

Exam unit III

Dexter Enrique Gómez Ek (2009060)

Universidad Politécnica de Yucatán

Data Engineering, DATA 2B

Programming

Professor Didier Gamboa

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Towers of Hanoi.

The project of unit is to develop a program which allow us to solve the Tower of Hanoi problem.

According to Britannica, the Hanoi Tower is a:

Puzzle involving three vertical pegs and a set of different sized disks with holes through their centres. The Tower of Hanoi is widely believed to have been invented in 1883 by the French mathematician Édouard Lucas, though his role in its invention has been disputed. Ever popular, made of wood or plastic, the Tower of Hanoi can be found in toy shops around the world.

“The Computer Journal” (1982) said the next about the Hanoi tower problem:

The Tower of Hanoi problem involves three pegs (P_1 , P_2 and P_3) and n discs (D_1 , D_2 , D_3 ... D_n) such that $D_1 < D_2 < \dots < D_n$, where D_1 is the smallest disc. Initially, all the n discs are placed on a peg P_i as a pyramid with D_1 on the top. The task is to move these n discs from P_i to P_j such that $i \neq j$, subject to the following constraints:

- C1: Only the top disc of a tower may be moved from one peg to the other;
- C2: No disc may rest upon a smaller disc at any time;
- C3: Only one disc may be moved at a time.

As you can see the problem involve certain constraints that made the problem be more easy to solve using recursive functions.

Using iterative solutions are not really easy, it needs a lot of code that makes a very complex program, so the only viable solution is using a recursive function.

The next image show the function that I have developed to solve the problem of the towers.

```

void
hanoi_towers (  int num,
                 char peg1,
                 char peg2,
                 char peg3)
{
    if (num == 1)
    {
        printf ("\n Move 1: %c --> %c", peg1, peg2);

        return;
    }

    hanoi_towers (  num - 1,
                    peg1,
                    peg3,
                    peg2);

    printf ("\n Move %d: %c --> %c", num, peg1, peg2);

    hanoi_towers (  num - 1,
                    peg3,
                    peg2,
                    peg1);
}
hanoi_towers.c

```

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The code was written following the GNU Coding Standard.

After compiling the code (using gcc on Linux) and executing it with $n = 3$ the program prints the steps to solve the problem of Towers of Hanoi. It looks like this:

```

dexterg@pop-os:~/Documents/programming_hw/programming_D2B/unit3_exam$ gcc hanoi_towers.c -o hanoi_towers
dexterg@pop-os:~/Documents/programming_hw/programming_D2B/unit3_exam$ ./hanoi_towers
How many disks?: 3

Move 1: 1 --> 2
Move 2: 1 --> 3
Move 1: 2 --> 3
Move 3: 1 --> 2
Move 1: 3 --> 1
Move 2: 3 --> 2
Move 1: 1 --> 2

```

The program offer solutions for large values of n , that confirm the program run correctly.

References.

Britannica, The Editors of Encyclopaedia. "Tower of Hanoi". Encyclopedia Britannica, Invalid Date, <https://www.britannica.com/topic/Tower-of-Hanoi>. Accessed 10 July 2021.

C Coding Style. Gnome Project webpage
<https://developer.gnome.org/programming-guidelines/stable/c-coding-style.html.en>

Wiley Heyden. "A Representation Approach to the Tower of Hanoi Problem". THE COMPUTER JOURNAL. VOL 25. 1982. P 442.