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Step1 Intial Population

$C_1 = [1,2,1,3,2,1,3]$ $C_4 = [1,3,2,3,1,2,1]$

$C_2 = [2,1,3,1,3,2,1]$ $C_5 = [2,2,1,1,3,3,2]$

$C_3 = [3,1,2,2,1,3,2]$ $C_6 = [3,1,3,2,2,1,1]$

step2 Fitness Calculation

1) F_1 : Tasks 1,3,6, Total time = 12 hours Cost = 5*10 + 4*8 + 3*9 =

F_2 : Tasks 2,5 , " = 14 hours Cost = 112 + 78 = 190

F_3 : Tasks 4,7 " = 16 hours Cost = 91 + 117 = 208

Total cost = (507) = f

Constraint ① 12 <= 24 ✓ ② 14 <= 30 ✓ ③ 16 <= 28 ✓

② F_1 : Tasks 2,4,7 Total time = 24 hour. Cost = 120 + 84 + 99 = 303

F_2 : Tasks 1,6 Total time = 8 hours , Cost = 60 + 24 = 84

F_3 : Tasks 3,5 " = 10 hours, Cost = 28 + 72 = 100

Total cost = (487) = f

Constraint ① ✓ ② ✓ ③ ✓

③

F_1 : Tasks 2,5 : 14 hours .. Cost = 8*15 + 6*14 = 204

F_2 : Task 3,4,7 , 20 hours cost = 36 + 70 + 108 = 214

F_3 : Task 1,6 8 hours Cost = 45 + 30 = 75

Total cost = 204 + 214 + 75 = (493)

Constraint ① ✓ ② ✓ ③ ✓

④

F_1 : Tasks 1,5,7 , Total time = 20 hours , Cost = 50 + 84 + 99 = 233

F_2 : 3,6 , Total time = 7 hours Cost = 36 + 24 = 60

F_3 : 2,4 15 hours , Cost = (512)

Constraint ① ✓ ② ✓ ③

⑤ F_1 : Tasks 3,4 Total time = 11 hours Cost = 32 + 84 = 116

F_2 : 1,2,7 Total time = 22 hours cost = 60 + 112 + 108 = 280

F_3 : 5,6 9 hours cost : 72 + 30 = 102

Total cost = (498) Constraint ① ✓ ② ✓ ③ ✓

⑥

F_1: Tasks 2,6,7 Total time = 20 hours Cost = 120 + 27 + 99 = 246

F_2: 4,5, 13 hours Cost = 70 + 78 = 148

F_3: 1,3 9 hours cost = 45 + 28 = 73

Constraint ① ✓ ② ✓ ③ ✓

step 3 selection mode (Roulette Wheel)

Total fitness = 507 + 550 + 480 + 520 + 580 + 495 = 3132

C_1 = 507/3132 = 0.162 C_2 = 0.176 C_3 = 0.153 C_4 = 0.166 C_5 = 0.185

C_6 = 0.158

random selected based on probabilities

P_1 : C_5 P_2 : C_3 P_3 : C_2 P_4 : C_6 P_5 : C_4 P_6 : C_1

based on the 80% crossover rate

Pair1 P_1 P_2 crossover point = 3

Pair2 P_3 P_4 = 5

Pair3 P_5 P_6 = 2

one point crossover

• Pair1

P_1 : [2,2,1,1,3,3,2]

P_2 : [3,1,2,2,1,3,2]

O1 : [2,2,1,2,1,3,2]

O2 : [3,1,2,1,3,3,2]

• Pair2

P_3 : [2,1,3,1,3,2,1]

P_4 : [3,1,3,2,2,1,1]

O3 : [2,1,3,1,3,1,1]

O4 : [3,1,3,2,2,2,1]

• Pair3

P_5 : [1,3,2,3,1,2,1]

P_6 : [1,2,1,3,2,1,3]

O5 : [1,3,1,3,2,1,3]

O6 : [1,2,2,3,1,2,1]

mutation:

· 20% chance

.02

Before : [3,1,2,1,3,3,2] index 1, 6

after : [3,3,2,1,3,1,2]

05

Before : [1,3,1,3,2,1,3] index 0, 4

after : [2,3,1,3,1,1,3]

new population

C_1 : [2,2,1,2,1,3,2] C_2 : [3,3,2,1,3,1,2]

C_3 : [2,1,3,1,3,1,1] ~~C_4 : [2,1,3,1,3,1,1]~~

C_4 : [3,1,3,2,2,2,1] C_5 : [2,3,1,3,1,1,3]

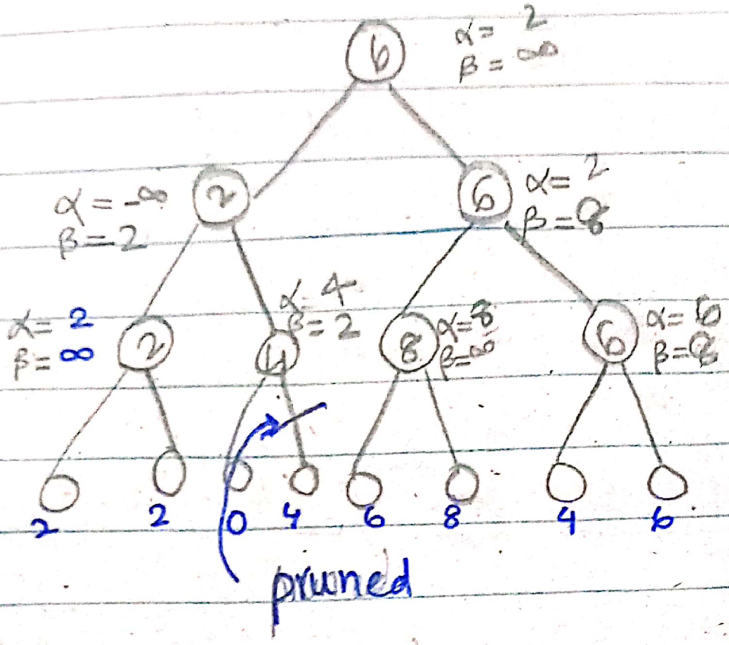
C_6 : [1,2,2,3,1,2,1]

Repeat

one algorithm should converge towards better solution

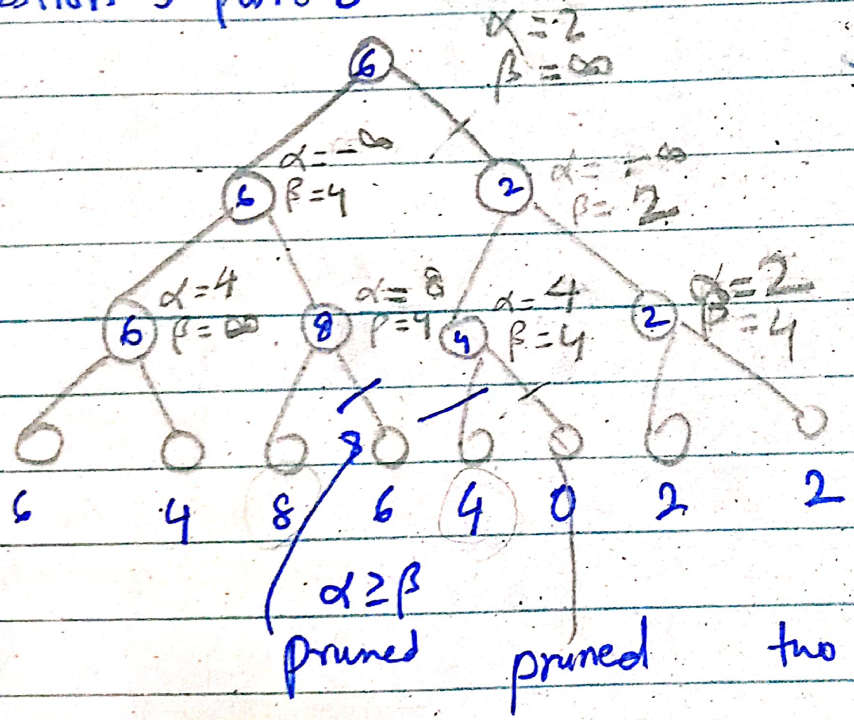
Global maximum.

Question 5 part a



max
min
max

Question 5 part b



max
min
max

two pruned nodes.

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part(a) Game Model

1. Players:

(1) Max(Defender): The AI powered Intrusion Detection system : to minimize the dmge caused by the attacker. Max aims to protect the network and maintain its integrity and availability, minimize dmge (data loss, down time etc)

(2) Min (Attacker): The cyber attacker : to maximize the dmage caused to the defender. Min aims to breach the security of the network

Decision making

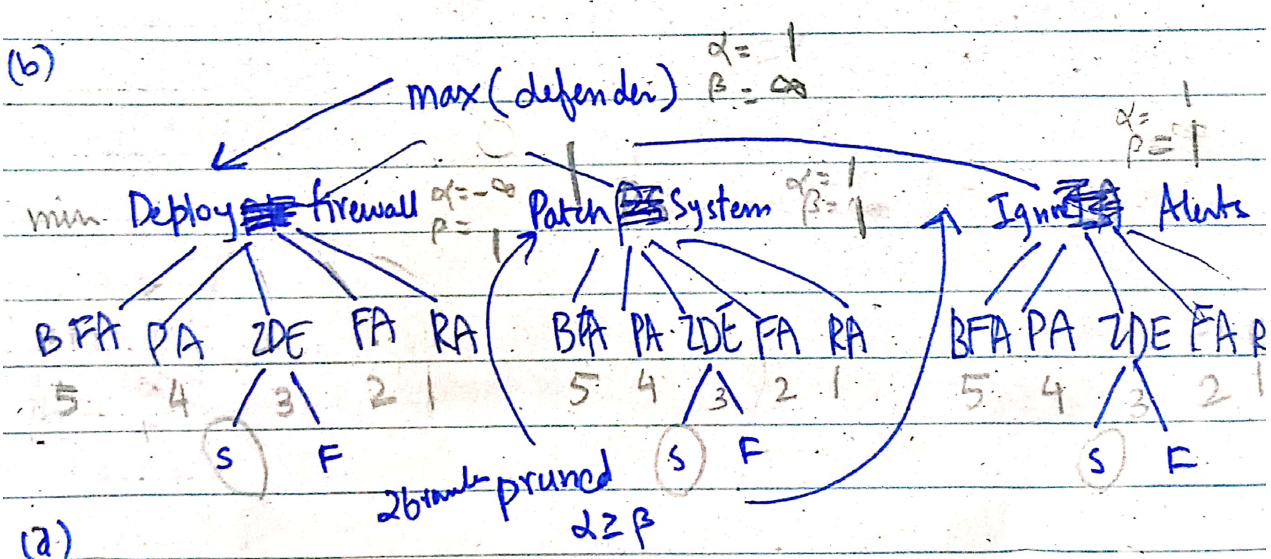
Max : Uses a strategy (Minimax or Expatimax) to choose the best defense. May use ML AI Machine learning to learn attacker patterns

Min : chooses an attack strategy to maximize dmge, considering Max's potential defenses.

Stochastic Elements:

- Probalistic attacks (eg zero-day) introduce uncertainity
- Defender must consider the expected value of actions
- strategy involves a mix of prevention and mitigation

(b)



(a)

E(X) = (prob of succes * dmge if succes) + (Prob of failure * dmge if failure)

suppose prob of succes = 0.5 Dmge if succes = 80
prob of failure = 0.5 Dmge if failure = 10

E(x) = (0.5 * 80) + (0.5 * 10) = 40+5

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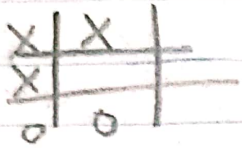
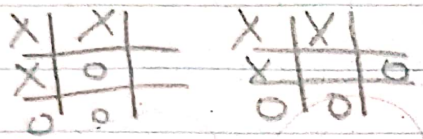
- Max should evaluate Expected dmge for each action
- choose action with lowest expected dmge
- Prob should be dynamically updated.

Question 4

move1 ~~one~~ X best move is to play at ~~the~~ move1



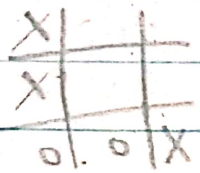
O has 6 possible moves



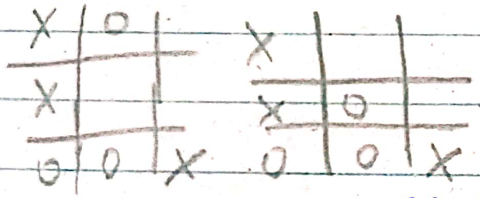
Total
100 - 10 - 100
+ 100 + 0
+ 0 + 0 + 0
= 90

100 + 0 - 100
+ 100 + 0 - 10
+ 0 + 0 = 90

move5



O has 6 possible move



0 + 10 - 90 + 100
- 100 + 10 + 0 + 0
= -70

10 + 0 - 90 + 100
+ 10 + 0 + 0 = -70