Summer Camp ‘13

Introduction to Microcontrollers

Shivendu Bhushan

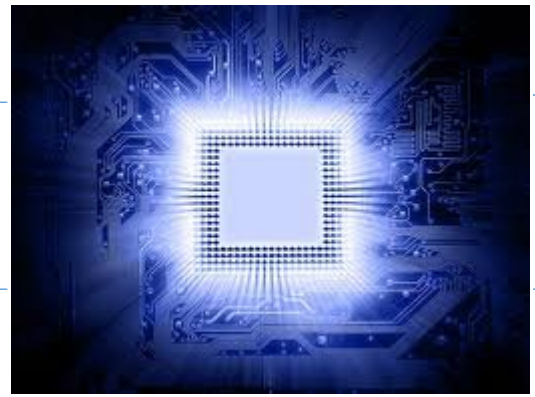
Embedded Systems

- Gadgets and devices
- Self controlled devices
- Contains I/O devices, storage devices and a central ‘controller’

Example: Music player

Output

Input



Controller

Output

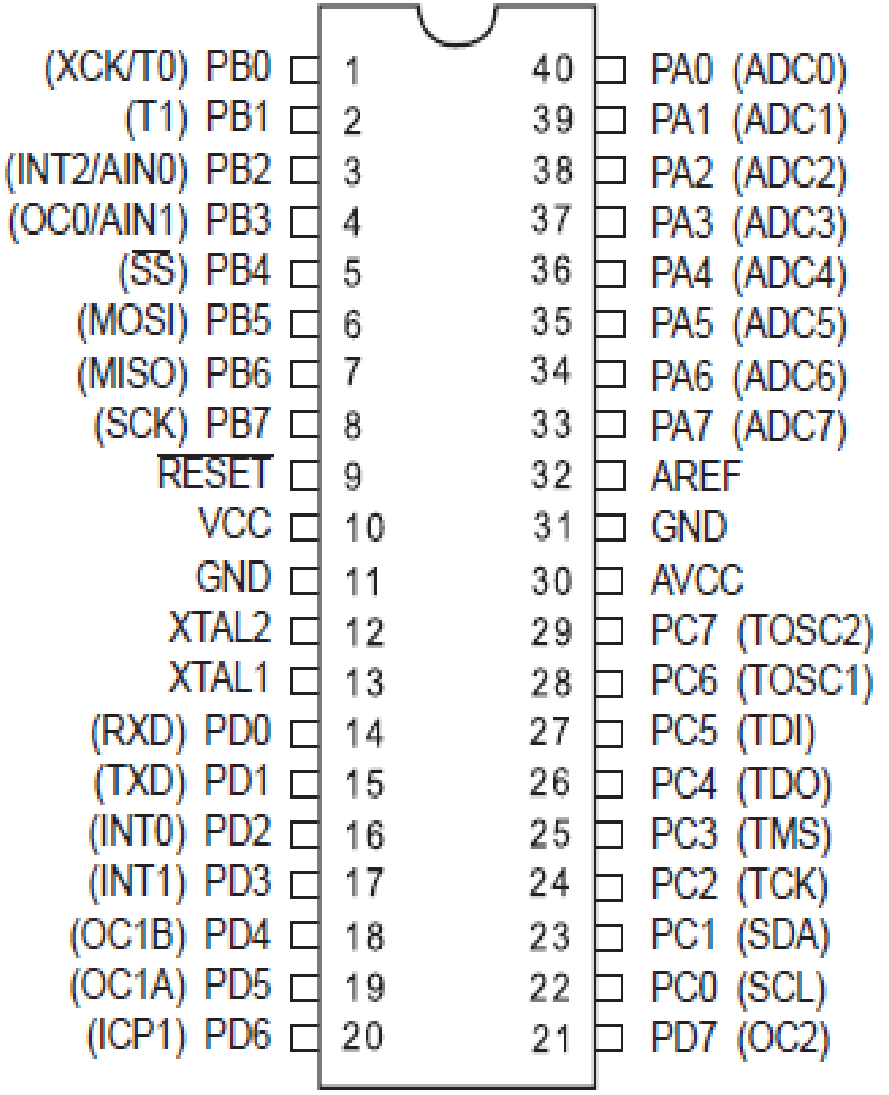
Storage Device

The Microcontrollers

- Why “micro”? Larger controllers are available too: processors that run computers.
- Out of several available vendors like Atmel, Intel, ARM, Cypress, etc. We will use Atmel ATmega microcontrollers.
- Like computers they execute programs.We will use C as the coding language.

Example: Atmega 16

- 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.



I/O Registers

- Input / Output is controlled through special variables called “**registers**”.
- Registers are actual hardware memory locations inside the µCs with predefined names and sizes.
- Assigning a value to these registers in the program changes the corresponding hardware configuration. And, these values can be altered multiple number of time at any point in the program.
- There are 3 registers that control the I/O pins: **DDR, PORT and PIN**.
- Each port has it’s own registers. Hence, **DDRA, PORTA, PINA** registers for port A; **DDRB, PORTB, PINB** for port B and likewise.

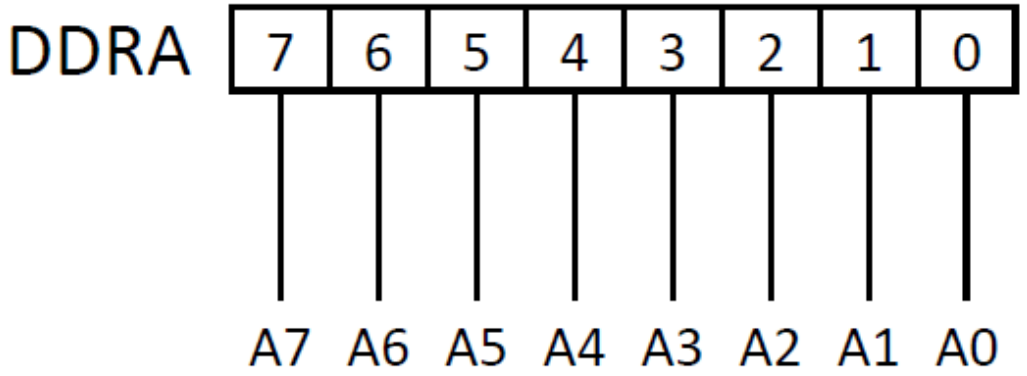
Registers

DDR(Data Direction Register)

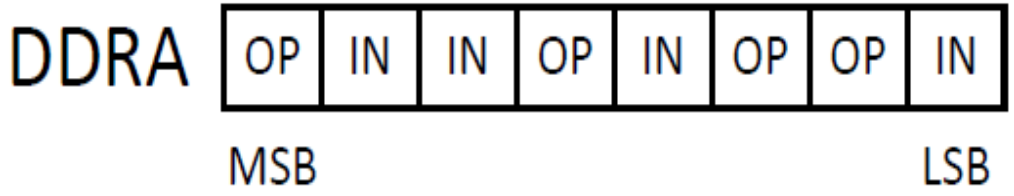
- Decides whether the pin is Input or Output.
- DDR is an 8 bit register. Each bit corresponds to a particular pin on the associated port.
- If a bit on the DDR register is 0, then the corresponding pin on the associated port is set as input.
- Similarly, if the bit is 1, then the pin is set as output.
- If a pin is configured as input, then it has some floating voltage unless an external voltage is applied.
- For an output pin, the voltage is fixed to a particular value.

Setting Register Values

- MSB of DDRA corresponds to the pin A7.



- If DDRA = 0b10010110, then:



PORT register

- PORT is also an 8 bit register. The bits on the PORT register correspond to the pins of the associated port in the same manner as in the case of the DDR register.
- PORT is used to set the **output** value.
- If the pin is set as **output**, then a PORT value of 1 will set voltage at that pin to 5V, and PORT value 0 sets the voltage to 0V.
- If the pin is configured as an **input,** PORT value serves the purpose of **pull up** or **pull down.**

PIN register

- PIN is a register whose value can be read, but cannot be changed inside the program.
- It gives the value of the actual voltage at a particular pin. 1, if the value at the required pinis 5V and 0 for 0V.

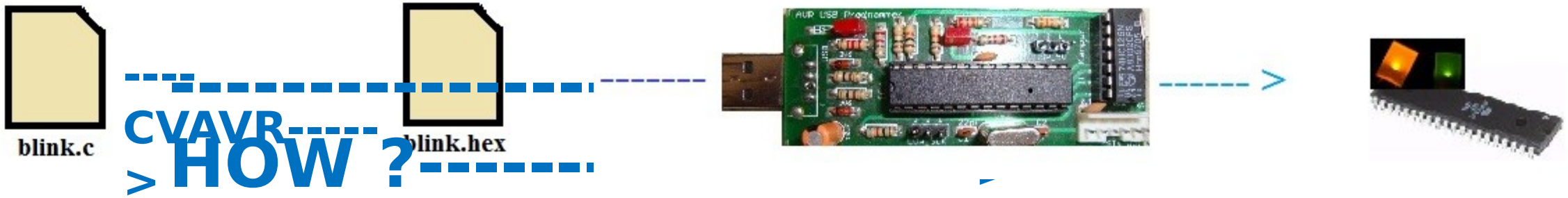
Summary

DDR = 0		DDR = 1	
PORT = 0	PORT = 1	PORT = 0	PORT = 1
Pin is input. If unconnected, **PIN** is 0.	Pin is input. If unconnected, **PIN** is 1.	Pin is output, value is 0. **PIN** is always equal to **PORT**	Pin is output, value is 5V. **PIN** is always equal to **PORT**

Applications(Takneek/Techkriti)

- Line Following Robots
- Wireless keyboard
- Wireless Gamepad
- Tachometer
- Music synthesizer
- Motion sensing games

How to program MCU ?



#Problem: What kind of files MCU can execute ?

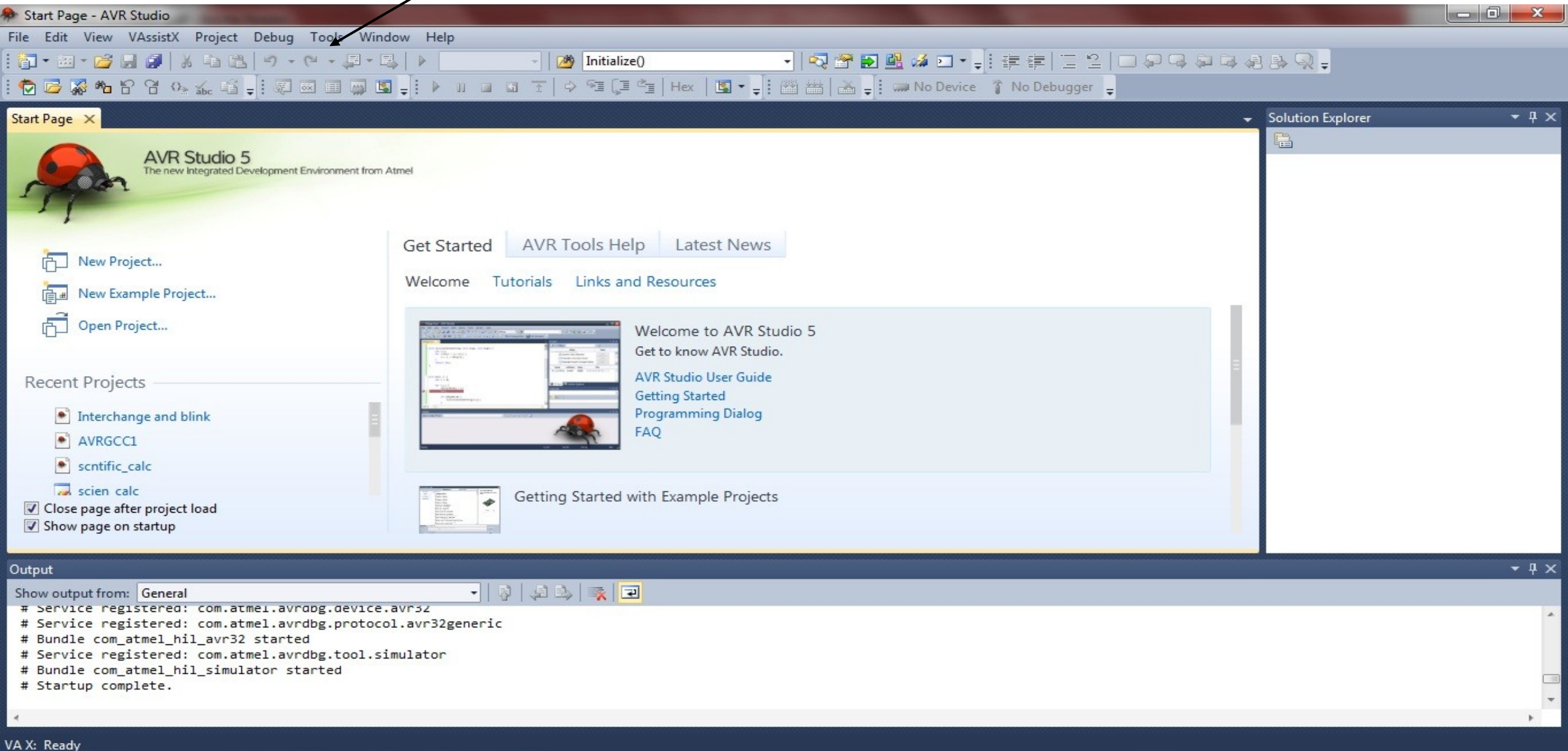
#Problem: How to transfer that file to MCU ?

Software needed:

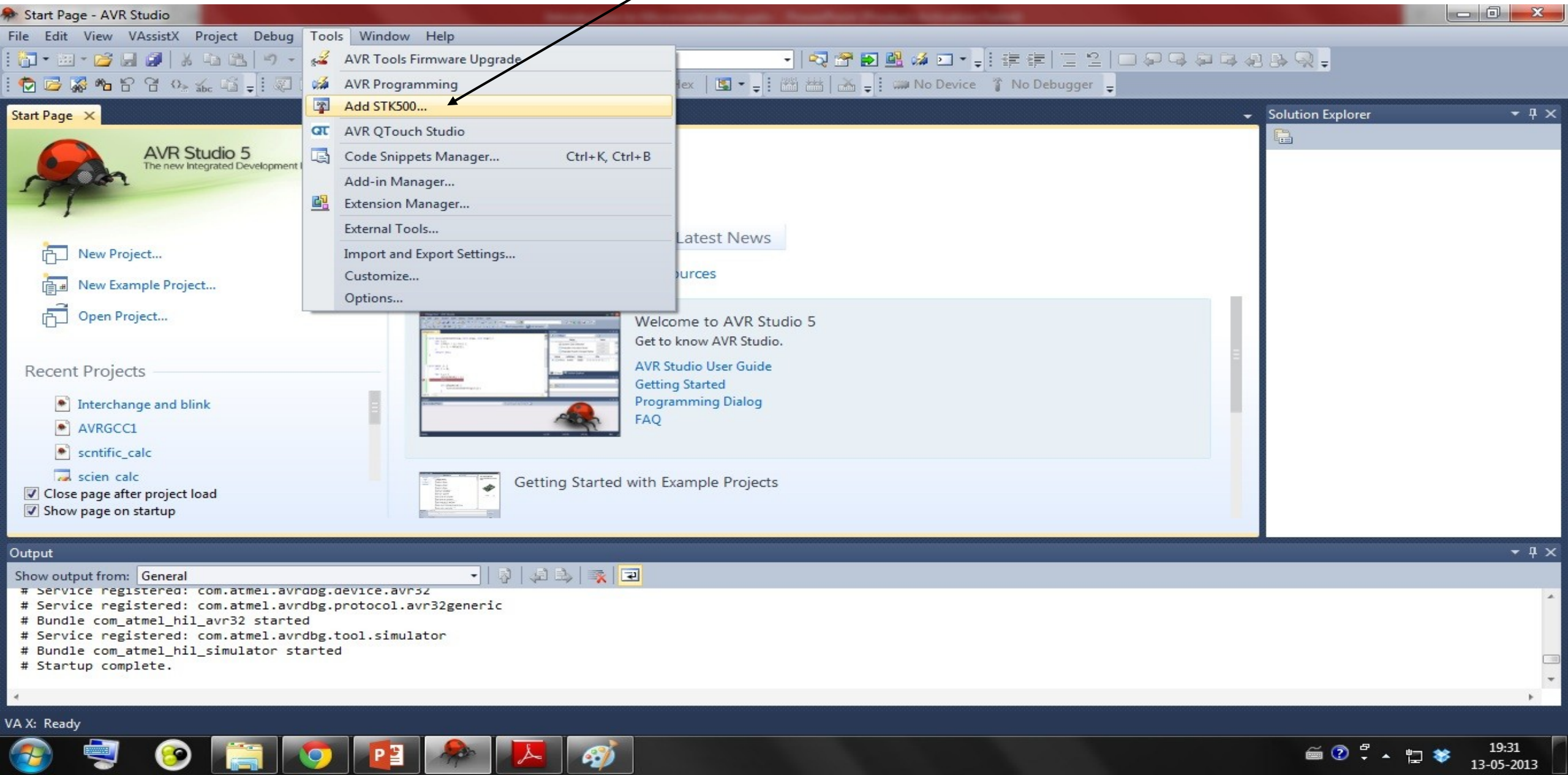
- **CVAVR**----> Editor and compiler
- **AVR Studio**---- > Transfer the code to Atmega
- **ISIS**--- > Circuit Simulator

AVR Studio

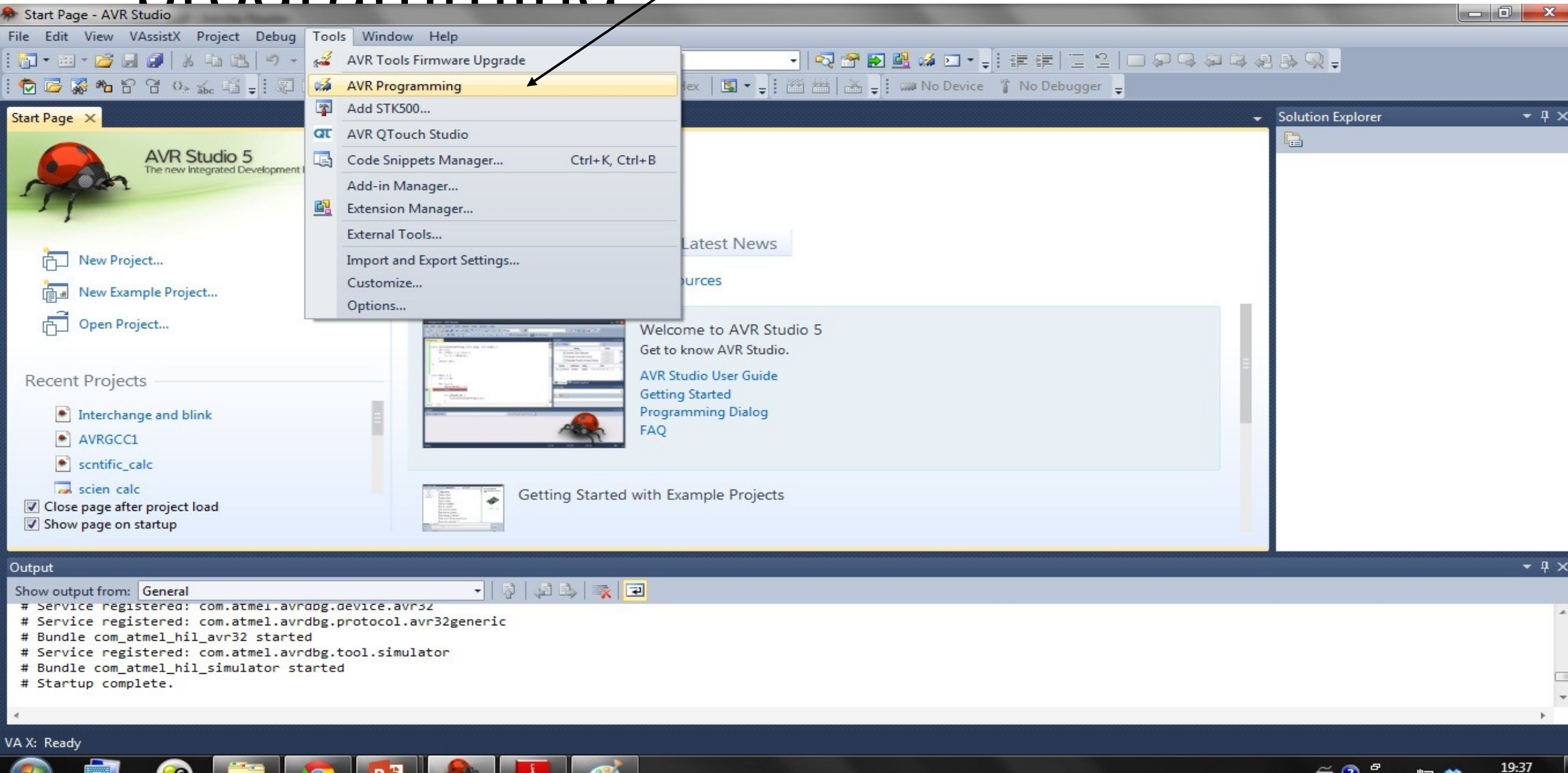
Select Tools



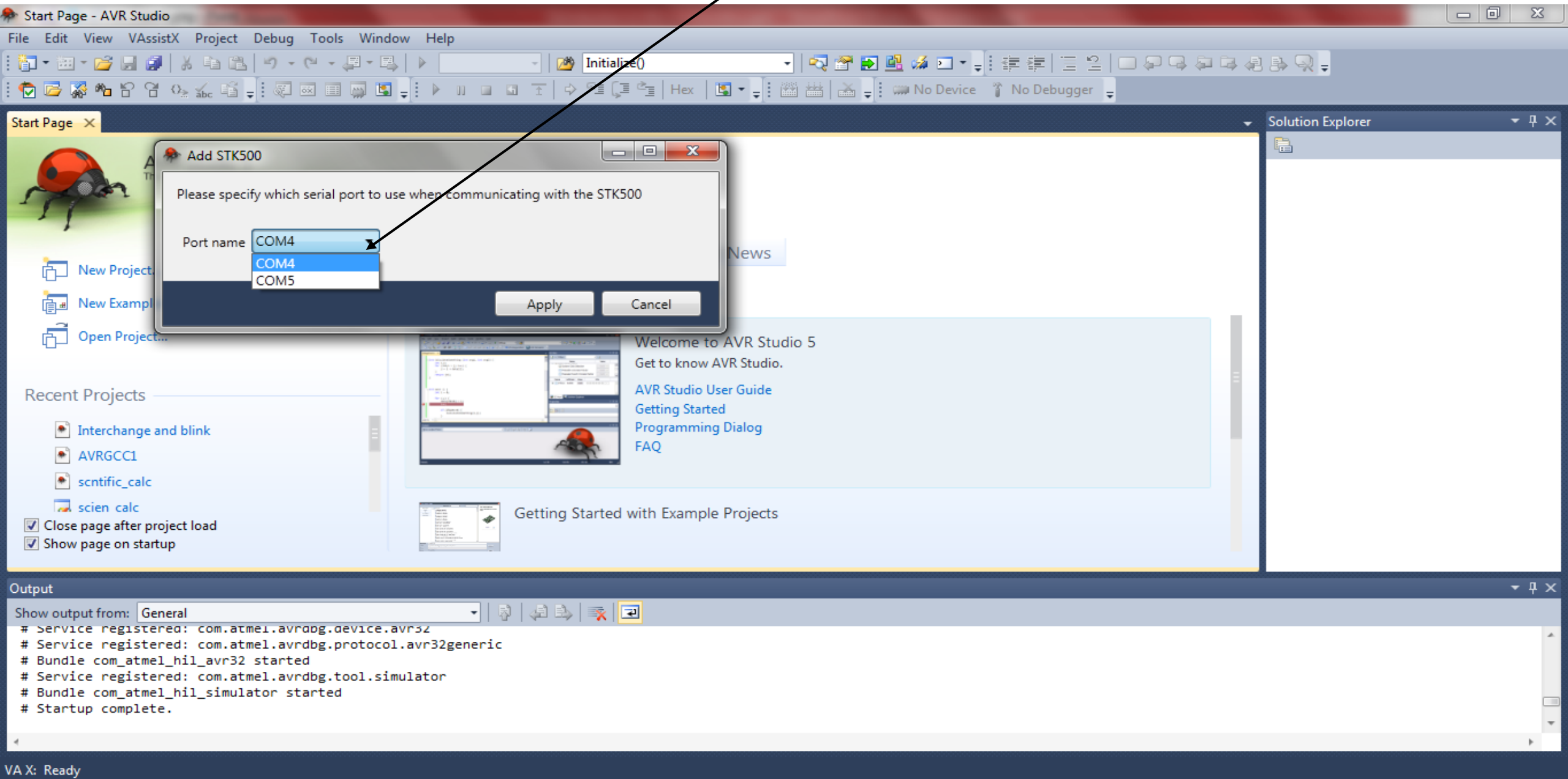
Select Add STK500



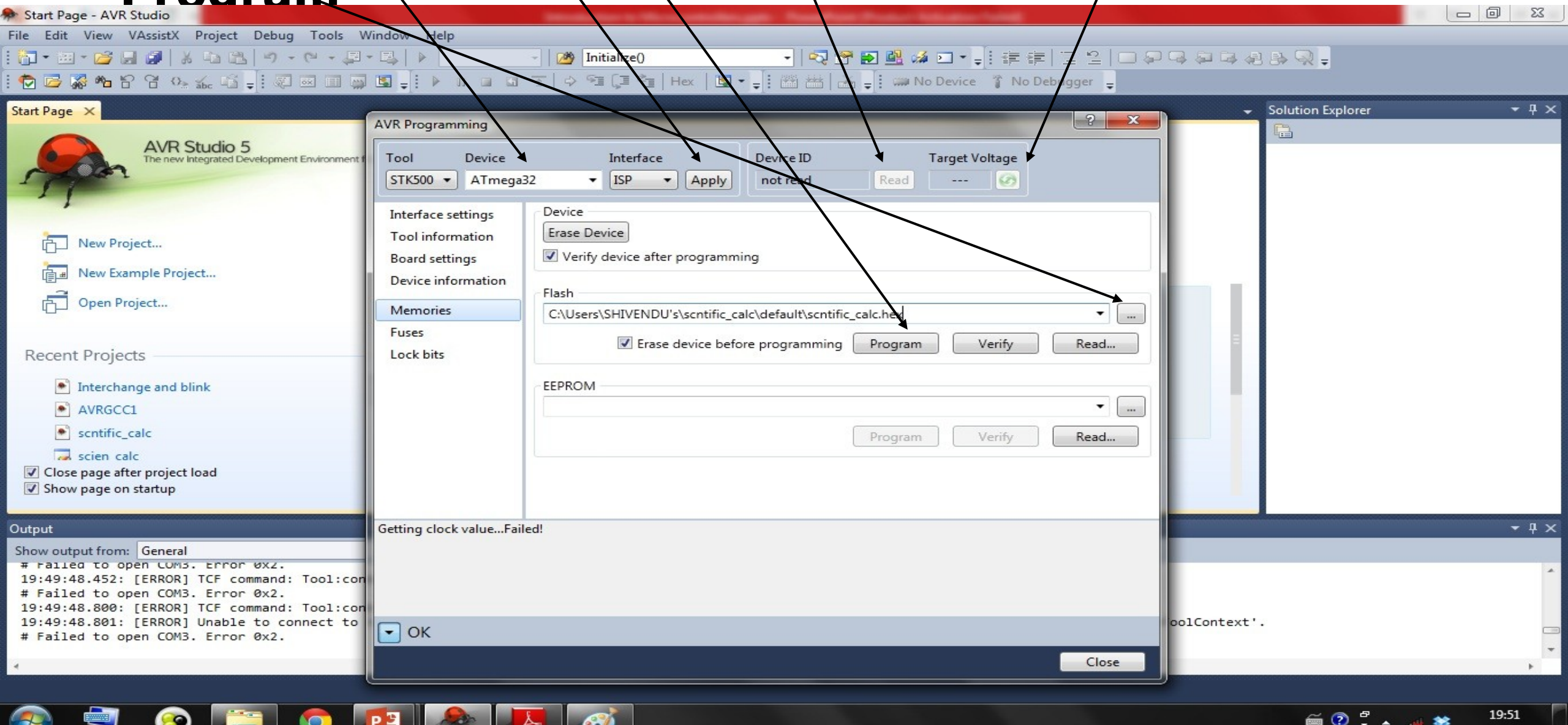
Select AVR programming



Select COM port



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



Thanks..!!