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# Homework 2

## Problem 1

### (a)

Player 2 would choose: (3, 14), (11, 8), (7, 12)
Player 1 would choose: (11,8)

### (b)

For Player 1: $k - U_A \leq \beta$. For Player 2: $k - U_B \leq \alpha$.

## Problem 2

### (a)

Let $c$ represents the color, $D_c$ represents the delegate $D$'s favorite color, $N_d(c, D_c)$ represents the number of M&Ms that $c \neq D_c$ for the delegate $D$ corresponding to the bowl index $d$. Then the score function will be $score = \sum_{d=1}^{3} N_d(c, D_c)$.

Action to take: iteratively check each M&M and place those not belonging to the certain bowl to where it should be one by one.

### (b)

One possible problem is that we might get stuck at local maximum, where exchanging the M&Ms does not improve the total score then we stop. Below is an example. It is still possible to converge on bowls full of one M&M color.

R R G G
R R B B
B B G G

### (c)

We might choose those M&M from line $A$ with contribution to the total score of 0, i.e. not match the color of the one right before, and insert to another line $B$. Line $A$ will have 0 decrease in the score, while the score of line $B$ might increase.

# Problem 3

### Converting to horn form

Let $S = \neg R$. Then the knowledge base can be re-writed as follows.

1. $A \wedge B \Rightarrow D$
2. $Q \wedge S \Rightarrow A$
3. $Q \wedge B \Rightarrow S$
4. $P \Rightarrow Q$
5. $P \Rightarrow B, B \Rightarrow P$
6. $B$

### Forward Chaining

7. $P$ by 5, 6
8. $Q$ by 4, 7
9. $S$ by 3, 6, 8
10. $A$ by 8, 9
11. $D$ by 1, 6, 10

### Backward Chaining

7. $D$ by pre-condition
8. $A \wedge B$ by 1, 7
9. $A$ by 8
10. $B$ by 8
11. $Q \wedge S$ by 2, 9
12. $Q$ by 11
13. $S$ by 11
14. $Q \wedge B$ by 3, 13
15. $P$ by 4, 12
16. $B$ by 5, 15

## Problem 4

### (a)

For the min node: 2, 1, 0, -1
For the expect node: 1.25, -0.25
For the max(root) node: 1.25
The root node should go left.

### (b)

Yes. Since we are doing DFS and cannot guarantee the value of the last two node. They may be large or small and could potential domainate the value.

### (c)

Given the value range, the seventh and eighth leaves need not to be evaluated. Since on the left side, we know the 0.75 branch contribute an expected value 0, even if on the right it min value is 2, the total expected value will at most be 1, which will not be chosen by the root node.

### (d)

We know $E[aX + b] = aE[X] + b$ by the property of expection, so the expected value will also perform a positive linear transformation, and the relative quantity will remain the same.