EE-475L: Computer Architecture

Lab Report 3

GNU Tool Chain for RISC-V

Submitted by

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Table of Contents

Task

Write an assembly program to find factorial of a number and convert it to machine code using GNU tool chain for RISC-V.

Solution

The assembly program to find factorial of a number is given below:

Table 1: factorial.s

```
addi x3, x0, 5                  #the number for which we want to find
factorial, n
addi x10, x0, 2
blt x3, x10, negative_and_zero  #if n < 1 then return 1
beq x3, x0, negative_and_zero   #if n == 0 then return 1

addi x1, x0, 2                  #used for comparison
beq x3, x1, two                 #find factorial of 2

add x4, x0, x3                  #result will be stored in this register
add x2, x0, x3                  #copy of n
addi x5, x5, 1                  #used for comparison

find:                           #used for n-1    (n)(n-1) ... 2
   addi x2, x2, -1
   add x3, x0, x4               #copy contents of x4 in x3
   j multiply

done:                           #checks if the factorial is found
   bne x2, x1, find
   j stop

add x4, x4, x3


multiply:                       #used for repeated additions, checks if
multiplication is completed
   add x7, x0, x2

multiply1:                      #used for repeated additions
   addi x7, x7, -1
   add x4, x4, x3
   bne x7, x5, multiply1
   j done

negative_and_zero:              #exception handler
   addi x4, x0, 1               #give factorial of negative numbers =  1
   j stop
two:
   addi x4, x0, 2
stop:
   j stop
```

and the machine code for the above assembly program is given below:

Table 2: machine code for factorial.s

```
00500193
00200513
04a1c463
04018263
00200093
04118263
00300233
00300133
00128293
fff10113
004001b3
0100006f
fe111ae3
0280006f
00320233
002003b3
fff38393
00320233
fe539ce3
fe5ff06f
00100213
0080006f
00200213
0000006f
```

Verification of generated machine code

Expected results from the above machine code are:

Register	Value (hex/decimal)
x4	0x78/120

Actual results are:

Conclusion

As the actual result is same as the expected result. So assembly code and machine code are working fine.