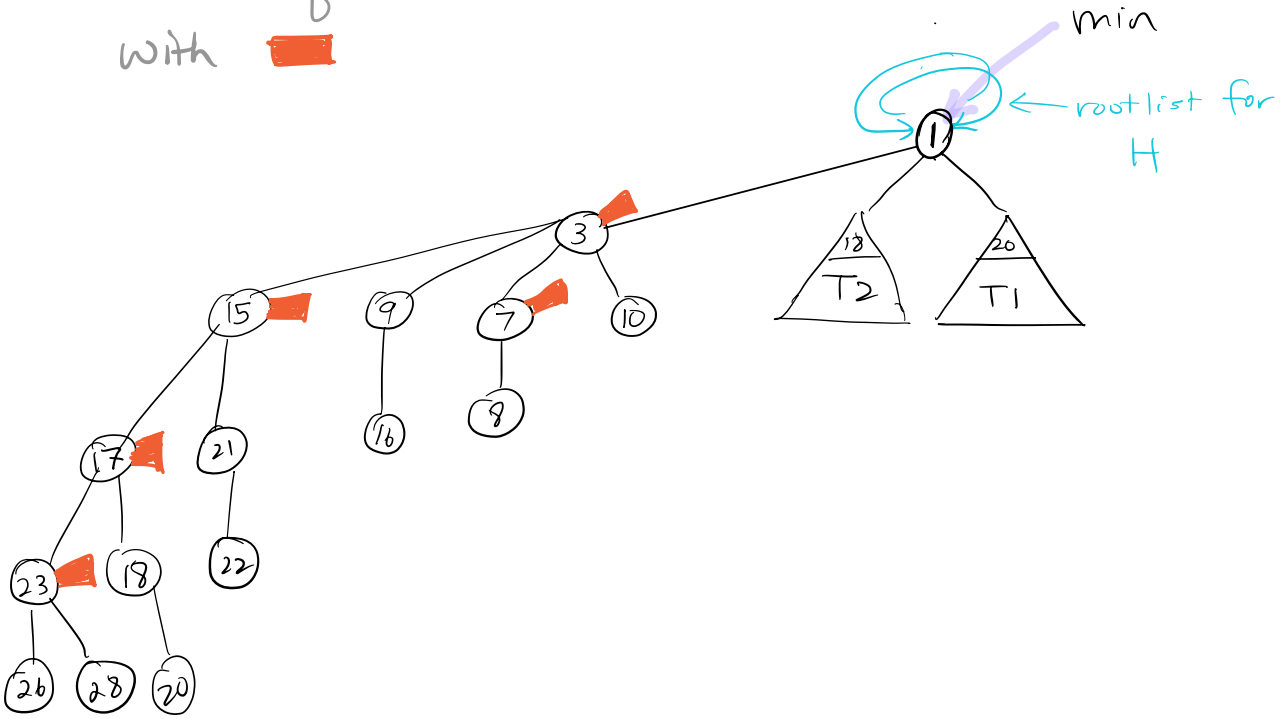
CSC1 429 Test 2 Name _____

Nov 27, 2023

1. (10 marks) Fib Heaps.

Show the result of the PrintHeap() operations in the sequence below. Marked nodes are indicated with [redacted]



Delete (22)

Print Heap()

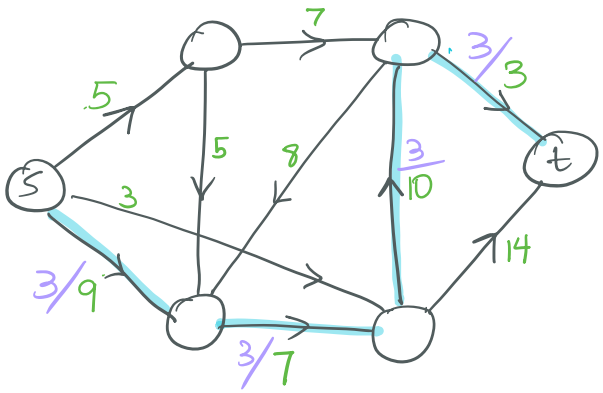
Delete (28)

Print Heap()

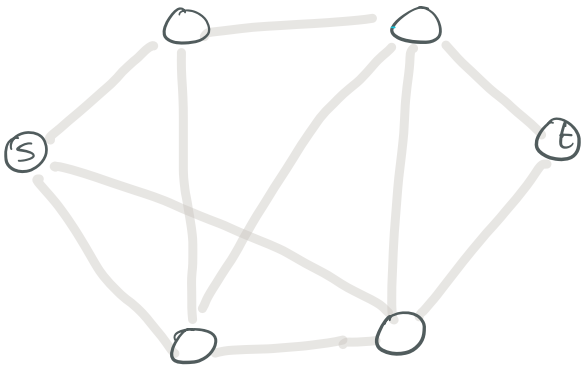
2. (10 marks) Use the Flow Augmenting path alg on the Network below. Show each flow and each residual network. Give the final, optimal flow and show a min cut.

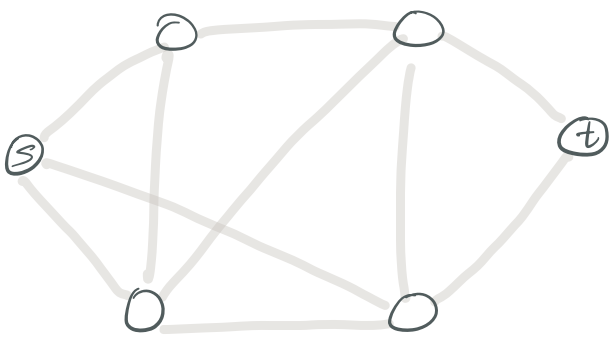
The first augmenting path is given, below.

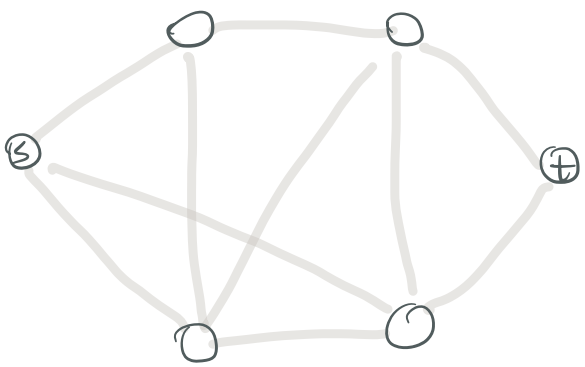
Flow

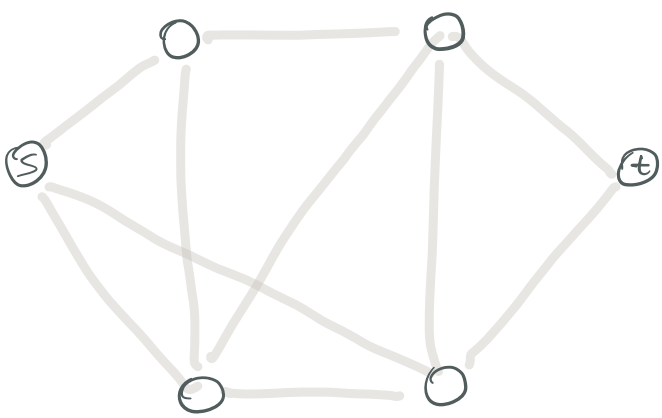


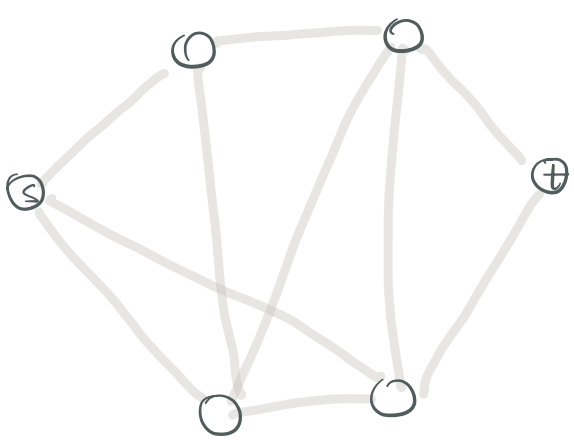
Residual



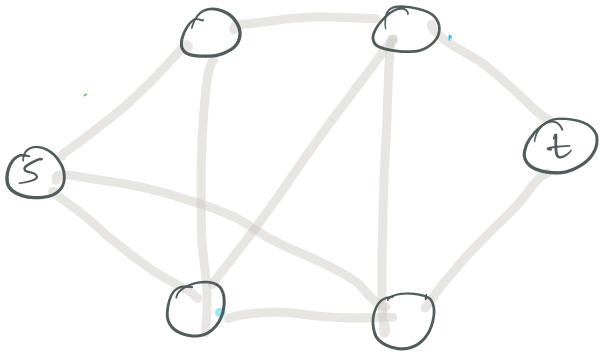




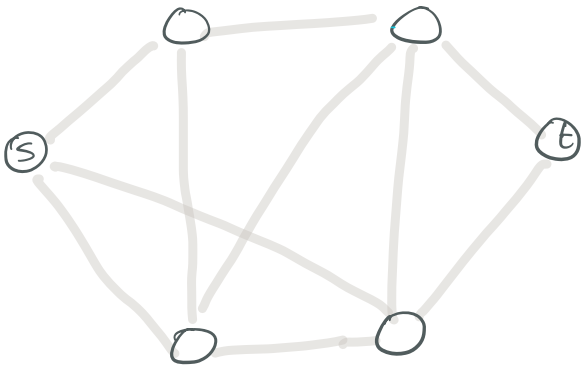


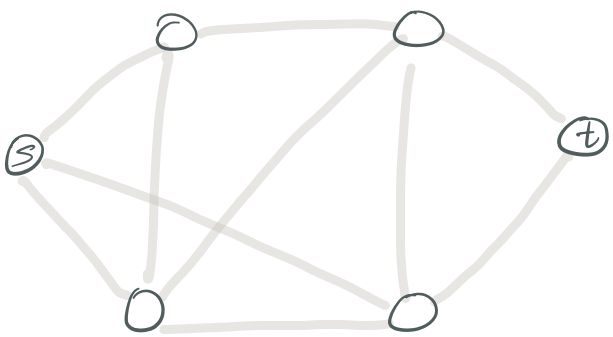


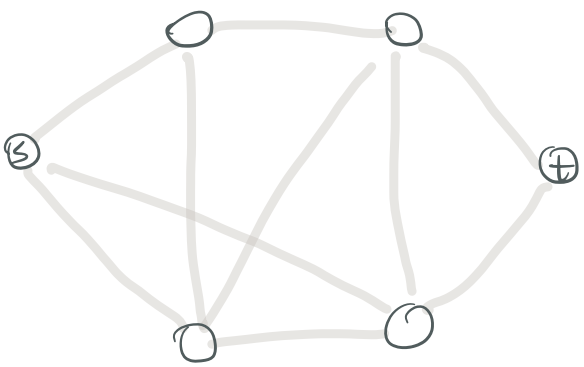
Flow

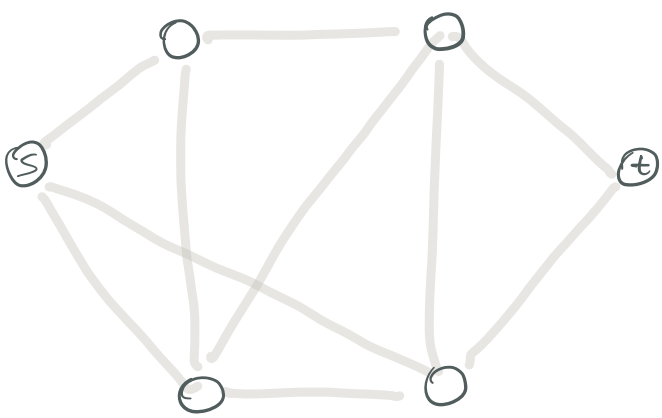


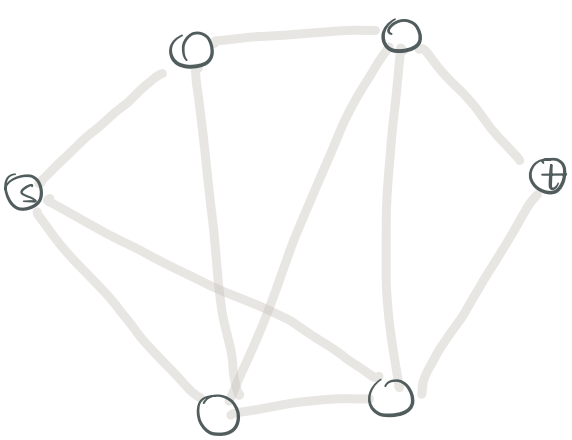
Residual











3. [10 marks] Use the Gale-Shapley algorithm to find a stable matching, given the preferences below:

A	B	C	D
w	w	z	y
y	y	w	z
z	x	x	w
x	z	y	x

w	x	y	z
D	B	B	B
C	C	C	A
B	B	A	D
A	A	D	C

Show each tentative match, and give the final matching. Note: Capital letters make offers to lower case letters. Only show the tentative & final matches - if an offer is declined right away, it does not show among the tentative matches.

4 [10 marks] Give a Dynamic Programming Solution to the Planet Hopping Problem

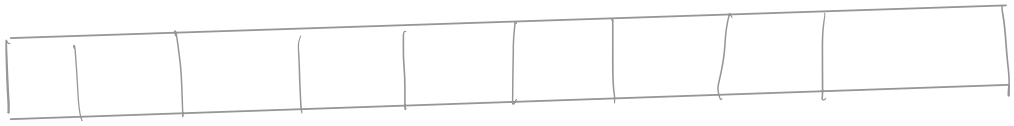
You are on Planet 1 and you want to travel home to Planet n, in the cheapest possible way. Each planet i has a launch fee $F(i)$, but also a limit $H(i)$ of the number of "hops" towards Planet n you can make: if $H(2) = 3$ then from planet 2 you can travel to planets 3, 4 or 5, each for the same price, $F(2)$.

Eg. (Start = 1, home = 8)

	1	2	3	4	5	6	7	8
$F	5	5	25	100	60	20	10	0
H	1	2	3	4	2	2	1	0

A possible way home is planets $1 \xrightarrow{\$5} 2 \xrightarrow{5} 3 \xrightarrow{25} 6 \xrightarrow{20} 8$.
$= \$55$

Come up with a Data Structure (hint: it looks like this:



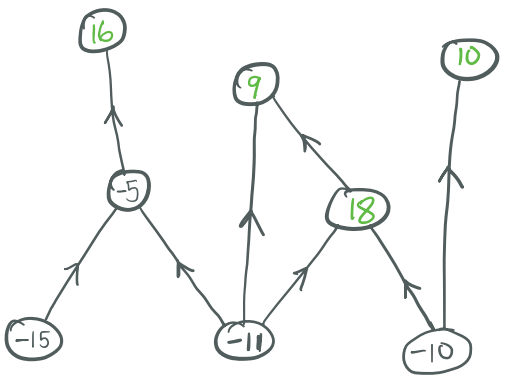
and say how you will fill it with values, and in the end how you can extract the best route to minimize cost. Show your results on the following input:

$F	10	20	5	25	5	100	10	10	0
H	4	2	1	4	1	2	2	2	0

5 [5 marks] Show how to construct a Network out of the following Project dependencies and values. Show the min cut, and tell what the corresponding set of feasible project is, and its value.

In my world, 

means "p must be done if q is to be done".



Show:

- the Network Flow network that models this problem.
- the maximum flow in the network (you do not have to show the steps to get a max flow), and its total value.
- the min cut in the network, and its total value.

— the projects that optimize profit
— the value of the profit