# Artificial Intelligence

**Compiled by :**

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## Chapter 2
*Problems only*

- **Different problems**:

✓ Water Jug Problem

✓ Tower of Hanoi Problem

✓ 8 Puzzle Problem

✓ River Crossing Problem: Farmer goat/ Bigamy Problem

✓ 8 Queen's Problem

✓ Missionary Cannibal Problem

✓ Flower Offering in a Temple

✓ Banana Problem

# Problem 1: Water Jug Problem

- You are given two jars of a 6L and 8L capacity. There is no marking on the jars. There is a water tap, which can be used to fill the jar. Your goal is to have exactly 4L water in 8L jar without taking any other jar or measuring device. Solve by production rule system.

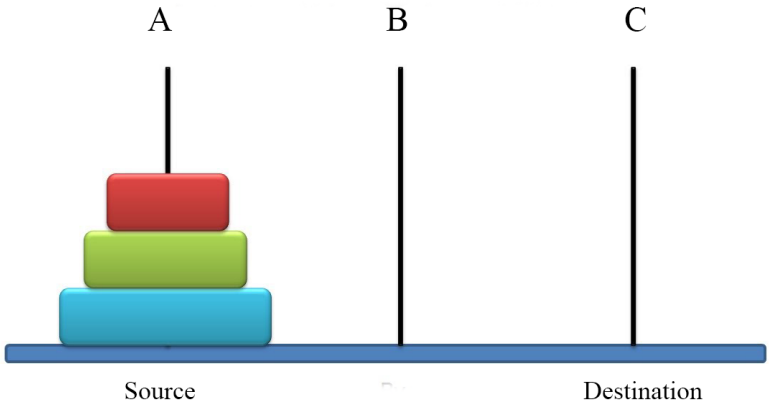
# Problem 2: Tower of Hanoi

Tower of Hanoi is a mathematical puzzle which consists of three towers (pegs) and a number of disks of different sizes, which can slide onto any peg.

**Rules:**

The mission is to transfer all the disks from source peg A to the destination peg C by using an intermediate peg B. A few rules to be followed for Tower of Hanoi are:

- Transfer the disks from the source peg to the destination peg such that at any point of the transformation no large size disk is placed on the smaller one.
- Only one disk may be moved at a time.
- Each disk must be stacked on any one of the pegs.



# Problem 2: Tower of Hanoi

Tower of Hanoi puzzle with n disks can be solved in minimum $\mathbf{2^n-1}$ steps. This presentation shows that a puzzle with 3 disks has taken $\mathbf{2^3 - 1 = 7}$ steps.

Now following could be the steps to solve the tower of Hanoi problem for 3 disks.

*Step1: Move disc 1 from A to C*

*Step 2: Move disc 2 from A to B*

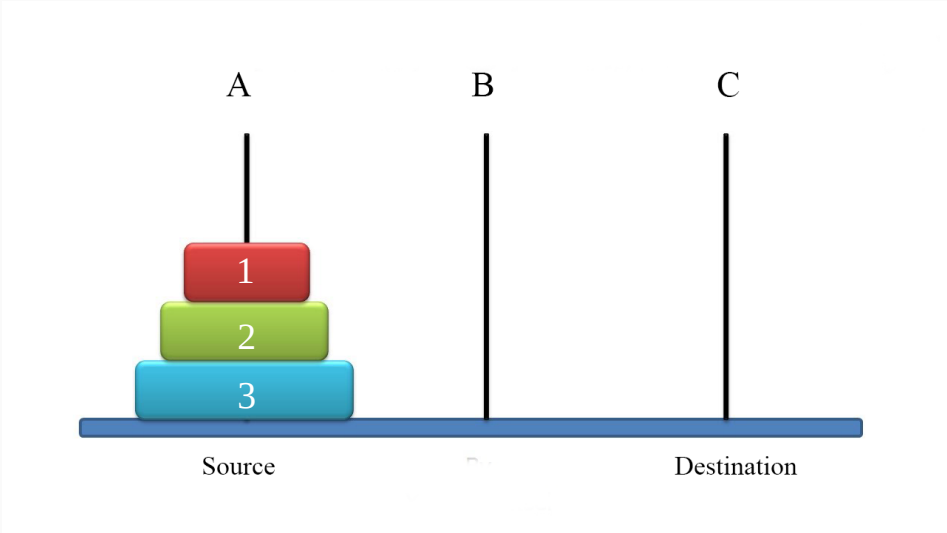
*Step 3: Move disc 1 from C to B*

*Step 4: Move disc 3 from A to C*

*Step 5: Move disc 1 from B to A*

*Step 6: Move disc 2 from B to C*

*Step 7: Move disc 1 from A to C*

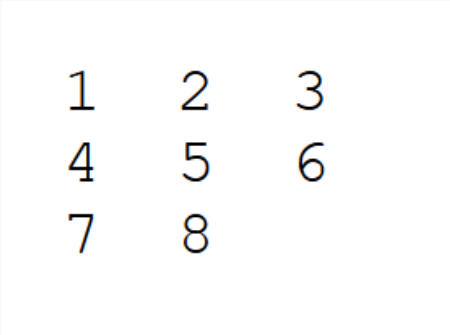



**Note: Illustrate the above steps diagrammatically if possible**

# Problem 3: 8 Puzzle Problem

- The problem consists of an 8 square frames and an empty slot. The tiles are numbered from 1-8. It is possible to move the tiles in the square field by moving the tiles into the empty slot.

- It is played on a 3-by-3 grid with 8 square blocks labeled 1 through 8 and a blank square. Your goal is to rearrange the blocks so that they are in order.



# Problem 3: 8 Puzzle Problem

It consists of :

i. Initial State:

```
    1  3
4   2  5
7   8  6
```

ii. Operators: Up, Down, Left, Right

iii. Final state or Goal State

```
1  2  3
4  5  6
7  8
```

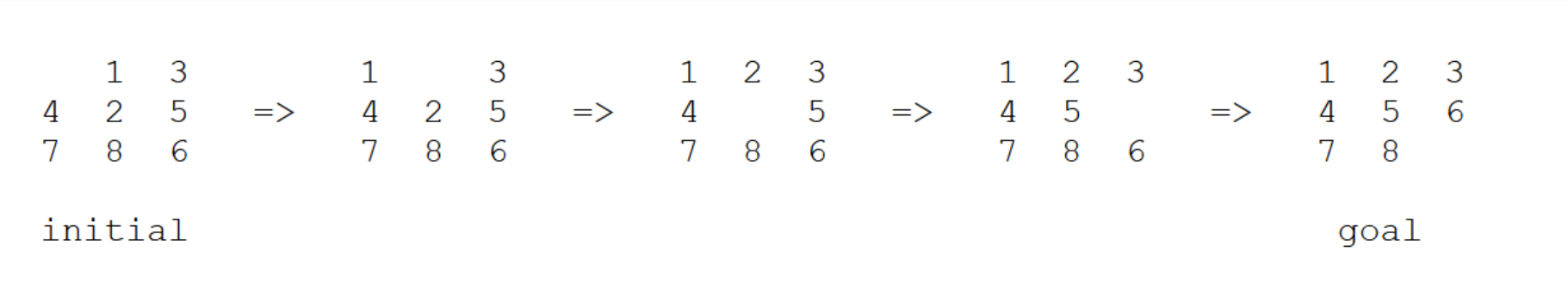
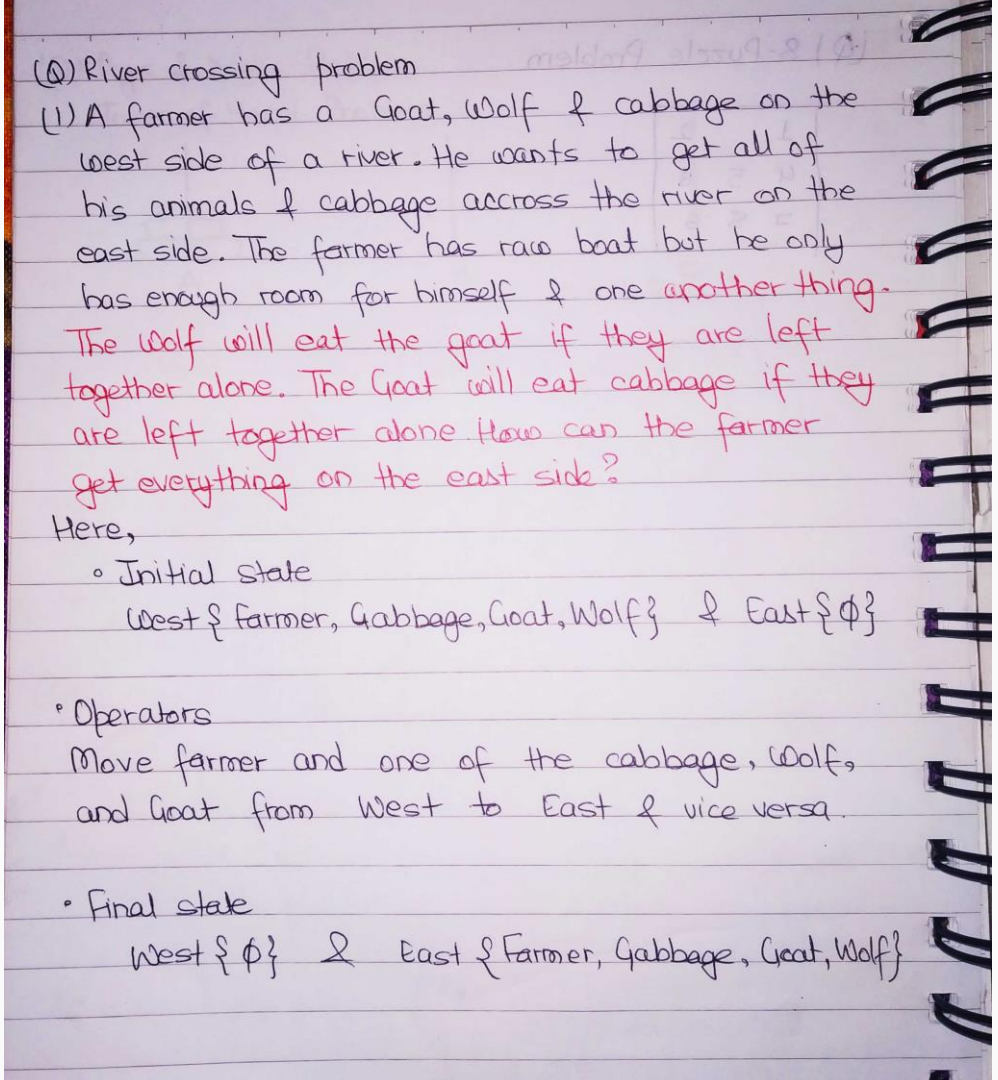



*Illustration with an example*

# Problem 4: River Crossing Problem (Farmer ,Wolf, Goat, Cabbage)



(Q) River crossing problem

(1) A farmer has a Goat, Wolf & cabbage on the west side of a river. He wants to get all of his animals & cabbage accross the river on the east side. The farmer has raw boat but he only has enough room for himself & one another thing. The Wolf will eat the goat if they are left together alone. The Goat will eat cabbage if they are left together alone. How can the farmer get everything on the east side?

Here,

- Initial state

  West { farmer, Gabbage, Goat, Wolf } & East { ϕ }

- Operators

  Move farmer and one of the cabbage, Wolf, and Goat from West to East & vice versa.

- Final state

  West { ϕ } & East { Farmer, Gabbage, Goat, Wolf }

# Problem 4: River Crossing Problem (Farmer ,Wolf, Goat, Cabbage)

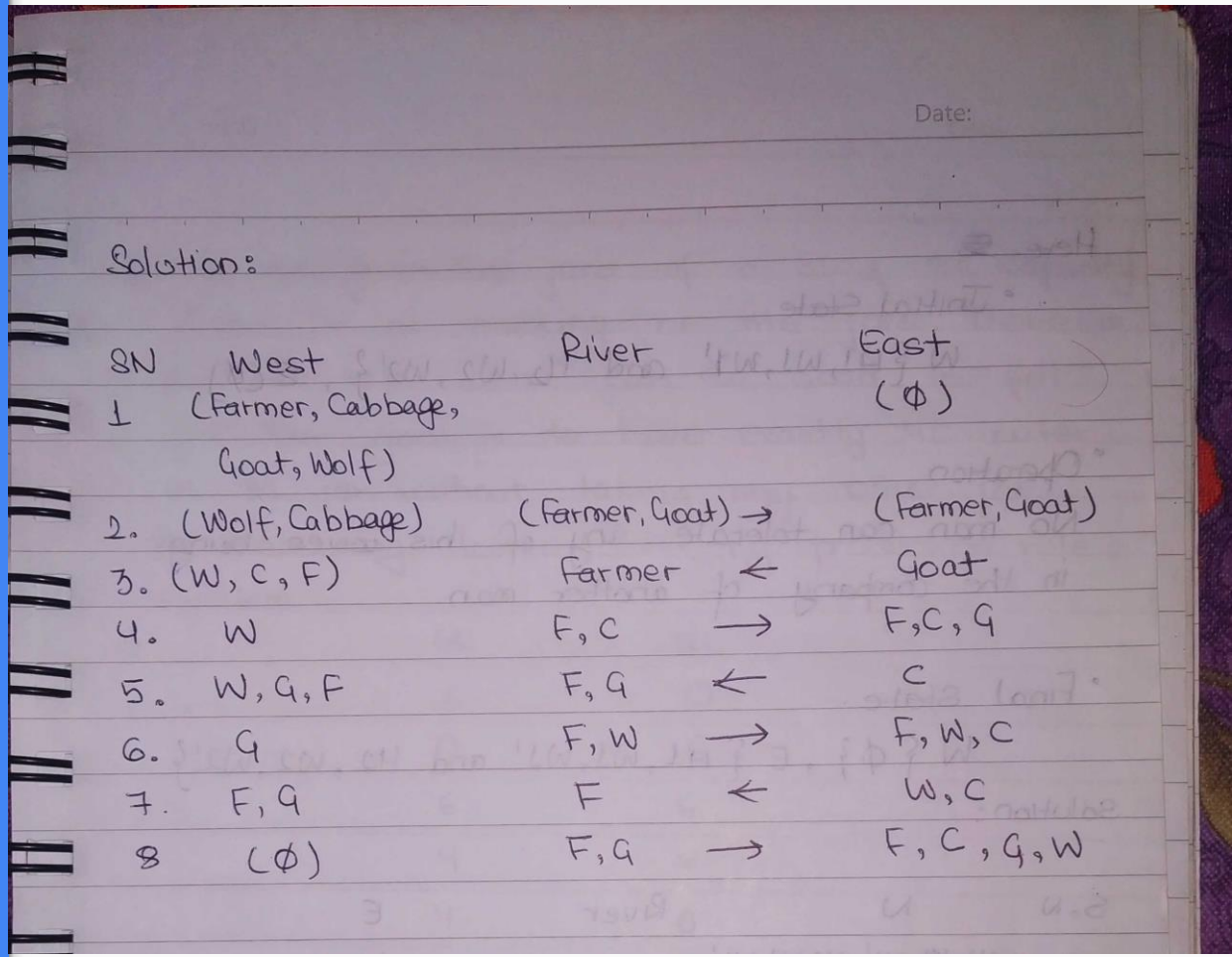
Let,

F = Farmer

W = Wolf

C = Cabbage

G = Goat



# Problem 5: River Crossing Problem (Bigamy Case)

Let,

W = West

E = East

H1= Husband 1

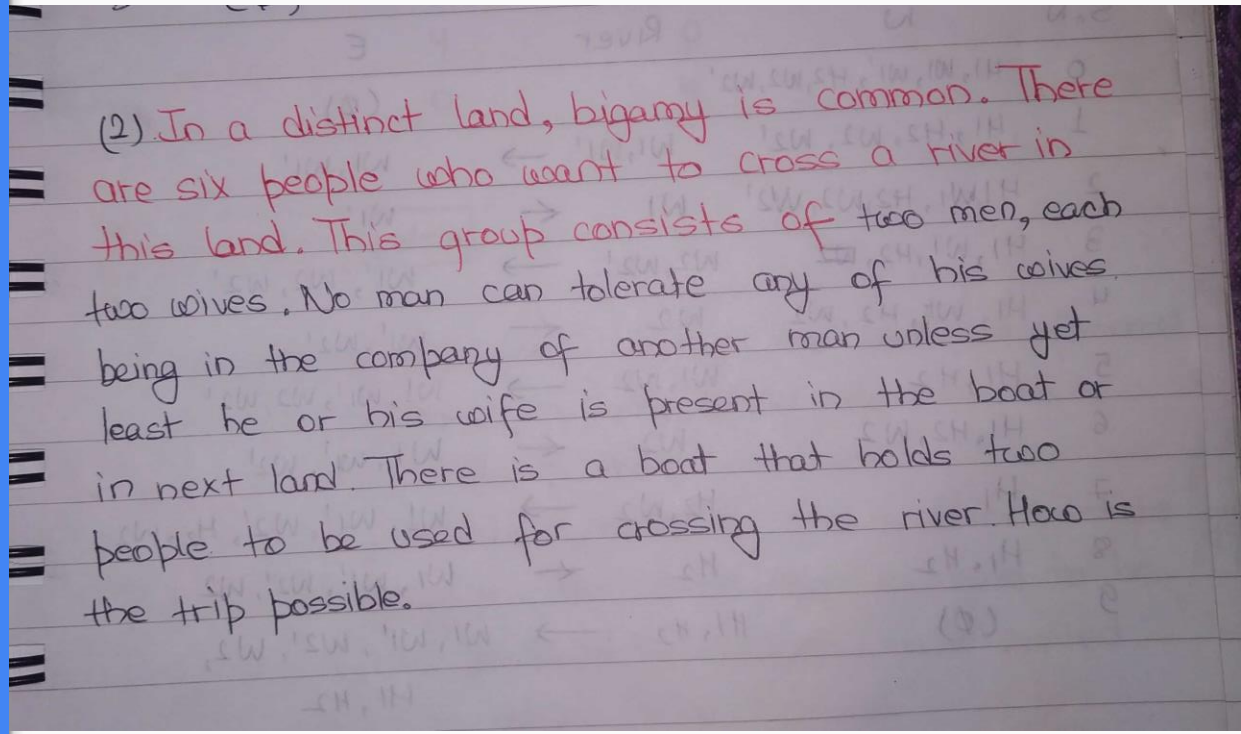
W1= Wife of Husband 1

W1'= Another Wife of Husband 1

H2= Husband 2

W2= Wife of Husband 2

W2'= Another Wife of Husband 2



# Problem 5: River Crossing Problem (Bigamy Case)

Let,

W = West

E = East

H1 = Husband 1

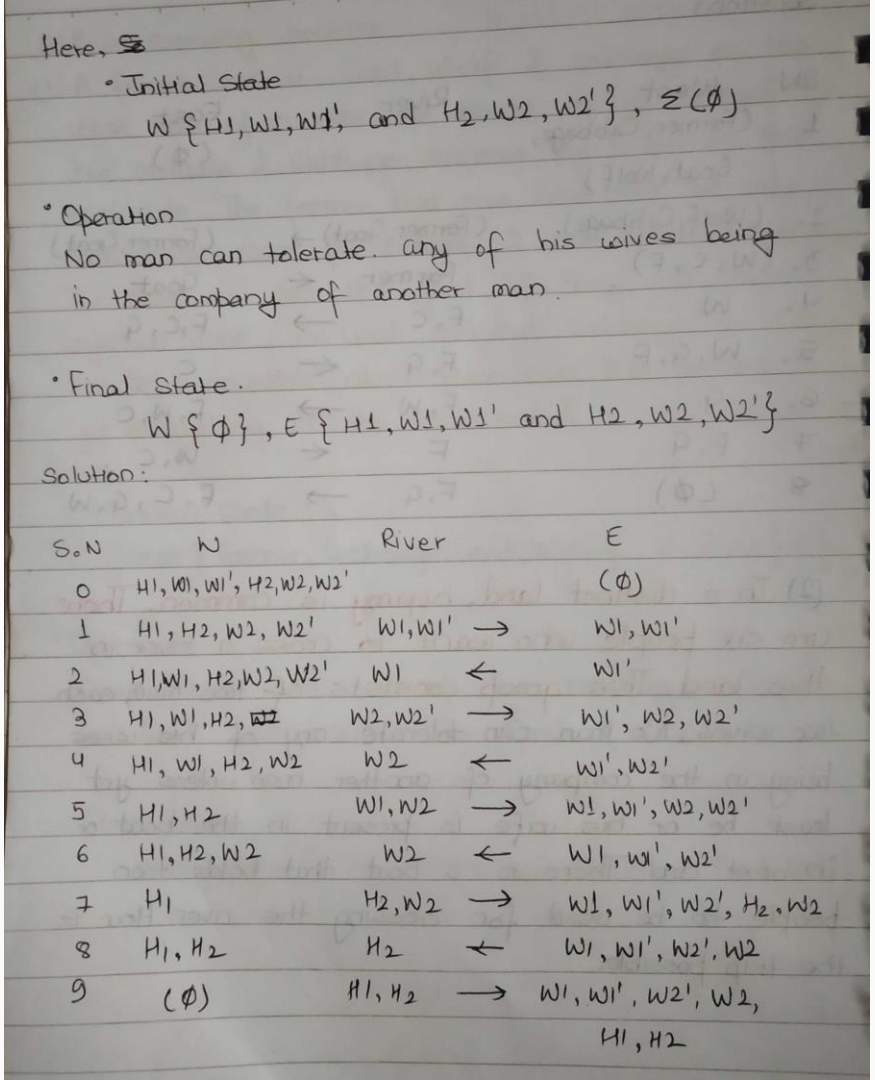
W1 = Wife of Husband 1

W1' = Another Wife of Husband 1

H2 = Husband 2

W2 = Wife of Husband 2

W2' = Another Wife of Husband 2



Here,

- Initial State

  W {H1, W1, W1', and H2, W2, W2'}, E (Ø)

- Operation

  No man can tolerate any of his wives being in the company of another man.

- Final State.

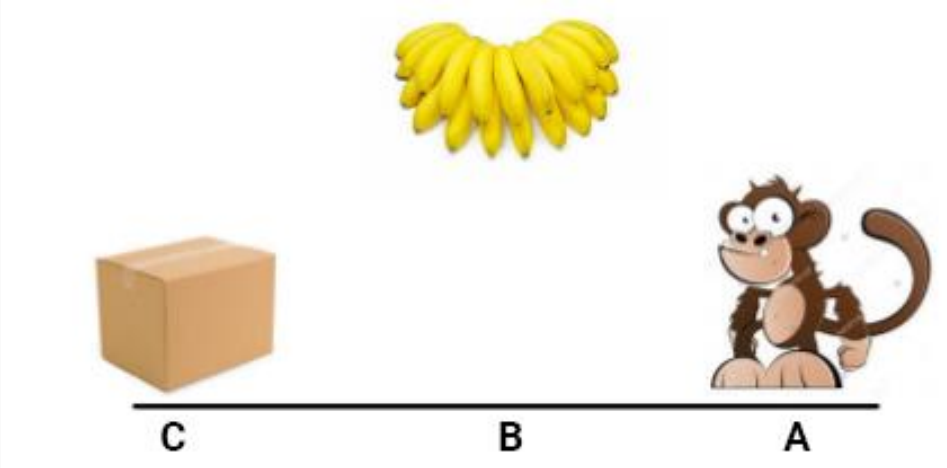
  W {Ø}, E {H1, W1, W1' and H2, W2, W2'}

Solution:

| S.N | W | River | | E |
|---|---|---|---|---|
| 0 | H1, W1, W1', H2, W2, W2' | | | (Ø) |
| 1 | H1, H2, W2, W2' | W1, W1' | → | W1, W1' |
| 2 | H1, W1, H2, W2, W2' | W1 | ← | W1' |
| 3 | H1, W1, H2, ~~W2~~ | W2, W2' | → | W1', W2, W2' |
| 4 | H1, W1, H2, W2 | W2 | ← | W1', W2' |
| 5 | H1, H2 | W1, W2 | → | W1, W1', W2, W2' |
| 6 | H1, H2, W2 | W2 | ← | W1, W1', W2' |
| 7 | H1 | H2, W2 | → | W1, W1', W2', H2, W2 |
| 8 | H1, H2 | H2 | ← | W1, W1', W2', W2 |
| 9 | (Ø) | H1, H2 | → | W1, W1', W2', W2, H1, H2 |

# Problem 6: Monkey Banana Problem

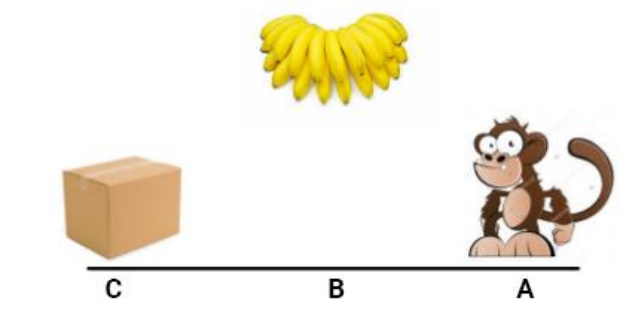
Question: “A monkey is in a room. A bunch of bananas is hanging from the ceiling. The monkey cannot reach then bananas directly. There is a box in the corner of the room. How can the monkey get the bananas ? ”



# Problem 6: Monkey Banana Problem

Question: “A monkey is in a room. A bunch of bananas is hanging from the ceiling. The monkey cannot reach then bananas directly. There is a box in the corner of the room. How can the monkey get the bananas ? ”

*Answer*: The monkey must push the box under the bananas, then stand on the box and grab the bananas.



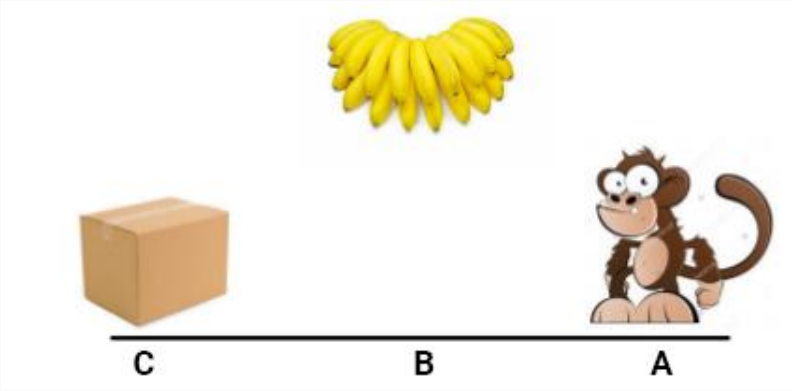

*Note: The solutions must proceed in an algorithm & each elements must be defined.*

# Problem 6: Monkey Banana Problem

- Initially, the monkey is at *location 'A'*, the banana is at *location 'B'* and the box is at *location 'C'*. The monkey and box have height "low"; but if the monkey climbs onto the box will have height "High", the same as the bananas.

• **The action available to the monkey include:**

- *"GO" from one place to another.*
- "PUSH" an object from one place to another.
- "Climb" onto an object.
- "Grasp" an object.




• Grasping results in holding the object if the monkey and the object are in the same place at the same height

# Problem 6: Monkey Banana Problem

**Initial States:** At (monkey, A), At (banana, B), At (box, C)

Position (monkey, low), Position (banana, high), Position (box, low)

**So the solution may be of following steps:**

1. GO (A,C) *// Monkey moves from position A to C*
2. PUSH (Box, C, B, Low) *// Monkey pushes Box from C to B but at low height*
3. Climb Up(Box , B) *// Monkey climb to the Box at position B*
4. Grasp (banana, B, High) *// Monkey grasp the banana from the Box at position B*
5. Climb down(Box) *// Monkey climb down from the box*
6. Push (Box, B, C, Low) *// Monkey pushes the box back to position C*

# Problem 6: Monkey Banana Problem (With a stick)

**Initial States:** At (monkey, A), At (banana, B), At (box, C), At(stick, Box, C)

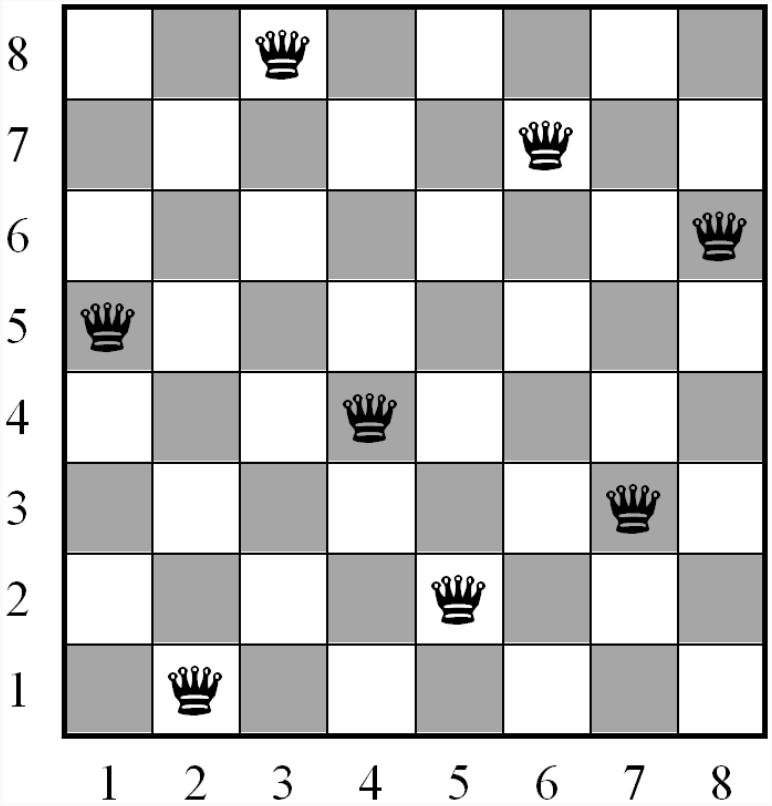
Position (monkey, low), Position (banana, high), Position (box, low)

## So the solution may be of following steps:

1. GO (A,C) *// Monkey moves from position A to C*
2. PUSH (Box, C, B, Low) *// Monkey pushes Box from C to B but at low height*
3. Grasp (Stick, Box, B ) *// Monkey grasp the stick from the top of box*
4. Climb Up(Box , B) *// Monkey climb to the Box at position B*
5. Hit (banana, B , Stick, High ) *// Monkey hit the banana from the top of box with a stick*
6. Climb down(Box) *// Monkey climb down from the box*
7. *Grasp (banana, B) // Monkey grasp & collect banana*
6. Push (Box, B, C, Low) *// Monkey pushes the box back to position C*

# Problem 7: 8 Queen's Problem

- The eight queens puzzle is the problem of placing eight chess queens on an 8×8 chessboard so that no two queens threaten each other; thus, a solution requires that no two queens share the same row, column, or diagonal.



# Problem 8: Flower Offering in a temple

- Consider a person having certain number of flowers and he has to visit 3 temples and has equally numbers to present flower to each temple. When enters in any temple with flowers, the number of flower just become double. After visiting each temple he returns with empty hand. How many flower were there with him initially and how many flower he offered to each temple ?

# Problem 9: Missionary Cannibal Problem

- 3 missionaries & 3 cannibals find themselves on one side of the river. The missionaries wants to manage the trip across the river in such a way that the no. of missionaries on either side of the river is never less than the number of cannibals who are on the same side. There is a single boat that holds 2 people at a time. Find a solution to get them across the river.

THANK YOU

# Any Queries ?