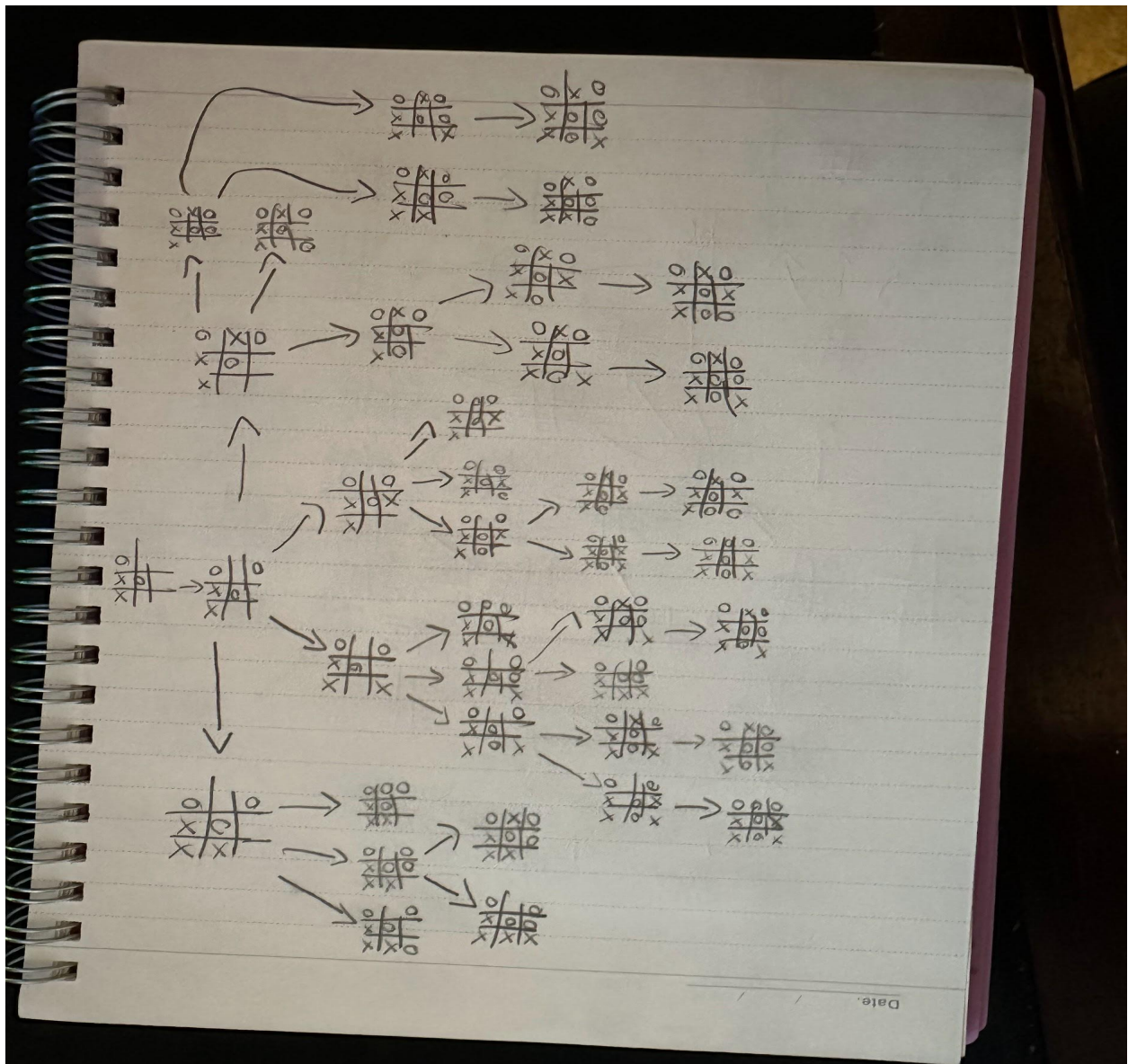


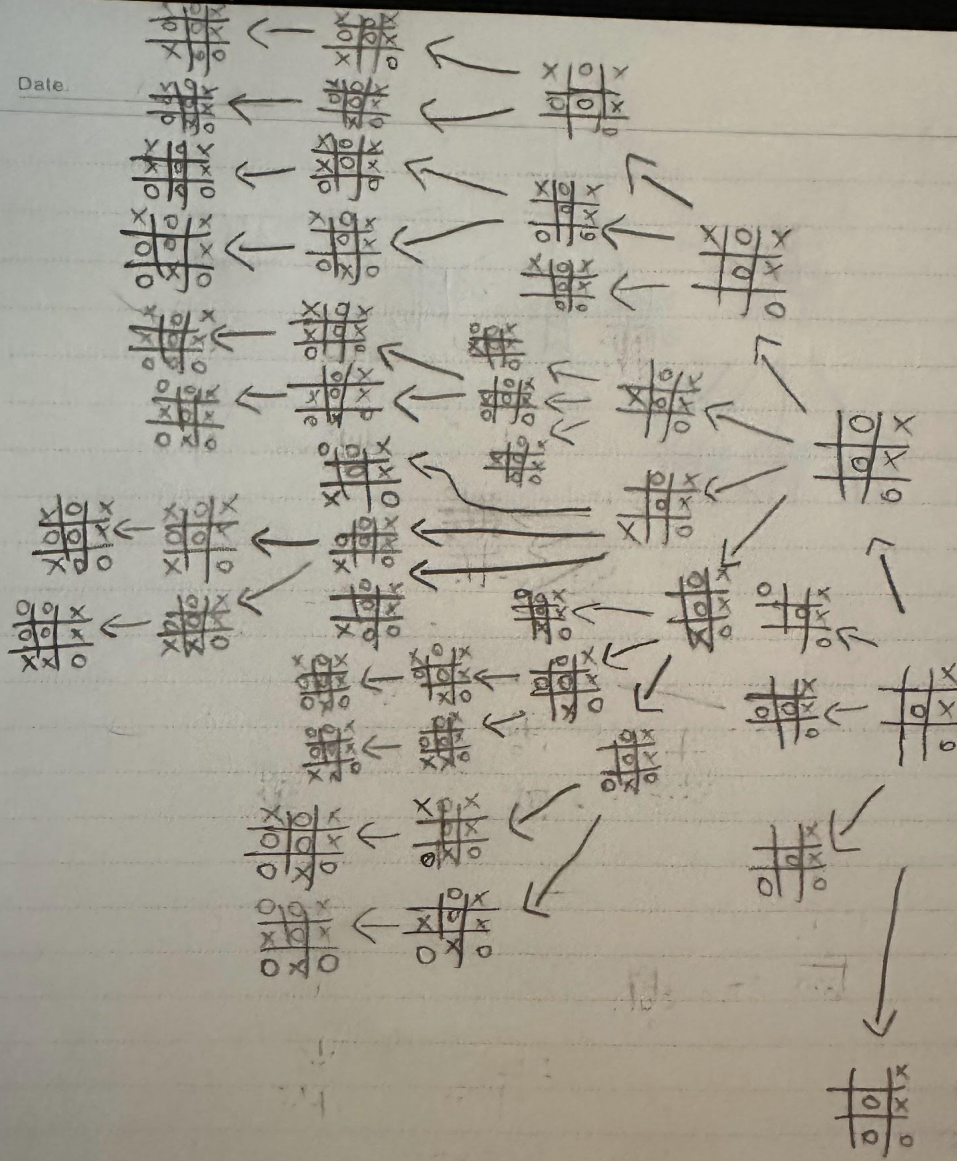
Problem 1:

Part 1:

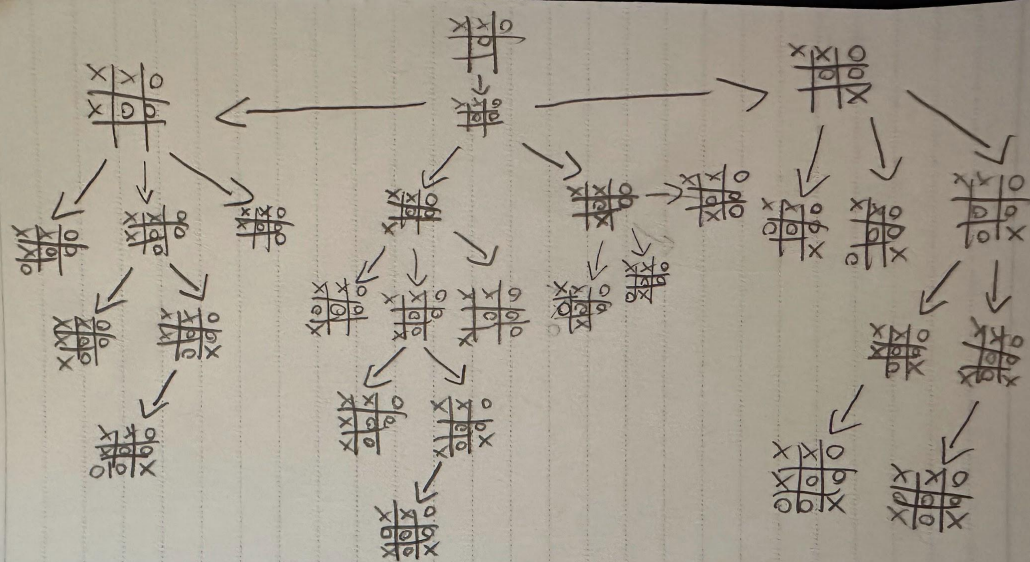
a)

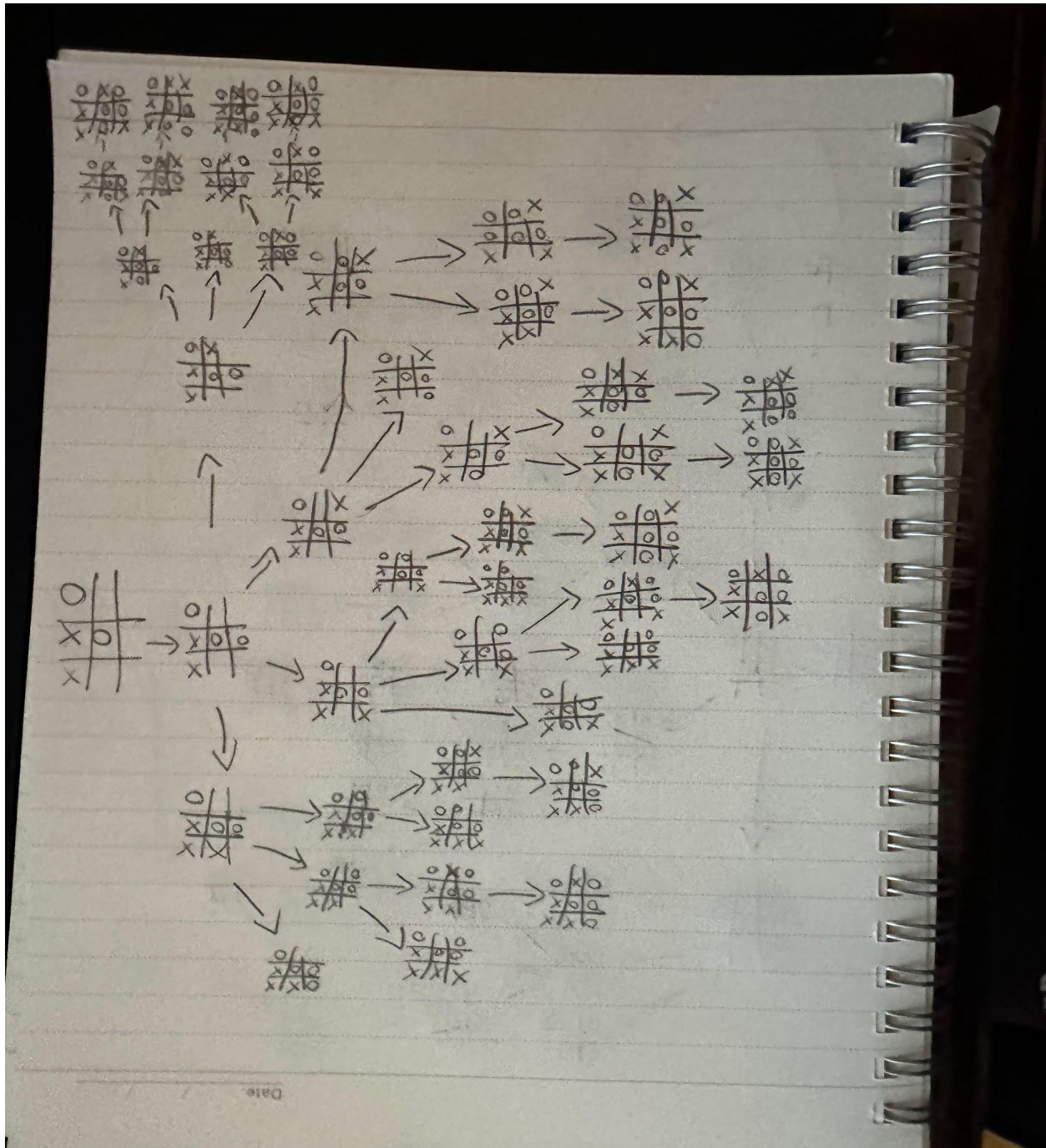


Date.



Date: / /





Part 2b:

S0= (WK:A1, WP: E3, WKn: B3, BK:A8, BP: F4, BB: C5)

w1: WK:A1->A2 S1= (WK:A2, WP: E3, WKn: B3, BK:A8, BP: F4, BB: C5)

w2: WK:A1->B2 S2= (WK:B2, WP: E3, WKn: B3, BK:A8, BP: F4, BB: C5)

w3: WK:A1->B1 S3= (WK:B1, WP: E3, WKn: B3, BK:A8, BP: F4, BB: C5)

w4: WP:E3->E4 S4= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F4, BB: C5)

w5: WP:E3->F4 S5= (WK:A1, WP: F4, WKn: B3, BK:A8, BP: N/A, BB: C5)
w6: WKn:B3->C5 S6= (WK:A1, WP: E3, WKn: C5, BK:A8, BP: F4, BB: C5)
w7: WKn:B3->A5 S7= (WK:A1, WP: E3, WKn: A5, BK:A8, BP: F4, BB: C5)
w8: WKn:B3->A1 S8= (WK:A1, WP: E3, WKn: A1, BK:A8, BP: F4, BB: C5)
w9: WKn:B3->C1 S9= (WK:A1, WP: E3, WKn: C1, BK:A8, BP: F4, BB: C5)

From w9

b1: BK:A8->B8 S10= (WK:A1, WP: E3, WKn: C1, BK:B8, BP: F4, BB: C5)
b2: BK:A8->A7 S11= (WK:A1, WP: E3, WKn: C1, BK:A7, BP: F4, BB: C5)
b3: BP:F4->E3 S12= (WK:A1, WP: N/A, WKn: C1, BK:A8, BP: F4, BB: C5)
b4: BP:F4->F3 S13= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: C5)
b5: BB:C5->B4 S14= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: B4)
b6: BB:C5->A3 S15= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: A3)
b7: BB:C5->D6 S16= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: D6)
b8: BB:C5->E7 S17= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: E7)
b9: BB:C5->F8 S18= (WK:A1, WP: E4, WKn: B3, BK:A8, BP: F3, BB: F8)

Part 2c:

NOTE: I used 9 for the value of the king as the value was missing in the instructions.

S1: W = 13 B = 13
S2: W = 13 B = 13
S3: W = 13 B = 13
S4: W = 13 B = 13
S5: W = 13 B = 12
S6: W = 13 B = 13
S7: W = 13 B = 13
S8: W = 13 B = 13
S9: W = 13 B = 13

State 5 has an advantage after the white pawn is moved because the black pawn is eliminated, lowering the total points.

Problem 2:

a)

Player moves from A to the left path (a)

Opponent moves to the right path (e)

The reward would be 2

Player moves from A to the middle

Opponent moves to the left path (f)

Reward is 1 but is less than 2

Player moves to g

Opponent moves to the right path (m)
Reward is 2 which equals previous best reward
Player moves from middle path to h
Opponent moves to the left path (n)
Reward is 1 which is less than 2
Player moves from A to the right path (b)
Opponent moves to the right path (k)
Reward is 1 but is less than 2
Overall best reward is 2 by MAX going left (a)

b)

Alpha = -infinity Beta = infinity
Player moves to the left path (a)
A = 5 B = infinity
Opponent moves to the right path (k)
A = -infinity B = 2
Player moves to the middle path
Opponent moves left (f)
A = -infinity B = 1
Paths g and h are blocked
Player moves to the right path (b)
A = 7 B = infinity
Opponent moves to the right path (k)
A = -infinity B = 1
Overall best reward is 2 by going LEFT

c)

Left path = $(5 + 3 + 2) / 3 = 3.33$
Middle path = $1 / 1 = 1$
Right path = $(4 + 7 + 1) / 3 = 4$
Player goes right (b)
Player goes middle (j)
Overall best reward is 7 by going right then middle

Problem 3:

a)

Player A (8 points)

/ \
Roll d6 Roll d4 + 1
/ / / \ \ \ / / \ \
1 2 3 4 5 6 2 3 4 5

b)

The best action for A is to roll the 4-sided dice and add 1 because this method guarantees a win when player A is at 8 points. $8 + 2, 3, 4,$ or 5 are all ≥ 10 whereas the d6 has a chance of rolling a 1 which would prevent player A from winning.

c)

Player B (7 points)

/ \
Roll d6 Roll d4 + 1
/ / / \ \ \ / / \ \
1 2 3 4 5 6 2 3 4 5

d)

The best action for B would be to roll the d4 and add one, as the roll has a 75% chance of winning the game ($\frac{3}{4}$). If the player rolled a d6, they would only have a 66% chance of winning ($\frac{4}{6}$).

Problem 4:

a)

1)

B11: (3,6,3)
B12: (2,5,6)
B13: (2,6,7)
B21: (3,5,7)
B22: (3,6,6)
B23: (4,4,7)
B31: (4,5,6)
B32: (4,6,5)
B33: (4,5,6)

2)

A1 -> B11
A2 -> B23

A3 -> B31

b)

The best starting move for A would be to go to A3. This gives them the chance for the most amount of points based on opponent countermoves while not giving too many points to another player.

c)

If A goes to A3, the best move for B is to go to B32, as they can get either 5 or 6 points for sure.

d)

The best move for C in this scenario would be to go to C1 (3,5,7) as they would receive 7 points and lead the group.

Problem 5:

a)

$$A: 10/21 + 1\sqrt{\ln(100)/21} = .94$$

$$B: 13/25 + 1\sqrt{\ln(100)/25} = .95$$

$$C: 9/17 + 1\sqrt{\ln(100)/17} = 1.05$$

$$D: 18/27 + 1\sqrt{\ln(100)/27} = 1.08$$

$$E: 6/10 + 1\sqrt{\ln(100)/10} = 1.28$$

Node E would be selected as it has the highest UCB value.

b)

$$A: 10/21 + 10\sqrt{\ln(100)/21} = 5.16$$

$$B: 13/25 + 10\sqrt{\ln(100)/25} = 4.81$$

$$C: 9/17 + 10\sqrt{\ln(100)/17} = 5.73$$

$$D: 18/27 + 10\sqrt{\ln(100)/27} = 4.80$$

$$E: 6/10 + 10\sqrt{\ln(100)/10} = 7.39$$

Node E would be selected as it has the highest UCB value.

c)

A higher C value will look at nodes with less visits more often, favoring exploration. A lower C value will exploit nodes with a high value, favoring exploitation.

d)

$$D: 21/36$$

D1: 2/3

D2: 1/3

D3: 0/3

Root Visits = 109

e)

A: $10/21 + .25\sqrt{\ln(109)/21} = .59$

B: $13/25 + .25\sqrt{\ln(109)/25} = .63$

C: $9/17 + .25\sqrt{\ln(109)/17} = .66$

D: $21/36 + .25\sqrt{\ln(109)/36} = .67$

D1: $2/3 + .25\sqrt{\ln(109)/3} = .98$

D2: $1/3 + .25\sqrt{\ln(109)/3} = .65$

D3: $0/3 + .25\sqrt{\ln(109)/3} = .31$

E: $6/10 + .25\sqrt{\ln(109)/10} = .77$

Node D1 would be selected due to having the highest UCB. Because the C value is lower, the search is prioritizing exploiting rather than exploring, hence why it is going to fo towards D2.