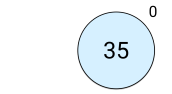
CIS3490 - A5

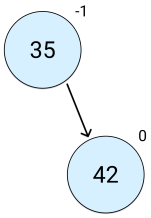
Name: Conor Roberts (#1056167)

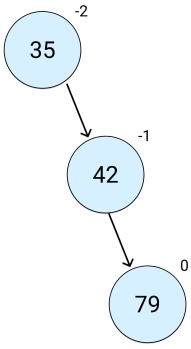
Date: April 4th, 2021

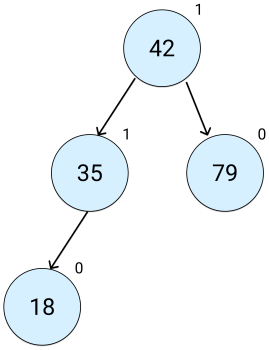
Question 1.1

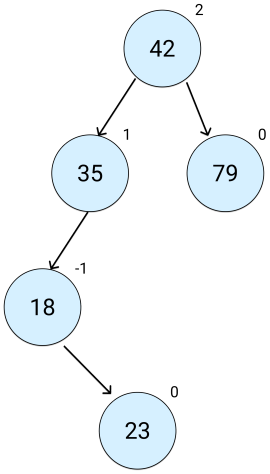
After Insertion

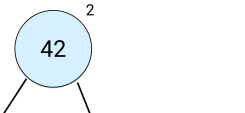




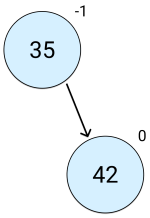


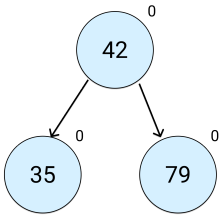


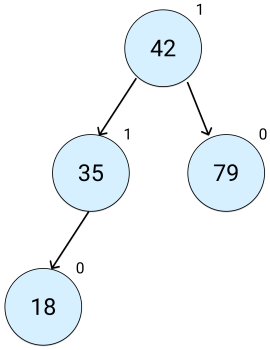


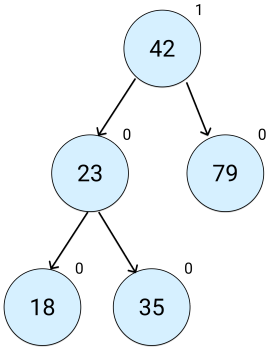


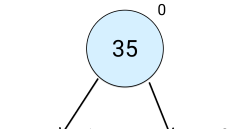
After Rotations

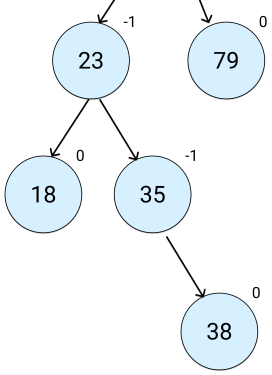


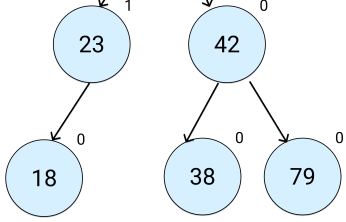












Question 1.2

Sort the array [23, 35, 42, 79, 18, 38] using heapsort

Heap Construction

This colour indicates two swapped elements

1. 23, 79, 42, 35, 18, 38
2. 79, 23, 42, 35, 18, 38
3. 79, 35, 42, 23, 18, 38

Constructed heap 79, 35, 42, 23, 18, 38

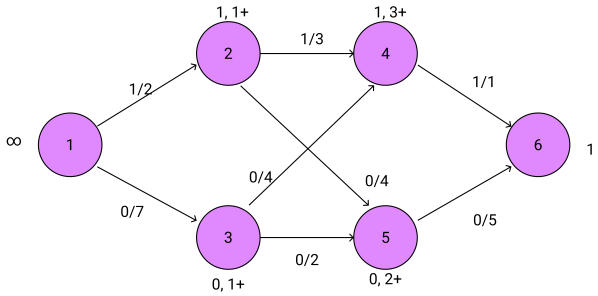
Heap Sorting

Initial	Process	Result
79, 35, 42, 23, 18, 38	Max removal	38, 35, 42, 23, 18, 79
38, 35, 42, 23, 18, 79	Downheap	42, 35, 38, 23, 18, 79
42, 35, 38, 23, 18, 79	Max removal	18, 35, 38, 23, 42, 79
18, 35, 38, 23, 42, 79	Downheap	38, 35, 18, 23, 42, 79
38, 35, 18, 23, 42, 79	Max removal	23, 35, 18, 38, 42, 79
23, 35, 18, 38, 42, 79	Downheap	35, 23, 18, 38, 42, 79
35, 23, 18, 38, 42, 79	Max removal	18, 23, 35, 38, 42, 79

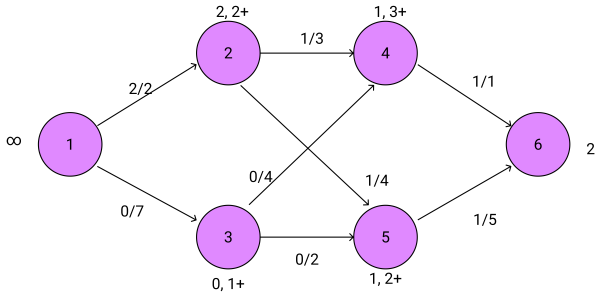
Sorted heap 18, 23, 35, 38, 42, 79

Question 2.1

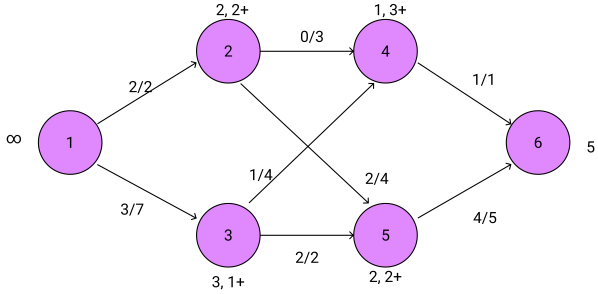
Max Flow: 1



Max Flow: 2



Max Flow: 5



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Question 2.2

Legend

Current ☐ Married ■ Freed ■

2. β proposes to A. A rejects.

1. α proposes to A. A accepts unconditionally.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

3. β proposes to D. D accepts unconditionally.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

4. γ proposes to B. B accepts unconditionally.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

5. δ proposes to D. D rejects.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

6. δ proposes to B. B accepts and leaves γ free.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

7. γ proposes to A. A accepts and leaves α free.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

8. α proposes to B. B rejects.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

9. α proposes to C. C accepts unconditionally.

(x,y)	A	B	C	D
α	1,3	2,3	3,2	4,3
β	1,4	4,1	3,4	2,2
γ	2,2	1,4	3,3	4,1
δ	4,1	2,2	3,1	1,4

Result: [{α, C}, {β, D}, {γ, A}, {δ ,B}]

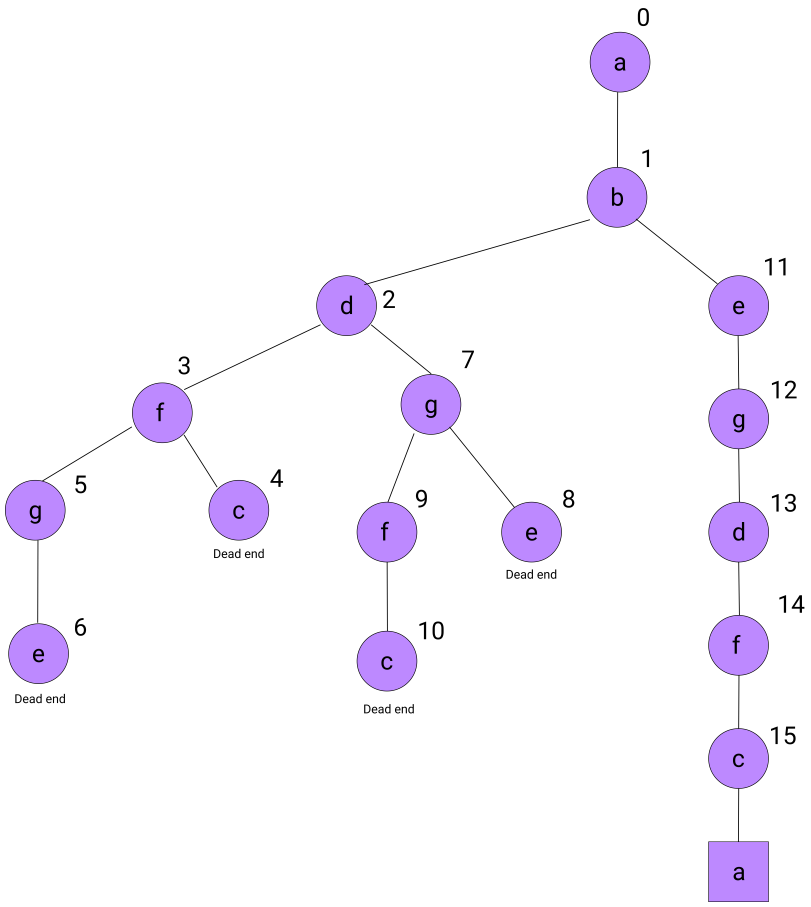
Question 3.1

1. C
2. C
3. B
4. C
5. C

Question 2.2

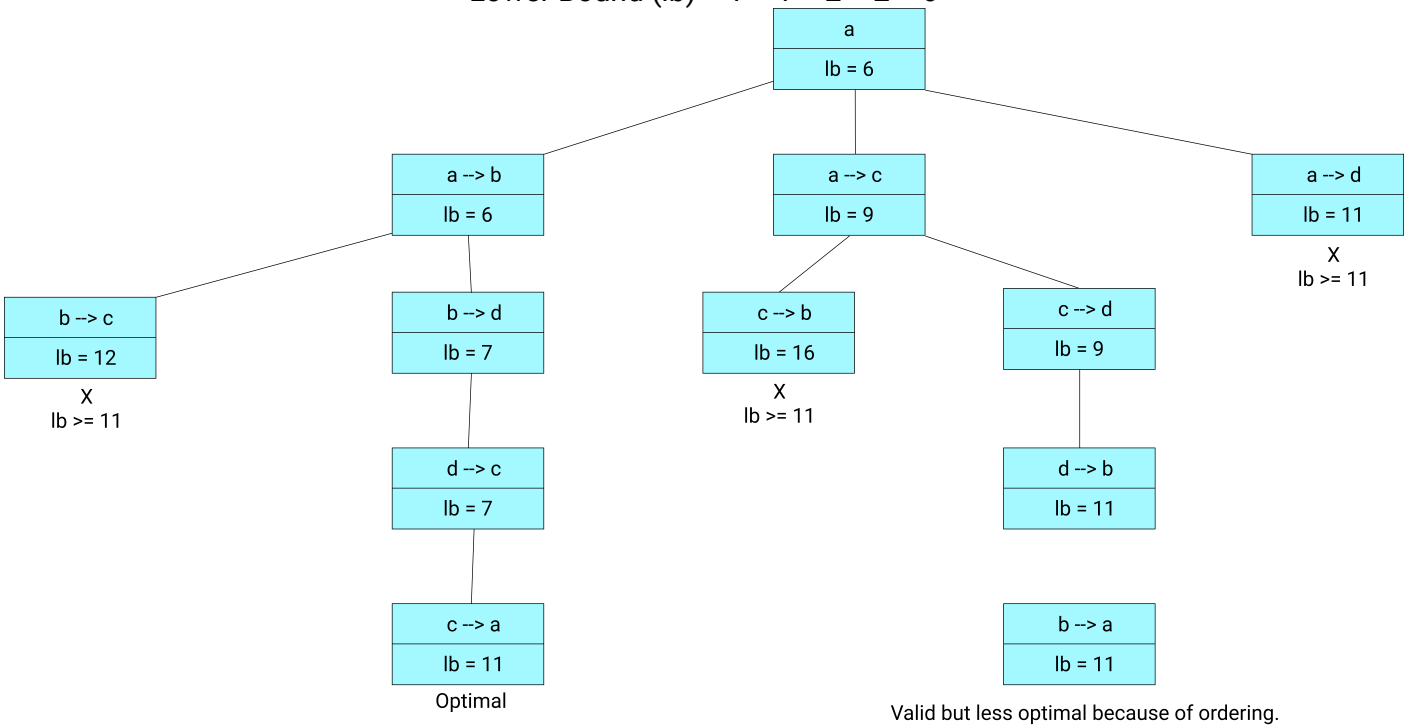
A. This is not possible because P!=NP and P!=NPC
B. This is not possible because there are NP problems that are neither P nor NPC
C. This is not possible because no problem is both P and NPC
D. This is possible because all P and NPC problems are withi NP and ther exist problems that are neither P nor NPC (as stated in B)

Question 4.1



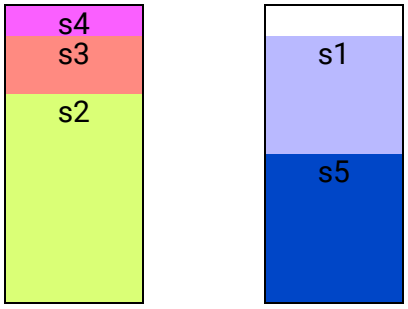
Question 4.2

Optimal Bound = ⌈[(2+5)+(2+3)+(5+1)+(3+1)]/2⌉ = 11
Lower Bound (lb) = 1 + 1 + 2 + 2 = 6



Question 5.1

Starting order [s_2, s_5,s_1,s_3,s_4]



Optimal = ⌈ 1.9/1 ⌉ = 2

This solution is optimal because it does not exceed the number of bins in that of an optimal case.

Question 5.2

Item	Weight	Value	Value/Weight
1	7	$42	6
2	3	$12	4
3	4	$40	10
4	5	$25	5

Sorted Ratios

10 (3), 6 (1), 5 (4), 4 (2)

Subsets (k=2)

∅, {1}, {2}, {3}, {1,2}, {1,3}, {1,4}, {2,3}, {2,4}, {3,4}

Subset	Added Items	Value
ø	3,1	$82
{1}	3	$82
{2}	3	$52
{3}	1	$82
{4}	3	$65
{1,2}		$54
{1,3}		$82
{1,4}	Impossible	
{2,3}		$52
{2,4}		$37
{3,4}	2	$65

Optimal

{1,3}, weight: 11, value: $82