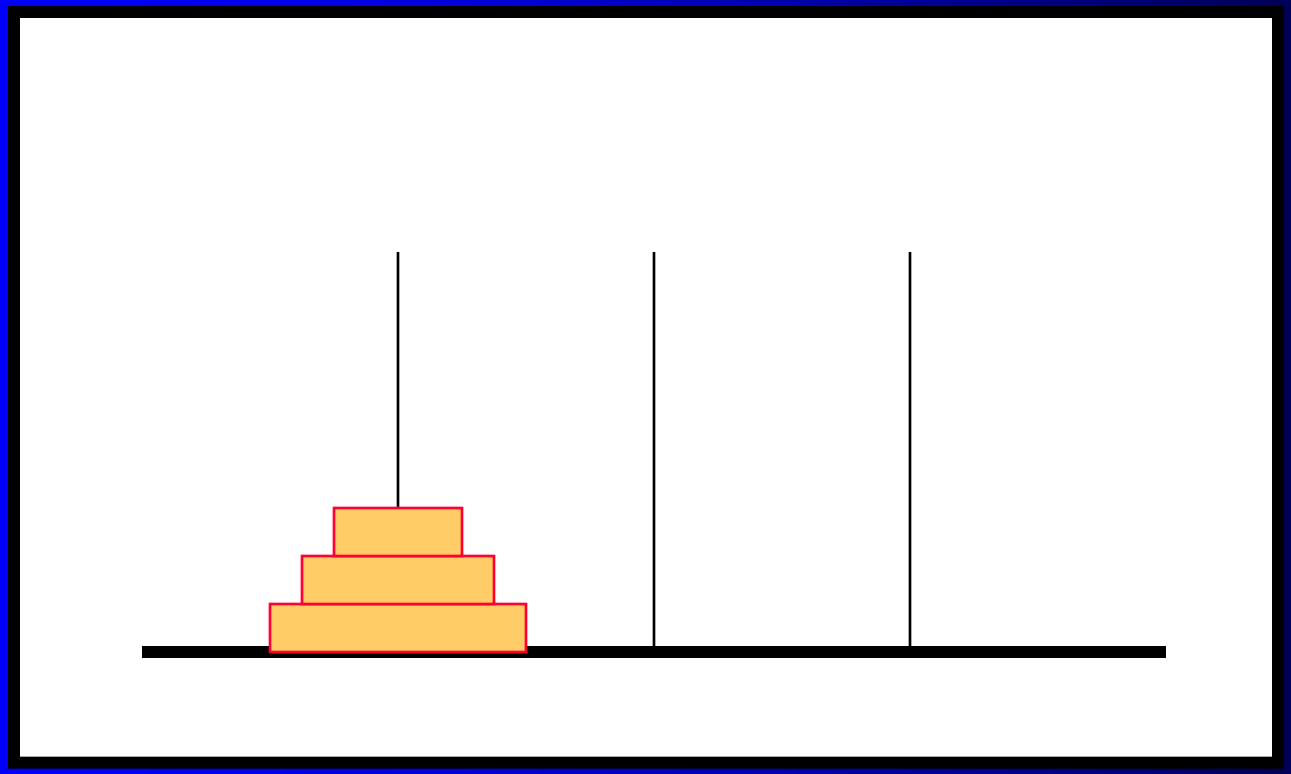
Recursion

- Reading: Savitch, Chapter 11

Recursion – Case Study

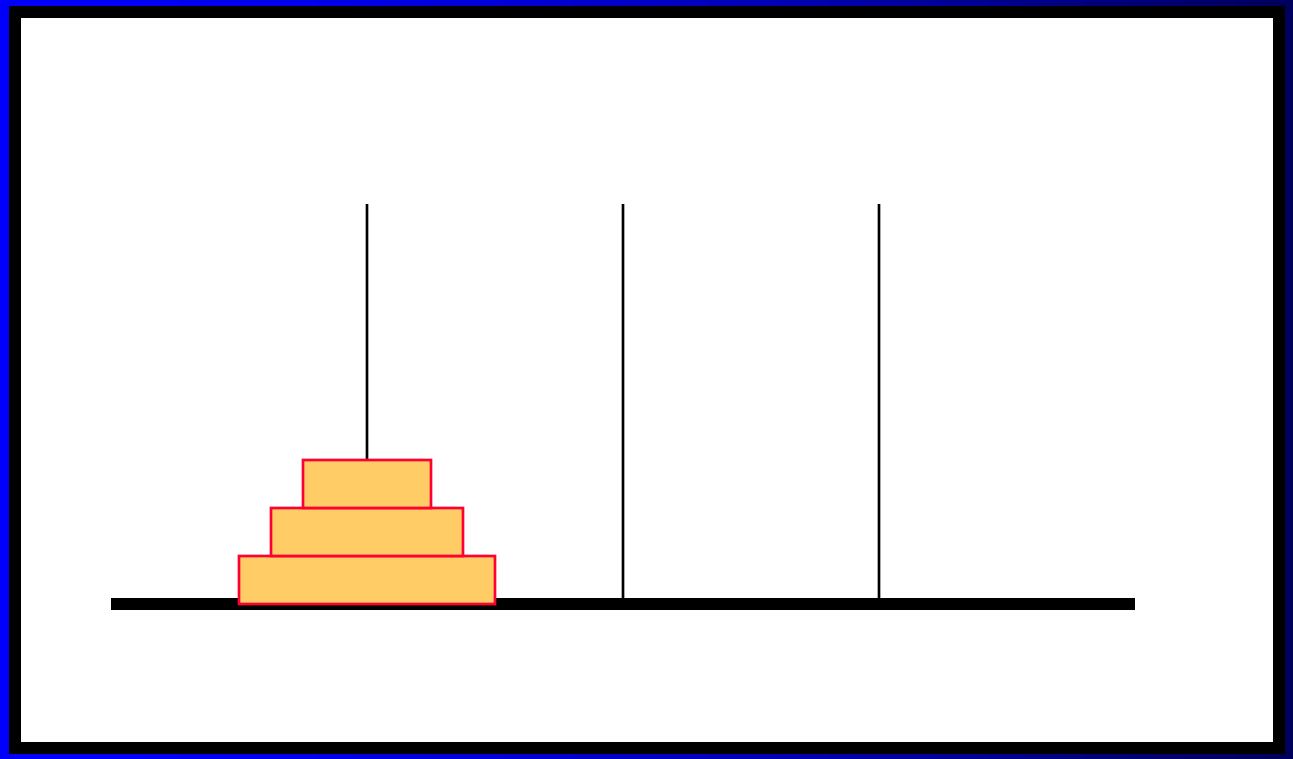
- The Towers of Hanoi



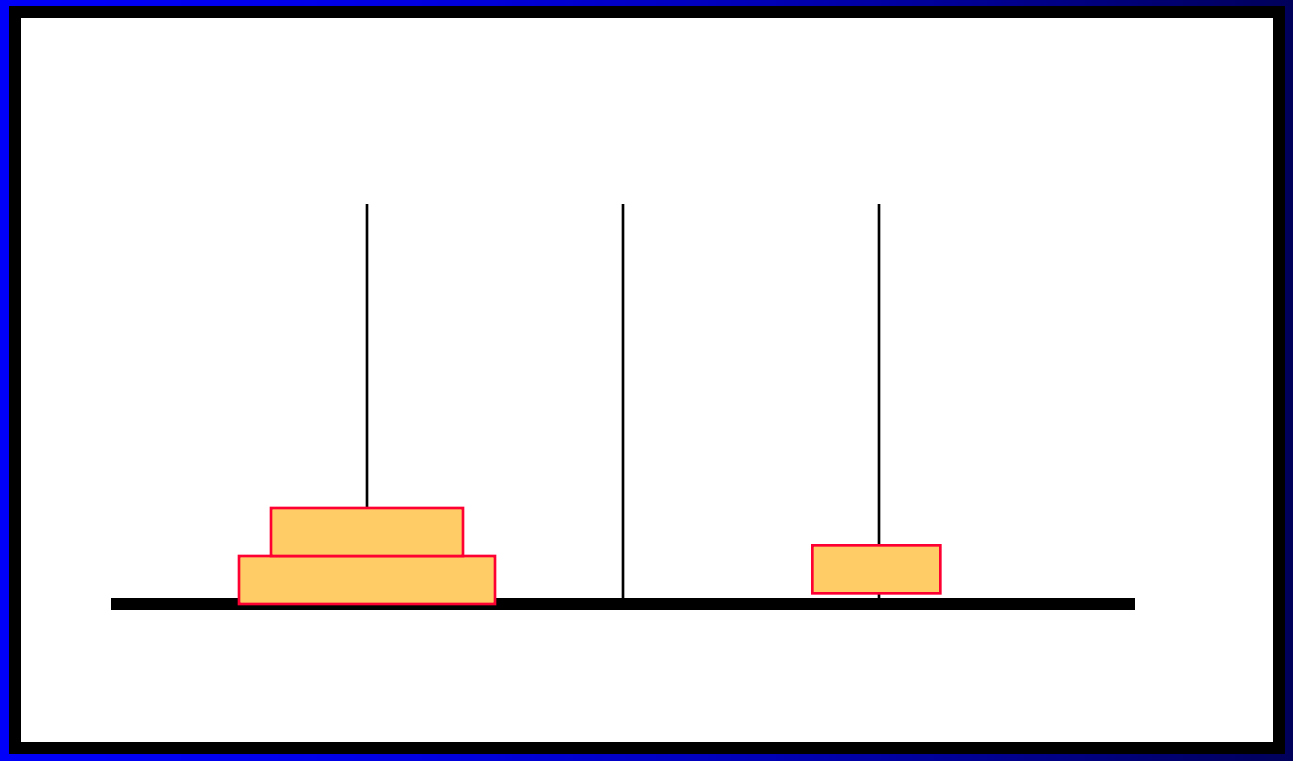
- The goal: to move all of the disks from their original (first) peg to the destination (third) peg.

- The rules:
  - can move one disk at a time.
  - cannot put a larger disk on top of a smaller disk.

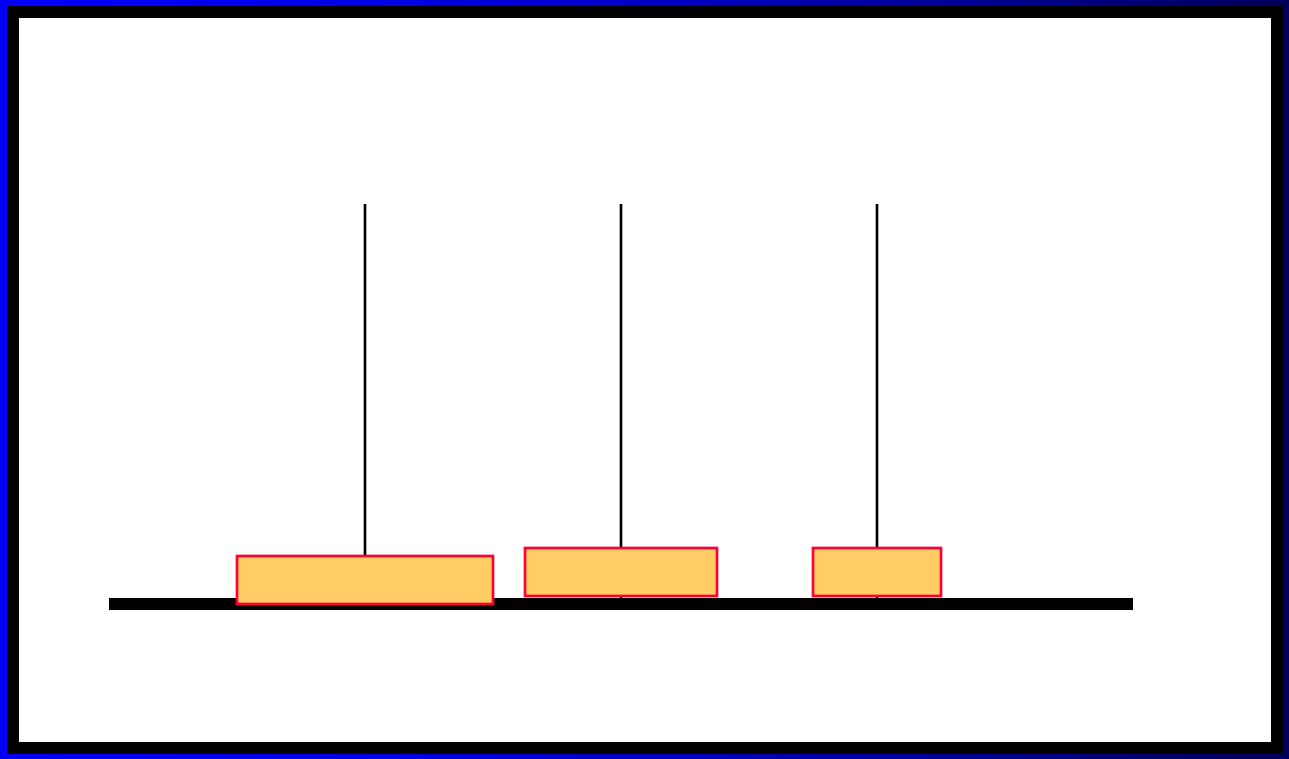
The Towers of Hanoi



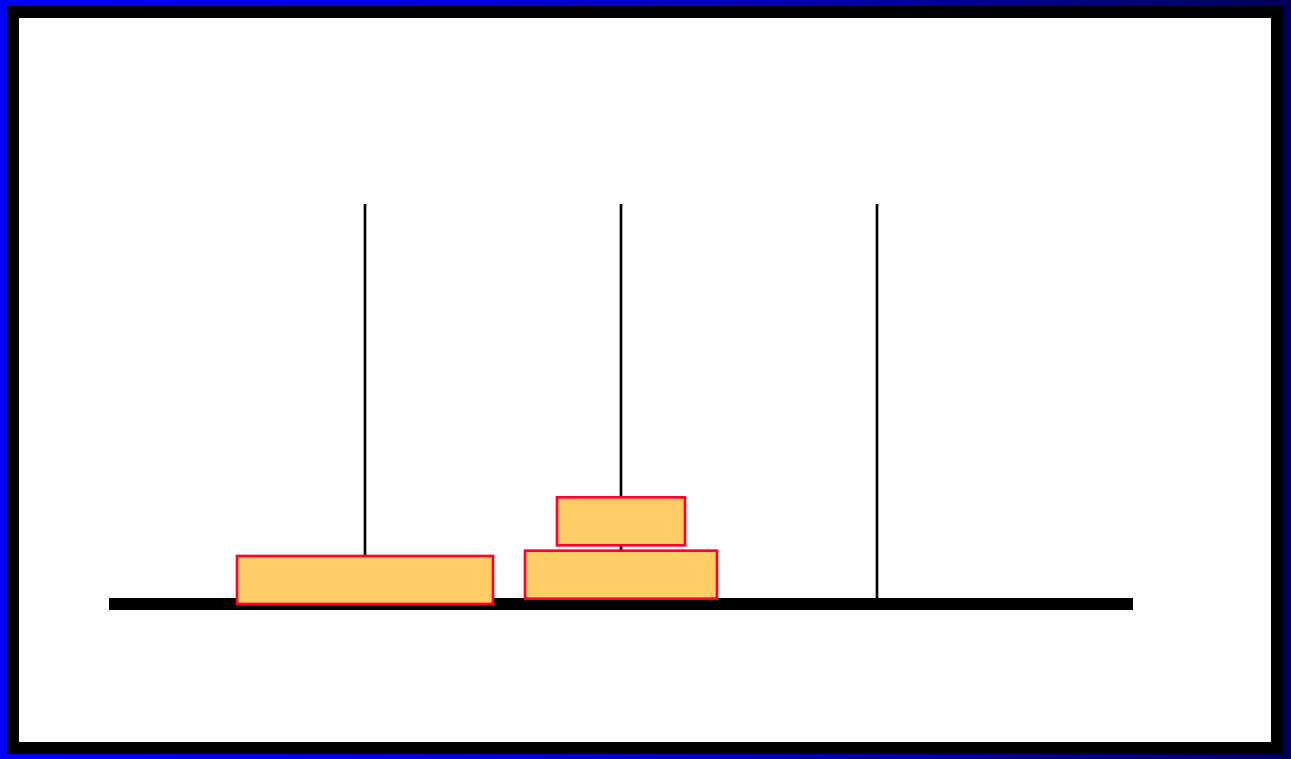
The Towers of Hanoi



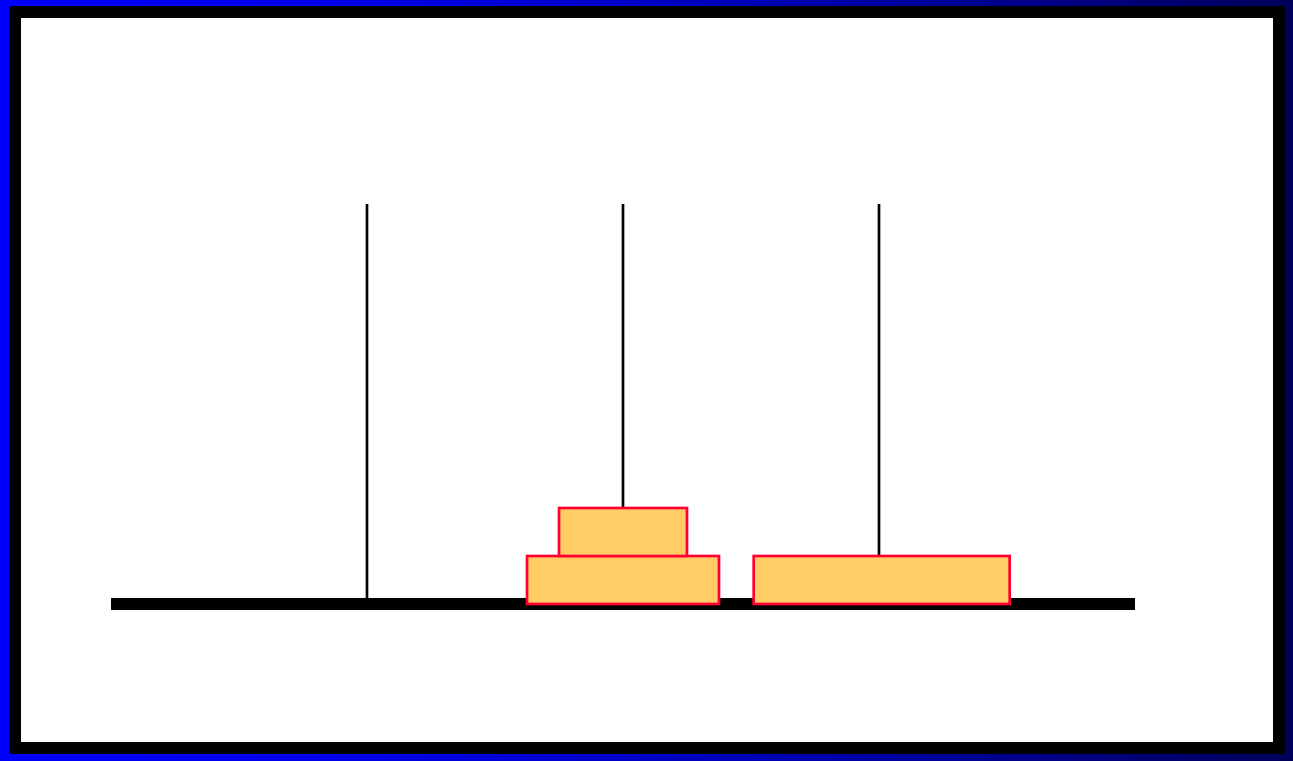
The Towers of Hanoi



The Towers of Hanoi



The Towers of Hanoi



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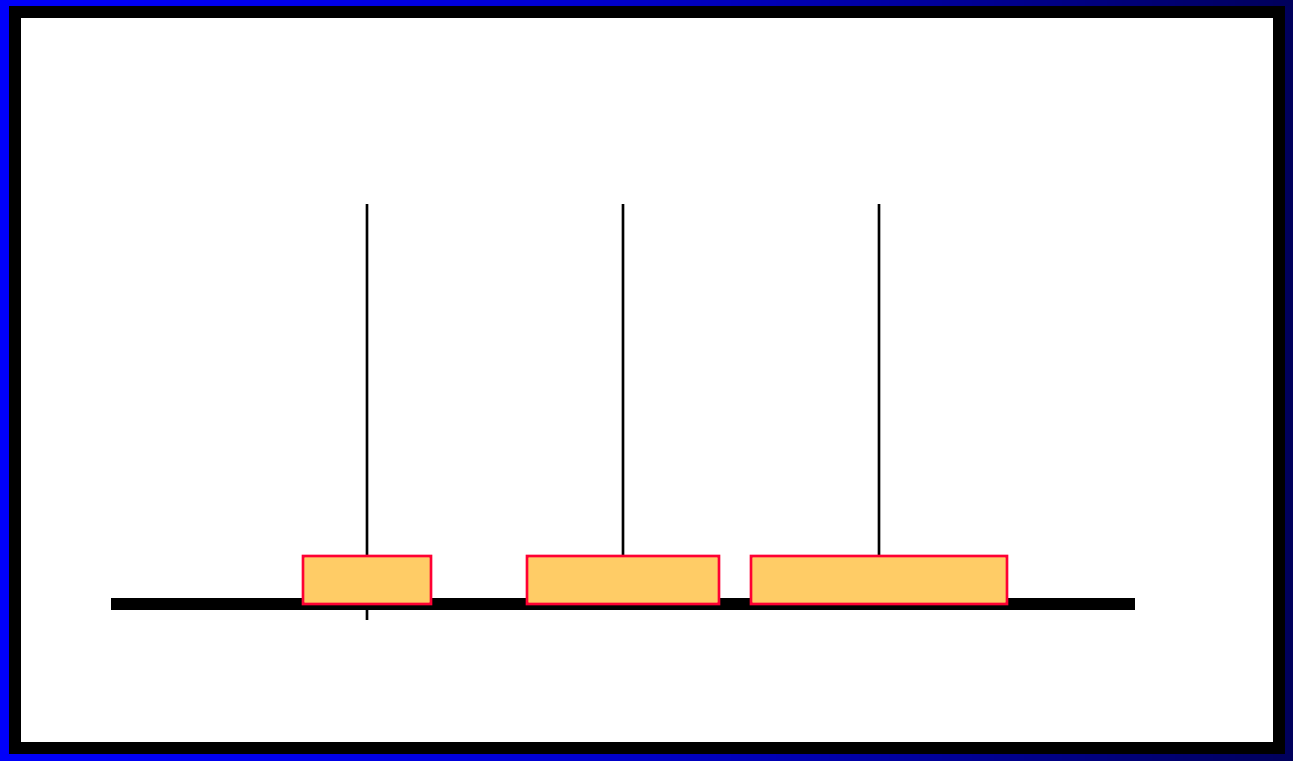

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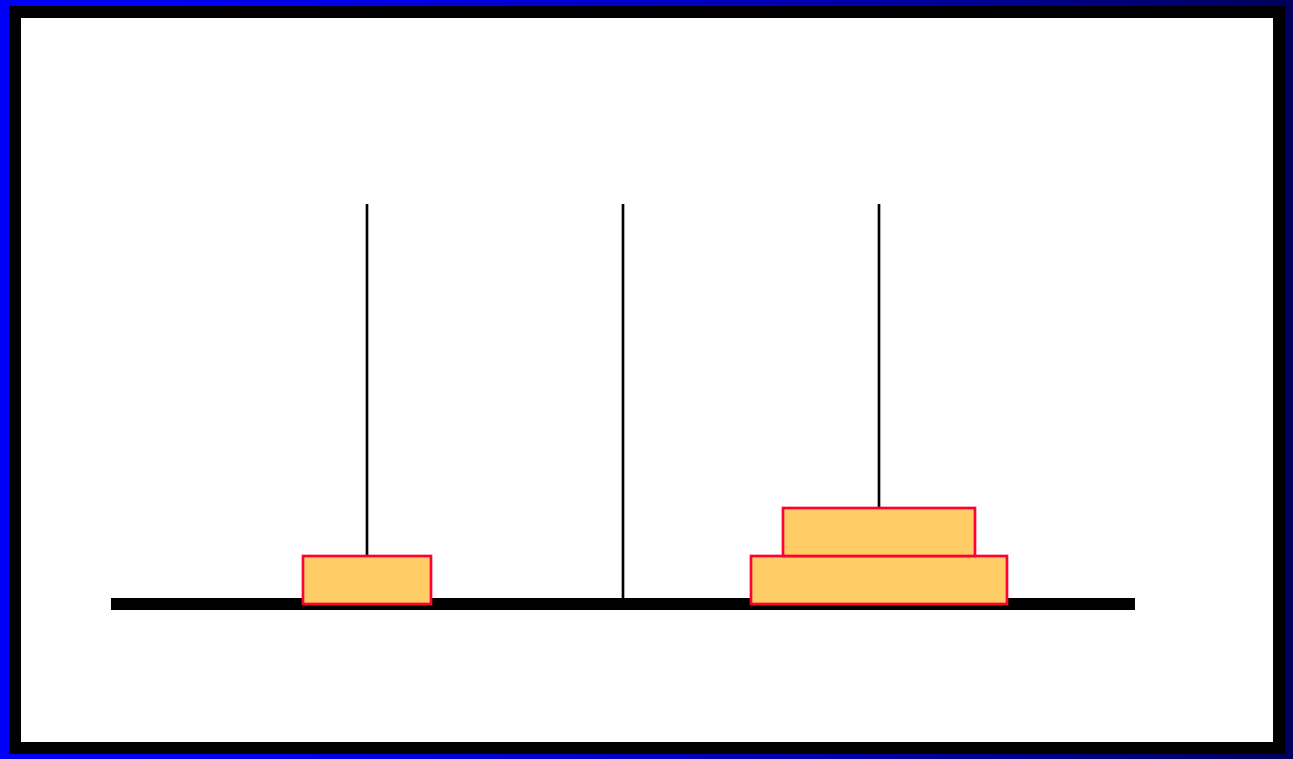
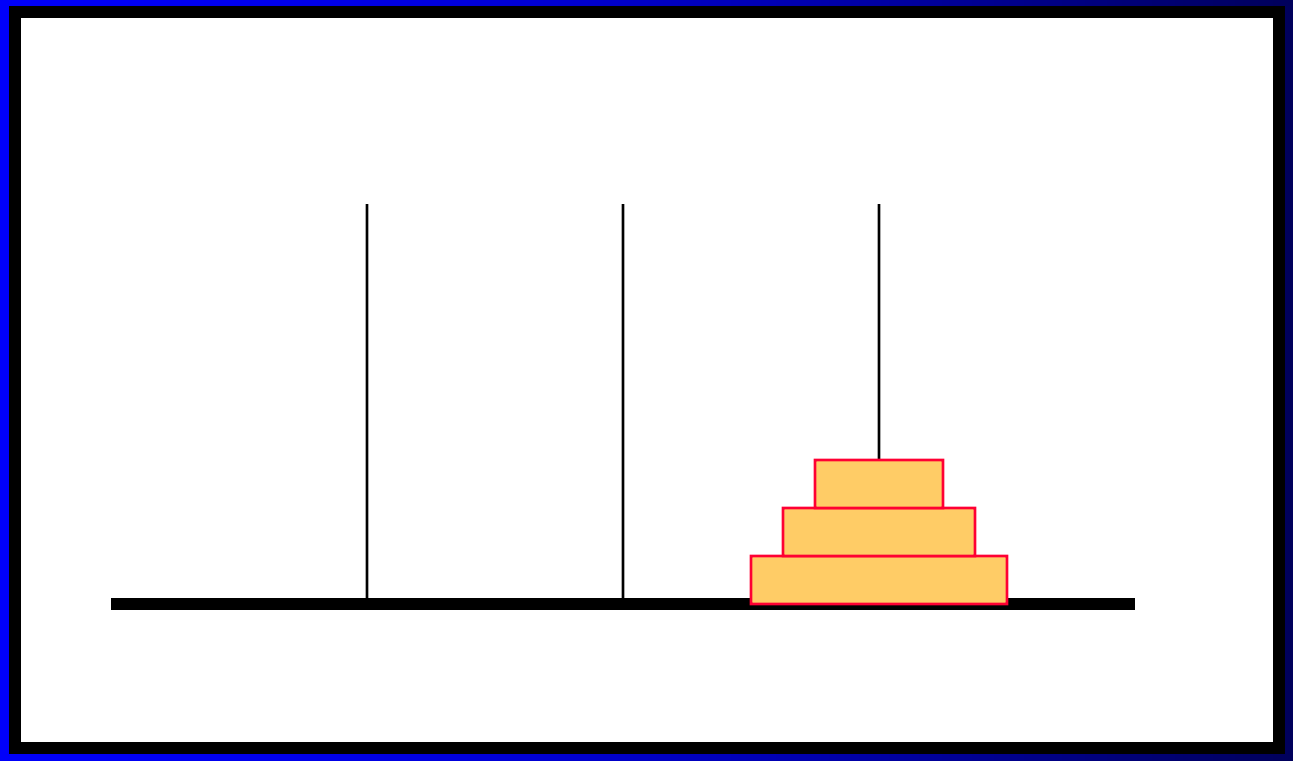


The Towers of Hanoi



```
//  TowersOfHanoi.java       By Lewis/Loftus

public class TowersOfHanoi {
   private int totalDisks;

    //Sets up the puzzle with the specified number of disks.
    public TowersOfHanoi (int disks) {
      totalDisks = disks;
    }
```

```
//Performs the initial call to moveTower to solve the
//puzzle.
//Moves the disks from tower 1 to tower 3 using tower 2.

public void solve () {
  moveTower (totalDisks, 1, 3, 2);
}
```

```
//Moves the specified number of disks from one tower to
//another by moving a subtower of n-1 disks out of the
//way, moving one disk, then moving the subtower back.
//Base case of 1 disk.
private void moveTower (int numDisks, int start, int end,
int temp) {
  if (numDisks == 1)
     moveOneDisk (start, end);
  else {
     moveTower (numDisks-1, start, temp, end);
     moveOneDisk (start, end);
     moveTower (numDisks-1, temp, end, start);
  }
}
```

```
    //Prints instructions to move one disk from the
    //specified start tower to the specified end tower.

    private void moveOneDisk (int start, int end) {
      System.out.println ("Move one disk from " + start + "
    to " + end);
   }
}
```

```
//  SolveTowers.java       By Lewis/Loftus

public class SolveTowers {

   public static void main (String[] args) {
      TowersOfHanoi towers = new TowersOfHanoi (4);

      towers.solve();
   }
}
```

- Program execution

% java SolveTower

Move one disk from 1 to 2
Move one disk from 1 to 3
Move one disk from 2 to 3
Move one disk from 1 to 2
Move one disk from 3 to 1
Move one disk from 3 to 2
Move one disk from 1 to 2
Move one disk from 1 to 3
Move one disk from 2 to 3
Move one disk from 2 to 1
Move one disk from 3 to 1
Move one disk from 2 to 3
Move one disk from 1 to 2
Move one disk from 1 to 3
Move one disk from 2 to 3