Department of Electrical and
Computer Engineering

EEL 4742C: Embedded Systems

Development Environment

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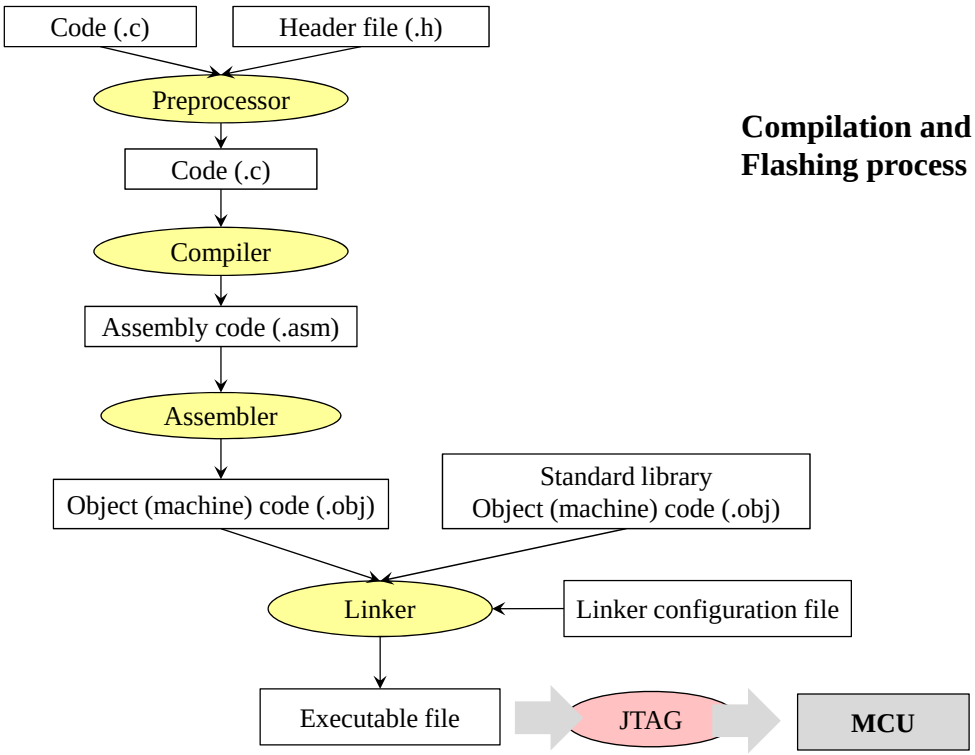
Development Environment

The compiler consists of:

- The pre-processor
- The assembler
- The linker

- The linker configuration file reflects the memory map
- E.g: it ensures the code is loaded in the FLASH partition of the memory, regular variables are loaded in the volatile memory, etc.



Compilation and Flashing process

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Programming & Debugging

Programming the MCU

- Flashing the code from the PC to the MCU's memory

Debugging

- The code runs in debug mode under the supervision of the debugger (on the PC)
- We can see/modify the registers and memory variables
- We can set breakpoints to halt the execution and inspect the data

- We want to program and debug **in-system,** without removing the chip from the product (or LaunchPad board in our case)

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Programming & Debugging

Joint Task Action Group (JTAG)

- It's a hardware module on the chip used for programming and debugging

- Standard JTAG has 4 pins (known as 4-wire JTAG)
- Smaller version is 2-wire JTAG; known as Spy-Bi-Wire (SBW); has fewer pins but is slower

- JTAG provides a set of commands that read/write to/from memory/CPU
- Supports programming and debugging

- JTAG has a **security fuse**
- It's blown to disable JTAG permanently
- Prevents intruders from stealing/modifying code on an embedded product

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Programming & Debugging

BootStrap Loader (BSL) … (a.k.a. Bootloader)

- A software in the MCU's memory used to update the code (also in the MCU's memory)
- Used when few JTAG pins are available (other pins are routed to a different functionality)
- Provides a set of commands to read/write memory locations

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Programming & Debugging

Flash Emulation Tool (FET)

- A hardware tool by TI to program and debug MSP430 MCUs
- Supports programming via 4-wire JTAG, 2-wire JTAG, Bootloader
- Supports debugging via JTAG

- FET supports a backchannel UART
- A communication pathway that goes via the USB to the computer
- Enables communication between MCU and PC
- We'll use this in the lab

- FET is implemented in two ways (next two slides)
- Standalone part
- Built-in the LaunchPad (FR6989 and G2553)

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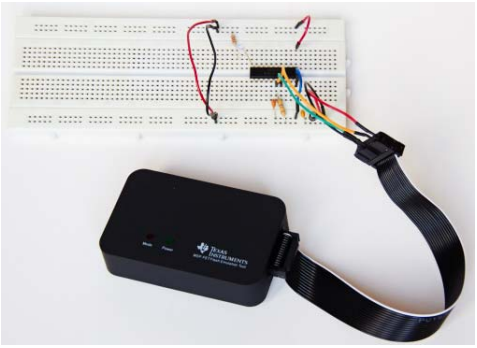
Programming & Debugging

- The black box is the FET tool



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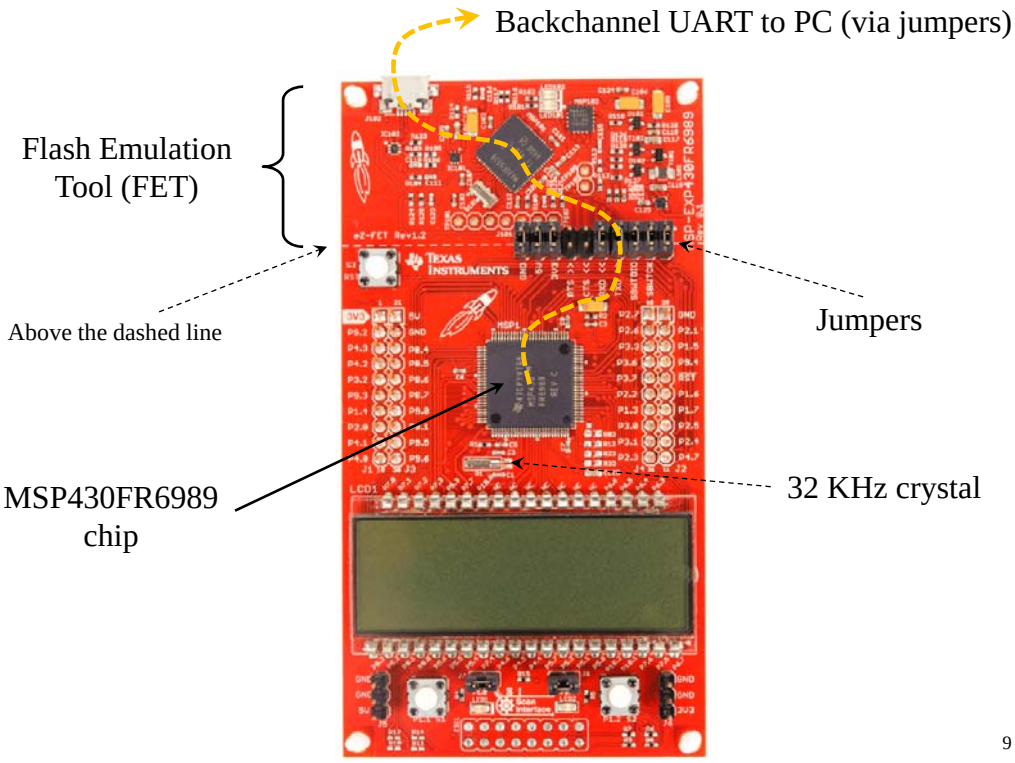

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Programming & Debugging

Other debugging tools…

- Trace buffer: records memory traffic (like an airplane's black box); found in advanced MCUs
- Multimeter: probing the pins to check the voltage/current
- Oscilloscope: used for high-frequency signals

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