CSPB 3104 - Park - Algorithms

Started on	Thursday, 7 March 2024, 4:21 PM
State	Finished
Completed on	Thursday, 7 March 2024, 4:34 PM
Time taken	13 mins 30 secs
Marks	22.00/22.00
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 3.00 out of 3.00

Let us assume that we are giving unlimited number of coins of the following denominations:

1 cents, 10 cents, 30 cent and 40 cents.

What is the minimum number of coins required to make up 60 cents?

2

Suppose, we employ the following strategy for making up a given amount x cents:

(a) Choose $(n_1 : \lfloor \frac{x}{40} \rfloor)$, 40 cent coins. Let $x := x - 40 * n_1$.

(b) Choose $(n_2 : \lfloor \frac{x}{30} \rfloor)$, 30 cent coins. Let $x := x - 30 * n_2$.

... and so on ...

(e) Choose $(n_5 : x)$ 1 cent coins.

How many coins does the greedy strategy require to make up 60 cents?

3

Which of the following is true about the set of US coins: 1 cents, 5 cents, 10 cents, 25 cents and 50 cents?

- (•) The denominations are set so that the greedy algorithm also happens to be optimal for coin changing
- ( ) Not all denominations can be changed
- ( ) Adding a 20 cent coin makes the greedy algorithm optimal
- ( ) Changing 99 cents requires at least 10 coins

Mark 1.00 out of 1.00

The correct answer is: The denominations are set so that the greedy algorithm also happens to be optimal for coin changing

Correct

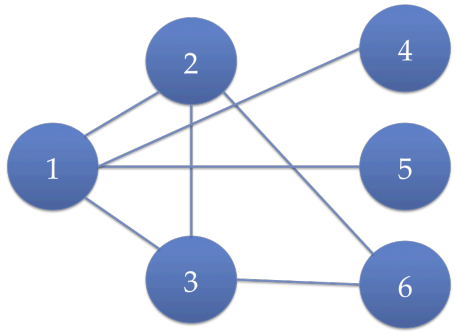
Marks for this submission: 3.00/3.00.

Question **2**

Correct

Mark 5.00 out of 5.00

Consider a social network involving 6 people numbered 1 through 6 as shown below.



Nodes represent people and edges represent friends.

A "Cover" for the network is a **subset of the people** who are (jointly) friends with everyone else. Formally, the definition is below:

A subset S of people (nodes) in the network is a cover if every person in the network is either part of the subset S or is friends with someone in the subset S.

For example,

The set {4, 5, 6} forms a cover for this set. Together they are friends with everyone else.

However, the subset {1,4} is not a cover since 6 is not a friend of 1 or 4.

What is the size of the smallest cover for the network above?

2

Which of the following sets forms the smallest possible cover?

- (•) 1,6 Correct
- ( ) 2,6
- ( ) 3,5
- ( ) 1,4,6

Mark 1.00 out of 1.00

The correct answer is: 1,6

Consider the following simple **Greedy Cover** Algorithm:

1. Pick the person with **maximum number of friends** in the network, add them to the cover.
2. Delete this person and their friends from the network.
3. Repeat step 1 until no people remain.

According to the algorithm, what is the id of the first person picked to belong to the cover?

1

What is true of the remaining network after node id 1 and its friends are deleted?

- (•) Only 6 remains in the network Correct
- ( ) Nothing remains

- Only two nodes 4,5 remain
- Only 5 remains in the network
- 2,3,4,5,6 remain

Mark 1.00 out of 1.00

The correct answer is: Only 6 remains in the network

What is the size of the smallest cover discovered by the greedy algorithm for the network above?

2

Correct

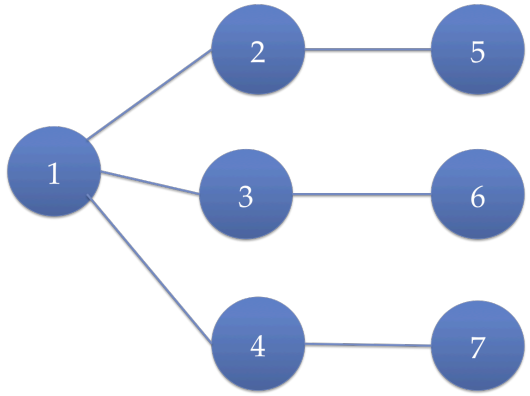
Marks for this submission: 5.00/5.00.

Question **3**

Correct

Mark 4.00 out of 4.00

Now consider the social network below:



Recall the definition of cover from the previous problem:

A subset S of people (nodes) in the network is a cover if every person in the network is either part of the subset S or is friends with someone in the subset S.

What is the size of the smallest possible cover for the network above?

3

Select the nodes that form part of the smallest vertex cover?

- (•) 2,3,4 Correct
- ( ) 1,4,7
- ( ) 1, 5, 7
- ( ) 1,5,6,7

Mark 1.00 out of 1.00

The correct answer is: 2,3,4

Now consider, again, the greedy algorithm discussed in the previous problem:

1. *Choose the person with the largest number of friends.*
2. *Add the person to the cover, and delete the person and his/her friends from the network.*
3. *Repeat 1-3 until the network is empty of people.*

Running the greedy algorithm on the network above, what is the first node selected for the cover?

1

What is the size of the cover discovered by the greedy algorithm?

4

Correct

Marks for this submission: 4.00/4.00.

Question **4**

Correct

Mark 3.00 out of 3.00

For a *single lecture hall,* the following meetings are proposed:

- M_1 start time: 1, finish time: 3
- M_2 start time: 0, finish time: 6
- M_3 start time: 3, finish time: 5
- M_4 start time: 5, finish time: 7
- M_5 start time: 7, finish time 8
- M_6 start time: 6, finish time 9

The maximum number of meetings that can be scheduled is:

4

Suppose M_2 must be scheduled, what is the maximum number of ***additional*** lectures that can be scheduled?

1

Suppose the scheduling problem is over **two** rather than one lecture hall. Which of the following statements is true:

- (•) All lectures can be scheduled using two lecture halls Correct
- ( ) At least three halls are needed to schedule all lectures
- ( ) There is a schedule that allows M_5 and M_6 to be scheduled in the same lecture hall
- ( ) The optimal schedule allows 3 lectures in each hall

Mark 1.00 out of 1.00

The correct answer is: All lectures can be scheduled using two lecture halls

Correct

Marks for this submission: 3.00/3.00.

Question **5**

Correct

Mark 7.00 out of 7.00

Consider a text files with a total of 100 characters consisting of

1. 'e' occurring 42 times
2. 'a' occurring 35 times
3. 'i' occurring 13 times
4. 'o' occurring 6 times
5. 'u' occurring 4 times.

We construct the optimal prefix code using Huffman prefix code algorithm covered in class.

Which of the following pairs are merged for the first step of the algorithm?

- (•) o,u are merged Correct
- ( ) o,i are merged
- ( ) all characters are merged
- ( ) a,e are merged

Mark 1.00 out of 1.00

The correct answer is: o,u are merged

After executing the full prefix tree construction, write down the number of bits in the optimal prefix code obtained?

# of bits for 'e': 1

# of bits for 'a': 2

# of bits for 'i': 3

# of bits for 'o': 4

# of bits for 'u': 4

What is the number of bits required to encode the file using the Huffman code? Write down the final answer as a number in the box below:

191

Correct

Marks for this submission: 7.00/7.00.