Lab: 04

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Computer Organization and Assembly Language

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Review Questions

1. **Name all eight 32-bit general-purpose registers.**
   - EAX, EBX, ECX, EDX, ESI, EDI, EBP, ESP
2. **Name all eight 16-bit general-purpose registers.**
   - AX, BX, CX, DX, SI, DI, BP, SP
3. **Name all eight 8-bit general-purpose registers.**
   - AH, AL, BH, BL, CH, CL, DH, DL
4. **What special purpose does the EAX register serve?**
   - The EAX register often serves as the accumulator, which is used for arithmetic operations and to store function return values.
5. **What is the purpose of the EIP register?**
   - The EIP (Extended Instruction Pointer) register holds the address of the next instruction to be executed.
6. **What is the purpose of the ESP register?**
   - The ESP (Extended Stack Pointer) register points to the top of the stack, managing the stack in stack operations.
7. **In the FLAT memory model, how many bits are used to hold a memory address?**
   - 32 bits are used to hold a memory address in the FLAT memory model.
8. **What is the meaning of the INCLUDE directive?**
   - The INCLUDE directive is used to include external files or libraries in the assembly program, making their contents available during the assembly process.
9. **What does the .CODE directive identify?**
   - The .CODE directive identifies the beginning of the code segment where the executable instructions are placed.
10. **Which directive begins a procedure and which directive ends it?**
    - The `PROC` directive begins a procedure, and the `ENDP` directive ends it.
11. **What is the purpose of the END directive?**
    - The END directive marks the end of the source file and specifies the entry point for the program.
12. **What does the PROTO directive do?**
    - The PROTO directive is used to declare the prototypes of procedures, defining their names and parameters.
13. **What types of files are produced by the assembler?**
    - The assembler produces object files (.obj) and listing files (.lst).
14. **What types of files are produced by the linker?**
    - The linker produces executable files (.exe) and map files (.map).

Programming Exercises

1. **Program to accumulate the sum of four integers in 32-bit registers:**

```
assembly
TITLE Accumulate Sum of Four Integers (accsum32.asm)
; This program moves four integers into registers and
accumulates their sum into the EAX register

.686
.MODEL flat, stdcall
.STACK

INCLUDE Irvine32.inc

.CODE
main PROC
    mov eax, 10000h   ; EAX = 10000h
    mov ebx, 20000h   ; EBX = 20000h
    mov ecx, 30000h   ; ECX = 30000h
    mov edx, 40000h   ; EDX = 40000h

    add eax, ebx      ; EAX = EAX + EBX
    add eax, ecx      ; EAX = EAX + ECX
    add eax, edx      ; EAX = EAX + EDX

    ; Exit program
    call ExitProcess
main ENDP
END main
```

OUTPUT:

```
D:\Code Playground\Assembly>accsum32.exe

  EAX=000A0000  EBX=00020000  ECX=00030000  EDX=00040000
  ESI=00401005  EDI=00401005  EBP=0019FF84  ESP=0019FF78
  EIP=0040102F  EFL=00000206  CF=0  SF=0  ZF=0  OF=0
```

2. **Program to accumulate the sum of four integers in 16-bit registers:**

```
TITLE Accumulate Sum of Four Integers (accsum16.asm)
; This program moves four integers into 16-bit registers and
accumulates their sum into the AX register

.686
.MODEL flat, stdcall
.STACK

INCLUDE Irvine32.inc

.CODE
main PROC
    mov ax, 1000h     ; AX = 1000h
    mov bx, 2000h     ; BX = 2000h
    mov cx, 3000h     ; CX = 3000h
    mov dx, 4000h     ; DX = 4000h

    add ax, bx        ; AX = AX + BX
    add ax, cx        ; AX = AX + CX
    add ax, dx        ; AX = AX + DX

    ; Exit program
    call ExitProcess
main ENDP
END main
```

OUTPUT:

```
D:\Code Playground\Assembly>accsum16.exe

  EAX=0019A000  EBX=00202000  ECX=00403000  EDX=00404000
  ESI=00401005  EDI=00401005  EBP=0019FF84  ESP=0019FF78
  EIP=0040102E  EFL=00000A86  CF=0  SF=1  ZF=0  OF=1
```