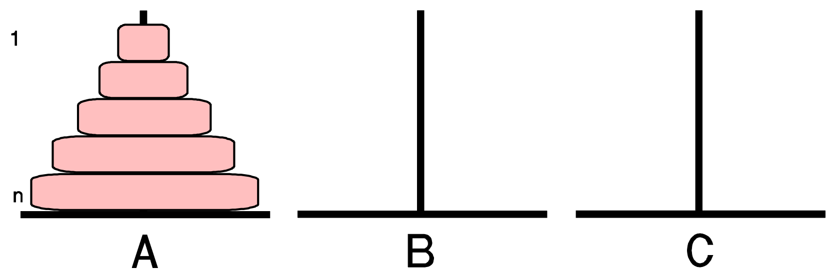
Towers of Hanoi

Move all the disks from peg A to peg C.

1. *Can only move one disk at a time*
2. *Can only place a smaller disk on top of a larger one*



Solution:

1. *Move top n-1 disks to peg B*
2. *Move disk n to peg C*
3. *Move n-1 disks on peg B to peg C*

Towers of Hanoi - Computer Solution

```
const int N = 64; // number of disks (don't really try 64!)

int main()
  {
    toh(N, 'A', 'C', 'B');
  }  // END main


void toh(int count, char start, char finish, char temp)
  {
   if(count > 0)
     {
      toh(count-1, start, temp, finish);
      cout << "Move disk " << count << "from peg " << start
           << " to peg " << finish << endl;
      toh(count-1, temp, finish, start);
     }  // END if
  }  // END toh
```

Mathematical Definition of Factorial

$$n! = \begin{cases} 1 & \text{, for } n = 0 \\ n * (n-1)! & \text{, for } n > 0 \end{cases}$$

This is called a "recurrence relation."

Necessary Characteristics for Using Recursion

1. *Problem solution can be expressed as a "smaller" version of itself.*
2. *Stopping case – At least one (often trivial) case can be computed non-recursively.*

C++ Implementation of Recursion

1. *When a subroutine is invoked, storage for arguments and local variables is allocated in a memory area called an "activation record"*

2. *Activation records are stored on the "stack."*

3. *Upon return, activation record is deallocated.*

4. *Activation record is also called a "stack frame"*

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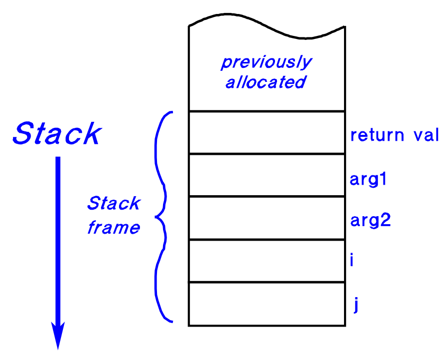
Example of an Activation Record

```
int func1 (int arg1, int arg2)
  {
   int i, j;
     .
     .
     .
   return(j);
```



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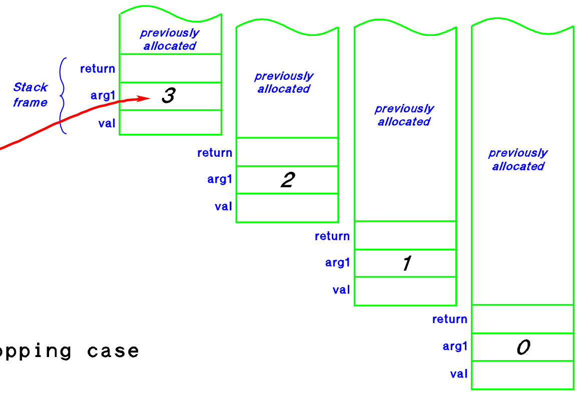
Recursion Example

```
void main()
  {
   int i = 3, j;
     .
     .
   j = fact(i);
     .
  } //END main

int fact (int arg1)
  {
   int val;

   if(arg1 <= 0) //stopping case
     val = 1;
   else
     val = arg1 * fact(arg1-1); //recursive call

   return val;
  } // end fact
```



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