Getting Started with the Atmel Mega2560

Questions?

Solderless Breadboards

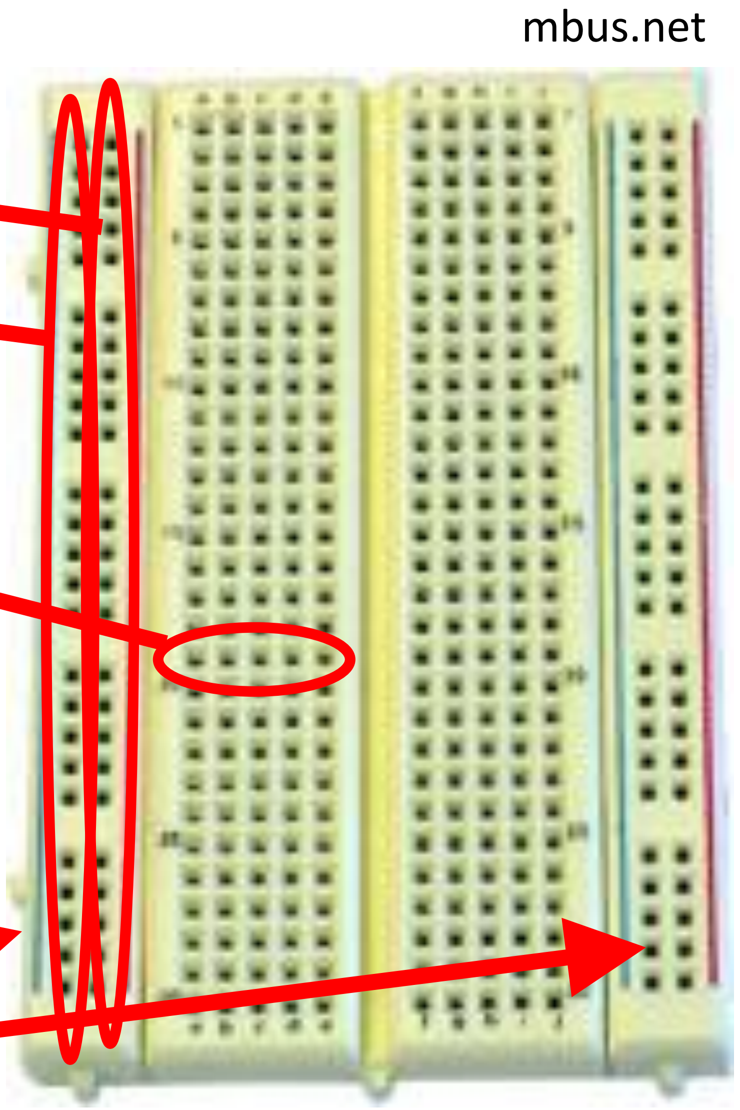
Power bus (red)

Ground bus

(blue)

Component bus

Note that the two sides are not connected



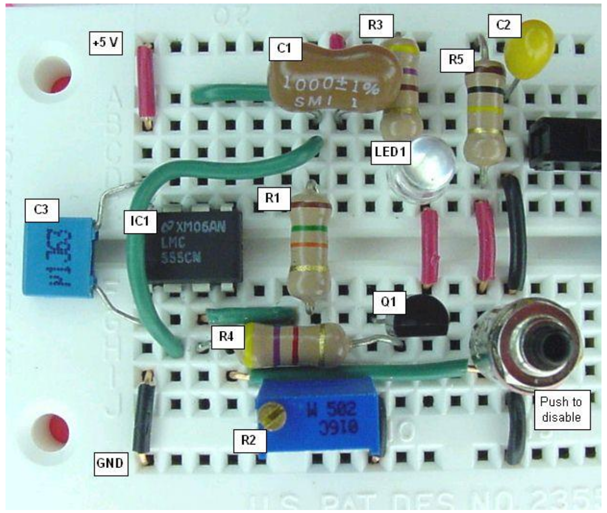
Wiring Standards

When possible, use wire colors for different types of signals:

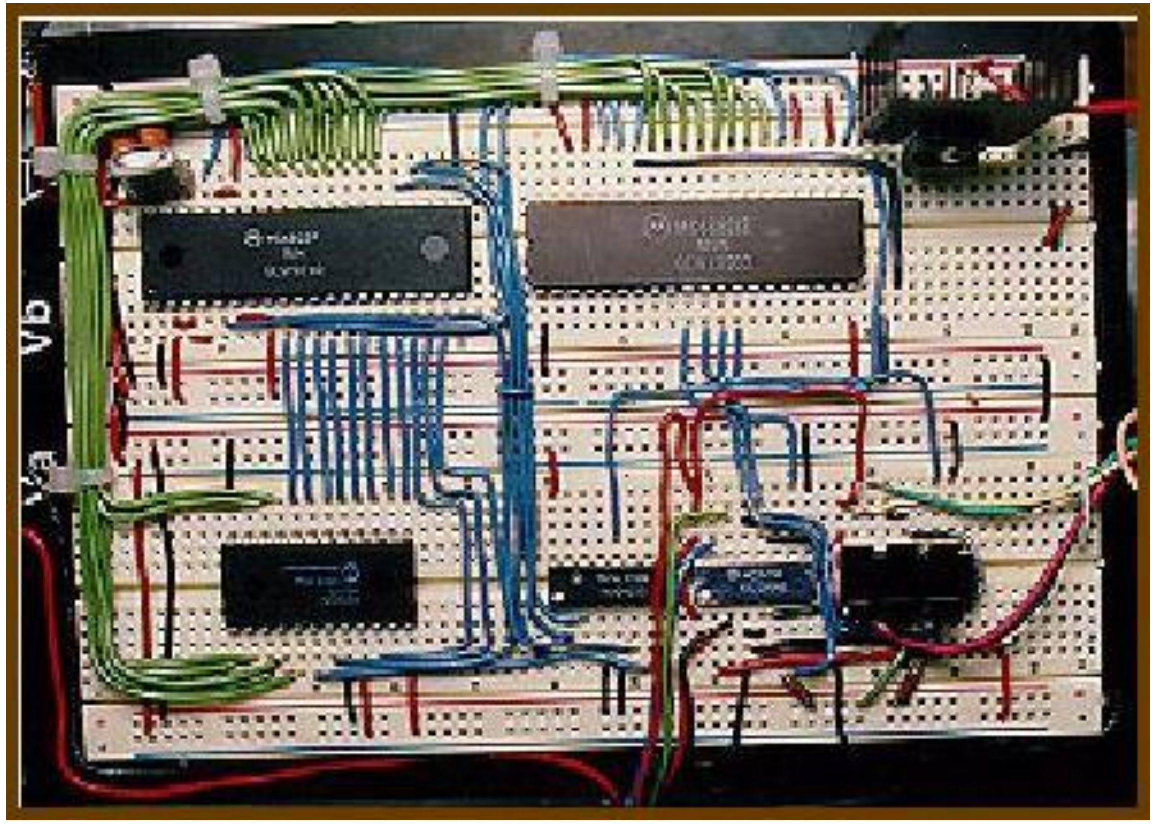
- Black: ground
- Red: power
- Other: various signals

Clean Wiring

A clean breadboard will make debugging easier – and it makes circuits more robust



www.linefollowing.com



tangentsoft.net

Care with Power

- Only insert components and wires into the breadboard when power is disconnected
- “Wire, check-twice, then power”
  - Never reverse power and ground (this is a very common mistake)
- Most chips that we will use expect +5V
  - More can destroy the chips
  - We will use DC/DC converters to step battery voltages down to +5V

Suggested Wiring Procedure

- Power supply
- Power/ground buses
- Insert primary components
- Wire power/ground for components
- Add signals and remaining components
- Test incrementally

Debugging Techniques

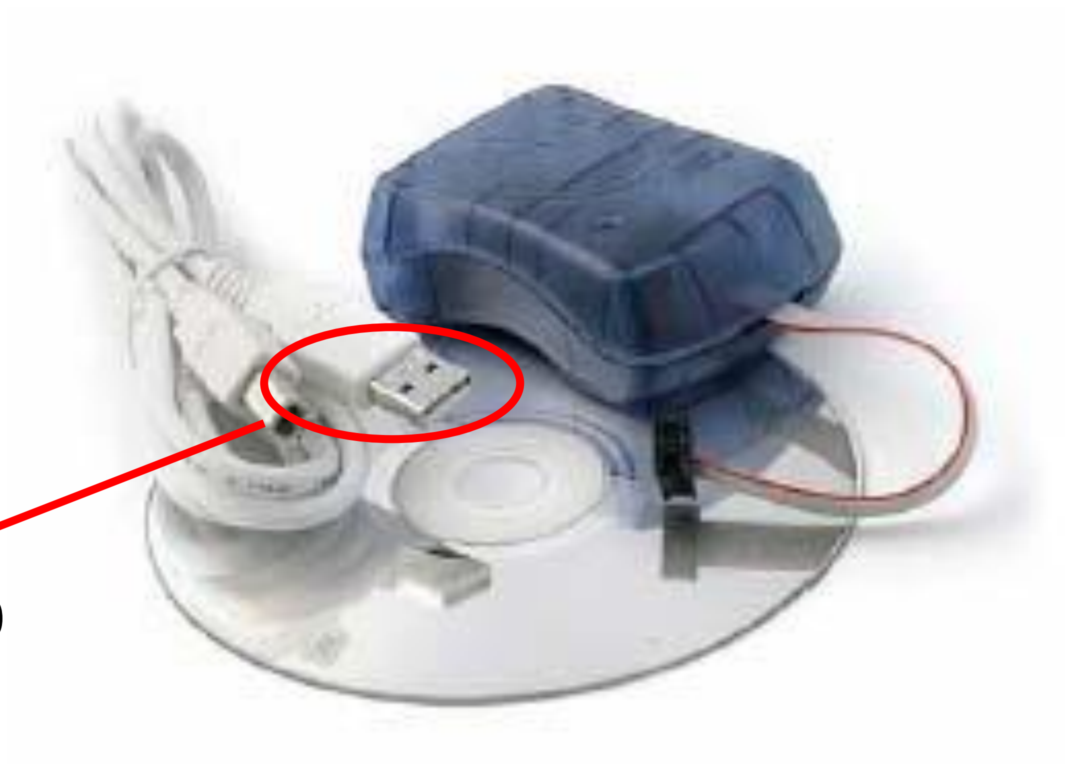
- Test incrementally
- Test intermediate sub-circuits

Physical Interface for Programming

AVR ISP

Physical Interface for Programming

AVR ISP



USB connection to your laptop

Physical Interface for Programming

AVR ISP

Header connection will connect to your circuit (through an adapter)

Be careful when you plug your circuit in (check before powering)

AVR ISPs are Cranky

- When things are plugged in and powered, you should see two green LEDs on the ISP (on most units)
- One red: usually means that your circuit is not powered
- Flashing orange: connector is backwards!
- Orange: the programmer is confused
    - Could be due to your circuit not being powered at 5V
    - Could be due to other problems
    - Check power and reboot the ISP

Compiling and Downloading Code

Once the chip is programmed, the AVR ISP will automatically reset the processor; starting your program

Hints

- Use LEDs to show status information (e.g., to indicate what part of your code is being executed)
- Remember: on the Arduino boards, there is a LED connected to port B, pin 7
- Have one LED blink in some unique way at the beginning of your program
- Go slow:
  - Implement and test incrementally
  - Insert plenty of pauses into your code (e.g., with delay_ms())

Project 0

- Summary:
  - Write program that flashes the LED attached to PORTB, pin 7 at a chosen (visible) frequency.
  - Connect 4 LEDs and a switch to your Arduino board
  - Write a program that: waits for the switch to close, then displays an interesting LED flashing pattern
- Details are on the class web page

Compiling and Downloading

Preparation:

- Create a class folder to work in: e.g., “ame3623”
- Check out your group’s svn tree into this folder:
  - http://www.cs.ou.edu/~fagg/classes/ame3623/svn.html

Compiling and Downloading

Preparation (unix only):

- You will work in: csesX/project0/project0/
- Makefile:
  - Copy csesX/makefile to project0/project0
  - No changes need to be made now, but the key lines are:
    - “TARGET” line is the name of the C file with the main function. Here, we have chosen “main”
    - “OULIB_DIR” references csesX/oulib/. In this example, it should be “../../oulib/”
- Create your C file in project0/project0/main.c
  - Most of you are using XCode for this

Compiling and Downloading (the Unix way)

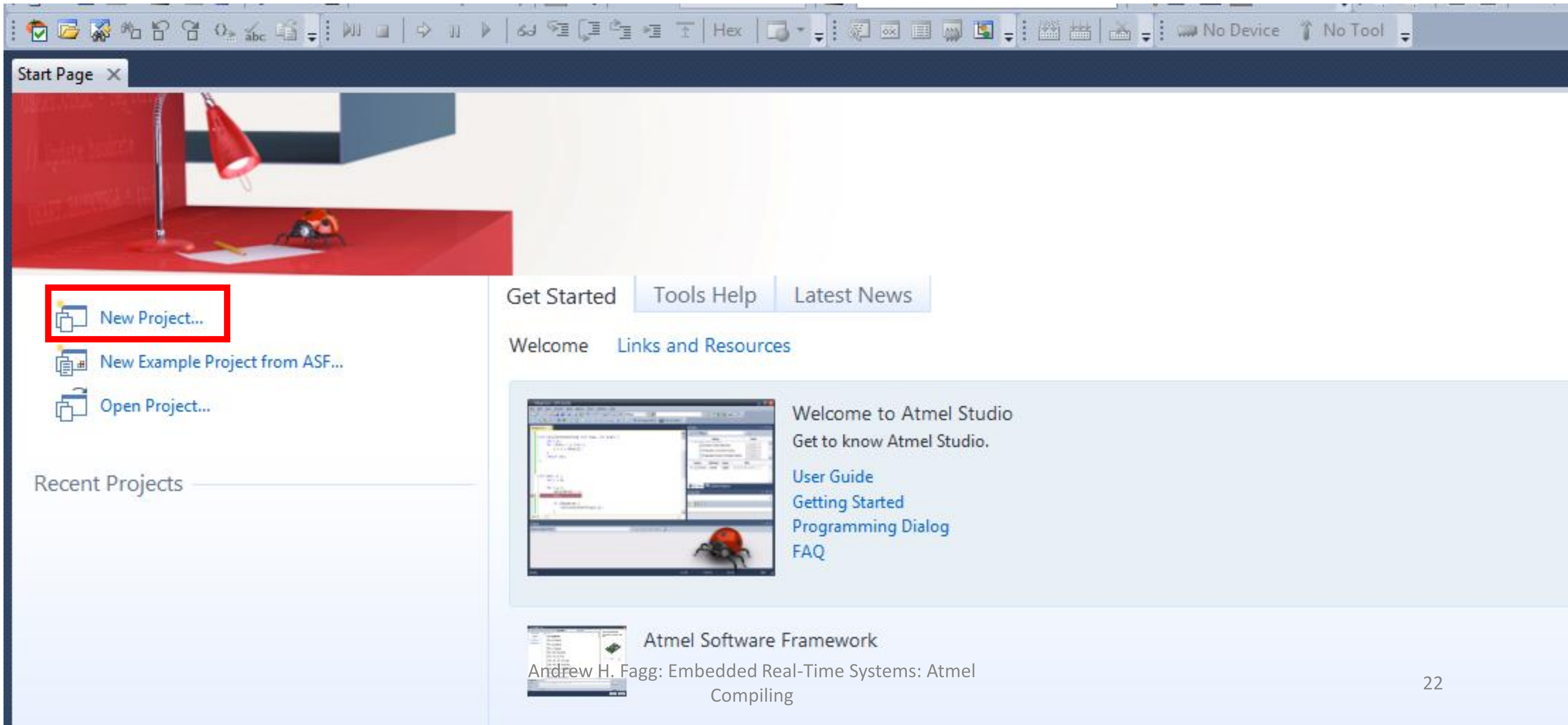
At the command line:

- “cd” to project0/project0/

- Type “make”
    - You should see no errors
    - If there are errors, then you must fix them before moving on

- Type “make program”
    - This will download your code to the processor
    - Again, you should see no errors

Windows: Getting Started

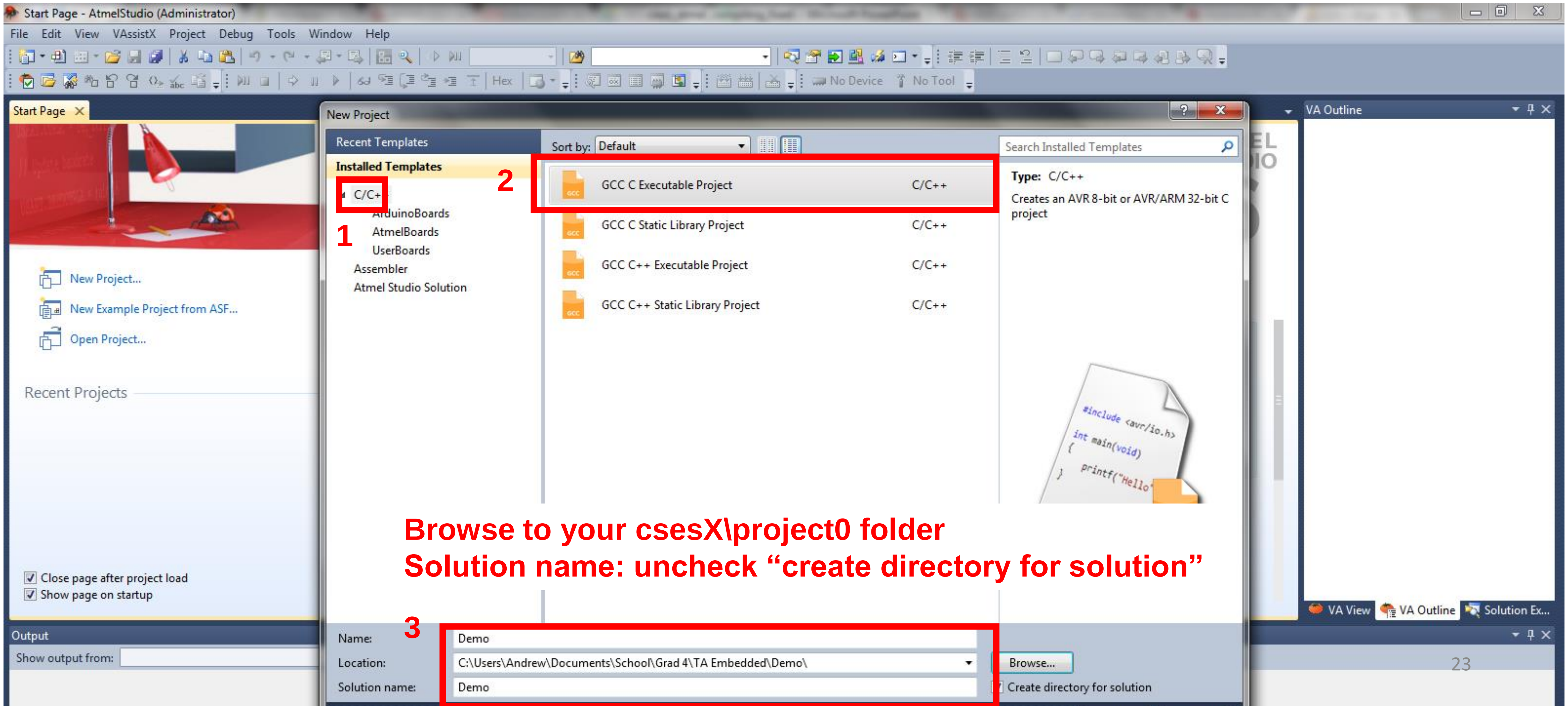


Welcome to Atmel Studio

Get to know Atmel Studio.

Atmel Software Framework

New Project



GCC C Executable Project	C/C++
GCC C Static Library Project	C/C++
GCC C++ Executable Project	C/C++
GCC C++ Static Library Project	C/C++

Type: C/C++

Creates an AVR 8-bit or AVR/ARM 32-bit C project

```
#include <avr/io.h>
int main(void)
{
    printf("Hello
}
```

Name: Demo

Location: C:\Users\Andrew\Documents\School\Grad 4\TA Embedded\Demo\

Browse...

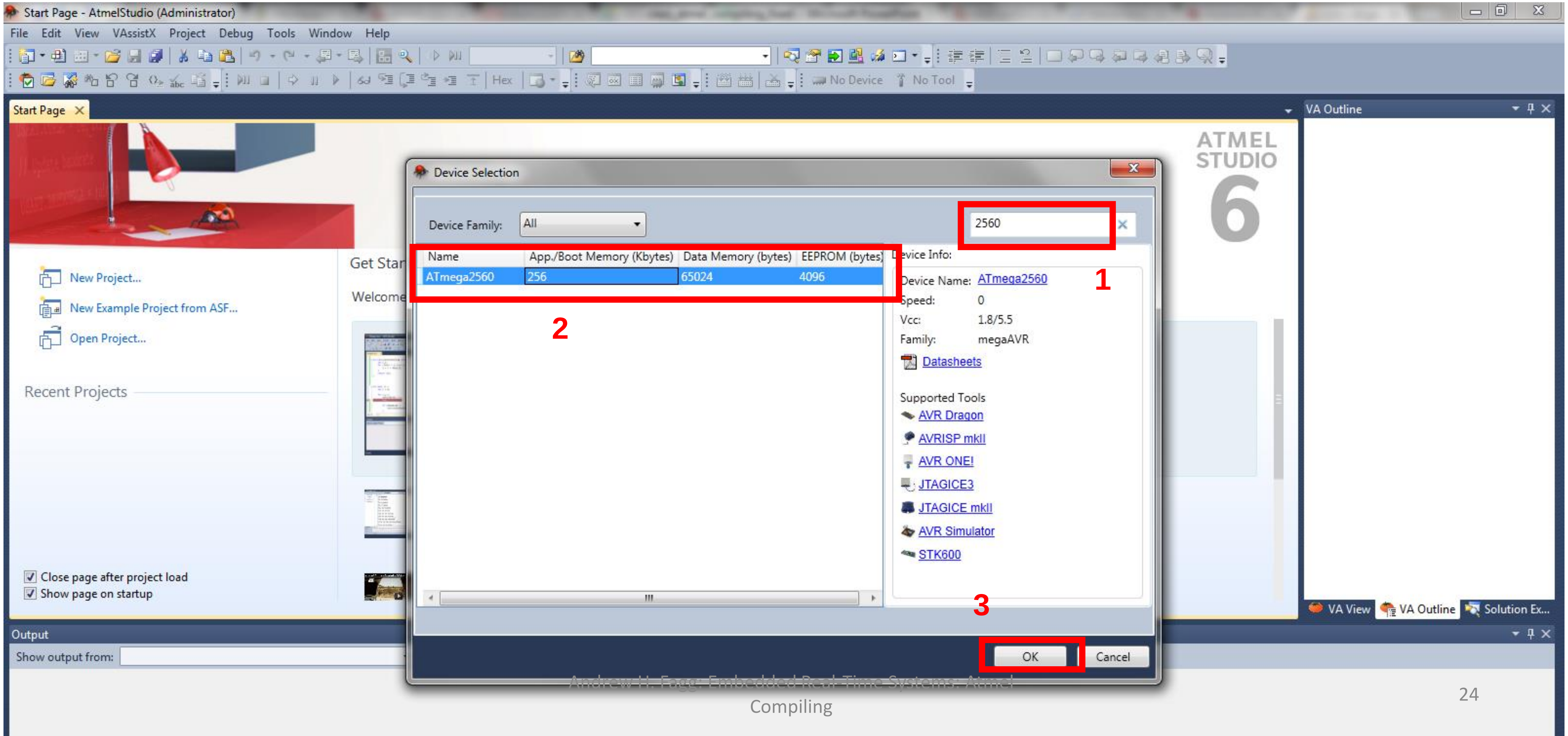
Solution name: Demo

Create directory for solution

Browse to your csesX\project0 folder

Solution name: uncheck "create directory for solution"

Select the ATmega2560



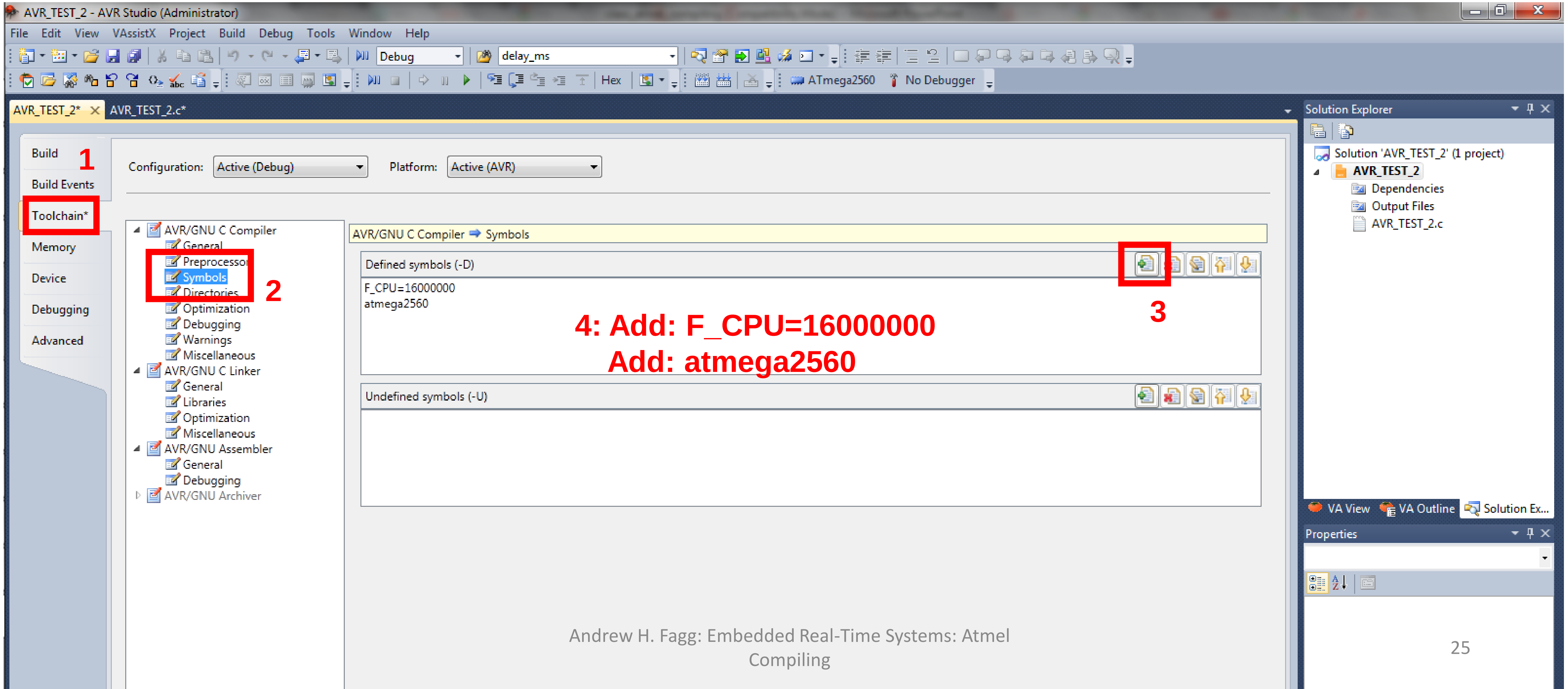
Name	App./Boot Memory (Kbytes)	Data Memory (bytes)	EEPROM (bytes)
ATmega2560	256	65024	4096

Device Info:

Device Name: ATmega2560
Speed: 0
Vcc: 1.8/5.5
Family: megaAVR
Datasheets

Supported Tools
AVR Dragon
AVRISP mkII
AVR ONE!
JTAGICE3
JTAGICE mkII
AVR Simulator
STK600

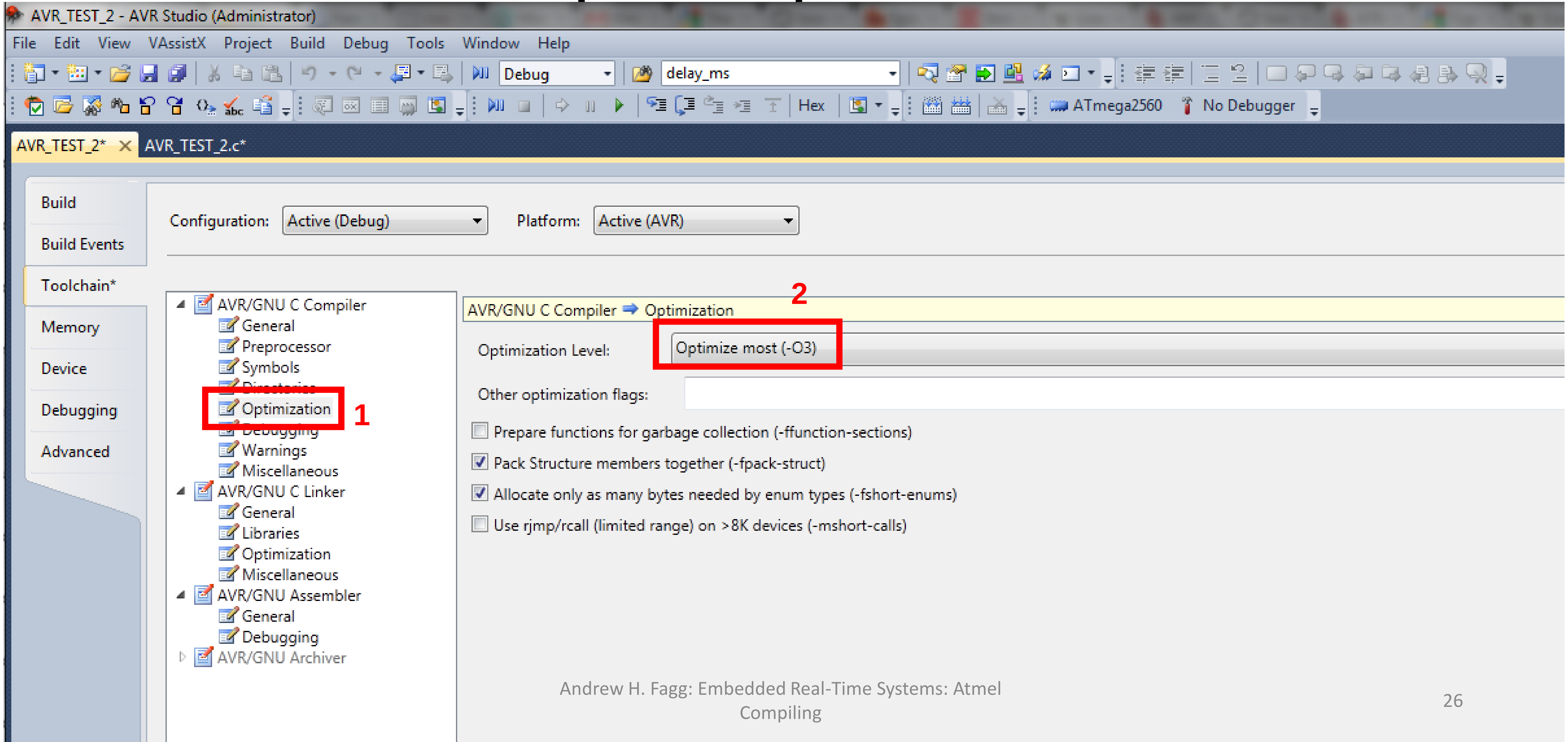
Project➔ <Project Name> Properties (Alt+F7)



```
F_CPU=16000000
atmega2560
```

4: Add: F_CPU=16000000
Add: atmega2560

Compiler Optimization



Configuration: Active (Debug)   Platform: Active (AVR)

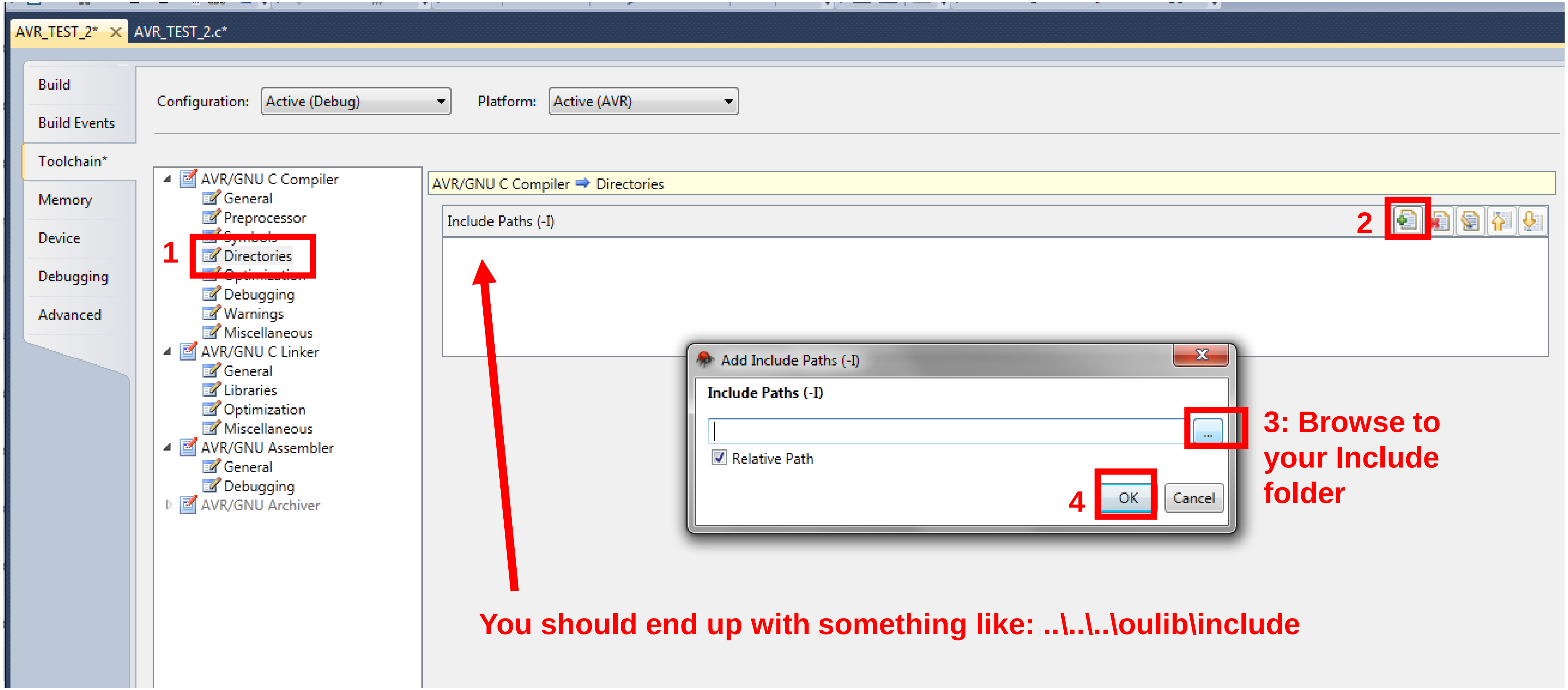
AVR/GNU C Compiler ➡ Optimization

Optimization Level: Optimize most (-O3)

Other optimization flags:

- [ ] Prepare functions for garbage collection (-ffunction-sections)
- [✓] Pack Structure members together (-fpack-struct)
- [✓] Allocate only as many bytes needed by enum types (-fshort-enums)
- [ ] Use rjmp/rcall (limited range) on >8K devices (-mshort-calls)

Add Directories



AVR_TEST_2* AVR_TEST_2.c*

Configuration: Active (Debug) Platform: Active (AVR)

AVR/GNU C Compiler ➡ Directories

Include Paths (-I)

Add Include Paths (-I)

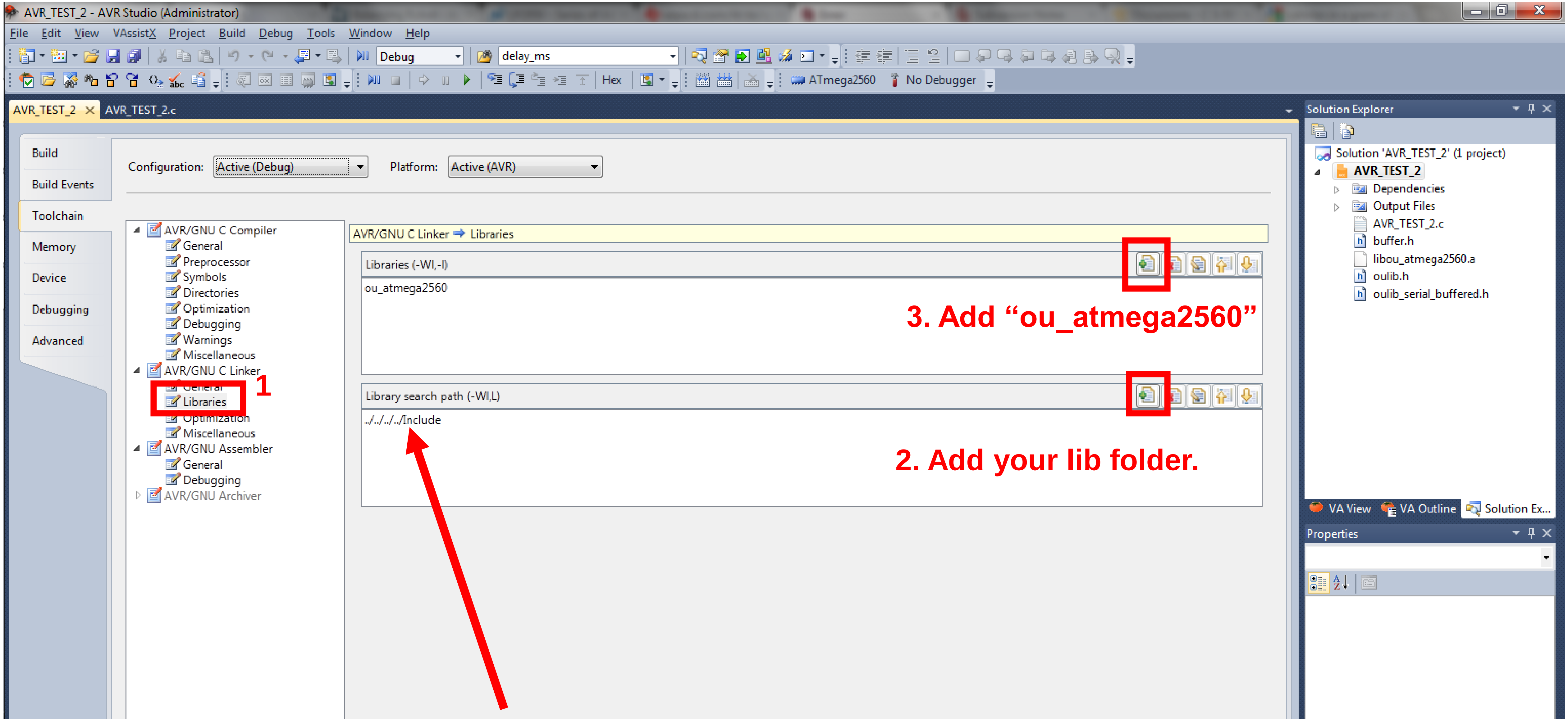
Include Paths (-I)

☑ Relative Path

3: Browse to your Include folder

You should end up with something like: ..\..\..\oulib\include

Add Libraries



Configuration: Active (Debug) Platform: Active (AVR)

AVR/GNU C Linker ➡ Libraries

Libraries (-Wl,-l)

ou_atmega2560

Library search path (-Wl,L)

../../../../Include

1

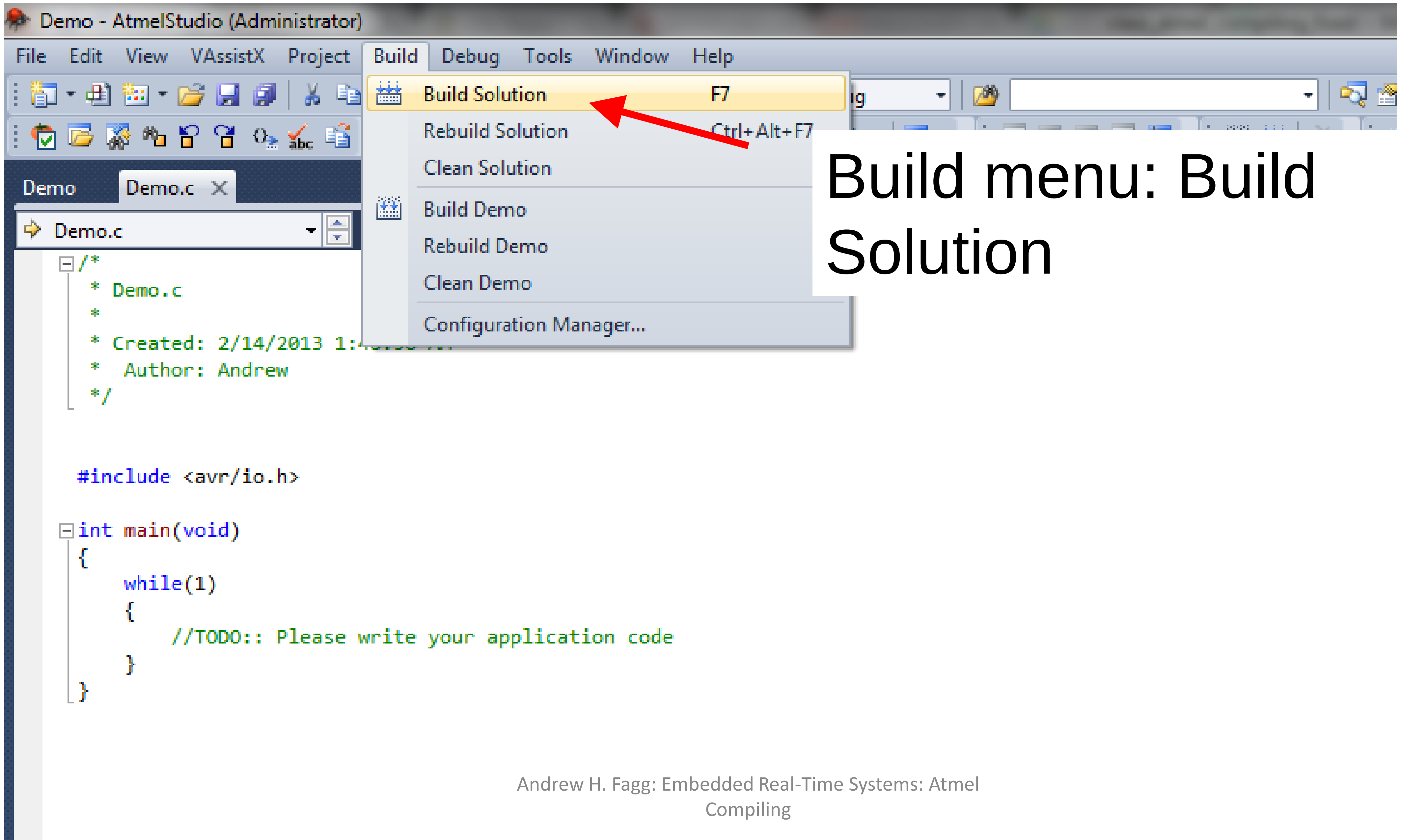
2. Add your lib folder.

3. Add “ou_atmega2560”

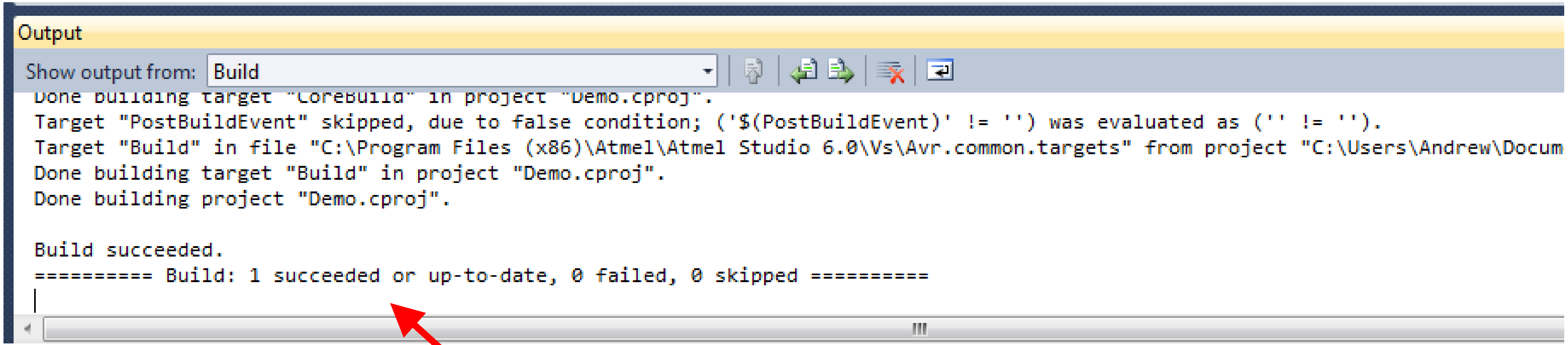
Now for the code…

```
#include "oulib.h"

int main(void)
{
  DDRB = 0x80;       // port B, pin 7

  while(1) {
     // Your code here
  }
}
```

Build menu: Build Solution


Demo - AtmelStudio (Administrator)
File Edit View VAssistX Project Build Debug Tools Window Help
Build Solution F7
Rebuild Solution Ctrl+Alt+F7
Clean Solution
Build Demo
Rebuild Demo
Clean Demo
Configuration Manager...
Demo
Demo.c

```
/*
 * Demo.c
 *
 * Created: 2/14/2013 1:
 *  Author: Andrew
 */


#include <avr/io.h>

int main(void)
{
    while(1)
    {
        //TODO:: Please write your application code
    }
}
```



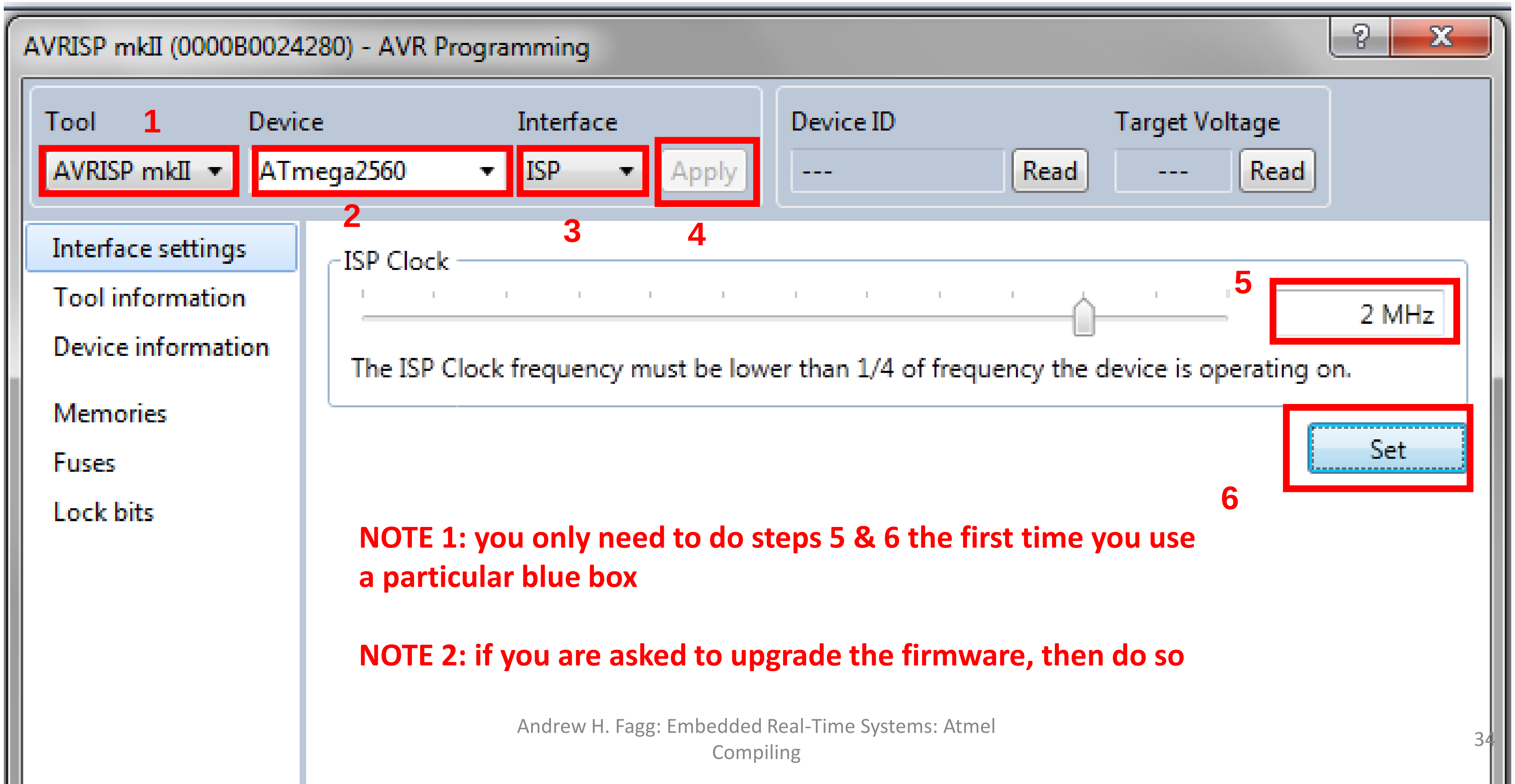
```
Done building target "CoreBuild" in project "Demo.cproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != '').
Target "Build" in file "C:\Program Files (x86)\Atmel\Atmel Studio 6.0\Vs\Avr.common.targets" from project "C:\Users\Andrew\Docum
Done building target "Build" in project "Demo.cproj".
Done building project "Demo.cproj".

Build succeeded.
========== Build: 1 succeeded or up-to-date, 0 failed, 0 skipped ==========
```

You should get this

Now We Are Ready…

- Plug the programmer into your computer **and** into the Arduino board (If it is not already)
- Make sure your Arduino board has power
  - Either from USB or batteries
- And download the program…
  - Tools Menu: Device Programming

Select the AVR Mk II

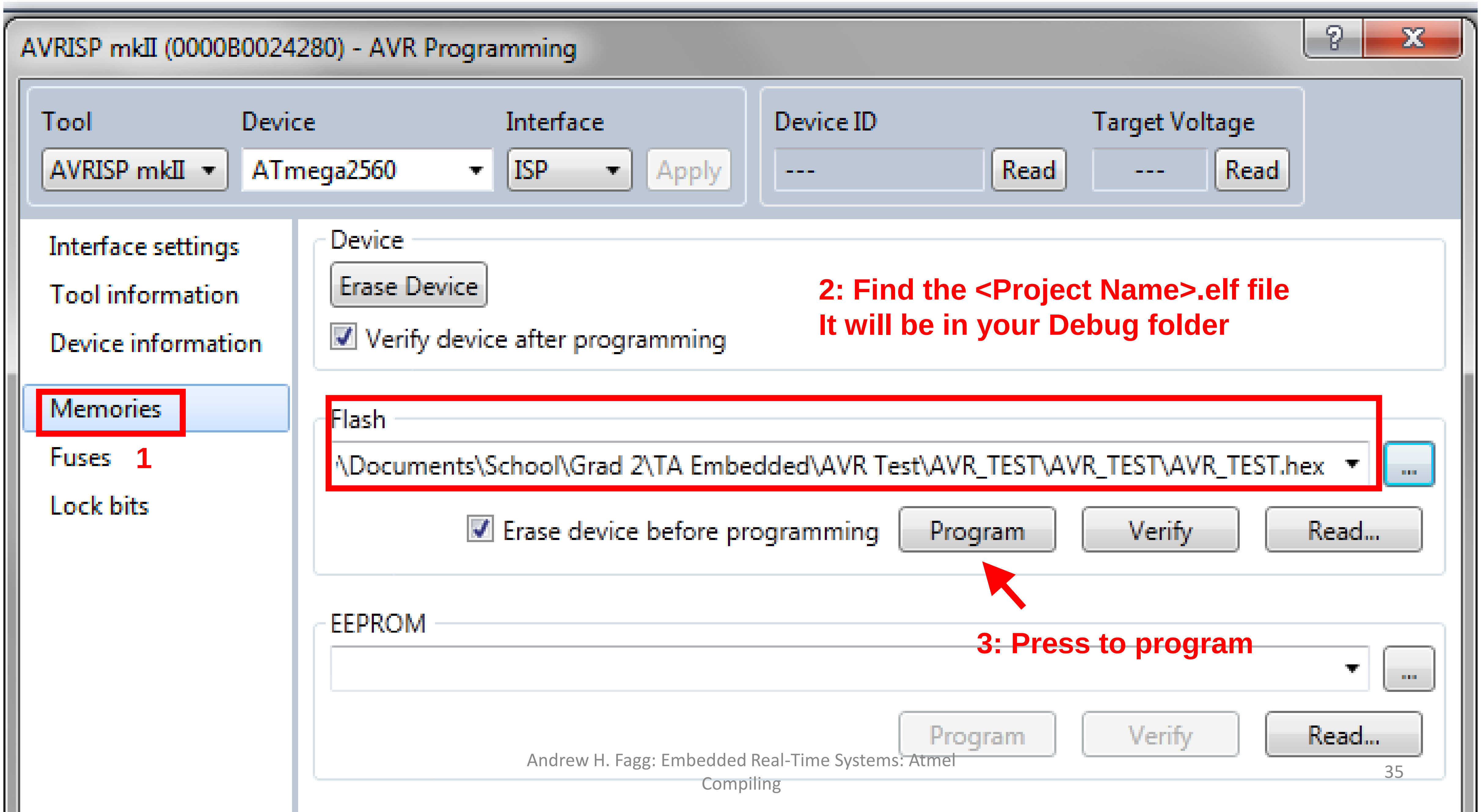


Tool: AVRISP mkII
Device: ATmega2560
Interface: ISP
Device ID: ---
Target Voltage: ---
ISP Clock: 2 MHz

The ISP Clock frequency must be lower than 1/4 of frequency the device is operating on.

NOTE 1: you only need to do steps 5 & 6 the first time you use a particular blue box

NOTE 2: if you are asked to upgrade the firmware, then do so



AVRISP mkII (0000B0024280) - AVR Programming

Tool: AVRISP mkII
Device: ATmega2560
Interface: ISP
Device ID: ---
Target Voltage: ---

Device
- ☑ Verify device after programming

Flash: \Documents\School\Grad 2\TA Embedded\AVR Test\AVR_TEST\AVR_TEST\AVR_TEST.hex
- ☑ Erase device before programming

EEPROM

1

2: Find the <Project Name>.elf file
It will be in your Debug folder

3: Press to program

Flashing?

Your program will start executing as soon as the download is complete …

Your on-board Light Emitting Diode should be blinking

Next Time

Finite State Machines