

CPSC 240: Computer Organization and Assembly Language

Assignment 04, Fall Semester 2023

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1. Download the “CPSC-240 Assignment04.docx” document.
2. Design the "multiple.asm" program, and use assembly language to realize the function of the following C++ instructions.
unsigned short num = 225;
unsigned short mul_15 = 0, other = 0;
if(num % 3 == 0 && num % 5 == 0) {
 mul_15++;
} else {
 other++;
}
}
3. Assemble the "multiple.asm" file and link the "multiple.o" file to get the "multiple" executable file.
4. Run the "multiple" file with the DDD debugger to display the memory of **num**, as well as the simulation results of **mul15** and **other**.
5. Insert source code (multiple.asm) and simulation results (GDB window) of the memory (num, mul_15, and other) in the document. Write an analysis to verify simulation results.
6. Save the file in pdf format and submit the pdf file to Canvas before 23:59 pm on 10/05/2023.

[Insert multiple.asm source code here]

```

1 ; ex4_if-else.asm
2 ; unsigned char num1 = 9, num2 = 5;
3 ; unsigned char max = 0, min = 0;
4 ; if(num1 < num2) {
5 ;     max = num2; min = num1;
6 ; } else {
7 ;     max = num1; min = num2;
8 ; }
9
10 section .data
11     num    dw    225                ;num1 = 09h
12     mul_15 db    0                 ;num1 = 09h
13     other  db    0                 ;num1 = 09h
14
15 section .text
16     global _start
17 _start:
18     mov     ax, word[num]    ;al = num1 = 09h
19     mov     bl, 3
20     div     bl
21     cmp     ah, 0            ;al-bl = num1-num2
22     je      mul_3
23     inc     byte[other]
24     jmp     done
25
26 mul_3:
27     mov     ax, word[num]    ;al = num1 = 09h
28     mov     bl, 5
29     div     bl
30     cmp     ah, 0            ;al-bl = num1-num2
31     je      mul_5
32
33
34 mul_5:
35     inc     byte[mul_15]
36
37
38
39
40 done:
41     mov     rax, 60           ;terminate excuting process
42     mov     rdi, 0           ;exit status
43     syscall                  ;calling system services

```

[Insert multiple simulation result here]


```
(gdb) x/uh &num
0x402000:          225
(gdb) x/uh &mul_15
0x402002:           1
(gdb) I
```

▲ 0x402002: 1

```
(gdb) x/uh &mul_15
0x402002:           1
(gdb) x/uh &other
0x402003:           0
(gdb) I
```

▲ 0x402003: 0

[Insert multiple simulation result verification here]

 **OnlineGDB** beta
online compiler and debugger for c/c++
code. compile. run. debug. share.

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





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main.cpp

```
12
13 int main()
14 {
15     unsigned short num = 225;
16     unsigned short mul_15 = 0, other = 0;
17     if(num % 3 == 0 && num % 5 == 0)
18     {
19         mul_15++;
20     }
21     else
22     {
23         other++;
24     }
25
26     cout << "mul_15: " << mul_15 << endl;
27     cout << "other: " << other << endl;
28
29
30
31     return 0;
```

   input

```
mul_15: 1
other: 0

...Program finished with exit code 0
Press ENTER to exit console.
```