HOW TO PROGRAM MCU?

Rudra Pratap Suman

Flash Back (Takneek/Techkriti)

- Line Following Robots
- Wireless keyboards
- Wireless Gamepad
- Tachometer
- They were made using Microcontrollers

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Tools Required -> CVAVR

PC Running IDE for entering,editing and compiling source program.

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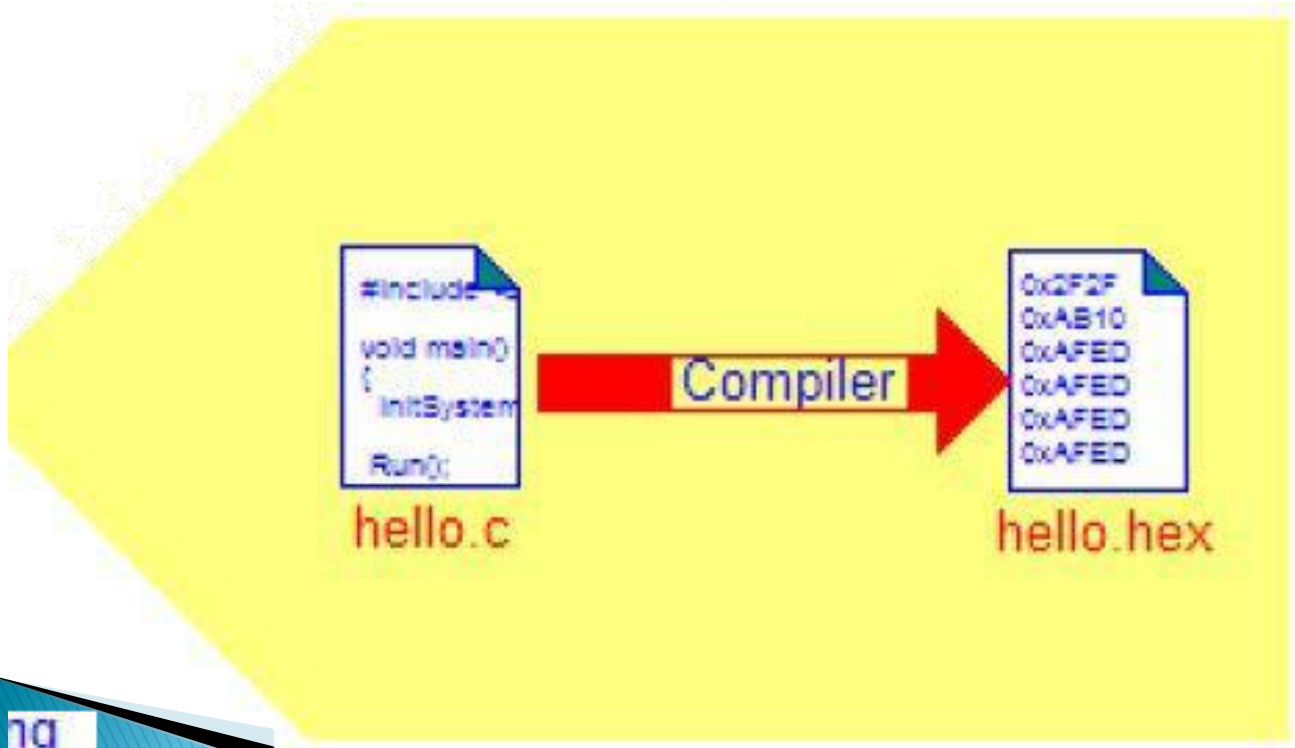
Compiler -> CVAVR

- The code is written in C language so we need to convert it into the format that Atmega understands



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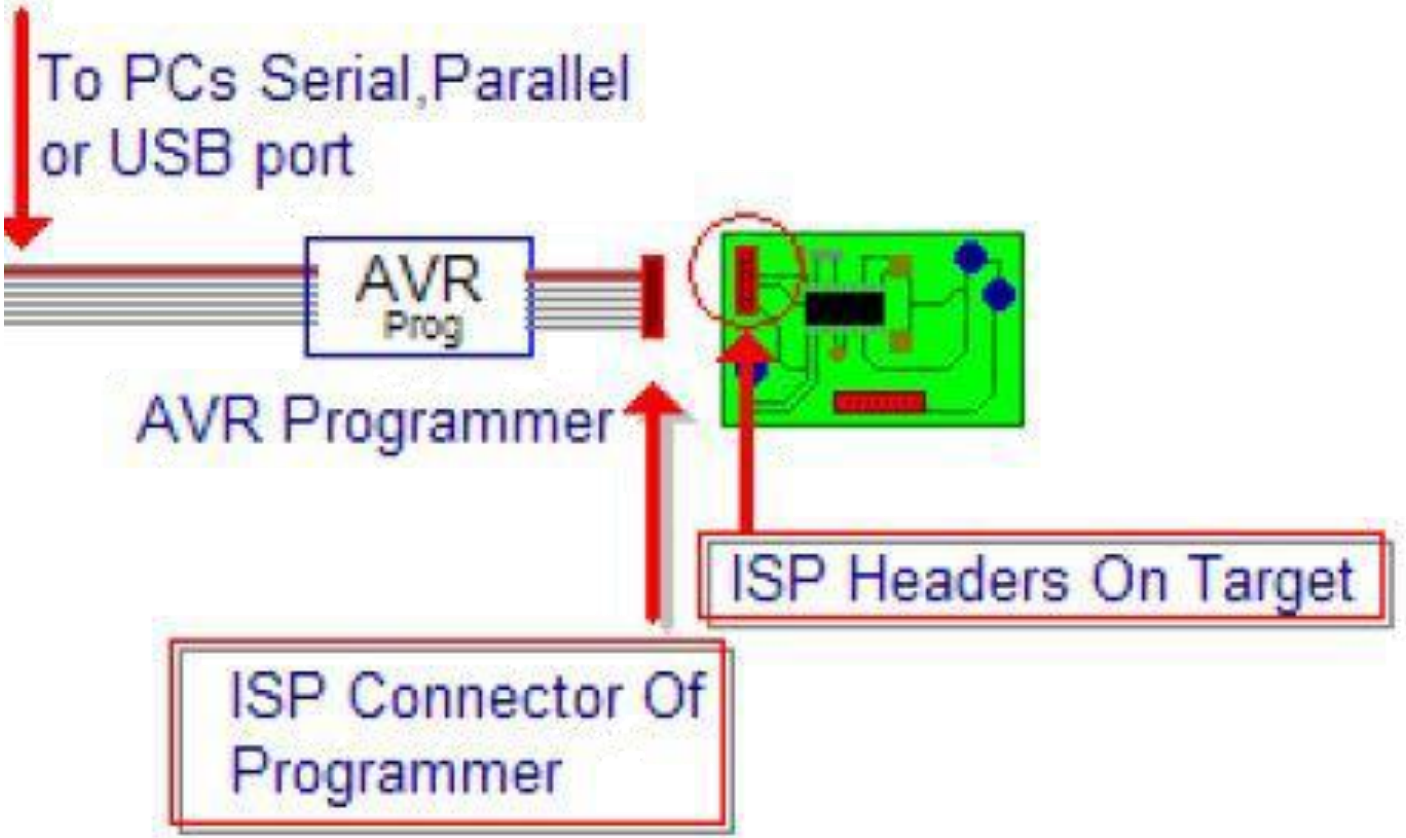
Transfer code to Atmega AVR Studio



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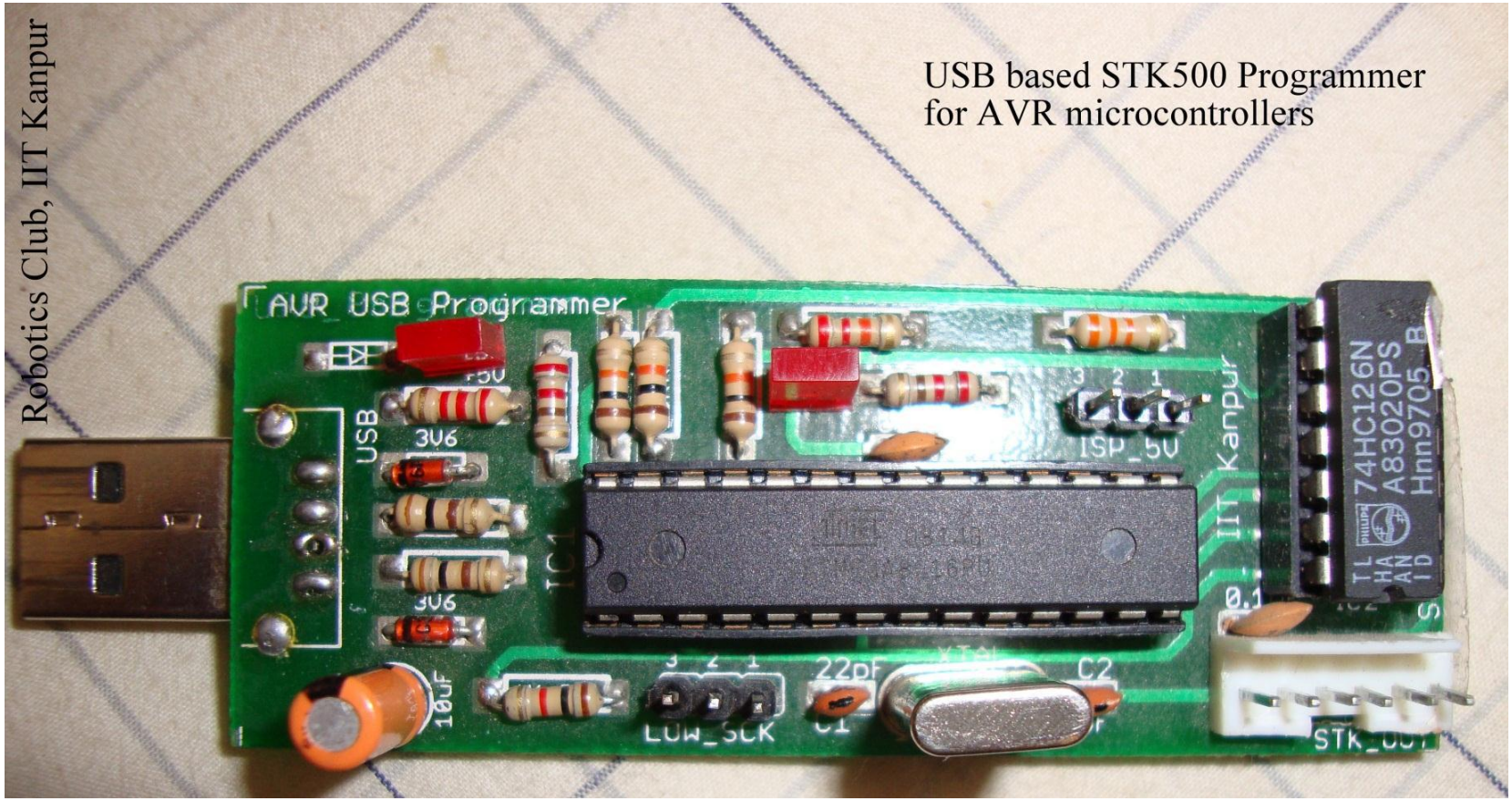
Avr Programmer



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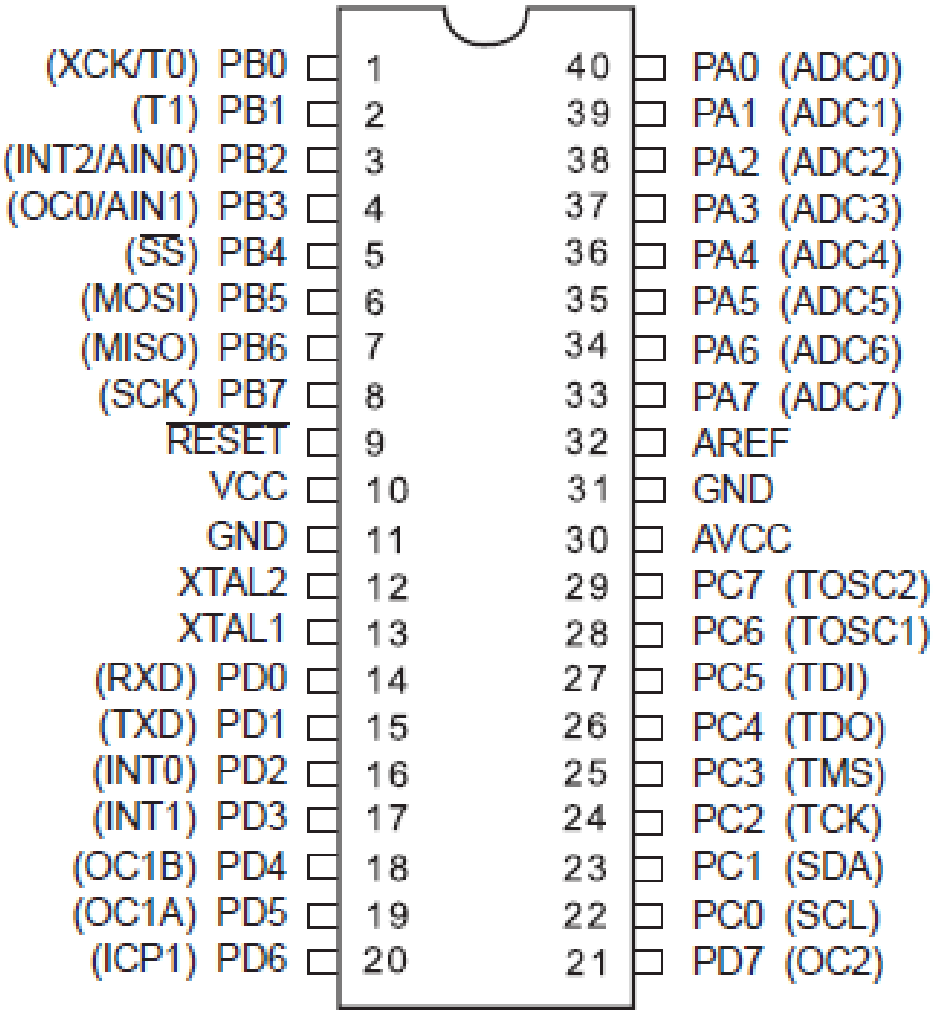
- So we need two softwares overall

a) CVAVR -> Editor and Compiler

b) Avr Studio -> Transfer Code to Atmega

The ATmega16

- 40 pin IC.
- 32 pins for I/O.
- 8 pins reserved.
- I/O pins divided into 4 groups of 8 pins, called ports.
- Ports labeled as A, B, C and D.



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Basics of C language

- If else block
- If(condition)

```
{
…
  …
 }
 else
{
…
  …
}
```

While & For

- While (conditon)

{

…

…

}

- for(initialisation; condition; increment)

{

…

…

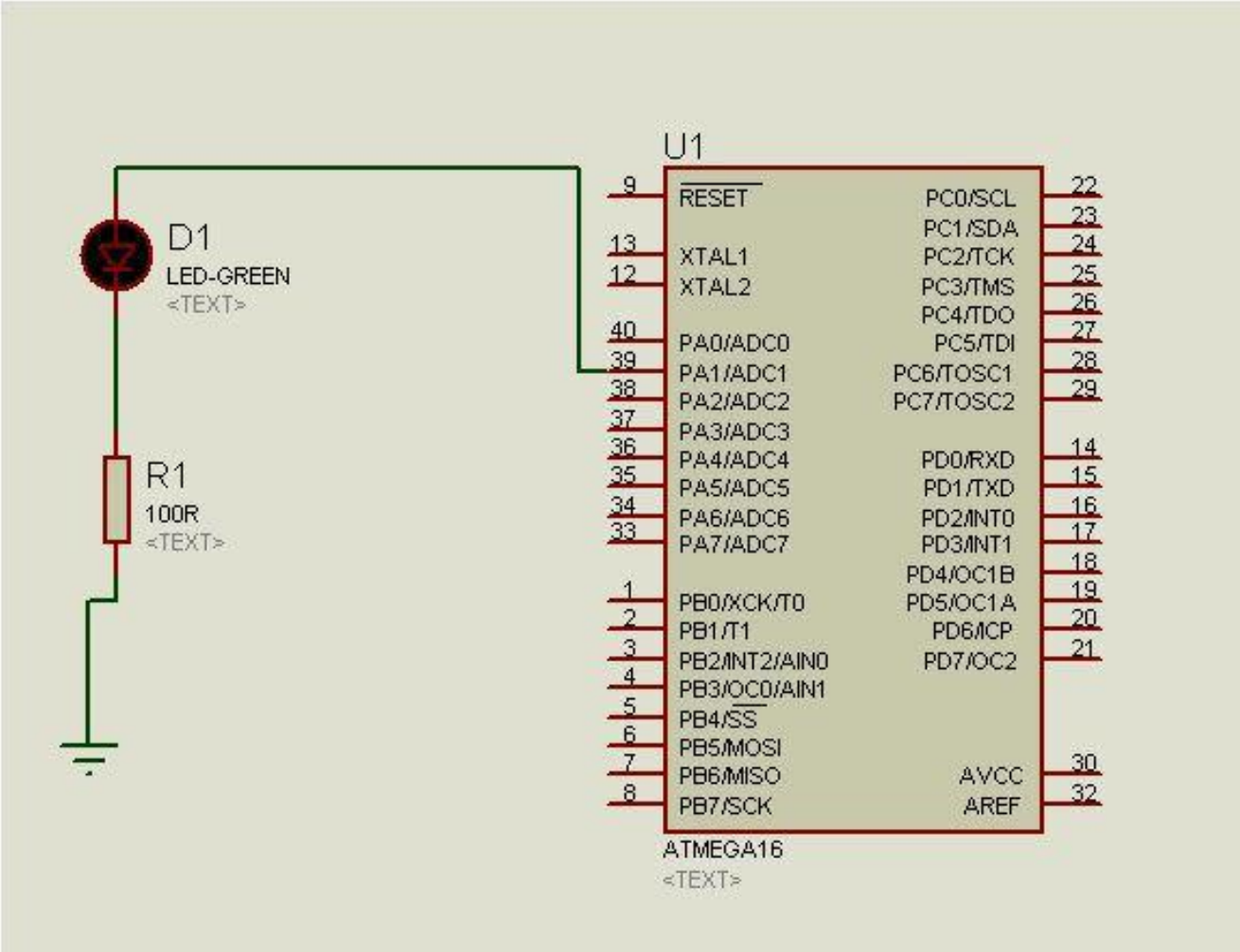
}

Some C operators

- | is bitwise OR. Eg. 10100111 | 11000101 = 11100111
- & is bitwise AND. Eg. 10100111 & 11000101 = 10000101
- ~ is bitwise NOT. Eg. ~10100110 = 01011001
- << is shift left. >> is shift right.

Lets Begin by blinking a simple LED

Circuit Diagram



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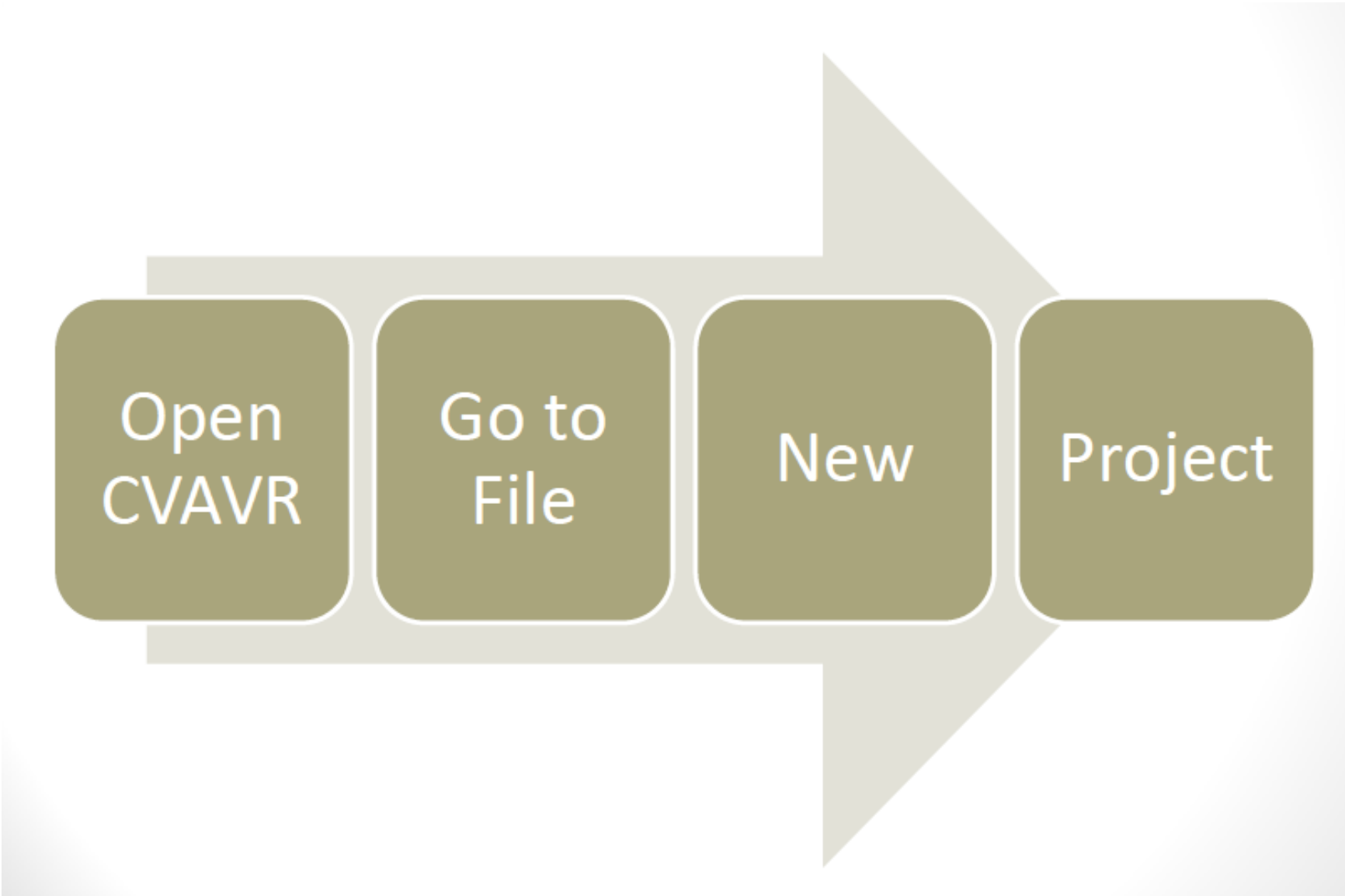
Getting Started with CVAVR



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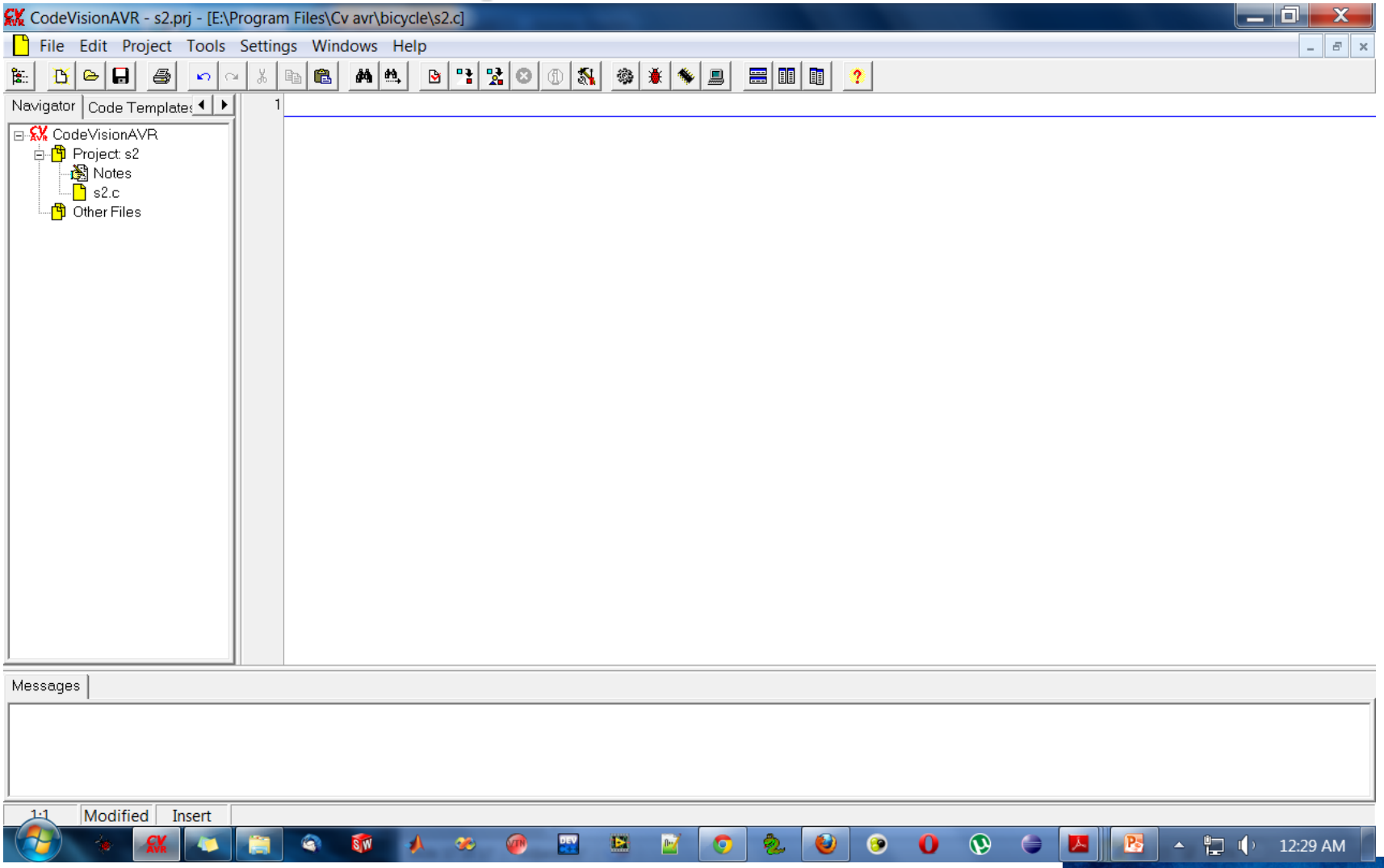
Open CVAVR



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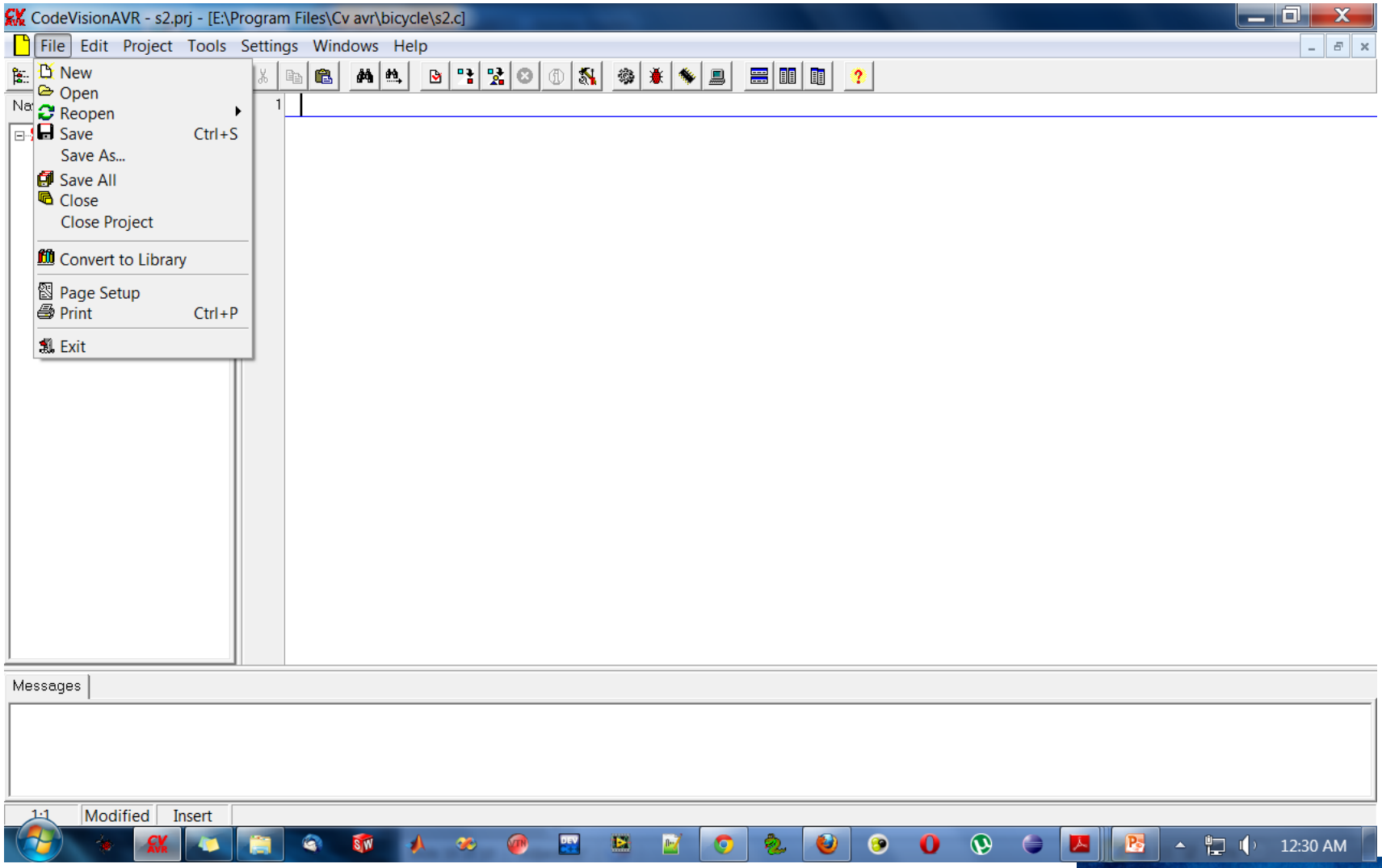
Go to File



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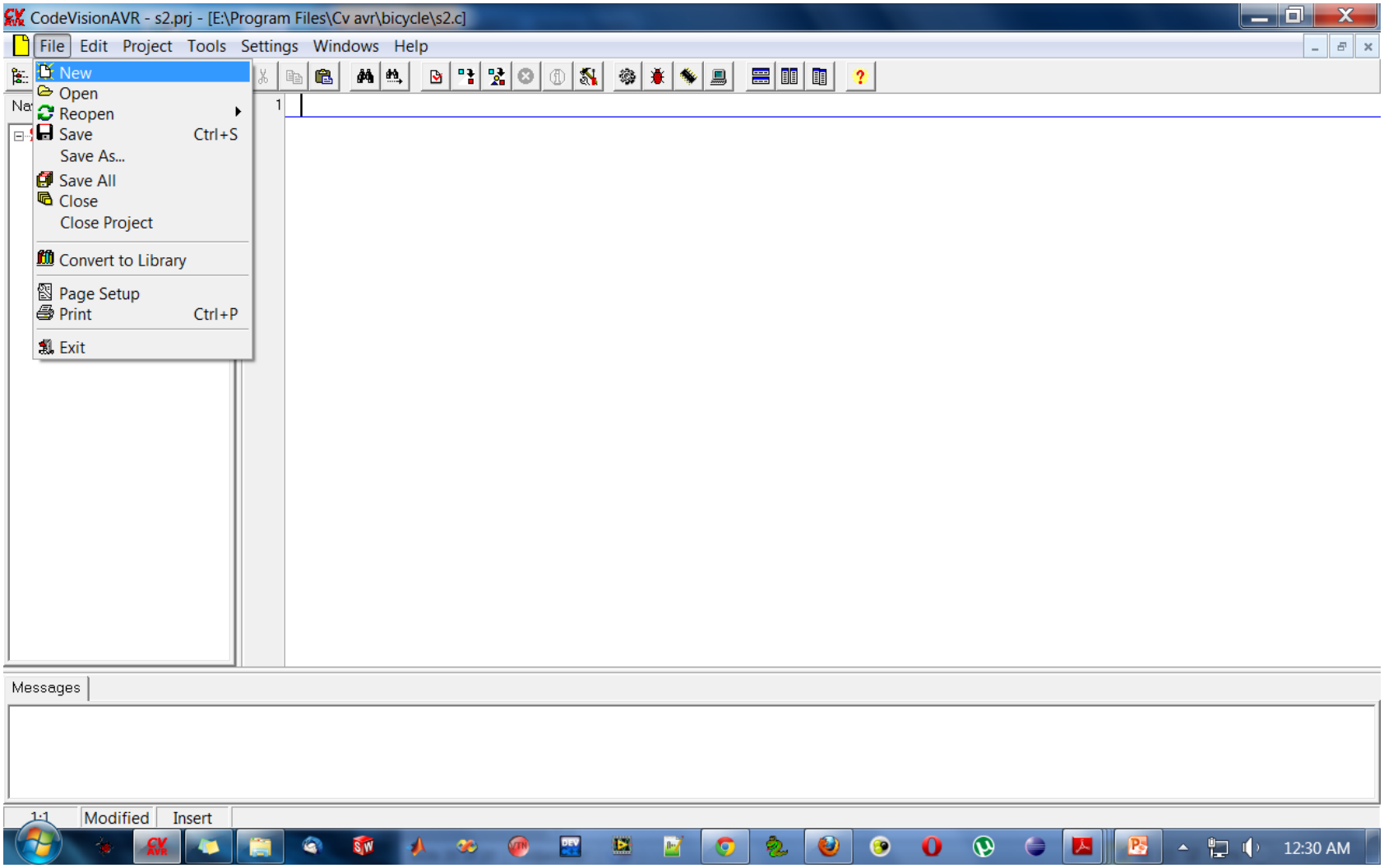
Click on New



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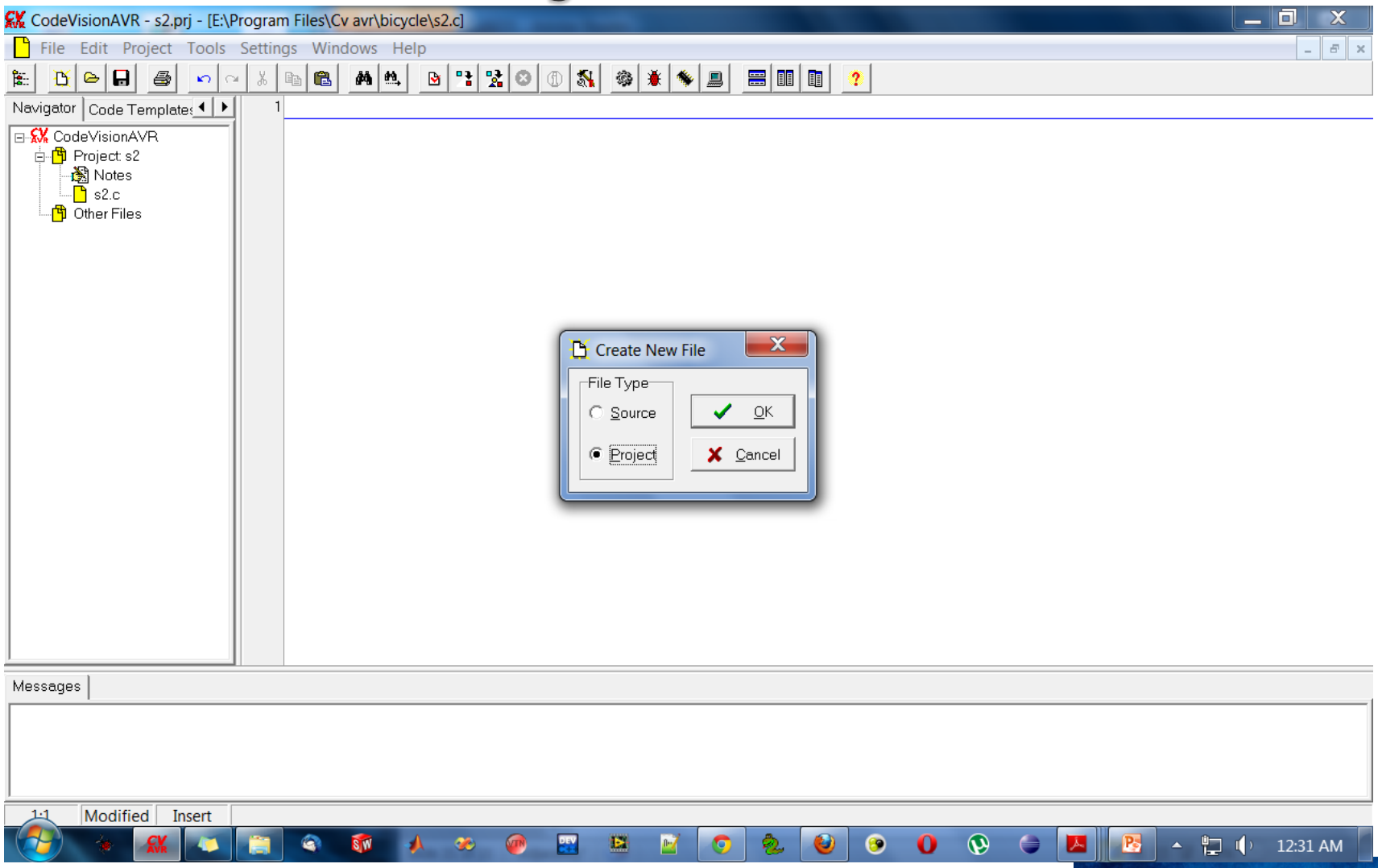
Select Project- > Click OK



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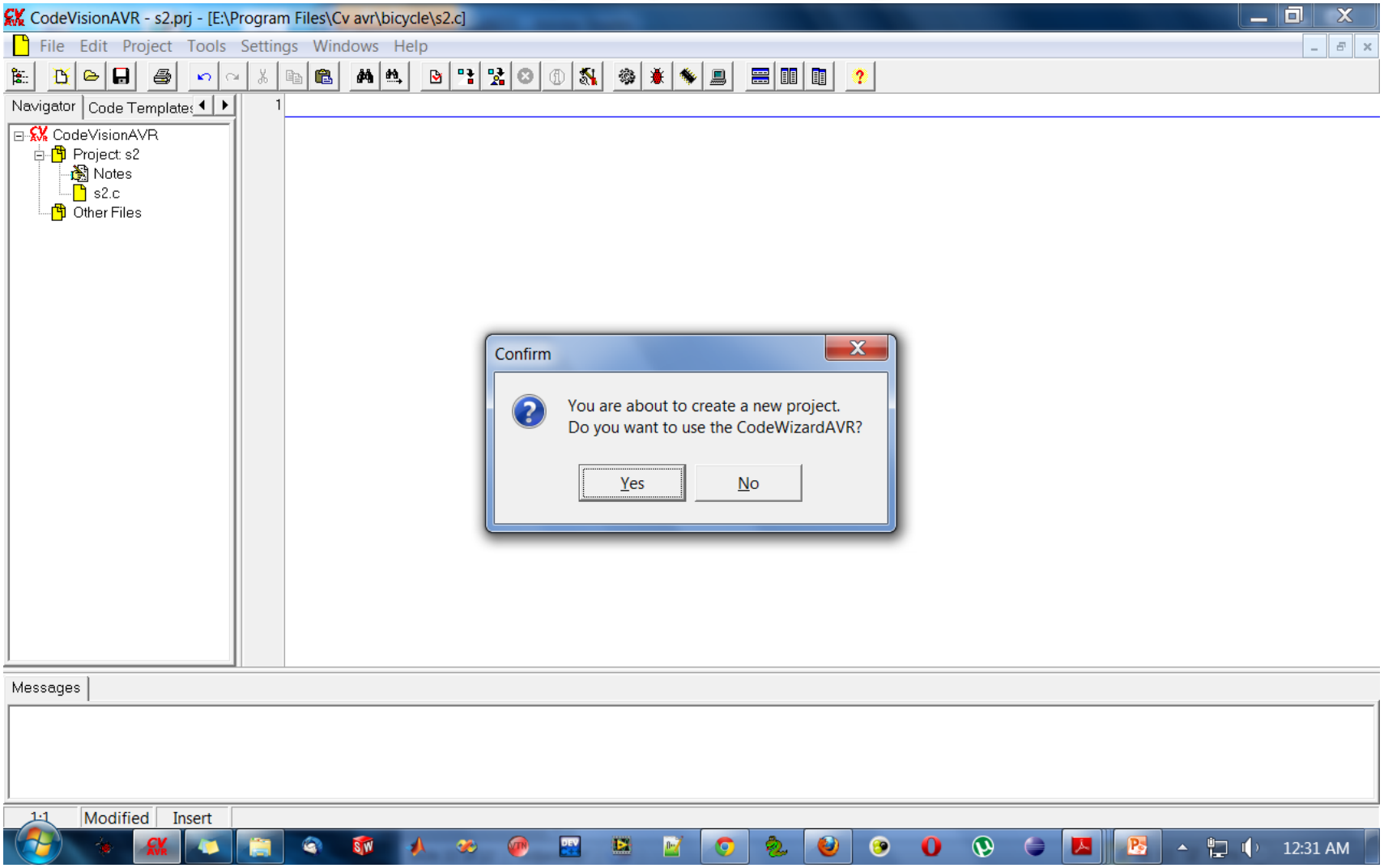
Click YES



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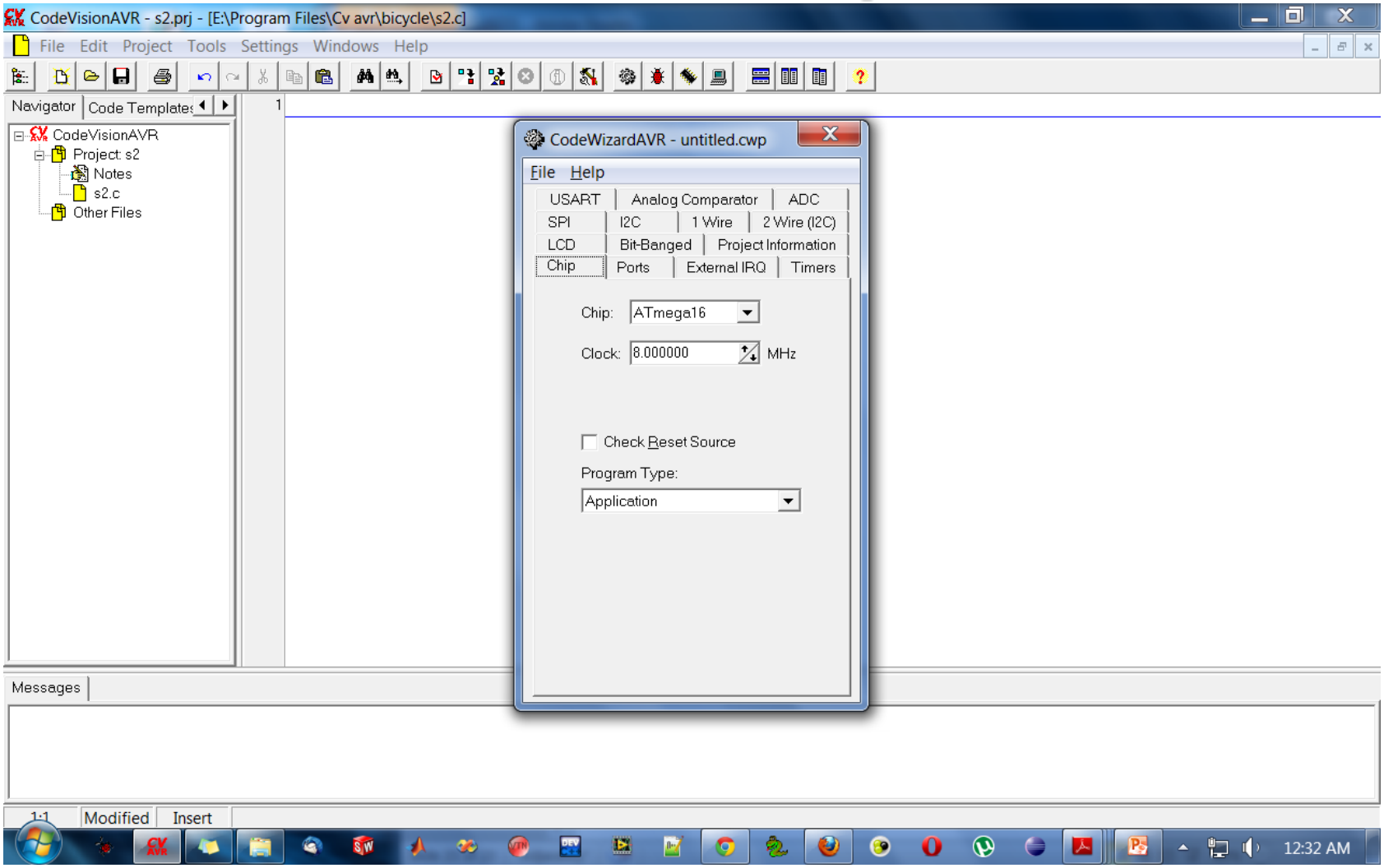
Select Chip



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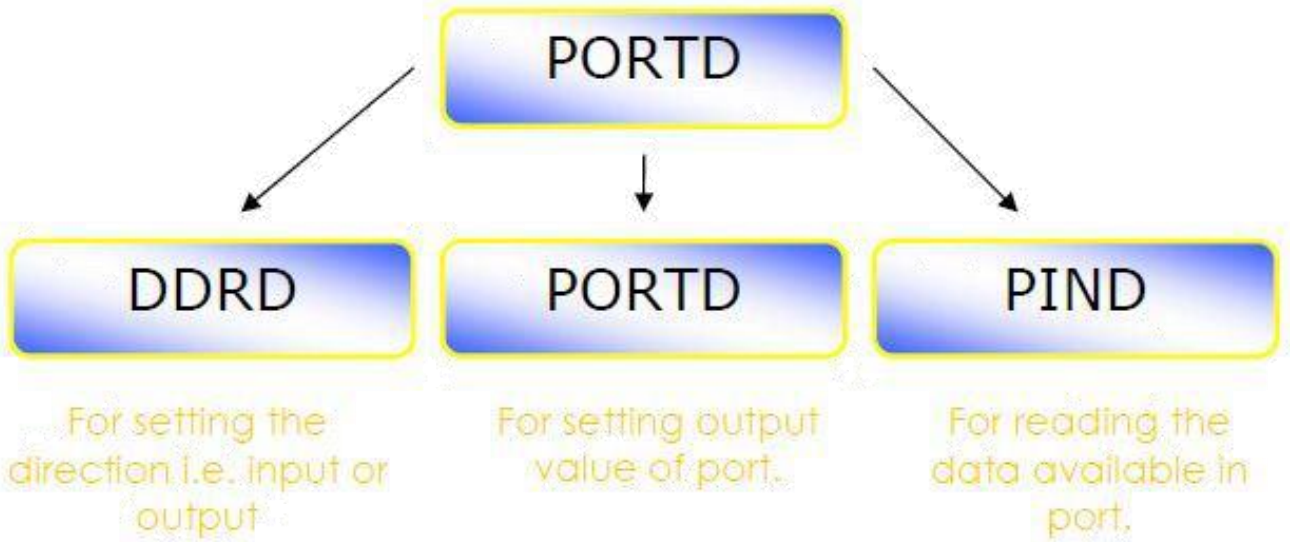
Introduction to I/O

- Atmega has total of 40 pins out of which 32 pins can be used as Input or Output
- These 32 pins are divided into 4 groups of 8 pins PORTA, PORTB , PORTC , PORTD

Accessing digital IO in C

Each PORT in AVR has three related Registers.



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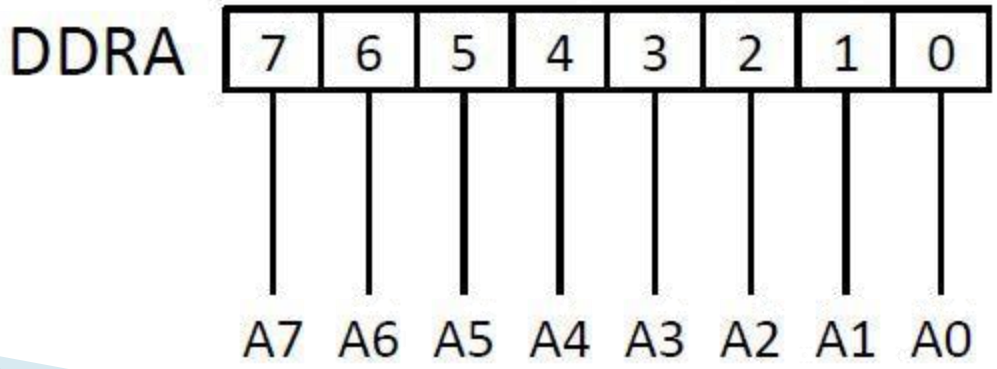
Data Direction register (DDR)

- This sets direction for all pins (32)
- Direction for these pins can be Input or Output
- To blink an LED we need to set pin as “OUTPUT” but “HOW“ ?
- DDRA = 0b00000001 ;
- DDRA = 0x01 ;
- 1 Stands for Output & 0 stands for Input



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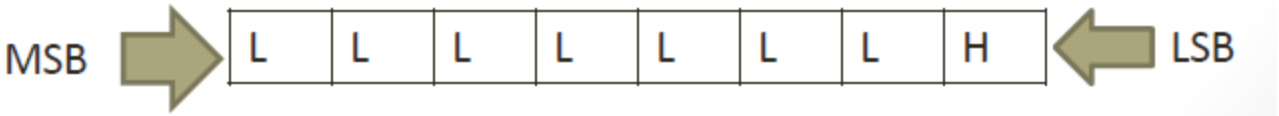
What Next ?

- We have set the Pin as Output
- What else do we need to light the LED ??
- Supply of 5 Volts !!! This is given by PORT Register

PORT Register

- Only after you have set the Pin to Output you can control them through this Register
- It is a 8 bit register . It corresponds to the pin in same manner as that of DDR Register
- Used to set output value (0 or 1) only if the corresponding Pin has been set as output by DDR Register
- PORTA= 0b 00000001; or
- PORTA= 0x01 ;
- 1 stands for 5V
- 0 stands for 0V



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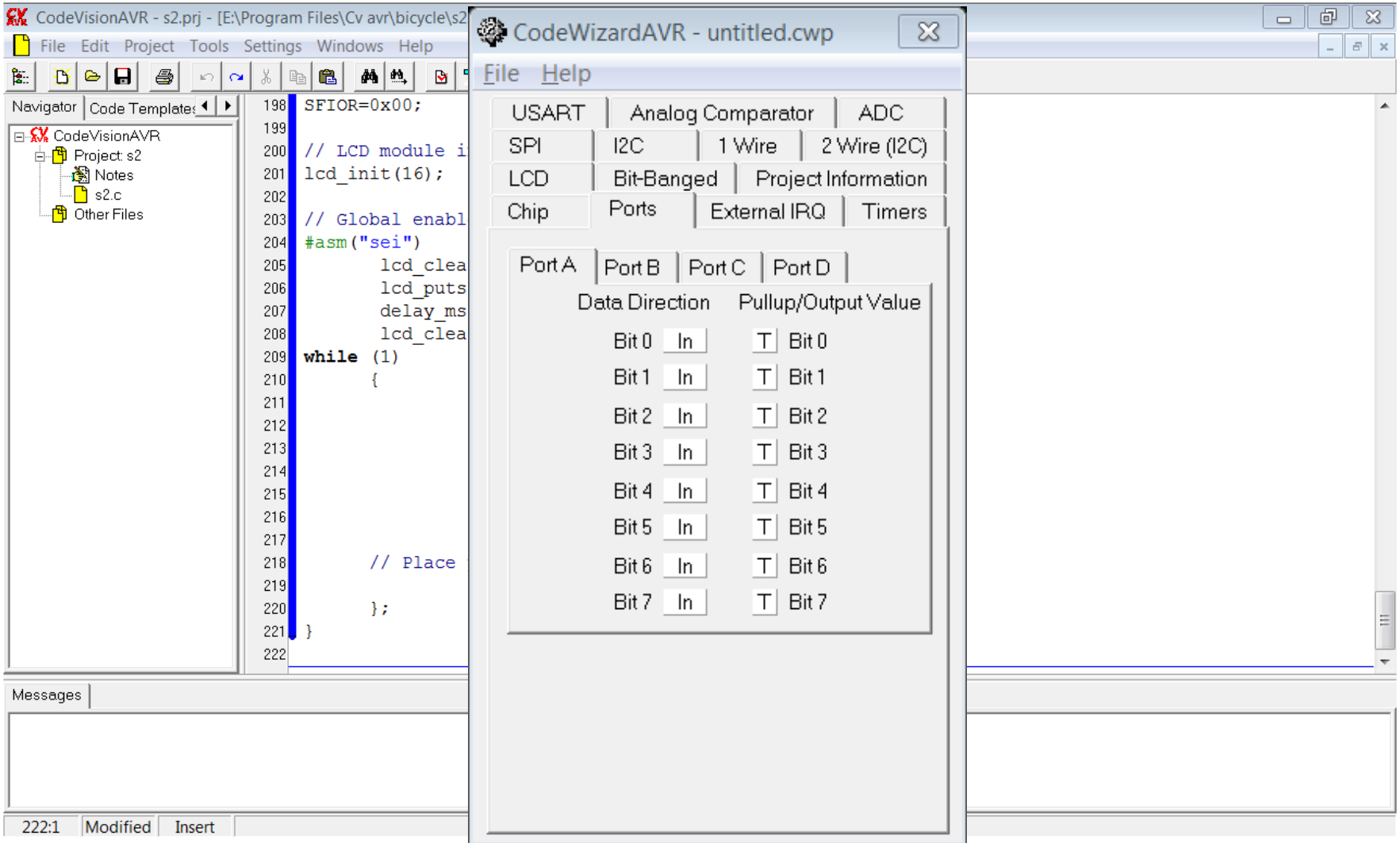
Setting I/O

Go to Ports



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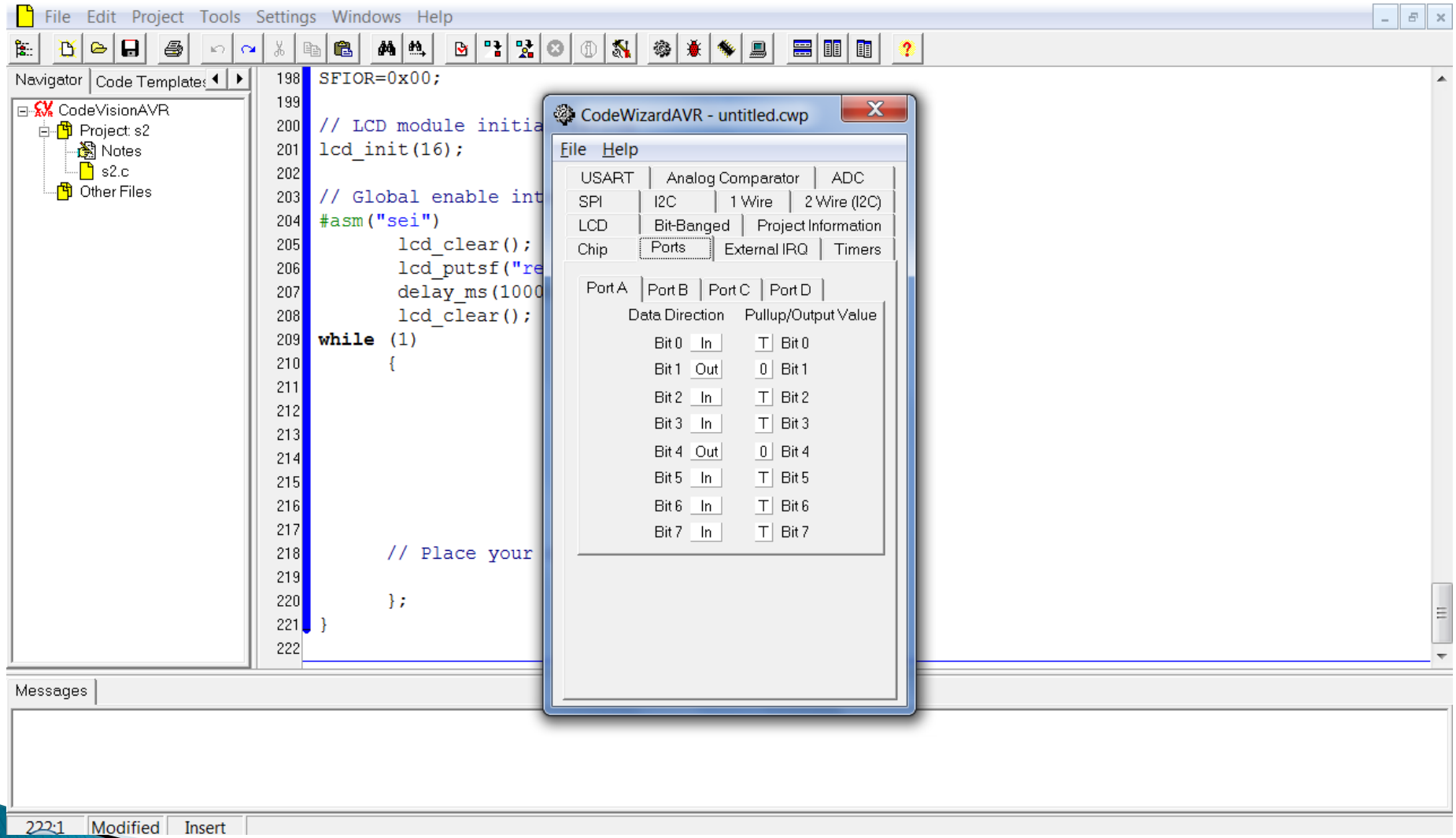
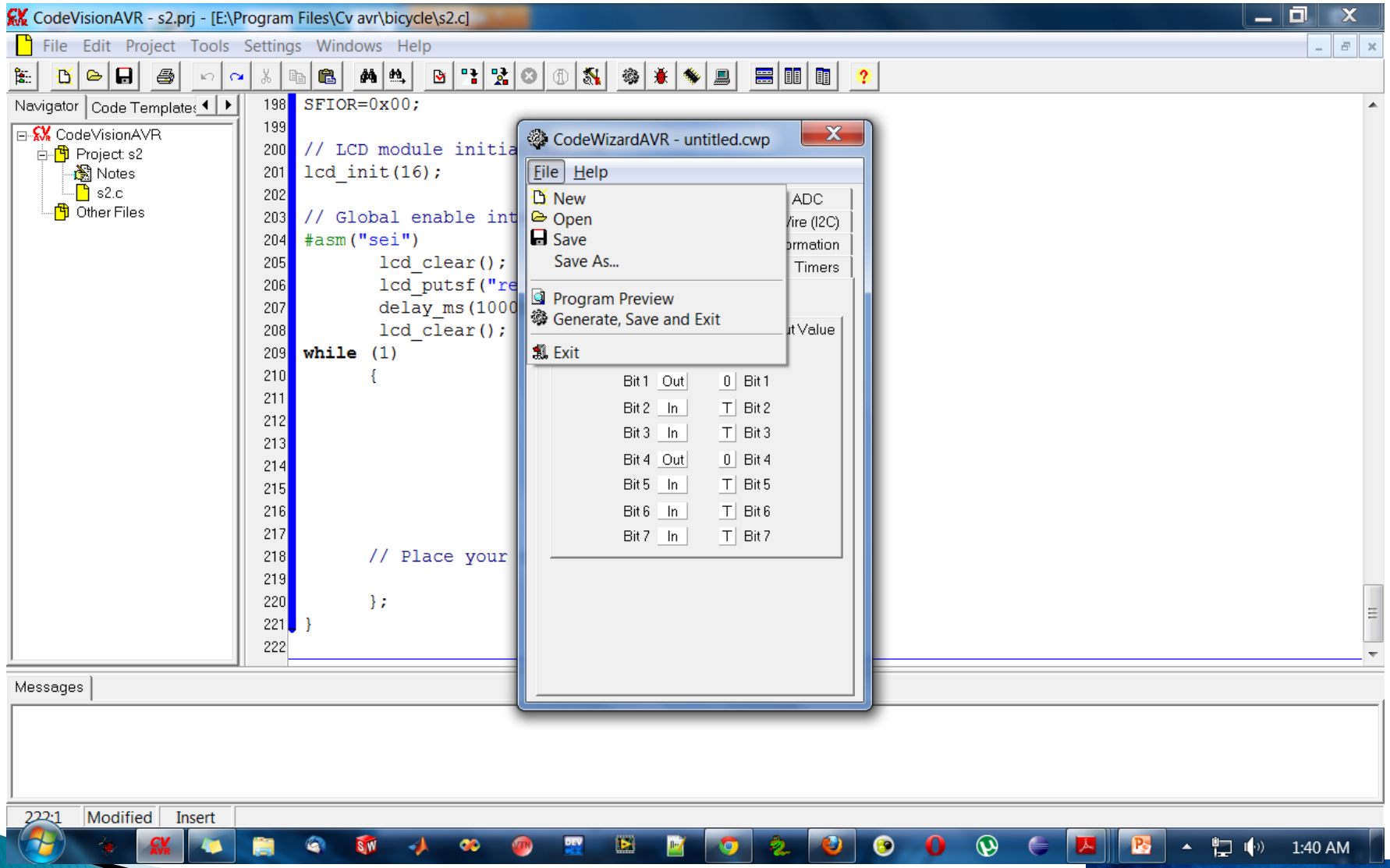
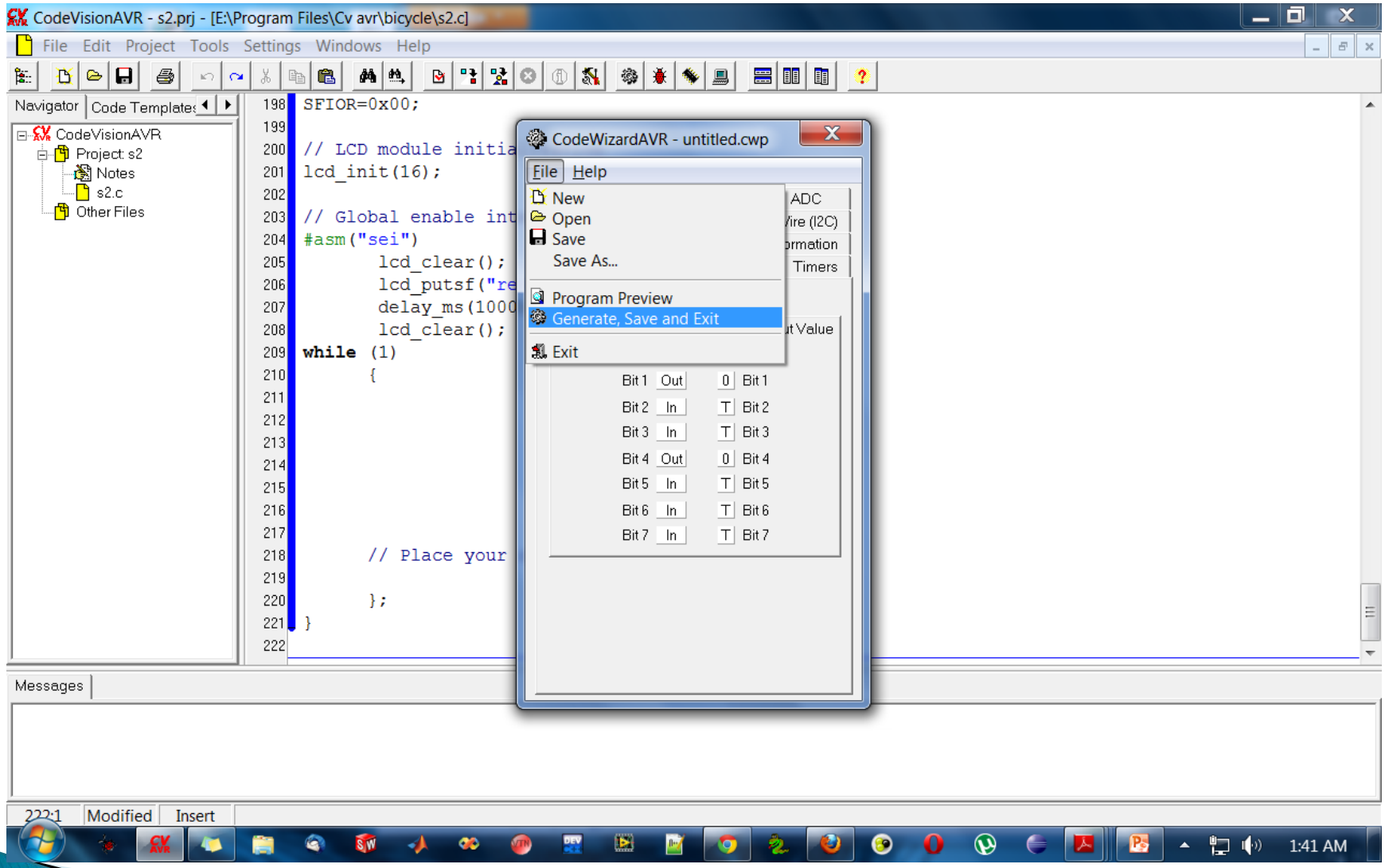
- Click on In to make that pin Output
- Can do so for all four ports



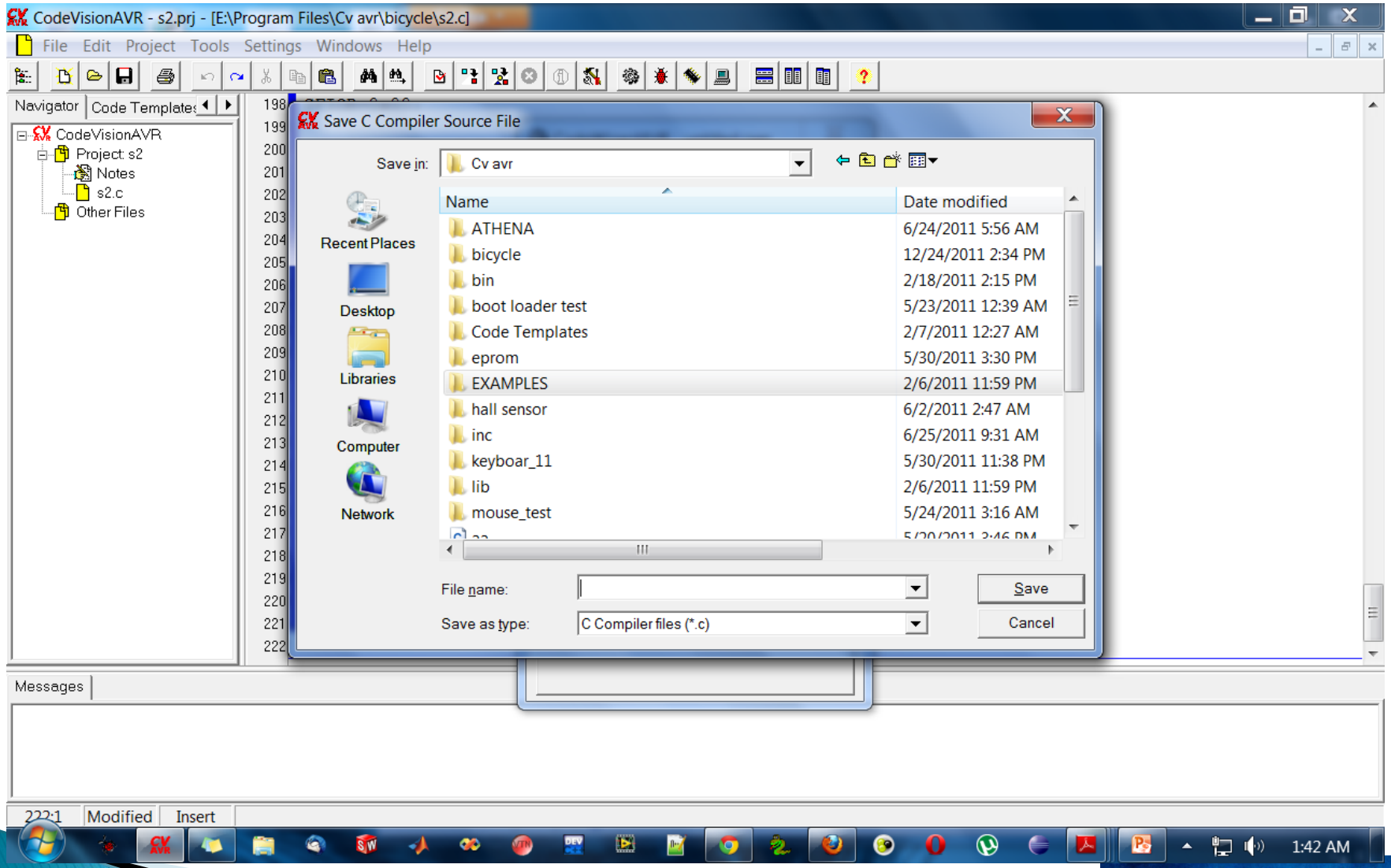
Click on File



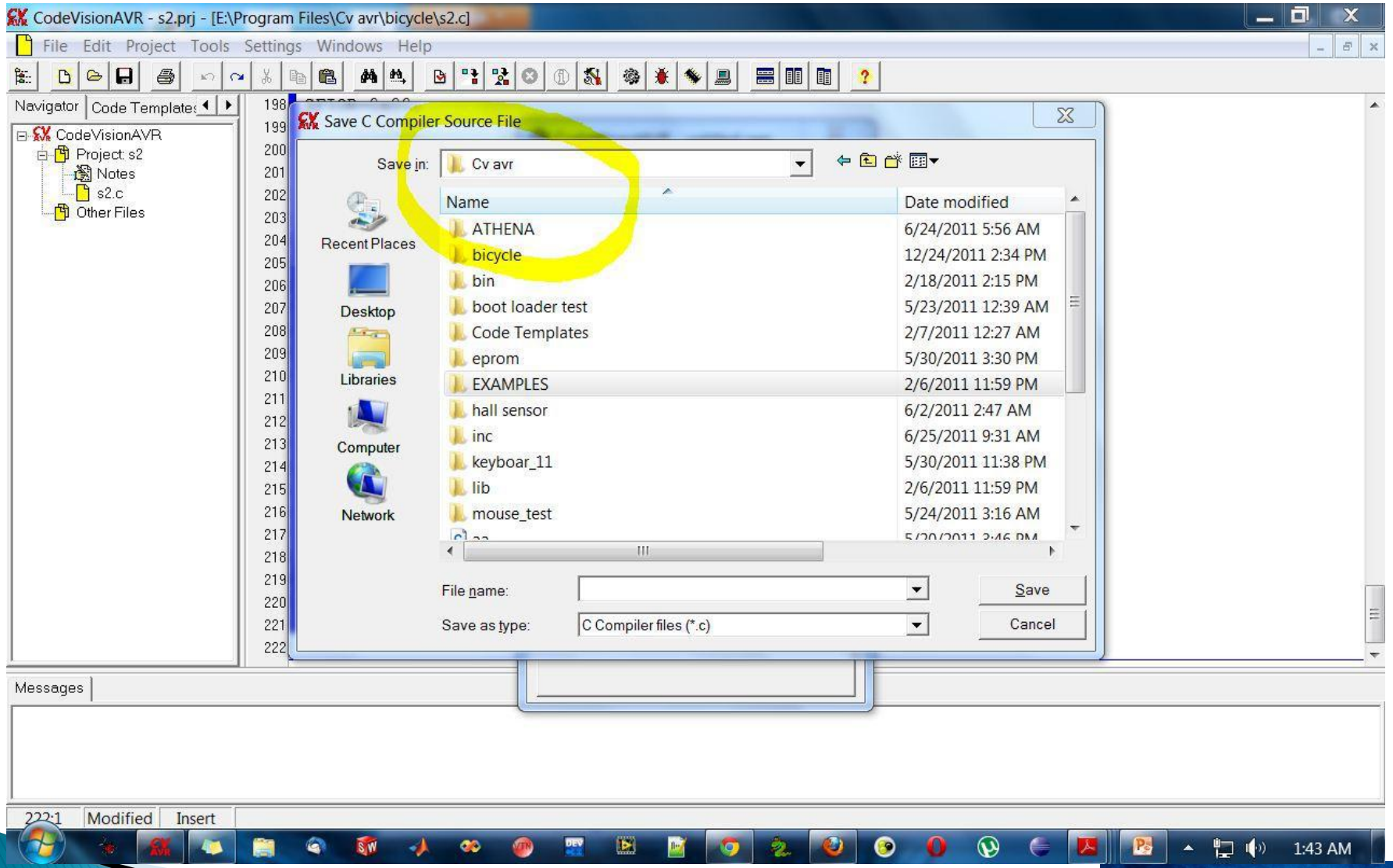
Generate Save and Exit



Enter name (3 times)

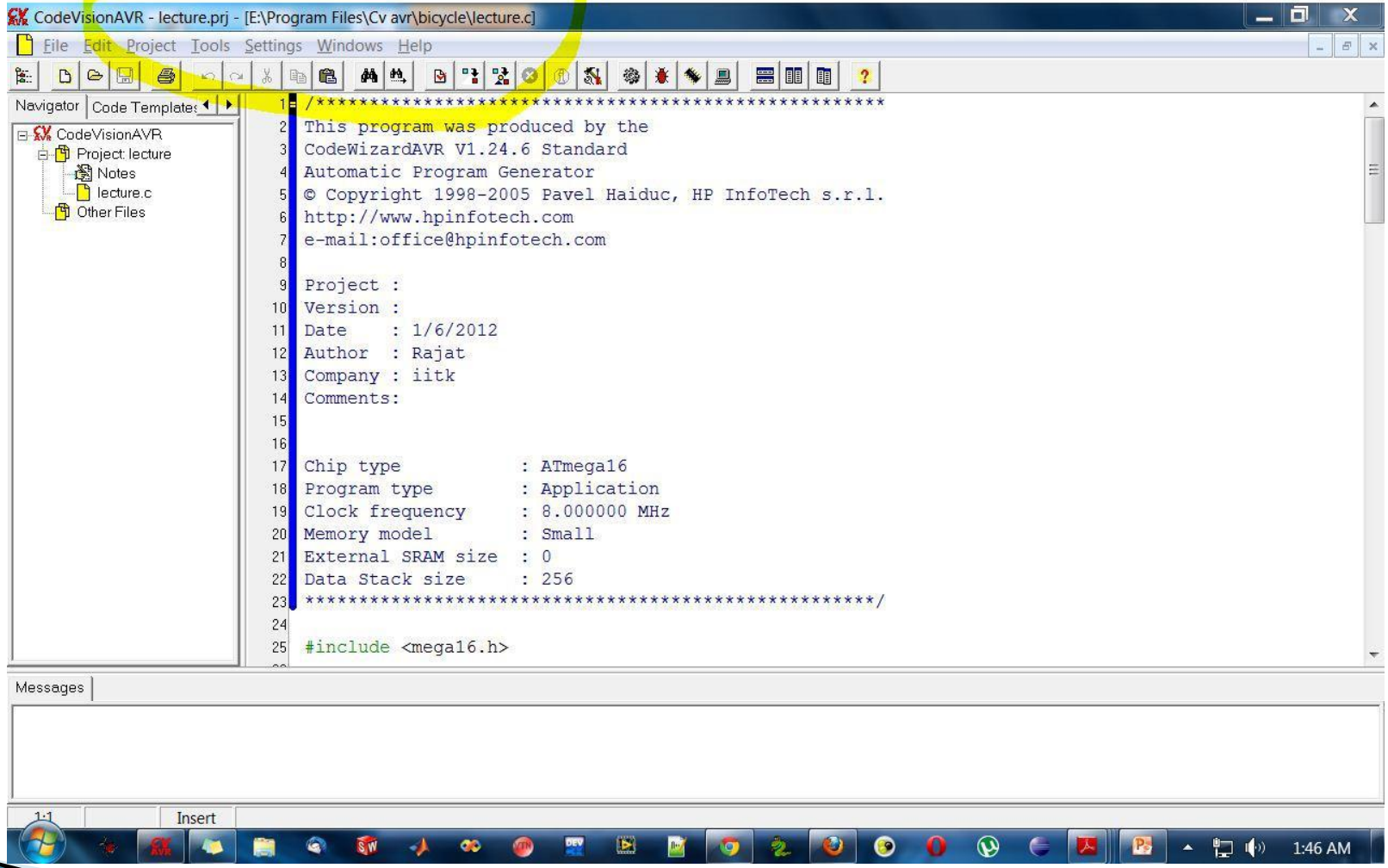


Where is the code stored ?



Then Click Save

Name of Project & Location



Writing the Code

- NOTE : We write our code in While block
- While (1)

```
{
 PORTA.1=1; // sets the Pin to 5 volts
 PORTA.1=0; // sets the Pin to 0 volts
 }
```

- This makes the LED to blink but we cannot see blinking !!!

- This is because Atmega runs at a frequency of 8000000 Hz
- We need to introduce delay so as to see blinking
- Use header file delay.h
- Function to be used · delay_ms(time in millis);
- While (1) {

```
delay_ms(1000);
PORTA.1=1;
delay_ms(1000);
PORTA.1=0;
}
```

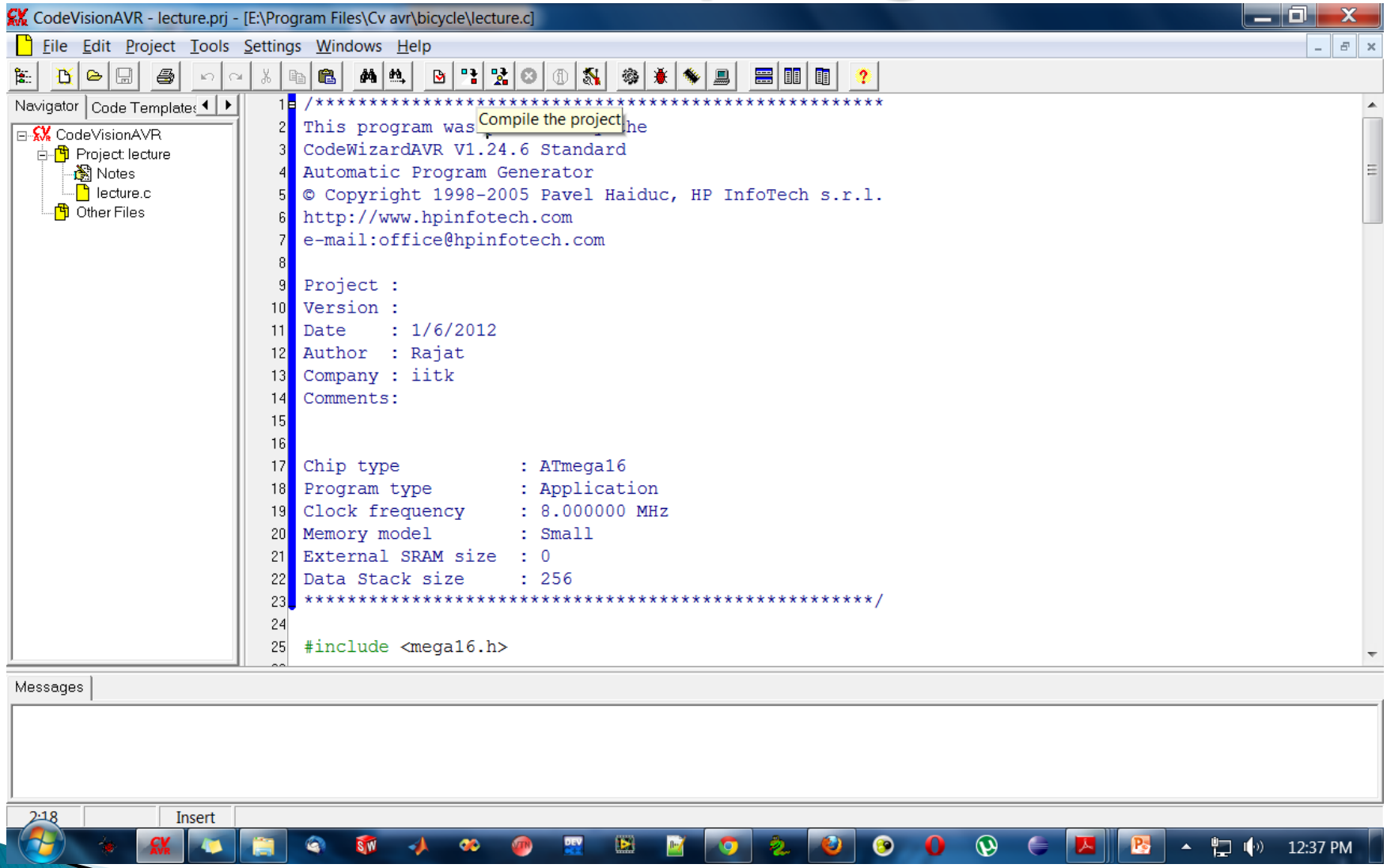
- This is because Atmega runs at a frequency of 8000000 Hz
- We need to introduce delay so as to see blinking
- Use header file delay.h
- Function to be used · delay_ms(time in millis);
- While (1) {

```
delay_ms(1000);
PORTA.1=1;
delay_ms(1000);
PORTA.1=0;
}
```

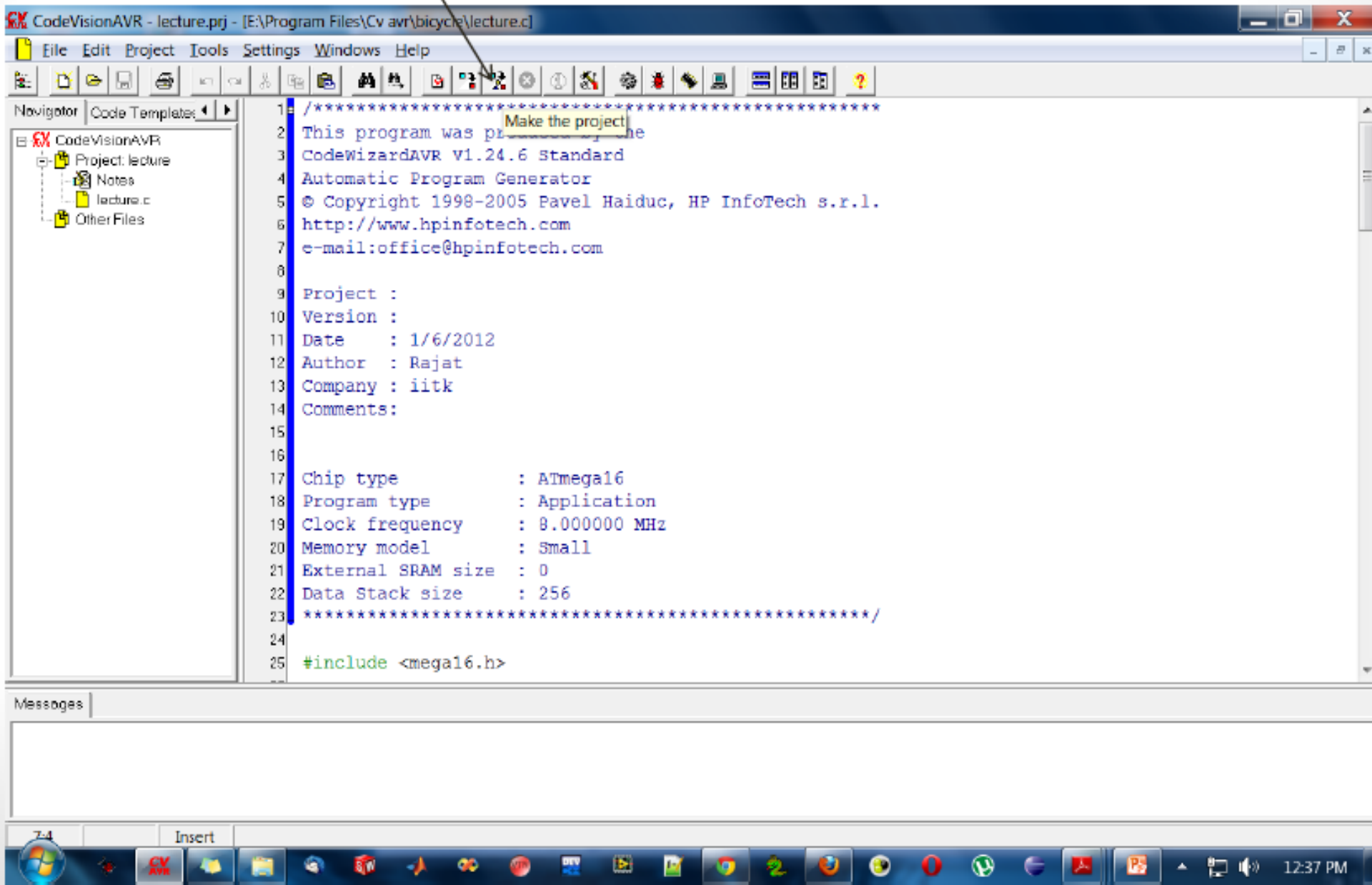
How to compile

- Code is written in C language but Atmega understands Hex file
- so we need to convert the C file to Hex file

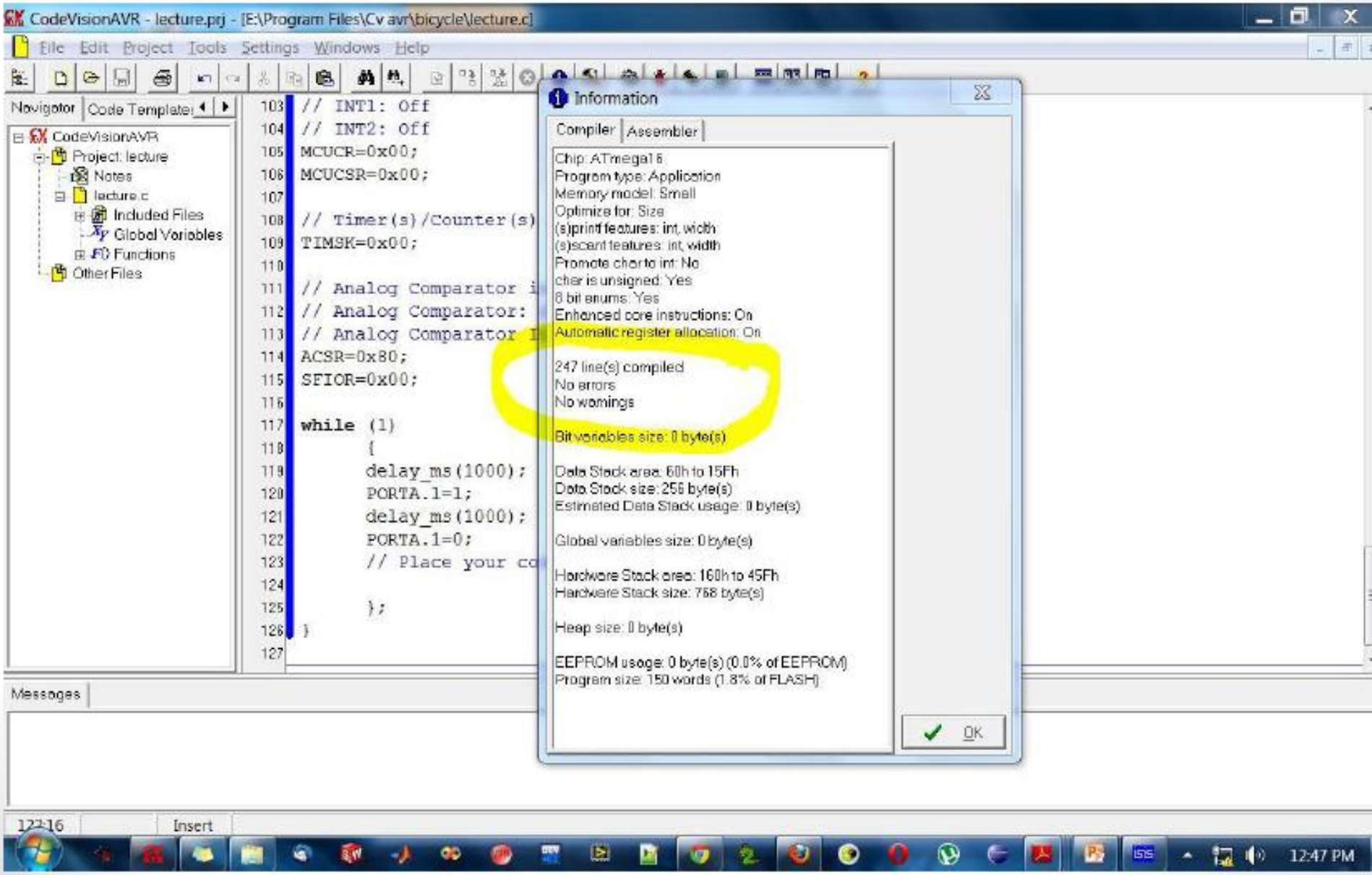
Compiling



Make the Project



Check for errors



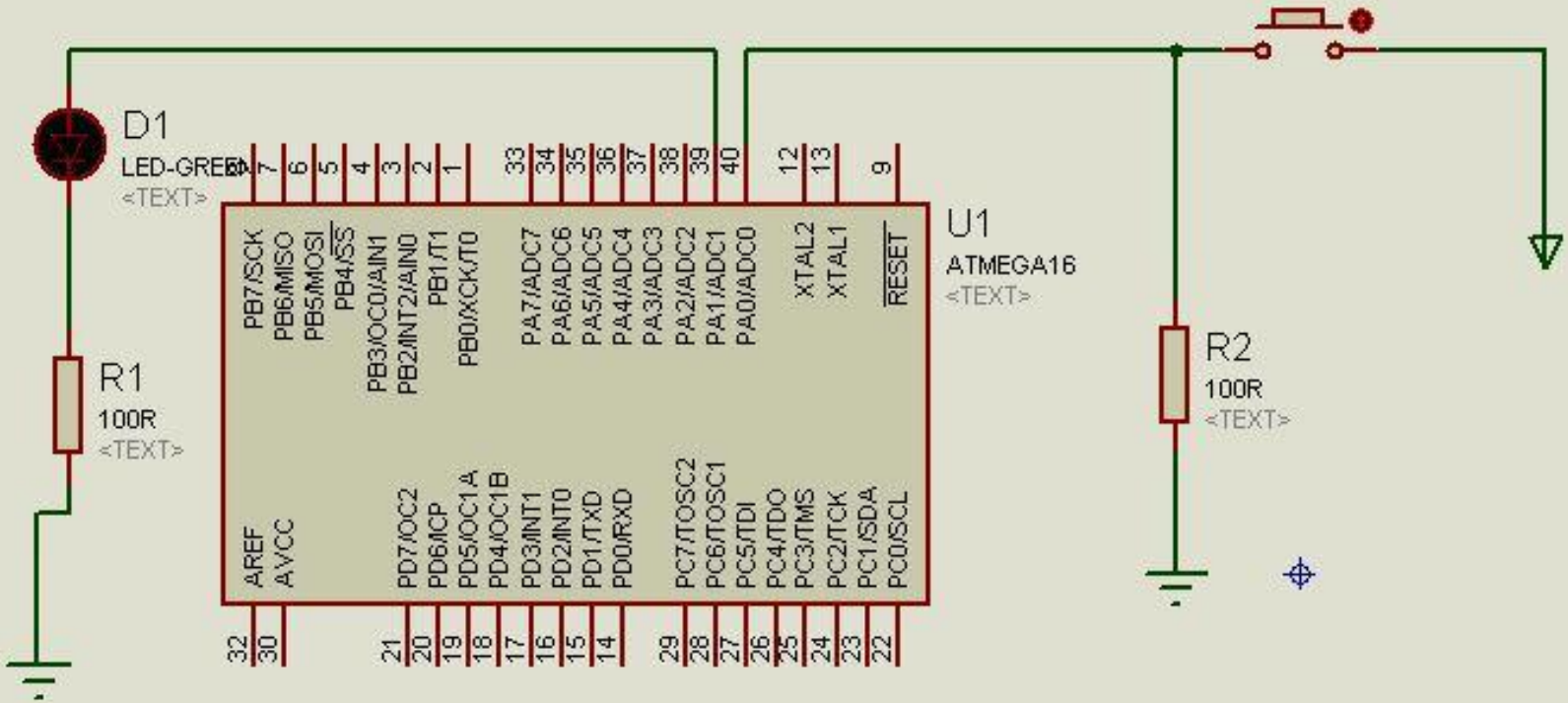
Hex File

- You can find the Hex file in Bin folder or the EXE folder of the directory where You installed CVAVR
- So we Have our Code ready
- Feed this code to Atmega using Programmer
- Lets see the code in action

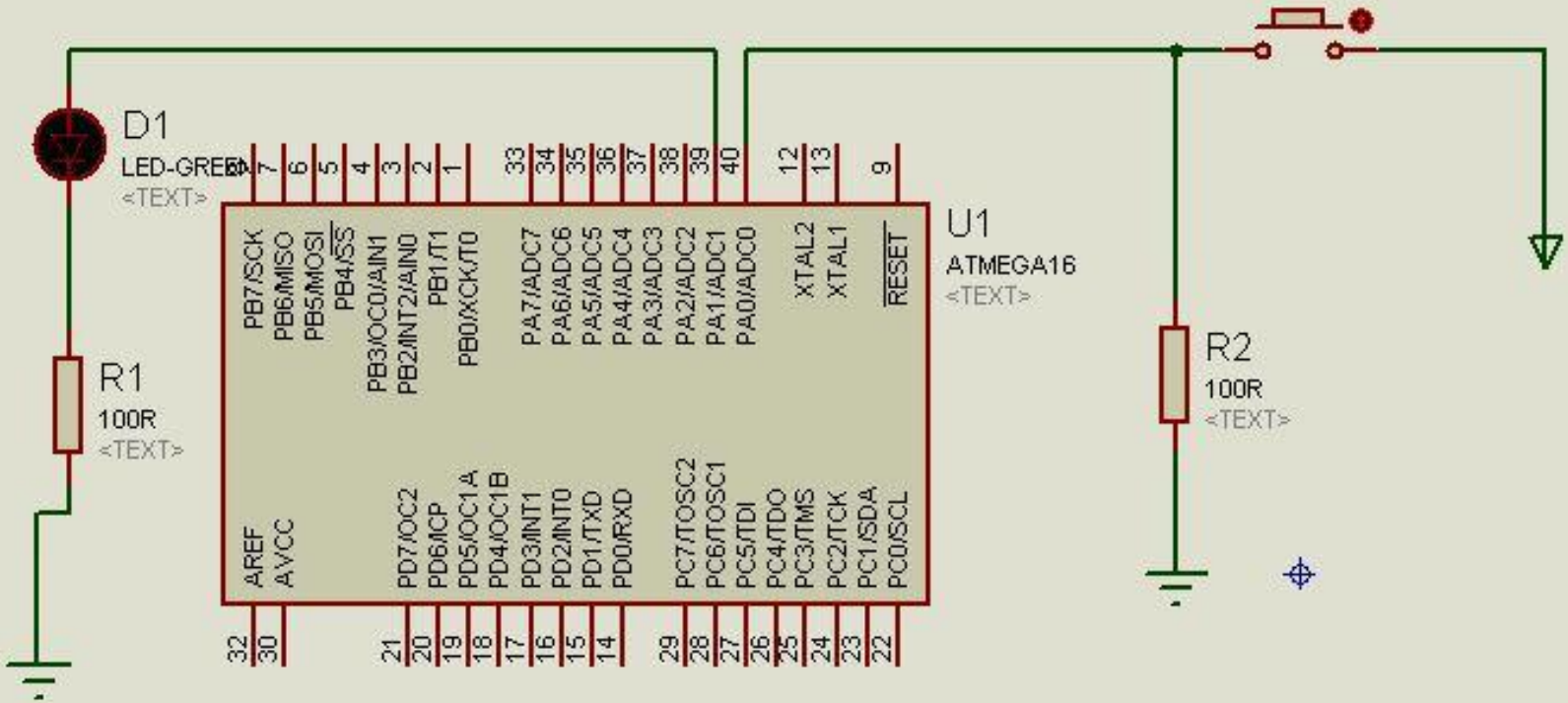
Lets add an Input

- Most Common Input - Button
- Since we have already made A0 as Input we connect a button to that pin
- If button is pressed light the LED else turn it off
- First draw the Circuit Diagram

Circuit Diagram



Circuit Diagram



PIN Register

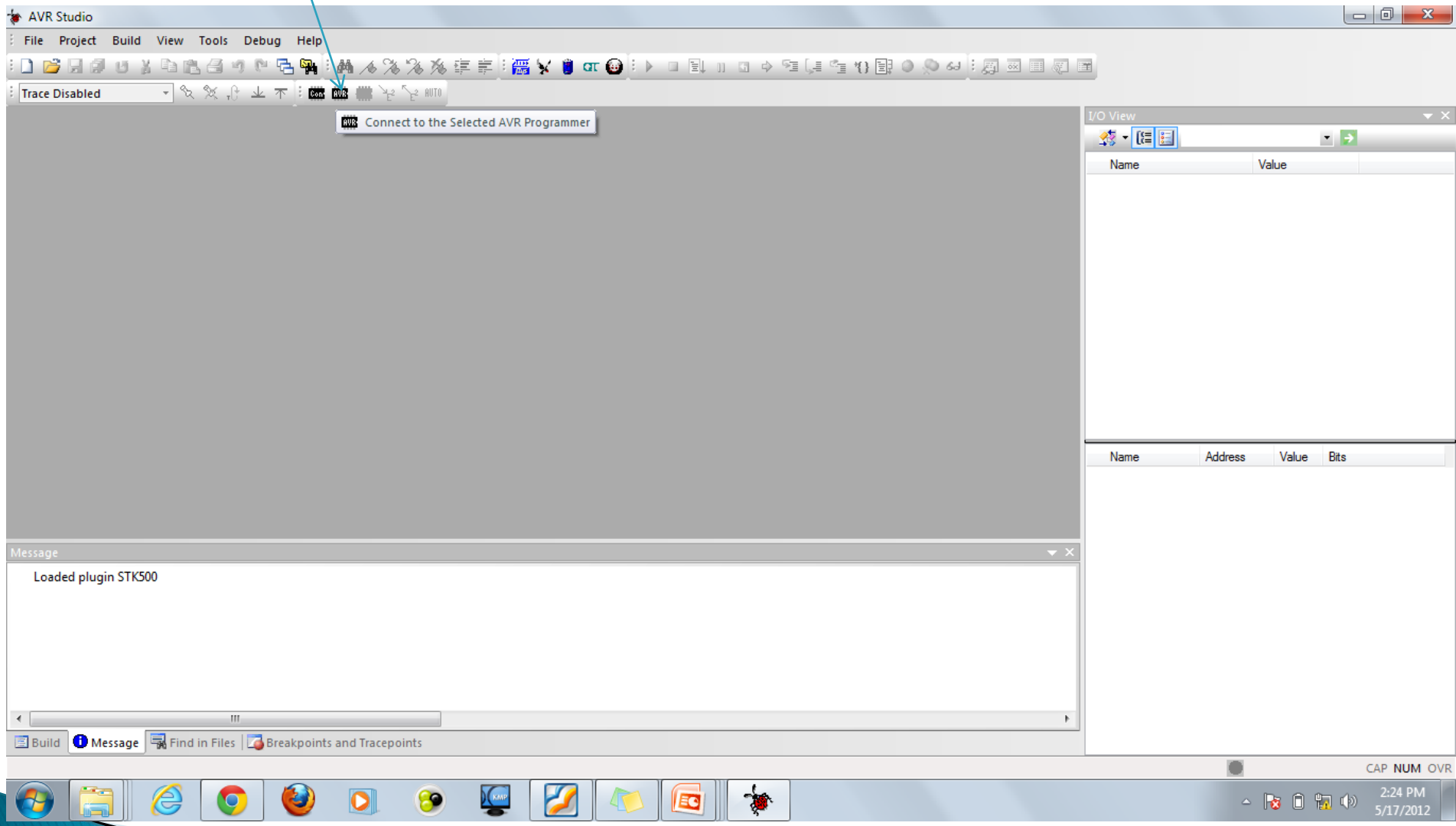
- It is a 8 bit register . It corresponds to the pin in same manner as that of DDR Register
- It is used to read voltage at a pin
- To be used only after the pin has been set as input by DDR register

Using Pin Register

- int a; // Define the variable a to store the value of voltage
- a=PINA.0; // read value at pin A.0 (make sure it is input)
- If (a==1) // if voltage is 5V {
- PORTA.1=1; // Light the LED
- }
- else
- {
- PORTA.1=0; // Turn off the LED
- }

AVR Studio4

Click on this icon



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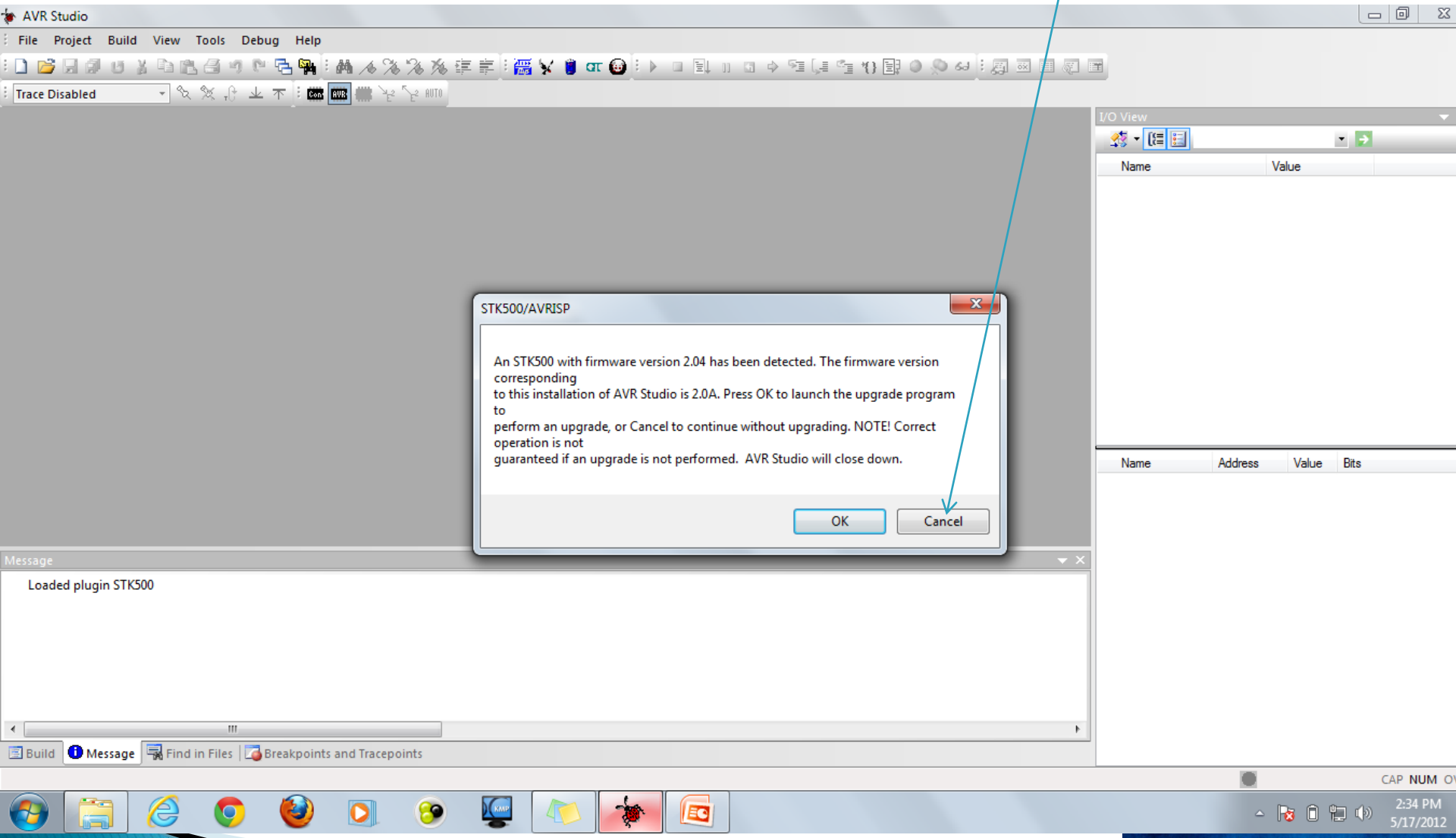
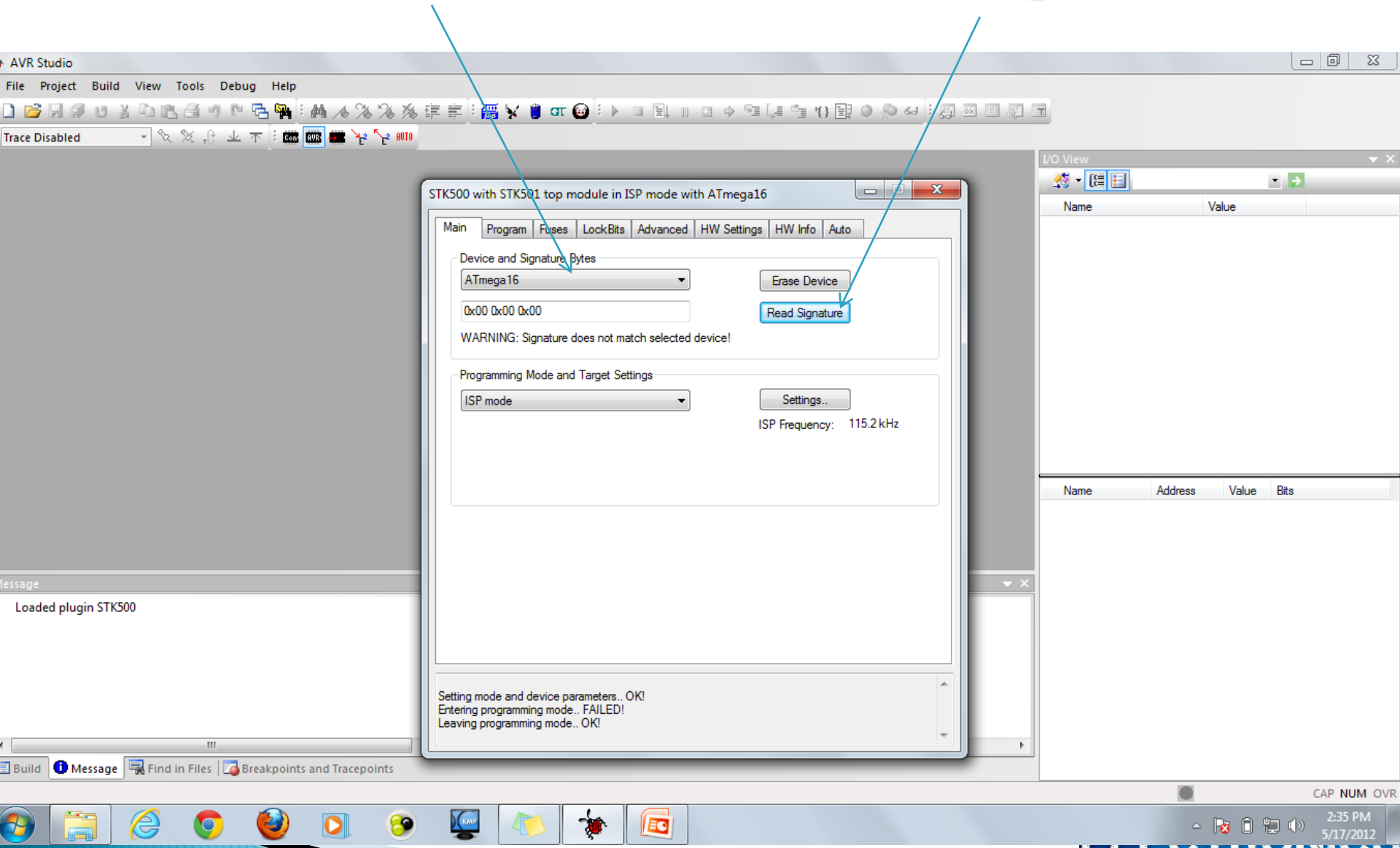
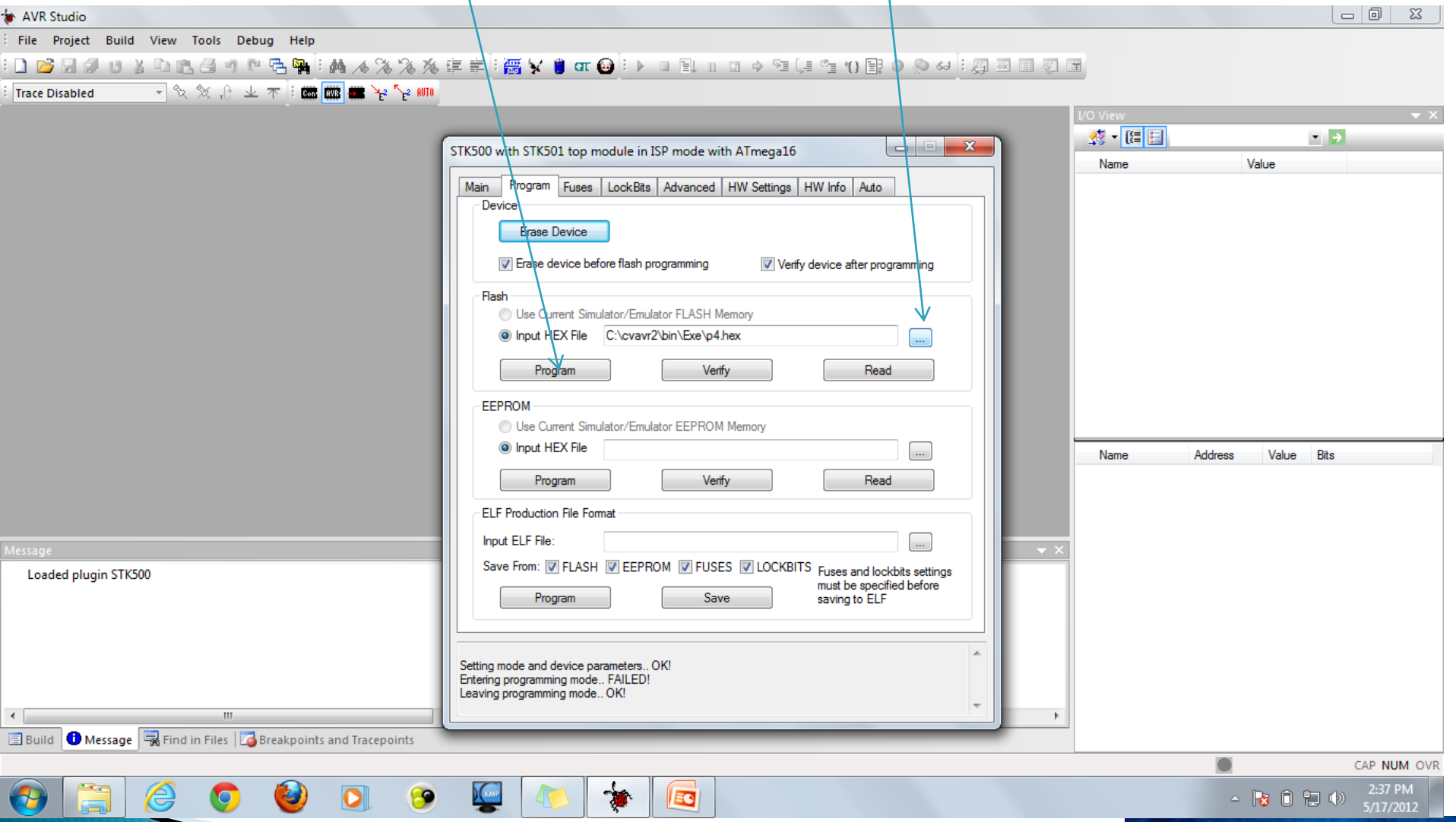
Click Cancel



Select Device and Read signature



Select Hex file and then click program



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Difference from Other

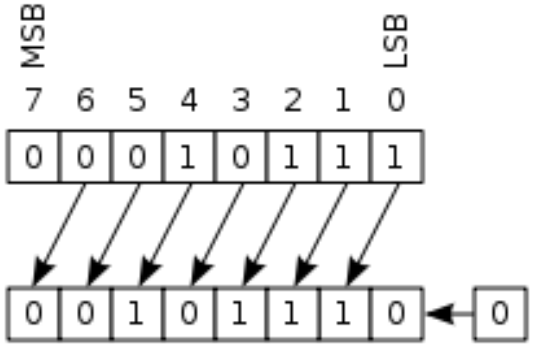
- You can’t write PORTA.1 in this
- User friendly
- Easy interface
- Can add external library

How to Access PortA.1

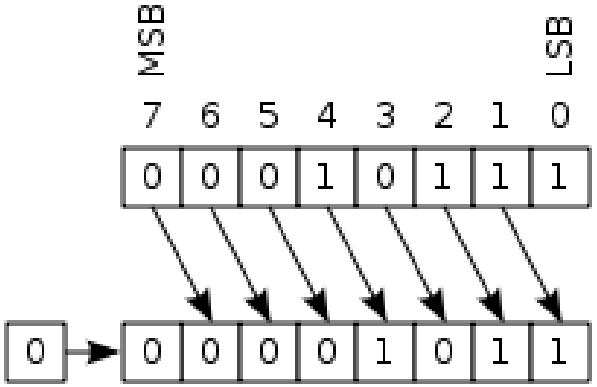
- Using simple bit wise C operation
- For PINA.1
- Value_PINA1=(PINA & 0b00000010)>>1
- For PORTA.1
- PORTA=PORTA | 0b00000010 // PORTA.1=1
- PORTA=PORTA & 0b11111101 // PORTA.1=0

How to Access PortA.x

- Left shit operator
- <<



- Right shift operator
- >>



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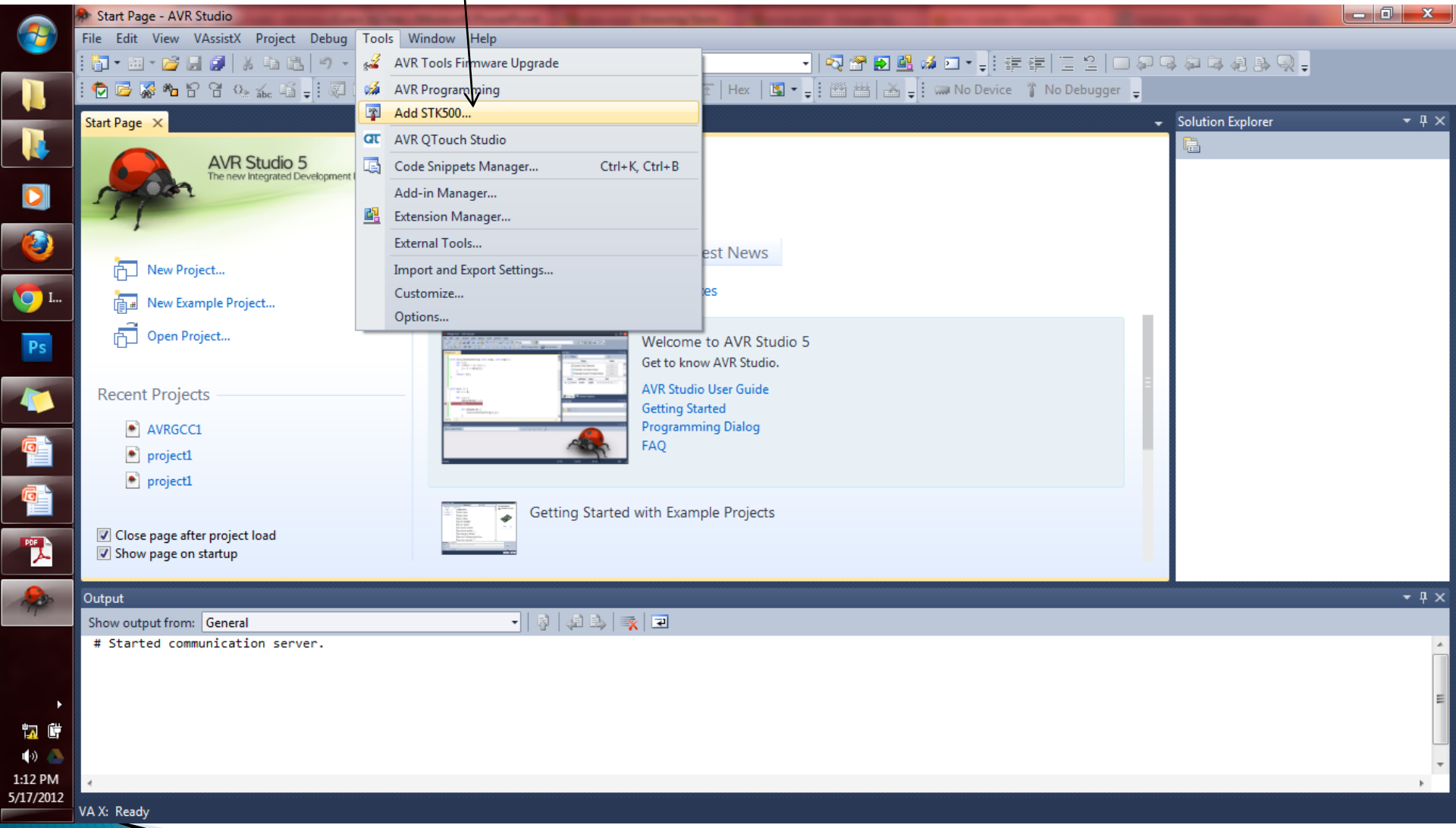
How to Access PortA.x

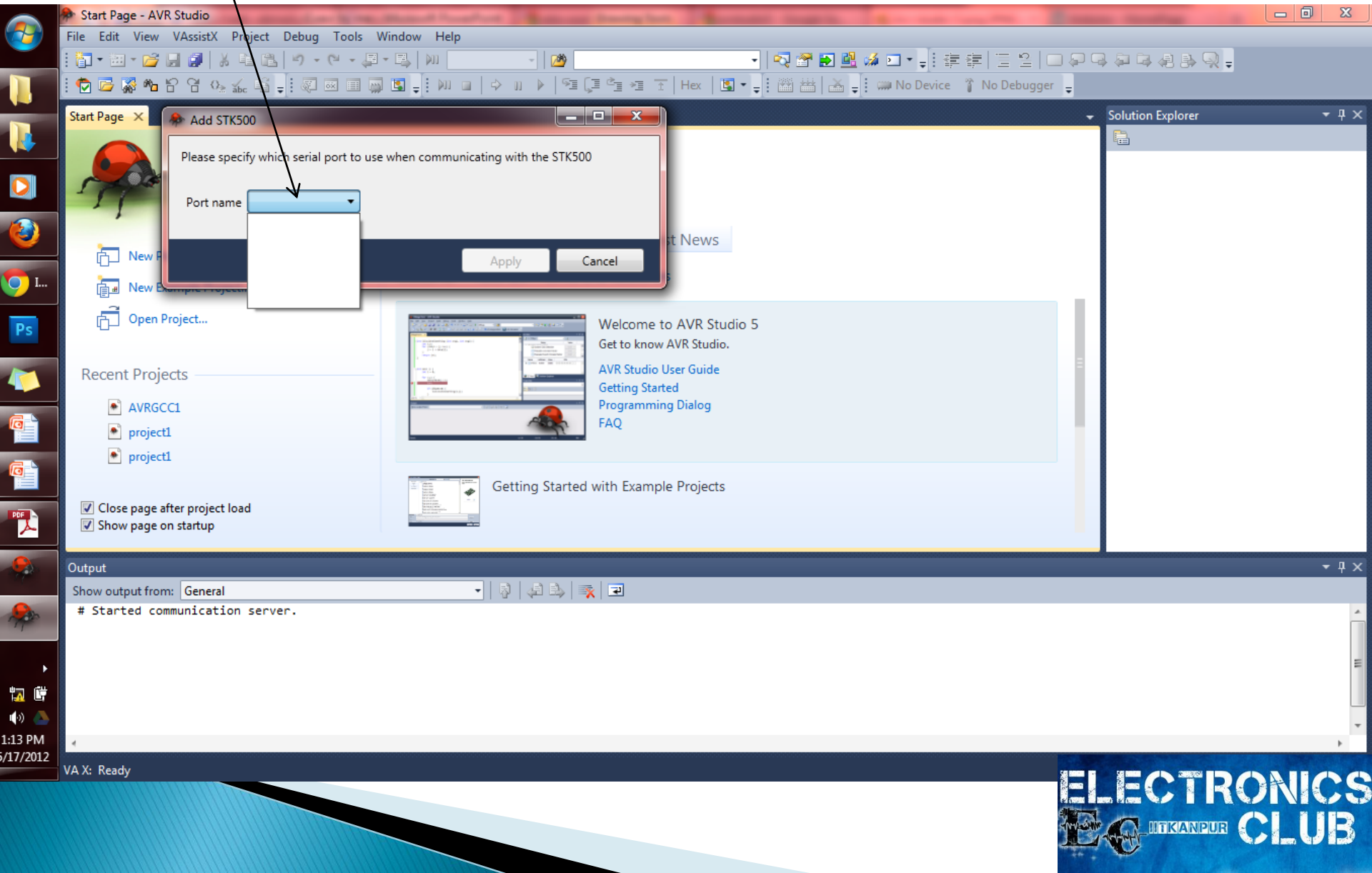
- For PINA.x
- Value_PINAx=(PINA & (1<<x))>>x
- For PORTA.1
- PORTA=PORTA | (1<<x) // to set PORTA.1=1
- PORTA=PORTA & (~(1<<x)) // set PORTA.1=0

Programming

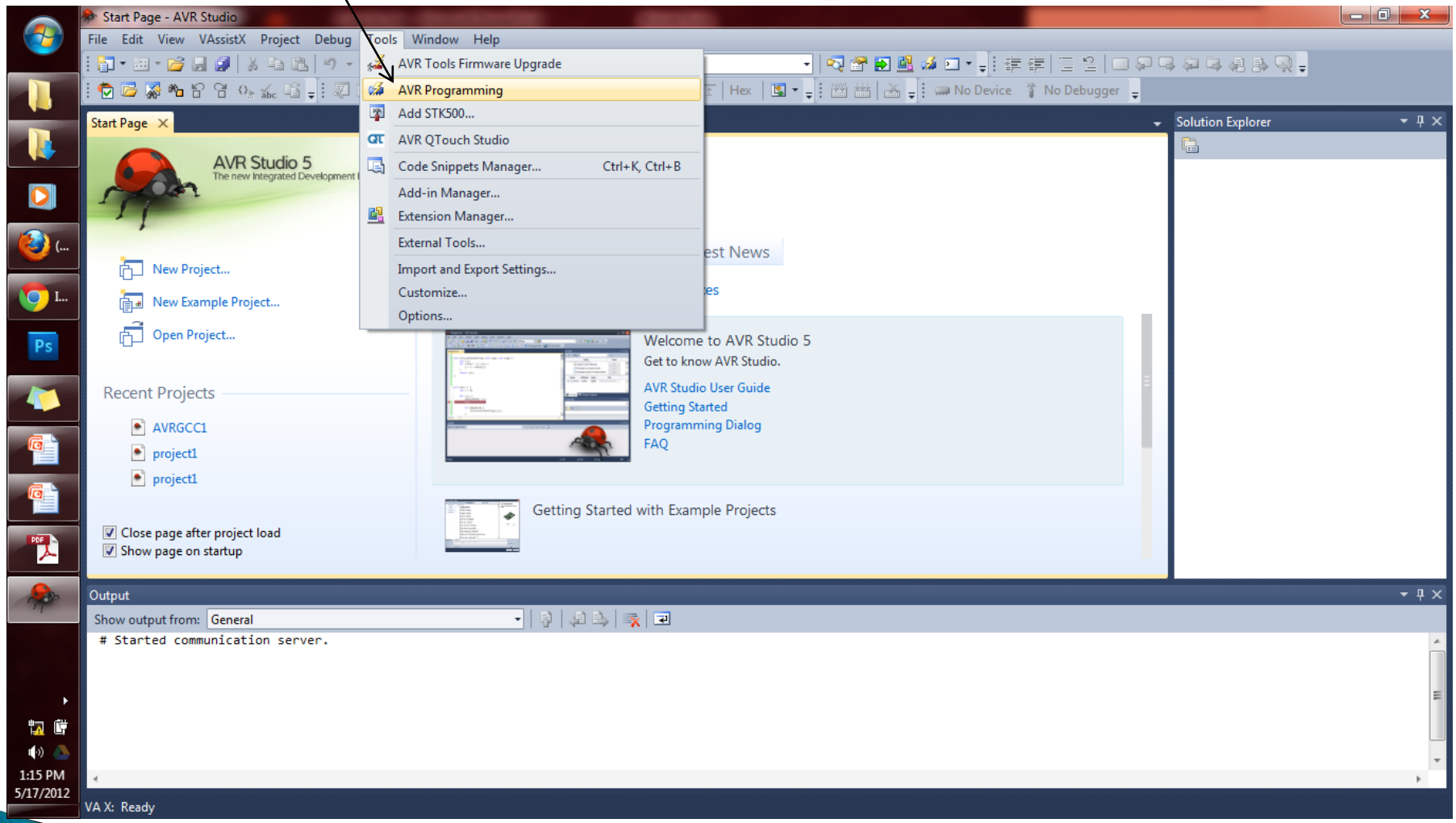
Add Stk500



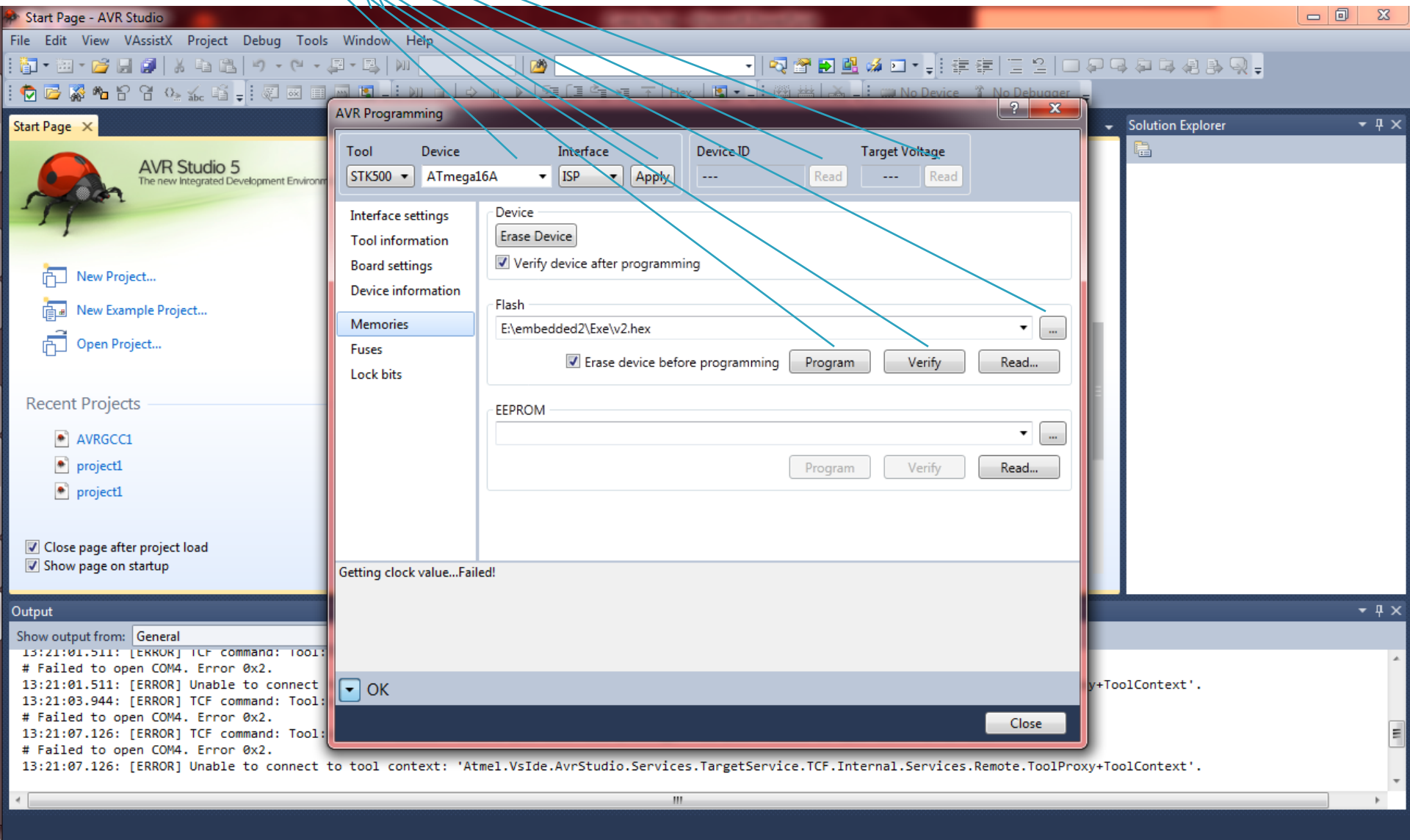
Select Com Port



Select AVR Programming



- Select Device→Click Apply→Read Device ID→Read target Voltage→Choose Hex File→Then Program



Thank you

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