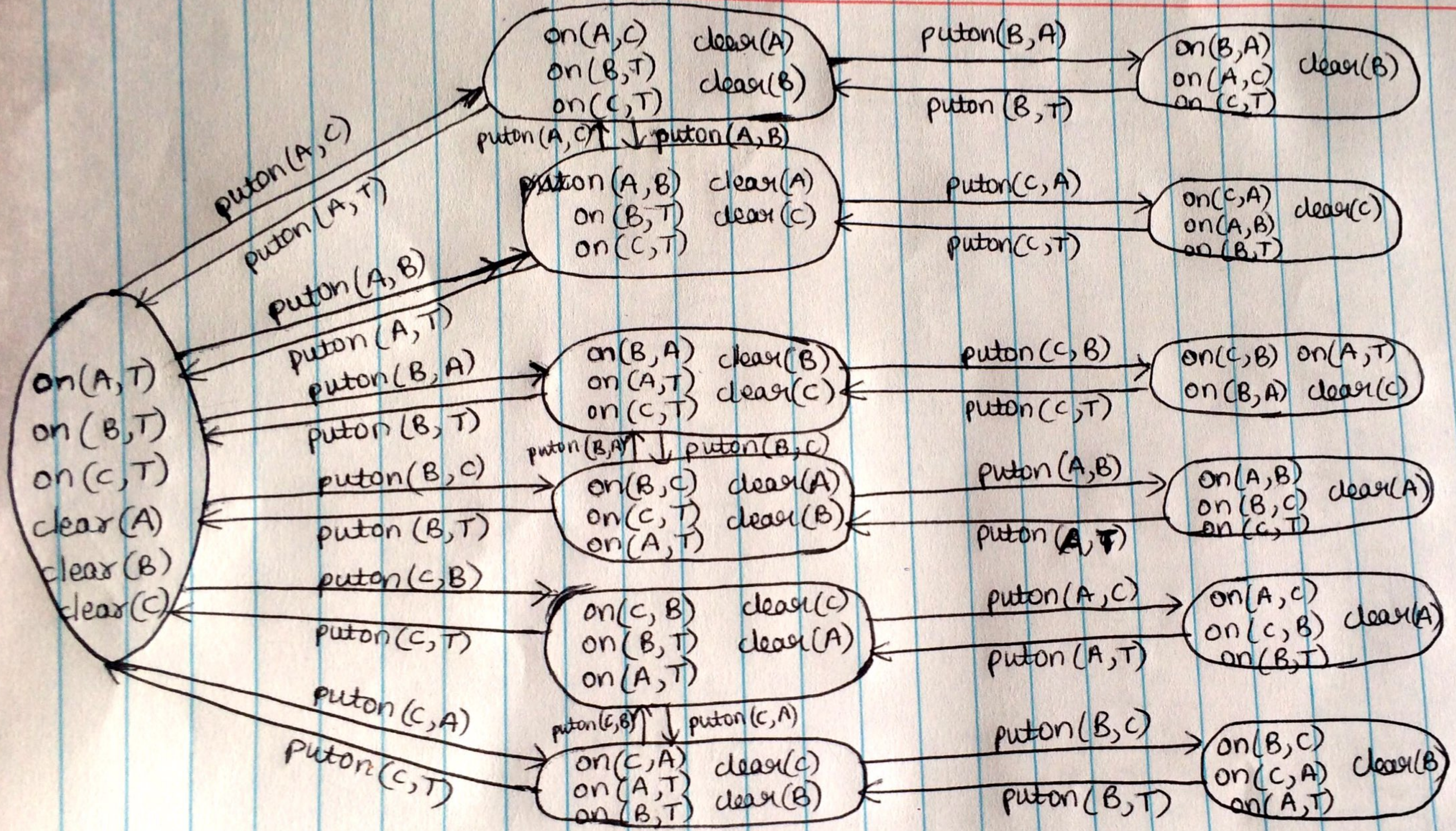
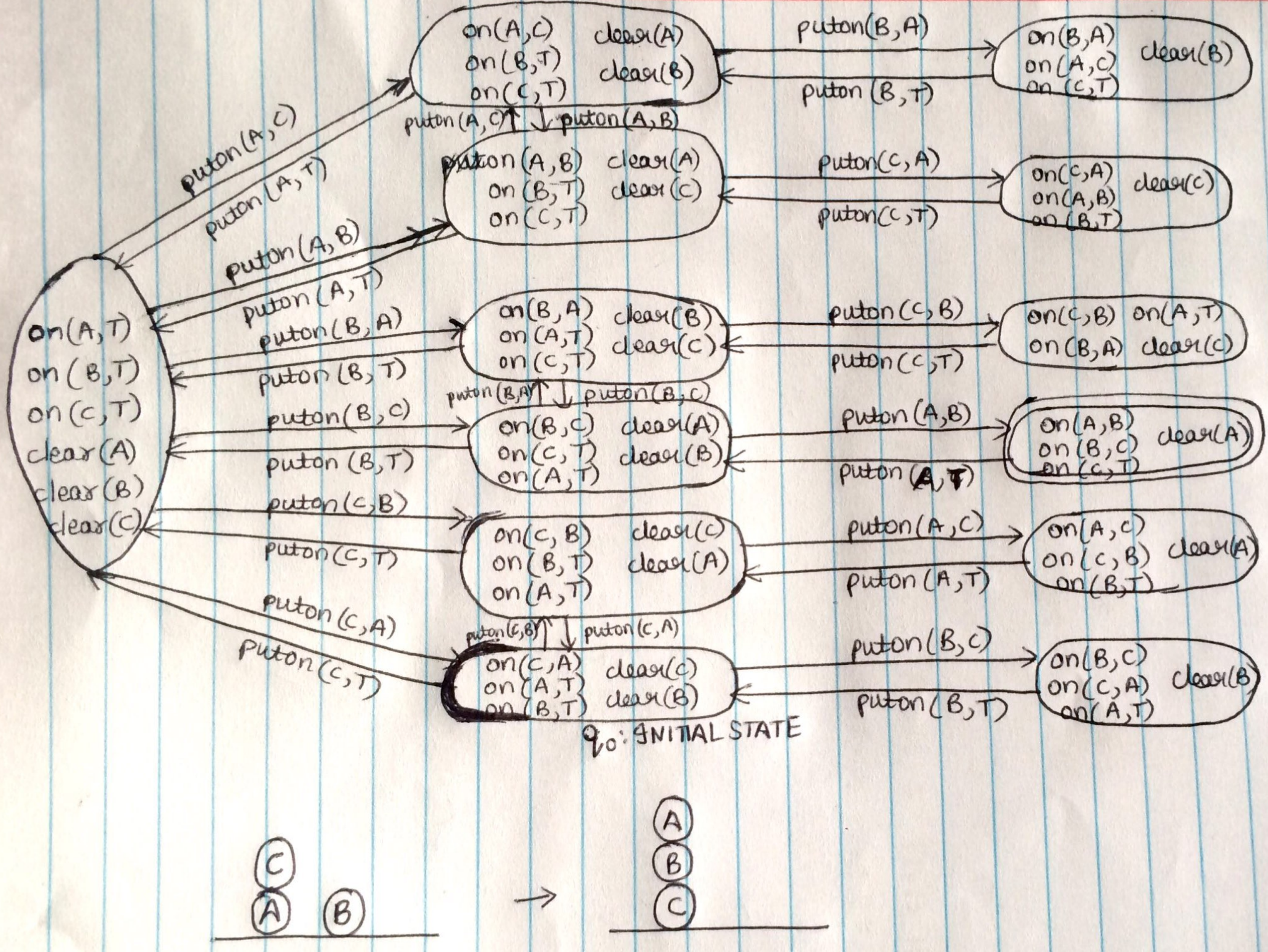
PROBLEM 1

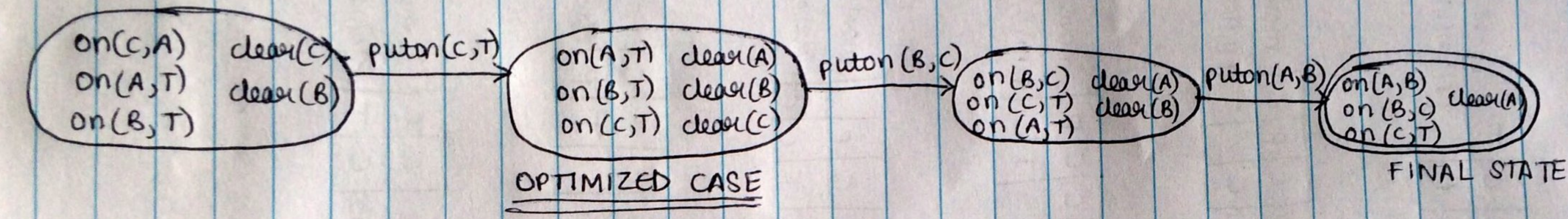

on(A,T)
on(B,T)
on(C,T)
clear(A)
clear(B)
clear(C)
puton(A,C)
puton(A,T)
puton(A,B)
puton(A,T)
puton(B,A)
puton(B,T)
puton(B,C)
puton(B,T)
puton(C,B)
puton(C,T)
puton(C,A)
puton(C,T)
on(A,C) clear(A)
on(B,T) clear(B)
on(C,T)
puton(A,C)
puton(A,B)
on(A,B) clear(A)
on(B,T) clear(C)
on(C,T)
on(B,A) clear(B)
on(A,T) clear(C)
on(C,T)
puton(B,A)
puton(B,C)
on(B,C) clear(A)
on(C,T) clear(B)
on(A,T)
on(C,B) clear(C)
on(B,T) clear(A)
on(A,T)
puton(C,B)
puton(C,A)
on(C,A) clear(C)
on(A,T) clear(B)
on(B,T)
puton(B,A)
puton(B,T)
puton(C,A)
puton(C,T)
puton(C,B)
puton(C,T)
puton(A,B)
puton(A,T)
puton(A,C)
puton(A,T)
puton(B,C)
puton(B,T)
on(B,A) clear(B)
on(A,C)
on(C,T)
on(C,A) clear(C)
on(A,B)
on(B,T)
on(C,B) on(A,T)
on(B,A) clear(C)
on(A,B) clear(A)
on(B,C)
on(C,T)
on(A,C) clear(A)
on(C,B)
on(B,T)
on(B,C) clear(B)
on(C,A)
on(A,T)

PROBLEM 2

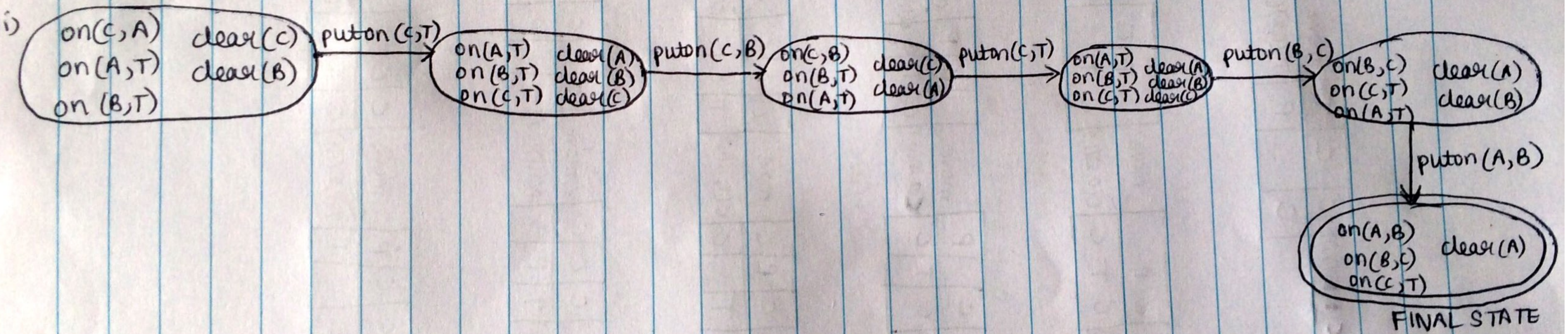

on(A,T)
on(B,T)
on(C,T)
clear(A)
clear(B)
clear(C)
puton(A,C)
puton(A,T)
puton(A,B)
puton(A,T)
puton(B,A)
puton(B,T)
puton(B,C)
puton(B,T)
puton(C,B)
puton(C,T)
puton(C,A)
puton(C,T)
on(A,C) clear(A)
on(B,T) clear(B)
on(C,T)
puton(A,C)
puton(A,B)
puton(B,A)
puton(B,T)
on(B,A) clear(B)
on(A,C)
on(C,T)
on(A,B) clear(A)
on(B,T) clear(C)
on(C,T)
puton(C,A)
puton(C,T)
on(C,A) clear(C)
on(A,B)
on(B,T)
on(B,A) clear(B)
on(A,T) clear(C)
on(C,T)
puton(B,A)
puton(B,C)
puton(C,B)
puton(C,T)
on(C,B) on(A,T)
on(B,A) clear(C)
on(B,C) clear(A)
on(C,T) clear(B)
on(A,T)
puton(A,B)
puton(A,T)
on(A,B) clear(A)
on(B,C)
on(C,T)
F: FINAL STATE
on(C,B) clear(C)
on(B,T) clear(A)
on(A,T)
puton(A,C)
puton(A,T)
on(A,C) clear(A)
on(C,B)
on(B,T)
puton(C,B)
puton(C,A)
on(C,A) clear(C)
on(A,T) clear(B)
on(B,T)
q_0: INITIAL STATE
puton(B,C)
puton(B,T)
on(B,C) clear(B)
on(C,A)
on(A,T)
C
A
B
A
B
C

Test Cases

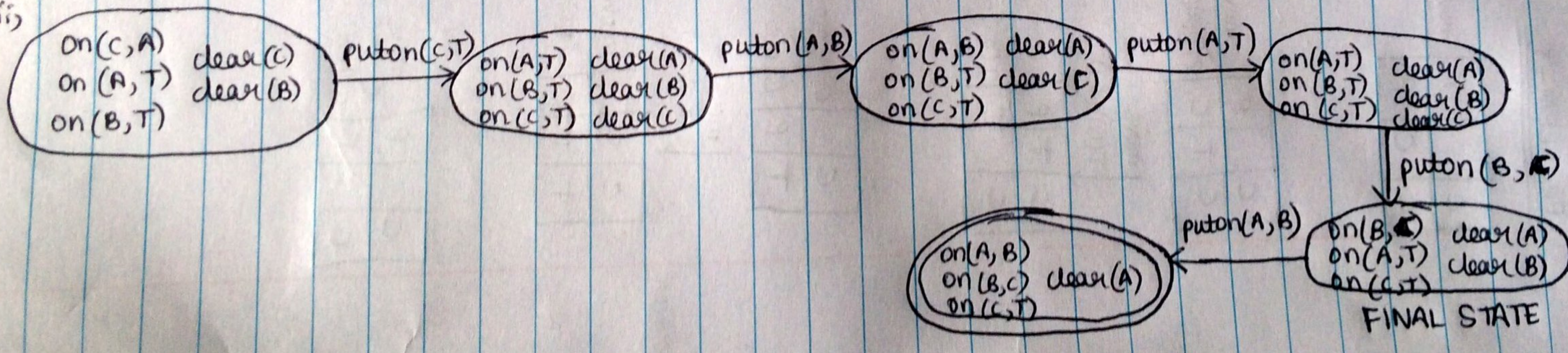
(i)



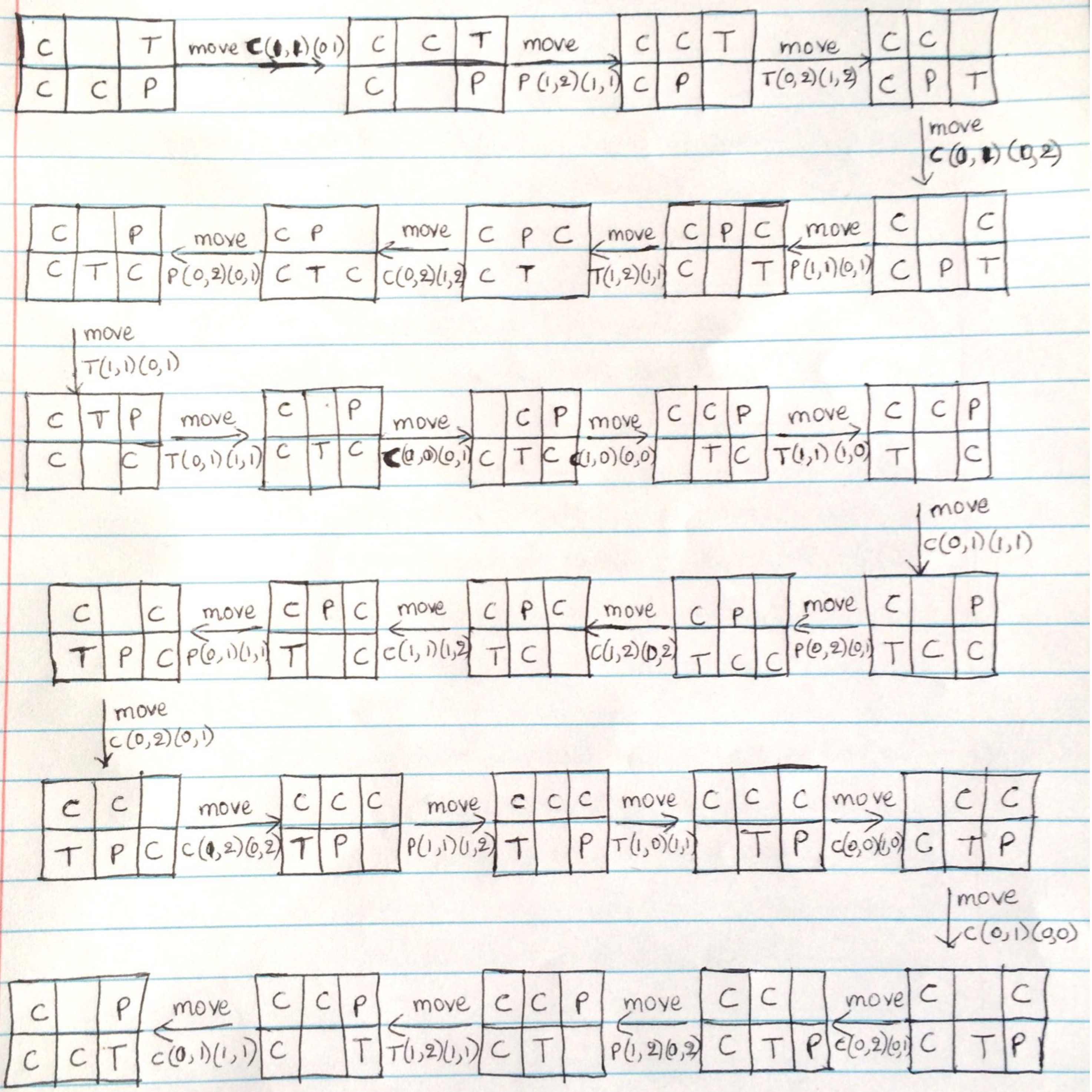
(ii)



(iii)



PROBLEM-3


move C(1,1)(0,1)
move P(1,2)(1,1)
move T(0,2)(1,2)
move C(0,1)(0,2)
move P(1,1)(0,1)
move T(1,2)(1,1)
move C(0,2)(1,2)
move P(0,2)(0,1)
move T(1,1)(0,1)
move T(0,1)(1,1)
move C(0,0)(0,1)
move C(1,0)(0,0)
move T(1,1)(1,0)
move C(0,1)(1,1)
move P(0,2)(0,1)
move C(1,2)(0,2)
move C(1,1)(1,2)
move P(0,1)(1,1)
move C(0,2)(0,1)
move C(1,2)(0,2)
move P(1,1)(1,2)
move T(1,0)(1,1)
move C(0,0)(1,0)
move C(0,1)(0,0)
move C(0,2)(0,1)
move P(1,2)(0,2)
move T(1,2)(1,1)
move C(0,1)(1,1)

PROBLEM 4

① $\sum_{i=1}^{n} i(i+1) = \frac{n(n+1)(n+2)}{3}$

By mathematical Induction:-

For $n=1$:- $\sum_{i=1}^{1} i(i+1) = 1(2) = 2$ (Left Hand Side)

$\frac{n(n+1)(n+2)}{3} = \frac{1(2)(3)}{3} = 2$ (Right Hand Side)

For $n=2$:- $\sum_{i=1}^{2} i(i+1) = 1(2) + 2(3) = 8$ (Left Hand Side)

$\frac{n(n+1)(n+2)}{3} = \frac{2(3)(4)}{3} = 8$ (Right Hand Side)

Let's assume this to be TRUE for $n=K$

For $n=K$:- $\sum_{i=1}^{K} i(i+1) = 1(2) + 2(3) + 3(4) + \dots + K(K+1)$ [Left Hand Side]

Which should be equal to Right Hand Side

$\therefore 1(2) + 2(3) + 3(4) + \dots + K(K+1) = \frac{K(K+1)(K+2)}{3} \longrightarrow (i)$

Now, it should be true for $n=K+1$

For $n=K+1$:- $\sum_{i=1}^{K+1} i(i+1) = 1(2) + 2(3) + 3(4) + 4(5) + \dots + K(K+1) + (K+1)(K+2)$

Substitute equation (i) here

$= \frac{K(K+1)(K+2)}{3} + (K+1)(K+2)$

$= \frac{K(K+1)(K+2) + 3(K+1)(K+2)}{3}$

$= \frac{(K+1)(K+2)[K+3]}{3}$

Hence Proved

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② $\sum_{i=0}^{n} i!\,i = (n+1)! - 1$

LHS : Left Hand Side

RHS : Right Hand Side

By Mathematical Induction :-

For n=0 :- $0!\,0 = 0$ (LHS)

$(0+1)! - 1 = 1 - 1 = 0$ (RHS)

As this is supposed to be true for n=k.

For n=k :- $\sum_{i=0}^{k} i!\,i = (k+1)! - 1 \longrightarrow$ i)

Now, let's prove that this is TRUE for n=k+1.

For n=k+1 :- $\sum_{i=0}^{k+1} i!\,i = \sum_{i=0}^{k} i!\,i + (k+1)!(k+1)$

Substitute i) here

$= [(k+1)! - 1] + [(k+1)!\,(k+1)]$

$= (k+1)!\,[1(k+1)] - 1$

$= (k+2)! - 1$

Hence Proved

③ $n! > 2^n$, $n \geq 4$

$\boxed{n \geq 4}$

By Mathematical Induction :- For n=4 :- $4! = 24$ (LHS)

$2^4 = 16$ (RHS)

Clearly $24 > 16$

∴ True for n

As this is supposed to be true for n=k

For n=k :- $k! > 2^k \rightarrow$ i) , $\boxed{k \geq 4}$

Now, let's prove that this is true for n=k+1

For n=k+1 :- $(k+1)!$

$= (k)!\,(k+1)$

Sub (i) here

$> 2^k (k+1)$

$(k+1) \geq$

$\Rightarrow \boxed{k \geq}$

Since $k \geq 4 \Rightarrow k+1$ will for sure be greater than 2

$> 2^k (2)$

$> 2^{k+1}$

Hence Proved

④ A : Set

A^c : Compliment of A

Show for $n>1$, $(A_1 \cup A_2 \cup A_3 \cup \cdots \cup A_n)^c = A_1^c \cap A_2^c \cap \cdots \cap A_n^c$

For $n=2$:- $(A_1 \cup A_2)^c = A_1^c \cap A_2^c$ (According to De Morghan's Law)

∴ Assume this to be true for $n=k$:-

$$(A_1 \cup A_2 \cup \cdots \cup A_k)^c = A_1^c \cap A_2^c \cap \cdots \cap A_k^{\cap} \rightarrow (i)$$

Now, prove this to be true for $n=k+1$:-

$$(A_1 \cup A_2 \cup \cdots \cup A_{k+1})^c = \cancel{A_1^c \cap A_2^c \cap \cdots \cap A_k^c \cap A_{k+1}^c}$$

~~Sub (i) here~~

$$= (A_1 \cup A_2 \cup \cdots \cup A_k \cup A_{k+1})^c$$

Sub (i) here

$$= (A_1 \cup A_2 \cup \cdots \cup A_k)^c \cap A_{k+1}^c$$

$$= A_1^c \cap A_2^c \cap \cdots \cap A_k^c \cap A_{k+1}^c$$

∴ Hence Proved