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1.

a)

Variables: {K1, K2, Q1, Q2}

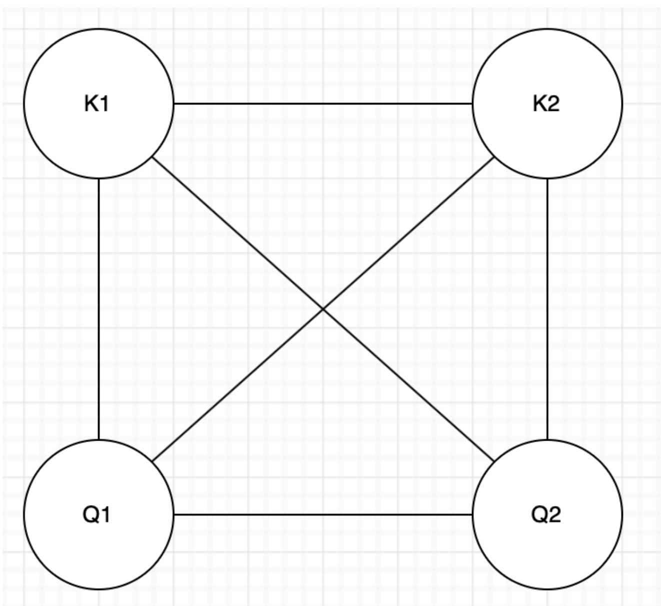
Domain (same for all variables): {1, 2, 3, 4}

Assume the horizontal axis is i and vertical axis is j.

Constraints: $Q1j = 3$, $Q2j = 4$, $K1j = 1$, $K2j = 2$,

$K1i \neq K2i \pm 2$, $K1i \neq Q1i \pm 1$, $K2i \neq Q2i \pm 1$, $K2i \neq Q1i \pm 2$,

$|Q1i\text{-}Q2i| \neq |Q1j\text{-}Q2j|$, $Q1i \neq Q2i$, $|Qi - Ki| \neq |Qj - Kj|$, $Qi \neq Ki$.



b)

$K1 = \{\cancel{1}, \cancel{2}, \cancel{3}, 4\}$

$K2 = \{\cancel{1}, \cancel{2}, \cancel{3}, 4\}$

$Q1 = \{\cancel{1}, \cancel{2}, \cancel{3}, 4\}$

$Q2 = \{\cancel{1}, \cancel{2}, \cancel{3}, 4\}$

Queue: $\cancel{K1i \neq K2i \pm 2}$, $\cancel{K2i \pm 2 \neq K1i}$, $\cancel{K1i \neq Q1i \pm 1}$, $\cancel{Q1i \pm 1 \neq K1i}$, $\cancel{K2i \neq Q2i \pm 1}$, $\cancel{Q2i \pm 1 \neq K2i}$, $\cancel{K2i \neq Q1i \pm 2}$, $\cancel{Q1i \pm 2 \neq K2i}$, $\cancel{|Q1i\text{-}Q2i| \neq |Q1j\text{-}Q2j|}$, $\cancel{|Q1j\text{-}Q2j| \neq |Q1i\text{-}Q2i|}$, $\cancel{Q1i \neq Q2i}$, $\cancel{Q2i \neq Q1i}$, $\cancel{|Qi - Ki| \neq |Qj - Kj|}$, $\cancel{|Qj - Kj| \neq |Qi - Ki|}$, $\cancel{Qi \neq Ki}$, $\cancel{Ki \neq Qi}$, $\cancel{Q1i \pm 1 \neq K1i}$,

~~$Q2i \pm 1 \neq K2i$, $Q1i \pm 2 \neq K2i$, $Q2i \neq Q1i$.~~

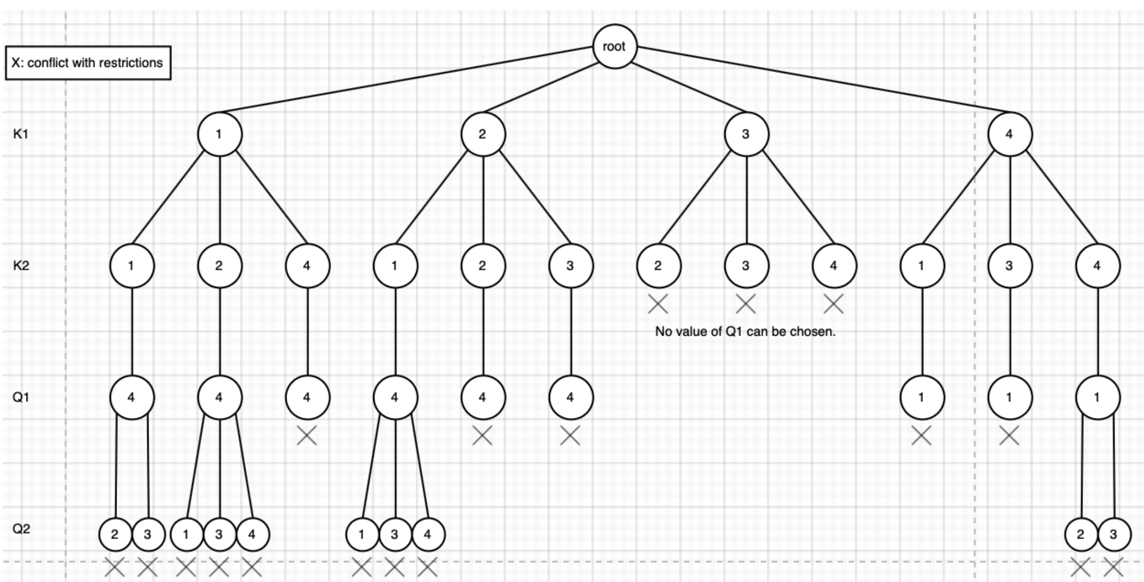
For the backtracking search, since there is no value left for each variable, a tree cannot be built using this method, as a result, no solution can be found.

c)

One step forward checking:

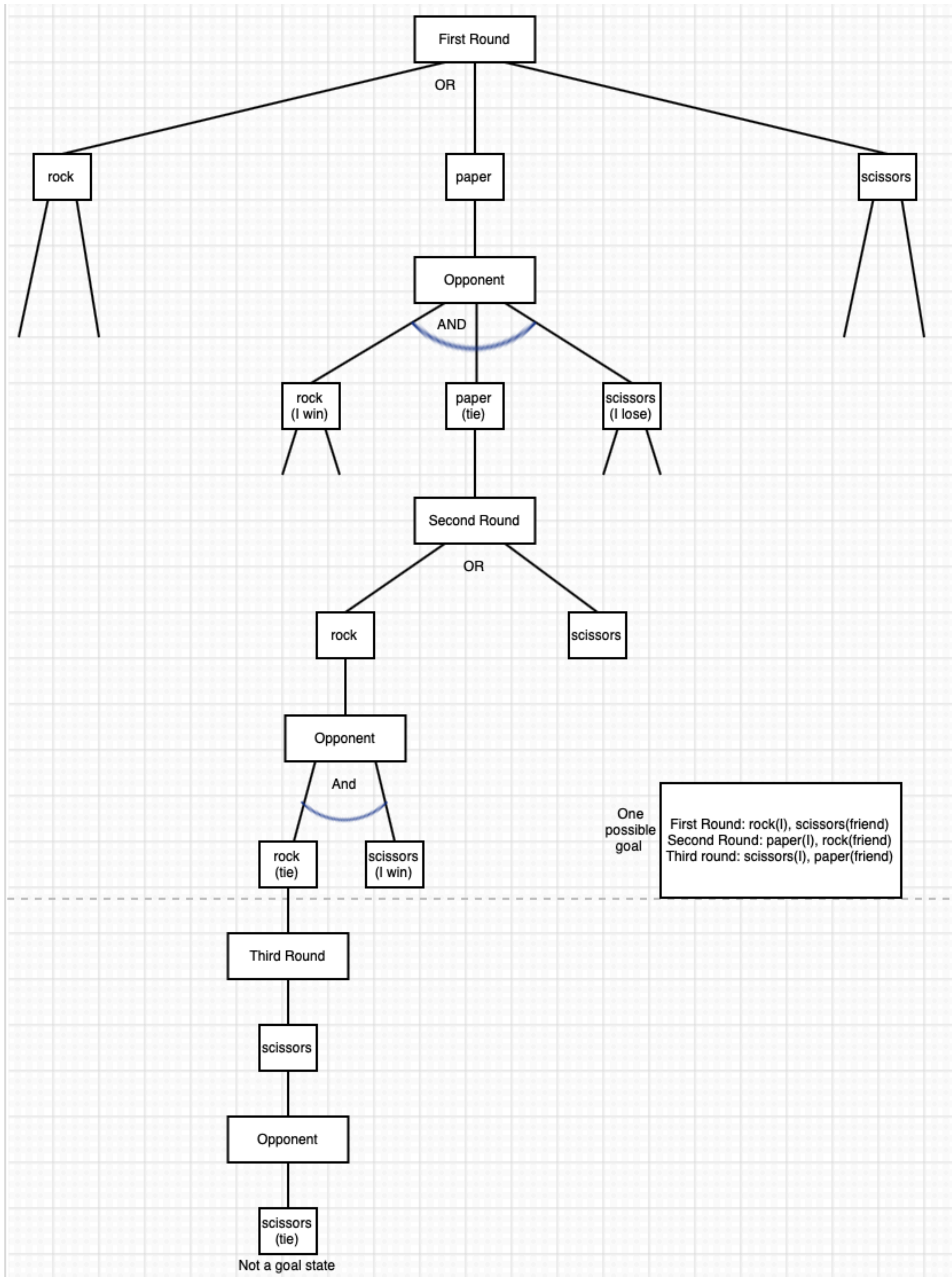
	Nothing Assigned	Assign K1 = 1	Assign K1 = 2	Assign K1 = 3	Assign K1 = 4
K1	1234	1	2	3	4
K2	1234	124	123	234	134
Q1	1234	4	4		1
Q2	1234	23	134	124	23

Backtracking search:



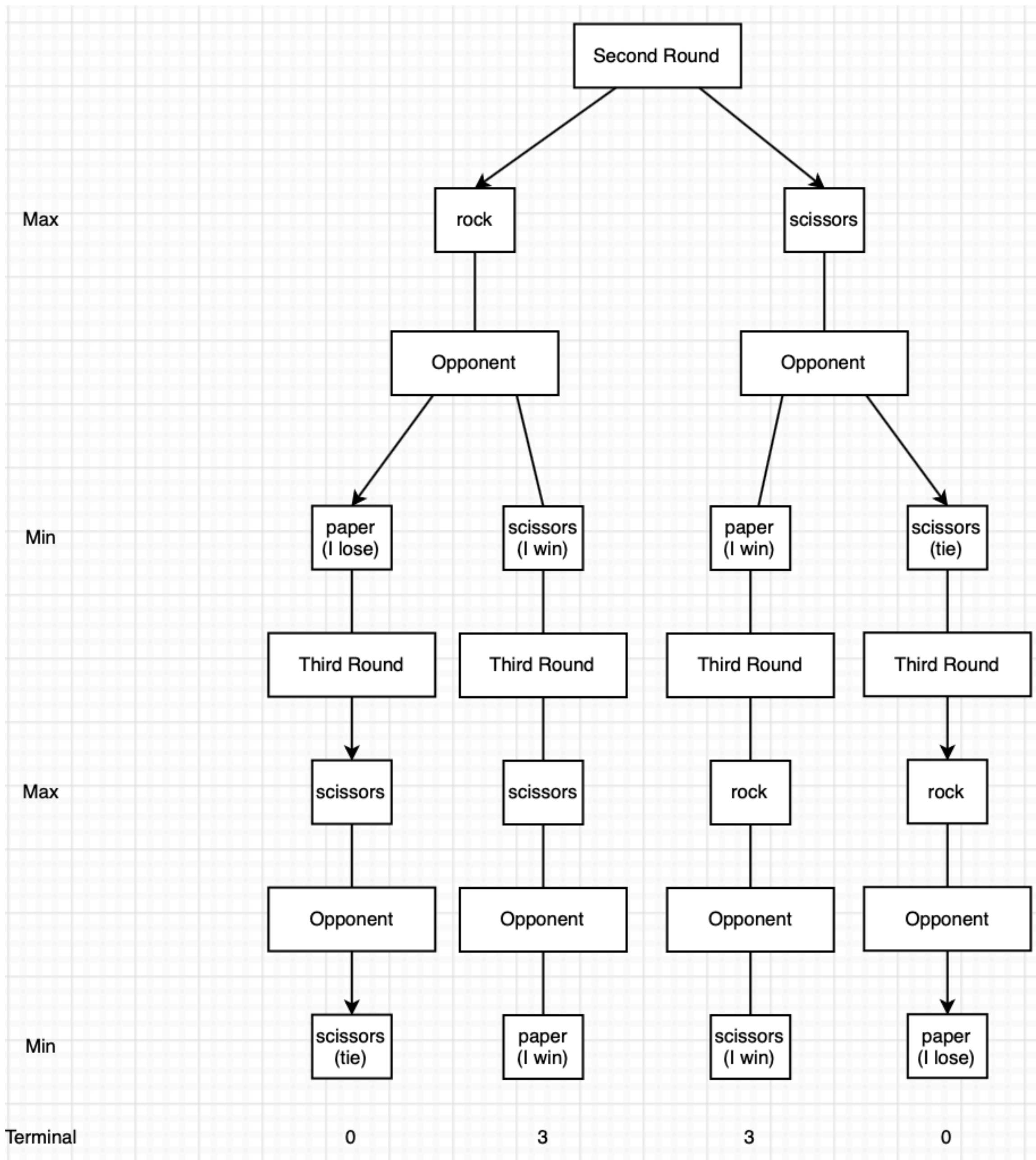
2.

a)



b)

In this situation, I can play **rock** or **scissors** and my friend can play **paper** or **scissors**. If I play rock, my friend plays scissors, then no matter what the result is in the third round, I win this match. However, if he plays paper, then I lose this round and we will tie using scissors at the third round and finally we tie this match. On the contrary, if I play scissors at the second round, my friend plays paper, then I win this match. Else if he plays scissors, then we tied at the second round and he will win me at the third round because I can only play rock and he can only play paper. So we will tie this match. In conclusion, I cannot guarantee a win of this game now.



The above graph is a game tree starting from second round. The connection with arrow is the direction of flow after applying minimax algorithm. This terminal result supports the idea that I cannot guarantee a win overall.

3)

a)

i)

A	B	C	A ∧ B	(A ∧ B) ∨ C
T	T	T	T	T
T	T	F	T	T
T	F	T	F	T
T	F	F	F	F
F	T	T	F	T
F	T	F	F	F
F	F	T	F	T
F	F	F	F	F

5 models

ii)

A	B	A => B	A ∧ (A => B)	A ∧ (A => B) ∧ ¬ B
T	T	T	T	F
T	F	F	F	F
F	T	T	F	F
F	F	T	F	F

0 models

iii)

We assume the statement is ¬f1 ∨ f2. In order to ensure this logic to be true, f1 should be false and f2 should be true. So for f1, exclude all values are true, all other combinations will lead to a false. As a result, we only need to consider that exempt condition. When f1 is true, B ∧ C is true. Thus the final result is still true for this situation. In conclusion, there are $2^5 = 32$ models.

b)

i)

A	B	C	f1: A=>B	f2: A ∨ C	f3: f1∧f2	f4: B ∨ C	f3 => f4
T	T	T	T	T	T	T	T
T	T	F	T	T	T	T	T
T	F	T	F	T	F	T	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	T	T	T	T	T
F	F	F	T	F	F	F	T

This is valid.

ii)

A	B	C	f1: A ∨ B	f2: f1=>C	f3: f2=>C	f4: B=>C	f5: f3∧f4	f2=>f5
T	T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	F	T
T	F	T	T	T	T	T	T	T
T	F	F	T	F	F	T	F	T
F	T	T	T	T	T	T	T	T
F	T	F	T	F	T	F	F	T
F	F	T	F	T	T	T	T	T
F	F	F	F	T	T	T	T	T

This is also valid.