ANSWERS

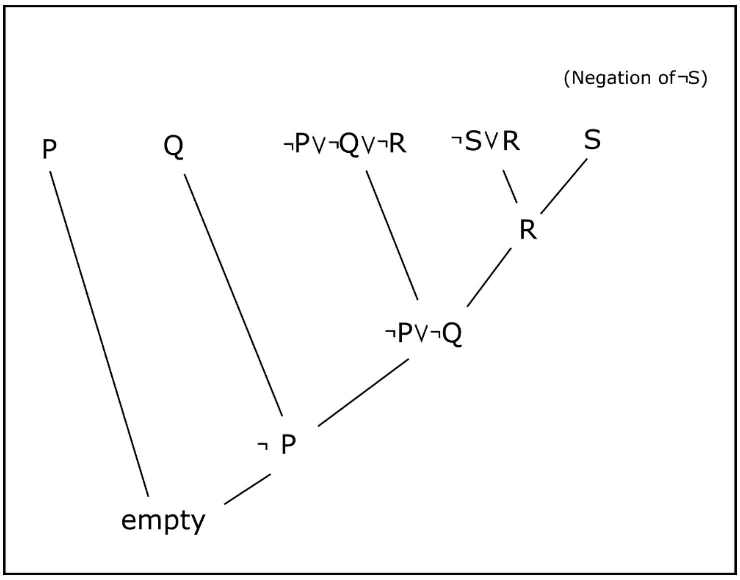
PROBLEM 1 – LOGIC

a)

1. $P \wedge Q$ given (premise)
2. P (from 1, decomposing a conjunction)
3. Q (from 1)
4. $P \rightarrow \neg(Q \wedge R)$ given
5. $\neg(Q \wedge R)$ (from 2,4)
6. $\neg Q \vee \neg R$ (from 5)
7. $\neg R$ (from 3,6)
8. $S \rightarrow R$ given
9. $\neg S$ (from 7,8)

b) Draw the truth table and see there is one row where 1,2, and 3 is true and $\neg$ S is also true there.

c)



d) First, we need to convert the definition of Green into CNF.

- $\forall x : Green(x) \leftrightarrow Bikes(x) \vee [\exists y : Drives(x, y) \wedge Electric(y)]$

  Break the double-implication into 2 conjoined implications

- $\forall x : [Green(x) \rightarrow Bikes(x) \vee [\exists y : Drives(x, y) \wedge Electric(y)]] \wedge$

  $[[Bikes(x) \vee [\exists y : Drives(x, y) \wedge Electric(y)]] \rightarrow Green(x)]$

  Convert implications to disjunctions

- $\forall x : [\neg Green(x) \vee Bikes(x) \vee [\exists y \; Drives(x, y) \wedge Electric(y)]] \wedge$

  $\neg[Bikes(x) \vee [\exists y \; Drives(x, y) \wedge Electric(y)] \vee Green(x)$

  Move negations inward

- $\forall x : [\neg Green(x) \vee Bikes(x) \vee [\exists y : Drives(x, y) \wedge Electric(y)]] \wedge$

  $\neg Bikes(x) \wedge \neg[\exists y \; Drives(x, y) \wedge Electric(y)] \vee Green(x)$

  Continue moving negations inward

- $\forall x : [\neg Green(x) \vee Bikes(x) \vee [\exists y \; Drives(x, y) \wedge Electric(y)]] \wedge$

  $\neg Bikes(x) \wedge [\forall y \; \neg Drives(x, y) \vee \neg Electric(y)] \vee Green(x)$

  Skolemizing produces an F(x) in place of the existential-quantified y:

- $\forall x : [\neg Green(x) \vee Bikes(x) \vee [Drives(x, F(x)) \wedge Electric(F(x))]] \wedge$
  $\neg Bikes(x) \wedge [\forall y : \neg Drives(x, y) \vee \neg Electric(y)] \vee Green(x)$

  Remove the universal quantifications, since all remaining variables are universally quantified.

- $[\neg Green(x) \vee Bikes(x) \vee [Drives(x,F(x)) \wedge Electric(F(x))]] \wedge$

  $\neg Bikes(x) \wedge [\neg Drives(x, y) \vee \neg Electric(y)] \vee Green(x)$

  Distribute the disjunction in the first half

- $[\neg Green(x) \vee Bikes(x) \vee Drives(x,F(x))] \wedge$
  $[\neg Green(x) \vee Bikes(x) \vee Electric(F (x))] \wedge$
  $\neg Bikes(x) \wedge [\neg Drives(x, y) \vee \neg Electric(y)] \vee Green(x)$

  Distribute the disjunction in the second half to produce a conjunction of 4 disjuncts (CNF).

- [¬Green(x) ∨ Bikes(x) ∨Drives(x,F(x))] ∧

  [¬Green(x) ∨ Bikes(x) ∨ Electric(F (x))] ∧

  [Green(x) ∨ ¬Bikes(x)] ∧
  [¬Drives(x, y) ∨ ¬Electric(y) ∨ Green(x)]

  Next, combine these 4 clauses with the other givens and add in the negation of the goal sentence: Green(Sophie). Then keep applying the resolution rule until θ = False is derived, indicating the contradiction.

  1. ¬Green(x) ∨Bikes(x) ∨Drives(x,F(x)) Given
  2. ¬Green(x) ∨Bikes(x) ∨Electric(F(x))] Given
  3. Green(x) ∨ ¬Bikes(x)] Given
  4. ¬Drives(x, y) ∨ ¬Electric(y) ∨Green(x) Given

  5. Electric(Tesla) Given

  6. Drives(Sophie,Tesla) Given
  7. ¬Green(Sophie) (Assuming negation of target sentence)
  8. ¬Drives(x, Tesla) ∨ Green(x) (Resolving 4 and 5 with θ = {y/Tesla})

  9. Green(Sophie) (Resolving 6 and 8 with θ = {x/Sophie})

  10. (Resolving 7 and 9 with θ = {})

  Notice that only 1 of the 4 clauses derived from the definition of Green was used to prove the target sentence.

PROBLEM 2 --INFORMED AND UNINFORMED SEARCH

a) Uniform cost:

Expanded nodes: A B C D E G2

Solution path: S D C G2

Path cost: 13. Optimal path. Uniform cost search is optimal when there are no negative path costs.

b) Breadth first:
Expanded: S A G1. (goal check is when childs are generated)

S. Path: S A G1

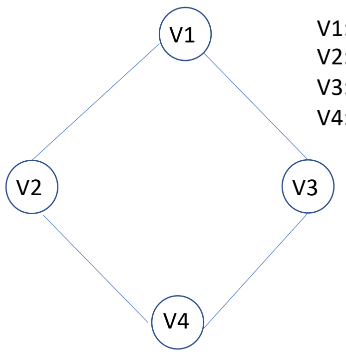
Path cost: 14. Not optimal. BFS is cost optimal only when the steps costs are identical

c) Depth first
Expanded nodes: S A B C F D E G3
Solution cost: 27

d) A*
Expanded nodes: S A B D C E G2
Solution path: S D C G2
Path cost: 13. Optimal.

PROBLEM 3 ---CSP CROSS WORD PUZZLE

a)



V1: 1-across
V2: 2-down
V3: 3-down
V4: 4-accross

b) C1: V1 has 5 letters

C2: V2 has 3 letters

C3: V3 has 3 letters

C4: V4 has 4 letters

C5: 3rd letter of V1 is the same letter as the first letter of V2

C6: 5th letter of V1 is the same letter as the first letter of V3

C7: 2nd letter of V4 is the same letter as 3rd letter of V2

….

….

…

c) Domains, according to node consistency:

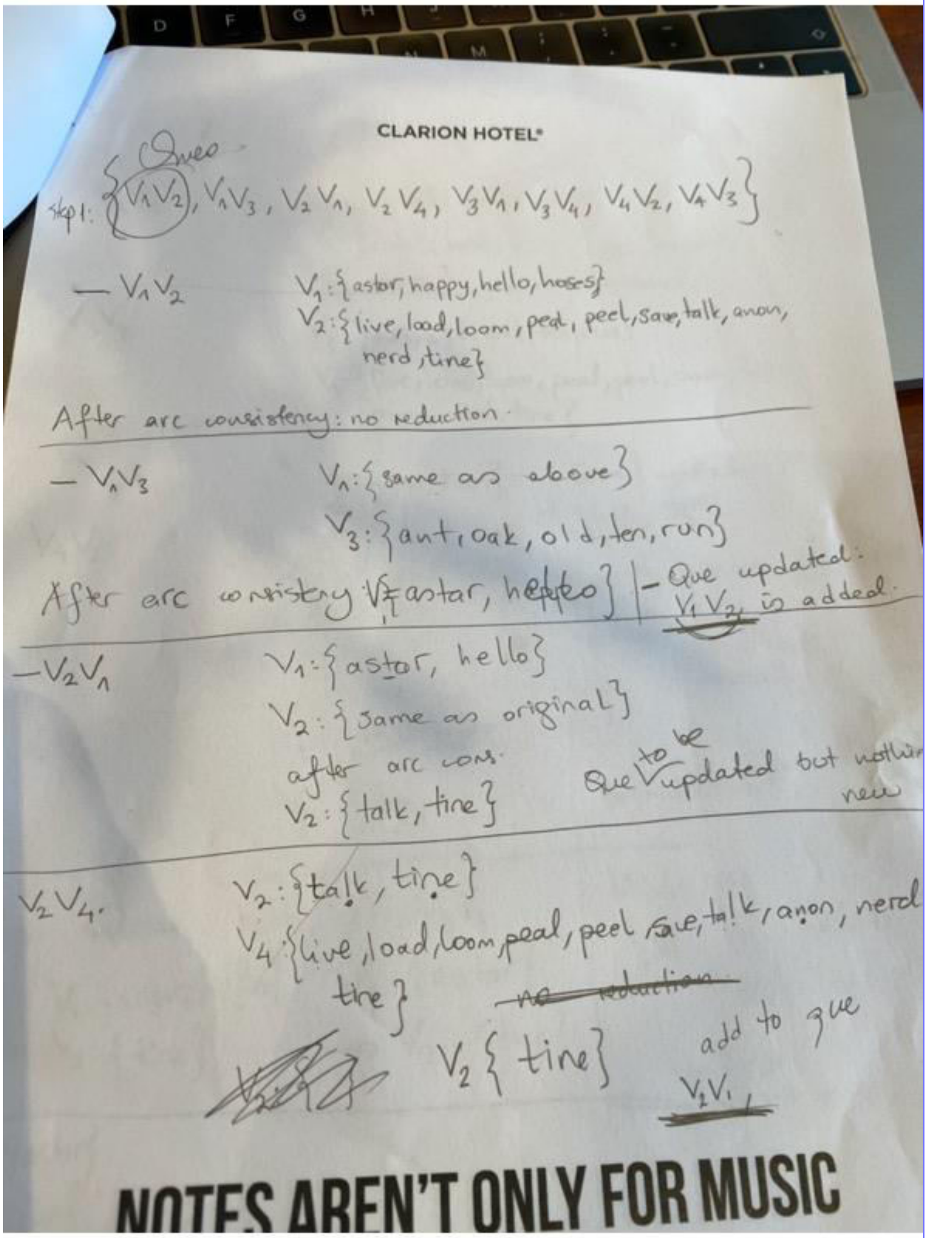
V1 ----Domain1={ astar, happy, hello, hoses}

V2 ----Domain2={ live, load, loam, peal, peel, save, talk, anon, nerd, tine }

V3 ----Domain3={ ant, oak, old, run, ten}

V2 ----Domain2={ live, load, loam, peal, peel, save, talk, anon, nerd, tine}

d)



CLARION HOTEL®

Queue

step 1: $\{V_1V_2, V_1V_3, V_2V_1, V_2V_4, V_3V_1, V_3V_4, V_4V_2, V_4V_3\}$

— V_1V_2 V_1: {astor, happy, hello, hoses}
V_2: {live, load, loom, peal, peel, save, talk, anon, nerd, tine}

After arc consistency: no reduction.

— V_1V_3 V_1: {same as above}
V_3: {ant, oak, old, ten, run}

After arc consistency V_1 {astar, hello} | – Que updated: ~~V_1V_2~~ is added.

—V_2V_1 V_1: {astor, hello}
V_2: {same as original}
after arc cons.
V_2: {talk, tine} Que to be updated but nothing new

V_2V_4. V_2: {talk, tine}
V_4 {live, load, loom, peal, peel, save, talk, anon, nerd, tine} ~~no reduction~~

V_2 {tine} add to que ~~V_2V_1~~

NOTES AREN'T ONLY FOR MUSIC

Kommentar [j1]: I think these two seem fine as is

Kommentar [j2]:

V_3V_1

V_3: {ant, old, oak, ten, run}
V_1: {astar, hello} no reduction

V_3V_4

V_3: {~~ant~~, ~~old~~, ~~oak~~, ten, run}
V_4: {live, load, loom, peal, peel, save, talk, anon, nerd, tine}

V_3: {ten, run} Que update:
+ V_3V_1, ~~[illegible]~~

V_4V_2:

V_4: {~~live~~, ~~load~~, ~~loom~~, ~~peal~~, ~~peel~~, ~~save~~, ~~talk~~, anon, nerd
V_2: {~~tine~~}
{tine} Que updated. V_4V_3 but already in the qu

V_4V_3.

V_4: {~~tine~~ ~~nerd~~ anon}
V_3: {ten, run} no reduction

Now Queue: V_1V_2, V_2V_1, V_3V_1

V_1V_2: V_1: {astar, hello} V_1: {astar}
V_2: {tine} $\rightarrow$ V_2 = {tine}

V_2V_1: ok.
V_3V_1: V_3: {~~ten~~, run}
V_1: {astar}
V_3: {run}

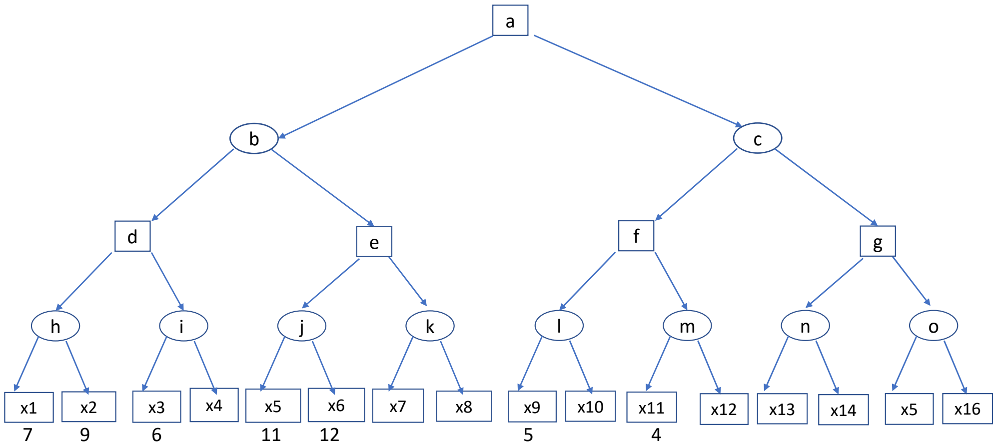
Solution:
V_1: {astar}
V_2: {tine}
V_3: {run}
V_4: {anon}

e) Finds the solution below:

A	S	T	A	R
		I		U
	A	N	O	N
		E		

PROBLEM 4 ---- ADVERSARIAL SEARCH

a) H=7,i<=6, d=7, j=11, e>=11, b= 7, c<=5, f<=5, l <=5, m<=4. solution=7
b) x4, k, x10, x12, and g are pruned



PROBLEM 5--- GAME THEORY

a) N={A1, A2}, Domains of A1=A2 ={0,10,20,30,40,50}, and the payoff fns are are specified by the following matrix

A1, Agent2	0	10	20	30	40	50
0	40, 0	0, 30	0, 30	0, 30	0, 30	0, 30
10	40, 0	30, 0	0,20	0, 20	0, 20	0, 20
20	40, 0	30, 0	20, 0	0, 10	0, 10	0, 10
30	40, 0	30, 0	20, 0	10, 0	0, 0	0, 0
40	40, 0	30, 0	20, 0	10, 0	0, 0	0, -10
50	40, 0	30, 0	20, 0	10, 0	0, 0	-10 , 0

b) There is no weakly dominant strategy eq. as neither player has a weakly dominant action. Notice that for both players, actions 30 and 40 weakly dominate every other action. But not wach other.

c) D) There is no strictly dominated action for either player and and hence all the action profiles survive IESD actions

d) We can eliminate the weakly dominated actions in the following order:
A:0
A2:0
A1: 50
A2: 50
A1:10
A2: 10
A1: 20

Which leads to the following set of outcomes {30,40} x {20,30,40}. However, tehre are other orders of elimination which lead to different outcomes.

e) The game is not dominance solvable.