Module 6 Graded Quiz

Due Nov 5, 2021 at 11:59pm **Points** 15 **Questions** 15
Available Oct 23, 2021 at 12am - Jan 21 at 11:59pm 3 months
Time Limit 120 Minutes

Attempt History

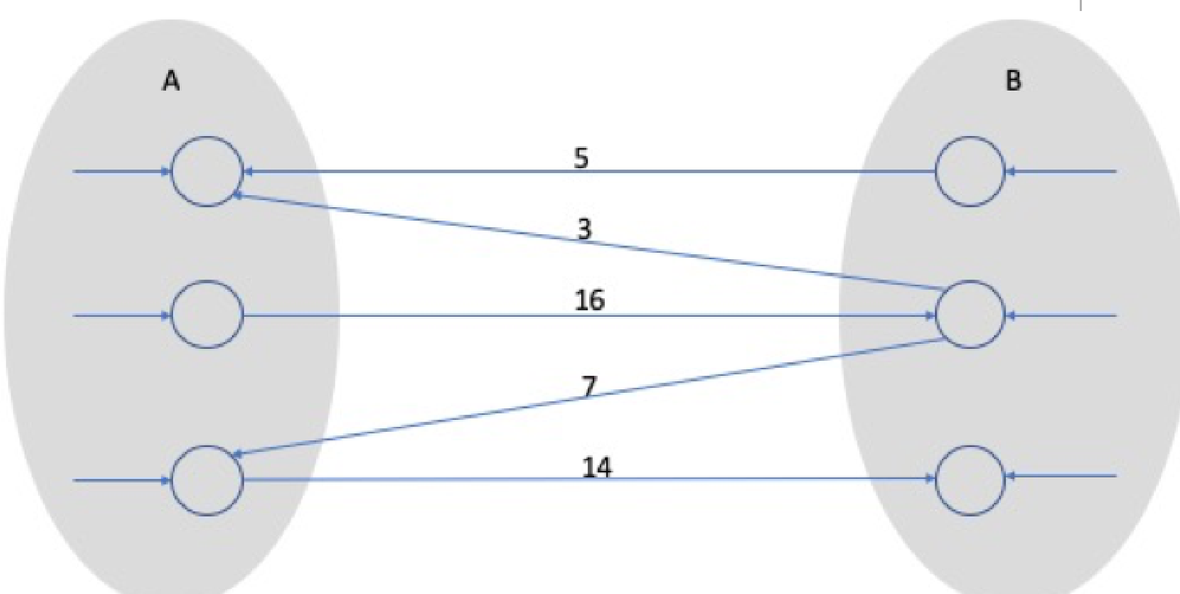
	Attempt	Time	Score
LATEST	Attempt 1	32 minutes	15 out of 15

Score for this quiz: **15** out of 15
Submitted Nov 5, 2021 at 9pm
This attempt took 32 minutes.

Question 1

1 / 1 pts

Suppose we are given a network partitioned into sets *A* and *B* such that source node $s \in A$ and sink node $t \in B$. This partition creates a cut in the network. Assume the edges that traverse the cut have an infinite capacity, and the edge values given represent the respective *flow* along each corresponding edge. Determine the total flow of this network.



- 45
- 10
- 30

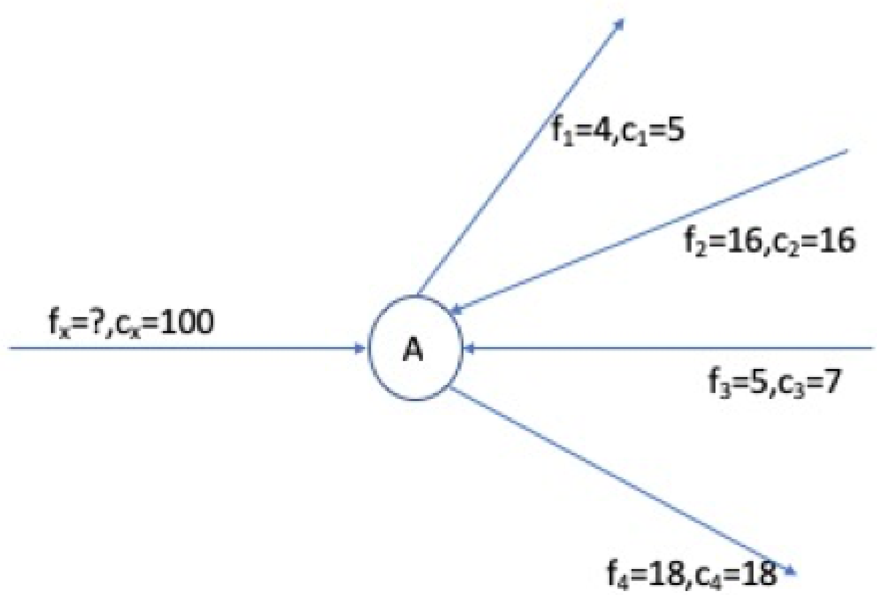
Correct!

- 15

Question 2

1 / 1 pts

Node *A* and its adjoining edges have been extracted from a network wherein f_i and c_i represent the flow and capacity of each edge *i* respectively. Use the following diagram to determine the value of f_x given that node *A* has been extracted from a valid network.



- 22
- 21
- 0

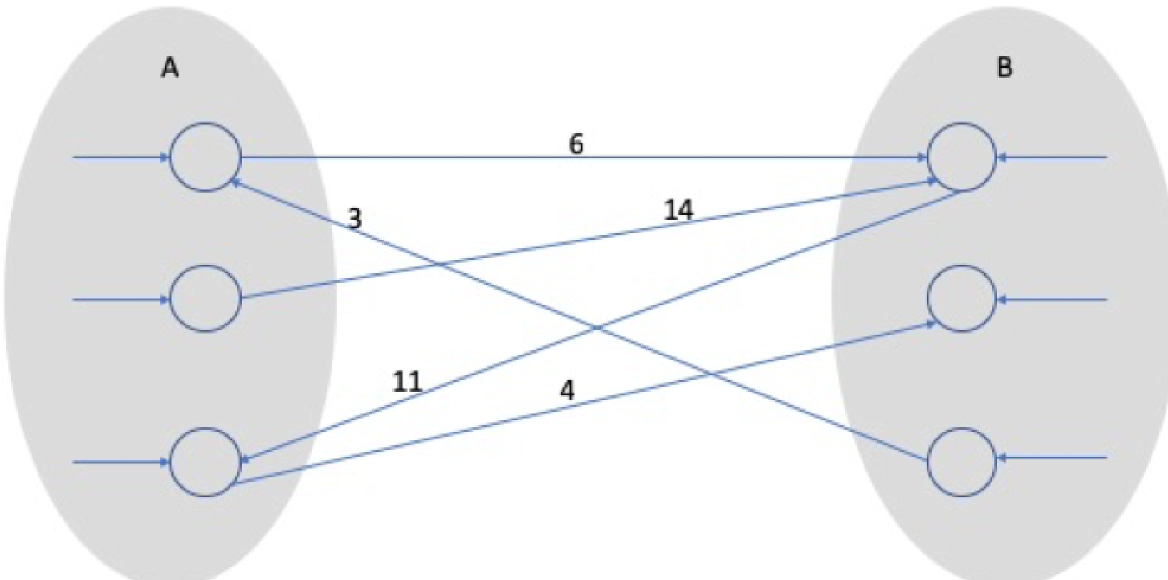
Correct!

- 1

Question 3

1 / 1 pts

Suppose we are given a network partitioned into sets *A* and *B* such that source node $s \in A$ and sink node $t \in B$. This partition creates a cut in the network. Let the values along each edge represent the *capacity* of that edge. Determine the *capacity* of this cut.



- 38

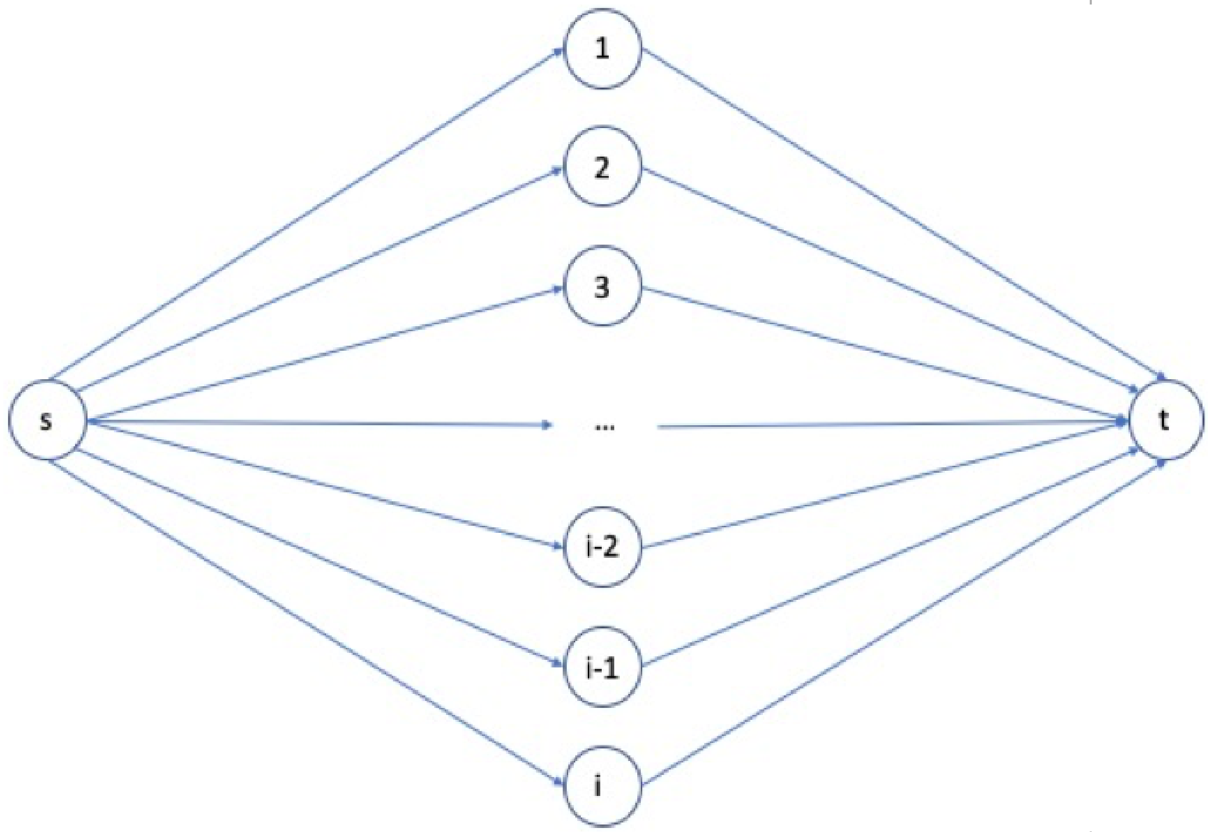
Correct!

- 24
- 27
- 14

Question 4

1 / 1 pts

Given a network with source node *s*, sink node *t*, and the following general topology, find an expression for the number of *s*-*t* cuts that exist in terms of the number of intermediary nodes *i*. Note that an intermediary node is any node that is not *s* or *t*.



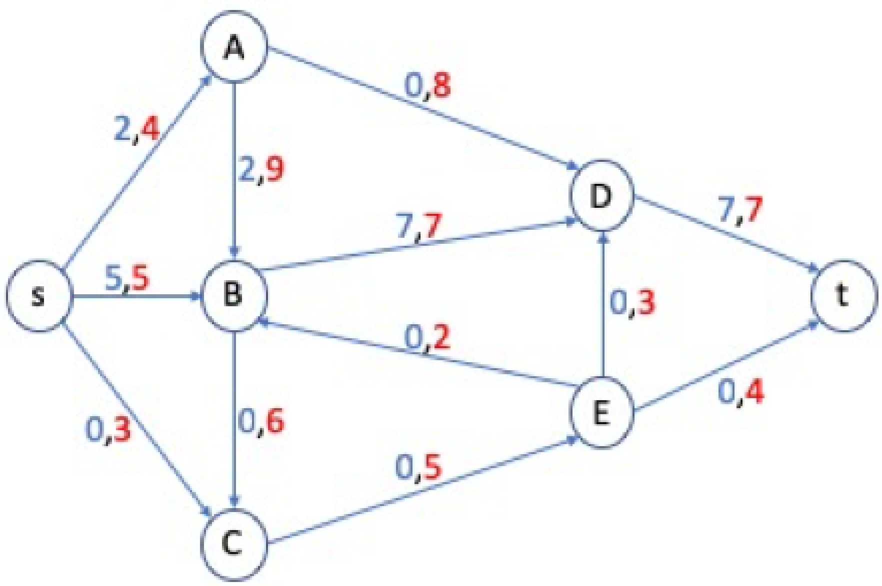
- i^i
- $(i)!$
- Correct! 2^i
- i^2

Question 5

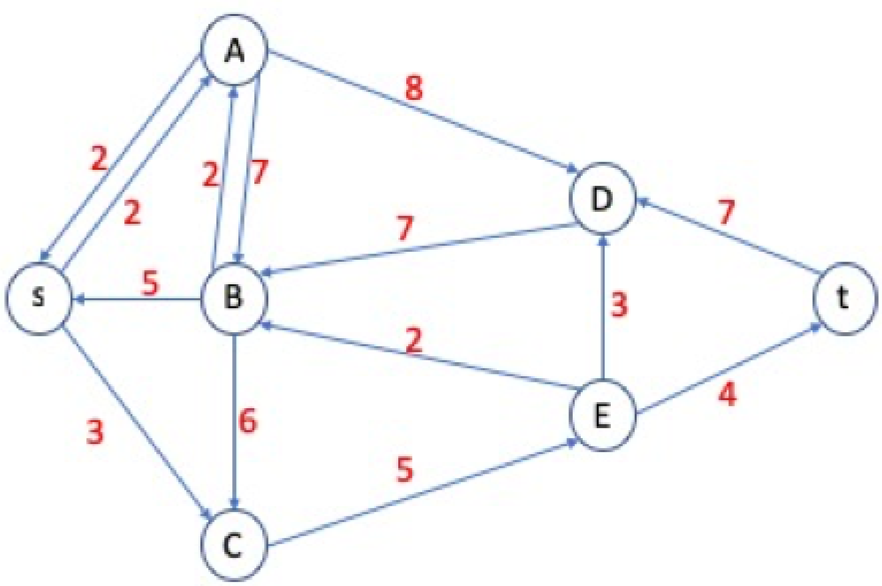
1 / 1 pts

You are given the following flow network with source node *s* and sink node *t* as it stands in the middle of execution of the Ford-Fulkerson algorithm after two paths have been augmented. You are given the corresponding residual graph at the same time step as well. Recall that we are trying to calculate the maximum flow value for this network. Suppose the next path the algorithm chooses to augment is the chain of nodes *P* = *S-A-D-B-C-E-T*. Give the updated flow values for each edge present in *P* after the augmentation is completed. Note that flow values are given in blue and capacity values are given in red. Also, recall the function *f((u,v))* denotes the flow of edge *(u,v)*.

Flow Network



Residual Graph



- f((S,A))=4, f((A,D))=10, f((B,D))=5, f((B,C))=8, f((C,E))=7, f((E,T))=6
- f((S,A))=4, f((A,D))=10, f((B,D))=9, f((B,C))=8, f((C,E))=7, f((E,T))=6

Correct!

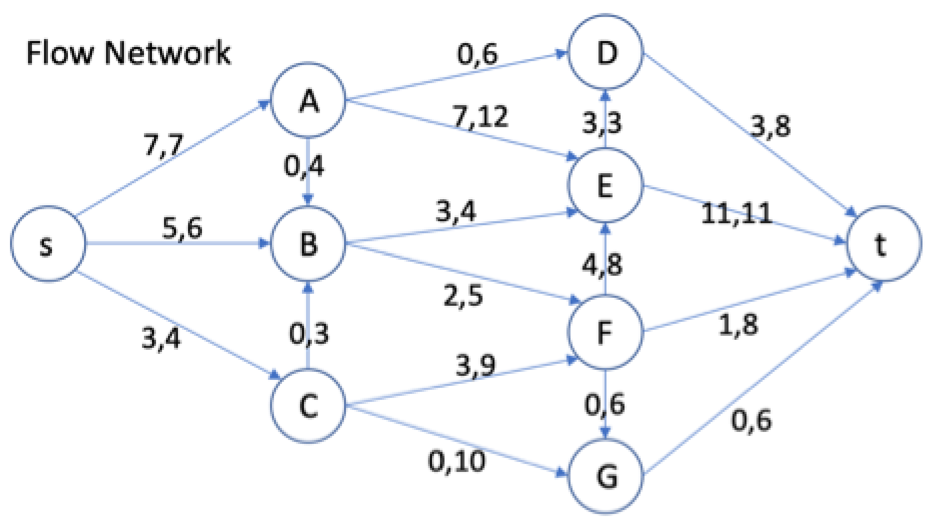
f((S,A))=4, f((A,D))=2, f((B,D))=5, f((B,C))=2, f((C,E))=2, f((E,T))=2

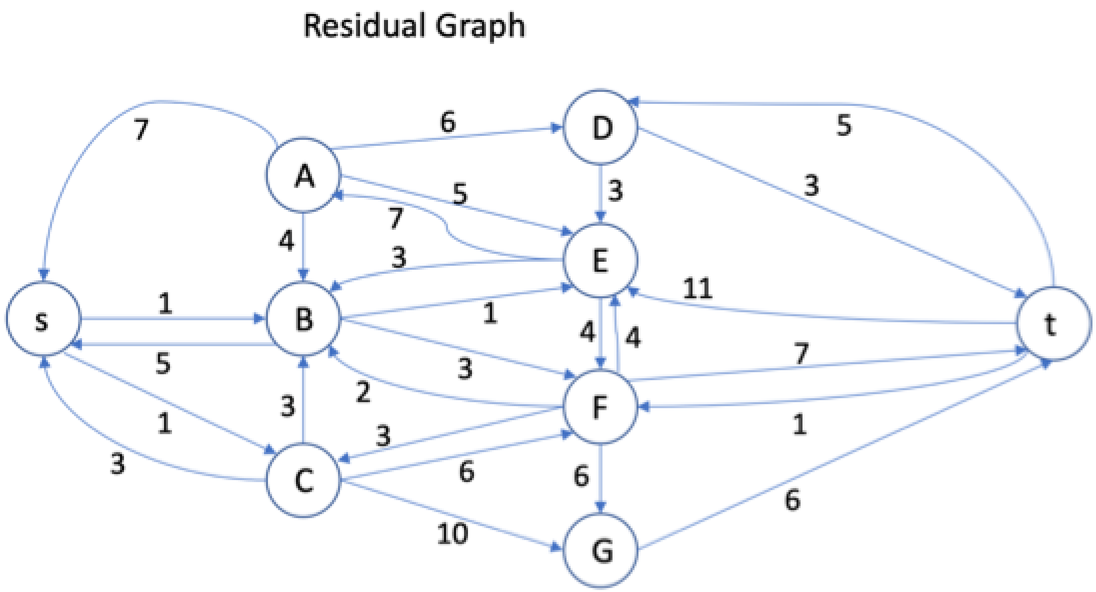
f((S,A))=4, f((A,D))=2, f((B,D))=9, f((B,C))=2, f((C,E))=2, f((E,T))=2

Question 6

1 / 1 pts

You are given the following flow network with source node s and sink node t as it stands in the middle of an execution of the Ford-Fulkerson algorithm after four paths have been augmented. You are given the corresponding residual graph at the same time step as well. Recall that we are trying to calculate the maximum flow value for this network. Suppose the next path the algorithm chooses to augment is the chain of nodes P = S-B-E-A-D-T. Give the updated flow values for each edge present in P after the augmentation is completed. Note that edge weights in the flow network are given as u,v where u is the flow value assigned to that edge and v is the capacity of the edge. The edge weights of the residual graph represent capacities only. Also, recall the function f((x,y)) denotes the flow of edge (x,y).





○ f((S,B))=6, f((B,E))=2, f((A,E))=8, f((A,D))=1, f((D,T))=4

○ f((S,B))=6, f((B,E))=2, f((A,E))=6, f((A,D))=1, f((D,T))=4

○ f((S,B))=6, f((B,E))=4, f((A,E))=8, f((A,D))=1, f((D,T))=4

Correct!

◉ f((S,B))=6, f((B,E))=4, f((A,E))=6, f((A,D))=1, f((D,T))=4

Question 7

1 / 1 pts

Answer true or false to the following statement and explain: The Ford-Fulkerson algorithm runs in polynomial time.

○ True – Because capacities are constant, Ford-Fulkerson runs in polynomial time.

True – The time complexity is the number of nodes in the network times the number of edges times the maximum capacity, which is a cubic function.

False – Because the capacity is represented with a logarithmic number of bits, FF always runs in exponential time.

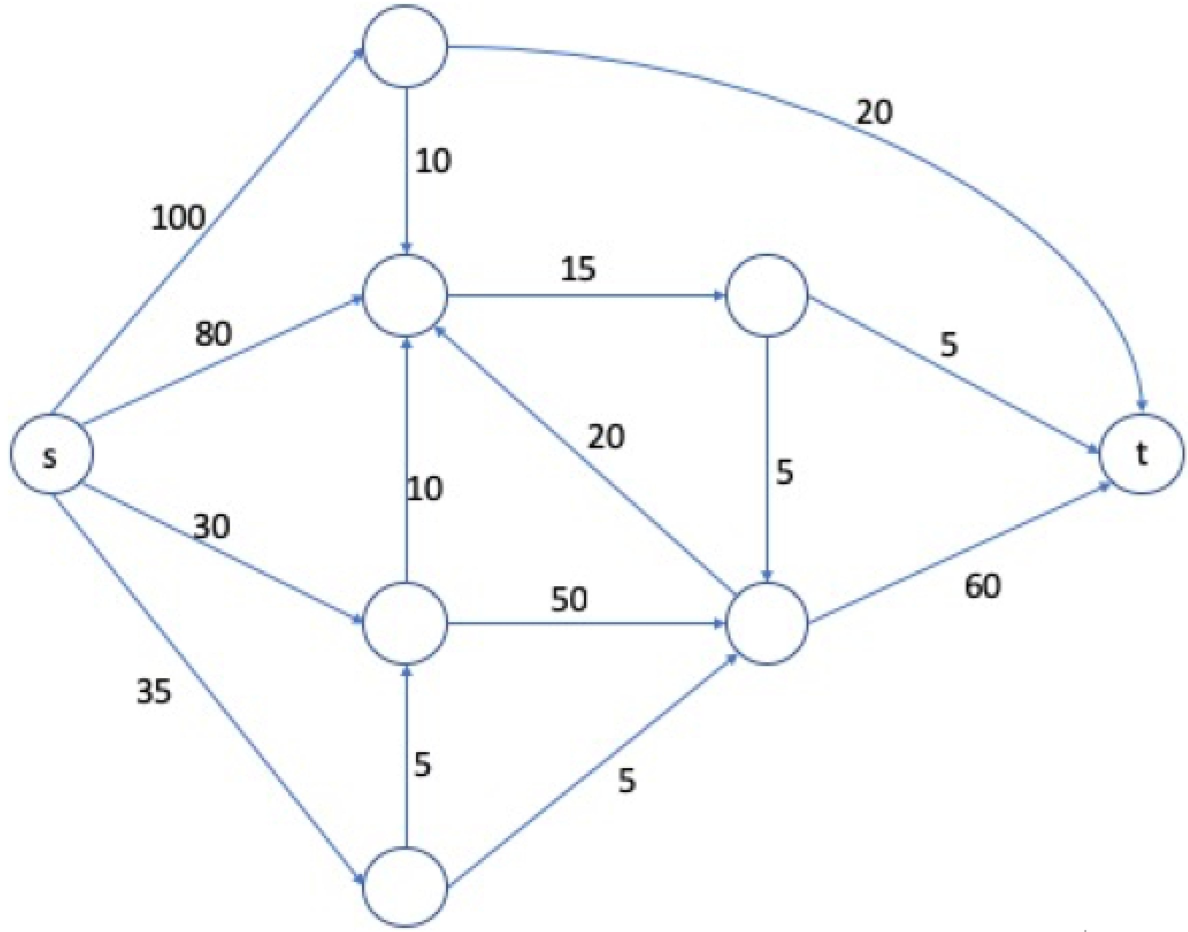
Correct!

False – This is only true if the capacities are some polynomial function of the number of nodes in the network.

Question 8

1 / 1 pts

The following directed graph is a network with source node *s* and sink node *t*. The edge weights represent *capacities* along each respective edge. Use the max flow-min cut theorem to determine the maximum possible flow of this network. Alternatively, you may apply the Ford-Fulkerson algorithm.



85

90

100

Correct!

70

Question 9

1 / 1 pts

The most efficient algorithm that currently exists to solve the max-flow problem is the Edmonds-Karp algorithm. This algorithm selects augmenting paths with the fewest number of edges. By which mechanism does Edmonds-Karp achieve this?

Correct!

- Breadth-First Search
- Bellman-Ford’s shortest path algorithm
- Dijkstra’s shortest path algorithm
- Depth-First Search

Question 10

1 / 1 pts

Which factor of the Capacity scaling algorithm ensures the number of while-loop iterations is logarithmic on the capacity?

- Δ is initialized to the power of two nearest to the capacity
- The Δ-residual graph at each iteration is smaller than the corresponding flow network
- There is a logarithmic number of bits required to represent the capacity

Correct!

- Δ is reduced by half after each iteration of the loop

Question 11

1 / 1 pts

Determine which of the following statements is true regarding the bipartite matching application of the network flows problem.

Correct!

- The capacity of the minimum cut is equal to the maximum cardinality of the bipartite matching

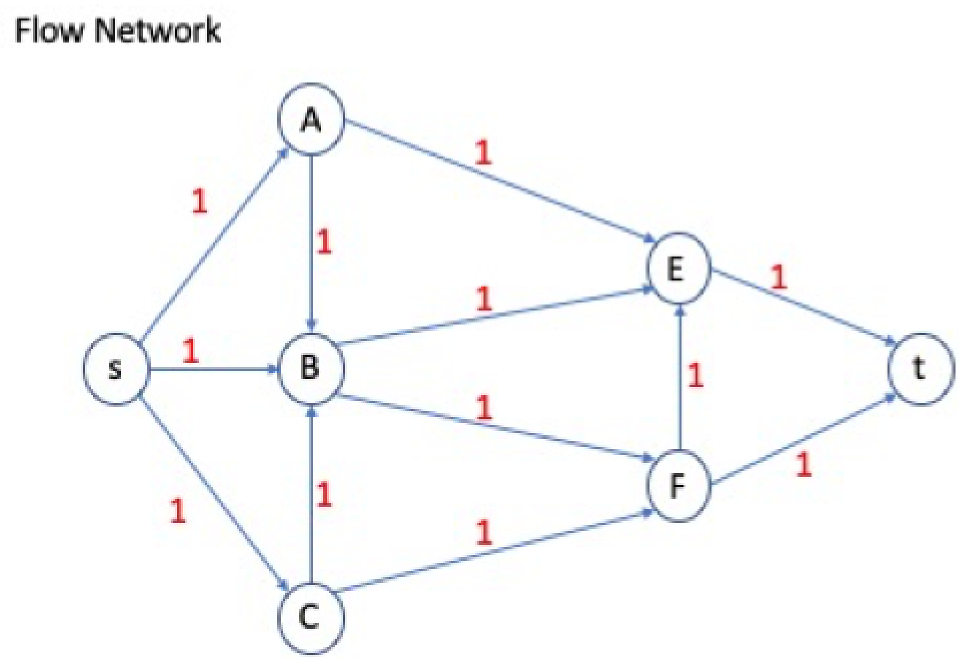
The number of edges between node sets L and R must be greater than the number of edges from source node s to each node in L.

The algorithm execution will fail to find a maximum cardinality bipartite matching if the capacity of each edge traversing node sets L and R is one.

Question 12

1 / 1 pts

Given the following flow network, use the max-flow/min-cut theorem to determine the number of edge-disjoint paths in the network. Note that the edge values represent *capacities*.



- 5
- 4
- Correct! 2
- 3

Question 13

1 / 1 pts

Given a flow network $G = (V, E)$ with flow assignment f, edge capacities c, and a corresponding residual network $G' = (V', E')$, which of the following describes the relationship between E and E'?

Correct!

- (selected) The capacity of an edge $e' \in E'$ is equal to $c(e) - f(e)$ for a corresponding $e \in E$.
- The capacity of an edge $e' \in E'$ is equal to $c(e) - f(e')$ for a corresponding $e \in E$.
- The capacity of an edge $e \in E$ is equal to $c(e) - f(e')$ for a corresponding $e' \in E'$.
- The capacity of an edge $e \in E$ is equal to $c(e') - f(e')$ for a corresponding $e' \in E'$.

Question 14

1 / 1 pts

Identify which of the following statements are true regarding any flow network G=(V,E). **Select all that apply.**

- [ ] G may not have a maximum flow.

The Ford-Fulkerson algorithm is guaranteed to run in polynomial time in the size of G when given G as an input.

Correct!

G has at least one minimum cut.

Correct!

G may have multiple minimum cuts.

Question 15

1 / 1 pts

Given a flow network $G = (V, E)$, edge capacities c, and a maximal flow assignment f, which of the following scenarios are possible? **Select all that apply.**

Correct!

For some cut $S, \overline{S}$ of G, the flow along an edge of $S, \overline{S}$ is strictly less than the capacity of that edge.

Correct!

$f(e) = c(e), \forall e \in E$

For a minimum cut $S, \overline{S}$ of G, the flow along an edge entering S is equal to the capacity of that edge.

For a minimum cut $S, \overline{S}$ of G the flow along an edge exiting S is strictly less than the capacity of that edge.

Quiz Score: **15** out of 15