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# Chapter 29 Check Point Questions

## Section 29.2

**▼29.2.1**

For the code WeightedEdge edge = new WeightedEdge(1, 2, 3.5), what is edge.u, edge.v, and edge.weight?

edge.u is 1, edge.v is 2, and edge.weight is 3.5

Hide Answer

**▼29.2.2**

What is the output of the following code?

```
List<WeightedEdge> list = new ArrayList<>();
list.add(new WeightedEdge(1, 2, 3.5));
list.add(new WeightedEdge(2, 3, 4.5));
WeightedEdge e = java.util.Collections.max(list);
System.out.println(e.u);
System.out.println(e.v);
System.out.println(e.weight);
```

The output is

```
2
3
4.5
```

Hide Answer

## Section 29.3

**▼29.3.1**

If a priority queue is used to store weighted edges, what is the output of the following code?

```
PriorityQueue<WeightedEdge> q = new PriorityQueue<>();
q.offer(new WeightedEdge(1, 2, 3.5));
q.offer(new WeightedEdge(1, 6, 6.5));
q.offer(new WeightedEdge(1, 7, 1.5));
System.out.println(q.poll().weight);
System.out.println(q.poll().weight);
System.out.println(q.poll().weight);
```

The output is

```
1.5
3.5
6.5
```

Hide Answer

### ▼29.3.2

If a priority queue is used to store weighted edges, what is wrong in the following code? Fix it and show the output.

```
List<PriorityQueue<WeightedEdge>> queues = new ArrayList<>();
queues.get(0).offer(new WeightedEdge(0, 2, 3.5));
queues.get(0).offer(new WeightedEdge(0, 6, 6.5));
queues.get(0).offer(new WeightedEdge(0, 7, 1.5));
queues.get(1).offer(new WeightedEdge(1, 0, 3.5));
queues.get(1).offer(new WeightedEdge(1, 5, 8.5));
queues.get(1).offer(new WeightedEdge(1, 8, 19.5));
System.out.println(queues.get(0).peek()
  .compareTo(queues.get(1).peek()));
```

The code is wrong because there is no queues.get(0). You need to first create and add a queue into queues using the following statements:

```
queues.add(new PriorityQueue<WeightedEdge>());
queues.add(new PriorityQueue<WeightedEdge>());
```

After the fix, the output is -1.

Hide Answer

### ▼29.3.3

Show the output of the following code.

```
public class Test {
  public static void main(String[] args) throws Exception {
    WeightedGraph<Character> graph = new WeightedGraph<>();
    graph.addVertex('U');
    graph.addVertex('V');
    int indexForU = graph.getIndex('U');
    int indexForV = graph.getIndex('V');
    System.out.println("indexForU is " + indexForU);
    System.out.println("indexForV is " + indexForV);
    graph.addEdge(indexForU, indexForV, 2.5);
    System.out.println("Degree of U is " +
      graph.getDegree(indexForU));
    System.out.println("Degree of V is " +
      graph.getDegree(indexForV));
    System.out.println("Weight of UV is " +
      graph.getWeight(indexForU, indexForV));
  }
}
```

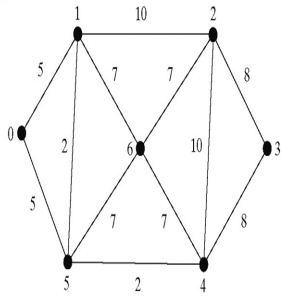
indexForU is 0
indexForV is 1
Degree of U is 1
Degree of V is 0
Weight of UV is 2.5

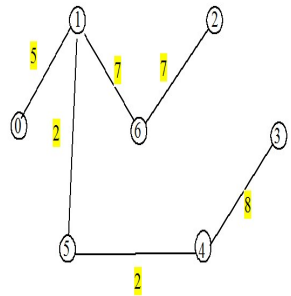
Hide Answer

## Section 29.4

### ▼29.4.1

Find a minimum spanning tree for the following graph.




Hide Answer

### ▼29.4.2

Is a minimum spanning tree unique if all edges have different weights?

Yes.

Hide Answer

### ▼29.4.3

If you use an adjacency matrix to represent weighted edges, what will be the time complexity for Prim's algorithm?

O(n^2logn), n is the number of vertices.

Hide Answer

### ▼29.4.4

What happens to the getMinimumSpanningTree() method in WeightedGraph if the graph is not connected? Verify your answer by writing a test program that creates an unconnected graph and invokes the getMinimumSpanningTree() method.

Line 95 in WeightedGraph.java, the loop

```
while (T.size() < numberOfVertices) {
```

continues if T.size() < numberOfVertices. If the graph is not connected, the v will be set to -1 in line 98, if no edges are found to connect vertices between T and V - T. In this case, the statement

```
if (v != -1)
  T.add(v); // Add a new vertex to the tree
else
  break; // The tree is not connected, a partial MST is found
```

causes the while loop in line 95 to end.

Hide Answer

### ▼29.4.5

Show the output of the following code:

```
public class Test {
  public static void main(String[] args) {
    WeightedGraph<Character> graph = new WeightedGraph<>();
    graph.addVertex('U');
    graph.addVertex('V');
    graph.addVertex('X');
    int indexForU = graph.getIndex('U');
    int indexForV = graph.getIndex('V');
    int indexForX = graph.getIndex('X');
    System.out.println("indexForU is " + indexForU);
    System.out.println("indexForV is " + indexForV);
    System.out.println("indexForX is " + indexForV);
    graph.addEdge(indexForU, indexForV, 3.5);
    graph.addEdge(indexForV, indexForU, 3.5);
    graph.addEdge(indexForU, indexForX, 2.1);
    graph.addEdge(indexForX, indexForU, 2.1);
    graph.addEdge(indexForV, indexForX, 3.1);
    graph.addEdge(indexForX, indexForV, 3.1);
    WeightedGraph<Character>.MST mst
      = graph.getMinimumSpanningTree();
    graph.printWeightedEdges();
    System.out.println(mst.getTotalWeight());
    mst.printTree();
  }
}
```

```
indexForU is 0
indexForV is 1
indexForX is 1
U (0): (0, 1, 3.5) (0, 2, 2.1)
V (1): (1, 0, 3.5) (1, 2, 3.1)
X (2): (2, 0, 2.1) (2, 1, 3.1)
5.2
Root is: U
Edges: (X, V) (U, X)
```

Hide Answer

## Section 29.5

### ▼29.5.1

Trace Dijkstra's algorithm for finding shortest paths from Boston to all other cities in Figure 29.1.

See the text.

Hide Answer

**▼29.5.2**

Is a shortest path between two vertices unique if all edges have different weights?

No.

Hide Answer

**▼29.5.3**

If you use an adjacency matrix to represent weighted edges, what would be the time complexity for Dijkstra's algorithm?

O(n^2logn), n is the number of vertices.

Hide Answer

**▼29.5.4**

What happens to the getShortestPath() method in WeightedGraph if the source vertex cannot reach all vertieces in the graph? Verify your answer by writing a test program that creates an unconnected graph and invoke the getShortestPath() method.

Line 185 in WeightedGraph.java, the loop

```
while (T.size() < numberOfVertices) {
```

continues if T.size() < numberOfVertices. If the graph is not connected, the v is set to -1 in line 185, if no edges are found to connect vertices between T and V - T, -1 will add to T in line 208. The statement

```
if (v != -1)
  T.add(v); // Add a new vertex to the tree
else
  break; // The tree is not connected, a partial MST is found
```

causes the while loop in line 185 to end.

Hide Answer

**▼29.5.5**

If there is no path from vertex v to the source vertex, what will be cost[v]?

cost[v] will be infinity.

Hide Answer

**▼29.5.6**

Assume that the graph is connected; will the getShortestPath method find the shortest paths correctly if lines 159-161 in WeightedGraph are deleted?

No. cost[i] will be zero for i.

Hide Answer

**▼29.5.7**

Show the output of the following code:

```
public class Test {
  public static void main(String[] args) {
    WeightedGraph<Character> graph = new WeightedGraph<>();
    graph.addVertex('U');
```

```
    graph.addVertex('V');
    graph.addVertex('X');
    int indexForU = graph.getIndex('U');
    int indexForV = graph.getIndex('V');
    int indexForX = graph.getIndex('X');
    System.out.println("indexForU is " + indexForU);
    System.out.println("indexForV is " + indexForV);
    System.out.println("indexForX is " + indexForV);
    graph.addEdge(indexForU, indexForV, 3.5);
    graph.addEdge(indexForV, indexForU, 3.5);
    graph.addEdge(indexForU, indexForX, 2.1);
    graph.addEdge(indexForX, indexForU, 2.1);
    graph.addEdge(indexForV, indexForX, 3.1);
    graph.addEdge(indexForX, indexForV, 3.1);
    WeightedGraph<Character>.ShortestPathTree tree =
      graph.getShortestPath(1);
    graph.printWeightedEdges();
    tree.printTree();
  }
}
```

```
indexForU is 0
indexForV is 1
indexForX is 1
U (0): (0, 1, 3.5) (0, 2, 2.1)
V (1): (1, 0, 3.5) (1, 2, 3.1)
X (2): (2, 0, 2.1) (2, 1, 3.1)
Root is: V
Edges: (V, U) (V, X)
```

Hide Answer

## Section 29.6

**▼29.6.1**

Why is the tree data field in NineTailModel in Listing 28.13 defined protected?

The tree data field in NineTailModel is accessed in WeightedTailModel. A new tree is created in WeightedTailModel.

Hide Answer

**▼29.6.2**

How are the nodes created for the graph in WeightedNineTailModel?

See the text.

Hide Answer

**▼29.6.3**

How are the edges created for the graph in WeightedNineTailModel?

See the text.

Hide Answer