國立清華大學資訊工程學系
11210 CS 410000 計算機結構
Homework 3

Deadline: 2023.10.30 23:59

> There are two parts in this homework.

PART I. - Procedure call

In this part, you are goint to write a MPS assembly program for the following C program.

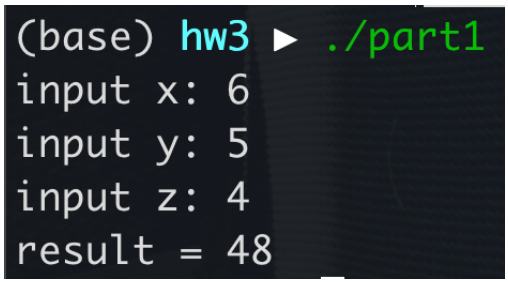
```c
#include <stdio.h>
#include <math.h>

int compare(int p, int q){
  if(p > q) return p + q;
  else return p;
}

int smod(int p , int q){
  int div,  divd;
  if(p > q) div = 2 + pow(2, p%4);
  else div = 4 + pow(2, q%4);
  div = div * 5;
  divd = p * 4 + q;
  return divd % div;
}

int main(){
   int x, y, z, ans;
   printf("input x: ");
   scanf("%d", &x);
   printf("input y: ");
   scanf("%d", &y);
   printf("input z: ");
   scanf("%d", &z);
   ans = smod(compare(x, y), z);
   printf("result = %d\n", ans);
   return 0;
}
```

Input constraints: $0 \leq x \leq 100, 0 \leq y \leq 100, 0 \leq z \leq 100$
Output format example:

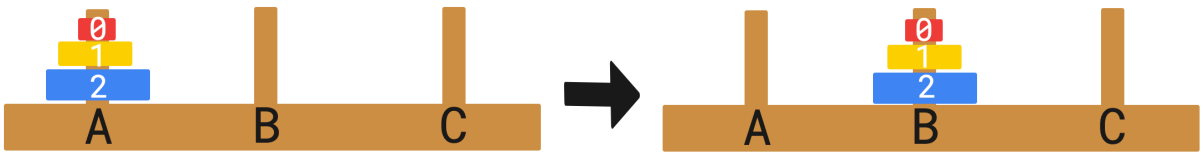


You must use the procedure (function) call to implement. Also, your program should terminal normally (the output should show "-- program is finished running -- ").

PART II. - Recursive call

In this part, you are going to write a MIPS assembly program that traces the step-by-step processes of the Towers of Hanoi puzzle and calculates the total number of movements.

The example C code and Input, Output format is shown below.



Tower of Hanoi (moving disks from A to B)

Example C program

```c
#include <stdio.h>

int cnt = 0;

void MoveTower(int disk, char source, char dest, char spare) {
    if(disk == 0) {
        // Move disk from source to dest
        printf("Move disk %d from %c to %c\n", disk, source, dest);
        ++cnt;
    }
    else {
        // Move the smaller disk from source to spare
        MoveTower(disk - 1, source, spare, dest);

        // Move disk from source to dest
        printf("Move disk %d from %c to %c\n", disk, source, dest);
        ++cnt;

        // Move the smaller disk from spare to dest
        MoveTower(disk - 1, spare, dest, source);
     }
}

int main() {
    int numDisks;
    printf("Please input the total number of disks: ");
    scanf("%d", &numDisks);
    MoveTower(numDisks - 1, 'A', 'B', 'C');

    printf("Total number of movement = %d\n", cnt);
    return 0;
}
```

Input constraints: $0 < numDisks <= 10$

Output format example:

```
(base) hw3 ▶ ./hanoi
Please input the total number of disks: 3
Move disk 0 from A to B
Move disk 1 from A to C
Move disk 0 from B to C
Move disk 2 from A to B
Move disk 0 from C to A
Move disk 1 from C to B
Move disk 0 from A to B
Total number of movement = 7
```

You must use the procedure (function) call to implement. Also, your program should terminal normally (the output should show "-- program is finished running -- ").

Submission (2 assembly programs)

Please name your assembly program with your student ID in the following format:

- `arch_hw3_p1_<student_ID>.asm`
- `arch_hw3_p2_<student_ID>.asm`

Use the eeclass (https://eeclass.nthu.edu.tw/) to submit your programs.

Grading Criteria

- Correctness: 80%
- Comment in program: 10%
- Output format: 10%

Remember Plagiarism is strictly prohibited.

Appendix

1. https://www.cs.cmu.edu/~cburch/survey/recurse/hanoiimpl.html