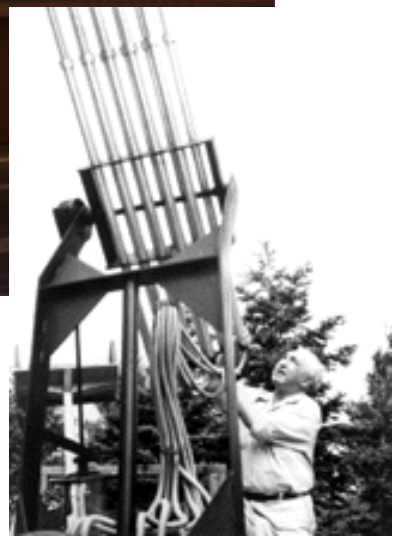
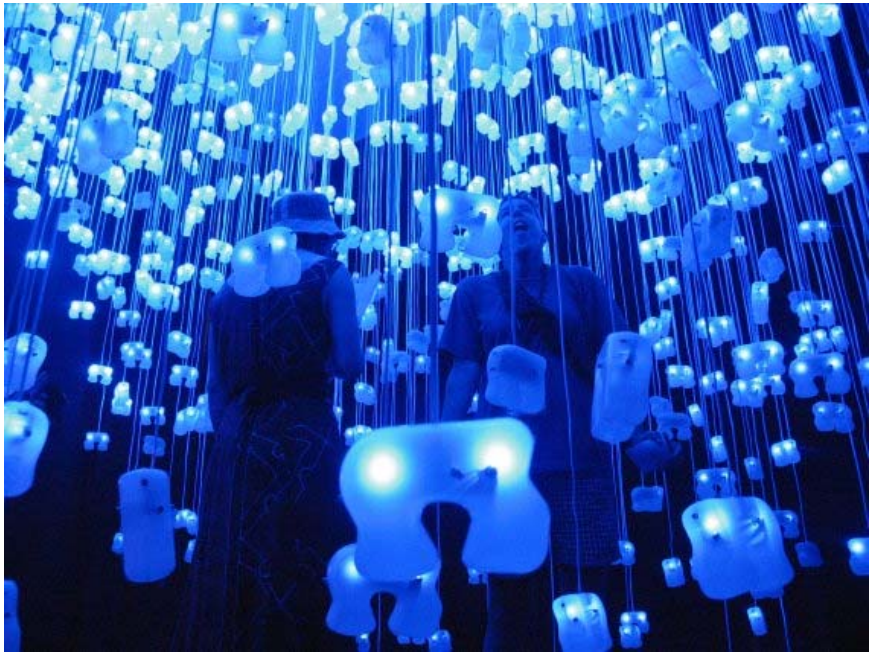


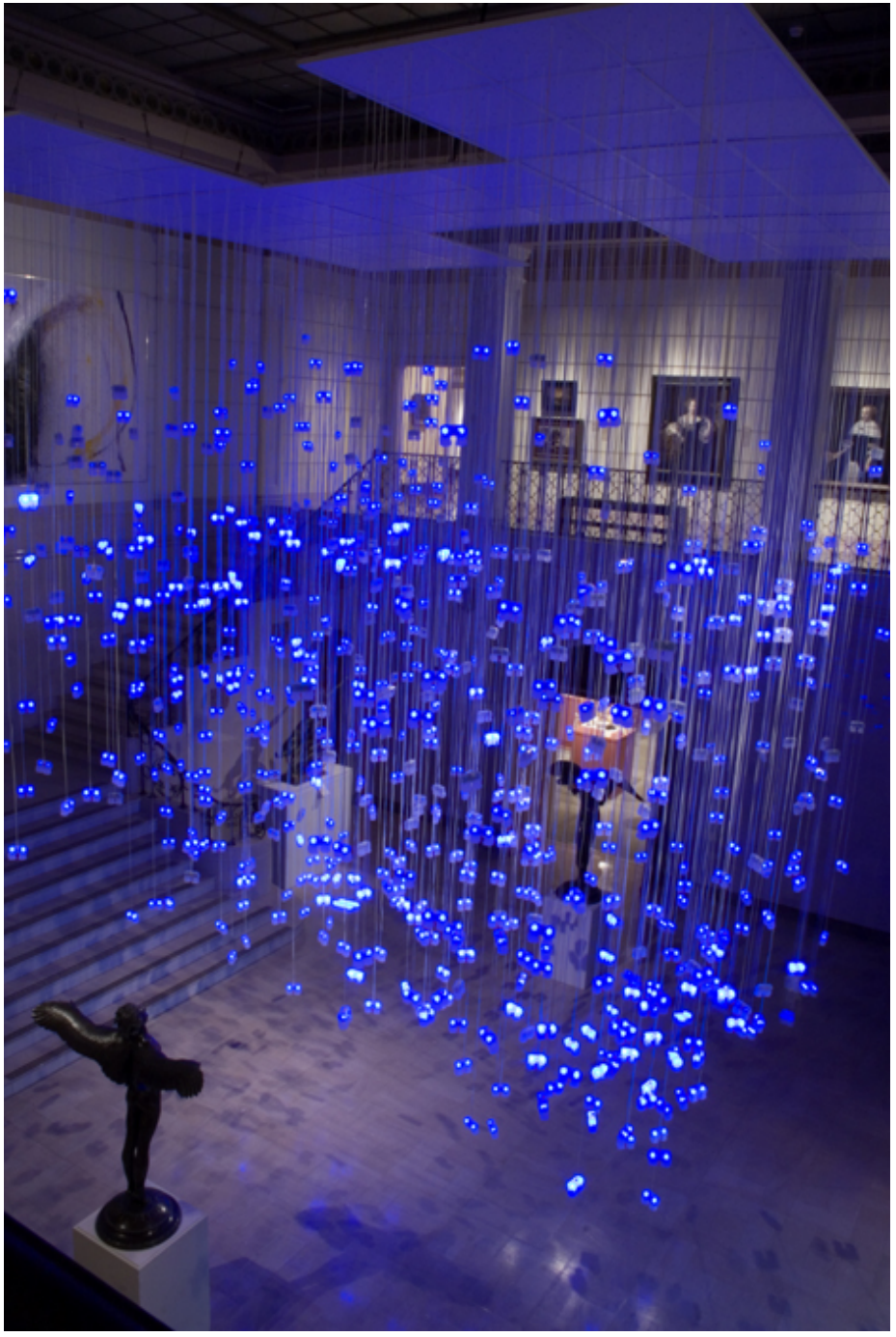
Bion

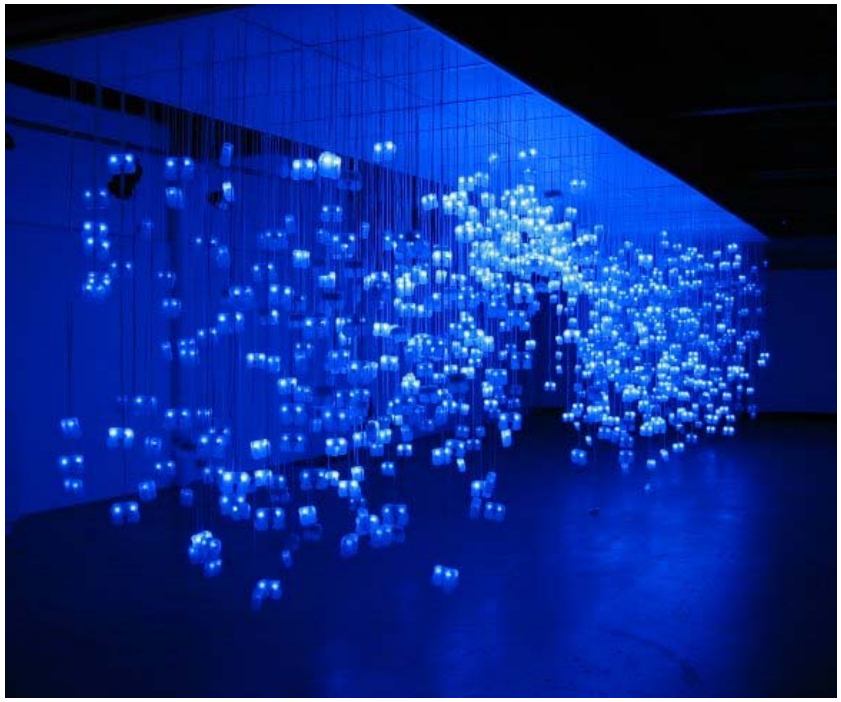
Sensor network:

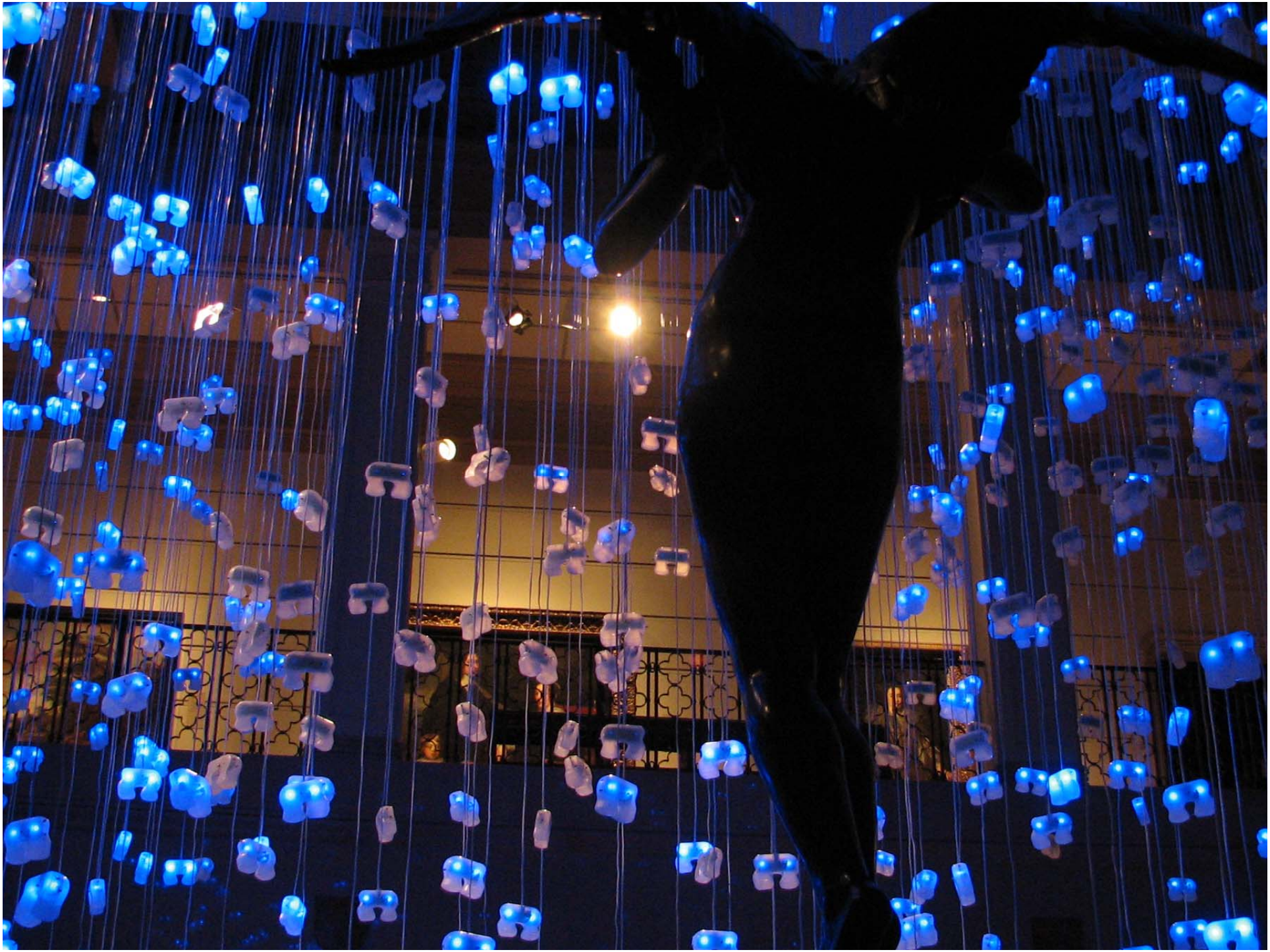
- 1000 sensor nodes
- 3 miles of telephone cable

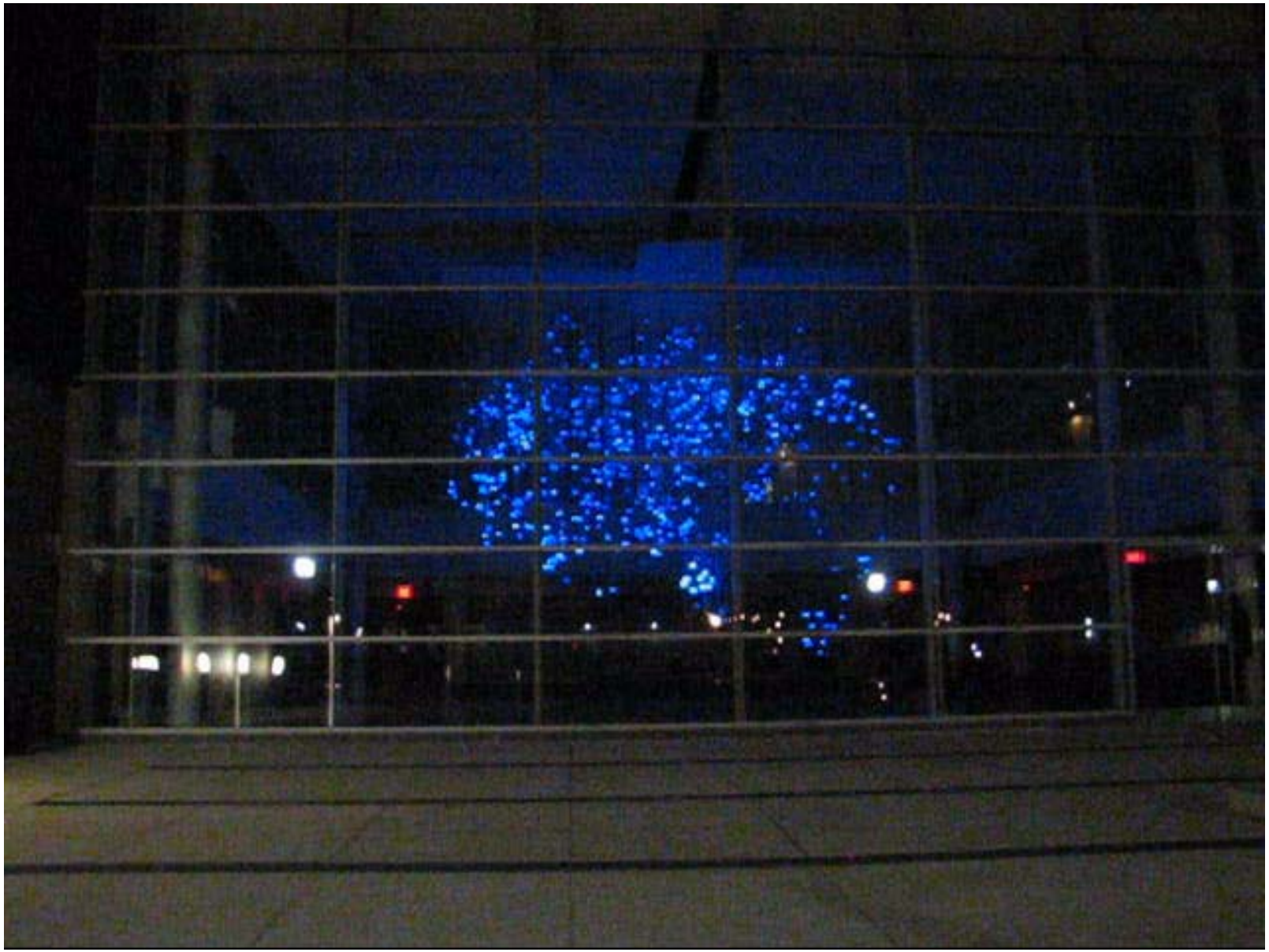
Wilhelm Reich





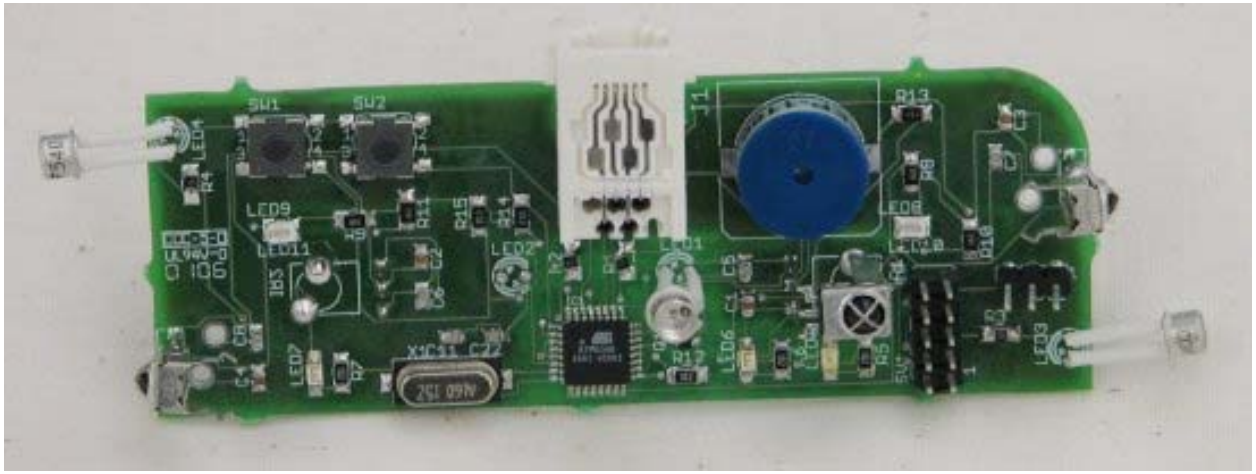






Project 1: Digital I/O and Timing

- Control of LEDs and Speaker
  - Precise timing requires timer use
- Respond to button presses



Part 1

- Internal 4-bit (software) counter
- Counter state is reflected by the LEDs
  - Total of 4 individually-controllable channels
  - (the 4 blue LEDs are controlled by one digital line)
- Each button release: increment the counter

Part 2

- Generate tone with the speaker
  - Different tone for each counter state (lower frequencies for higher values)
- Speaker is controlled by a digital I/O line
  - So: in one of two states
  - Tones are produced by producing a “square wave” at a given frequency

Required Components

Modular code

- Implement a separate function: DisplayCounter()

  Translates the current counter value into the LED state

Project Administrivia

Due in 12 days (Feb 26th)

- Demonstrate to me, Di Wang, or Dan Flippo
- Documented code: hand-in on D2L
  - One copy per 2-person group
- Personal report: distribution of work
- Lab appointments:
  - Check the appointments page
  - Send email to es@cs.ou.edu

Bion Care

- Hold bions on the side of the board (don’t touch the components)
- Minimize the bending of the components
- Don’t let the bion come in contact with metal while it is powered on

- If things get hot: disconnect power immediately and ask for help

Getting Started

See: http://www.cs.ou.edu/~fagg/classes/general/atmel/

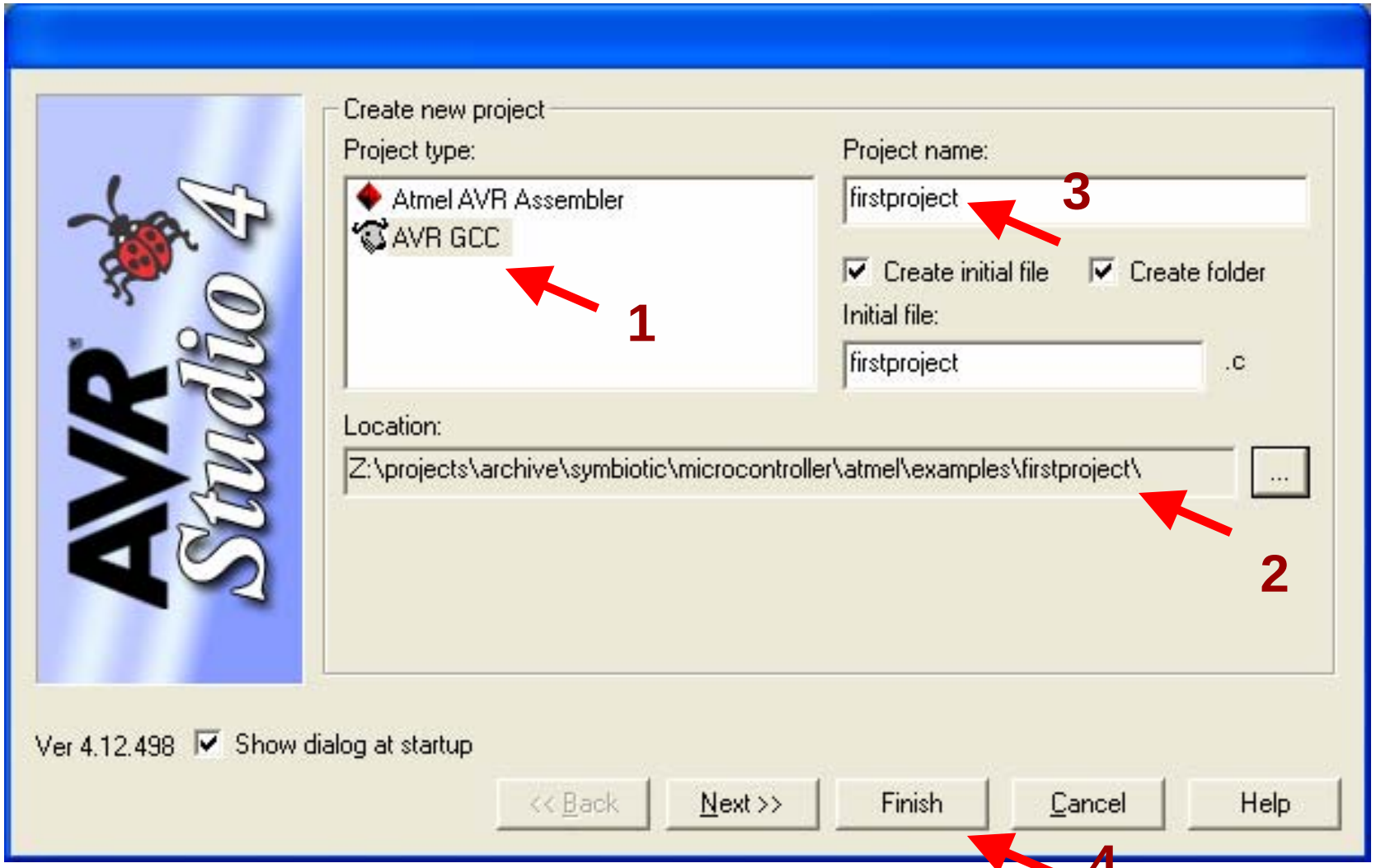
Summary:

- (perhaps) Install AVRstudio
- Install WinAVR
- Plug the programmer into your computer
- Plug the programmer into the bion
- Plug the power into the bion
- Create a program

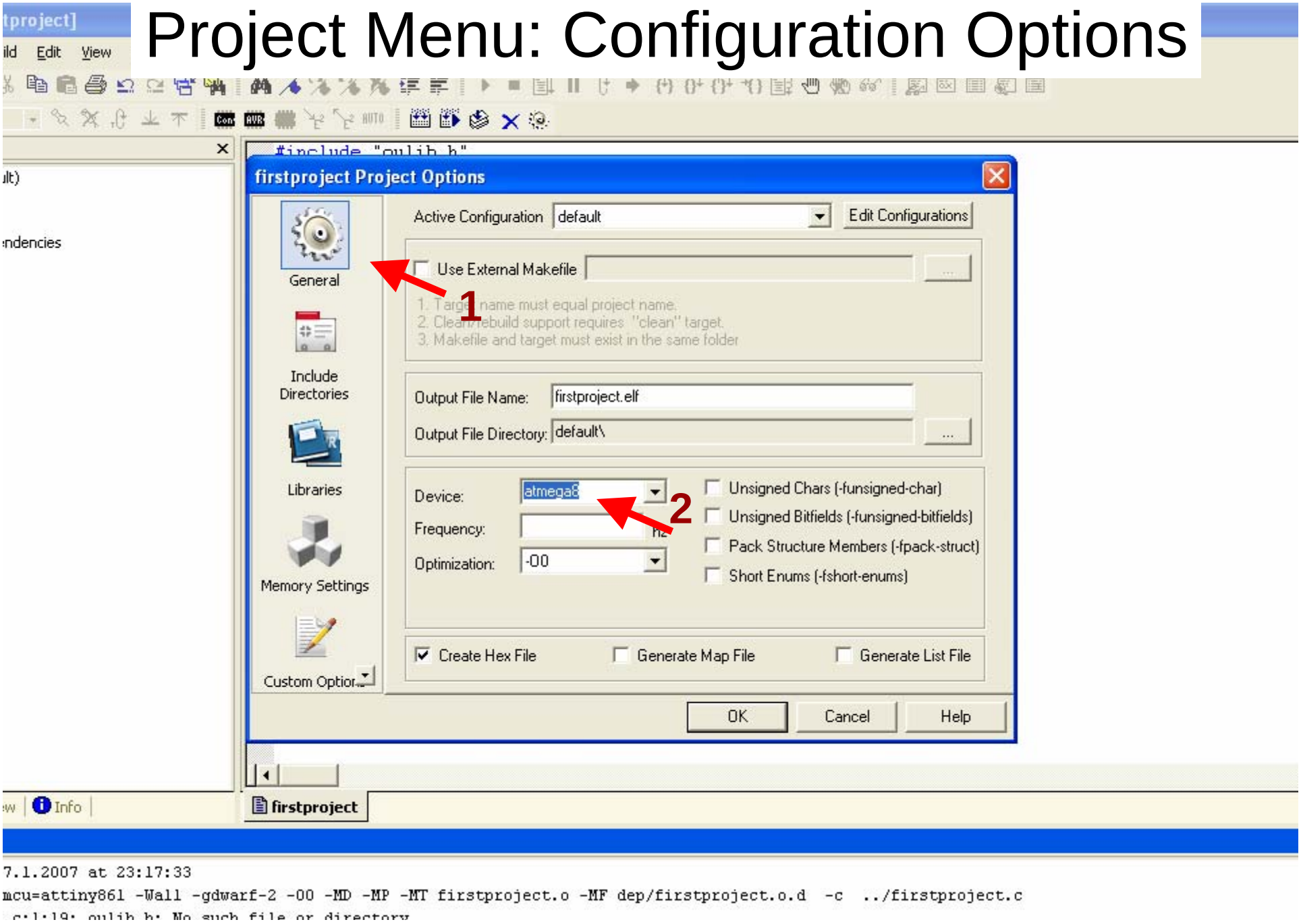
Compiling and Downloading (the unix way)

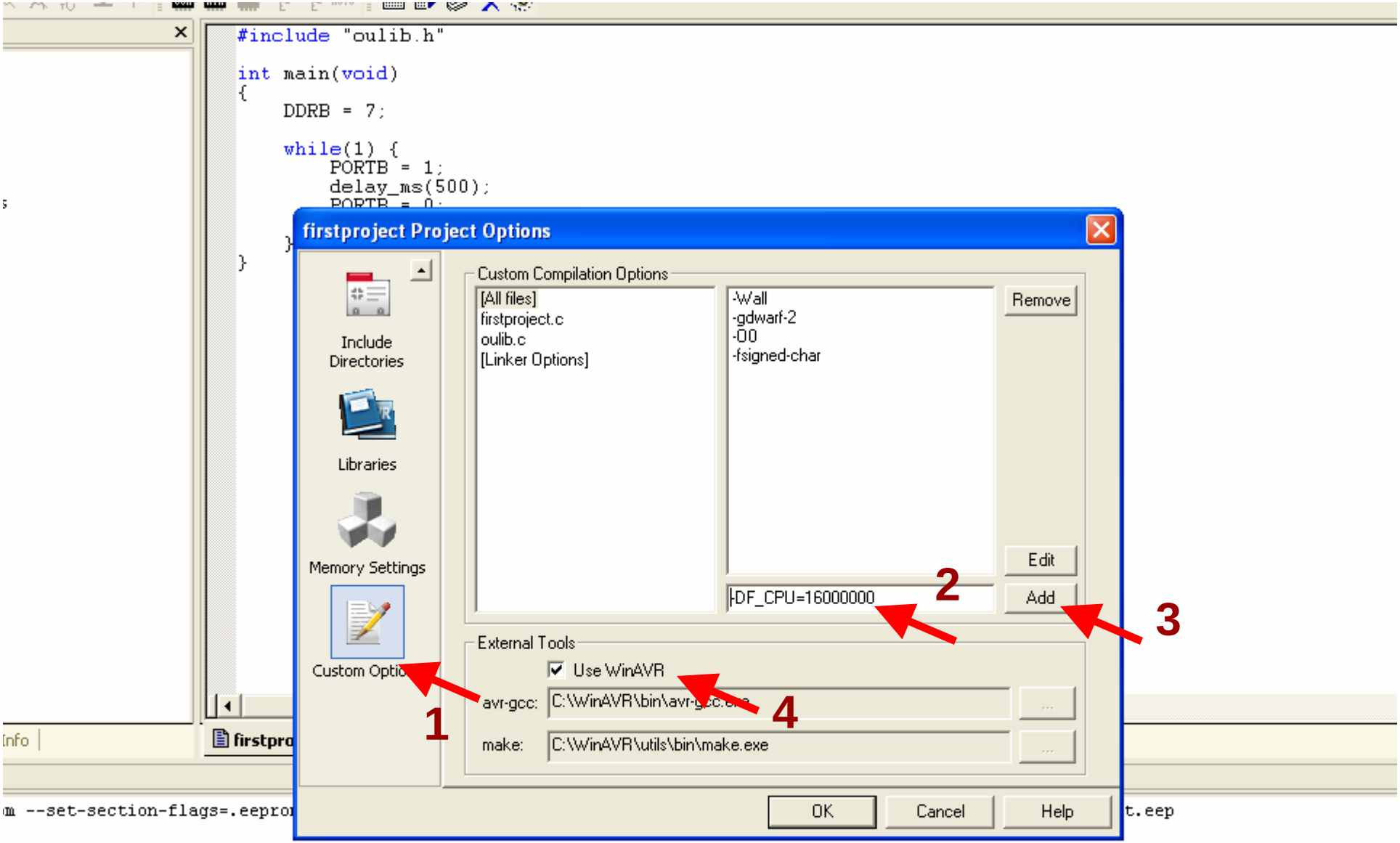
- Obtain a copy of the “makefile”
  - Modify the “TARGET” line for your program
- Type “make”
  - You should see no errors
- Type “make program”
  - This will download your code to the bion
  - Again, you should see no errors

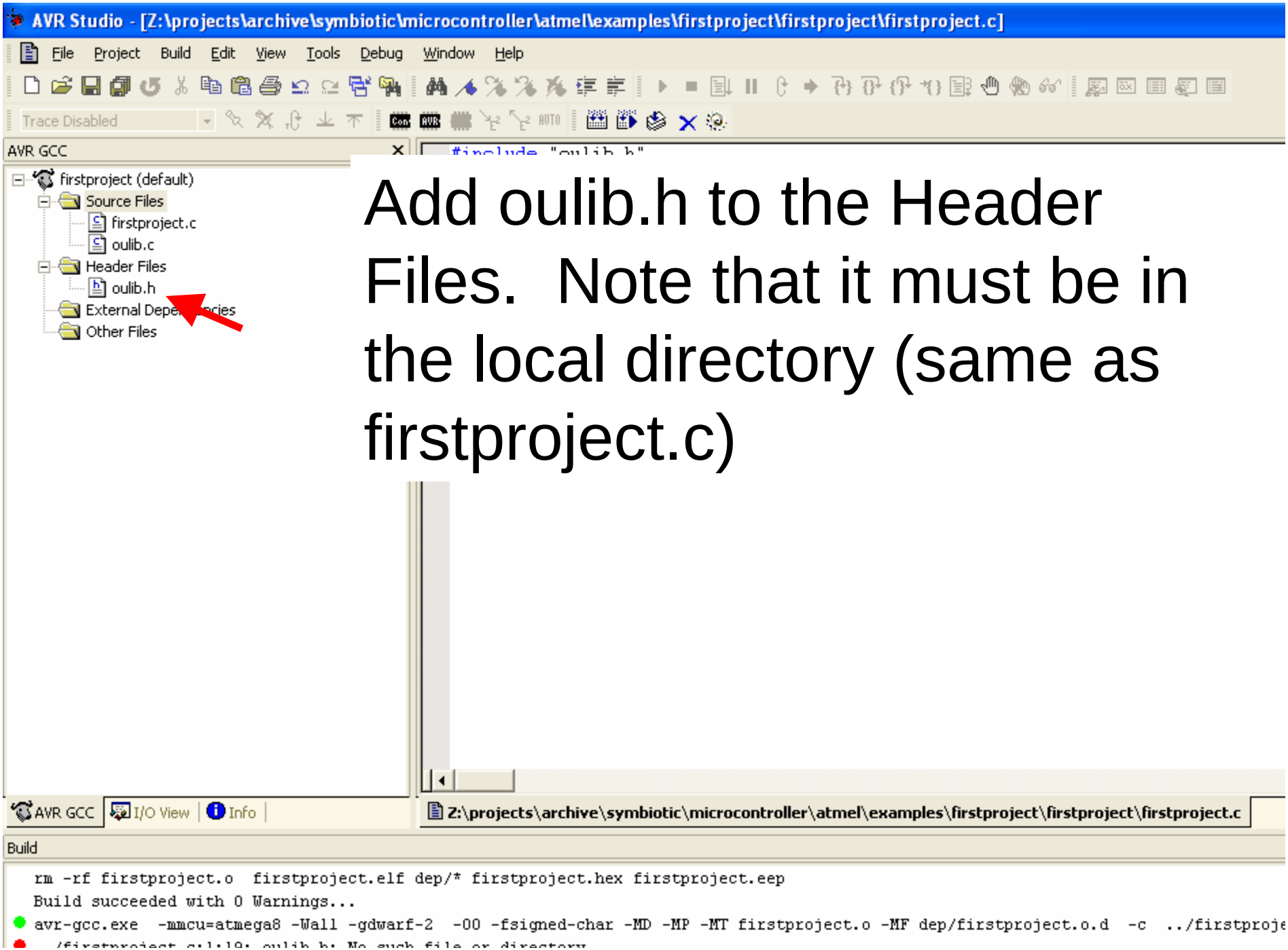
Project Menu: New Project



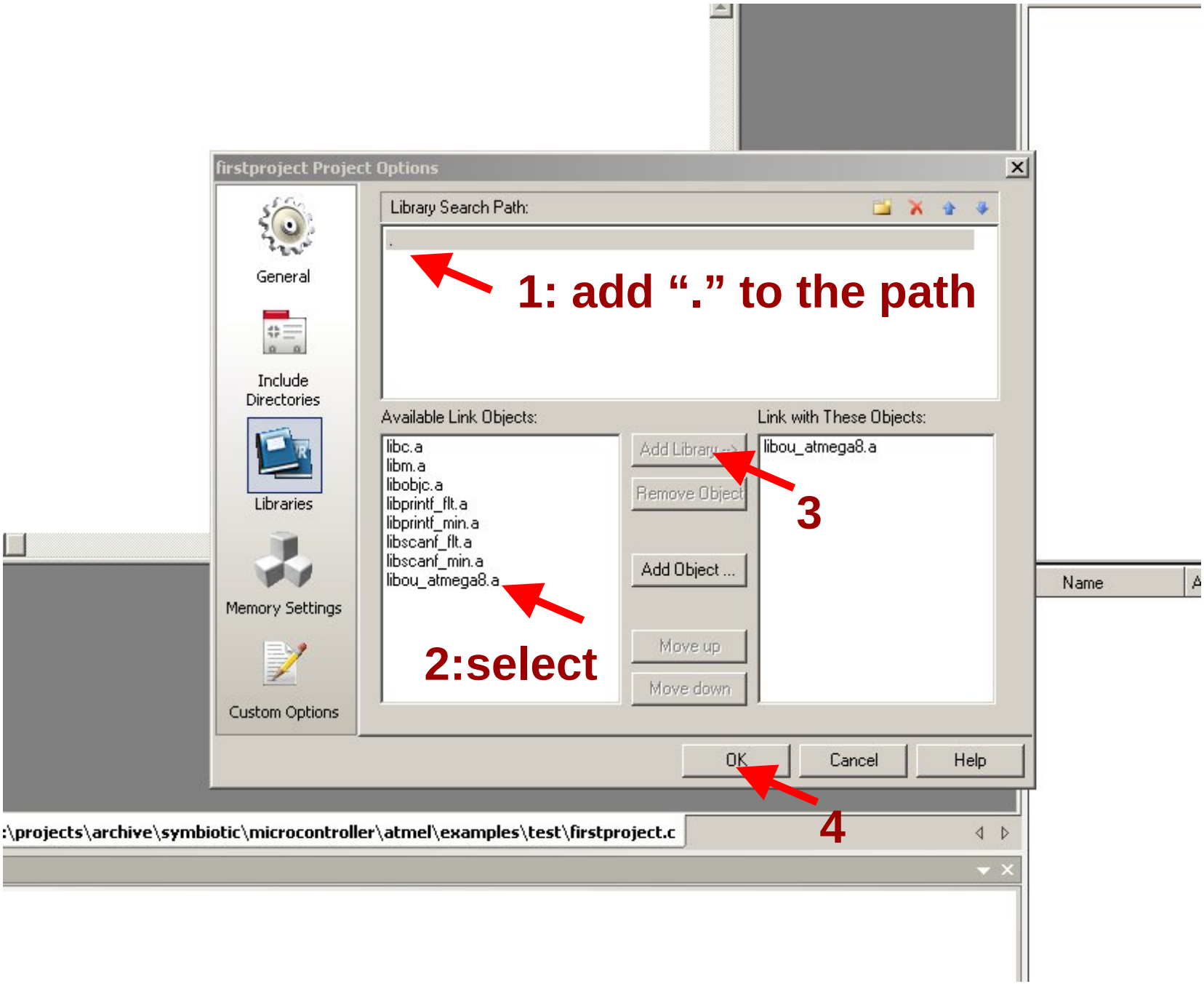
Project Menu: Configuration Options

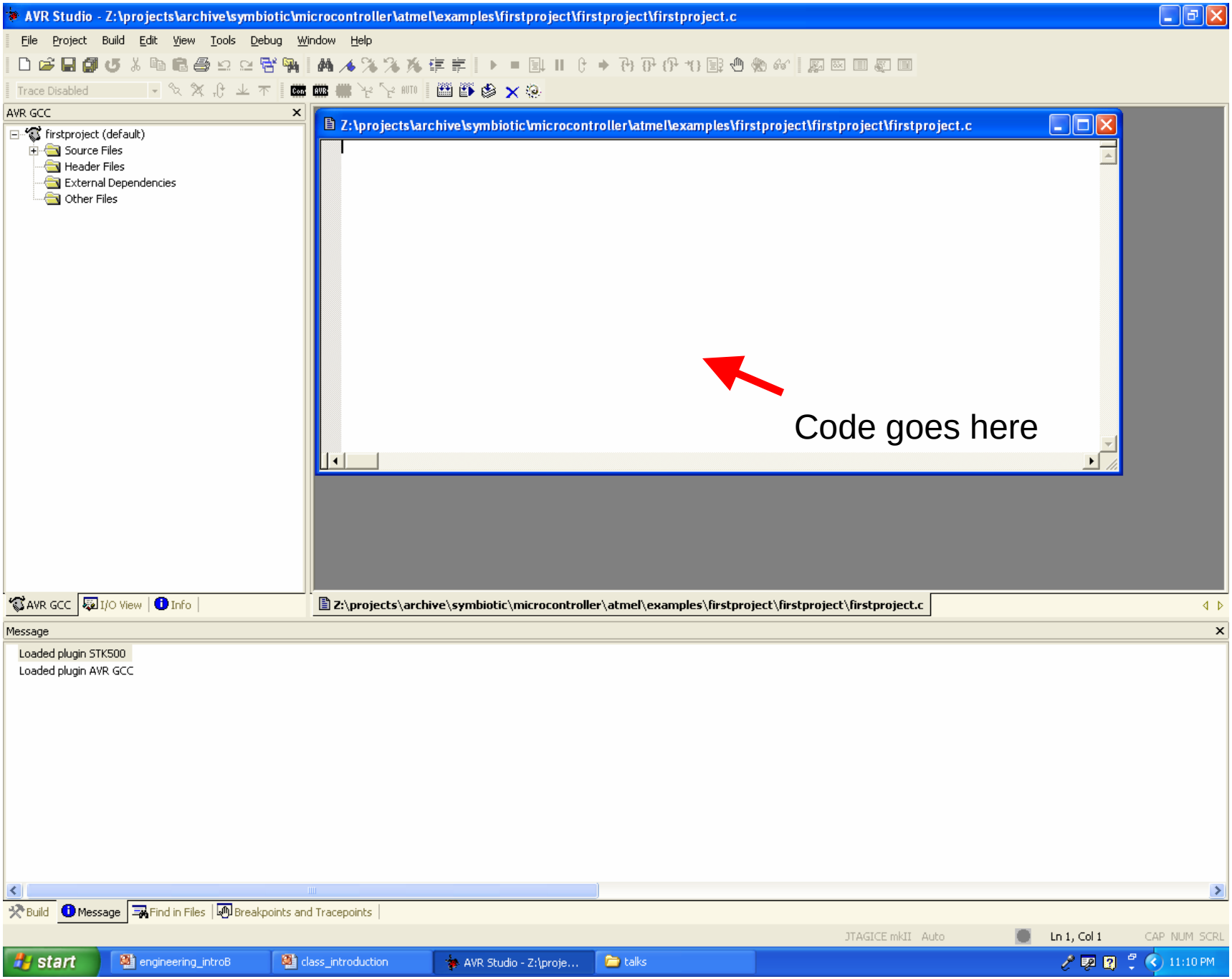



#include "oulib.h"
int main(void)
{
DDRB = 7;
while(1) {
PORTB = 1;
delay_ms(500);
firstproject Project Options
Include Directories
Libraries
Memory Settings
Custom Optio
Custom Compilation Options
[All files]
firstproject.c
oulib.c
[Linker Options]
-Wall
-gdwarf-2
-O0
-fsigned-char
Remove
Edit
-DF_CPU=16000000
Add
External Tools
Use WinAVR
avr-gcc:
C:\WinAVR\bin\avr-
make:
C:\WinAVR\utils\bin\make.exe
OK
Cancel
Help
1
2
3
4
--set-section-flags=.eepro
t.eep
(39.4% Full)
tloader)
(1.6% Full)



Add oulib.h to the Header Files. Note that it must be in the local directory (same as firstproject.c)


firstproject Project Options
General
Include Directories
Libraries
Memory Settings
Custom Options
Library Search Path:
.
1: add "." to the path
Available Link Objects:
libc.a
libm.a
libobjc.a
libprintf_flt.a
libprintf_min.a
libscanf_flt.a
libscanf_min.a
libou_atmega8.a
2:select
Add Library ...
Remove Object
Add Object ...
Move up
Move down
Link with These Objects:
libou_atmega8.a
3
OK
Cancel
Help
4
:\projects\archive\symbiotic\microcontroller\atmel\examples\test\firstproject.c
Name

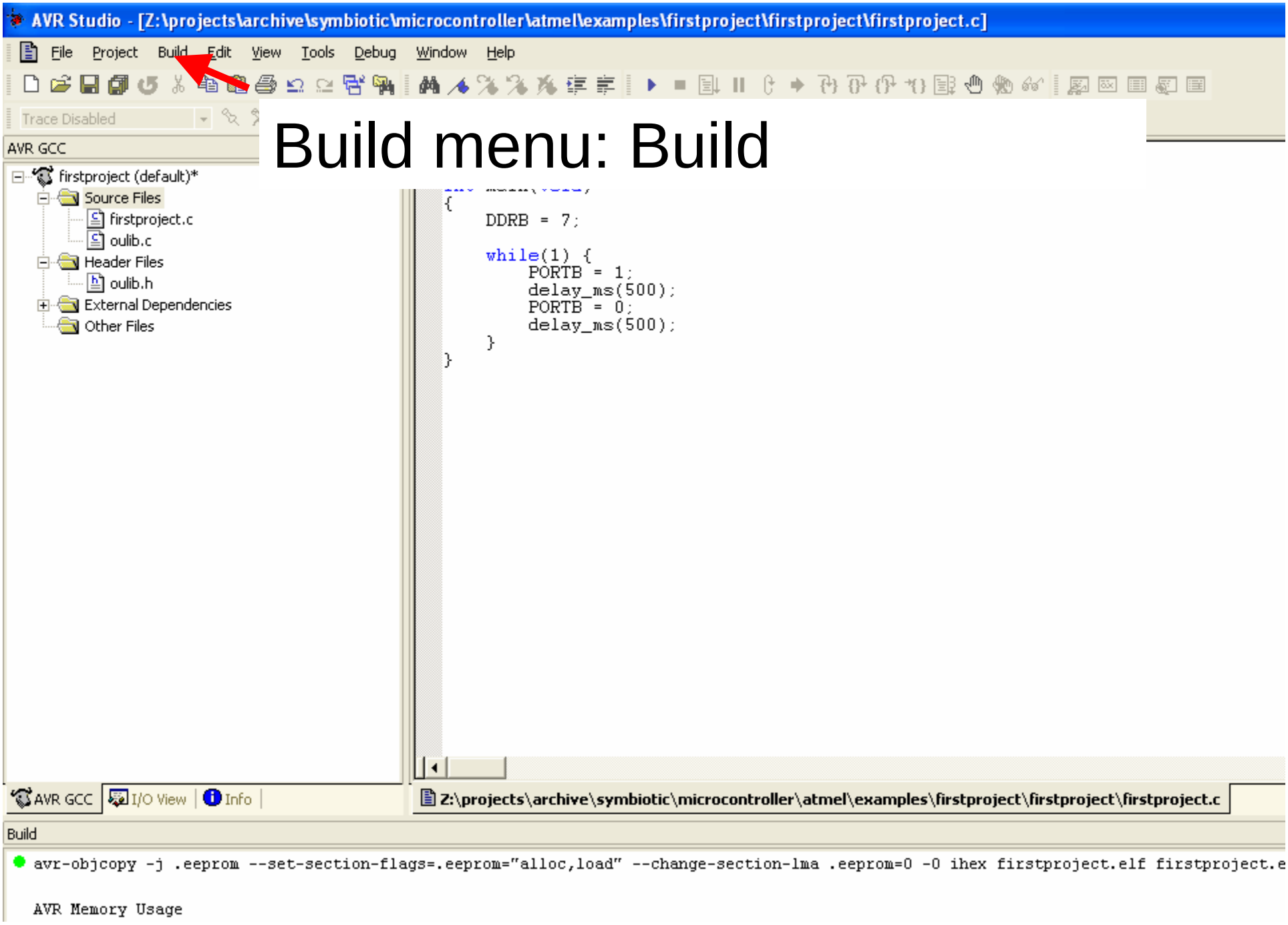

AVR Studio - Z:\projects\archive\symbiotic\microcontroller\atmel\examples\firstproject\firstproject\firstproject.c
File Project Build Edit View Tools Debug Window Help
Trace Disabled
AVR GCC
firstproject (default)
Source Files
Header Files
External Dependencies
Other Files
Z:\projects\archive\symbiotic\microcontroller\atmel\examples\firstproject\firstproject\firstproject.c
Code goes here
AVR GCC
I/O View
Info
Z:\projects\archive\symbiotic\microcontroller\atmel\examples\firstproject\firstproject\firstproject.c
Message
Loaded plugin STK500
Loaded plugin AVR GCC
Build
Message
Find in Files
Breakpoints and Tracepoints
JTAGICE mkII Auto
Ln 1, Col 1
CAP NUM SCRL
start
engineering_introB
class_introduction
AVR Studio - Z:\proje...
talks
11:10 PM

Now for the code…

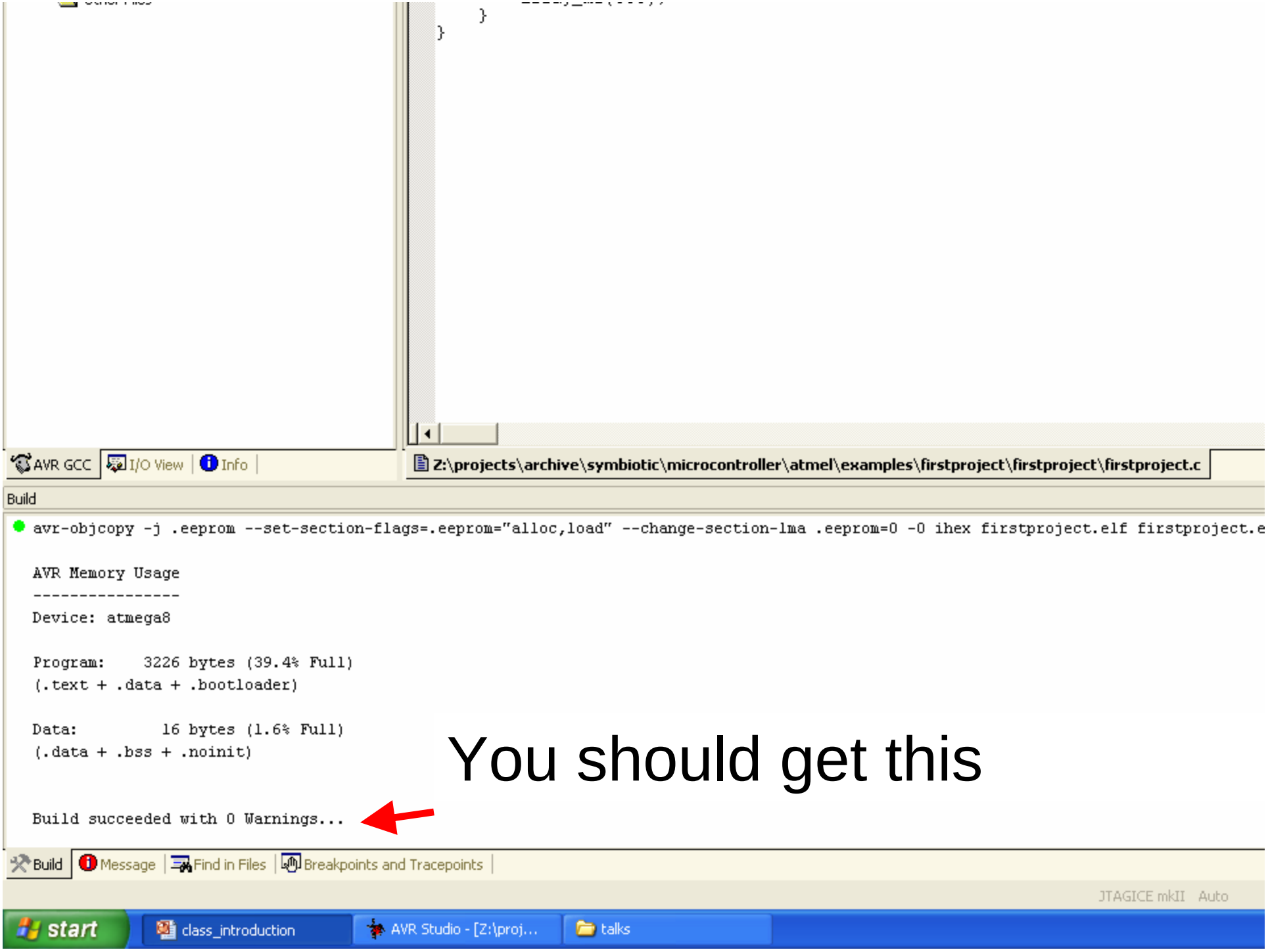
```
#include "oulib.h"

int main(void)
{
   DDRB = 7;

   while(1) {
       PORTB = 1;
       delay_ms(500);
       PORTB = 0;
       delay_ms(500);
   }
}
```

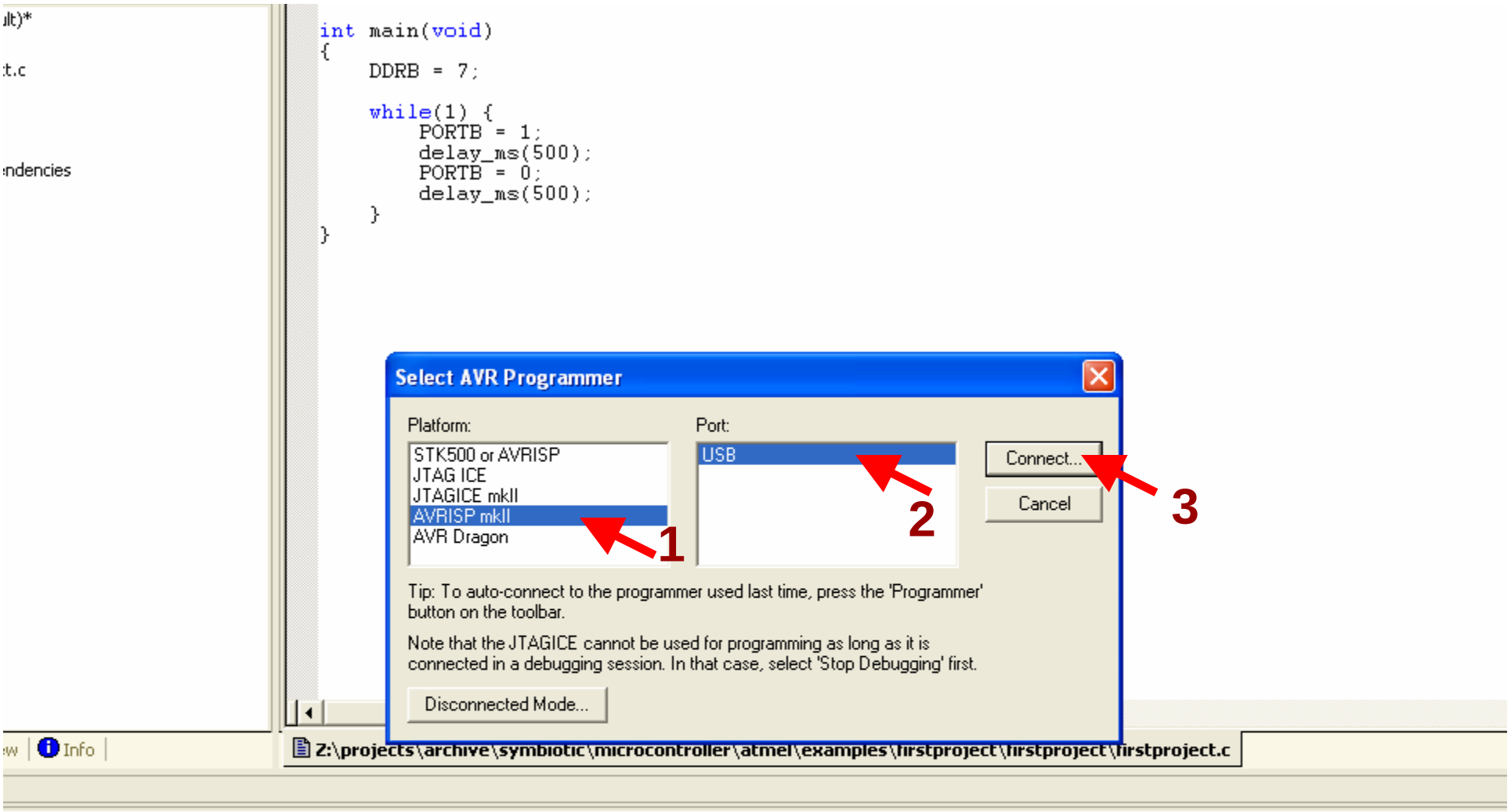


Build menu: Build


}
}
AVR GCC
I/O View
Info
Z:\projects\archive\symbiotic\microcontroller\atmel\examples\firstproject\firstproject\firstproject.c
Build
avr-objcopy -j .eeprom --set-section-flags=.eeprom="alloc,load" --change-section-lma .eeprom=0 -O ihex firstproject.elf firstproject.e
AVR Memory Usage
Device: atmega8
Program: 3226 bytes (39.4% Full)
(.text + .data + .bootloader)
Data: 16 bytes (1.6% Full)
(.data + .bss + .noinit)
Build succeeded with 0 Warnings...
You should get this
Build
Message
Find in Files
Breakpoints and Tracepoints
JTAGICE mkII Auto
start
class_introduction
AVR Studio - [Z:\proj...
talks

Now We Are Ready…

- Plug the programmer into the bion (If it is not already)
- Power up the bion
- And download the program…
  - Tools Menu: AVR: Connect

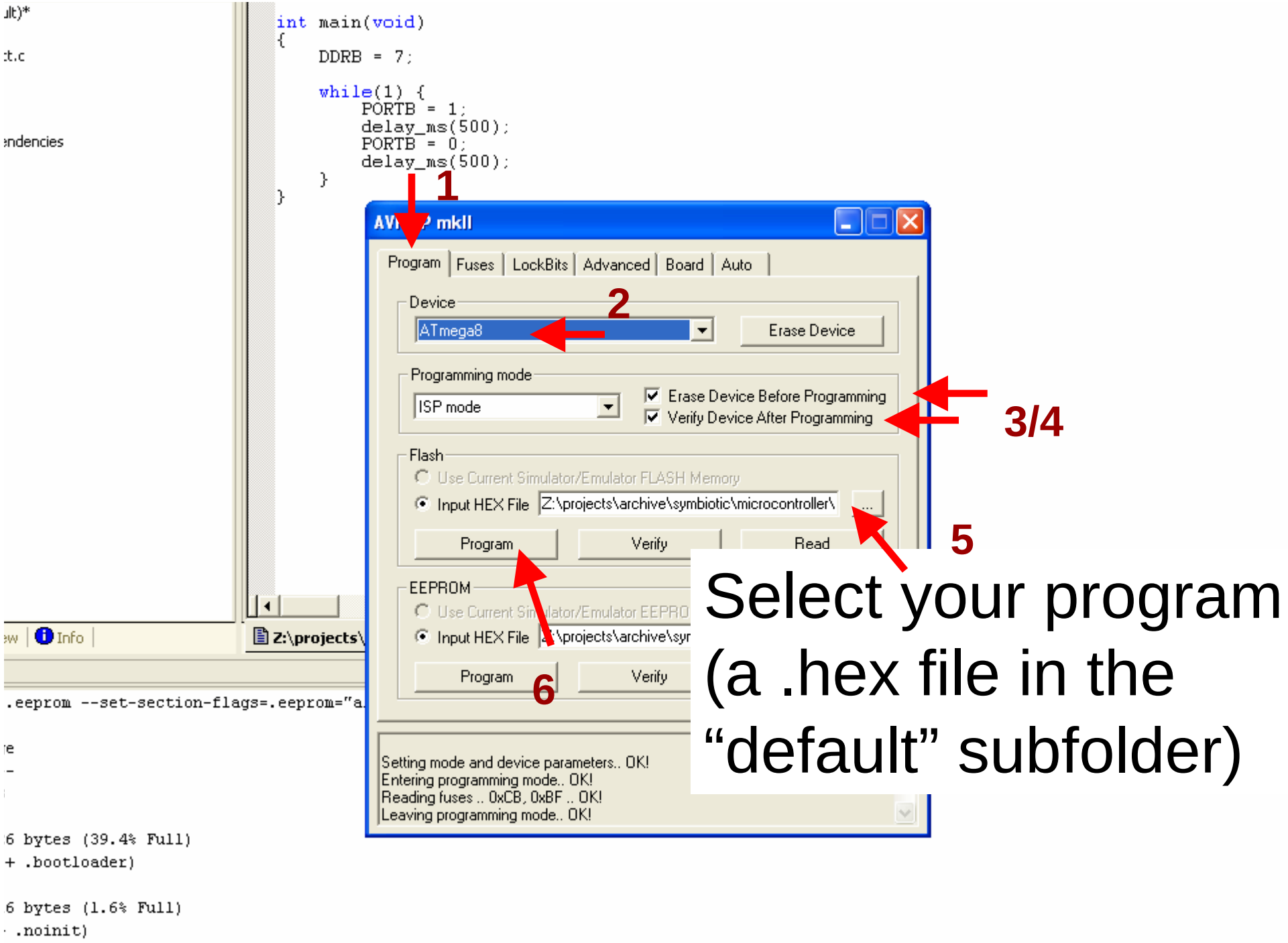



```
.eeprom --set-section-flags=.eeprom="alloc,load" --change-section-lma .eeprom=0 -O ihex firstproject.elf firstproject.eep

e
-


6 bytes (39.4% Full)
+ .bootloader)

6 bytes (1.6% Full)
 .noinit)
```



Select your program (a .hex file in the “default” subfolder)

Flashing?

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

Your green Light Emitting Diode should be blinking at 1 Hertz (once per second)