CS302 - Data Structures *using C++*

Topic: The Towers of Hanoi

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AUTONOMOUS ROBOTS LAB

The Towers of Hanoi

- **Introduction to the problem**
  - The “Towers of Hanoi” is a mathematical puzzle where one has three pegs and n disks and the goal is to move the entire stack to another rod, obeying a set of rules.
- **The Rules of the “Towers of Hanoi”**
  - Only one disk may be moved at a time
  - Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack: a disk can only be moved if it is the uppermost disk on a stack.
  - No disk may be placed on top of a smaller disk.

The Towers of Hanoi

- **Problem Statement**
  - Beginning with n disks on pole A and zero disks on poles B and C, solve `towers(n,A,B,C)`

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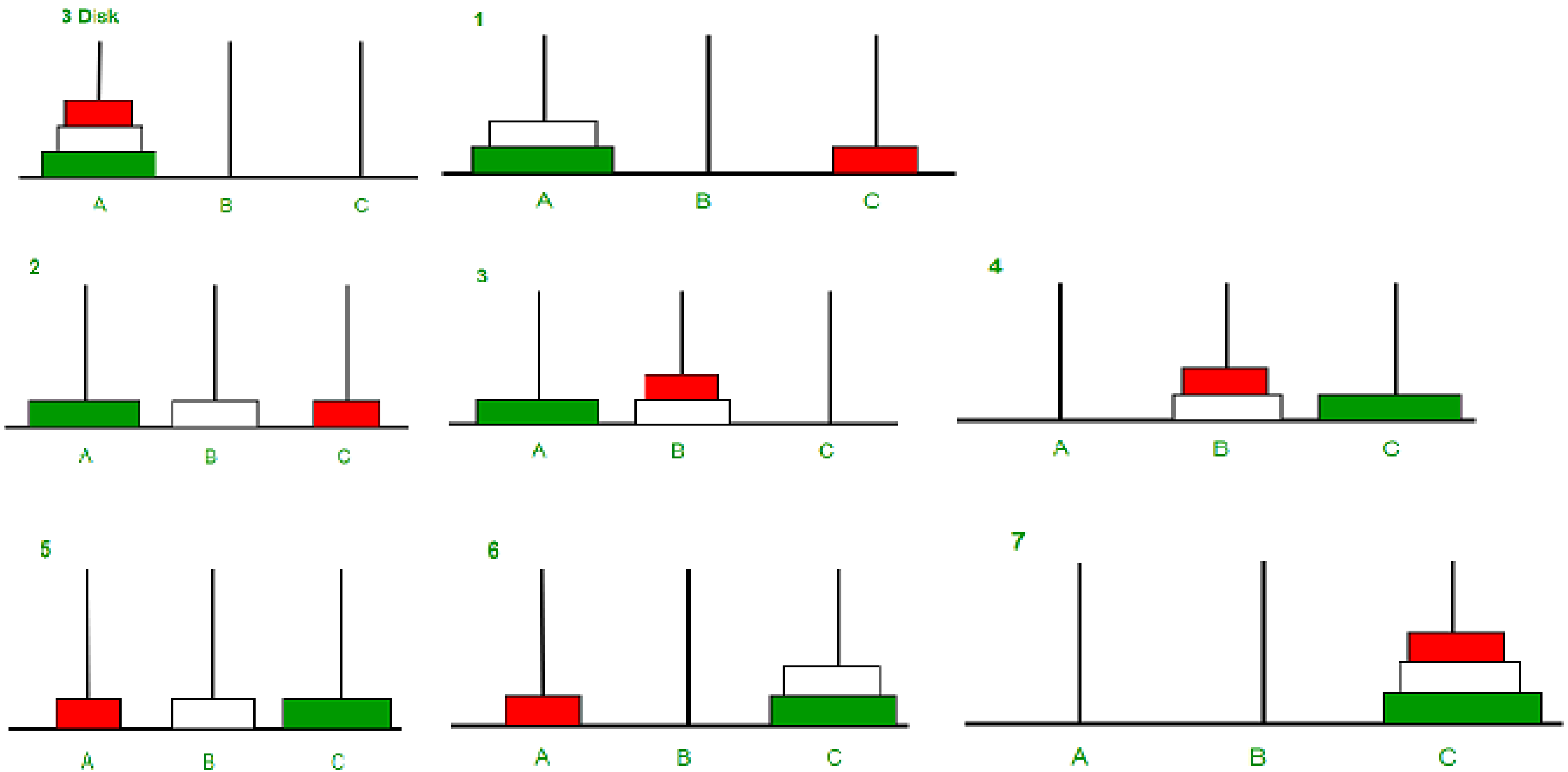
- **Solution**
  - With all disks on A, solve `towers(n-1,A,C,B)`
  - With the largest disk on pole A and all the others on pole C, solve `towers(n-1,A,B,C)`
  - With the largest disk on pole B and all the other disks on pole C, solve `towers(n-1,C,B,A)`

The Towers of Hanoi



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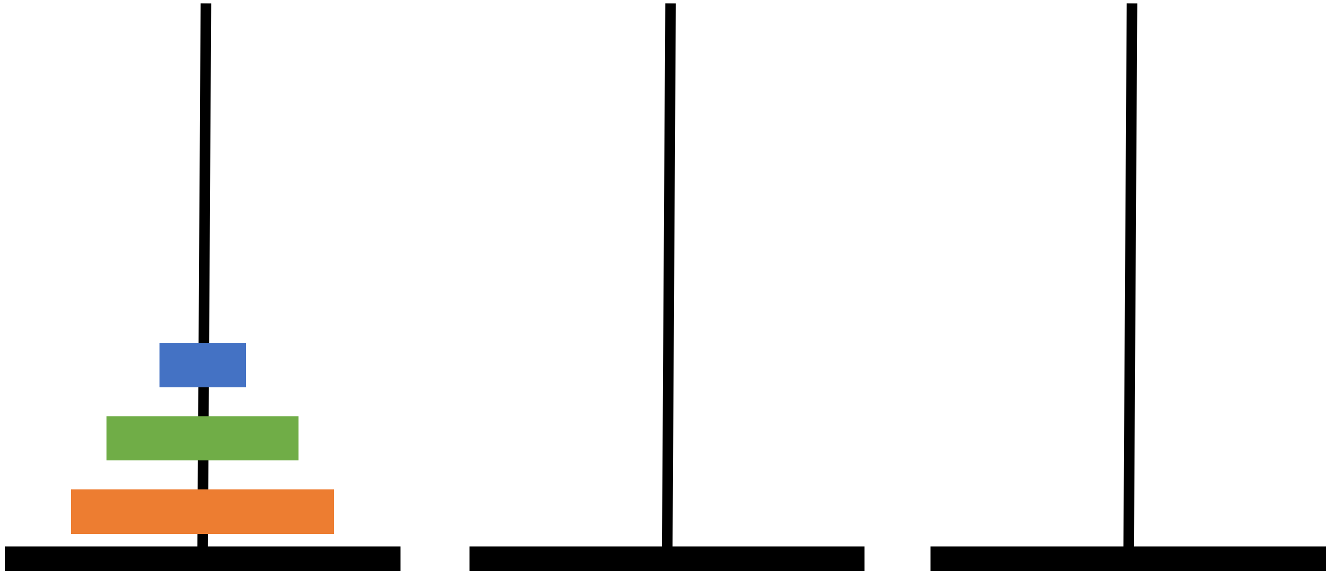

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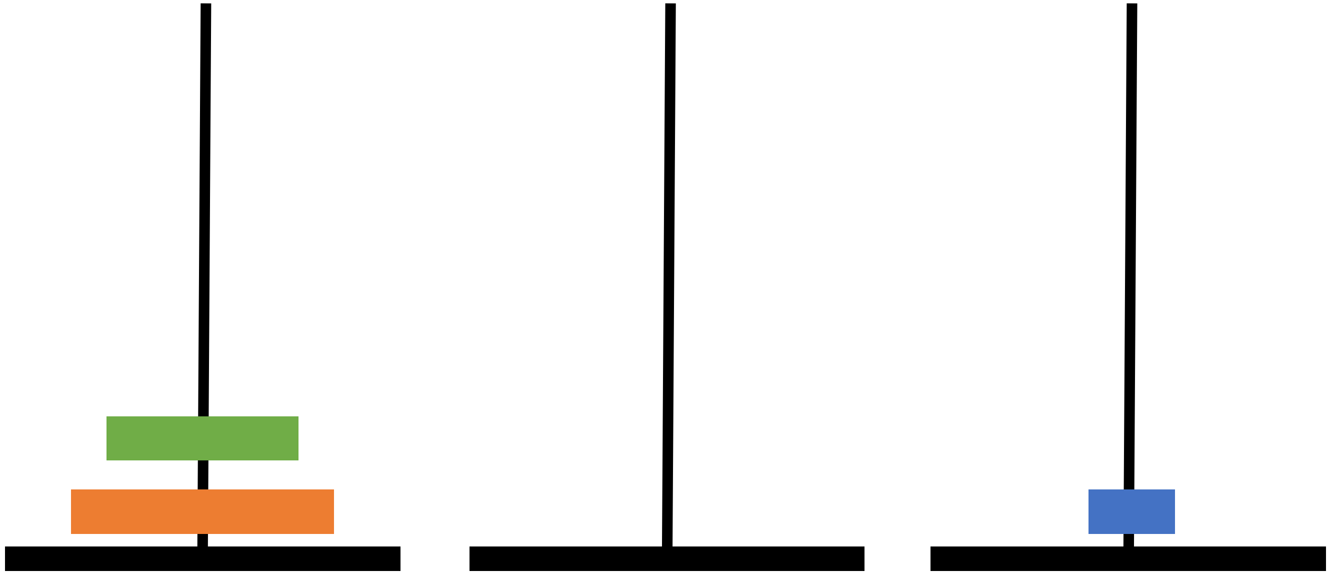

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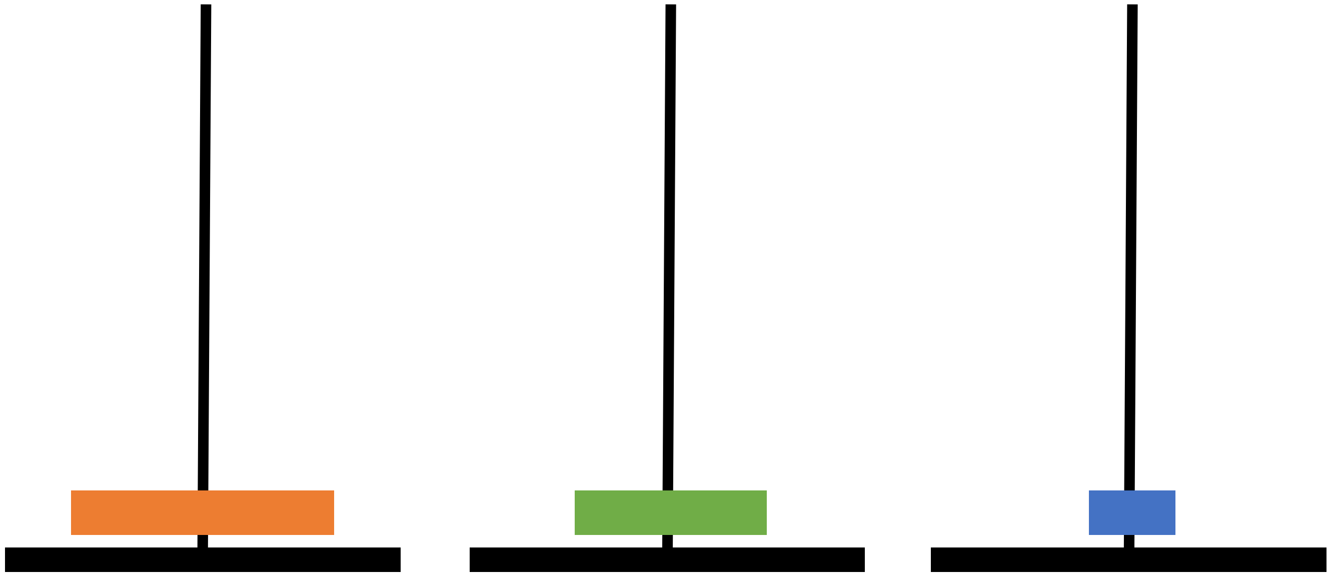

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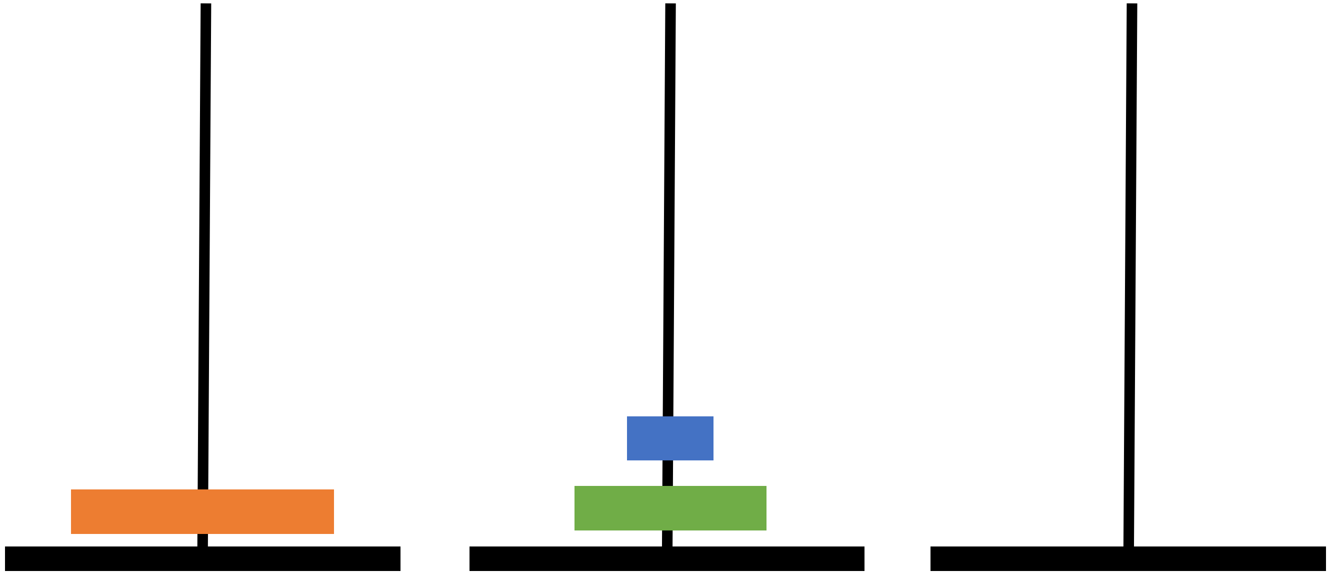

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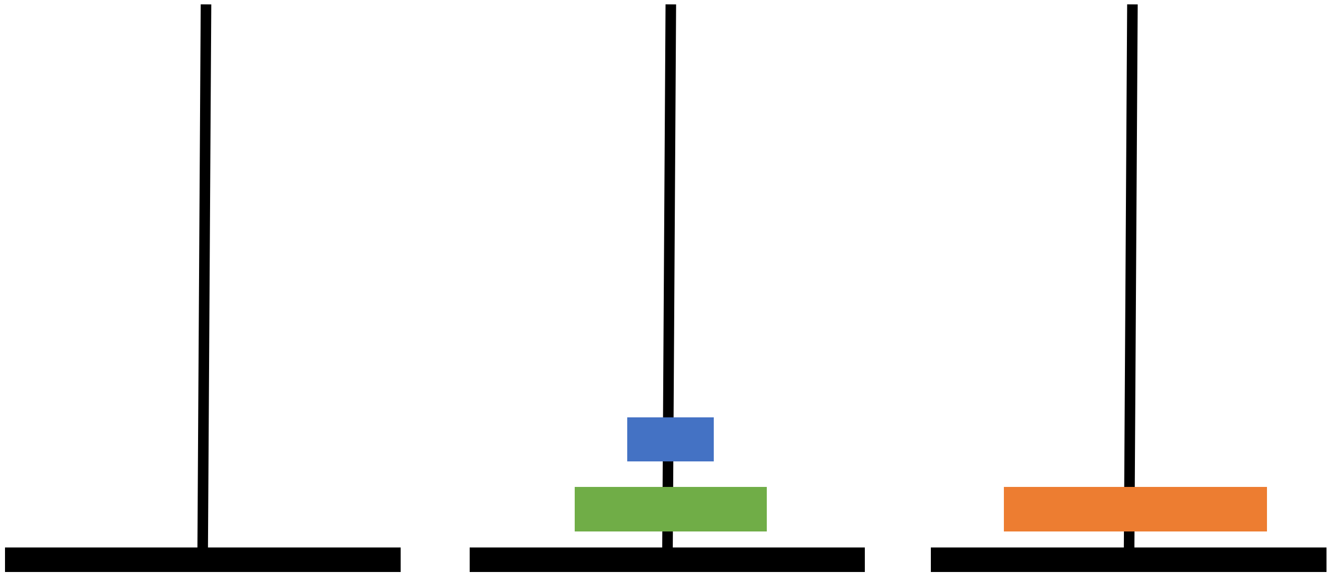

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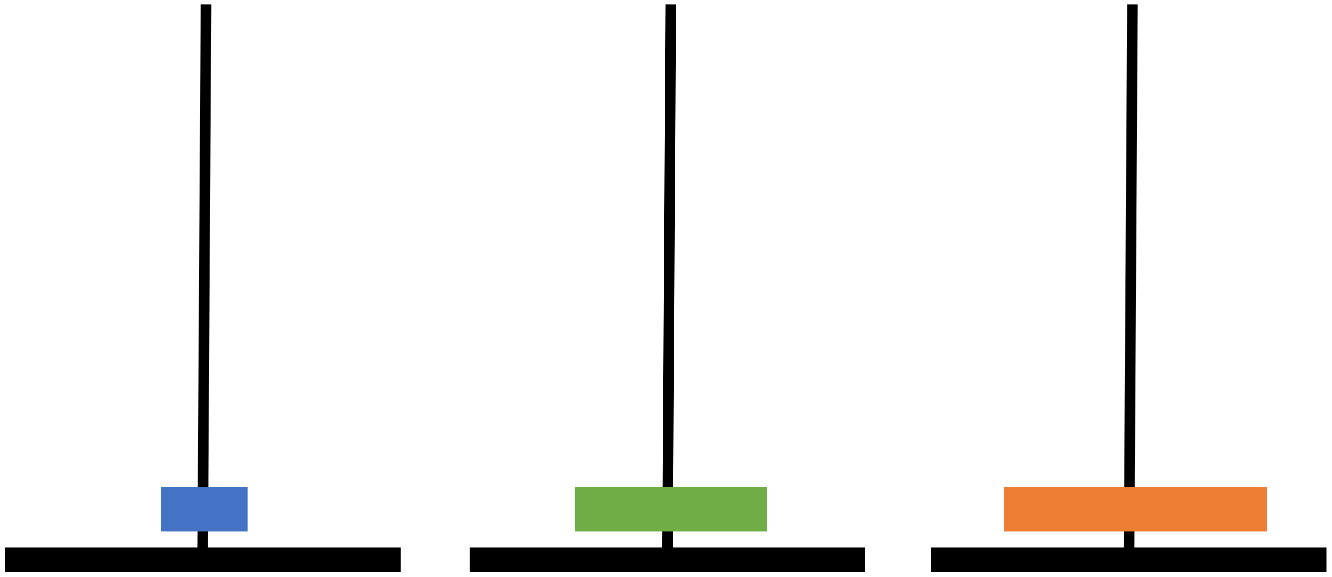

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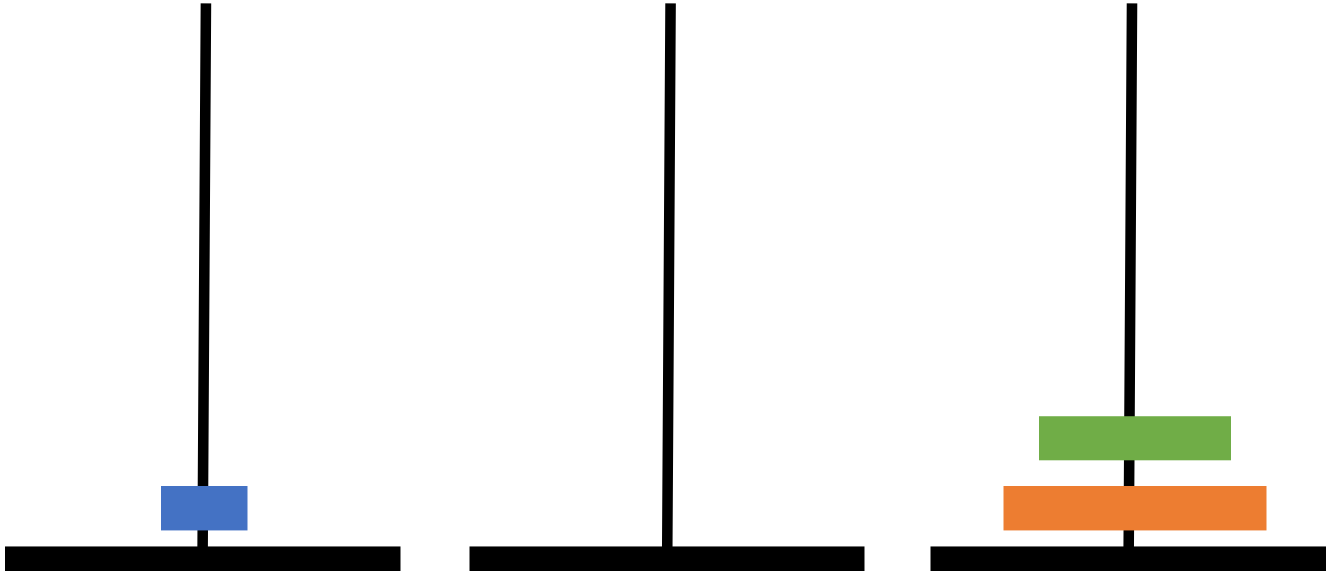

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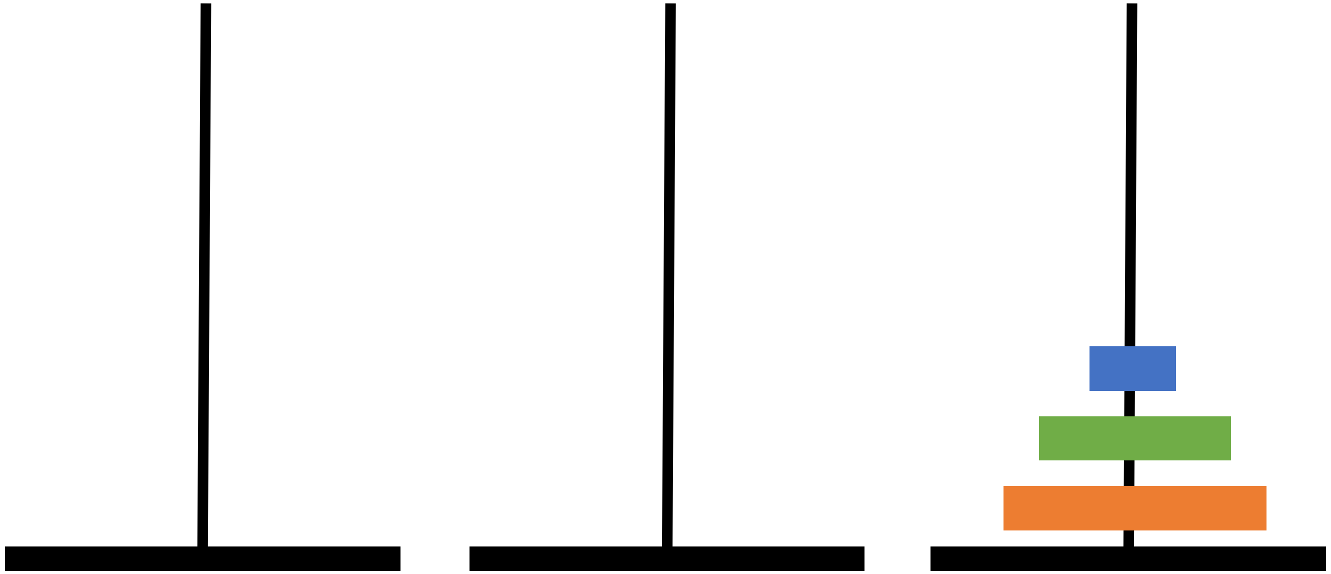

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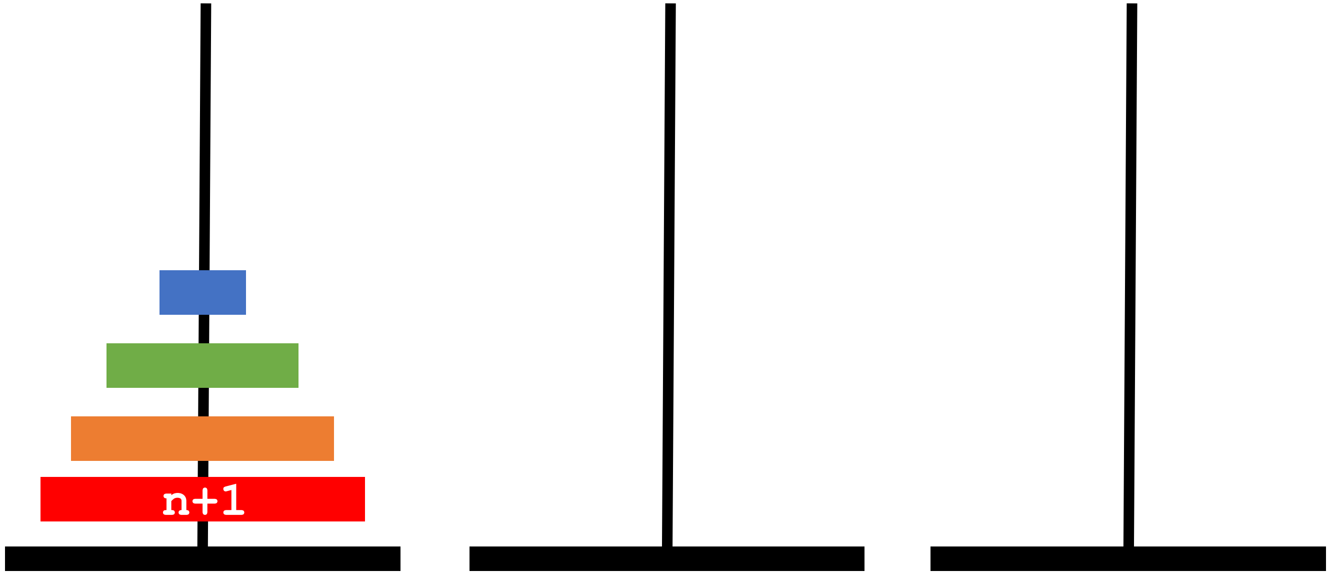

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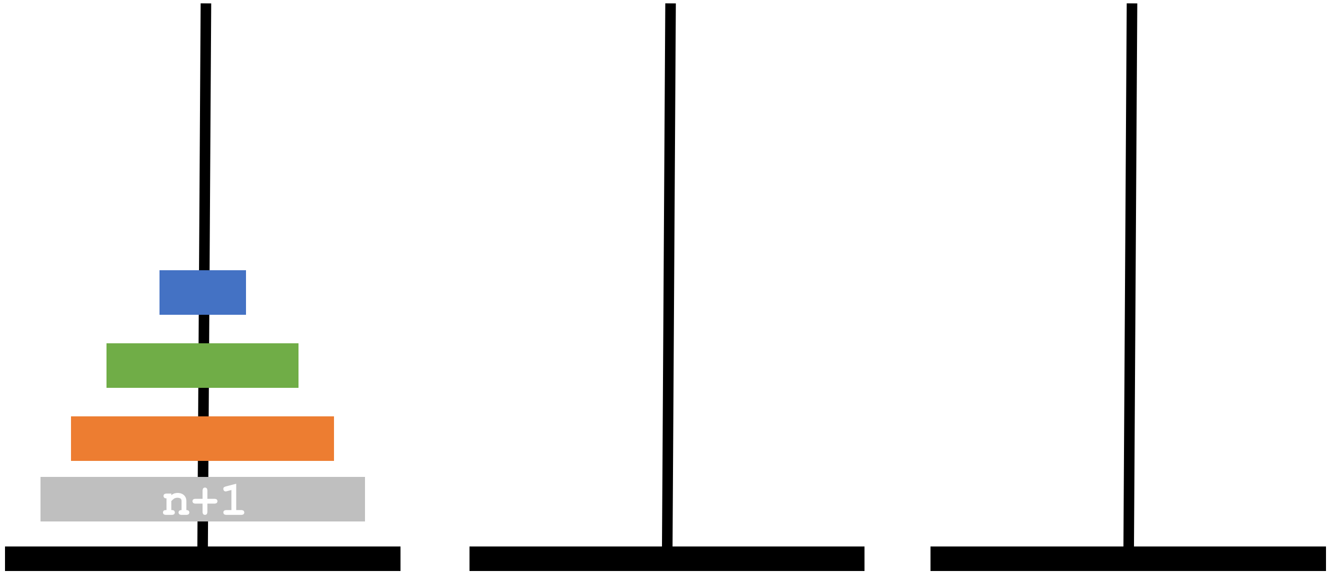

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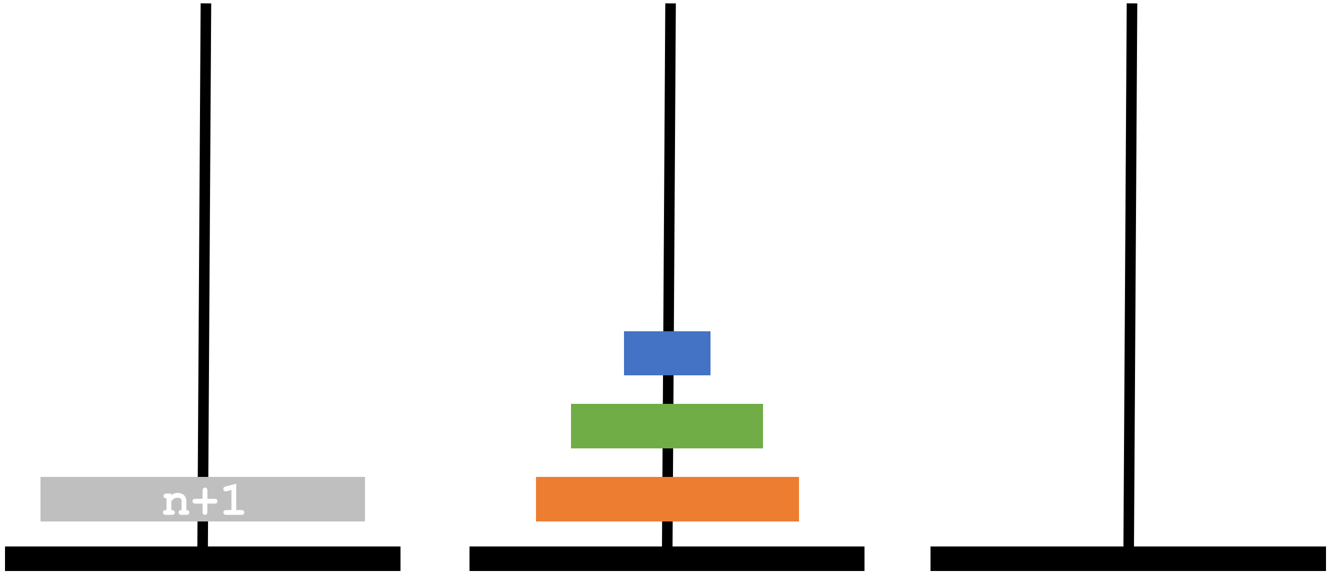

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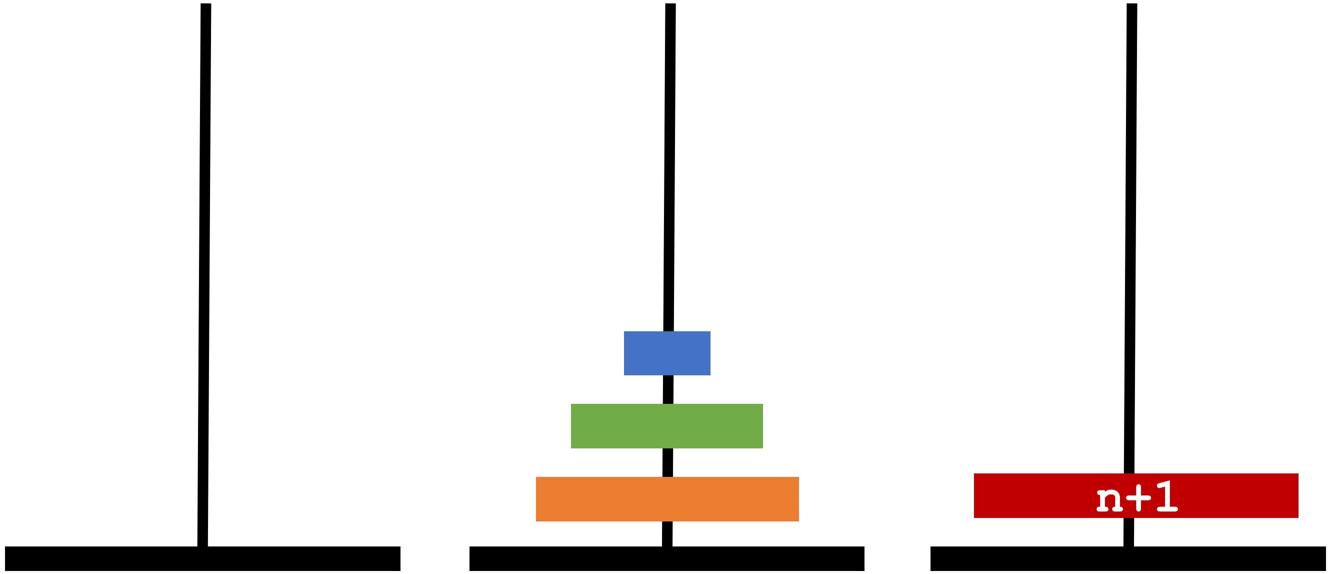

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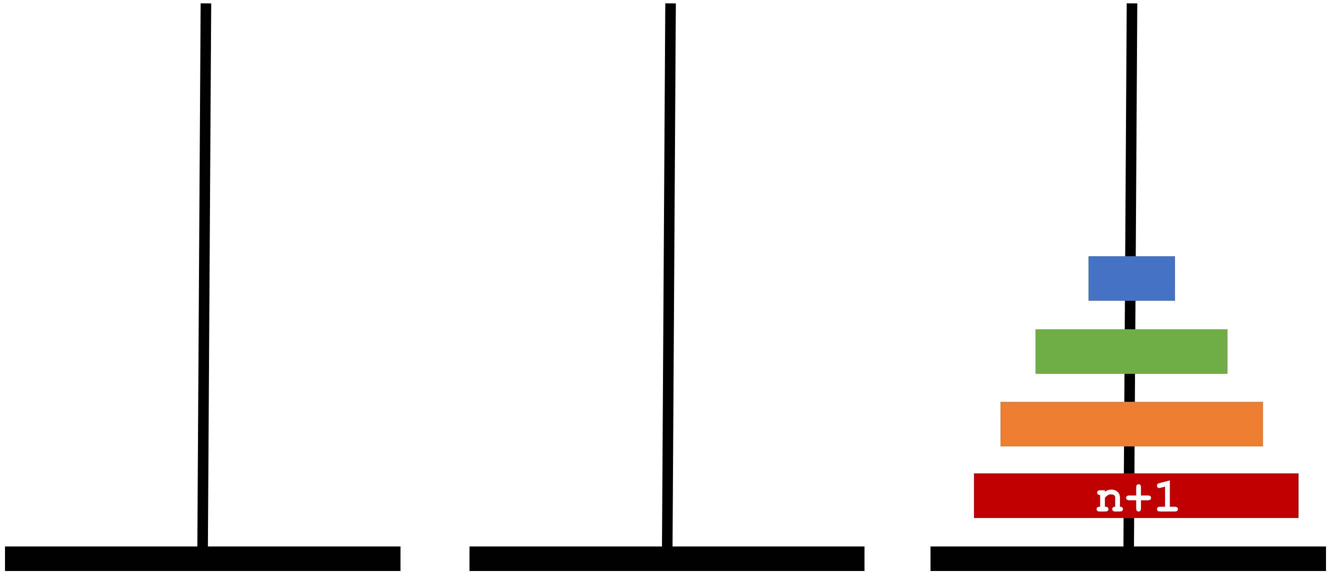

The Towers of Hanoi

```
#include <iostream>
using namespace std;

void solveTowers(int n, char from_rod, char to_rod, char aux_rod)
{
          if (n == 1)
          {
              // Move from SRC to DST
              cout << "Move disk 1 from rod " << from_rod << " to rod " <<
              to_rod << endl;
              return;
          }

          solveTowers(n-1, from_rod, aux_rod, to_rod);
          // Move from SRC: FROM_ROD to DST: TO_ROD with SPARE: AUX_ROD
          cout << "Move disk " << n << " from rod " << from_rod << " to rod
" << to_rod << endl;

          // Move from SRC: AUX_ROD to DST: TO_ROD with SPARE: FROM_ROD
          solveTowers(n-1, aux_rod, to_rod, from_rod);
}

int main()
{
          int n = 3; // Number of disks
          solveTowers(n, 'A', 'C', 'B'); // A, B and C are names of rods
          return 0;
}
```

The Towers of Hanoi

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          // Move from SRC: AUX_ROD to DST: TO_ROD with SPARE: FROM_ROD
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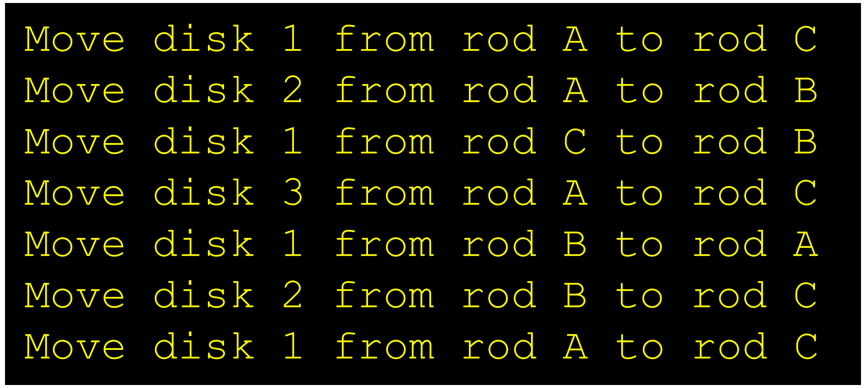
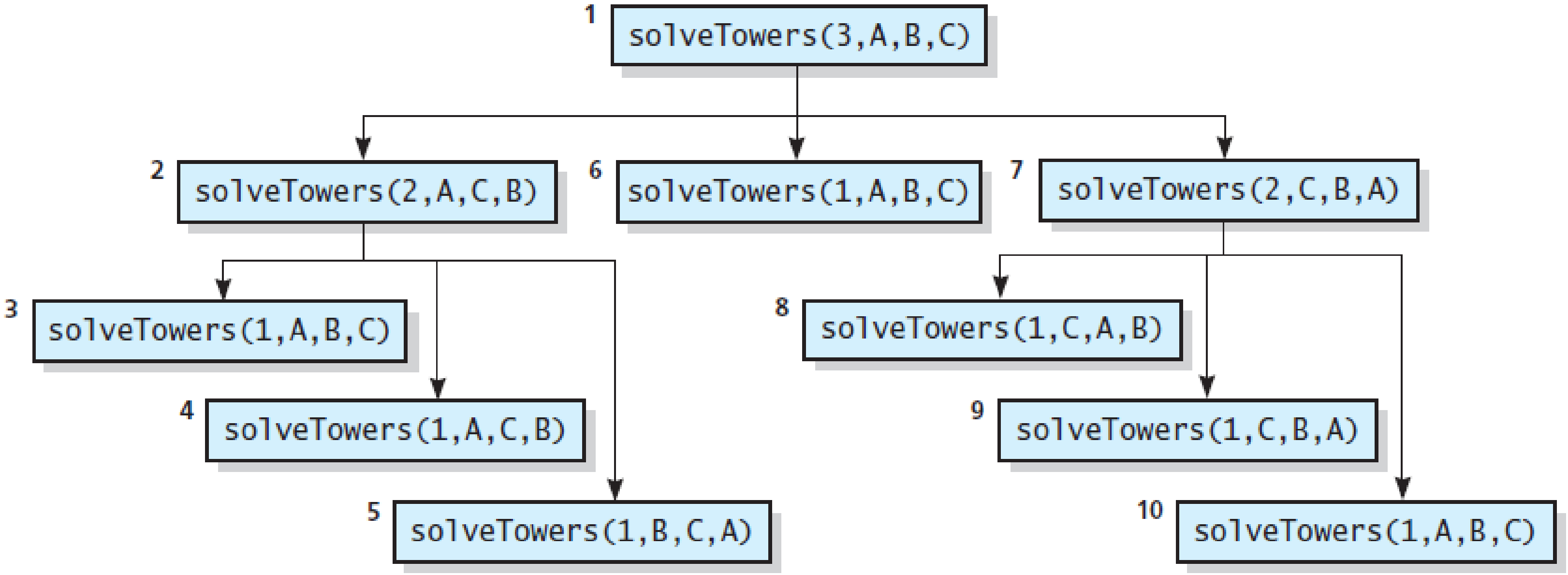


```
Move disk 1 from rod A to rod C
Move disk 2 from rod A to rod B
Move disk 1 from rod C to rod B
Move disk 3 from rod A to rod C
Move disk 1 from rod B to rod A
Move disk 2 from rod B to rod C
Move disk 1 from rod A to rod C
```

The Towers of Hanoi

- Order of recursive calls that results from `solveTowers(3,A,B,C)`



Thank you