CPSC 240: Computer Organization and Assembly Language
Assignment 07, Fall Semester 2024

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Quiz Questions:

From the textbook "X86-64 Assembly Language Programming with Ubuntu," study quiz questions 3 and 4 on page 216. Students do not need to submit answers to the quiz questions as they are found in Appendix D of the textbook.

Programming:

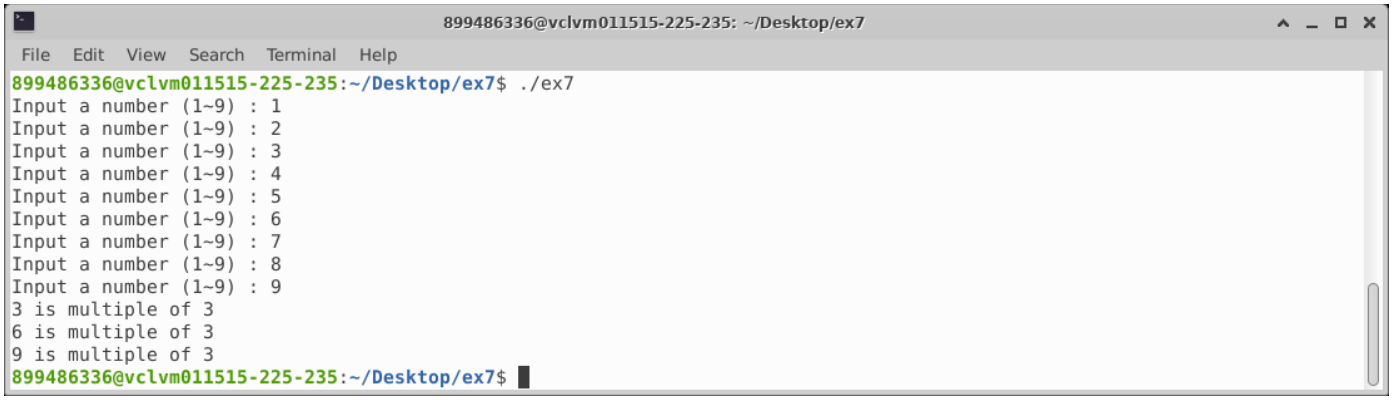
1. Download the “CPSC-240 Assignment07.docx” document.
2. Design the "input.asm" program, input 9 values from 1 to 9 from the keyboard, find out the multiples of 3 from the input values, and display the multiples of 3 in the terminal emulator window. The corresponding C/C++ code is as follows:

```
char msg1[] = "Input a number (1~9): ";
char msg2[] = " is Multiple of 3.";
char buffer[2];
char num;
char ascii[10];

register int r10 = 0;
do {
   cout << msg1;
   cin >> buffer;
   ascii[r10] = buffer[0];
   r10++;
} while(r10 < 9);
r10 = 0;
do {
   num = atoi(ascii[r10]);
   if(num%3 == 0) {
      cout << ascii[r10] << msg2;
   }
   r10++;
} while(r10 < 9);
```

3. Assemble the "input.asm" file and link the "input.o" file to get the "input" executable file.
4. Run the "input" file to display the input value and multiple of 3 in Terminal Emulator window.
5. Insert source code (input.asm) and simulation results (Terminal Emulator window) at the bottom of the document. Write an analysis to verify the simulation results.
6. Save the file in pdf format and submit the pdf file to Canvas before the deadline.

Sample output:

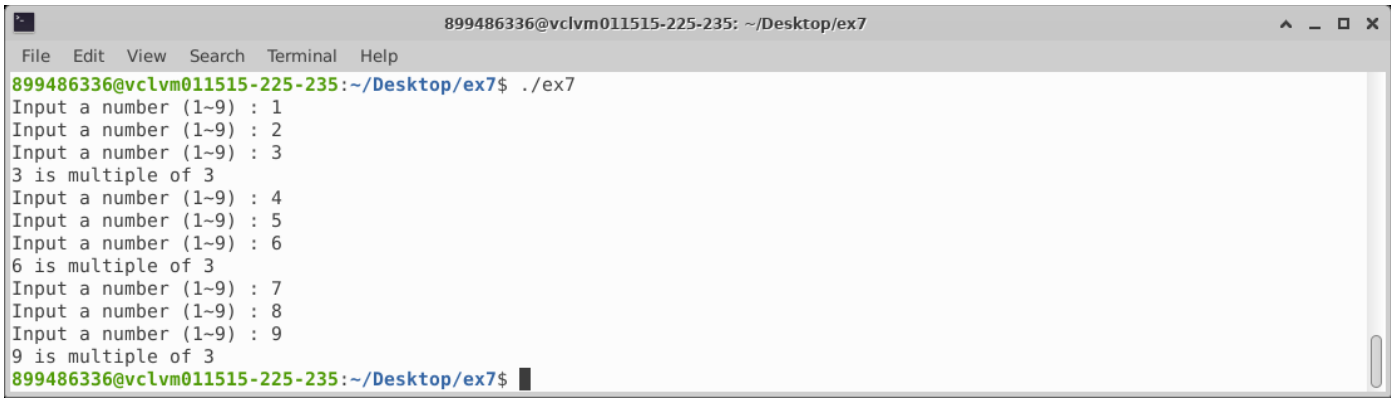


Alternatively, the corresponding C/C++ code can be replaced as follows:

```
char num;
char buffer;
char msg1[] = "Input a number (1~9): ";
char msg2[] = " is multiple of 3.";

register int r10 = 0;
do {
    cout << msg1;
    cin >> buffer;
    num = atoi(buffer);
    if(num%3 == 0) {
        cout << buffer << msg2;
    }
    r10++;
} while(r10 < 9);
```

Sample output:



[Insert input.asm source code here]

```
; input.asm;
; char msg1[] = "Input a number (1~9): ";
; char msg2[] = " is a Multiple of 3.";
; char buffer[2];
; char num;
; char ascii[10];
; register int r10 = 0;
; do {
;       cout << msg1;
;       cin >> buffer;
;       ascii[r10] = buffer;
;       r10++;
; } while(r10 < 9);
; r10 = 0;
; do {
;       num = atoi(ascii[r10]);
;       if(num%3 == 0) {
;               cout << ascii[r10] << msg2;
;       }
;       r10++;
; } while(r10 < 9);

section .data
msg1        db "Input a number (1~9): ", 0
msg2        db " is a Multiple of 3.", 0
newline             db 10, 0

section .bss
buffer      resb 2
ascii       resb 10

section .text
  global _start

_start:
  ; Initialize r10 to 0
  xor   r10, r10

input_loop:
```

```
    ; Print msg1
    mov rax, 1              ; sys_write
    mov rdi, 1              ; file descriptor (stdout)
    mov rsi, msg1 ; message to write
    mov rdx, 23             ; message length
    syscall                 ; call kernel

    ; Read input into buffer
    mov rax, 0              ; sys_read
    mov rdi, 0              ; file descriptor (stdin)
    mov rsi, buffer; buffer to store input
    mov rdx, 2              ; number of bytes to read
    syscall                 ; call kernel

    ; Store input in ascii array
    mov al, [buffer]
    mov [ascii + r10], al

    ; Increment r10
    inc   r10

    ; Check if r10 < 9
    cmp r10, 9
    jl      input_loop

    ; Reset r10 to 0
    xor   r10, r10

check_loop:
    ; Load ASCII character from ascii array
    movzx     rax, byte [ascii + r10]

    ; Convert ASCII to integer by subtracting '0'
    sub   rax, '0'

    ; Check if the number is a multiple of 3
    xor   rdx, rdx
    mov rbx, 3
    div   rbx
    cmp rdx, 0
```

```
    jne   not_multiple

    ; Print the number
    mov rax, 1              ; sys_write
    mov rdi, 1              ; file descriptor (stdout)
    lea   rsi, [ascii + r10]
    mov rdx, 1              ; number of bytes to write
    syscall                 ; call kernal

    ; Print msg2
    mov rax, 1              ; sys_write
    mov rdi, 1              ; file descriptor (stdout)
    mov rsi, msg2 ; message to write
    mov rdx, 21             ; message length
    syscall                 ; call kernel

    ; Print newline
    mov rax, 1              ; sys_write
    mov rdi, 1              ; file descriptor (stdout)
    mov rsi, newline        ; newline character
    mov rdx, 1              ; number of bytes to write
    syscall                 ; call kernel

not_multiple:
    ; Increment r10
    inc   r10

    ; Check if r10 < 9
    cmp r10, 9
    jl      check_loop

    ; Exit program
    mov rax, 60             ; sys_exit
    xor   rdi, rdi      ; exit code 0
    syscall                 ; call kernel
```

[Insert input simulation result here]

```
riley@theWeakest:~/Downloads/Riley Blacklock - Coding Portfolio/CPSC240 - Assembly/Assignment 7$ ./input
Input a number (1~9): 1
Input a number (1~9): 2
Input a number (1~9): 3
Input a number (1~9): 4
Input a number (1~9): 5
Input a number (1~9): 6
Input a number (1~9): 7
Input a number (1~9): 8
Input a number (1~9): 9
3 is a Multiple of 3.
6 is a Multiple of 3.
9 is a Multiple of 3.
riley@theWeakest:~/Downloads/Riley Blacklock - Coding Portfolio/CPSC240 - Assembly/Assignment 7$
```

[Insert the simulation result verification here]

input.asm U | inputsimulation.c U

CPSC240 - Assembly > Assignment 7 > inputsimulation.c > main()

```c
int main() {
    char msg1[] = "Input a number (1~9): ";
    char msg2[] = " is a Multiple of 3.";
    char buffer[2];
    char ascii[10];
    int r10 = 0;

    do {
        printf("%s", msg1);
        scanf("%1s", buffer);
        ascii[r10] = buffer[0];
        r10++;
    } while (r10 < 9);

    r10 = 0;
    do {
        int num = ascii[r10];
        if (num % 3 == 0) {
            printf("%c%s\n", ascii[r10], msg2);
        }
        r10++;
    } while (r10 < 9);
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS COMMENTS bash - Assignment 7

```
riley@theWeakest:~/Downloads/Riley Blacklock - Coding Portfolio/CPSC240 - Assembly/Assignment 7$ ./inputsimulation
Input a number (1~9): 1
Input a number (1~9): 2
Input a number (1~9): 3
Input a number (1~9): 4
Input a number (1~9): 5
Input a number (1~9): 6
Input a number (1~9): 7
Input a number (1~9): 8
Input a number (1~9): 9
3 is a Multiple of 3.
6 is a Multiple of 3.
9 is a Multiple of 3.
```

Ln 28, Col 2 Spaces: 4 UTF-8 LF {} C