

Intro to AI Written Assignment #1



Information

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- Online Version: [\(https://hackmd.io/PjbPwQsETb2OQXuKBArpFg\).](https://hackmd.io/PjbPwQsETb2OQXuKBArpFg)



A1

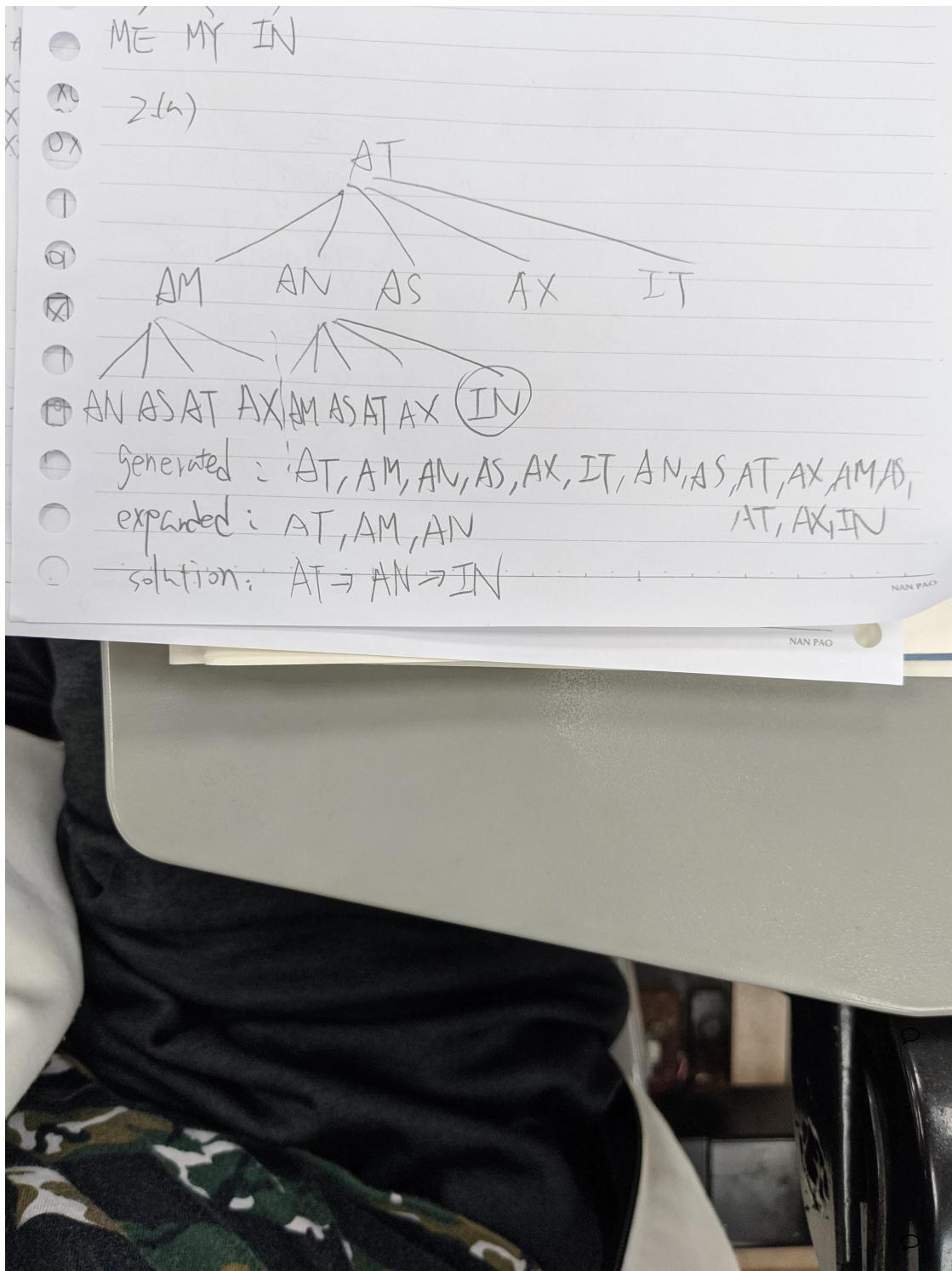
- Robot Mouse Races
 - P(Performance Measure)
 - Time
 - E(Environment)
 - Maze
 - A(Actuators)
 - Robot's Hardwares(wheel controller, engine, etc.)
 - S(Sensors)
 - Camera
- Robothespian
 - P(Performance Measure)
 - Simlarity to human
 - E(Environment)
 - Real World
 - A(Actuators)
 - Robot's Hardwares(Robotic arms, legs, articulations, etc.)
 - S(Sensors)
 - Camera(visual sensor), Audio Senser



A2

2.a



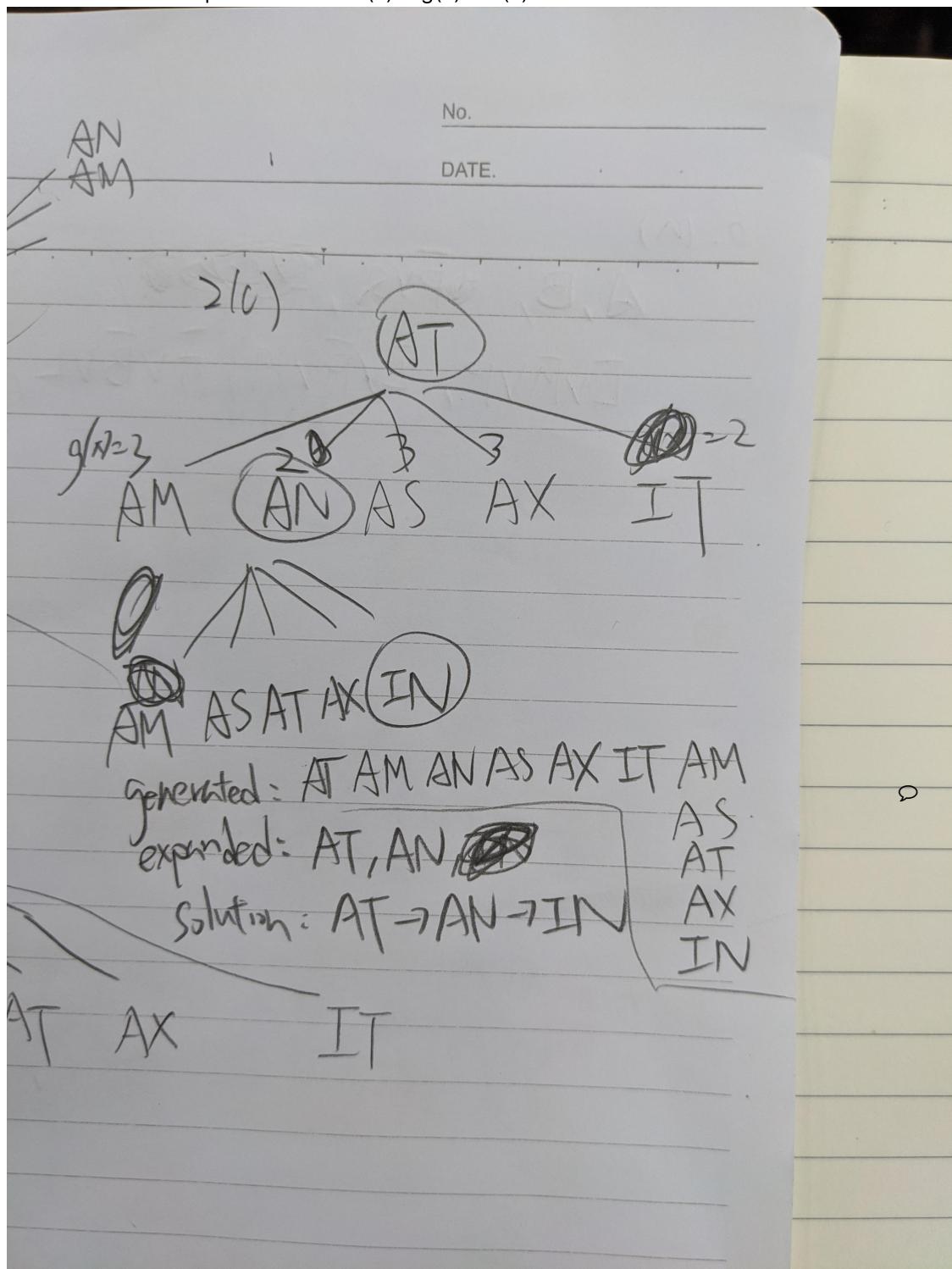


2.b

Since each operation can reduce hamming distance by at most 1, the shortest path is at least of the size of hamming distance

2.c

If use A* search with hamming distance heuristic,
AT and IT will be expand first with $f(x) = g(x) + h(x) = 1 + 1$.



A3

No
Da

3. Init domain ~~$\{0 \sim 9\}$~~ $\{0 \sim 9\} = D_x D_y D_z$

$X = Y^2, X = Z^3$

check arc

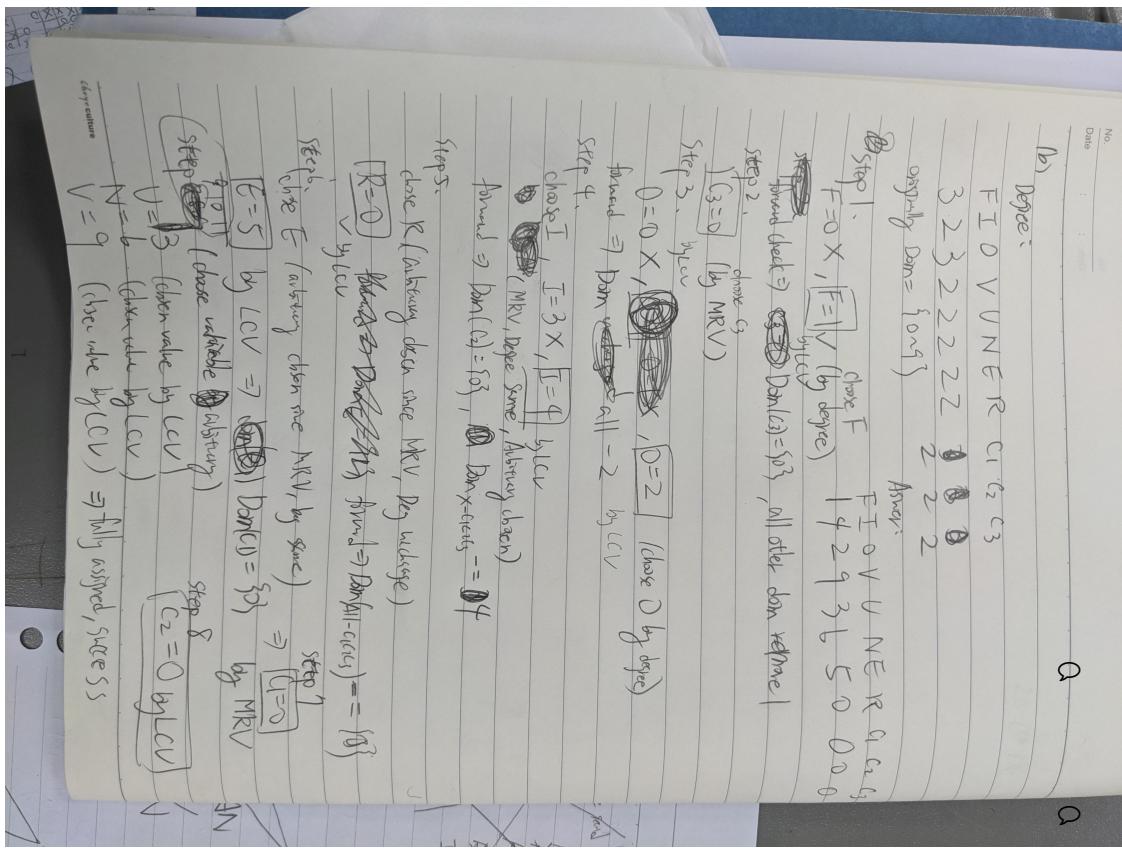
$X \rightarrow Y$	$D_Y = \{0, 1, 2, 3\}$
$X \rightarrow Z$	$D_Z = \{0, 1, 2\}$
$Y \rightarrow X$	$D_X = \{0, 1, 4, 9\} \Rightarrow$ check ($X \rightarrow Z$) again
$X \rightarrow Z$	$D_Z = \{0, 1\}$
$Z \rightarrow X$	$D_X = \{0, 1\}$
$X \rightarrow Y$	$D_Y = \{0, 1\}$ \Rightarrow check ($X \rightarrow Y$) again

No further changes \Rightarrow end so: $D_X = D_Y = D_Z = \{0, 1\}$

4.

FIVE	FOUR	1	2
-FOUR	+ ONE	2	
ONE	FIVE	1	4

A4**4.b**



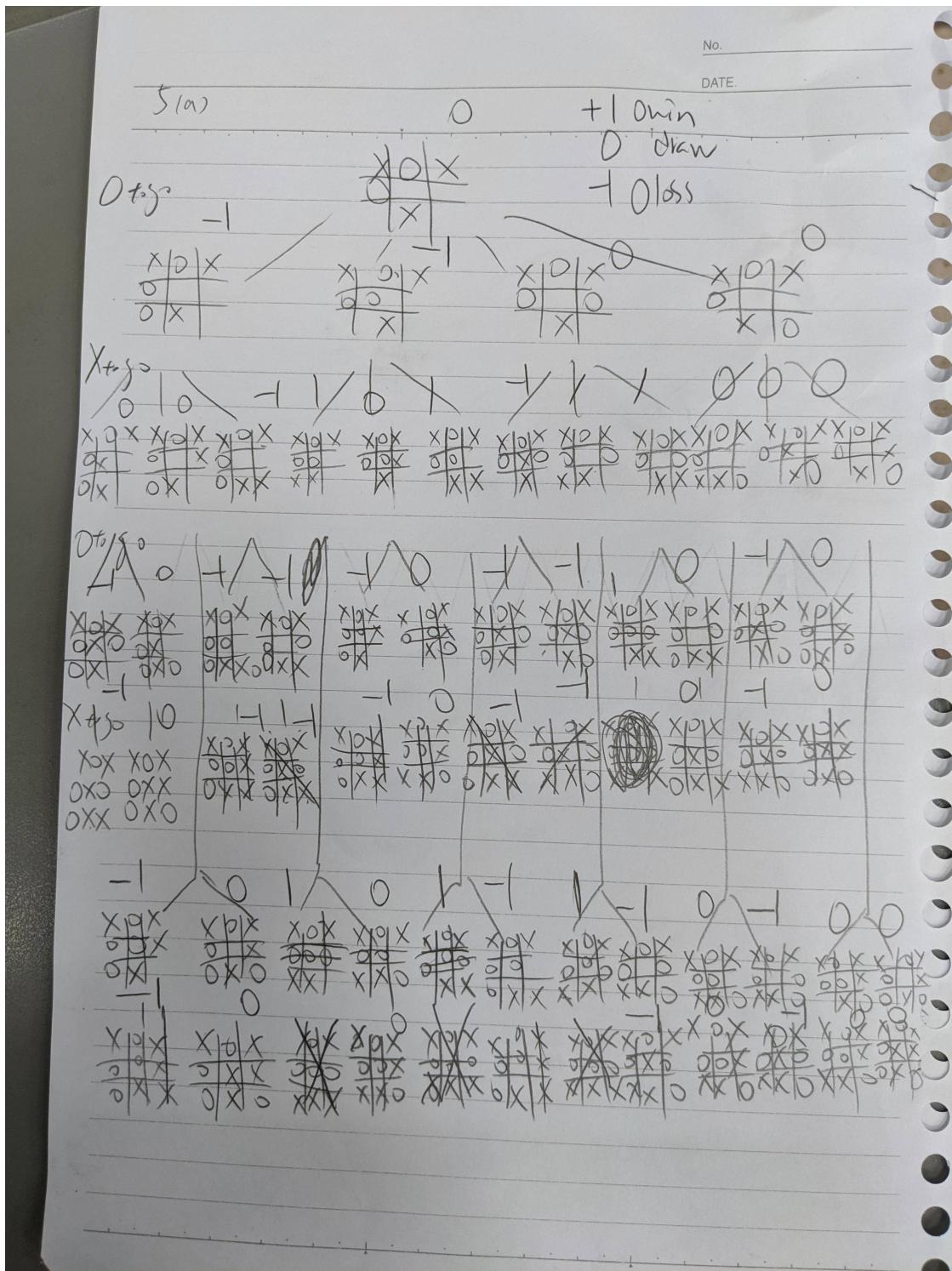
4.a

$X \rightarrow Z$ $D_X = \{0, 1, 4, 9\} \Rightarrow \text{check } (X \rightarrow Z) \text{ again}$
 $Z \rightarrow X$ $D_Z = \{0, 1\}$
 $X \rightarrow Y$ $D_X = \{0, 1\}$ $D_Y = \{9\} \Rightarrow \text{check } (X \rightarrow Y) \text{ again}$
 No further changes \Rightarrow end so: $D_X = D_Y = D_Z = \{0, 1\}$

4.
 FIVE $\begin{matrix} 0 \\ 3 \\ 6 \\ 2 \\ 1 \end{matrix} \begin{matrix} C_1 \\ C_2 \\ C_3 \end{matrix}$
 FOUR $\begin{matrix} 1 \\ 0 \\ 3 \\ 5 \\ 4 \end{matrix} R$
 $\underline{-FOUR} \Rightarrow +ONE$
 ONE $\begin{matrix} 1 \\ 0 \\ 3 \\ 5 \\ 4 \end{matrix} \begin{matrix} C_1 \\ C_2 \\ C_3 \end{matrix}$
 FIVE $\begin{matrix} 1 \\ 0 \\ 3 \\ 6 \\ 5 \end{matrix} \begin{matrix} C_1 \\ C_2 \\ C_3 \end{matrix}$

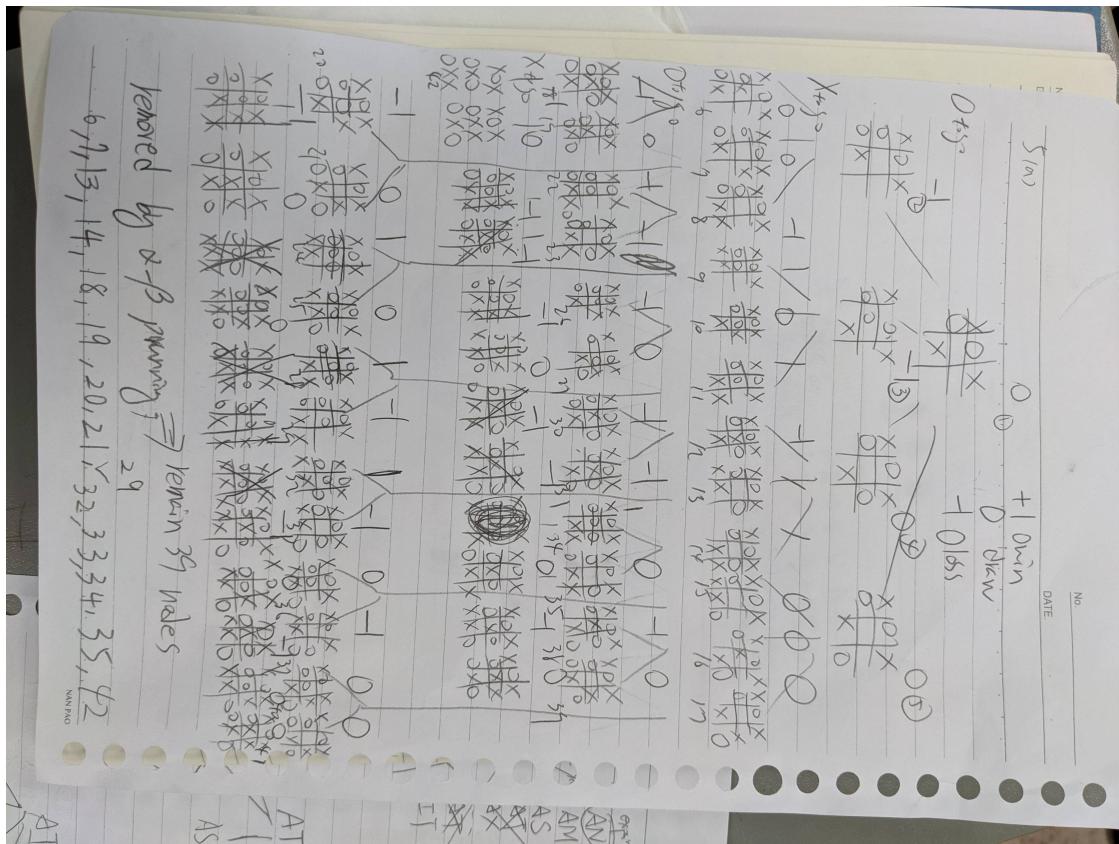
(a)
 Variables: $X = \{F, I, O, V, U, N, E, R, C_1, C_2, C_3\}$
 Domain: $D = \{0, 1, 2, 3, \dots, 9\}$ ~~There is $c_3 = 0$~~
 Constraints:
 1. X pairwise distinct (except C_1, C_2, C_3)
 2. $F \neq 0, O \neq 0$
 3. $10C_1 + E = R + E$
 4. $10C_2 + V = U + N + C_1$
 5. $10C_3 + I = O + D + C_2$
 6. $F = C_3 + F$

A5**5.a**



5.b

remain 39 nodes



A6

6.a

- R1. $\neg A$
- R2. B
- R3. $P \Rightarrow Q$ to $\neg P \Rightarrow Q$
- R4. $A \wedge M \Rightarrow P$ to $\neg(A \wedge M) \vee Q$ to $\neg A \vee \neg M \vee Q$
- R5. $L \wedge B \Rightarrow M$ to $\neg L \vee \neg B \vee M$ (similarly to 4.)
- R6. $A \wedge B \Rightarrow L$ to $\neg A \vee \neg B \vee L$ (similarly to 4.)

6.b

- R1-R6. as 6.a
 - R0. $\neg Q$ (to do proof by contradiction)
 - R7. $R1 \wedge R4$ to $\neg M \vee Q$
 - R8. $R1 \wedge R6$ to $\neg B \vee L$
 - R9. $R2 \wedge R5$ to $\neg L \vee M$
 - R10. $R2 \wedge R8$ to L
 - R11. $R9 \wedge R10$ to M
 - R12. $R7 \wedge R11$ to Q
 - R13. empty clause by $R0 \wedge R12$
- => Proof by contradiction ($R1-6 \wedge \neg Q$ is unsatisfiable)