distances :

	s_0	s_1	s_2	s_3	s_4	s_5
0	∞	∞	∞	∞	∞	0
1	-3	∞	3	4	2	0
2	-3	0	3	3	0	0
3	-4	-2	3	3	0	0
4	-6	-2	3	2	0	0
5	-6	-2	3	0	0	0
6	-6	-2	3	0	0	0

According to these values, you deduce that:

- ☐ there is no shortest path
- ☐ we found all shortest paths to reach s_5
- ☐ there is a negative cycle
- ☐ we found all shortest paths to reach s_0
- ☐ there is no negative cycle
- ☐ we can deduce nothing

Question 4 ♣ The halting problem which aims to determine if a program terminates, is:

- ☐ solved only if P=NP.
- ☐ a problem of class P
- ☐ a problem of class NP
- ☐ an undecidable decision problem

Question 5 ♣ A collision within a hash-table :

- ☐ makes the hash-table broken
- ☐ can be managed using linked lists
- ☐ occurs only if the array is smaller than the number of elements to store
- ☐ does not depend on the hash function

Question 6 ♣ Which of the following problems can be solved using the dynamic programming principle ?

- ☐ The problem of computing a 'road' itinerary
- ☐ The problem of identifying connected subgraphs
- ☐ The network routing problem
- ☐ The money placement problem
- ☐ None of these

Question 7 To answer the question: "is there a Hamiltonian circuit in the graph?", an exhaustive algorithm needs in the worst case:

- ☐ $\mathcal{O}(2^n)$ iterations
- ☐ $\mathcal{O}(n)$ iterations
- ☐ $\mathcal{O}(log(n))$ iterations
- ☐ $\mathcal{O}(n^2)$ iterations
- ☐ $\mathcal{O}(n!)$ iterations

Question 8 ♣ Which of the following problems are of class NP?

- ☐ Independent Set problem
- ☐ Say if a program terminates.
- ☐ 2-coloring graph problem
- ☐ Hamiltonian circuit problem

Question 9 ♣ A « Branch and Bound » algorithm...

- ☐ ... may not find a solution when there is one.
- ☐ ... guarantees the optimal solution.
- ☐ ... avoids exploring worse solutions.
- ☐ ... always finds a solution when there is one
- ☐ ... has a polynomial complexity

Question 10 In a min-heap, with the smallest element at the root, the greatest element can be found in:

- ☐ $\mathcal{O}(\log n)$
- ☐ $\mathcal{O}(n \log n)$
- ☐ $\mathcal{O}(1)$
- ☐ $\mathcal{O}(n)$