

Computer Science Department
California State University, Fullerton

CPSC 240-11/12 Computer Organization and Assembly Language
Quiz 01

12:00 noon to 1:15 pm

Thursday, September 28, 2023

Student Name: _____

Last 4 digits of ID: _____

Note:

- University regulations on academic honesty will be strictly enforced.
- You have 75 minutes to complete this Quiz.
- Open books, slides and sample programs.
- Turn off or turn vibration your cell phone.
- Use “yasm” assembler to assemble the source code.
- Use “ld” linker to link the object code
- Use “ddd” debugger to simulate the executable code.
- Each student can only submit solution once, and secondary submissions will not be graded. If you have submitting problems, please inform your instructor before you leave the classroom.
- Any content submitted after the due date will be regarded as a make-up quiz.

Quiz 01

1. Download the “CPSC-240-11 Quiz 01.docx” document.
2. Convert the following C/C++ variable declarations and arithmetic operations to x86-64 assembly language. Use the “yasm” assembler to assemble the program, the “ld” linker to link the object code, and the “ddd” debugger to simulate the executable code.

NOTE: variable sizes and program functions should be equivalent to C/C++ instructions.

```
unsigned char num1 = 215;           //unsigned 8-bit variable
unsigned char num2 = 65;            //unsigned 8-bit variable
unsigned char num3 = 115;           //unsigned 8-bit variable
unsigned short diff = 0;            //unsigned 16-bit variable
unsigned int product = 0;           //unsigned 32-bit variable
```

```
diff = short(num1 - num2);
product = diff * short(num3);
```

3. After assembling and linking, run the DDD debugger to display the simulation results of the values of num1, num2, num3, diff, and product in GDB panel before terminate program.
4. Insert source code and the simulation results (GDB panel) to the bottom of the document.
5. Save the file in pdf or docx format and submit the pdf or docx file to Canvas before the deadline.
6. Deadline is 1:15 pm on 09/28/2023.

[Copy and paste your assembly source code here:]

```
;quiz01_11.asm

;unsigned char num1 = 215;           //data type: 8 bits
;unsigned char num2 = 65;            //data type: 8 bits
;unsigned char num3 = 115;           //data type: 8 bits
;unsigned short diff = 0;            //data type: 16 bits
;unsigned int product = 0;           //data type: 32 bits
;diff = short(num1 - num2);
;product = short(num3) * diff;

section .data
    num1    db    215                ;num1 = 0xD7
    num2    db    65                 ;num2 = 0x41
    num3    db    115                ;num3 = 0x73
    diff    dw    0                  ;diff = 0x00
    product dd    0                  ;product = 0x0000
```

```

section .text
    global _start
_start:
    mov     ah, 0                ;ah = 0
    mov     al, byte[num1]       ;al = num1 = 0xD7
    sub     al, byte[num2]       ;al = al-num2 = 0xD7-0x41 = 0x96
    sbb     ah, 0                ;ah = ah - 0 - CF = 0
    mov     byte[diff], al       ;[diff] = al = 0x96 = 150
    mov     byte[diff+1], ah     ;[diff+1] = ah = 0x00 = 0

    mov     al, byte[num3]       ;al = num3 = 0x73
    cbw                     ;convert al to ax, ax = 0x0073
    mul     word[diff]           ;dx:ax = ax*diff = 0x0000 4362
    mov     word[product+2], dx   ;product+2 = dx = 0x0000
    mov     word[product+0], ax   ;product+0 = ax = 0x4362

    mov     rax, 60              ;terminate excuting process
    mov     rdi, 0               ;exit status
    syscall                     ;calling system services

```

[Attach GDB window with all memory data here:]

```

(gdb) step
(gdb) x/ub &num1
0x402000:    215
(gdb) x/ub &num2
0x402001:    65
(gdb) x/ub &num3
0x402002:    115
(gdb) x/uh &diff
0x402003:    150
(gdb) x/uw &product
0x402005:    17250
(gdb) I

```