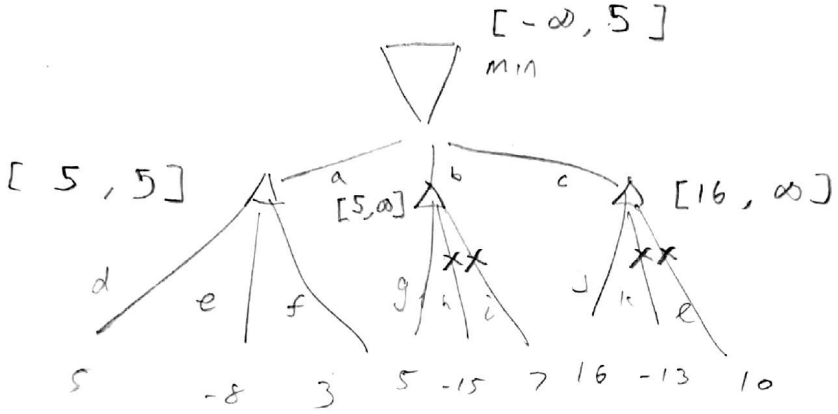
Question 1: Game Tree Search

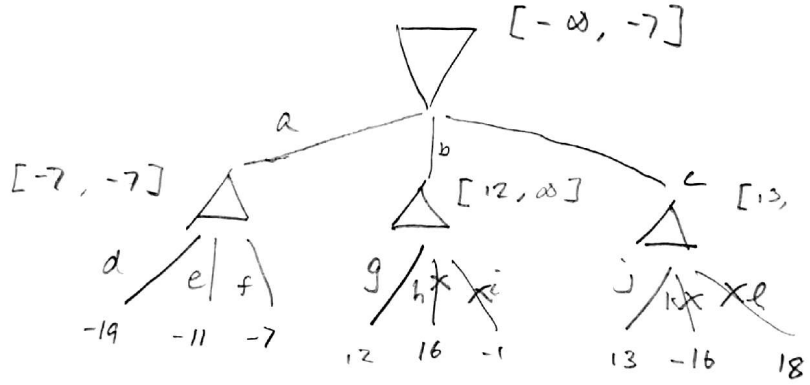
i)



h, i, k, ℓ are pruned

Final value of min is 5

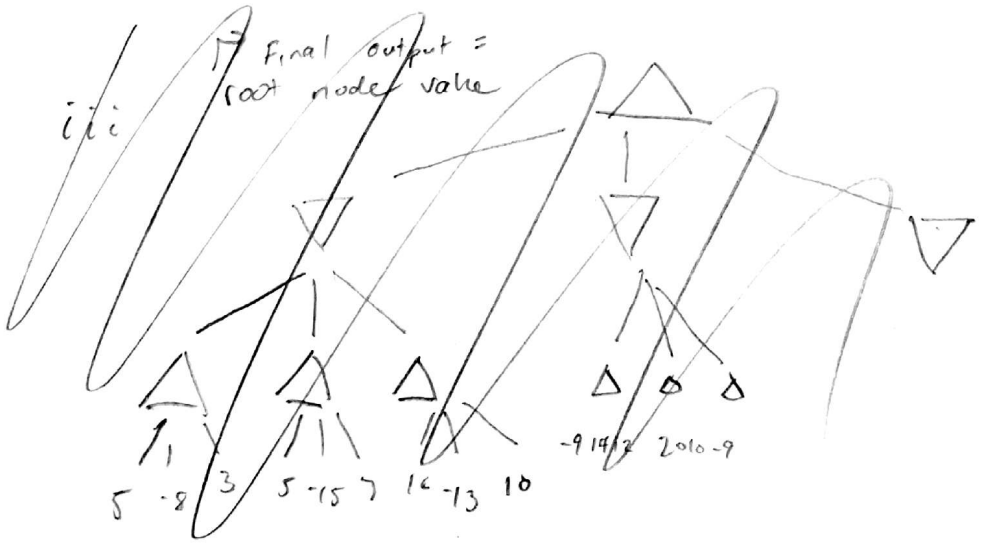
ii



~~h, i, k, ℓ are pruned~~ b, c are pruned. See (iii)

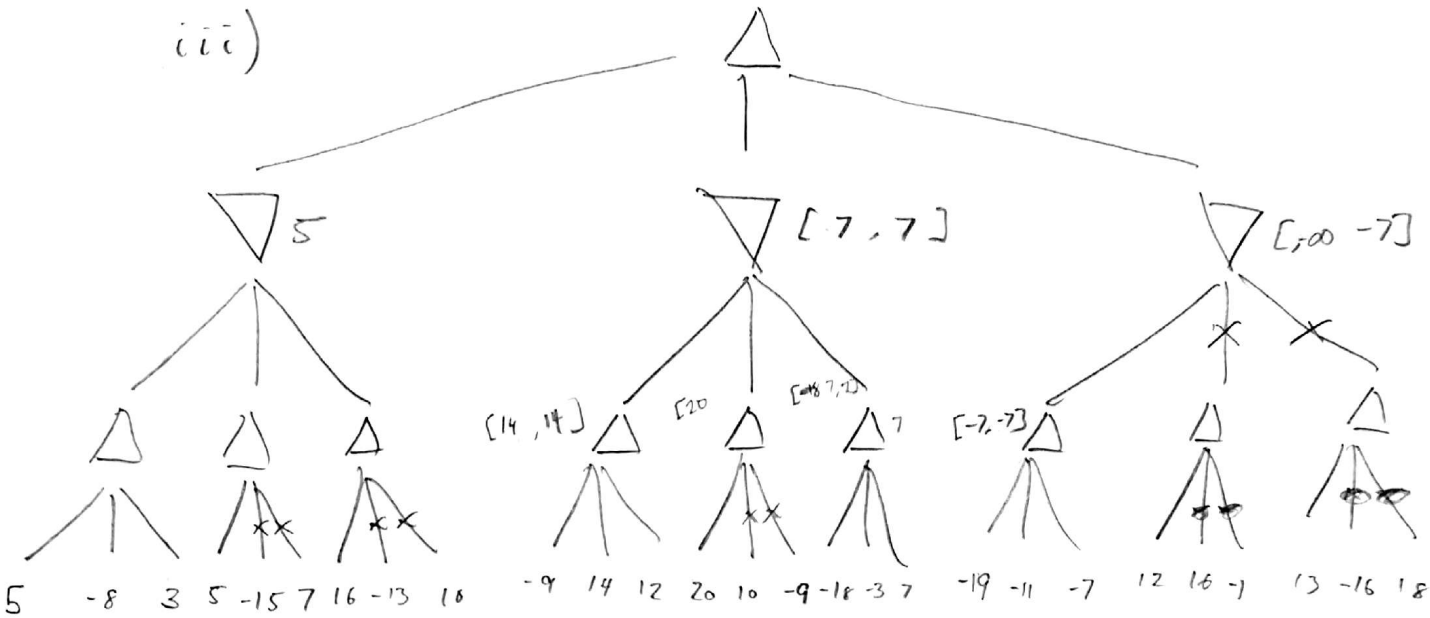
Final value is -7

iii



[7, ∞]

iii)

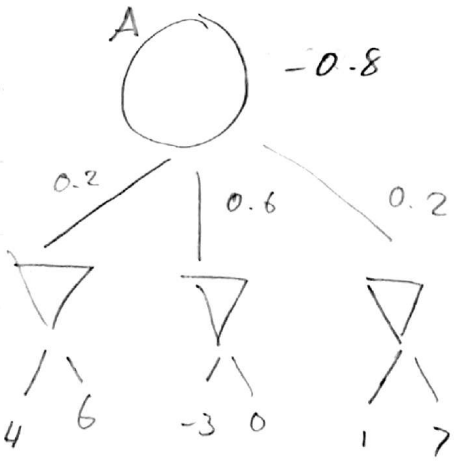


Final Value is 7

& nodes are pruned

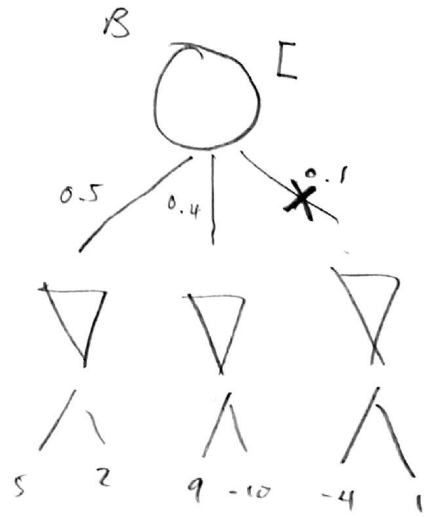
Question 7

iv) Expectimax Alpha-Beta Pruning Udacity Video



0.2 (4) + 0.6 (-3) + 0.2 (1) =

0.8 - 1.8 + 0.2 = -0.8



0.5 (2) + 0.4 (-10)

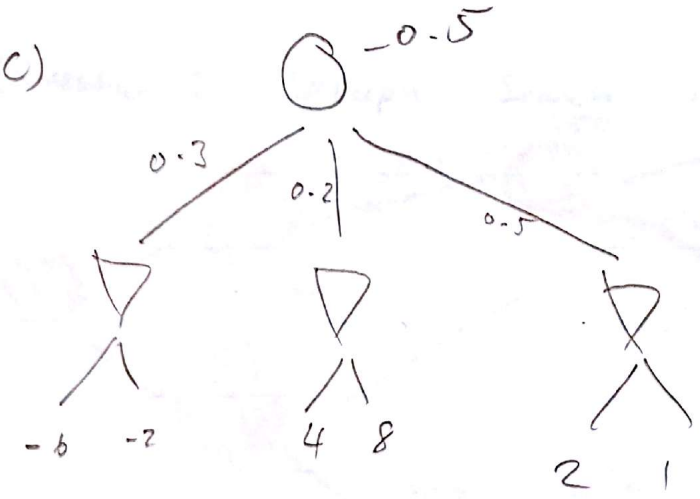
1 - 4 = -3

After this the right node is pruned since

-3 + 0.1 (10) = -2

which is less than -0.8

c)



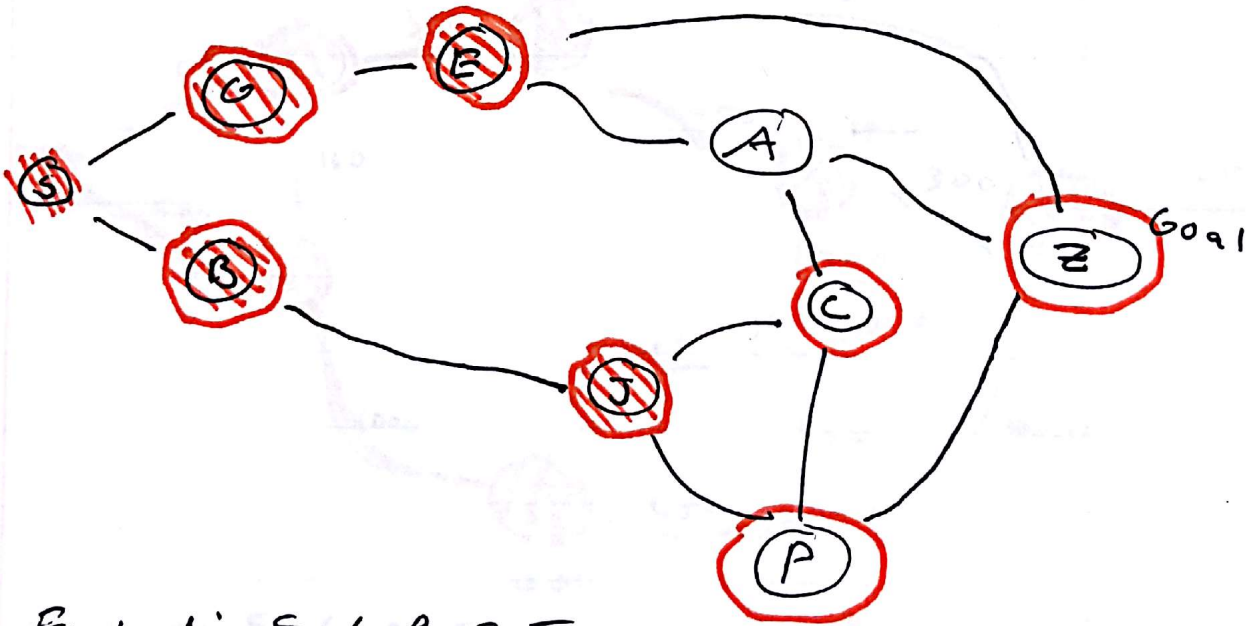
$0.3(-6) + 0.2(4) + 0.5(1)$

$-1.8 + 0.8 + 0.5$

-0.5

Question 2 : Graph Search

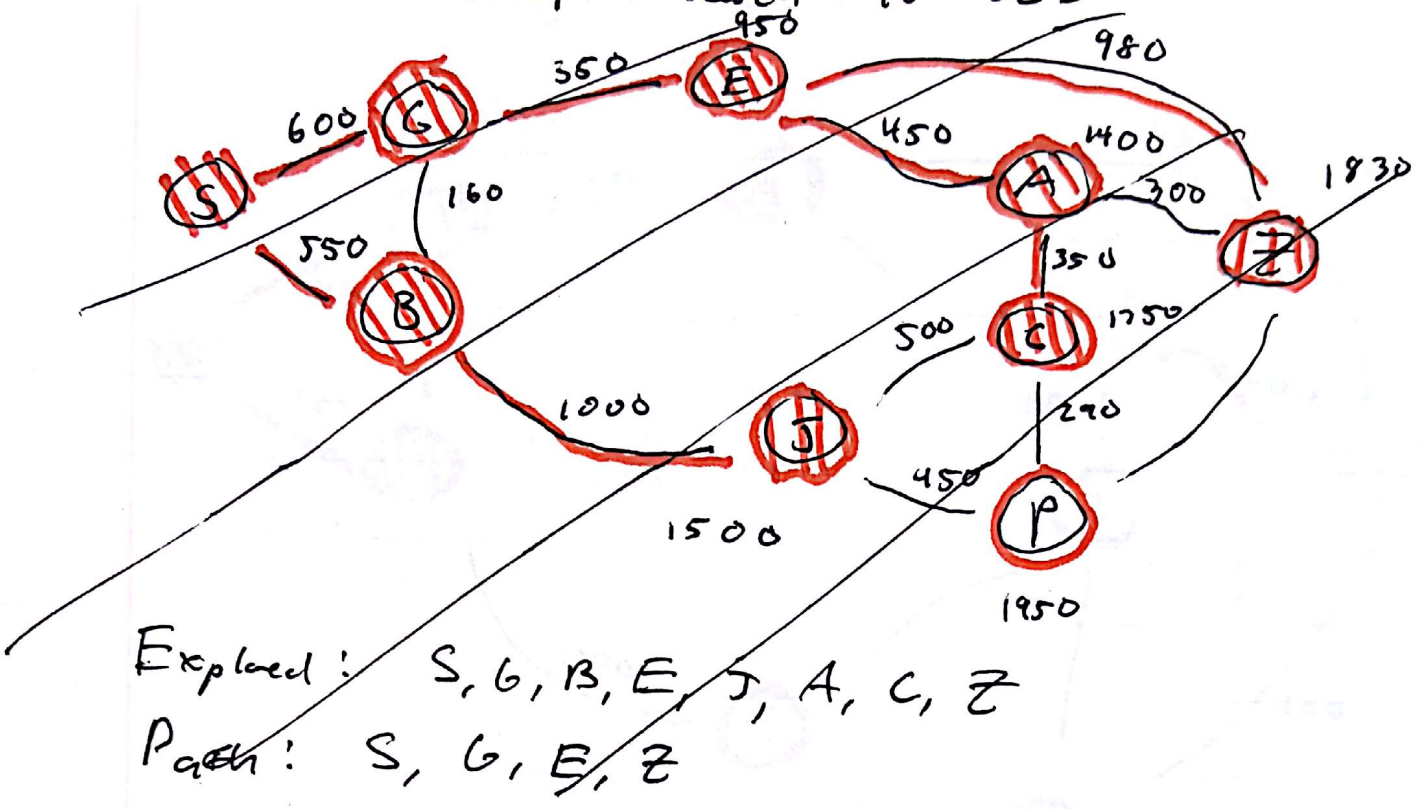
i) BFS



Explored : S, G, B, E, J

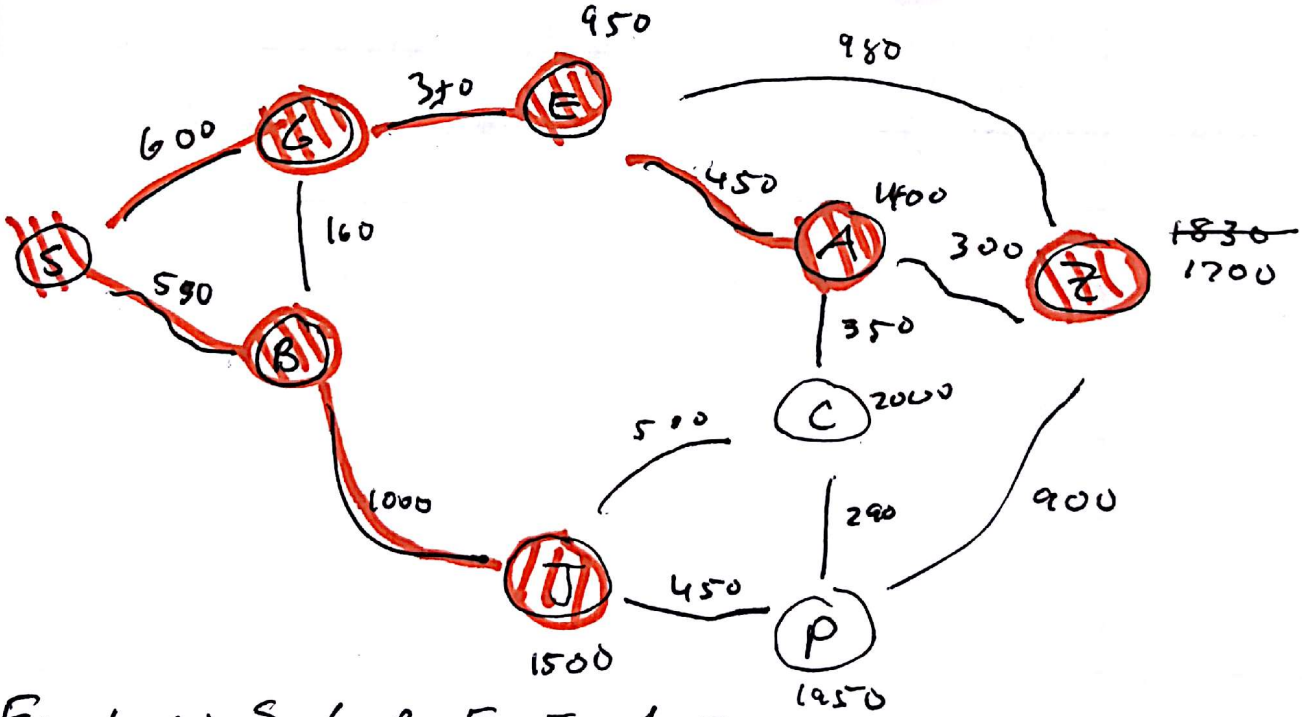
S, G, E, Z

Question 2: Graph Search ii: UCS



Explored: S, G, B, E, J, A, C, Z

Path: S, G, E, Z

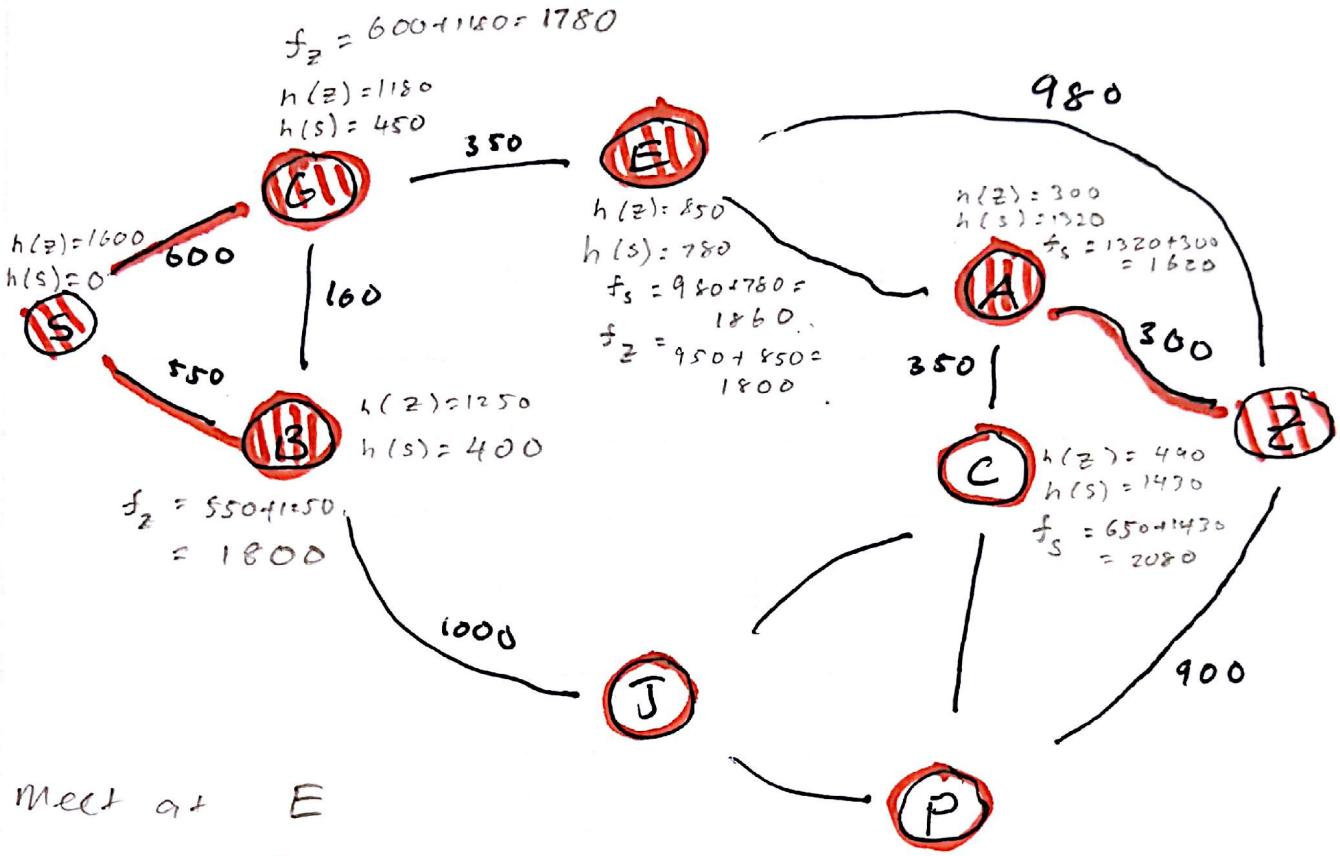


Explored: S, G, B, E, J, A, Z

Path, S, G, E, A, Z

h = straight line

A* search $f = g + h$ g = path cost



Meet at E

Explored: S, G, B, E, A, Z

Path: S, G, E, A, ~~Z~~

Question 4: Probability & Inference

Question 30

$E(Exam) = 35 \cdot P(G) + 30 \cdot P(S) + 35 \cdot P(I)$

You want to pick the skill that maximizes this expected value. Since you only have time to practice one skill, only one of A, B, or C can be true.

Let A be true and B, C False

$P(G \mid A, !B) = 0.75$

$P(S \mid A, !C) = 0.7$

$P(I \mid !B, !C) = 0.1$

$E(Exam \mid A, !B, !C) =$

$35 \cdot (0.75) + 30(0.7) + 35(0.1) = 50.75$

Let B be true, A, C False

$P(G \mid !A, B) = 0.75$

$P(S \mid !A, !C) = 0.2$

$P(I \mid B, !C) = 0.65$

$E(Exam \mid !A, B, !C) =$

$35(0.75) + 30(0.2) + 35(0.65) = 55$

choose B

Let C be true, A, B False

$P(G \mid !A, !B) = 0.3$; $P(S \mid !A, C) = 0.7$;

$P(I \mid !B, C) = 0.65$

$E(Exam \mid !A, !B, C) = 35(0.3) + 30(0.7) + 35(0.65) =$

54.25

ii. Given that we have studied Algorithms, we want to compute $E(Exam \mid A, B, !C)$ and compare that to $E(Exam \mid A, !B, C)$. We will return whichever is greater.

$P(G \mid A, B) = 0.95$

$P(S \mid A, !C) = 0.7$

$P(I \mid B, !C) = 0.65$

$E(Exam \mid A, B, !C) = 0.95(35) + 0.7(30) + 0.65(35)$

$= 77$

Now, to calculate $E(Exam \mid A, !B, C)$

$P(G \mid A, !B) = 0.75$

$P(S \mid A, C) = 0.9$

$P(I \mid !B, C) = 0.65$

$E(Exam \mid A, !B, C) = 0.75(35) + 0.9(30) + 0.65(35) = 76.$

Since $E(Exam \mid A, B, !C) > E(Exam \mid A, !B, C)$, I would choose to study Bayes Rule

$P(B) = 0.4$ $\quad P(!B) = 0.6$

$P(C) = 0.6$ $\quad P(!C) = 0.4$

iii) Given these Prior Probabilities, we first need to compute $P(G), P(S), P(I)$

$$P(G) = P(G|!A,!B)\,P(!A,!B) + P(G|!A,B)\,P(!A,B) + P(G|A,!B)\,P(A,!B) + P(G|A,B)\,P(A,B)$$

Notice, A, B, C are all independent.

$$P(G) = 0.3\,(0.2)(0.6) + 0.75\,(0.2)(0.4) + 0.75\,(0.8)(0.6) + 0.95\,(0.8)(0.4)$$

$$= 0.76$$

$$P(S) = P(S|!A!C)\,P(!A,!C) + P(S|!A,C)\,P(!A,C) + P(S|A,!C)\,P(A,!C) + P(S|A,C)\,P(A,C)$$

$$= 0.2\,(0.2)(0.4) + 0.7\,(0.2)(0.6) + 0.7\,(0.8)(0.4) + 0.9\,(0.8)(0.6) = 0.756$$

$$P(I) = P(I|!B,!C)\,P(!B,!C) + P(I|!B,C)\,P(!B,C) + P(I|B,!C)\,P(B,!C) + P(I|B,C)\,P(B,C)$$

$$= 0.1\,(0.6)(0.4) + 0.65\,(0.6)\,0.6 + 0.65\,(0.4)(0.4) + 0.85\,(0.4)(0.6) = 0.566$$

$P(G) = 0.76$ $\quad P(!G) = 0.24$

$P(S) = 0.756$ $\quad P(!S) = 0.244$

$P(I) = 0.566$ $\quad P(!I) = 0.434$

Points

0 $P(!G, !S, !I) = 0.24(0.244)(0.434) = 0.02541504$

35 $P(G, !S, !I) = 0.76(0.244)(0.434) = 0.08045096$

30 $P(!G, S, !I) = 0.24(0.756)0.434 = 0.07874496$

35 $P(!G, !S, I) = 0.24(0.244)(0.566) = 0.03314496$

65 $P(!G, S, I) = 0.24(0.756)(0.566) = 0.10269504$

65 $P(G, S, !I) = 0.76(0.756)(0.434) = 0.24935904$

70 $P(G, !S, I) = 0.76(0.244)(0.566) = 0.10495904$

100 $P(G, S, I) = 0.76(0.756)(0.566) = 0.3252096$

To find the median grade use the above probabilities to find the 50th percentile.

$P(!G, !S, !I) + P(!G, S, !I) + P(G, !S, !I)$
$+ P(!G, !S, I) + P(G, S, !I) + P(!G, S, I)$
$= 0.56984$

So the median grade is 65

$P(A) = 0.8$ $\quad P(\neg A) = 0.2$

$P(B) = 0.4$ $\quad P(\neg B) = 0.6$

$P(C) = 0.6$ $\quad P(\neg C) = 0.4$

iv) We want to know what is the probability of scoring 65 points given !B. The combinations that are valid are

(G, S); (G, I); (S, I); (G, S, I)

$$P(G, S \mid \neg B) = P(G, S \mid A, C, \neg B)\, P(A, C) + P(G, S \mid A, \neg C, \neg B)\, P(A, \neg C) + P(G, S \mid \neg A, C, \neg B)\, P(\neg A, C) + P(G, S \mid \neg A, \neg C, \neg B)\, P(\neg A, \neg C)$$

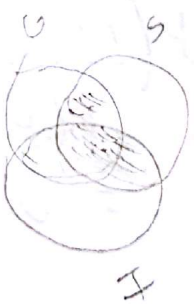
$$= (0.75)(0.9)(0.8)(0.6) + (0.75)(0.7)(0.8)(0.4) + (0.3)(0.7)(0.2)(0.6) + (0.3)(0.2)(0.2)(0.4)$$

$$= 0.522$$

$$P(G, I \mid \neg B) = P(G, I \mid A, C, \neg B)\, P(A, C) + P(G, I \mid A, \neg C, \neg B)\, P(A, \neg C) + P(G, I \mid \neg A, C, \neg B)\, P(\neg A, C) + P(G, I \mid \neg A, \neg C, \neg B)\, P(\neg A, \neg C)$$

$$= 0.75(0.65)(0.8)(0.6) + 0.75(0.1)(0.8)(0.4) + 0.3(0.65)(0.2)(0.6) + 0.3(0.1)(0.2)(0.4)$$

$$= 0.2838$$



$$P(S, I) = P(S, I \mid A, C, \neg B)\, P(A, C) + P(S, I \mid A, \neg C, \neg B)\, P(A, \neg C) + P(S, I \mid \neg A, C, \neg B)\, P(\neg A, C) + P(S, I \mid \neg A, \neg C, \neg B)\, P(\neg A, \neg C)$$

$$= (0.9)(0.65)(0.8)(0.6) + (0.7)(0.1)(0.8)(0.4) + (0.7)(0.65)(0.2)(0.6) + (0.2)(0.1)(0.2)(0.4)$$

$$= 0.3594$$

$$P(G, S, I) = P(G, S, I \mid A, C, \neg B)\, P(A, C) + P(G, S, I \mid A, \neg C, \neg B)\, P(A, \neg C) + P(G, S, I \mid \neg A, C, \neg B)\, P(\neg A, C) + P(G, S, I \mid \neg A, \neg C, \neg B)\, P(\neg A, \neg C)$$

$$= (0.75)(0.9)(0.65)(0.8)(0.6) + (0.75)(0.7)(0.1)(0.8)(0.4) + (0.3)(0.7)(0.65)(0.2)(0.6) + (0.3)(0.2)(0.1)(0.2)(0.4)$$

$$= 0.24426$$

$$P((G, S) \cup (G, I) \cup (S, I)) = P(G, S) + P(G, I) + P(S, I) - 3\, P(G, S, I)$$

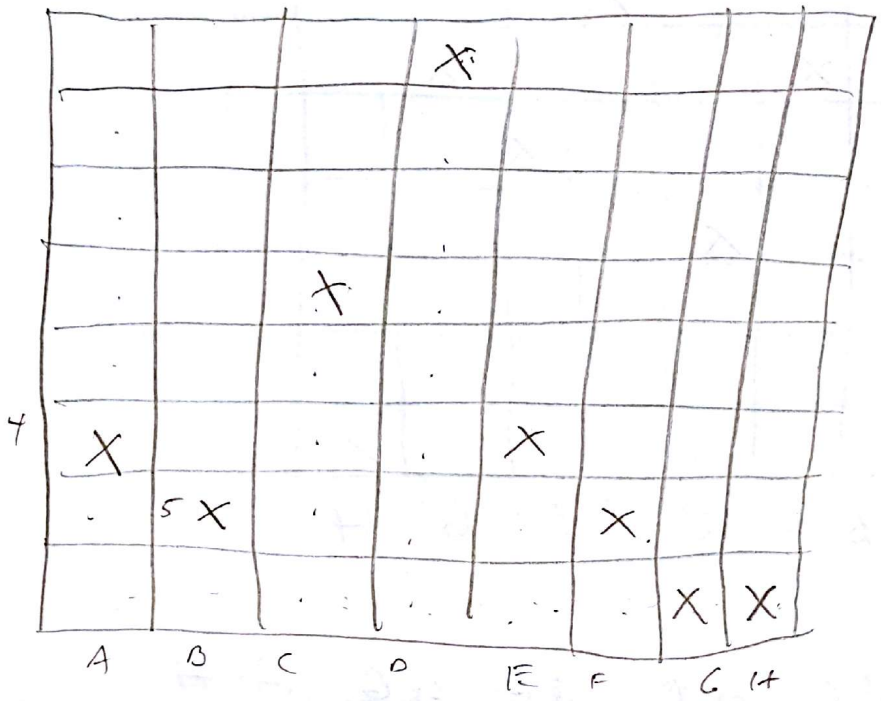
$$= 0.522 + 0.2835 + 0.3594 - 3(0.24426)$$

$$= 0.43252$$

Probability of getting at least medium given not Bayes is 0.43252.

Genetic Algorithms i)

3 2 5 8 3 2 1 1



A D, A F, A G, A H

B C, B D, B E, B G, B H

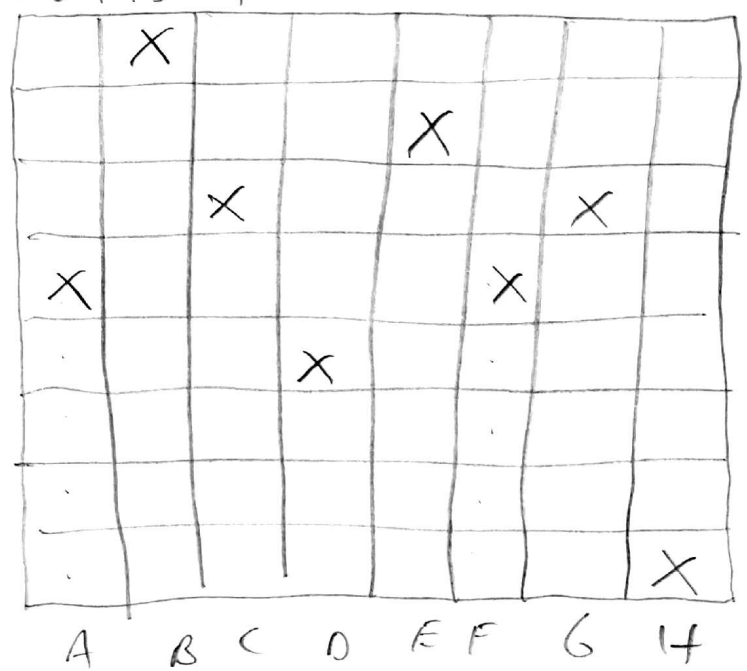
C D, C H

D E, D F, D G, D H

E H,

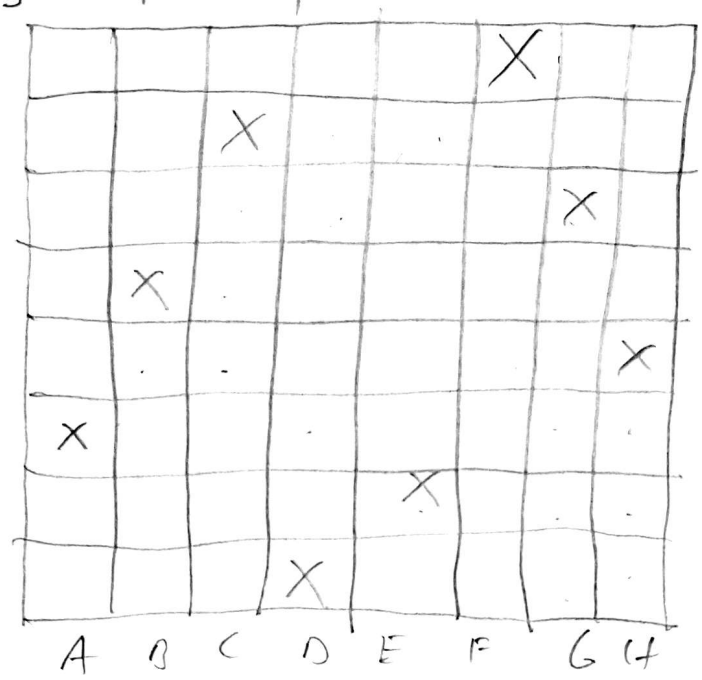
F H

5 8 6 4 7 5 6 1



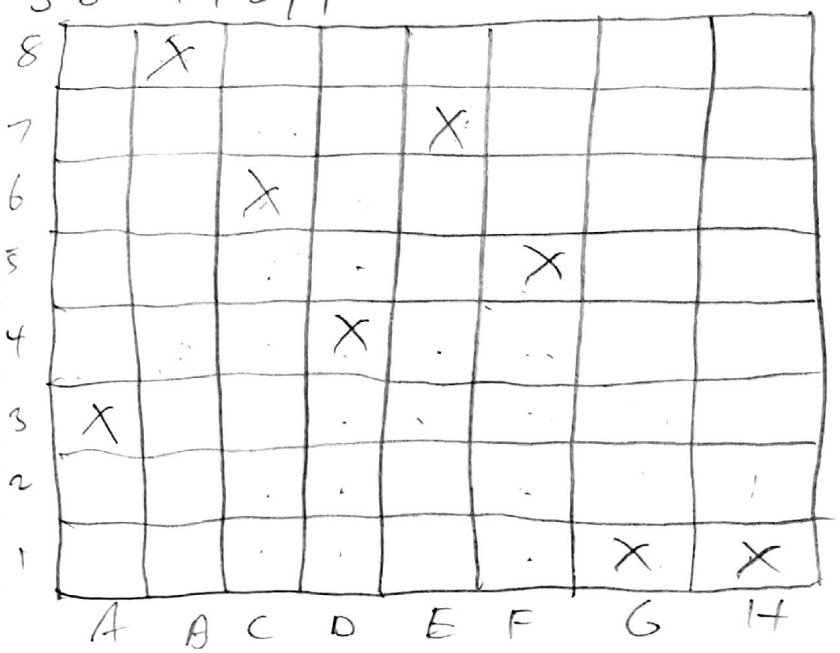
AB, AC, AD, AE, AG, AH
BC, BD, BE, BF, BG, BH
CD, CE, CF
DE, DF, DG, DH
EF, EG, EH
FH
GH

3 5 7 1 2 8 6 4



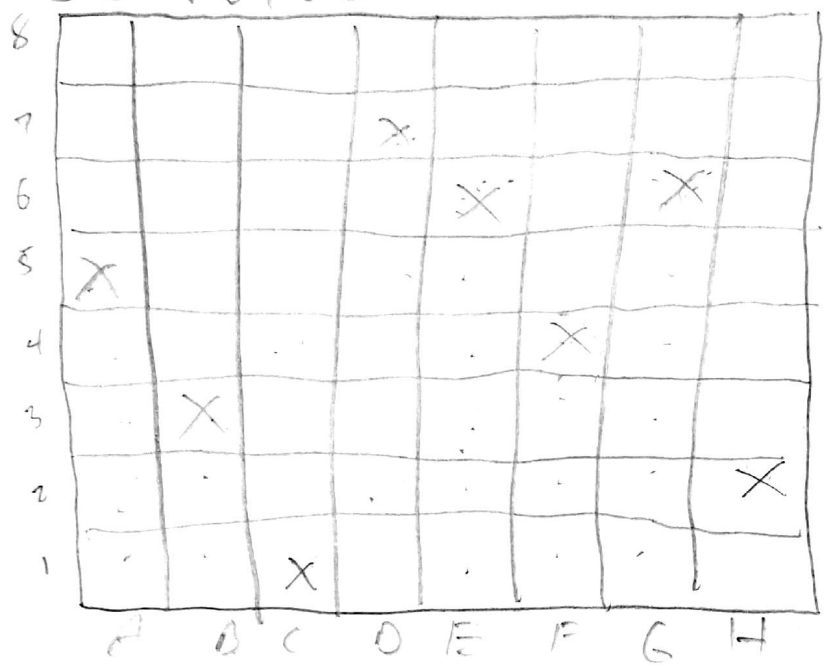
AB, AC, AD, AE, AG, AH
BC, BD, BF, BG, BH
CD, CE, CF, CG, CH
DF, DG, DH
EF, EG, EH
FG, FH
GH

3 8 6 4 7 5 1 1



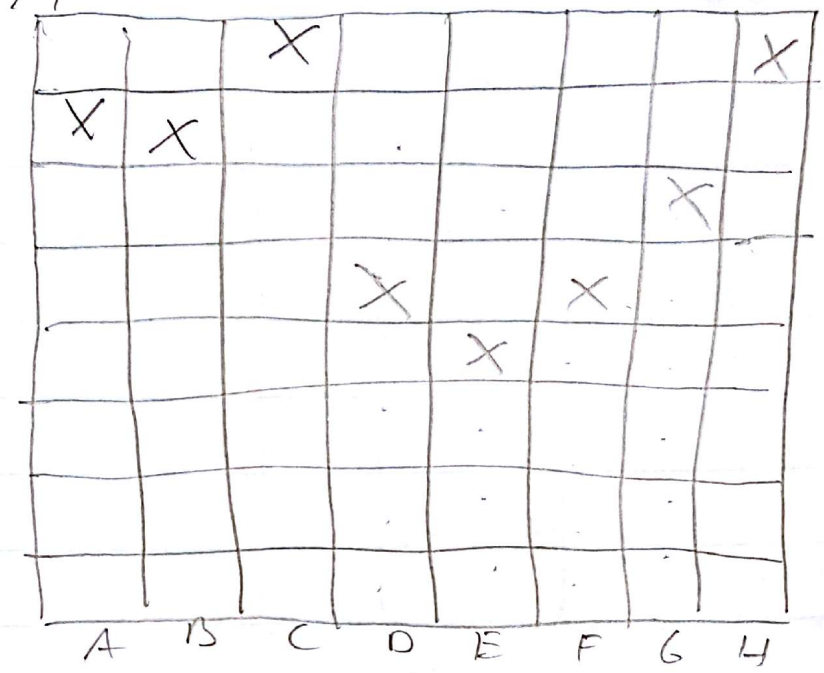
AB, AC, AD, AE, AG, AH
BC, BD, BE, BF, BG, BH
CD, CE, CF, CG
DE, DF, DH
EF, EG, EH
FG, FH

5 3 1 7 6 4 6 2



AB, AC, AD, AE, AF, AG, AH
BC, BD, BF, BG, BH
CD, CE, CG, CH
DF, DG, DH
EF, EH
FG,
GH

77 8 5 4 5 6 8



AC, AD, AE, AF, AG, AH
BE, BG, BH
CD, CE, CG
DG, DH
EH
FH
GH

Quest. 5

Genetic Algorithms Part (ii)

Most fit states: 58647561.

35712864.

38647511

1. 38647561 : 38647511
                 58647561

f 8 4 1 7 2 6 3

5 8 4 1 3 6 2 7

3 5 8 4 1 7 2 6

3 5 2 8 1 7 4 6

3 5 7 1 4 2 8 6

3 8 4 7 1 6 2 5