Computer Organization, Spring 2018
HW1: MIPS Programming
Due Date: 2018/04/02

1. Goal:

- In hw 1, students will learn how to write MIPS code, and know the difference between assembly and high-level languages. In order to test the correctness of program, students should use a MIPS simulator – MARS to simulate the programs.

2. Download and Using MARS:

A. Download and installation:

1. Download MARS from the page:
   http://courses.missouristate.edu/KenVollmar/MARS/
2. Download the version chosen by yourself, and install it

B. Steps for running a MIPS code on MARS:

1. File -> New
2. Write MIPS code
3. Run -> Assemble (F3)
4. Run -> Go (F5)

3. HW Description:

A. Factorial:

The attached files factorial.c and factorial.s are modified from the example given in textbook for computing n!. In this part, please execute factorial.s on MIPS simulator MARS for practice.

B. 1A2B : (30%)

Input two 4-digit numbers (For each number, the four digits are all different. If there are same digits, you need to output "ERROR!"). The program should output xAyB.

A = the case that the digit in the 1st number is the same to the digit in the 2nd number and the positions are matched.

B = the case that the digit in the 1st number is the same to the digit in the 2nd number but the positions are unmatched.

x = number of case A

y = number of case B

Input:
4629
6324
Output:
1A2B

Input:
7777
Output:
ERROR!

C. Draw a diamond: (30%)

Input a number n, draw a diamond with the length of its diagonal line equal to 2n-1.

Input:
3
Output:

```
  *
 ***
*****
 ***
  *
```

D. Mathematical expression: (40%)

Input 3 integers: A , B and M, calculate their R, where R is defined as follows

$$R := A^B \bmod M$$

You should use recursion to finish this program.

(A, B and M are in the range of 0 to 65536)

Input:

9527

91

1001

Output:

210

4. Reference Algorithms：

- "factorial.c"：C code for "factorial", modified from the example given in textbook.

- "factorial.s"：MIPS code for "factorial", modified from the example given in textbook.

- "1A2B.cpp" : C++ code for "1A2B"

- "mod_op.cpp：C++ code for "modulo operation"
- "diamond.cpp：C++ code for "diamond"

5. Reference Instructions:
- **Example of print string:**

```
# print a string on the console interface
li $v0, 4              # set service code (print_string service) into $v0
la $a0,string           #load the address of the string to be printed into $a0
syscall               # print the string
```

- **Example of division:**

  div $t1,$t2   # t1 / t2

  mflo $t3   #copy quotient to $t3

  mfhi $t4   #copy remainder to $t4

- **Example of multiplication:**

  mult $a0, $a1   # a0 * a1

  mfhi $a2   # 32 most significant bits of multiplication to $a2

  mflo $a3   # 32 least significant bits of multiplication to $a3

6. Deadline:

A. One person per group for this lab. Please upload your files onto E3 (eCampus) platform.

B. The files you should hand in include:

   1. 1A2B.s

   2. diamond.s

   3. mod_op.s

   Please compress these files into one zip file, and name your zip file as "HW1_ID.zip" (rar file is not accepted).

C. Deadline：2018/04/02 23:59. The grade of delayed submission will be 10% off for each day. Late hand-in is limited to four days at most.

D. Any assignment work by fraud will get a zero point.