

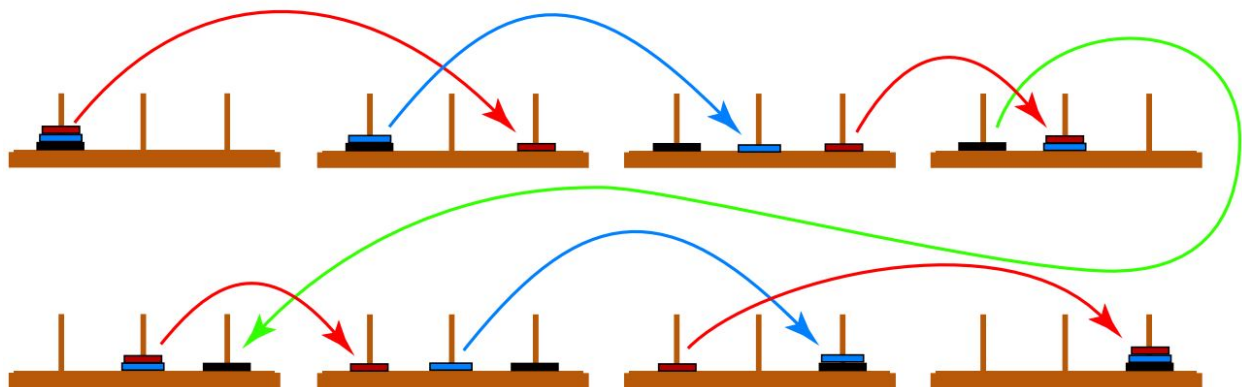
Tower of Hanoi is a mathematical puzzle proposed by Eduard Lucas, a French mathematician in 1883. This puzzle is based on the legend about the Tower of Brahma which has 3 rods with one of them being surrounded by 64 disks. The main idea of solving this puzzle is to determine the number of steps required to move the n-number of disks in the Lucas puzzle, from the source rod to the target rod through a spare rod, with the rule that the disk placed on top of a disk must be larger than the one below. The closed pattern to determine the minimal number of steps to move the disk is represented as  $T_n = 2^n - 1$  and  $T_n = 2T_{n-1} + 1$ .

The equation above can be considered as a loop (recurrence relation). It involves calling itself repeatedly up to or without a certain limit to calculate the exact number of steps that this solution requires. This is where the recursive takes place in solving the Tower of Hanoi.

We start with n-number of disks on the first rod. According to the puzzle rule, we can transfer n-1 disks from the top to the third rod with  $T_{n-1}$  step. The largest plate on the first rod is then moved to the second rod with one step. Next, move the disks on the third rod using the  $T_{n-1}$  step to the second rod, placing the disks on top of the largest disk we placed earlier. So we can see that

$$T_n = 2T_{n-1} + 1$$

With the initial condition being  $T_1 = 1$ , because we can move one disk from the first rod to the second rod in only one step.



Administrator: C:\Windows\System32\cmd.exe

Microsoft Windows [Version 10.0.14393]  
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C:\Users\Administrator1\Downloads>type main.c

#include <stdio.h>  
#include <time.h>

void hanoi(int n, char source, char spare, char target) {  
 if (n > 0) {  
 hanoi(n - 1, source, target, spare);  
 hanoi(n - 1, spare, source, target);  
 }  
}

int main() {  
 int n;  
 clock\_t exec = clock();  
 printf("n: ");  
 scanf("%d", &n);  
 hanoi(n, 'A', 'B', 'C');  
 printf("Time: %f\n", (double)(clock() - exec) / CLOCKS\_PER\_SEC);  
 return 0;  
}

C:\Users\Administrator1\Downloads>main.exe

n: 16  
Time: 0.562000

C:\Users\Administrator1\Downloads>main.exe

n: 36  
Time: 540.008000

C:\Users\Administrator1\Downloads>

Task Manager

File Options View

Processes Performance Users Details Services

CPU  
0% 2.19 GHz

Memory  
5.7/56.0 GB (10%)

Ethernet  
S: 16.0 Kbps R: 0 Kbps

CPU

Intel(R) Xeon(R) CPU E5-2660 0 @ 2.20GHz

% Utilization over 60 seconds

0% 100%

Utilization Speed Maximum speed: 2.19 GHz  
0% 2.19 GHz Sockets: 1  
Processes Threads Handles Virtual processors: 8  
79 1198 47048 Virtual machine: Yes  
L1 cache: N/A

Up time  
18:11:28:25

Fewer details

Open Resource Monitor

3:49 PM  
3/28/2022