

# CENG 336 - Spring 23

## Recitation 0

# Outline

- Course Conduct
- Brief Introduction to Hardware
  - PIC18F8722/PIC18F4620 microcontrollers
  - MCDEV Kit
- Brief Introduction to Software
  - MPLAB X IDE
  - PICSimlab
- MPLAB X IDE Basics
  - Creating a project
  - Loading your program to the microcontroller
  - Debugging with breakpoints

# Course Conduct

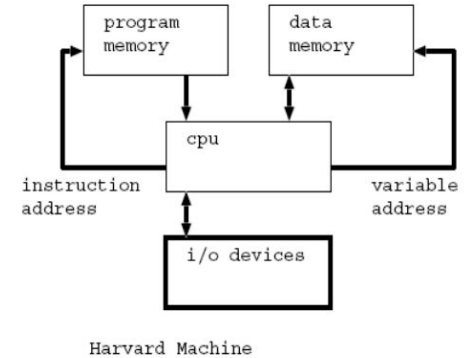
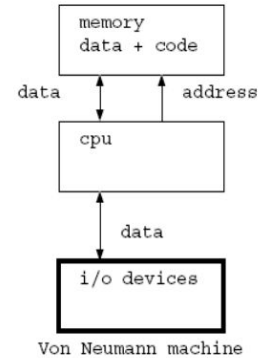
- 4 Assignments (Done In Pairs except THE1 - 37%)
  - THE1: PIC Assembly Basics, Round Robin Architecture (4% - İlker Işık)
  - THE2: Interrupts, Timers, Programming a 7-Seg Display (9% - İlker Işık)
  - THE3: Programming the ADC, LCD Display (10% - Merve Asiler)
  - THE4: Serial Communication, RTOS (12% - A. Cem Önem / Merve Taplı)
  - **THE1.5: Making sure you are set up (checking software/hardware) (2%)**
- Lab Review Exam (Individual - 20%): Complete a Programming Task in ~3 Hours
- Midterm + Final (18% - 25%)
- TAs: A. Cem Önem, Merve Taplı, İlker Işık, Merve Asiler

# Hardware - Introduction to PIC

- Range of low end 8-bit microcontrollers to high end 32-bit microcontrollers made by Microchip Technology.
- Smallest has only 6 pins, largest 144 pins.
- Cheap, you can pick them up at less than \$1-\$10 each.
- Targeted at a various applications: consumer products, automotive, home appliance, connectivity, etc.

# Hardware - Introduction to PIC

- **Harvard Architecture**
- For example, PICs use:
  - Data memory(RAM): a
  - small number of **8bit**, 16bit or 32bit registers
  - Program memory (ROM): relatively large number of 12bit,
  - 14bit, **16bit** or 24bit wide registers
- It is a RISC (Reduced Instruction Set Computer) design



# Hardware - PIC18F8722

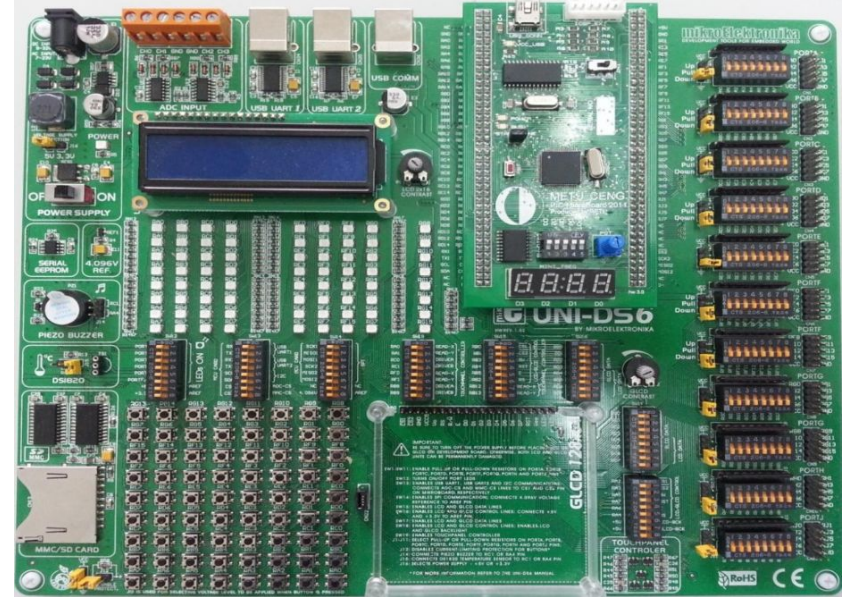
- The MC on our boards :)
- Harvard Architecture: 128Kx16 Bit ROM, 4096x8-Bit RAM (16 Banks)
- 4 Addressing Modes (inherent, literal, direct, indirect)
- 75+8 Instructions (fixed length encoding - 16-bit)
- 31x21 Bit Hardware Stack
- 9 I/O Ports, 5 Timers
- 3 External Interrupts, PORTB Interrupt on Input Change
- 2 USART serial ports (both synchronous/asynchronous)
- 10-bit ADC Module
- **Max. 40 MHz Clock - 1 Instruction cycle is 4 clock cycles**

# Hardware - PIC18F4620

- The MC on the Simulator PICSimlab
- Very similar to PIC18F8722. Differences Cem can think of:
  - Less ROM: 64K x 16-Bit
  - One less USART module
  - One less 8-bit timer module
  - Less pins -> No PORT-F/G/H/J
- None of these differences will be prohibitive in your assignments. We have a great deal of experience with this MC as well :)
- Course material should 99% apply. We would inform you on the critical differences from PIC18F8722 (there aren't many).

# Hardware - MCDEV Kit

- Contains buttons, LCD display, 7-Seg display, a POT for ADC module, LEDs, even a buzzer readily connected to your MC.
- We also supply a PIC-kit MC programmer to load your code to the MC.





# Software

- MPLAB X IDE (v5.45 - Install right away!) - run the .sh file within:

<https://ww1.microchip.com/downloads/en/DeviceDoc/MPLABX-v5.45-linux-installer.tar>

- MPLAB XC8 Compiler (v2.30 - Install right away!) - make executable and run:

<https://ww1.microchip.com/downloads/en/DeviceDoc/xc8-v2.30-full-install-linux-x64-installer.run>

- mdb (should have been installed with MPLAB X, check you PATH environment variable)
- cutecom

> sudo apt install cutecom

- We may need you to install these later:
  - PICSimlab (v0.8.12)
  - PICSimlab MPLAB X Plugin (for v5.40-5.45)
  - Lcgamboa's tty0tty fork (v0.8.8)

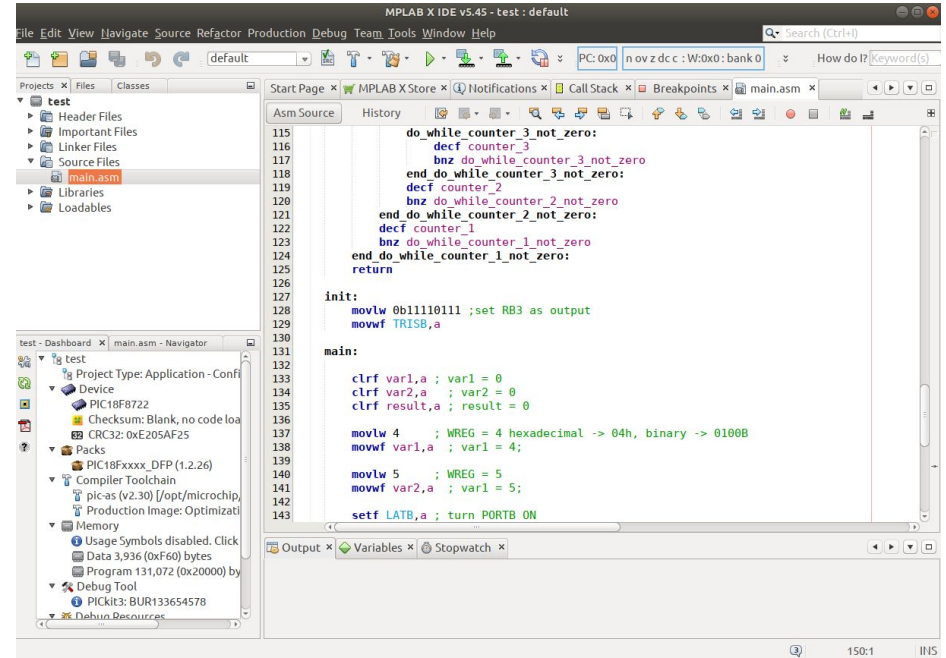
**Make sure you use *these* versions for compatibility with lab PCs and us!**

# Software

- ***We only support Ubuntu 18.04-20.04-22.04 x86-64 in this course for software issues.*** Use other OSes at your own risk. Windows will be troublesome when you debug serial communication programs. MPLAB X IDE does not support M1-2 chip Macbooks.
- We will supply a virtual machine image for you to implement your assignments, but do install these software if your machine is compatible.
- Part of THE1.5 will be about whether you have installed your software correctly or have a reliable VM setup going.

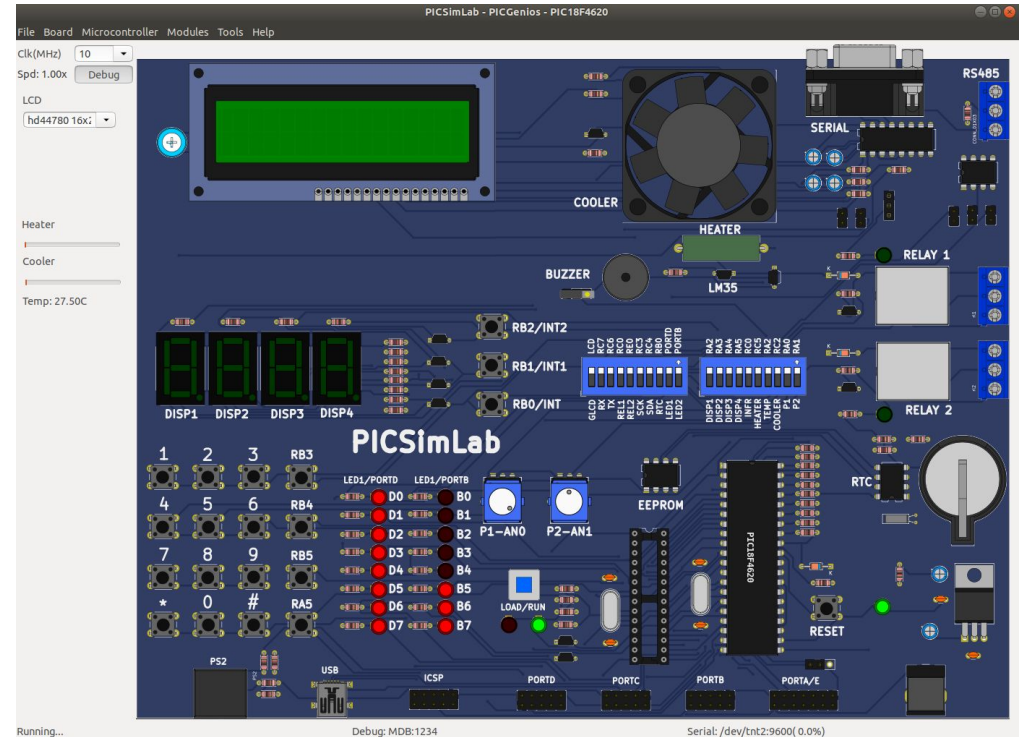
# Software - MPLAB X IDE

- You will use this IDE to write assembly/C code to your target MC and load it to the board/PICSimlab.
- Contains a simulator/debugger.



# Software - PICSimlab

- Simulates PIC18F4620 and a board similar to MCDEV kit.
- We will share a separate installation/usage manual if it is required for THE1.5



# Demo In Progress...

- If you could not attend the recit... skip to 27:40 in recording
- We show how to create a project within MPLAB X IDE
- Write some assembly code / put files to our project
- Adjust clock speed and other settings for our MC
- Run it within the simulator, put breakpoints.
- Measure how much time passed between breakpoints
- View memory locations
- Load it to the board

# Resources

- **The Holy Datasheet (if Cem and the datasheet contradict, believe the datasheet!)**
- Manuals provided with MCDEV Kit
- ODTUClass page and the documents shared there