Assembly Language Lab # 1
Introduction

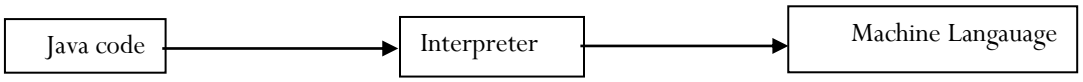
Introduction to Assembly Language

Objective:

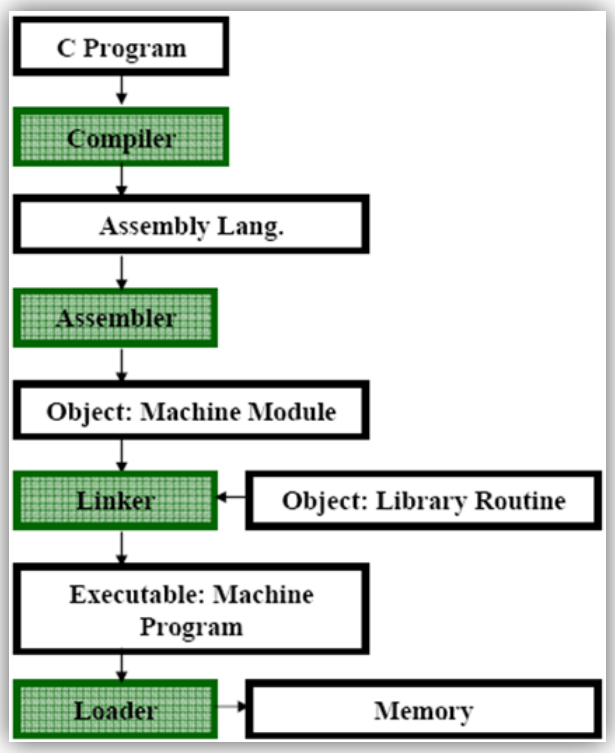
To be familiar with Assembly Language,

Introduction:

- Machine language can be made directly from java code using interpreter .



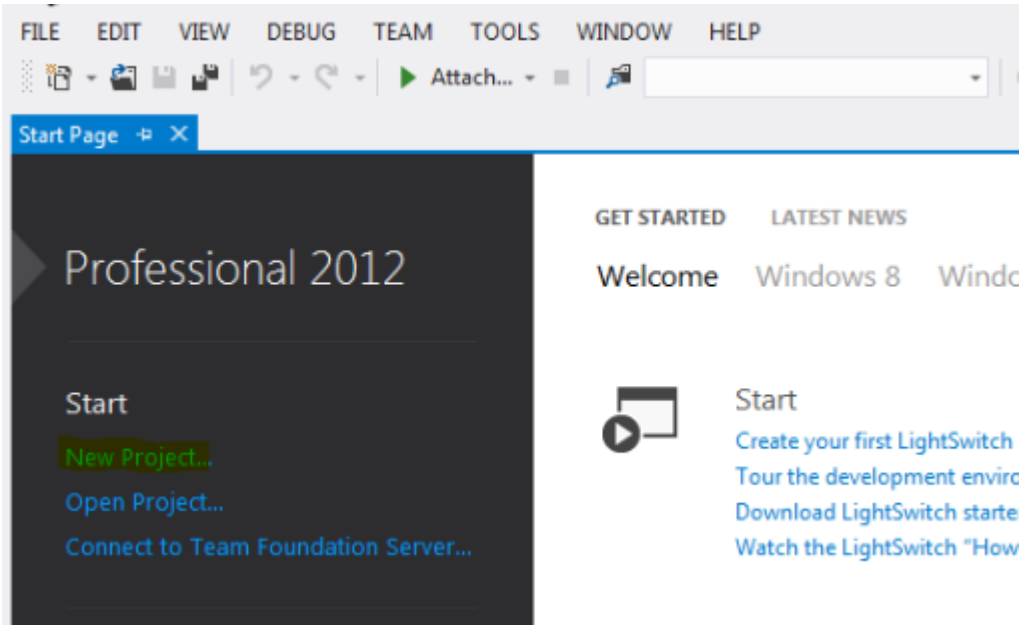
- C ,C++ code is executed faster than Java code ,because they transferred to assembly language before machine language .



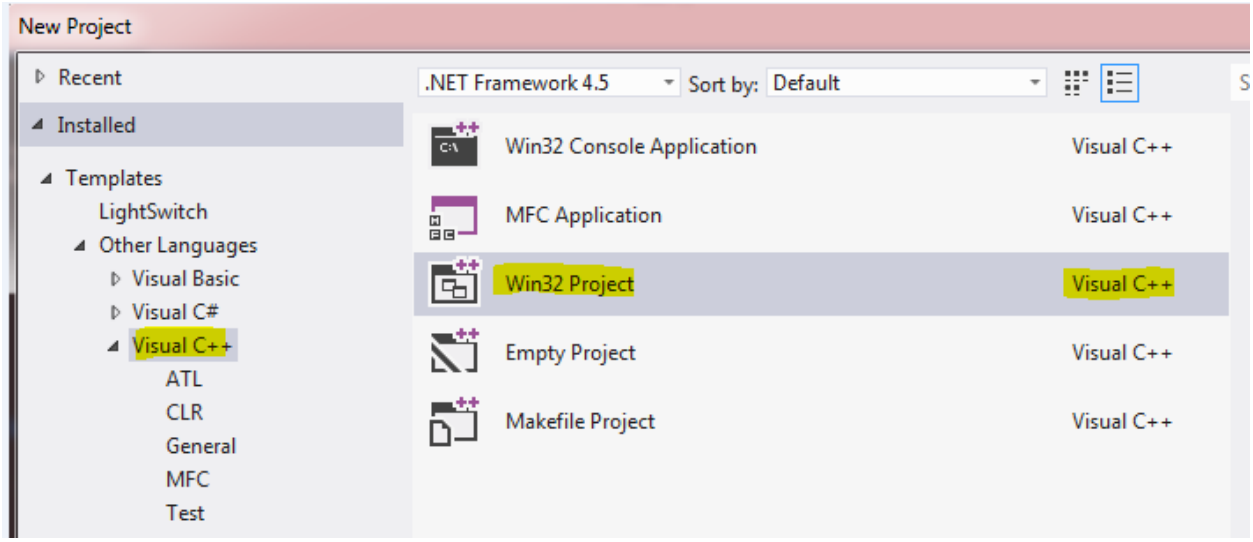
❖ Visual Studio 2012

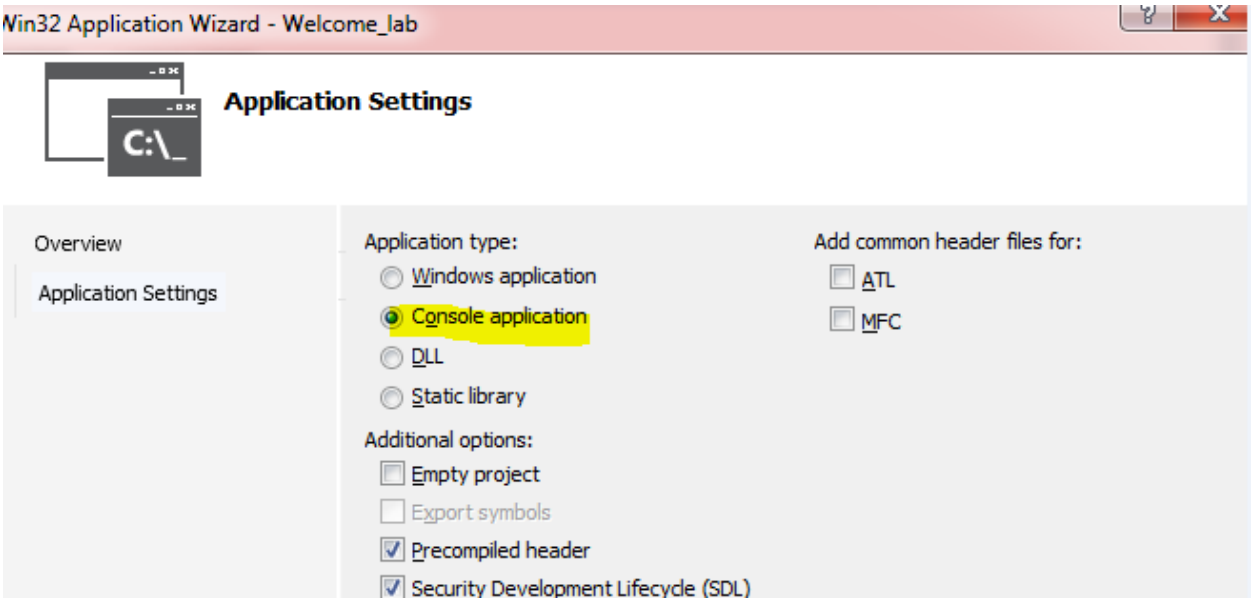
To convert C++ program to assembly language.

1. From **File** menu >> choose **new** >> then choose **project**.
Or from the **start** page choose **new project.**



2. Then the new project window will appear,
- choose visual C++ and win32 console application
- The project name is welcome:



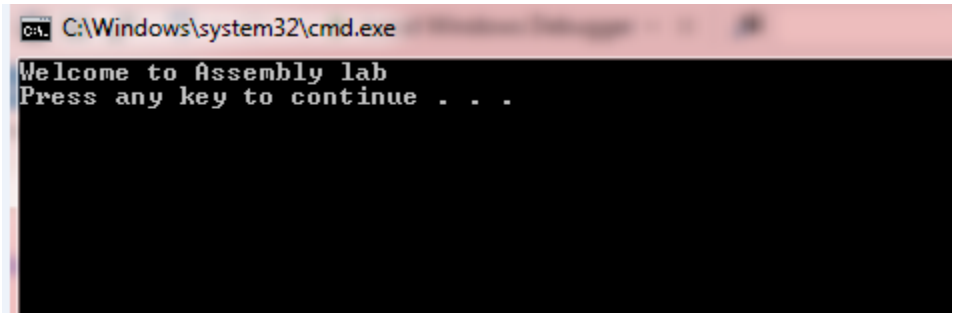


3. Write C++ Program that print "Welcome all to our assembly Lab \n"

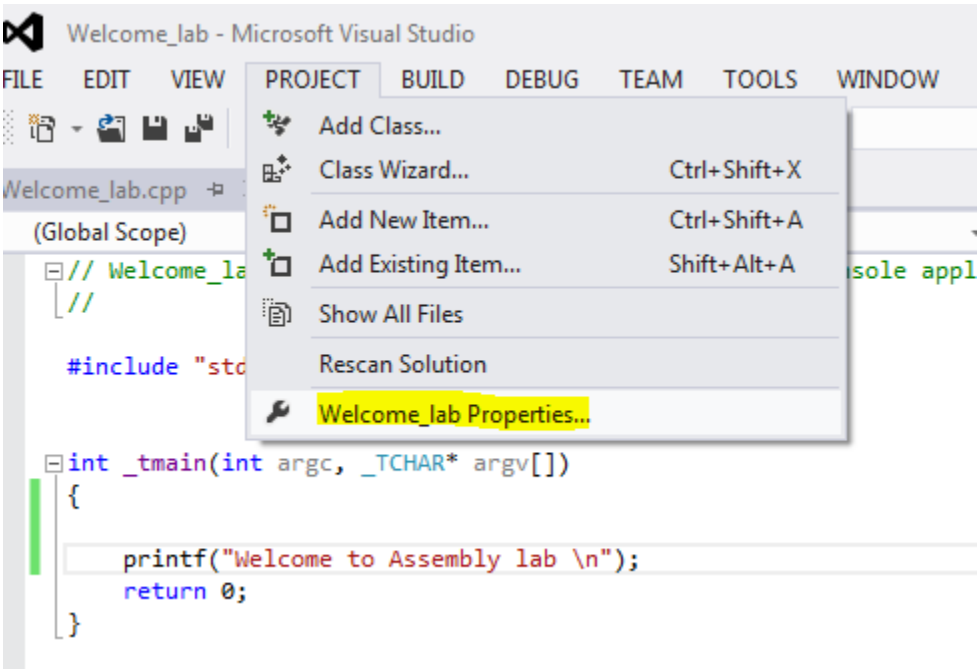
```
(Global Scope)
// Welcome_lab.cpp : Defines the entry point for the console applicatio
//

#include "stdafx.h"


int _tmain(int argc, _TCHAR* argv[])
{

    printf("Welcome to Assembly lab \n");
    return 0;
}
```

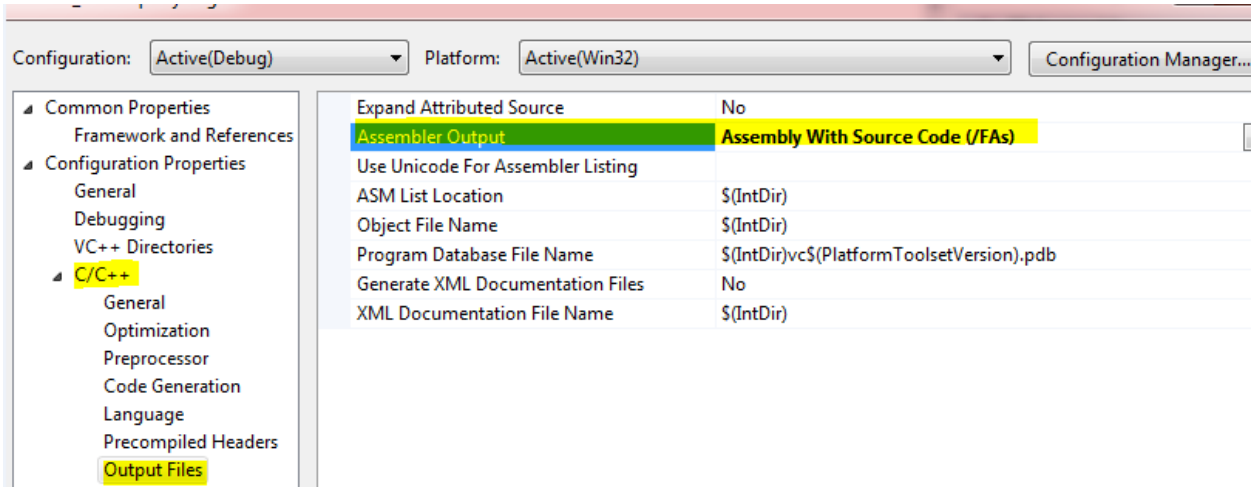
4. **To run the project, do the following two steps in order:**
   a. From **build** menu choose **build Welcome**.
   b. From **debug** menu choose **start without debugging**.

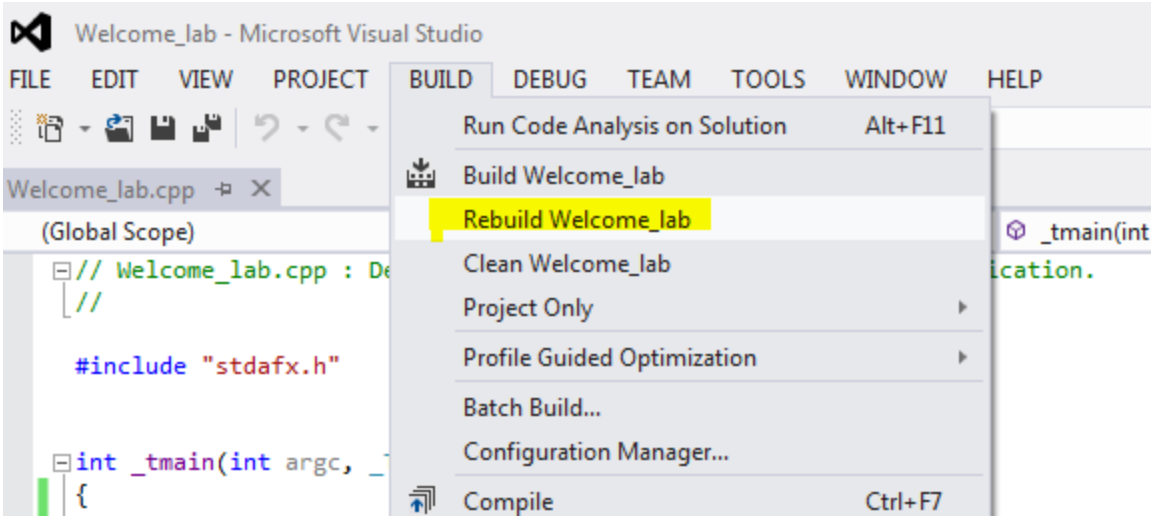
The output is



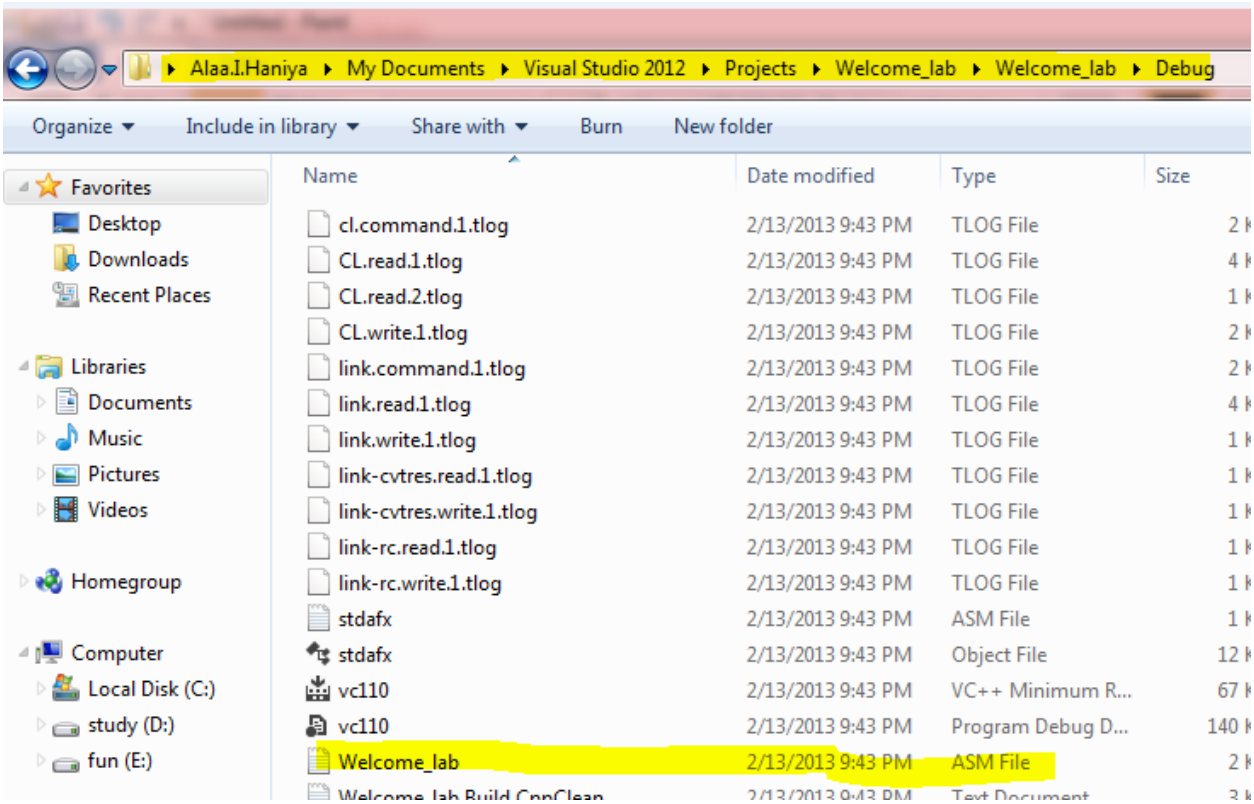
5. To convert C++ code to Assembly code we follow these steps:







We will find the Assembly code on the project folder we save in (*Visual Studio 2012\Projects\Welcome\Welcome\Debug*), named as **Welcome.asm**



Part of the code:

```
52  ; 9     :
53  ; 10    :     printf("Welcome to Assembly lab \n");
54
55      mov esi, esp
56      push    OFFSET ??_C@_0BK@OEAIDFJJ@Welcome?5to?5Assembly?5lab?5?6?$AA@
57      call    DWORD PTR __imp__printf
58      add esp, 4
59      cmp esi, esp
60      call    __RTC_CheckEsp
61
62  ; 11    :     return 0;
63
```

❖ *Assembly Language:*

Assembly Language is a programming language that is very similar to machine language, but Uses symbols instead of binary numbers. It is converted by the assembler (e.g. Tasm and Masm) Into executable machine-language programs

❖ *Assembly Language Tools:*

Software tools are used for editing, assembling, linking, and debugging assembly language programming. You will need an assembler, a linker, a debugger, and an editor.

1. *Assembler*

An **assembler** is a program that converts **source-code** programs written in **assembly language** into **object files** in machine language. Popular assemblers have emerged over the years for the Intel family of processors. These include MASM (Macro Assembler from Microsoft), TASM (Turbo Assembler from Borland), NASM (Netwide Assembler for both Windows and Linux), and GNU assembler distributed by the free software foundation.

2. *Linker*

A linker is a program that combines your program's object file created by the assembler with other object files and link libraries, and produces a single executable program. You need a linker utility to produce executable files.

• Link.exe creates an .exe file from an .obj file.

3. *Debugger*

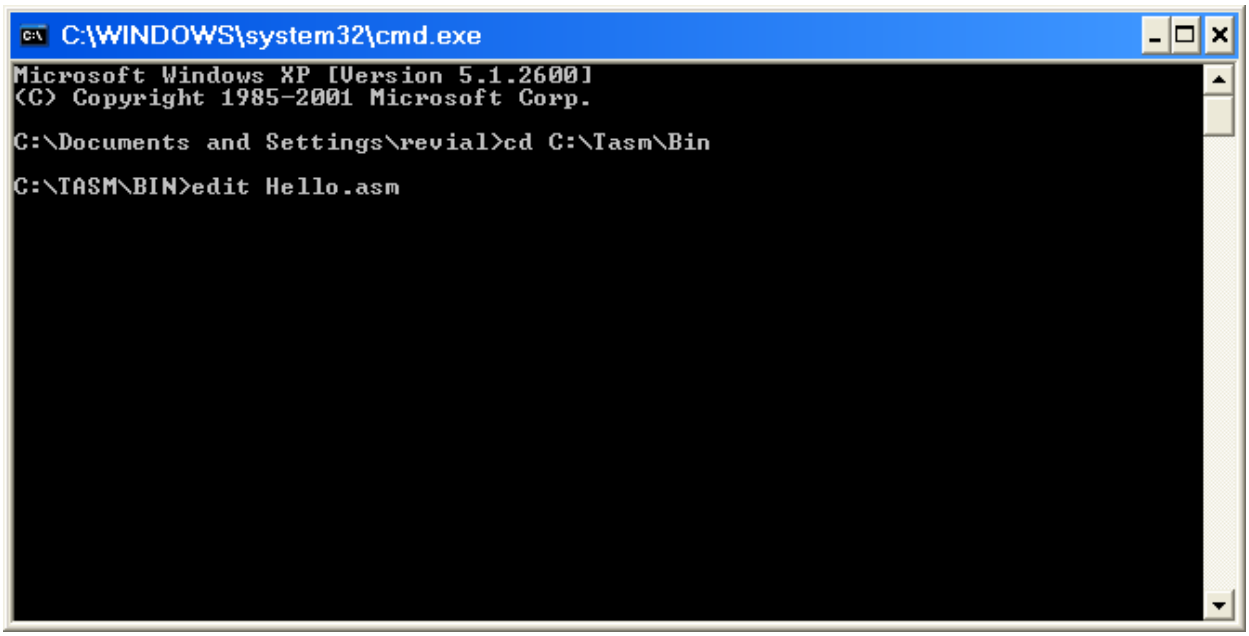
A debugger is a program that allows you to trace the execution of a program and examine the content of registers and memory.

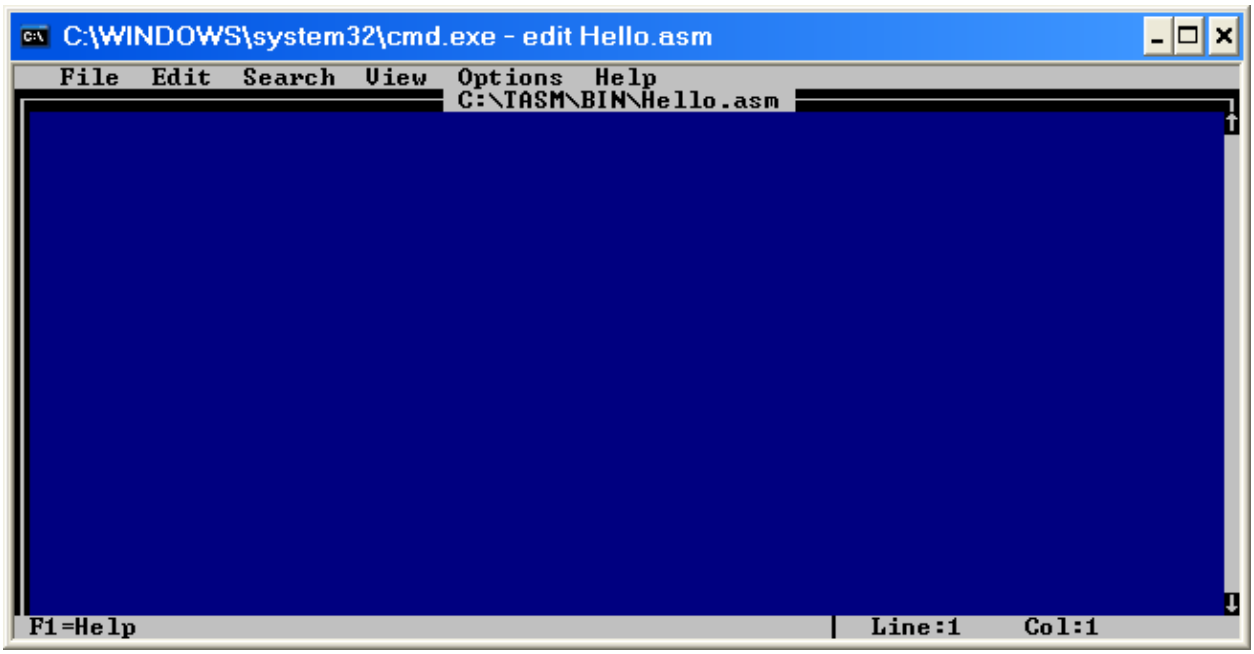
4. *Editor*

You need a text editor to create assembly language source files. MASM6.15 has its own editor or you can use for example Notepad++.

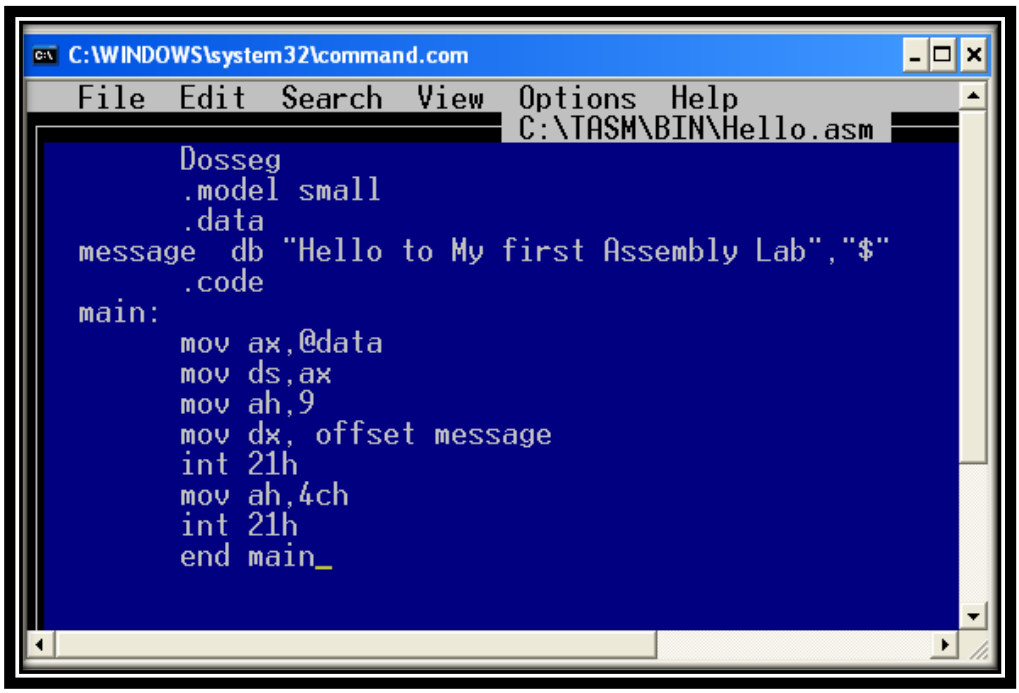
❖ *Running Hello Program on Tasm assembler:*

1- Click **Start** ⍰ **(All) Programs** ⍰ **Run** then write **cmd** and click **OK.**
2- Go to directory **C:\Tasm\Bin**
3- Type the command **C:\Tasm\Bin\edit Hello.asm**
4- A blue screen will open.

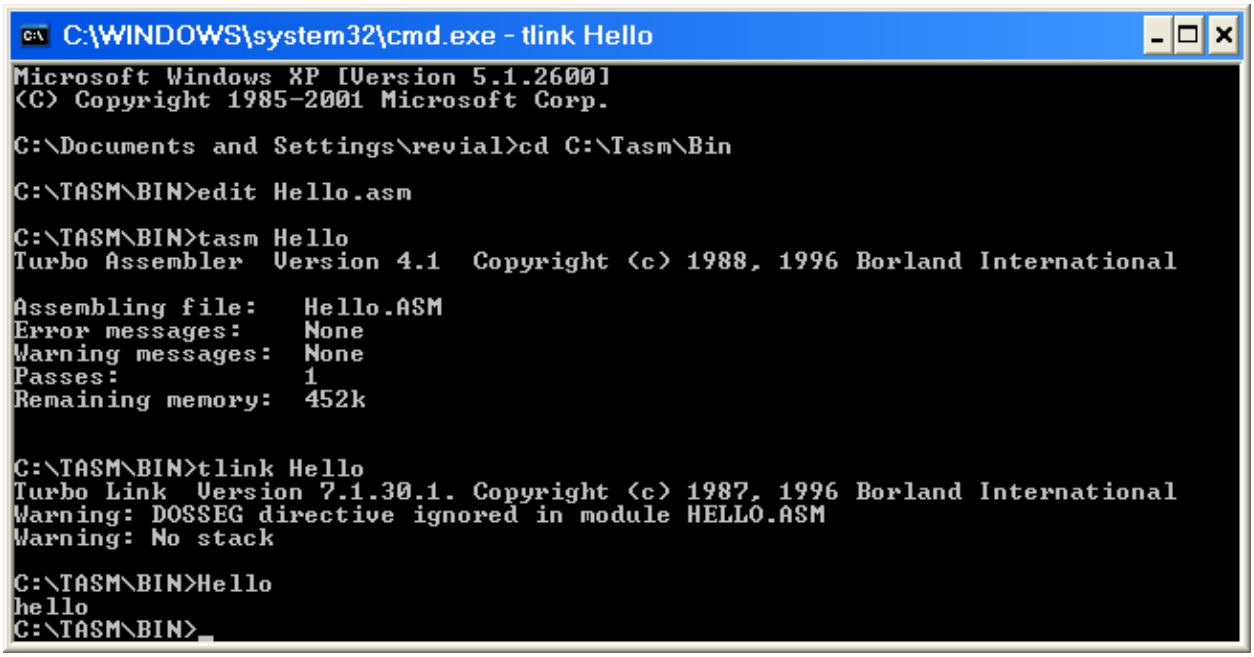




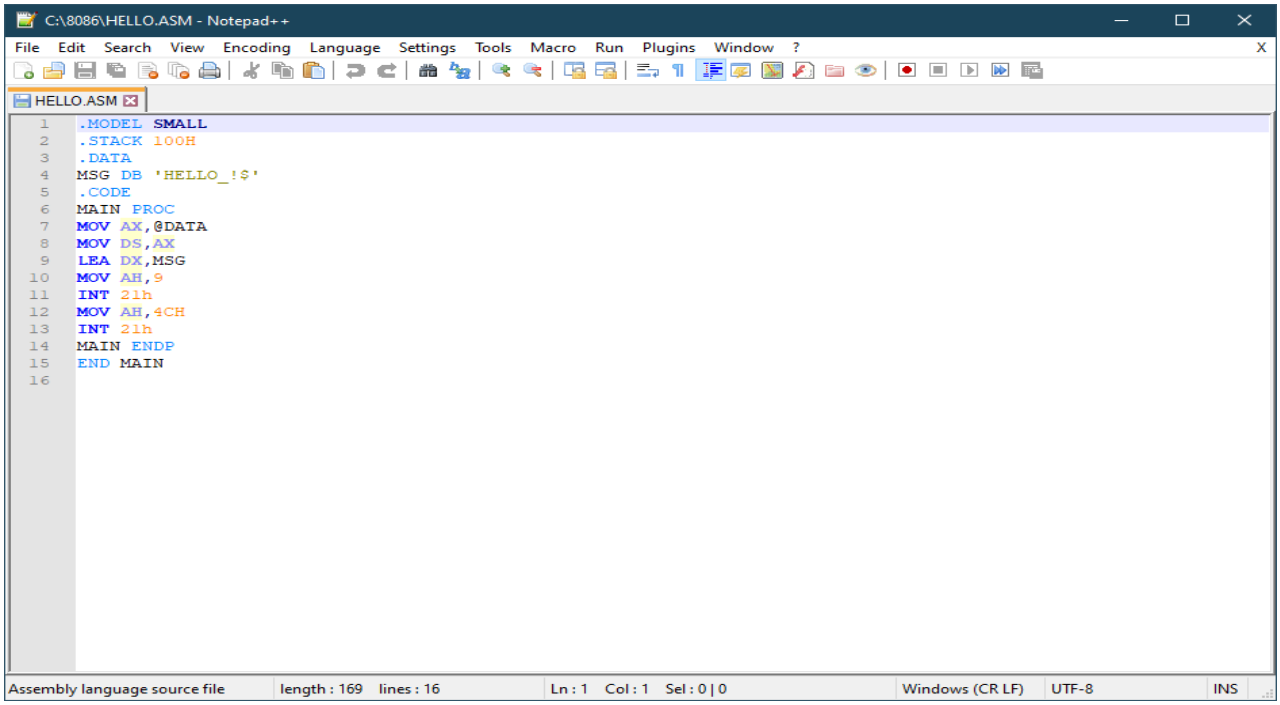
5- Write the following Hello program



6- Write **C:\Tasm\Bin\tasm hello.asm** to create the file **hello.obj** This file is the machine language for the program.
7- Write **C:\Tasm\Bin\ tlink hello.obj** to create the file **hello.exe** This file is executable program.
8- Finally, write **C:\Tasm\Bin \hello.exe** You will show the message hello, world on DOS screen



I prefer a light weight and good editor like Notepad++7 with beautiful syntax highlighting.
So, we will use this editor for program writing.
You can download it at https://notepad-plus-plus.org/downloads/v7.0/



❖ *How to Debugging Assembly Language programs:*

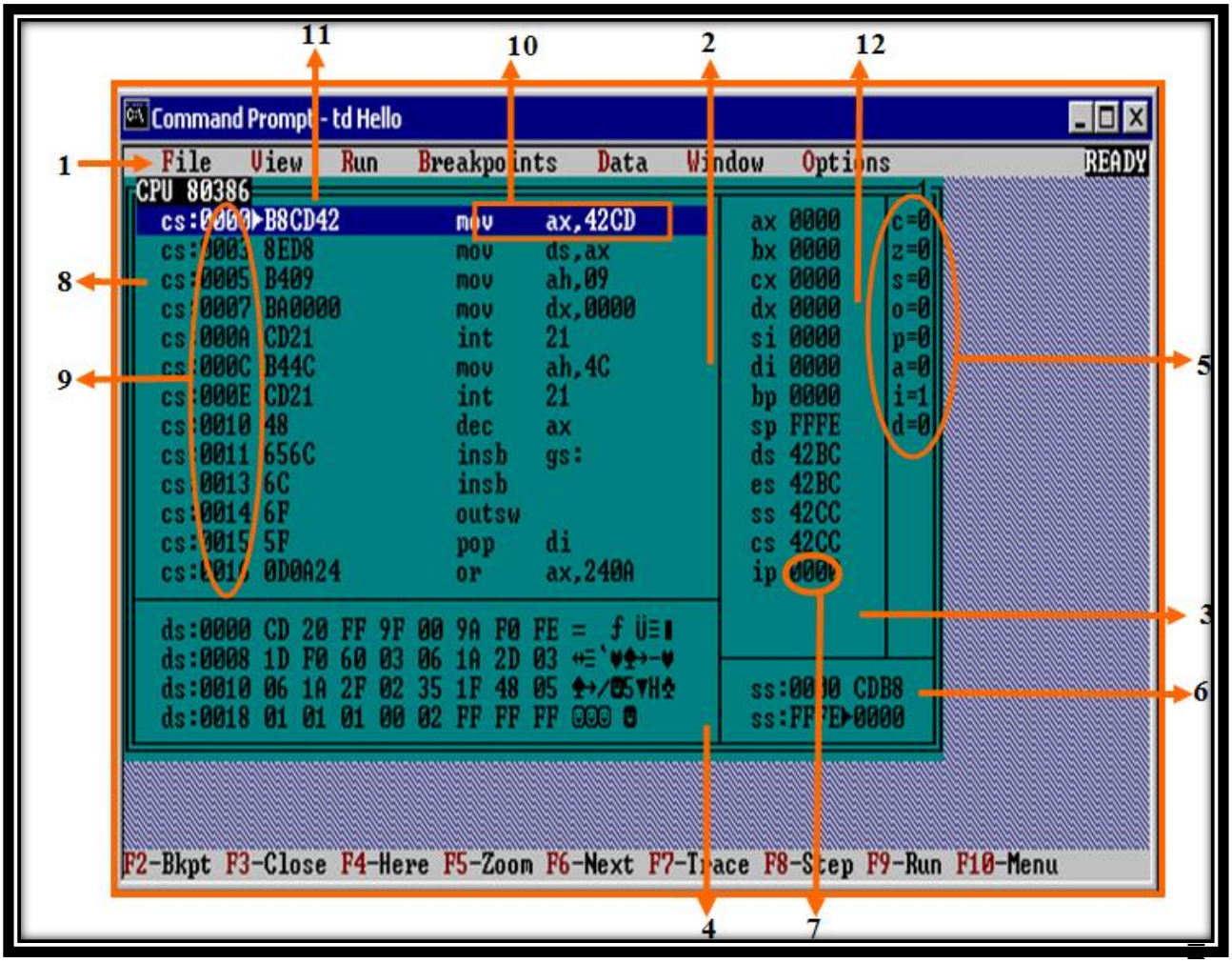
Using Tasm Turbo Debugger:

The Turbo Debugger is a program that allows you to single-step your program (that means run it line-by-line while you watch what happens). You can observe the registers, the memory dump, individual variables, flags, and the code as you trace through your program.

Also it is used to debug errors that have to be made by logic reasons.

After you write your program you can use assembly turbo debugger by follow the following:

C:\Tasm\Bin\td Hello



Number	Description
1	**Indicate to the menu bar of turbo debugger**
2	**Indicate to the region contain Code pane**
3	**Indicate to the region contain Register pane**
4	**Indicate to the region contain Data pane**
5	**Indicate to the region contain Flag pane**
6	**Indicate to the region contain Stack pane**
7	**Indicate to the instruction pointer (IP) it contains the offset address of the instruction will be execute.**
8	**Indicate to Code register that have value of (42CC) and we get it from register pane.**
9	**The offset address of each instruction**
10	**This statement tell the assembler to put (@data) default offset address in AX and this value from figure equal to (42CD)**
11	**indicate to the machine language of statement and from figure it is equal to (B8CD42)**
12	**This column is the values of Registers.**

❖ *Debugging Assembly Language programs*

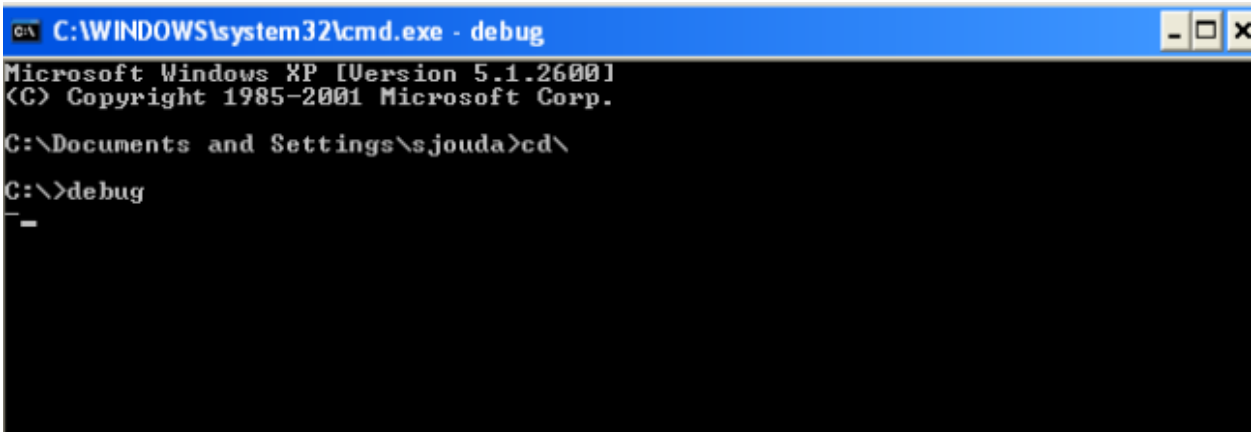
For Debugging you can use:

Debug hello.exe

COMMAND	SYNTAX	FUNCTION	EXAMPLE
Register	**R** [Register Name]	Examine or modify the contents of an internal register of the CPU	-**R** AX (AX reg.) -**RF** ZR (zero flag)
Dump	**D** [Start Addr] [End Addr]	Display the contents of memory locations specified by Address	-**D** DS:100 200 -**D** start-add end-add
Enter	**E** [Address] [Data]	Enter or modify the contents of the specified memory locations	-**E** DS:100 22 33 -**E** address data data
Fill	**F** [Start Addr] [End Addr] [Data]	Fill a block of memory with data	-**F** DS:100 120 22
Assemble	**A** [Starting address]	Convert assembly lang. instructions into machine code and store in memory	-**A** CS:100 -**A** start-address
Un-assemble	**U** [Starting Address]	Display the assembly instructions and its equivalent machine codes	-**U** CS:100 105 -**U** start-add end-add
Trace	**T** [Address][Number]	Line by line execution of specific number of assembly lang. instructions	-**T**=CS:100 -**T**=starting-address
Go	**G** [Starting Address] [Breakpoint Add.]	Execution of assembly language instructions until Breakpoint address	-**G**=CS:100 117 -**G**=start-add end-add

❖ *Invoking Debug*

To invoke the DEBUG program, a user opens command promote window and enters the following:



A (Assemble)

Assemble a program into machine language. Command formats:

```
A
A address
```

If only the offset portion of *address* is supplied, it is assumed to be an offset from CS. Here are examples:

Example	Description
`A 100`	Assemble at CS:100h.
`A`	Assemble from the current location.
`A DS:2000`	Assemble at DS:2000h.

When you press Enter at the end of each line, Debug prompts you for the next line of input. Each input line starts with a segment-offset address. To terminate input, press the Enter key on a blank line. For example:

```
-a 100
5514:0100 mov ah,2
5514:0102 mov dl,41
5514:0104 int 21
5514:0106
```

D (Dump)

The D command displays memory on the screen as single bytes in both hexadecimal and ASCII. Command formats:

```
D
D address
D range
```

If no address or range is given, the location begins where the last D command left off, or at location DS:0 if the command is being typed for the first time. If *address* is specified, it consists of either a segment-offset address or just a 16-bit offset. *Range* consists of the beginning and ending addresses to dump.

Example	Description
`D F000:0`	Segment-offset
`D ES:100`	Segment register-offset
`D 100`	Sffset

Q (Quit)

The Q command quits Debug and returns to DOS.

R (Register)

The R command may be used to do any of the following: display the contents of one register, allowing it to be changed; display registers, flags, and the next instruction about to be executed; display all eight flag settings, allowing any or all of them to be changed. There are two command formats:

```
R
R register
```

Here are some examples:

Example	Description
R	Display the contents of all registers.

T (Trace)

The T command executes one or more instructions starting at either the current CS:IP location or at an optional address. The contents of the registers are shown after each instruction is executed. The command formats are:

```
T
T count
T =address count
```

Where *count* is the number of instructions to trace, and *address* is the starting address for the trace. Examples:

Example	Description
T	Trace the next instruction.
T 5	Trace the next five instructions.
T =105 10	Trace 16 instructions starting at CS:105.