LAB 02

COMPUTER ORGANIZATION AND ASSEMBLY LANG(COAL)

STUDENT NAME ROLL NO SEC

SIGNATURE & DATE

MARKS AWARDED: ______________

NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES (NUCES), KARACHI

Version: 1.0

Prepared by: Amin Sadiq

Date:

EL 2003 COMP ORG & ASSEMBLY LANGUAGE LAB

LABORATORY MANUAL Fall 2021Instructor: Aamir Ali, Aashir Mehboob, Amin Sadiq, Qurat-ul-Ain, M Kariz, Rabia

Lab Session 02

Objectives:

- Debugging of programs
- Basic elements of Assembly language
- Defining Data
- Intrinsic Data Types

Steps Involved in Creating and Running a Program:

Assemble r:

It converts the assembly language to machine language (Object Code) May contain unresolved references (i.e. file contains some or all of complete program)

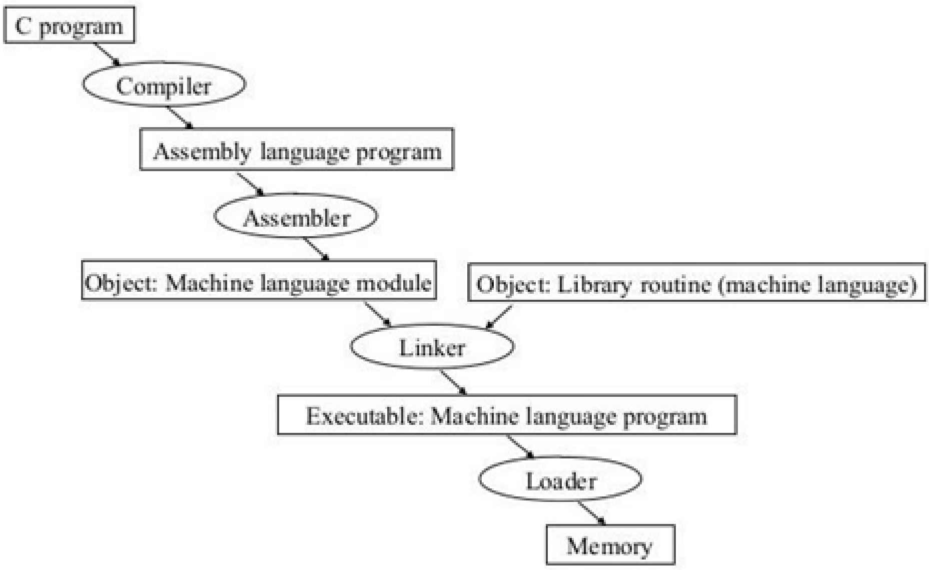
Linker:

A program that combines object files to create a single "executable" file. Major functional difference is that all references are resolved. (i.e. Program contains all parts needed to run) A program that loads executable files into memory, and may initialize some registers (e.g. IP) and starts it going.

Debugger:

A program that loads but controls the execution of the program. To start/stop execution, to view and modify state variables.

Steps in Creating & Running Code:


C program
Compiler
Assembly language program
Assembler
Object: Machine language module
Object: Library routine (machine language)
Linker
Executable: Machine language program
Loader
Memory

Section 1: Debugging our program

We have seen how to configure Visual Studio 2019 for Assembly Language and tested it with a sample program. The output of our sample program was displayed using a console window but it is usually more desirable to watch the step by step execution of our program with each line of code using breakpoints.

Let us briefly define the keywords relevant to debugging in Visual Studio and then we will cover an example for understanding.

Debugger

The (Visual Studio) debugger helps us observe the run-time behavior of our program and find problems. With the debugger, we can break the execution of our program to examine our code, examine and edit variables, view registers, see the instructions created from our source code, and view the memory space used by our application.

Breakpoint

A breakpoint is a signal that tells the debugger to temporarily suspend execution of your program at a certain point. When execution is suspended at a breakpoint, your program is said to be in break mode.

Code Stepping

One of the most common debugging procedures is stepping: executing code one line at a time. The Debug menu provides three commands for stepping through code:

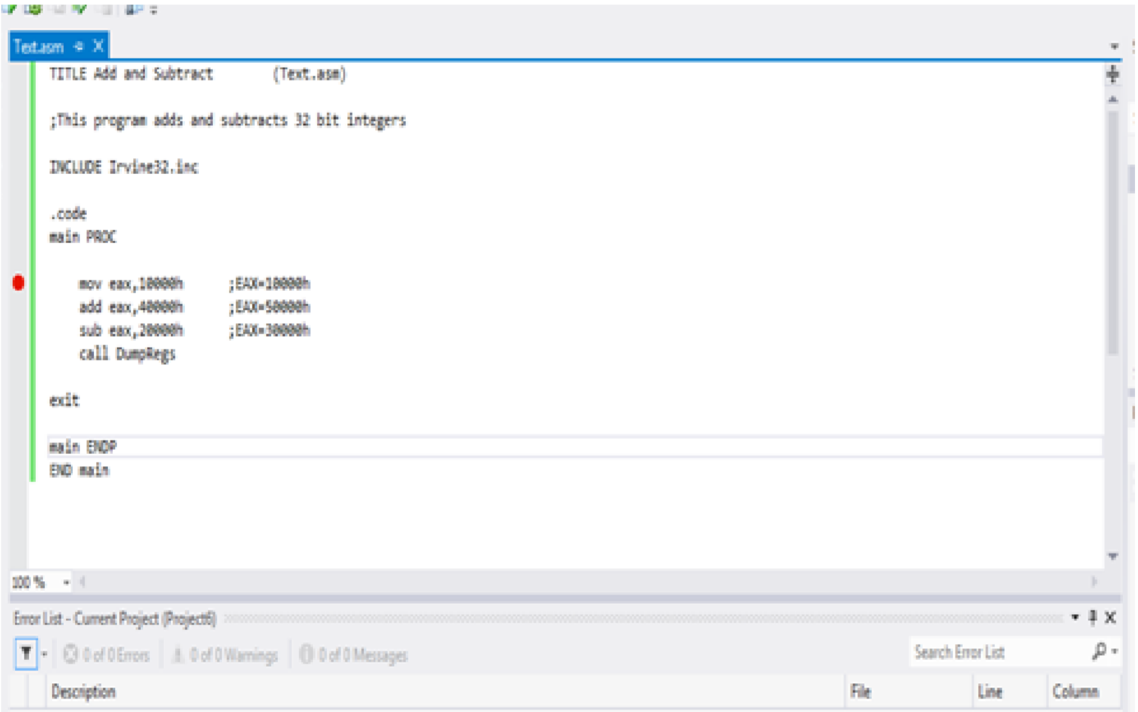
- Step Into (By pressing F11)
- Step Over (By pressing F10)
- Step Out (Shift+F11)

Single Stepping

To see the values of internal registers and memory variables during execution, let us use an example. Copy the following code onto your Test.asm file.k

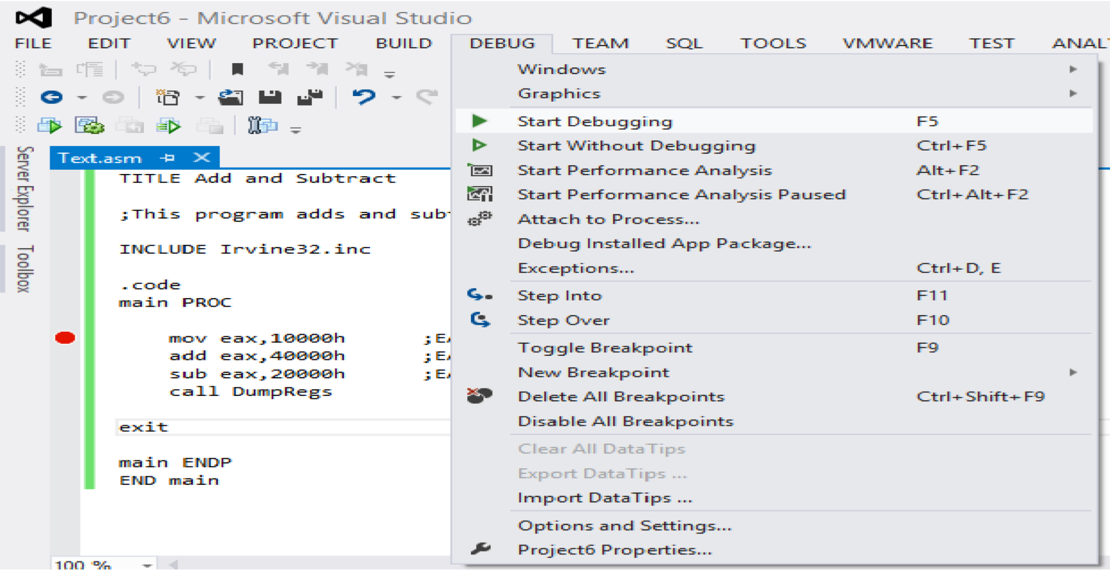
```
TITLE Add and Subtract
INCLUDE Irvine32.inc
.code
main PROC
mov eax,   10000h      ; EAX =10000h
add  eax,   40000h     ; EAX =50000h
sub eax,    20000h     ; EAX =30000h
call DumpRegs
exit
main ENDP
END main
```

1. Right-click on line 6 to insert a breakpoint.



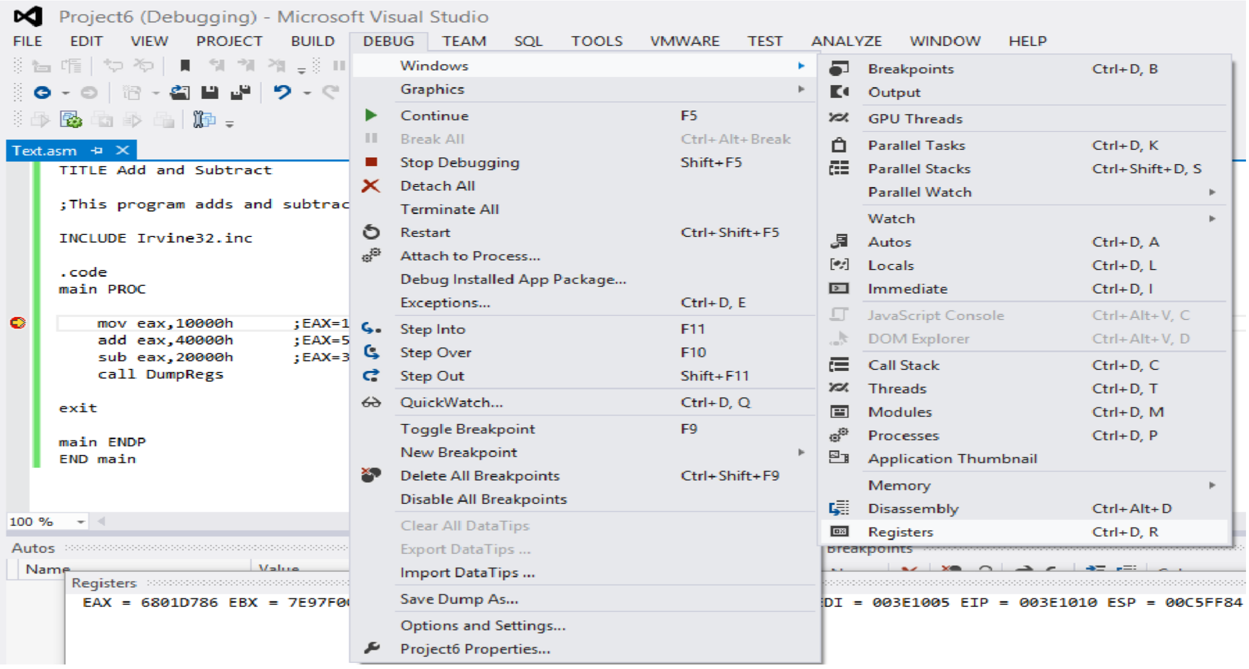
```
TITLE Add and Subtract        (Text.asm)

;This program adds and subtracts 32 bit integers

INCLUDE Irvine32.inc

.code
main PROC

    mov eax,10000h      ;EAX=10000h
    add eax,40000h      ;EAX=50000h
    sub eax,20000h      ;EAX=30000h
    call DumpRegs

exit

main ENDP
END main
```

2. Click on **Debug** tab from the toolbar, select **Start Debugging** OR press **F10** to start stepping over the code.



```
TITLE Add and Subtract

;This program adds and sub

INCLUDE Irvine32.inc

.code
main PROC

    mov eax,10000h        ;E
    add eax,40000h        ;E
    sub eax,20000h        ;E
    call DumpRegs

exit

main ENDP
END main
```

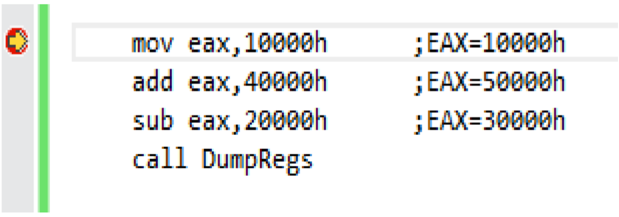
3. Click on **Debug** tab than select Windows after that open menu and select **Registers** option.



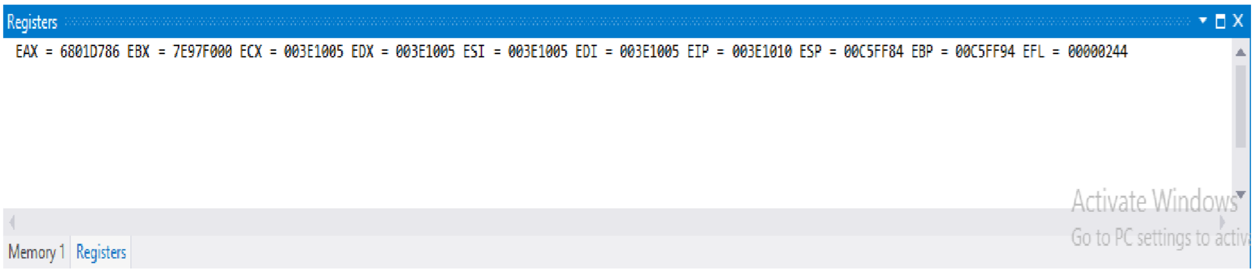
```
TITLE Add and Subtract

;This program adds and subtrac

INCLUDE Irvine32.inc

.code
main PROC

    mov eax,10000h          ;EAX=1
    add eax,40000h          ;EAX=5
    sub eax,20000h          ;EAX=3
    call DumpRegs

exit

main ENDP
END main
```

```
EAX = 6801D786 EBX = 7E97F0
DI = 003E1005 EIP = 003E1010 ESP = 00C5FF84
```

4. Breakpoint set on 1st instruction

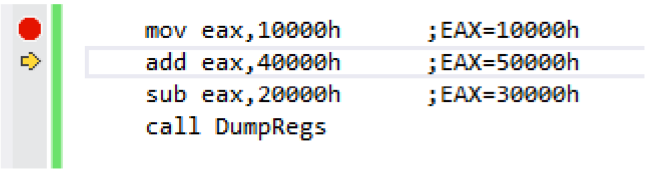


```
mov eax,10000h      ;EAX=10000h
add eax,40000h      ;EAX=50000h
sub eax,20000h      ;EAX=30000h
call DumpRegs
```

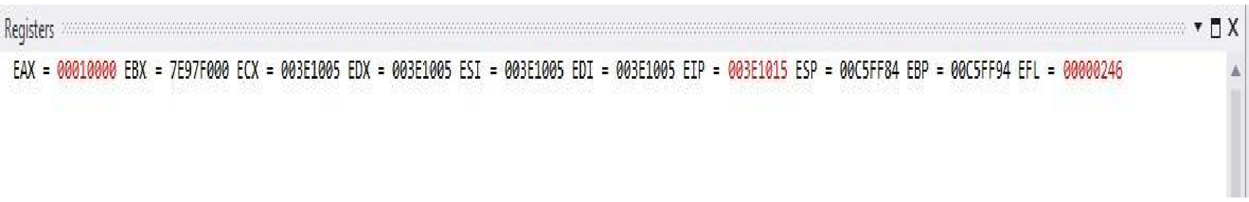


```
EAX = 6801D786 EBX = 7E97F000 ECX = 003E1005 EDX = 003E1005 ESI = 003E1005 EDI = 003E1005 EIP = 003E1010 ESP = 00C5FF84 EBP = 00C5FF94 EFL = 00000244
```

Press **F10** again to execute next line.

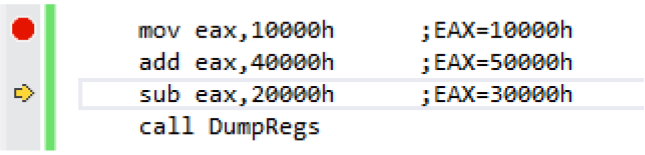


```
mov eax,10000h        ;EAX=10000h
add eax,40000h        ;EAX=50000h
sub eax,20000h        ;EAX=30000h
call DumpRegs
```

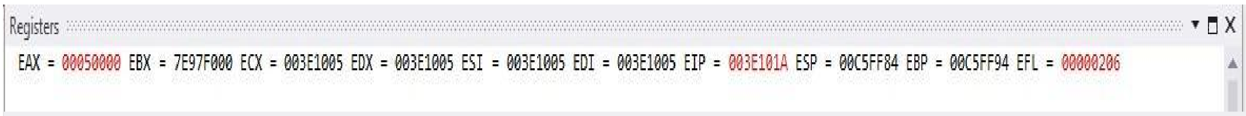


```
EAX = 00010000 EBX = 7E97F000 ECX = 003E1005 EDX = 003E1005 ESI = 003E1005 EDI = 003E1005 EIP = 003E1015 ESP = 00C5FF84 EBP = 00C5FF94 EFL = 00000246
```

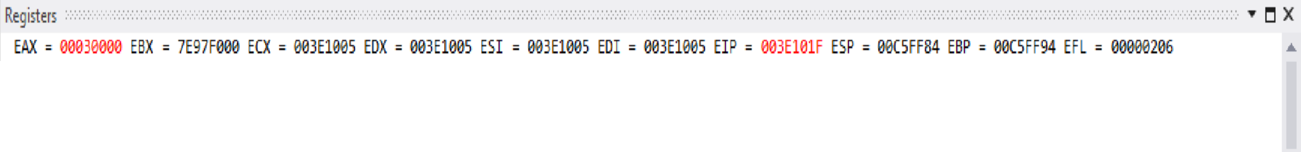
Again press **F10** key for next instruction execution.



```
mov eax,10000h        ;EAX=10000h
add eax,40000h        ;EAX=50000h
sub eax,20000h        ;EAX=30000h
call DumpRegs
```



```
EAX = 00050000 EBX = 7E97F000 ECX = 003E1005 EDX = 003E1005 ESI = 003E1005 EDI = 003E1005 EIP = 003E101A ESP = 00C5FF84 EBP = 00C5FF94 EFL = 00000206
```



```
EAX = 00030000 EBX = 7E97F000 ECX = 003E1005 EDX = 003E1005 ESI = 003E1005 EDI = 003E1005 EIP = 003E101F ESP = 00C5FF84 EBP = 00C5FF94 EFL = 00000206
```

Press **F10** again, the program will not terminate after executing the current instruction and as soon as it reaches the line with a call to **DumpRegs**

Section 3: Introduction to registers

To speed up the processor operations, the processor includes some internal memory storage locations, called **Registers**. The registers store data elements for processing without having to access the memory.

Processor Registers

There are ten 32-bit and six 16-bit processor registers in IA-32 architecture. The registers are grouped into three categories:

- General registers.
- Control registers.
- Segment registers.

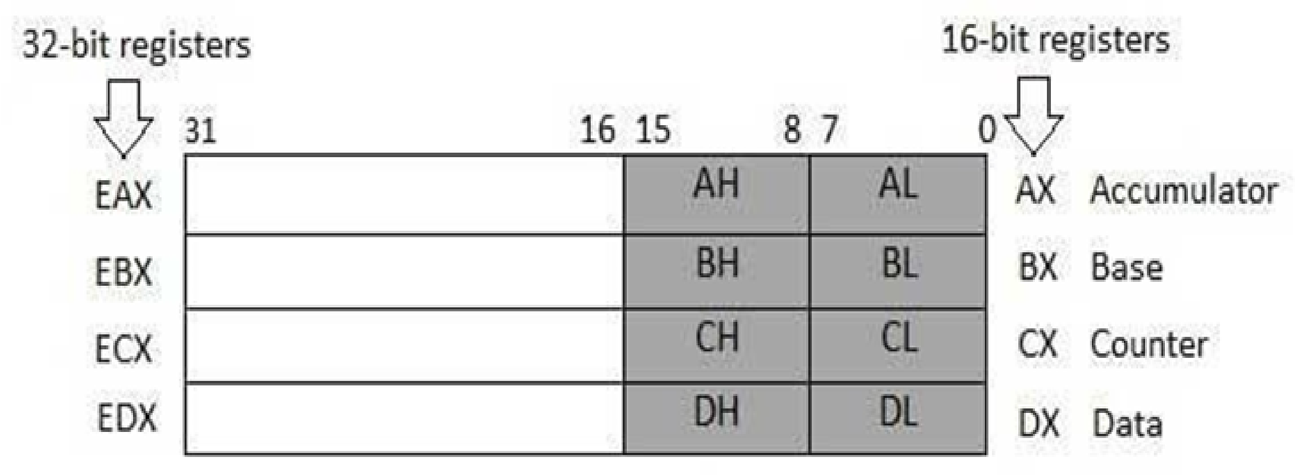
Furthermore, the general registers are further divided into the following groups:

- Data registers.
- Pointer registers.
- Index registers.

Data Registers

Four 32-bit data registers are used for arithmetic, logical, and other operations. These 32-bit registers can be used in three ways:

- As complete 32-bit data registers: EAX, EBX, ECX, EDX.
- Lower halves of the 32-bit registers can be used as four 16-bit data registers: AX, BX, CX and DX.
- Lower and higher halves of the above-mentioned four 16-bit registers can be used as eight 8-bit data registers: AH, AL, BH, BL, CH, CL, DH, and DL



AX (Accumulator): It is used in input/output and most arithmetic instructions. For example, in multiplication operation, one operand is stored in EAX or AX or AL register according to the size of the operand.

BX (Base register): It could be used in indexed addressing.

CX (Counter register): The ECX, CX registers store the loop count in iterative operations.

DX (Data register): It is also used in input/output operations. It is also used with AX register along with DX for multiply and division operations involving large values.

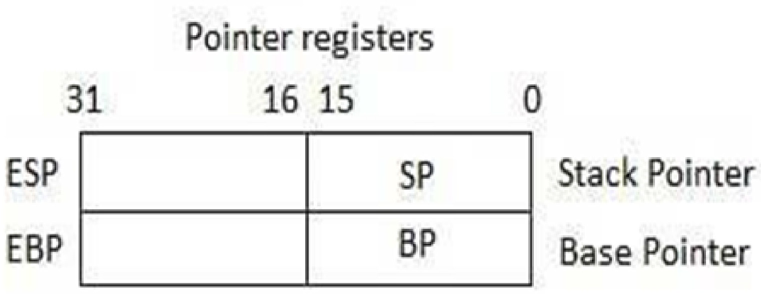
Pointer Registers

The pointer registers are 32-bit EIP, ESP, and EBP registers and corresponding 16-bit right portions IP, SP, and BP. There are three categories of pointer registers:

Instruction Pointer (IP): The 16-bit IP register stores the offset address of the next instruction to be executed. IP in association with the CS register (as CS:IP) gives the complete address of the current instruction in the code segment.

Stack Pointer (SP): The 16-bit SP register provides the offset value within the program stack. SP in association with the SS register (SS:SP) refers to be current position of data or address within the program stack.

Base Pointer (BP): The 16-bit BP register mainly helps in referencing the parameter variables passed to a subroutine. The address in SS register is combined with the offset in BP to get the location of the parameter. BP can also be combined with DI and SI as base register for special addressing.

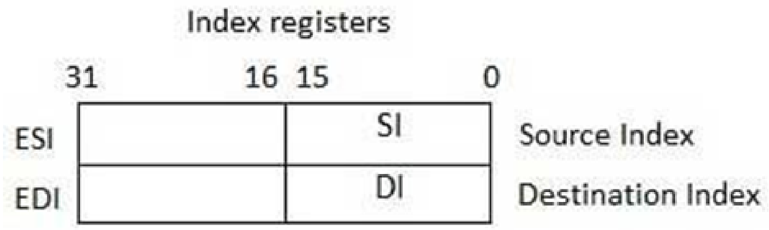


Index Registers

The 32-bit index registers, ESI and EDI, and their 16-bit rightmost portions. SI and DI, are used for indexed addressing and sometimes used in addition and subtraction. There are two sets of index pointers.

Source Index (SI): It is used as source index for string operations.

Destination Index (DI): It is used as destination index for string operations.



Basic Element of Assembly Language

Integer Constants

Integer constants are made up of an optional leading sign, one or more digits and an optional suffix character.

Format:

[{+ | -}] digits radix

Examples:

26	for decimal
26d	for decimal
10111110b	for binary
42o	for octal
1Ah	for Hexadecimal
0A3h	for Hexadecimal

Character Constants

Character constants are made up of a single character enclosed in either single or double quotes.

Example:

'A' "d"

String Constants

A string of characters enclosed in either single or double quotes.

Example:

"Hello World"

Identifiers

An identifier is a programmer-defined name of a variable, procedure or code label.

Format:

They may contain between 1 and 247 characters. They are not case sensitive. The first character must be a letter (A..Z, a..z), underscore (_), @ , ?, or $. Subsequent characters may also be digits.

An identifier cannot be the same as an assembler reserved word. For example: reserved words are instruction mnemonics, directives, attributes, operators, predefined symbols.

Examples:

myVar
_abc
hello2

Memory Segments

A segmented memory model divides the system memory into groups of independent segments referenced by pointers located in the segment registers. Each segment defines the area of our program that contains data variables, code and stack, respectively.

Data segment: It is the memory region, where data elements are stored for the program. This section cannot be expanded after the data elements are declared, and it remains static throughout the program.

Code segment: This section defines an area in memory that stores the instruction codes. This is also a fixed area.

Stack segment: This segment contains data values passed to procedures within the program.

Directives

A directive is a command embedded in the source code that is recognized and acted upon by the assembler. Directives do not execute at runtime. They can assign names to memory segments. In

MASM, directives are case insensitive. For example, it recognizes .data, .DATA and .Data as equivalent.

Let us see what different directives we can use to define segments of our program:

The **.DATA** directive identifies the area of a program containing variables:

Syntax:

.data

The **.CODE** directive identifies the area of a program containing executable instructions:

Syntax:

.code

The **.STACK** directive identifies the area of a program holding the runtime stack, setting its size:

Syntax:

.stack 100h

INSTRUCTIONS

An *instruction* is a statement that becomes executable when a program is assembled. Instructions are translated by the assembler into machine language bytes, which are loaded and executed by the CPU at runtime. An instruction contains four basic parts:

- Label (optional)
- Instruction mnemonic (required)
- Operand(s) (usually required)
- Comment (optional)

The basic syntax of an Assembly Language instruction is as:

[*label*:] *mnemonic* [*operands*] [;*comment*]

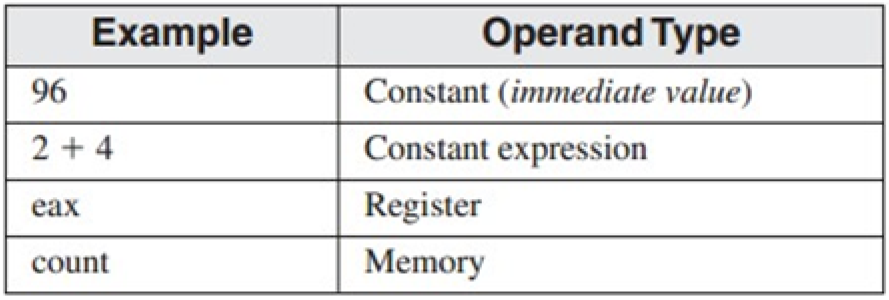
where elements in square brackets are optional. We will now see what each of these elements.

Label: A *label* is an identifier that acts as a place marker for instructions and data. A label placed just before an instruction implies the instruction's address. Similarly, a label placed just before a variable implies the variable's address.

Mnemonics: An instruction mnemonic is a short word that identifies an instruction to perform an operation. Following are examples of instruction mnemonics:

mov: Moves (assigns) one value to another.
add: Adds two values
sub: Subtracts one value from another
mul: Multiplies two values
jmp: Jumps to a new location
call: Calls a procedure

Operands: Assembly language instructions can have between zero and three operands, each of which can be a register, memory operand, constant expression, or input-output port.



Example	Operand Type
96	Constant (*immediate value*)
2 + 4	Constant expression
eax	Register
count	Memory

Example:

The MOV instruction has two operands:

mov count , ebx ; move EBX to count

In a two-operand instruction, the first operand is called the destination. The second operand is the source. In general, the contents of the destination operand are modified by the instruction.

Comments: Comments are an important way for the writer of a program to communicate information about the program's design to a person reading the source code.

Comments can be specified in two ways:

- **Single-line comments**: beginning with a semicolon character (;). All characters following the semicolon on the same line are ignored by the assembler.

- **Block comments**: beginning with the COMMENT directive and a user-specified symbol. For example,

COMMENT !

This line is a comment.

This line is also a comment.

!

Data Types

MASM defines **intrinsic data types**, each of which describes a set of values that can be assigned to variables and expressions of the given type.

BYTE	8-bit unsigned integer
SBYTE	8-bit signed integer. S stands for signed
WORD	16-bit unsigned integer
SWORD	16-bit signed integer
DWORD	32-bit unsigned. D stands for double
QWORD	64-bit integer. Q stands for quad
TBYTE	80-bit integer. T stands for ten

Section 4: Exercise

Implement all of these equations in assembly language.

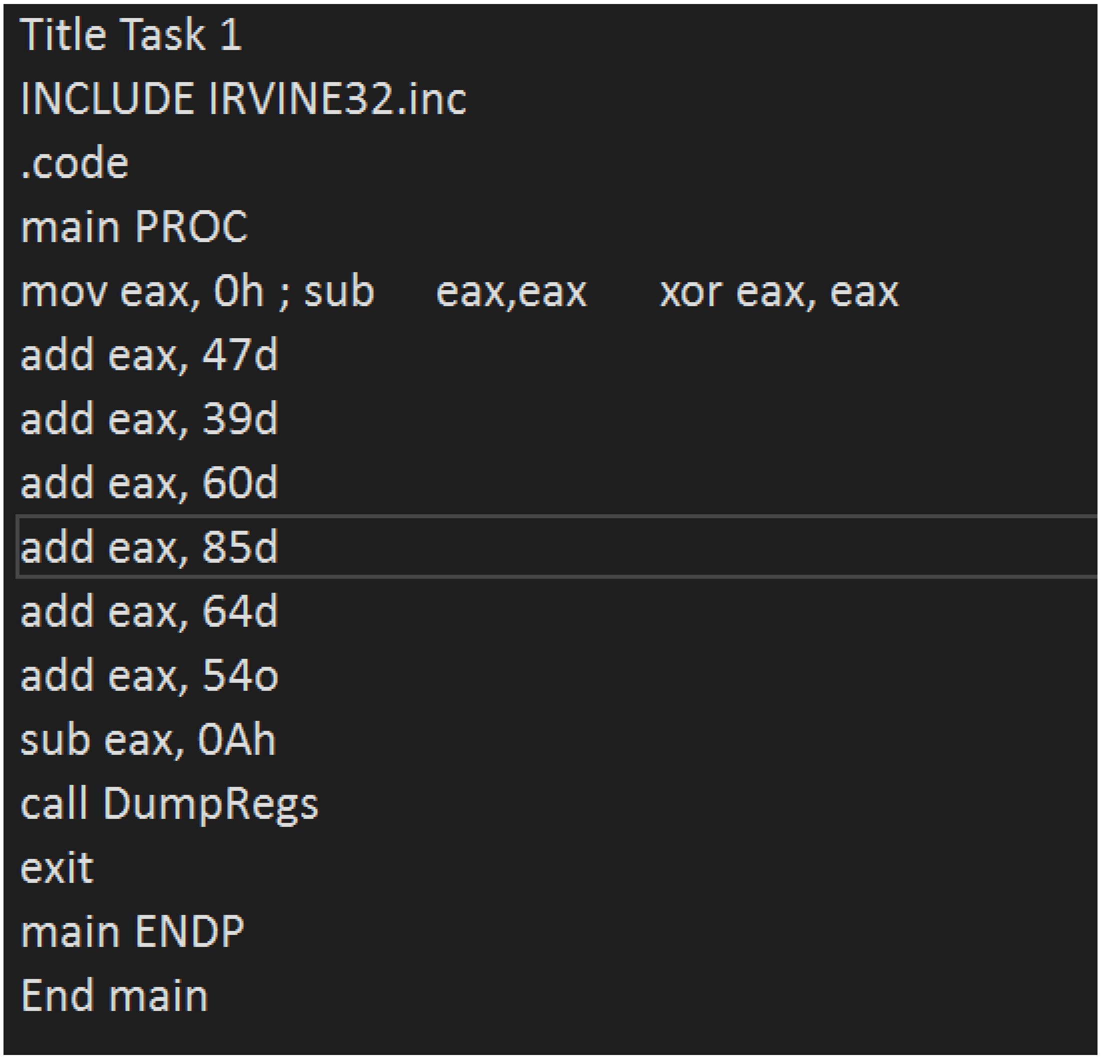
- 47 + 39 + 60 + 85 + 64+54o-0Ah
- 30- 9 + 186 – 150
- 101110 + 50Ah + 6710d + 1010001 + F
- 10001101 – D83h + 385+10 + 1111101 – E+F

Write a program in assembly language that implements following expression:

- edx = eax + 1 + ebx + edx – ecx + 0Ah-65o+73d
- eax = 5ADh – eax + 65o + 65d – 11110111 + 150

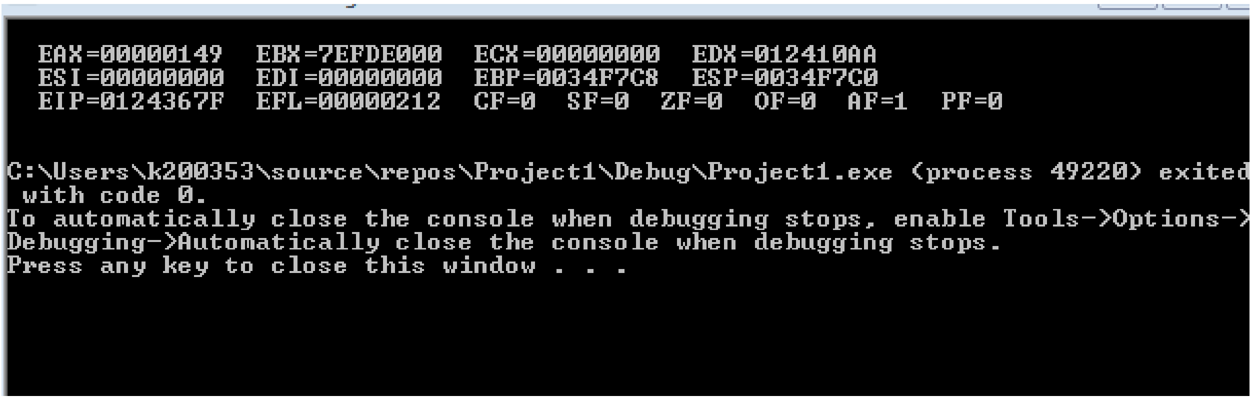
Task 1:

Source Code



```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax      xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

Output File

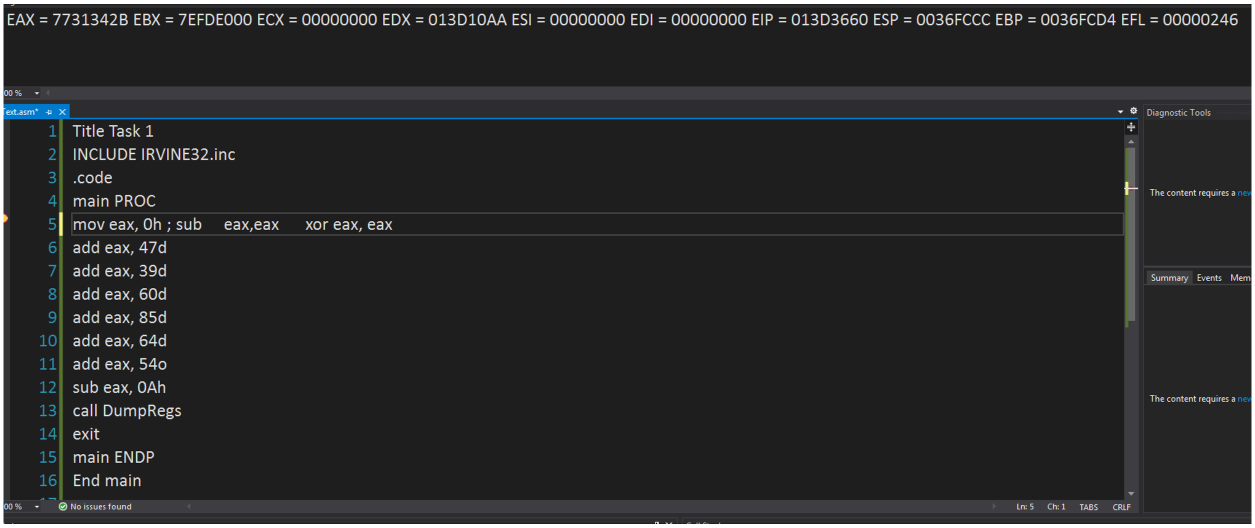


```
  EAX=00000149  EBX=7EFDE000  ECX=00000000  EDX=012410AA
  ESI=00000000  EDI=00000000  EBP=0034F7C8  ESP=0034F7C0
  EIP=0124367F  EFL=00000212  CF=0  SF=0  ZF=0  OF=0  AF=1  PF=0


C:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 49220) 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 . . .
```

Comment: Adding And Subtracting different values in the register EAX

Debugging:

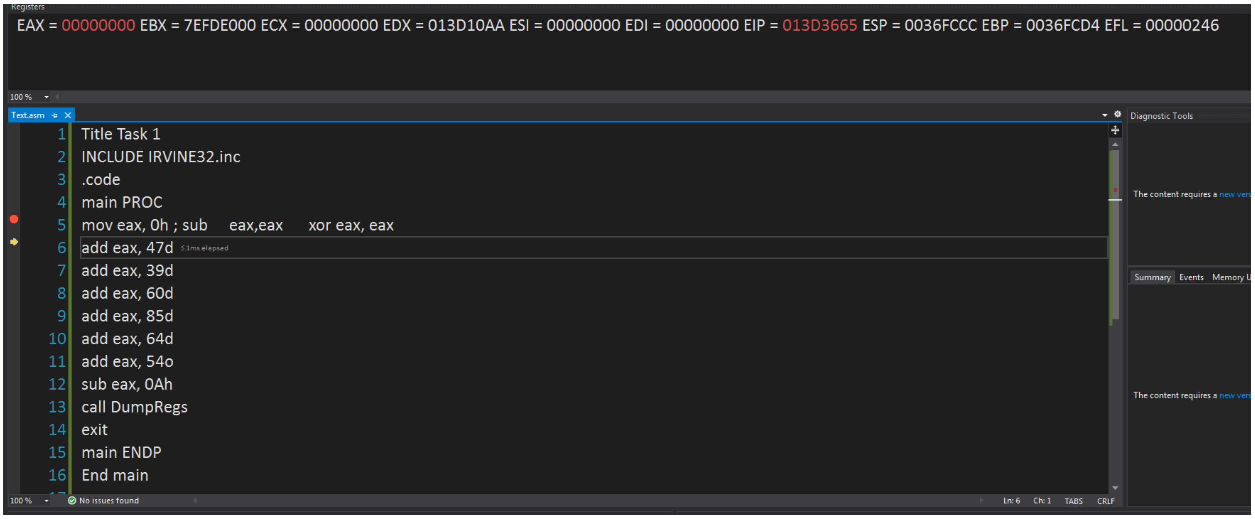
Step1:



```
EAX = 7731342B EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3660 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000246
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax      xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

Step 2:

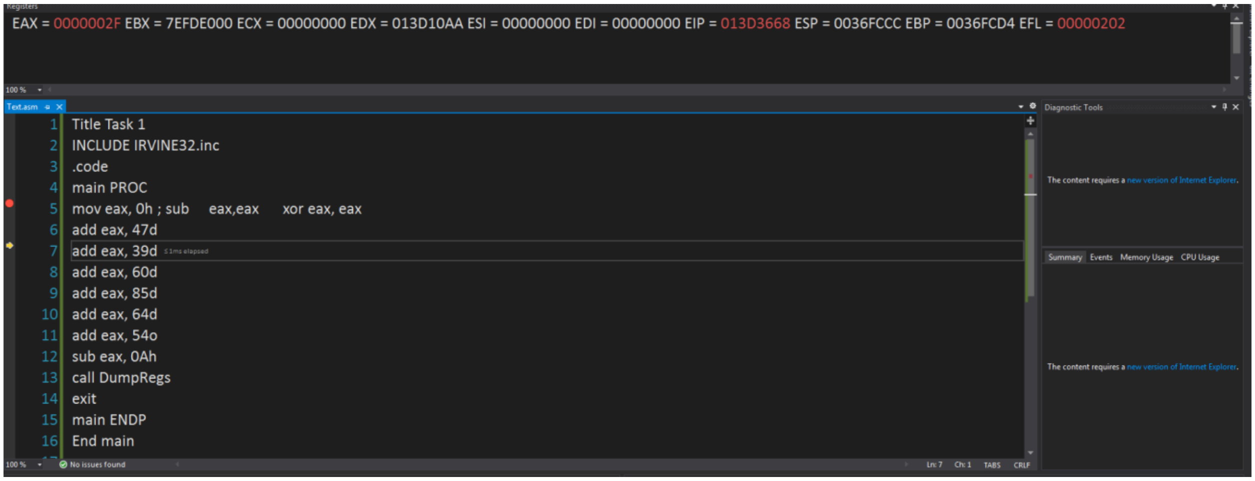


```
EAX = 00000000 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3665 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000246
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax      xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

Step 3:

Mohsin Ali Mirza **K200353** **3E-BSCS**



```
EAX = 0000002F EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3668 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000202
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

Text.asm
Diagnostic Tools
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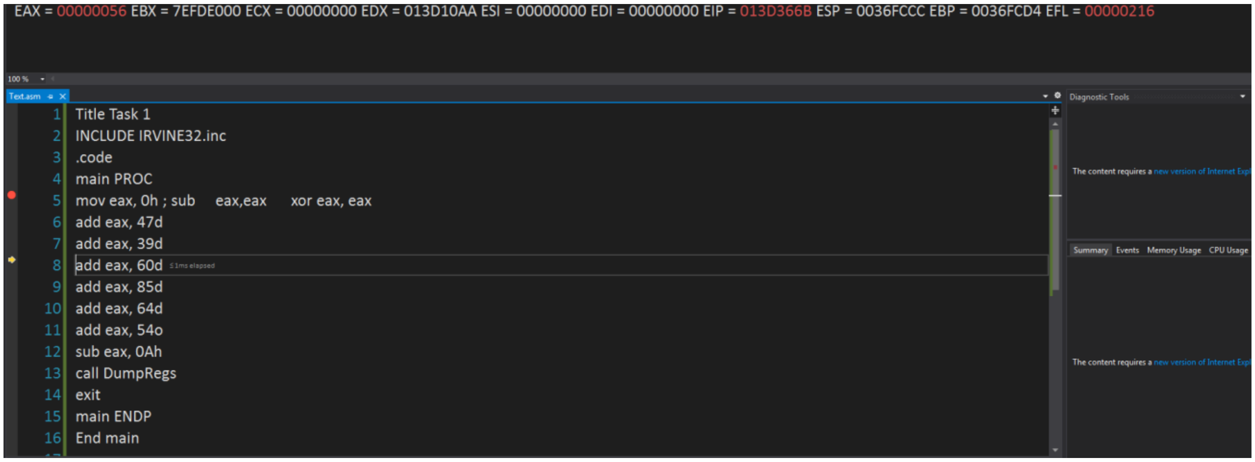
Summary Events Memory Usage CPU Usage
No issues found
Ln: 7 Ch: 1 TABS CRLF

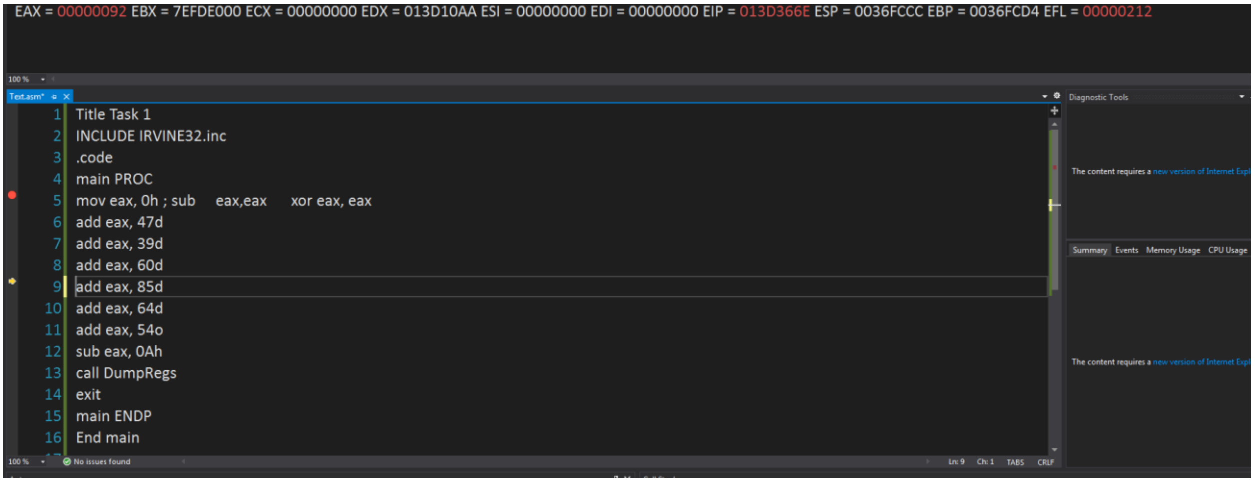
Step 4:



```
EAX = 00000056 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D366B ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000216
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

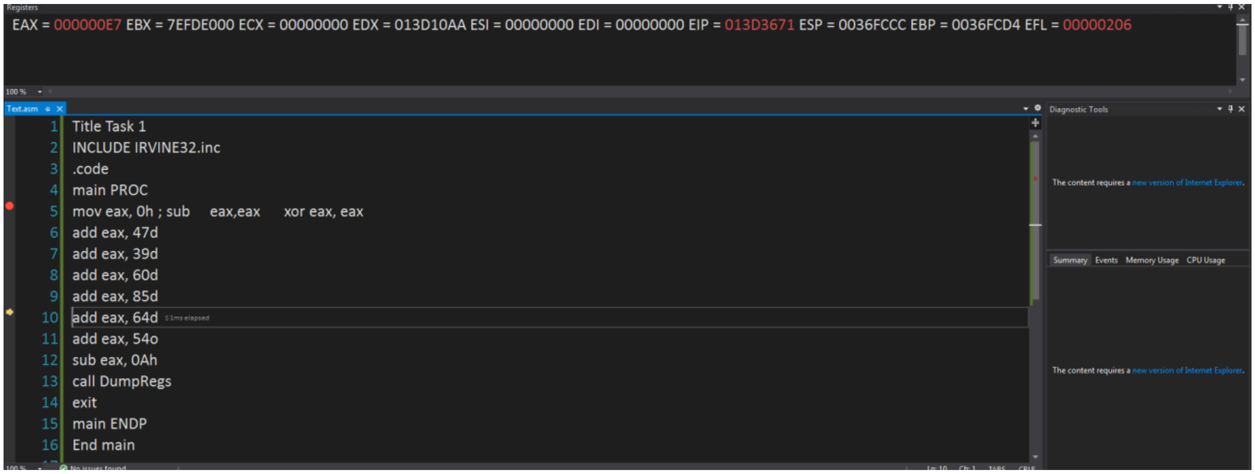
Step 5:



```
EAX = 00000092 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D366E ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000212
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub     eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

Step 6:



```
EAX = 000000E7 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3671 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000206
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub    eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

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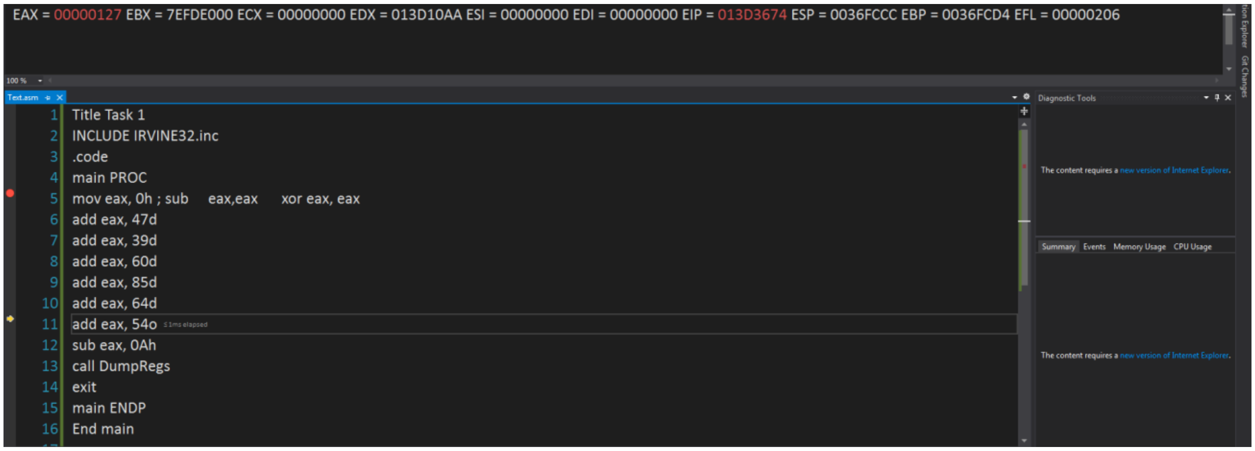
Step 7:



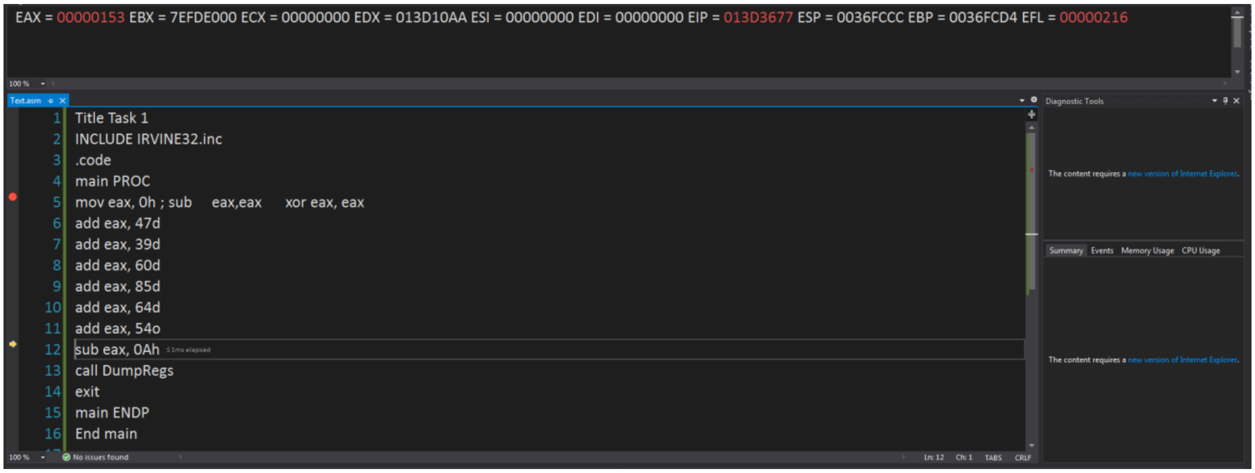
```
EAX = 00000127 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3674 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000206
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub    eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

The content requires a new version of Internet Explorer.

The content requires a new version of Internet Explorer.

Step 8:



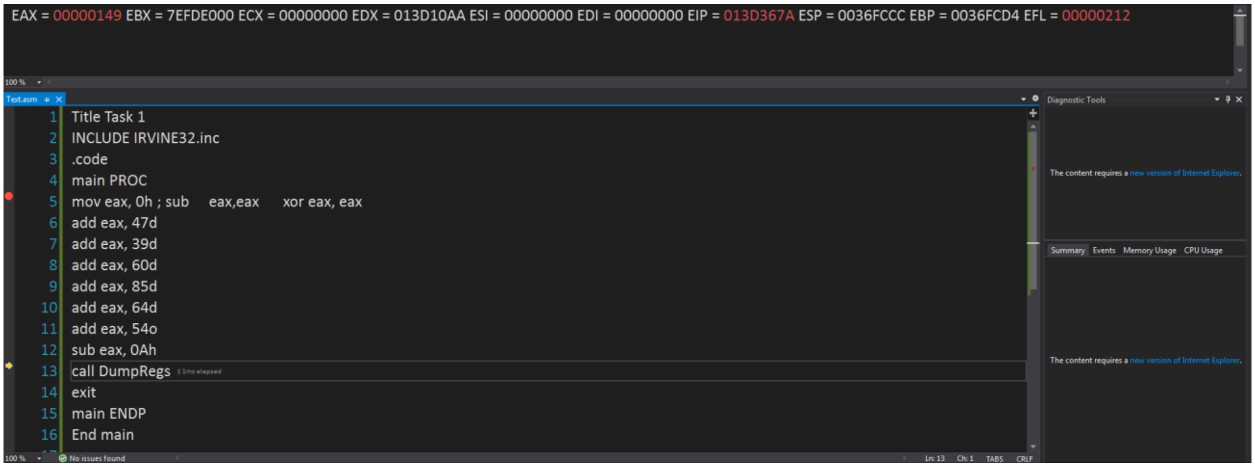
```
EAX = 00000153 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D3677 ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000216
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub    eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit
main ENDP
End main
```

The content requires a new version of Internet Explorer.

The content requires a new version of Internet Explorer.

Step 9:



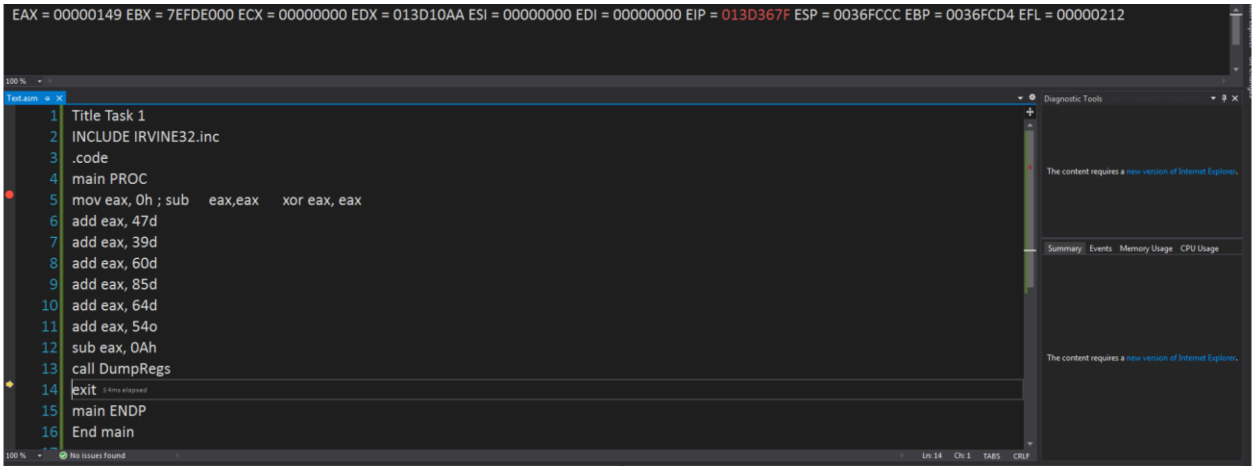
```
EAX = 00000149 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D367A ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000212
```

```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub    eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs ≤1ms elapsed
exit
main ENDP
End main
```

The content requires a new version of Internet Explorer.

The content requires a new version of Internet Explorer.

Step 10:



```
EAX = 00000149 EBX = 7EFDE000 ECX = 00000000 EDX = 013D10AA ESI = 00000000 EDI = 00000000 EIP = 013D367F ESP = 0036FCCC EBP = 0036FCD4 EFL = 00000212
```

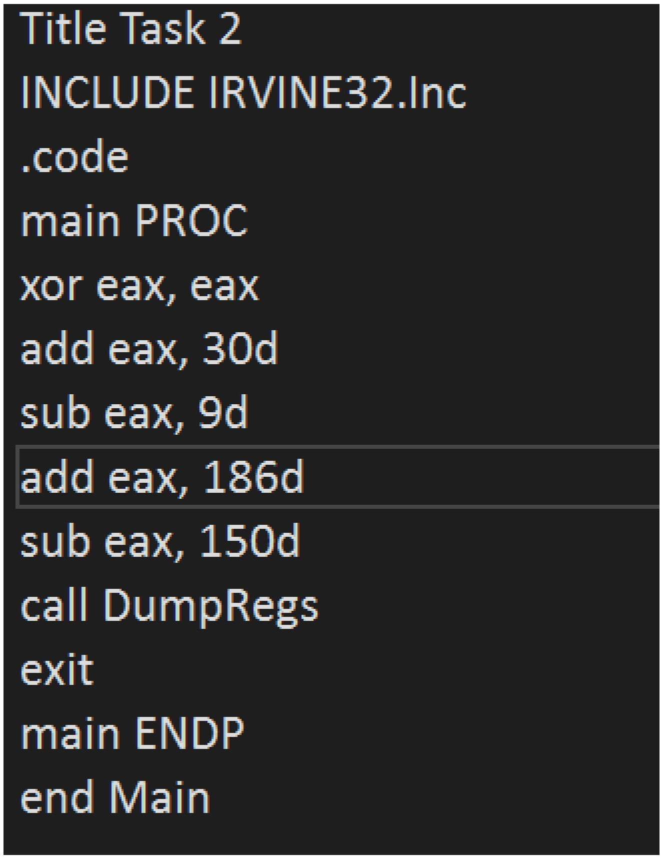
```
Title Task 1
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 0h ; sub    eax,eax     xor eax, eax
add eax, 47d
add eax, 39d
add eax, 60d
add eax, 85d
add eax, 64d
add eax, 54o
sub eax, 0Ah
call DumpRegs
exit ≤4ms elapsed
main ENDP
End main
```

The content requires a new version of Internet Explorer.

The content requires a new version of Internet Explorer.

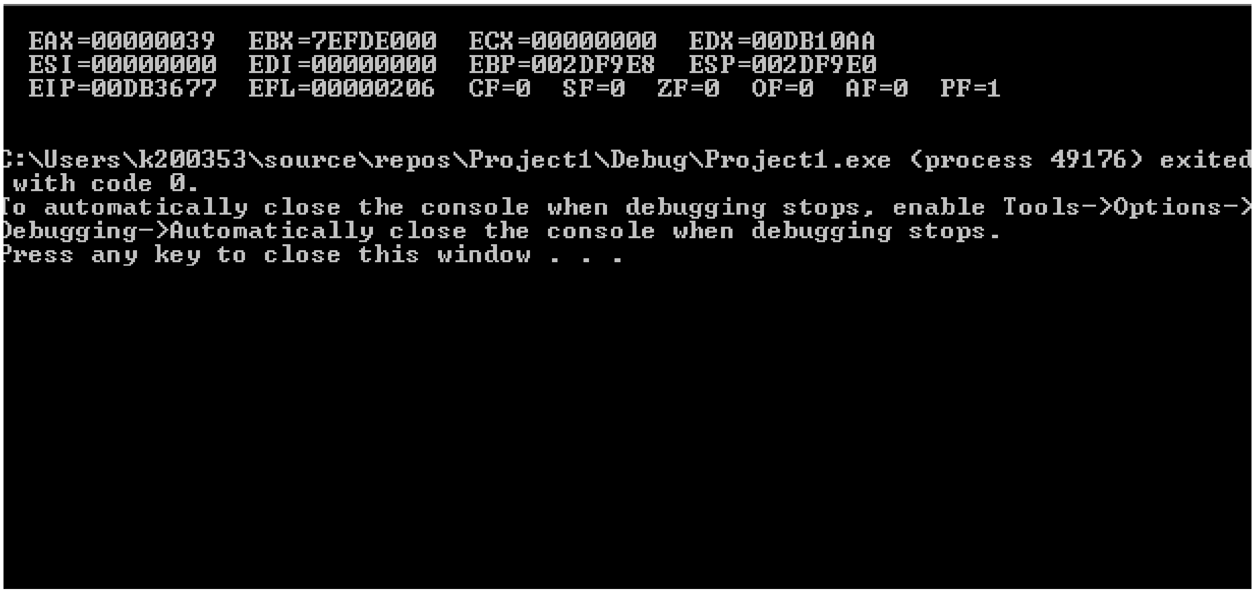
Task 2:

Source Code



```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

Output File



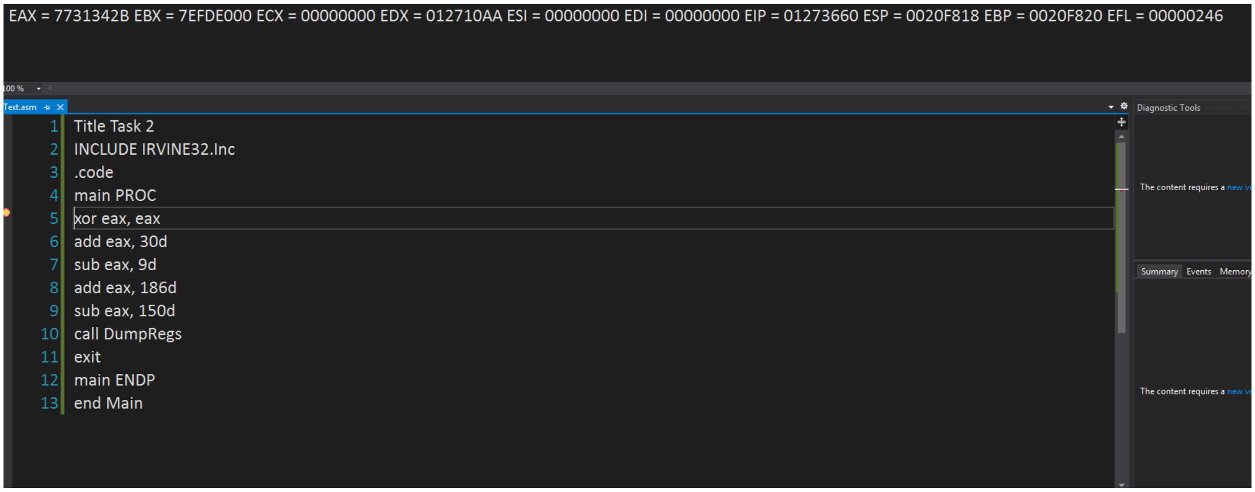
```
  EAX=00000039  EBX=7EFDE000  ECX=00000000  EDX=00DB10AA
  ESI=00000000  EDI=00000000  EBP=002DF9E8  ESP=002DF9E0
  EIP=00DB3677  EFL=00000206  CF=0  SF=0  ZF=0  OF=0  AF=0  PF=1


C:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 49176) 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 . . .
```

Comment: Learning How To Use Xor to set the value of EAX to 0 and getting more familiar with the directives and operands.

Debugging

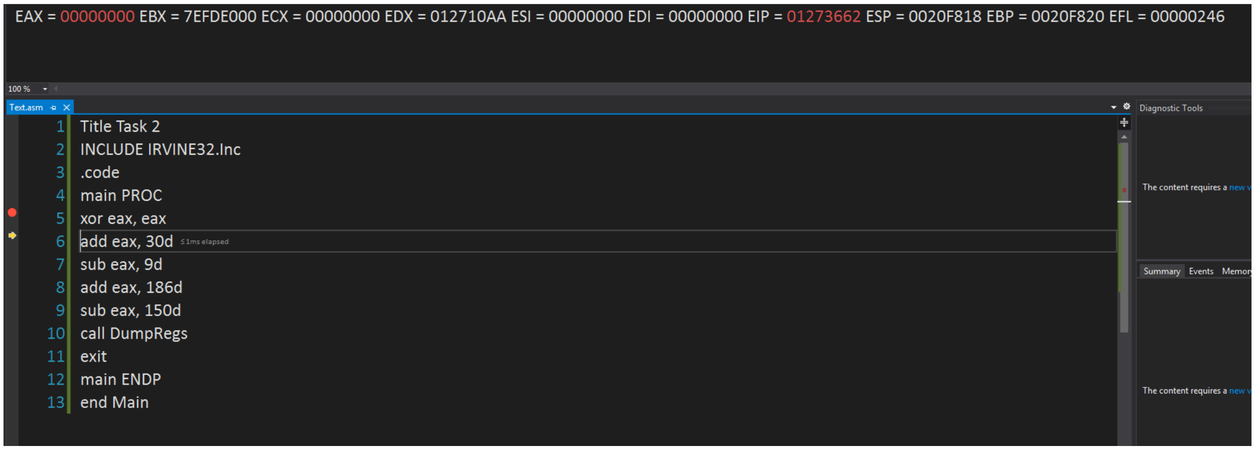
Step 1:



```
EAX = 7731342B EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273660 ESP = 0020F818 EBP = 0020F820 EFL = 00000246
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

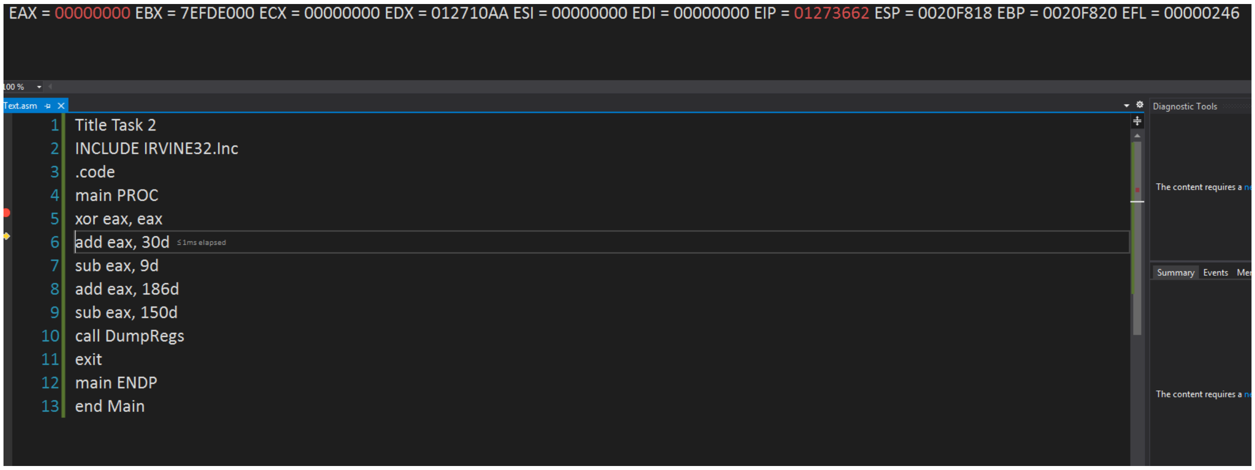
Step 2:



```
EAX = 00000000 EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273662 ESP = 0020F818 EBP = 0020F820 EFL = 00000246
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d  ≤ 1ms elapsed
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

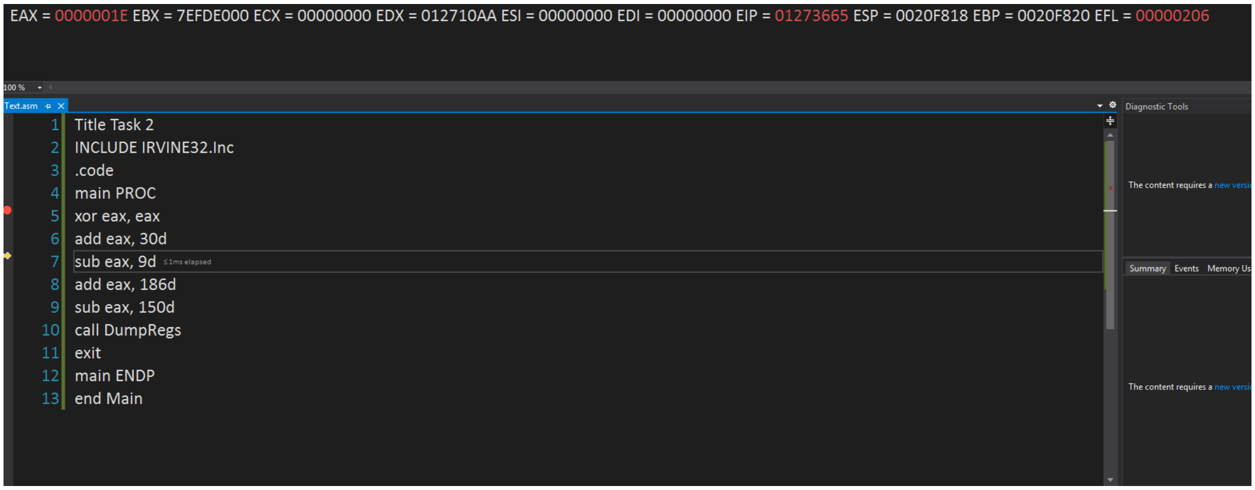
Step 3:



```
EAX = 00000000 EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273662 ESP = 0020F818 EBP = 0020F820 EFL = 00000246
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d ≤1ms elapsed
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

Step 4:



```
EAX = 0000001E EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273665 ESP = 0020F818 EBP = 0020F820 EFL = 00000206
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d ≤1ms elapsed
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

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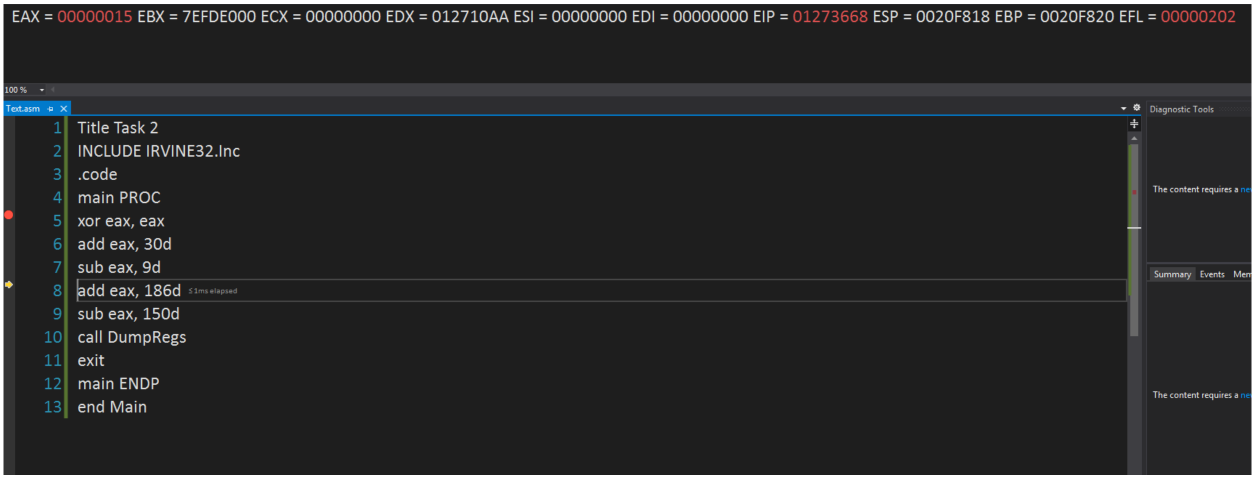
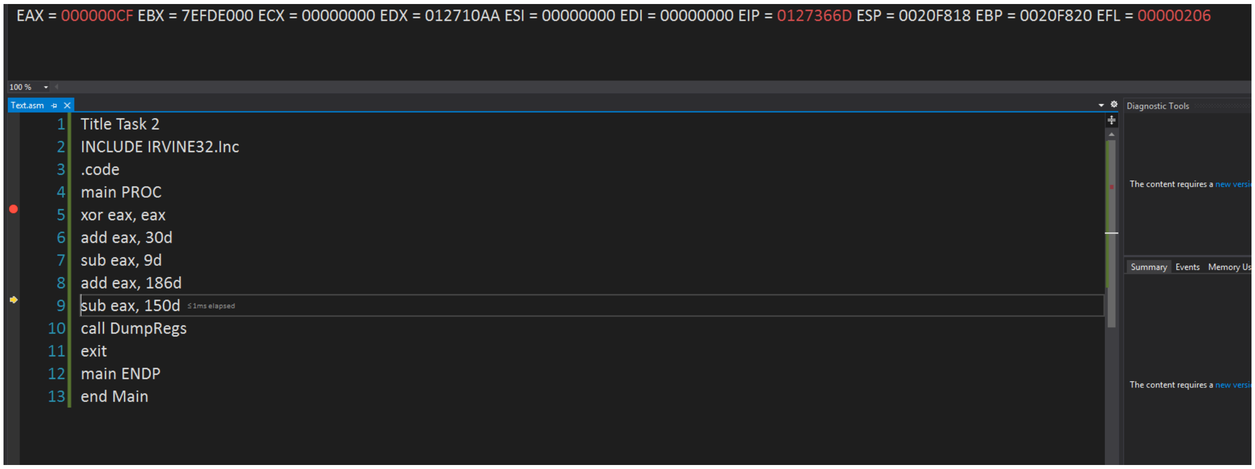
Step 5:



```
EAX = 00000015 EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273668 ESP = 0020F818 EBP = 0020F820 EFL = 00000202
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d ≤1ms elapsed
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

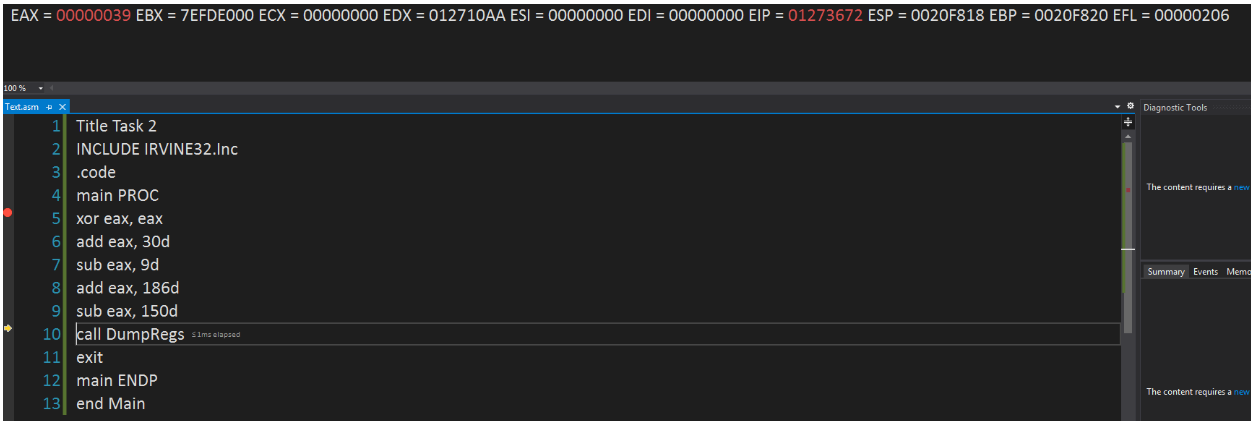
Step 6:



```
EAX = 000000CF EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 0127366D ESP = 0020F818 EBP = 0020F820 EFL = 00000206
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

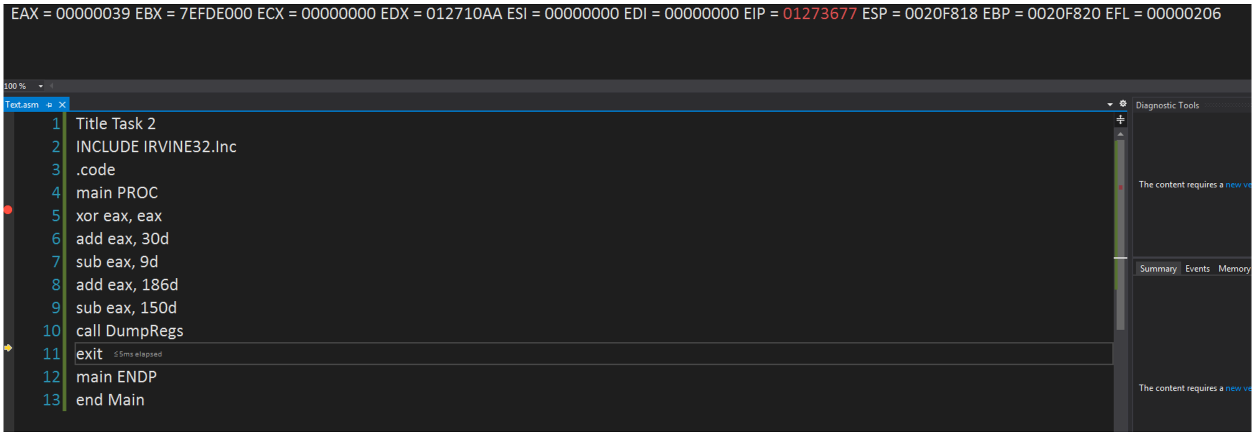
Step 7:



```
EAX = 00000039 EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273672 ESP = 0020F818 EBP = 0020F820 EFL = 00000206
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

Step 8:

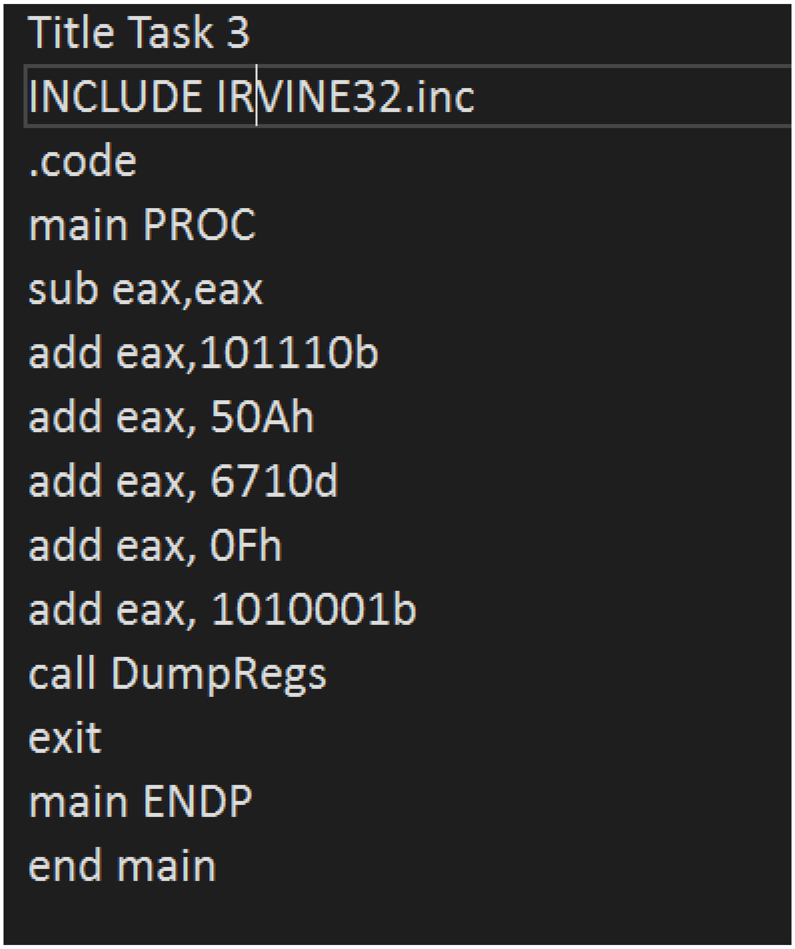


```
EAX = 00000039 EBX = 7EFDE000 ECX = 00000000 EDX = 012710AA ESI = 00000000 EDI = 00000000 EIP = 01273677 ESP = 0020F818 EBP = 0020F820 EFL = 00000206
```

```
Title Task 2
INCLUDE IRVINE32.Inc
.code
main PROC
xor eax, eax
add eax, 30d
sub eax, 9d
add eax, 186d
sub eax, 150d
call DumpRegs
exit
main ENDP
end Main
```

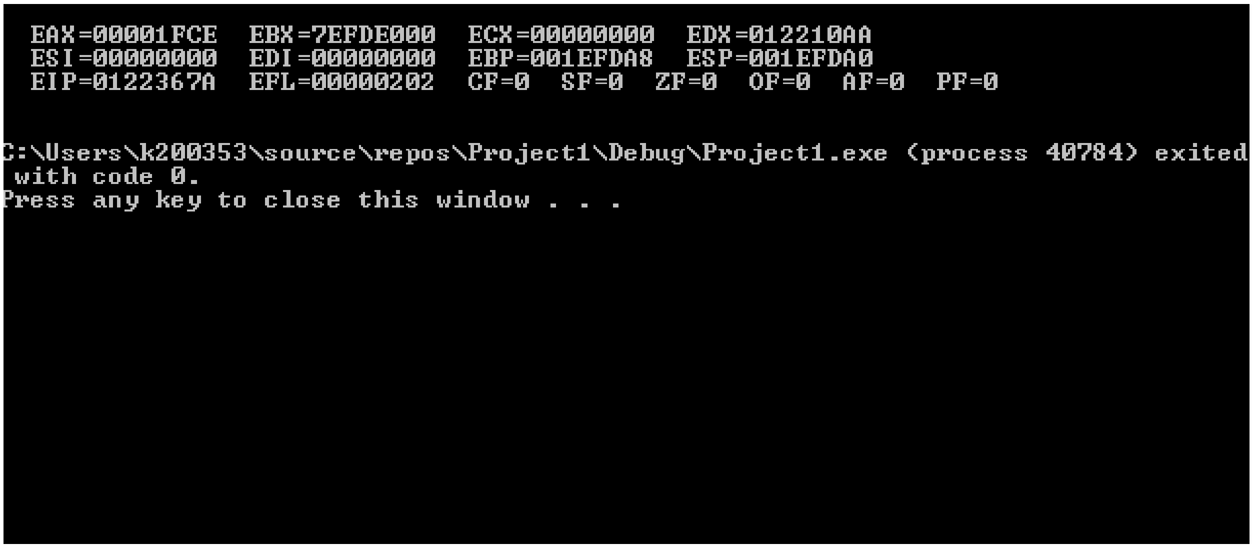
Task 3:

Source Code



```
Title Task 3
INCLUDE IRVINE32.inc
.code
main PROC
sub eax,eax
add eax,101110b
add eax, 50Ah
add eax, 6710d
add eax, 0Fh
add eax, 1010001b
call DumpRegs
exit
main ENDP
end main
```

Output File



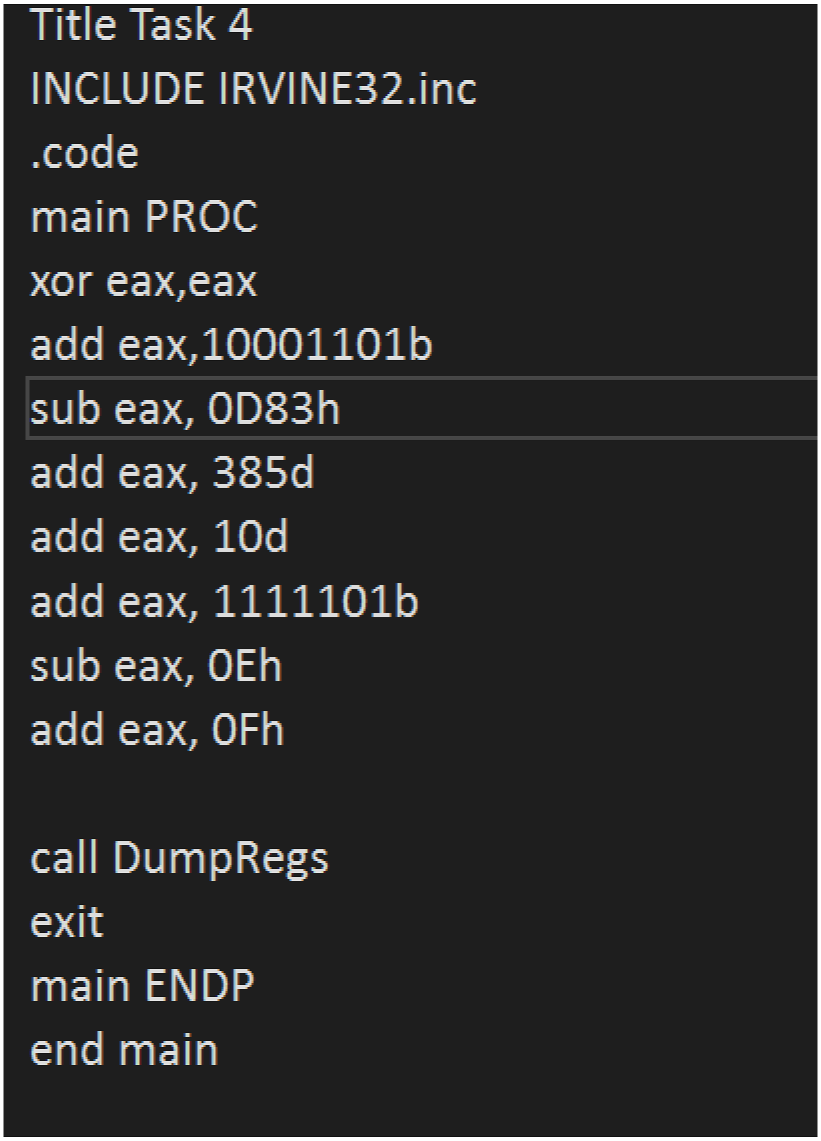
```
  EAX=00001FCE  EBX=7EFDE000  ECX=00000000  EDX=012210AA
  ESI=00000000  EDI=00000000  EBP=001EFDA8  ESP=001EFDA0
  EIP=0122367A  EFL=00000202  CF=0  SF=0  ZF=0  OF=0  AF=0  PF=0


C:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 40784) exited
 with code 0.
Press any key to close this window . . .
```

Comment: The Code was running successfully

Task 4:

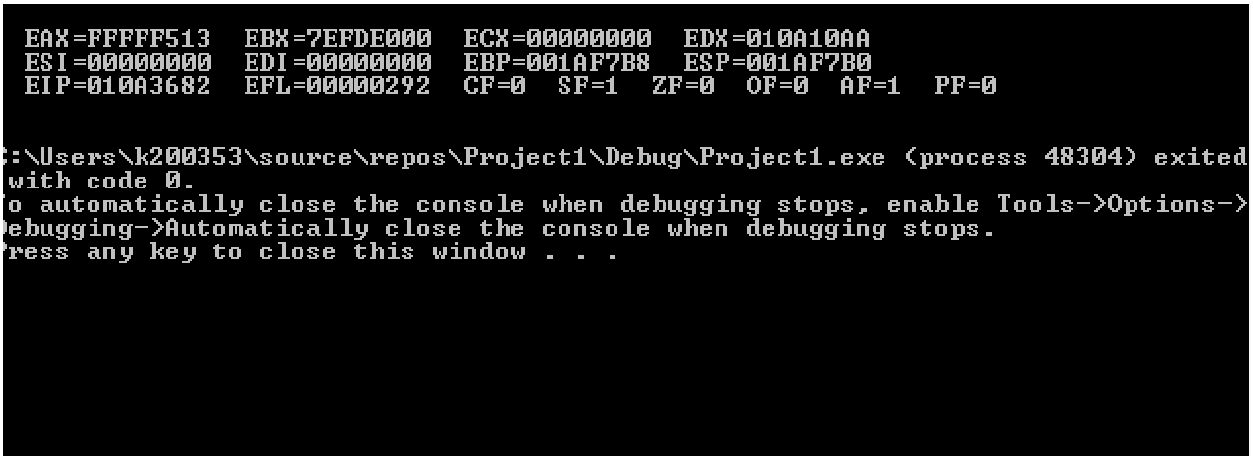
Source Code



```
Title Task 4
INCLUDE IRVINE32.inc
.code
main PROC
xor eax,eax
add eax,10001101b
sub eax, 0D83h
add eax, 385d
add eax, 10d
add eax, 1111101b
sub eax, 0Eh
add eax, 0Fh

call DumpRegs
exit
main ENDP
end main
```

Output File



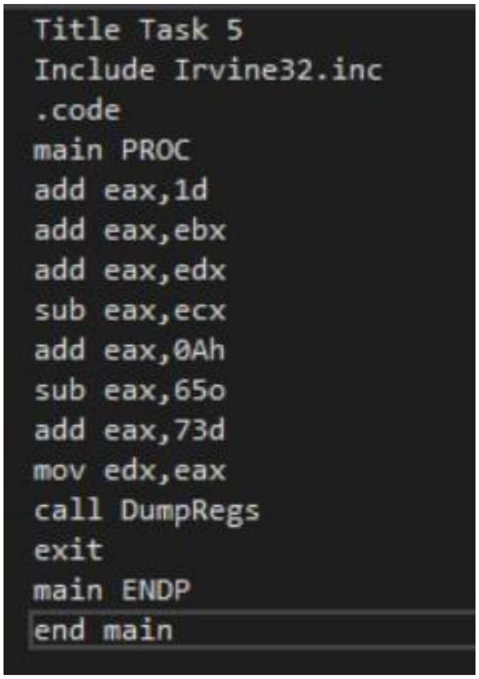
```
 EAX=FFFFF513  EBX=7EFDE000  ECX=00000000  EDX=010A10AA
 ESI=00000000  EDI=00000000  EBP=001AF7B8  ESP=001AF7B0
 EIP=010A3682  EFL=00000292  CF=0  SF=1  ZF=0  OF=0  AF=1  PF=0


:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 48304) exited
with code 0.
o automatically close the console when debugging stops, enable Tools->Options->
ebugging->Automatically close the console when debugging stops.
ress any key to close this window . . .
```

Comment: Code was running as predicted

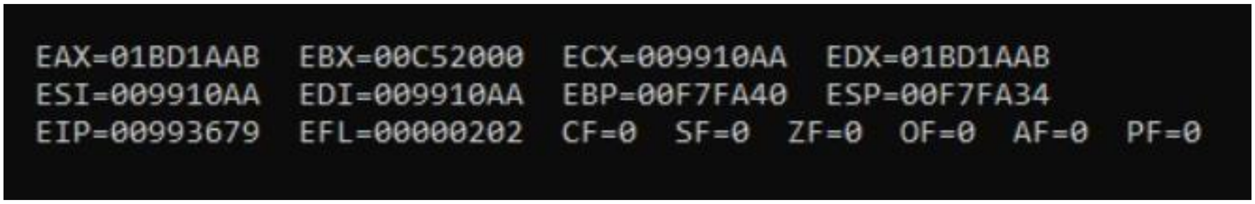
Task 5:

Source Code



```
Title Task 5
Include Irvine32.inc
.code
main PROC
add eax,1d
add eax,ebx
add eax,edx
sub eax,ecx
add eax,0Ah
sub eax,65o
add eax,73d
mov edx,eax
call DumpRegs
exit
main ENDP
end main
```

Output File

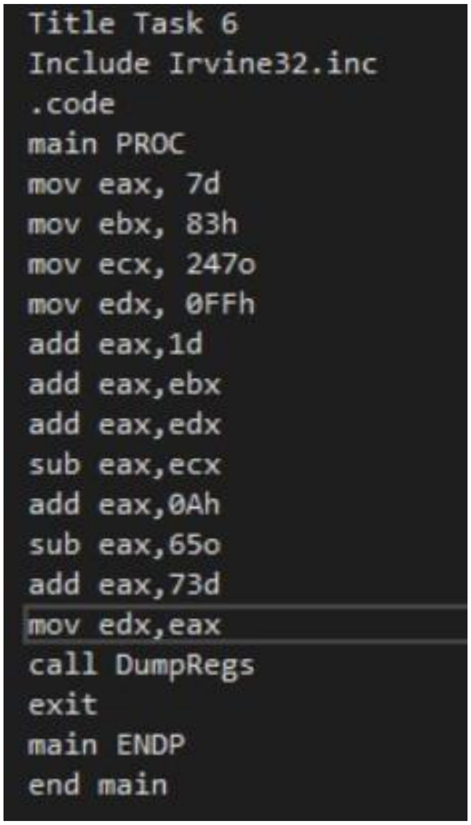


```
EAX=01BD1AAB  EBX=00C52000  ECX=009910AA  EDX=01BD1AAB
ESI=009910AA  EDI=009910AA  EBP=00F7FA40  ESP=00F7FA34
EIP=00993679  EFL=00000202  CF=0  SF=0  ZF=0  OF=0  AF=0  PF=0
```

Comment: Running per default values

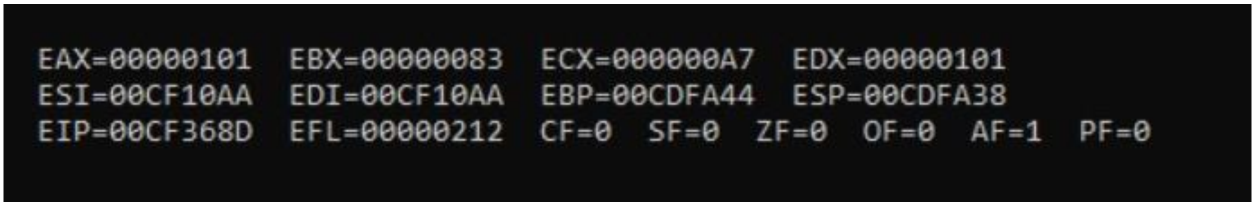
Task 6:

Source Code



```
Title Task 6
Include Irvine32.inc
.code
main PROC
mov eax, 7d
mov ebx, 83h
mov ecx, 247o
mov edx, 0FFh
add eax,1d
add eax,ebx
add eax,edx
sub eax,ecx
add eax,0Ah
sub eax,65o
add eax,73d
mov edx,eax
call DumpRegs
exit
main ENDP
end main
```

Output File

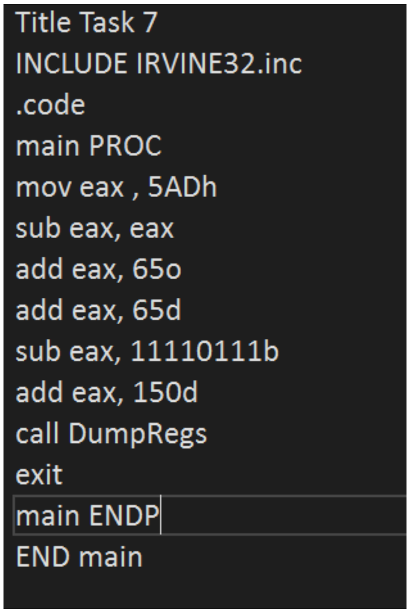


```
EAX=00000101  EBX=00000083  ECX=000000A7  EDX=00000101
ESI=00CF10AA  EDI=00CF10AA  EBP=00CDFA44  ESP=00CDFA38
EIP=00CF368D  EFL=00000212  CF=0  SF=0  ZF=0  OF=0  AF=1  PF=0
```

Comment: Using Pre Defined Values for the registers

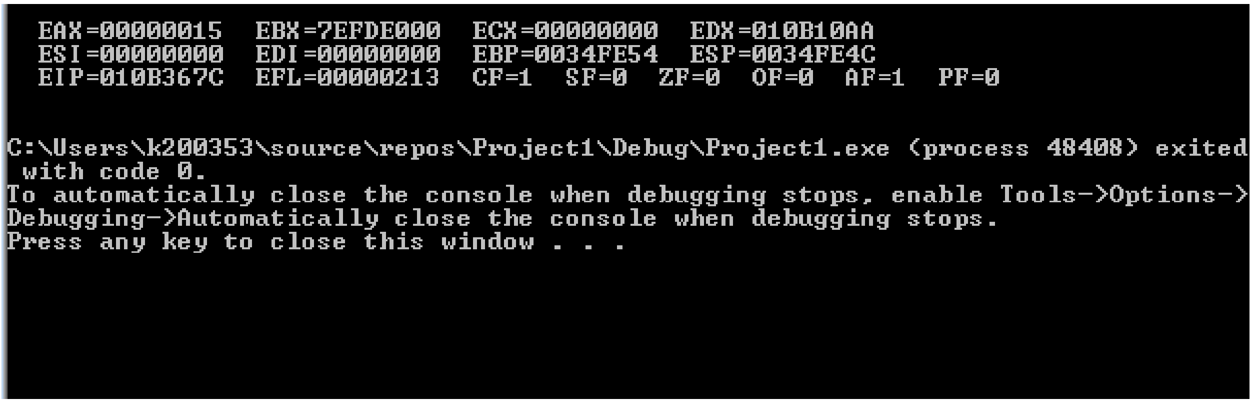
Task7:

Source Code



```
Title Task 7
INCLUDE IRVINE32.inc
.code
main PROC
mov eax , 5ADh
sub eax, eax
add eax, 65o
add eax, 65d
sub eax, 11110111b
add eax, 150d
call DumpRegs
exit
main ENDP
END main
```

Output File



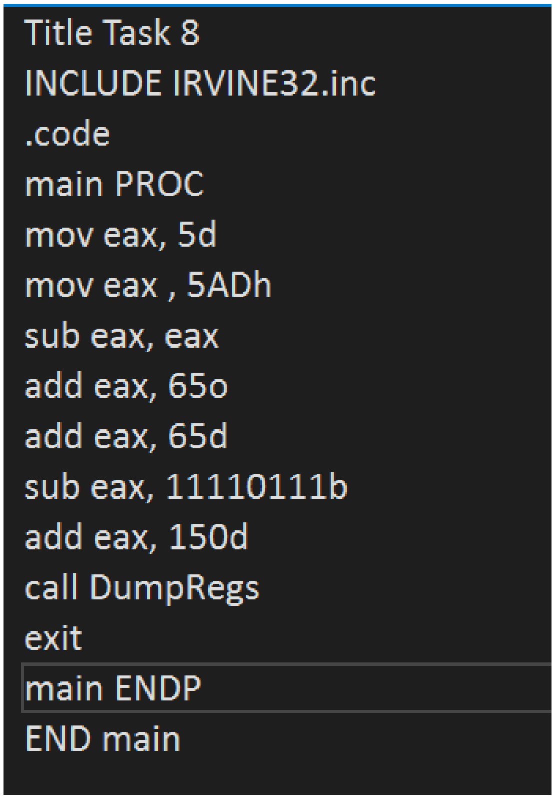
```
  EAX=00000015  EBX=7EFDE000  ECX=00000000  EDX=010B10AA
  ESI=00000000  EDI=00000000  EBP=0034FE54  ESP=0034FE4C
  EIP=010B367C  EFL=00000213  CF=1  SF=0  ZF=0  OF=0  AF=1  PF=0


C:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 48408) 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 . . .
```

Comment: Running per default values for the registers

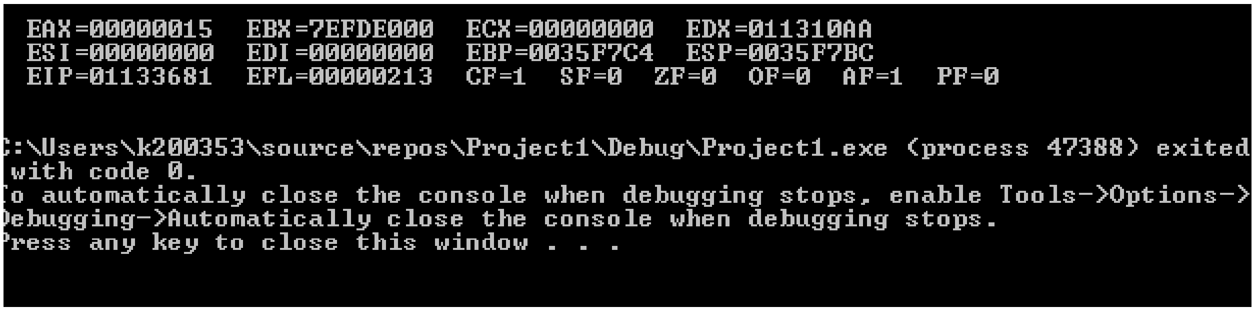
Task 8:

Source Code



```
Title Task 8
INCLUDE IRVINE32.inc
.code
main PROC
mov eax, 5d
mov eax , 5ADh
sub eax, eax
add eax, 65o
add eax, 65d
sub eax, 11110111b
add eax, 150d
call DumpRegs
exit
main ENDP
END main
```

Output File



```
  EAX=00000015  EBX=7EFDE000  ECX=00000000  EDX=011310AA
  ESI=00000000  EDI=00000000  EBP=0035F7C4  ESP=0035F7BC
  EIP=01133681  EFL=00000213  CF=1  SF=0  ZF=0  OF=0  AF=1  PF=0


C:\Users\k200353\source\repos\Project1\Debug\Project1.exe (process 47388) 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 . . .
```

Comment: Using Pre Defined Values for the registers