Computer Science Department
California State University, Fullerton

CPSC 240-09/10 Computer Organization and Assembly Language
Quiz 01
3:00 pm to 4:15 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-240-09 Quiz 01.docx" document from Canvas.
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 = 225;          //unsigned 8-bit variable
unsigned char num2 = 125;          //unsigned 8-bit variable
unsigned char num3 = 133;          //unsigned 8-bit variable
unsigned short product = 0         //unsigned 16-bit variable
unsigned char quotient = 0;        //unsigned 8-bit variable
unsigned char remainder = 0;       //unsigned 8-bit variable

product = num1 * num2;
quotient = product / num3;
remainder = product % num3;
```

3. After assembling and linking, run the DDD debugger to display the simulation results of the values of num1, num2, num3, product, quotient, and remainder 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 4:15 pm on 09/28/2023.

[Copy and paste your assembly source code here:]

```
;quiz01_9.asm
;unsigned char num1 = 225;                          //data type: 8 bits
;unsigned char num2 = 125;                          //data type: 8 bits
;unsigned char num3 = 133;                          //data type: 8 bits
;unsigned short product = 0                             //data type: 16 bits
;unsigned char quotient = 0;                        //data type: 8 bits
;unsigned char remainder = 0;                       //data type: 8 bits
;product = num1 * num2;
;quotient = product / num3;
;remainder = product % num3;

section .data
      num1       db         225                  ;num1 = 0xE1
      num2       db         125                  ;num2 = 0x7D
      num3       db         133                  ;num3 = 0x85
      product    dw         0                    ;product = 0x0000
      quotient   db         0                    ;quotient = 0x00
```

```
      remainder  db        0                    ;remainder = 0x00

section .text
      global _start
_start:
      Mov       al, byte[num1]                 ;al = num1 = 0xE1
      mul       byte[num2]                     ;ax = al*num2 = 0xE1*0x7D = 0x6DDD
      mov       word[product], ax              ;product = ax = 0x6DDD = 28125
      div       byte[num3]                     ;ah=ax%num3=0xD3, al=ax/num3=0x3E
      mov       byte[quotient], al             ;quotient = al = 0xD3 = 211
      mov       byte[remainder], ah            ;remainder = ah = 0x3E = 62

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

[Attach GDB panel with all memory data here:]

```
(gdb) x/ub &num1
0x402000:       225
(gdb) x/ub &num2
0x402001:       125
(gdb) x/ub &num3
0x402002:       133
(gdb) x/uh &product
0x402003:       28125
(gdb) x/ub &quotient
0x402005:       211
(gdb) x/ub &remainder
0x402006:       62
(gdb)
```