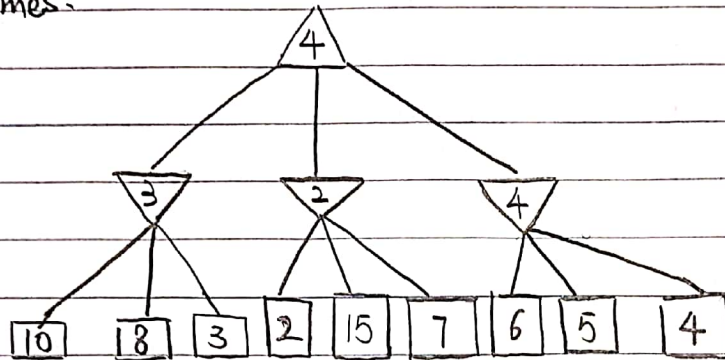CS 3346. Assignment 2
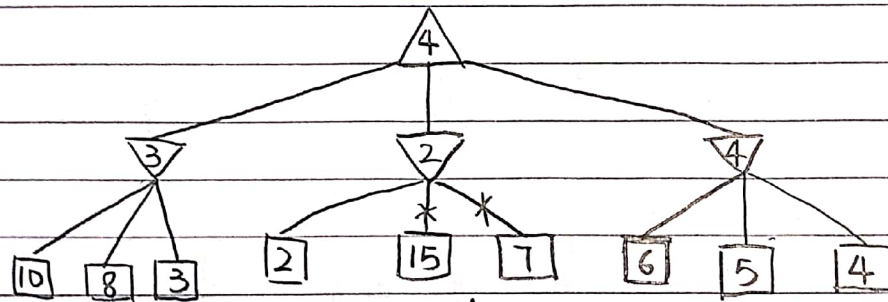
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Student #: 25097676

Q1 Games:

1.

2.

nodes 15, 7 can be pruned from the game tree above through alpha-beta pruning.

3.

$(10+8+3)/3$ $(2+15+7)/3$ $(6+5+4)/3$

$= 7$ $= 8$ $= 5$
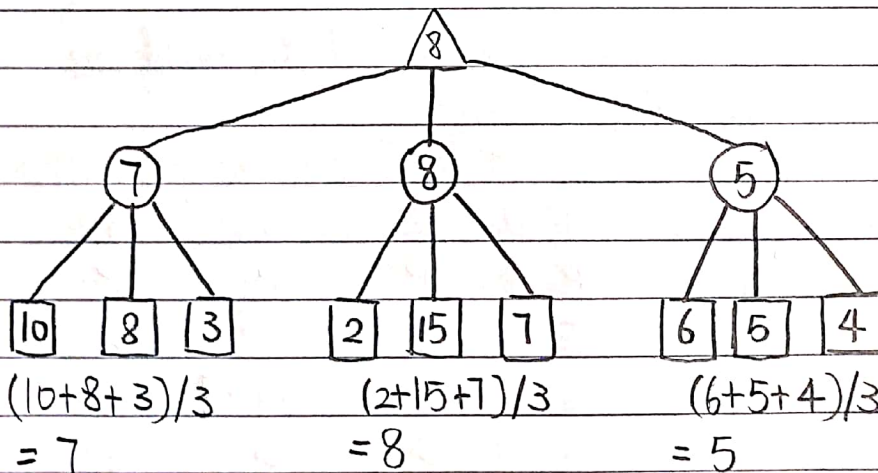
4. No nodes can be pruned, because there is no concept of "optimal play" by adversary, it is just unknown, and no matter we what we have seen so far, the content of unexplored children could change expectimax value remarkably.

Q2 CSPs: Trapped Pacman

1. Variables(X_i)   Domains (or unary constraints)

Variables(X_i)	Domains (or unary constraints)
X_1	$\{P\}$
X_2	$\{G, E\}$
X_3	$\{G, E\}$
X_4	$\{G, E\}$
X_5	$\{P\}$
X_6	$\{P, G, E\}$

Binary Constraints:
$$X_2 \neq X_3$$
$$X_3 \neq X_4$$

2.

X_1	P	Ⓖ	Ⓔ
X_2	Ⓟ	G	E
X_3	Ⓟ	G	E
X_4	Ⓟ	G	E
X_5	P	Ⓖ	Ⓔ
X_6	P	G	E

3. According to MRV, X_1 and X_5 could be the first variables that the solver assign.

4.

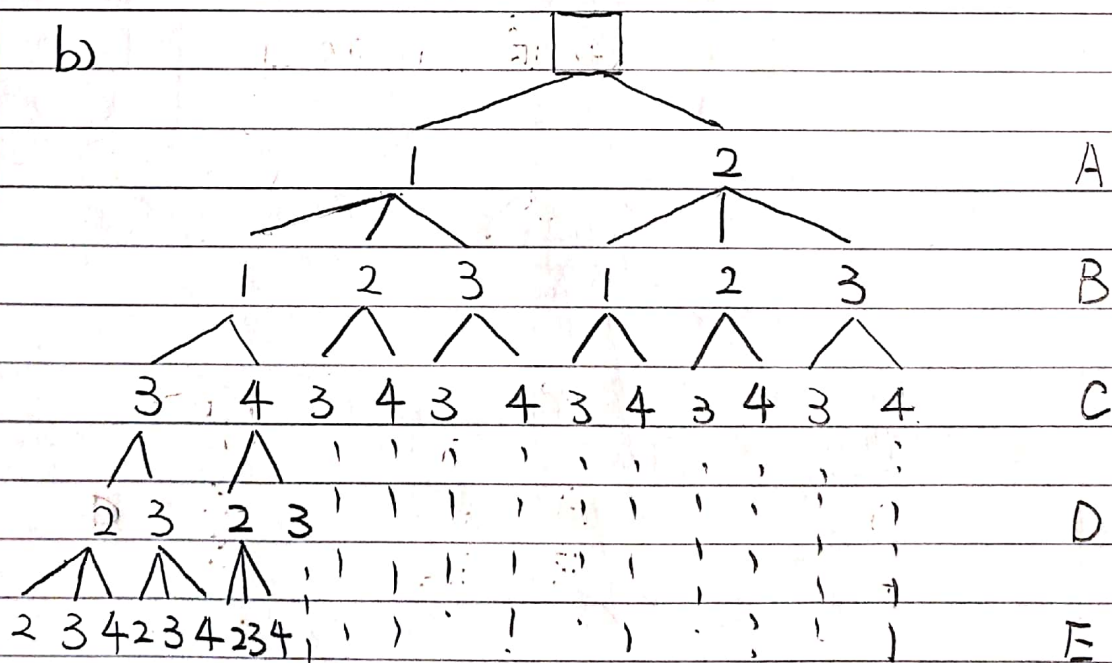| Solution #	1	2	3	4	5
X_1	P	P	P	P	P
X_2	E	G	G	G	E
X_3	G	E	G	G	G
X_4	E	G	G	E	G
X_5	P	P	P	P	P
X_6	G	G	G	G	G

Q3 CSPs:

a)
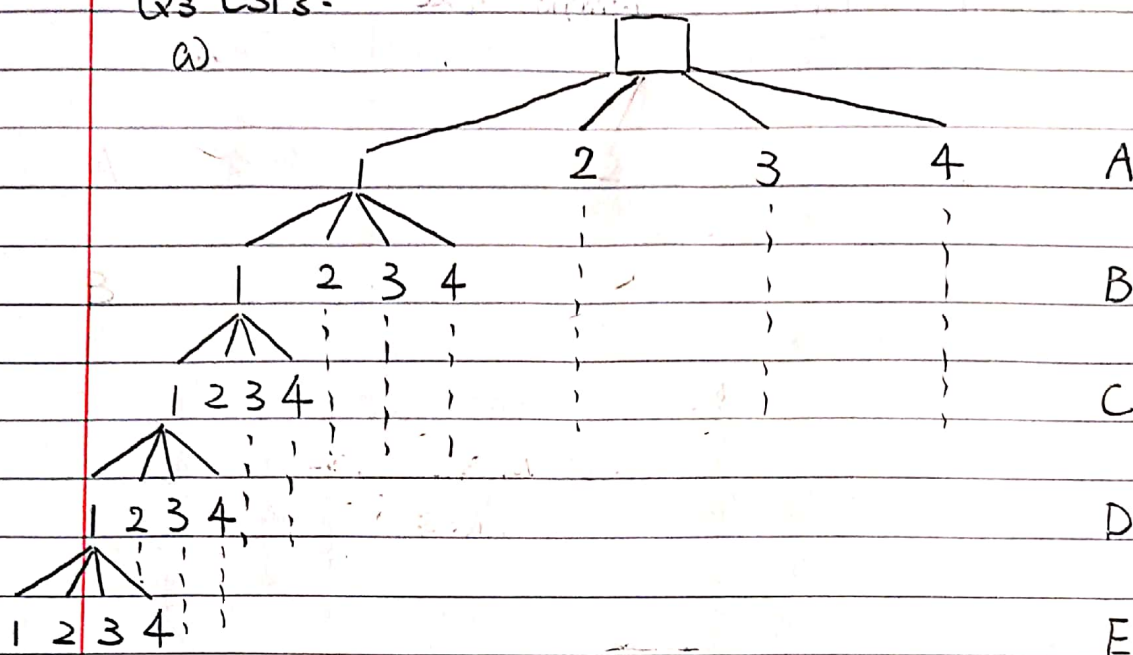
$$4 \times 4 \times 4 \times 4 \times 4 = 4^5 = 1024$$

∴ there are 1024 leaf nodes in the Generate and Test tree for the original problem.

b)

$$2 \times 3 \times 2 \times 2 \times 3 = 72$$

∴ there are 72 leaf nodes in the Generate and Test tree for the arc consistent problem

c) Eliminating D:

$r_1: A \leq D$	A	D
	1	2
	1	3
	2	3

$r_2: E \neq D$	E	D
	2	3
	3	2
	4	2
	4	3

$r_4(E,D)$	D	E
	2	2
	2	3
	2	4
	3	2
	3	3

$r_5: r_4 \bowtie r_2$	D	E
	3	2
	2	3
	2	4

$r_6: r_1 \bowtie r_5$	A	D	E
	1	2	3
	1	2	4
	1	3	2
	2	3	2

$r_7: \pi_{\{A,E\}} r_6$	A	E
	1	3
	1	4
	1	2
	2	2

A
{1,2}

A≠B

B
{1,2,3}

E-A is odd

$r_7(A,E)$

B<E

{2,3,4}

E
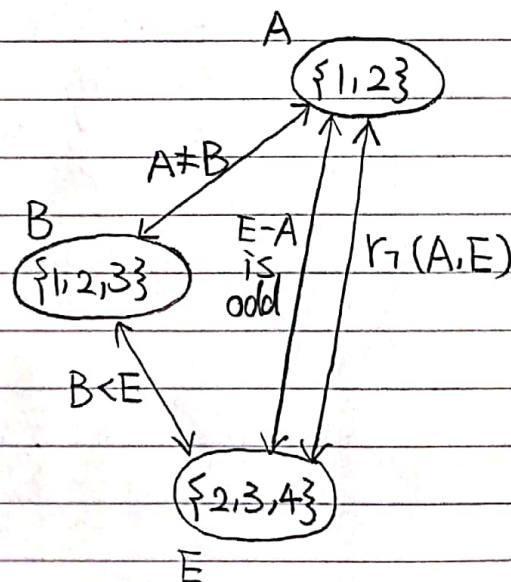
Eliminating E:

$r_1: B<E$	B	E
	1	2
	1	3
	1	4
	2	3
	2	4
	3	4

$r_2: E-A$ is odd	A	E
	1	2
	1	4
	2	3

$r_7 (A, E)$	A	E
	1	3
	1	4
	1	2
	2	2

$r_3: r_2 \bowtie r_7$	A	E
	1	4
	1	2

$r_4: r_1 \bowtie r_3$	A	B	E
	1	1	2
	1	1	4
	1	2	4
	1	3	4

$r_5: \pi\{A, B\} r_4$	A	B
	1	1
	1	2
	1	3
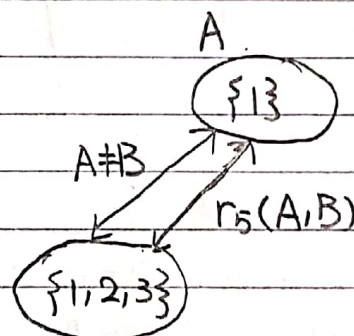
Eliminating B:

$r_1: A \neq B$	A	B
	1	2
	1	3

$r_5 (A, B)$	A	B
	1	1
	1	2
	1	3

$r_2: r_1 \bowtie r_5$	A	B
	1	2
	1	3

$r_3: \pi\{A\} r_2$	A
	1

d)

A tree diagram (backtracking search tree):

Level λ (root)

A: 1, 2

B: under A=1: 1 (×, A≠B), 2, 3; under A=2: 1, 2 (×, A≠B), 3

D: 2, 3 (and branches with × A<D)

E: 2, 3, 4 (with constraints ×, B<E, E−A is odd, B≠E, E≠D)

C: 3, 4, 3, 4, 3, 4, 3, 4 (with constraints ✓, E≠C, D<C, E≠C, ✓, E≠C, D<C, E≠C)

Solution 1: A=1, B=2, C=3, D=2, E=4

Solution 2: A=1, B=3, C=3, D=2, E=4