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Week 8 Quiz

The due date for submitting this assignment has passed.

Due on 2021-10-20, 23:59 IST.

Score: 10/10=100%

Assignment submitted on 2021-10-12, 15:17 IST

All questions carry equal weightage. You may submit as many times as you like within the deadline. Your final submission will be graded.

1) Which of the following is a linear constraint? ***2 points***

- 8x + 33yz + 14z ≥ 21
- 8xy + 33y + 14z ≤ 21
- 8x + 33y + 14z = 21
- 8x + 33y + 14xyz ≥ 21

Yes, the answer is correct.
Score: 2

Feedback:
In a linear constraint, variables should not be multiplied together. For instance, x^2 , xy, xyz etc are not linear terms.

Accepted Answers:
8x + 33y + 14z = 21

2) The President is arriving to inaugurate a stadium. He will go directly from the airport to the stadium. Security considerations require two routes to be available for the President that do not overlap on any section of road, though the routes can cross each other at intersections. ***2 points***

This can be modelled as a network flow problem where the source and target are the airport and the stadium, road intersections are nodes and each road segment is an edge. The actual flow problem to be solved is to:

- Assign a total of capacity 2 to all outgoing edges from the source and find a feasible flow.
- Assign a total of capacity 2 to all incoming edges to the target and find a feasible flow.
- Assign each edge capacity 1 and check that the maximum flow is less than 2.
- Assign each edge capacity 1 and check that the maximum flow is at least 2.

Yes, the answer is correct.
Score: 2

Feedback:
We need two edge disjoint paths from source to target, so set each edge capacity to 1 and check for a flow of size 2 or more.

Accepted Answers:
Assign each edge capacity 1 and check that the maximum flow is at least 2.

3) City authorities are concerned about traffic accidents on major roads. They would like to have ambulances stationed at road intersections to quickly reach the scene of any accident along these roads. To minimize response time, ambulances are to be located at intersections with traffic lights so that any segment of road can be reached by at least one ambulance that does not have to pass through a traffic light to reach the scene of the accident. If we model the road network as a graph, where intersections with traffic lights are vertices and edges represent road segments between traffic lights, the graph theoretic question to be answered is: ***2 points***

- Find a spanning tree with minimum cost.
- Find a minimal colouring.
- Find a minimum size vertex cover.
- Find a minimum size independent set.

Yes, the answer is correct.
Score: 2

Feedback:
Find a minimum vertex cover. Each ambulance covers the adjacent roads, and all roads are covered in this way.

Accepted Answers:
Find a minimum size vertex cover.

4) We have an exponential time algorithm for problem A, and problem A reduces in polynomial time to problem B. From this we can conclude that: ***2 points***

- B has an exponential time algorithm.
- B cannot have a polynomial time algorithm.
- A cannot have a polynomial time algorithm.
- None of the other choices are correct.

Yes, the answer is correct.
Score: 2

Feedback:
None of the above. A reduction can transfer a positive propoerty from B to A or a negative property from A to B

Accepted Answers:

None of the other choices are correct.

5) Suppose SAT reduces to a problem C. To claim that C is NP-complete, we additionally need to show that: ***2 points***

- (•) There is a checking algorithm for C.
- ( ) Every instance of C maps to an instance of SAT.
- ( ) Every instance of SAT maps to an instance of C.
- ( ) C does not have an efficient algorithm.

Yes, the answer is correct.
Score: 2

Feedback:
The reduction establishes NP-hardness. We have to show that C is in NP, for which a checking algorithm suffices.

Accepted Answers:
There is a checking algorithm for C.