

CPSC 240: Computer Organization and Assembly Language

Assignment 02, Fall Semester 2023

CWID:885857847 _____ Name:Kush
Patel _____

1. Download the "CPSC-240 Assignment02.docx" document.
2. Design the "addition.asm" program, and use assembly language to realize the function of the following C++ instructions.

```
unsigned short num1 = 50000;  
unsigned short num2 = 40000;  
unsigned int sum = 0;  
sum = int(num1 + num2);
```
3. Assemble the "addition.asm" file and link the "addition.o" file to get the "addition" executable file.
4. Run the "addition" file with the DDD debugger to display the simulation results of num1 and num2, as well as the simulation results of sum.
5. Insert source code (addition.asm) and simulation results (DDD debugger window) of the memory (num1, num2, and sum) in the document. Use calculator or hand calculation to verify the simulation results.
6. Design the "subtraction.asm" program, and use assembly language to realize the function of the following C++ instructions.

```
signed short num1 = 20000;  
signed short num2 = 30000;  
signed int dif = 0;  
dif = int(num1 - num2);
```
7. Assemble the "subtraction.asm" file and link the "subtraction.o" file to get the "subtraction" executable file.
8. Run the "subtraction" file with the DDD debugger to display the simulation results of num1 and num2, as well as the simulation results of diff.
9. Insert source code (subtraction.asm) and simulation results (DDD debugger window) of the memory (num1, num2, and dif) in the document. Use calculator or hand calculation to verify the simulation results.
10. Save the file in pdf format and submit the pdf file to Canvas before 23:59 pm on 09/13/2023.

[Insert addition.asm here]

```
; addition.asm  
; unsigned short num1 = 50000;  
; unsigned short num2 = 40000;  
; unsigned int sum = 0;  
; sum = int(num1 + num2);
```

```

section .data
    num1 dw 50000
    num2 dw 40000
    sum dd 0
section .text
    global _start
_start:
    mov dx, 0
    mov ax, word[num1]          ;al = num1 = 64h
    add ax, word[num2]          ;al = al + num2 = 2Ch
    adc dx, 0                   ;ah = ah + 0 + CF = 01h
    mov word[sum+0], ax          ;sum = al = 9ch
    mov word[sum+2], dx          ;sum = ah = 0ffh
                                ;mov word[sum], ax
    Mov rax, 60                 ;terminate excuting process
    mov rdi, 0                  ;exit status
    syscall

```

[Insert addition simulation result here]

```

1 ; addition.asm
2 ; unsigned short num1 = 50000;
3 ; unsigned short num2 = 40000;
4 ; unsigned int sum = 0;
5 ; sum = int(num1 + num2);
6 section .data
7     num1 dw 50000
8     num2 dw 40000
9     sum dd 0
10 section .text
11     global _start
12 _start:
13     mov     dx, 0
14     mov     ax, word[num1]           ;al = num1 = 64h
15     add     ax, word[num2]           ;al = al + num2 = 2Ch
16     adc     dx, 0                    ;ah = ah + 0 + CF = 01h
17     mov     word[sum+0], ax           ;sum = al = 9ch
18     mov     word[sum+2], dx           ;sum = ah = 0ffh
19                                     ;mov word[sum], ax
20     Mov     rax, 60                   ;terminate excuting process
21     mov     rdi, 0                   ;exit status
22     syscall
23
24

```

```

(gdb) break 20
Breakpoint 1 at 0x401028: file addition.asm, line 20.
(gdb) x/uh &num1
0x402000:      50000
(gdb) |

```

```

▲ 0x402000: 50000

```

```

1 ; addition.asm
2 ; unsigned short num1 = 50000;
3 ; unsigned short num2 = 40000;
4 ; unsigned int sum = 0;
5 ; sum = int(num1 + num2);
6 section .data
7     num1 dw 50000
8     num2 dw 40000
9     sum dd 0
10 section .text
11     global _start
12 _start:
13     mov     dx, 1
14     mov     ax, word[num1]
15     add     ax, word[num2]
16     adc     dx, 0
17     mov     word[sum+0], ax
18     mov     word[sum+2], dx
19
20     Mov     rax, 60
21     mov     rdi, 0
22     syscall
23
24

```

;al = num1 = 64h
 ;al = al + num2 = 2Ch
 ;ah = ah + 0 + CF = 01h
 ;sum = al = 9ch
 ;sum = ah = 0ffh
 ;mov word[sum], ax
 ;terminate excuting process
 ;exit status

```

(gdb) x/uh &num1
0x402000:      50000
(gdb) x/uh &num2
0x402002:      40000
(gdb) |

```

```

▲ 0x402002: 40000

```

```

1 ; addition.asm
2 ; unsigned short num1 = 50000;
3 ; unsigned short num2 = 40000;
4 ; unsigned int sum = 0;
5 ; sum = int(num1 + num2);
6 section .data
7     num1 dw 50000
8     num2 dw 40000
9     sum dd 0
10 section .text
11     global _start
12 _start:
13     mov     dx, 0
14     mov     ax, word[num1]           ;al = num1 = 64h
15     add     ax, word[num2]           ;al = al + num2 = 2Ch
16     adc     dx, 0                    ;ah = ah + 0 + CF = 01h
17     mov     word[sum+0], ax           ;sum = al = 9ch
18     mov     word[sum+2], dx           ;sum = ah = 0ffh
19                                     ;mov word[sum], ax
20     Mov     rax, 60                   ;terminate excuting process
21     mov     rdi, 0                   ;exit status
22     syscall
23
24

```

```

Breakpoint 1, _start () at addition.asm:20
(gdb) x/uw %sum
0x402004:      90000
(gdb) |

```

```

▲ 0x402004: 90000

```

[Insert addition simulation result verification here]

TI-84 PLUS CE

NORMAL FLOAT AUTO REAL DEGREE MP

50000+40000

90000

stat plot f1 tblset f2 format f3 calc f4 table f5

y=

window

zoom

trace

graph

quit

ins



2nd

mode

del

A-lock

link

list

alpha

x.tan

stat

test A

angle B

draw C

distr



math

apps

prgm

vars

clear

matrix D

sin E

cos F

tan G

π H

x^{-1}

sin

cos

tan

[Insert subtraction.asm here]

```
; subtraction.asm
; signed short num1 = 20000;
; signed short num2 = 30000;
; signed int dif = 0;
; dif = int(num1 - num2)

section .data
    num1    dw    20000
    num2    dw    30000
    dif     dd     0

section .text
    global _start

_start:
    mov ax, word[num1]
    sub ax, word[num2]
    sbb dx, 0
    mov     word[dif + 0], ax
    mov     word[dif + 2], dx

    mov rax, 60
    mov rdi, 0
    syscall
```

[Insert subtraction simulation result here]

<pre> 1 ; subtraction.asm 2 ; signed short num1 = 20000; 3 ; signed short num2 = 30000; 4 ; signed int dif = 0; 5 ; dif = int(num1 - num2) 6 7 section .data 8 num1 dw 20000 9 num2 dw 30000 10 dif dd 0 11 12 section .text 13 global _start 14 15 _start: 16 mov ax, word[num1] 17 sub ax, word[num2] 18 sbb dx, 0 19 mov word[dif + 0], ax 20 mov word[dif + 2], dx 21 22 mov rax, 60 23 mov rdi, 0 24 syscall </pre>	<pre> 1 ; subtraction.asm 2 ; signed short num1 = 20000; 3 ; signed short num2 = 30000; 4 ; signed int dif = 0; 5 ; dif = int(num1 - num2) 6 7 section .data 8 num1 dw 20000 9 num2 dw 30000 10 dif dd 0 11 12 section .text 13 global _start 14 15 _start: 16 mov ax, word[num1] 17 sub ax, word[num2] 18 sbb dx, 0 19 mov word[dif + 0], ax 20 mov word[dif + 2], dx 21 22 mov rax, 60 23 mov rdi, 0 24 syscall </pre>
<pre> Breakpoint 1, _start () at subtraction.asm:22 (gdb) x/dh &num1 0x402000: 20000 (gdb) x/dh &num2 0x402002: 30000 </pre>	<pre> (gdb) x/dh &num2 0x402002: 30000 (gdb) x/dw &dif 0x402004: -10000 (gdb) </pre>
▲ 0x402004: -10000	▲ 0x402004: -10000

[Insert subtraction simulation result verification here]

TI-84 Plus CE

NORMAL FLOAT AUTO REAL DEGREE MP

20000-30000

-10000

stat plot f1 tblset f2 format f3 calc f4 table f5

y=

window

zoom

trace

graph

quit

ins

2nd

mode

del

A-lock

link

list

alpha

x,tan

stat

test A

angle B

draw C

distr

math

apps

prgm

vars

clear

matrix D

sin⁻¹ E

cos⁻¹ F

tan⁻¹ G

π H