CSPB 3104 - Park - Algorithms

Started on	Tuesday, 23 April 2024, 7:02 PM
State	Finished
Completed on	Tuesday, 23 April 2024, 7:41 PM
Time taken	39 mins 17 secs
Marks	30.00/30.00
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 6.00 out of 6.00

Consider the pseudocode for Dijkstra algorithm:

```
def dijkstra(G, src):
    # G has n nodes and m edges
1:    pq = empty heap
2:    for each node v:
3:        if (v == src):
4:            d[v] = 0
5:        else:
6:            d[v] = \(\infty\)
7:        insert v into pq with key d[v]
8:    while (pq is not empty):
9:        u = extractMin(pq)
10:        for each outgoing edge (u,v):
11:            relax the edge (u,v).
12:            d[v] may change: restore heap property
```

The input graph has **240** nodes and **856** edges

(A) How many times does the loop in line 8 run for this input graph?

240   ✔

(B) Which operation is used to restore the heap property in line 12?

◯ Heapify

◯ Bubble Down

◯ Extract Min

◉ Bubble Up   ✔   Correct

> Mark 2.00 out of 2.00
>
> The correct answer is: Bubble Up

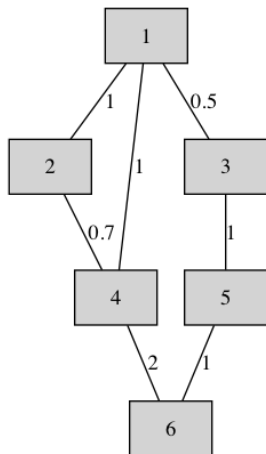(C) How many times does line 11 run in the worst case (assume input graph has **240** nodes and **856** edges)?

856   ✔

Question **2**

Correct

Mark 8.00 out of 8.00

Consider the following graph below:

We wish to calculate a Minimal Spanning Tree (MST) for the graph. Answer the questions below concerning MSTs.

(A) Which of the following edges **must** be part of every MST for this graph?

◉ (1,3)   ✔   Correct
◯ (1,2)
◯ (1,4)
◯ (4,6)

> Mark 2.00 out of 2.00
>
> The correct answer is: (1,3)

(B) Which of the following edges can never be part of an MST for this graph?

◯ (1,2)
◯ (1,4)
◯ (1,3)
◉ (4,6)   ✔   Correct

> Mark 2.00 out of 2.00
>
> The correct answer is: (4,6)

(C) If we were to use Kruskal's algorithm to construct a MST, what is the first edge to be added to this MST?

◉ (1,3)   ✔   Correct
◯ (1,2)
◯ (4,6)
◯ (1,4)

> Mark 2.00 out of 2.00
>
> The correct answer is: (1,3)

(D) What is the total sum of edge weights for the MST?
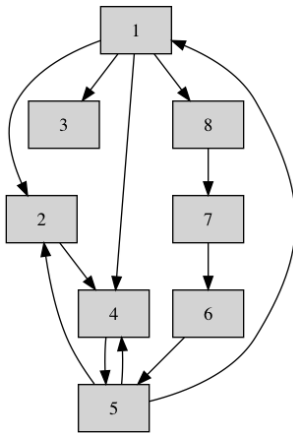
4.2	✔

Question **3**

Correct

Mark 6.00 out of 6.00

Consider the graph shown below.

How many (maximal) strongly connected components does it have?

2	✔

For a DFS of the graph starting from node 1, write down the ID of the node that finishes last.

1	✔

The SCC algorithm performs DFS on the transpose graph. Write down the ID of the node that is chosen for the first such reverse DFS visit.

1	✔

Question **4**

Correct

Mark 10.00 out of 10.00

A directed graph G with 8 nodes has four (maximal) SCCs given consisting of the nodes

{1,2,5}, {4,6,8}, {3}, {7}

For each of the statements below, write TRUE if it is true and FALSE otherwise (case sensitive answer).

1. The graph has at least 6 edges.

TRUE	✔

2. The graph has at most 34 edges.

TRUE	✔

3. If the edge (1,5) were not to exist, then (1,2) and (2,5) must both exist.

TRUE	✔

4. There is at least one incoming edge for node 4.

TRUE	✔

We are now provided the additional information that the edges (5,3) and (4,6) exist in the graph. Which of the following edges cannot exist knowing this information?

○ (3,7)

○ (6,4)

⊙ (3,1)   ✔   Correct

○ (8,5)

> Mark 2.00 out of 2.00
>
> The correct answer is: (3,1)