

MICROPROCESSOR AND
ASSEMBLY LANGUAGE
ASSIGNMENT #2

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Question #1:

```
INCLUDE Irvine32.inc
.data
array DWORD 7,4,3,11,1
count DWORD ?
scount DWORD ?
.code
main PROC
    mov ecx, LENGTHOF array -1
outer_loop:
    mov esi,0
    mov count, ecx
    inner_loop:
        mov eax, array[esi]
        add esi, TYPE array
        mov edx, array[esi]
        call DumpRegs
        cmp eax, array[esi]
        jle L2
        xchg eax, array[esi]
        mov array[esi - 4],eax
        mov edx, array[esi]
    L2:
        call DumpRegs
        loop inner_loop
    mov ecx, count
    loop outer_loop
    mov esi, OFFSET array
    mov ebx,1
    mov ecx, SIZEOF array
    call DumpMem
    exit
main ENDP
END main
```

```
Microsoft Visual Studio Debug Console

EAX=00000007 EBX=0092E000 ECX=00000004 EDX=00000004
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000004 EBX=0092E000 ECX=00000004 EDX=00000007
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000007 EBX=0092E000 ECX=00000003 EDX=00000003
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000003 EBX=0092E000 ECX=00000003 EDX=00000007
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000007 EBX=0092E000 ECX=00000002 EDX=00000008
ESI=0000000C EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000007 EBX=0092E000 ECX=00000002 EDX=00000008
ESI=0000000C EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000297 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=1

EAX=00000008 EBX=0092E000 ECX=00000001 EDX=00000001
ESI=00000010 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000212 CF=0 SF=0 ZF=0 OF=0 AF=1 PF=0

EAX=00000001 EBX=0092E000 ECX=00000001 EDX=00000008
ESI=00000010 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000004 EBX=0092E000 ECX=00000003 EDX=00000003
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000003 EBX=0092E000 ECX=00000003 EDX=00000004
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000004 EBX=0092E000 ECX=00000002 EDX=00000007
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000004 EBX=0092E000 ECX=00000002 EDX=00000007
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000293 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=0

EAX=00000007 EBX=0092E000 ECX=00000001 EDX=00000001
ESI=0000000C EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000001 EBX=0092E000 ECX=00000001 EDX=00000007
ESI=0000000C EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000003 EBX=0092E000 ECX=00000002 EDX=00000004
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000003 EBX=0092E000 ECX=00000002 EDX=00000004
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000297 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=1

EAX=00000004 EBX=0092E000 ECX=00000001 EDX=00000001
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0
```

```
Microsoft Visual Studio Debug Console
EAX=00000003 EBX=0002E000 ECX=00000002 EDX=00000004
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000297 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=1

EAX=00000004 EBX=0002E000 ECX=00000001 EDX=00000001
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000001 EBX=0002E000 ECX=00000001 EDX=00000004
ESI=00000008 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000206 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=1

EAX=00000003 EBX=0002E000 ECX=00000001 EDX=00000001
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A3684 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

EAX=00000001 EBX=0002E000 ECX=00000001 EDX=00000003
ESI=00000004 EDI=002A10AA EBP=00B3FEB0 ESP=00B3FEB0
EIP=002A36A3 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

Dump of offset 002A6000
-----
01 00 00 00 03 00 00 00 04 00 00 00 07 00 00 00
0B 00 00 00

D:\Coding\Microprocessor and Assembly Language\Assignment2\Debug\Assignment2.exe (process 12010) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

Question #2:

```
INCLUDE Irvine32.inc
```

```
.data
```

```
array DWORD 7,4,3,11,1
```

```
.code
```

```
main PROC
```

```
    mov esi,0
```

```
    mov ecx, LENGTHOF array -1
```

```
    mov eax, array[esi]
```

```
    mov ebx, array[esi]
```

```
L1:
```

```
    add esi, TYPE array
```

```
    cmp eax, array[esi]
```

```
    jle L2
```

```
    mov eax, array[esi]
```

```
L2:
```

```
    cmp ebx, array[esi]
```

```
    jge L3
```

```
    mov ebx, array[esi]
```

```
L3:
```

```
    loop L1
```

```
    call DumpRegs
```

```
    exit
```

```
main ENDP
```

```
END main
```

```
Microsoft Visual Studio Debug Console

EAX=00000001  EBX=0000000B  ECX=00000000  EDX=009B10AA
ESI=00000010  EDI=009B10AA  EBP=006FF84C  ESP=006FF840
EIP=009B369C  EFL=00000206  CF=0  SF=0  ZF=0  OF=0  AF=0  PF=1

D:\Coding\Microprocessor and Assembly Language\Assignment2\Debug\Assignment2.exe (process 5724) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

Question #3:

```
INCLUDE Irvine32.inc
.data
num DWORD 172
.code
main PROC
    mov eax, num
    mov ebx, 2
    mov edx, 0
    div ebx
    call DumpRegs
    cmp edx, 0
    je L1
    mov dl, 'N'
    jmp L2
L1:
    mov dl, 'Y'
L2:
    call DumpRegs
    exit
main ENDP
END main
```

When number is 172

```
Microsoft Visual Studio Debug Console

EAX=00000056 EBX=00000002 ECX=002110AA EDX=00000000
ESI=002110AA EDI=002110AA EBP=009FFDAC ESP=009FFDA0
EIP=00213676 EFL=00000246 CF=0 SF=0 ZF=1 OF=0 AF=0 PF=1

EAX=00000056 EBX=00000002 ECX=002110AA EDX=00000059
ESI=002110AA EDI=002110AA EBP=009FFDAC ESP=009FFDA0
EIP=00213686 EFL=00000246 CF=0 SF=0 ZF=1 OF=0 AF=0 PF=1

D:\Coding\Microprocessor and Assembly Language\Assignment2\Debug\Assignment2.exe (process 16788) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

When number is 91

```
Microsoft Visual Studio Debug Console

EAX=0000002D EBX=00000002 ECX=003510AA EDX=00000001
ESI=003510AA EDI=003510AA EBP=006FF9E8 ESP=006FF9DC
EIP=00353676 EFL=00000246 CF=0 SF=0 ZF=1 OF=0 AF=0 PF=1

EAX=0000002D EBX=00000002 ECX=003510AA EDX=0000004E
ESI=003510AA EDI=003510AA EBP=006FF9E8 ESP=006FF9DC
EIP=00353686 EFL=00000202 CF=0 SF=0 ZF=0 OF=0 AF=0 PF=0

D:\Coding\Microprocessor and Assembly Language\Assignment2\Debug\Assignment2.exe (process 7928) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

Question #4:

```
INCLUDE Irvine32.inc
.data
pin1 DWORD 5,2,4,1,3
pin2 DWORD 4,3,5,3,4
.code
main PROC
    mov esi,0
    mov ecx, 1
```

L1:

```
mov edx, pin2[esi]
cmp ecx, 1
je digit1
cmp ecx, 2
je digit2
cmp ecx, 3
je digit3
cmp ecx, 4
je digit4
cmp ecx, 5
je digit5
digit1:
    cmp edx, 5
    jl ter
    cmp edx, 9
    jg ter
    mov eax, ecx
    jmp continue
digit2:
    cmp edx, 2
    jl ter
    cmp edx, 5
    jg ter
    mov eax, ecx
    jmp continue
digit3:
    cmp edx, 4
    jl ter
    cmp edx, 8
    jg ter
    mov eax, ecx
    jmp continue
digit4:
    cmp edx, 1
    jl ter
    cmp edx, 4
    jg ter
    mov eax, ecx
    jmp continue
digit5:
    cmp edx, 3
    jl ter
    cmp edx, 6
    jg ter
    mov eax, 5
    jmp ter
continue:
    call DumpRegs
    add esi, TYPE pin1
```

```

        inc ecx
        jmp L1
    ter:
        cmp eax, 5
        jne L2
        call DumpRegs
        mov eax, 0

    L2:
        call DumpRegs

    exit
main ENDP
END main

```

The screenshot shows the Microsoft Visual Studio Debug Console with a dark background. It displays assembly instructions and the corresponding register values (EAX, ESI, EIP, EBX, EDI, EFL, ECX, EBP, ZF, SF, OF, AF, PF) for several instructions. The instructions are: `inc ecx`, `jmp L1`, `cmp eax, 5`, `jne L2`, `call DumpRegs`, `mov eax, 0`, and `call DumpRegs`. The register values are shown in hexadecimal. The console also displays the exit code 0 and the path to the executable file.

```

Microsoft Visual Studio Debug Console

EAX=00000001 EBX=00723000 ECX=00000001 EDX=00000005
ESI=00000000 EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436D7 EFL=00000297 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=1

EAX=00000002 EBX=00723000 ECX=00000002 EDX=00000002
ESI=00000004 EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436D7 EFL=00000293 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=0

EAX=00000003 EBX=00723000 ECX=00000003 EDX=00000004
ESI=00000008 EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436D7 EFL=00000297 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=1

EAX=00000004 EBX=00723000 ECX=00000004 EDX=00000001
ESI=0000000C EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436D7 EFL=00000293 CF=1 SF=1 ZF=0 OF=0 AF=1 PF=0

EAX=00000005 EBX=00723000 ECX=00000005 EDX=00000003
ESI=00000010 EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436E7 EFL=00000246 CF=0 SF=0 ZF=1 OF=0 AF=0 PF=1

EAX=00000000 EBX=00723000 ECX=00000005 EDX=00000003
ESI=00000010 EDI=000410AA EBP=005CFC74 ESP=005CFC68
EIP=000436F1 EFL=00000246 CF=0 SF=0 ZF=1 OF=0 AF=0 PF=1

D:\Coding\Microprocessor and Assembly Language\Assignment2\Debug\Assignment2.exe (process 7780) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .

```