



~~程序代写代做 CS 编程辅导~~

lecture 1



# ECE 2560 Introduction to Microcontroller-Based Systems

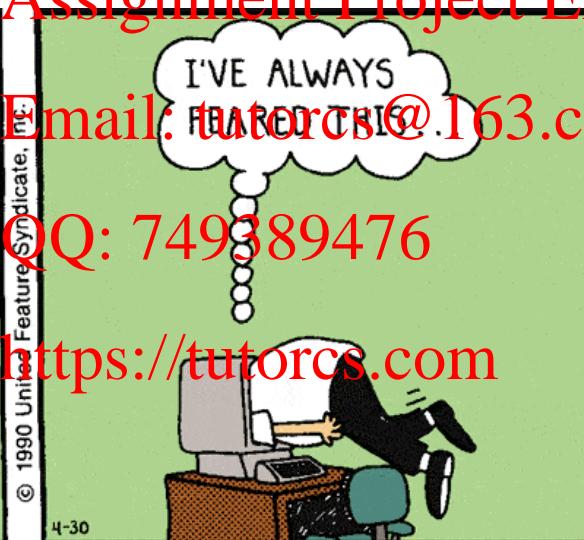
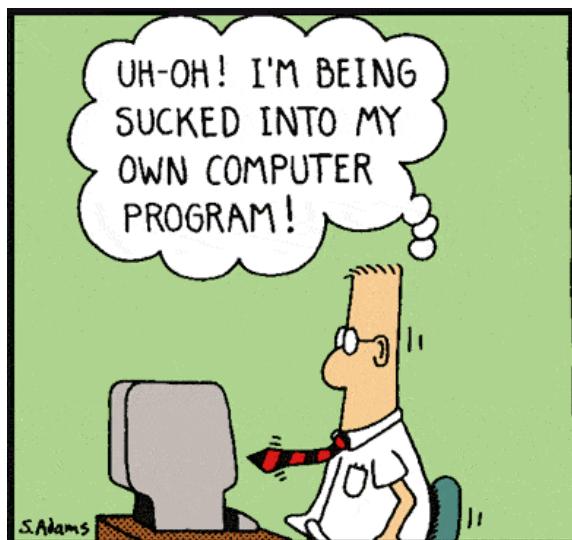
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# Syllabus

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**Instructor:** Irem Eryilmaz

**Email:** [eryilmaz.4@osu.edu](mailto:eryilmaz.4@osu.edu)



**Office:** Dreese Lab

**Class schedule:** We Fr 4:10 pm – 5:05 pm Dreese 113

**Office hours:** To be announced

**In person**

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**Communication:** Email – Both ways

When sending email, please start subject with “ECE 2560”

**QQ: 749389476**

**Email availability:** I usually reply to emails within 24 hours on OSU days

No promises over weekends or official holidays

No promises right before a deadline when I receive a burst of student email

⇒ Do not wait until the very last moment



# Learning Objectives

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## ECE 2560 Introduction to Microcontroller-Based Systems

- Hardware and software architecture of a typical microcontroller
- Assembly Machine language programming
- Interfacing peripheral components and input-output programming
- Real-time computer applications

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### Course Goals

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- Learn the architecture, programming, and interface requirements of a commercially used microcontroller. TI MSP430FR6989
- Learn to interface a microcontroller to memory, parallel ports, serial ports, etc.
- Learn to apply microcontroller systems to solve real-time problems

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# 2560 within ECE Courses



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## **Prerequisites and Co-requisites:**

Prereq: 2000, 2060, 2061  
2017; and EnGraph 167,  
Engineer 192.01H, or 192.02H;  
major; or prereq or concurrence  
with 2060, 2061, 2067, and permission of department



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**Required Background:** Mostly self contained

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# ECE 2060 Digital Logic will help you succeed

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- Numeral Systems, 1's and 2's complement – will review starting on Fr

# Basic understanding of programming

- Flowcharts, pseudocode etc.
  - Some fundamental algorithms
  - Conditional statements (`if`), loops (`for`),
  - Pointers and addressing – very straightforward in assembly



# 2560 within ECE Courses

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What's next?

## ECE 3567 Microcontroller

- Laboratory in which a microcontroller is used to interface real-world hardware to make a functional system
- Same microcontroller (MSP430FR6989 LaunchPad Development Kit), same IDE (Code Composer Studio) but C instead of assembly



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## ECE 5362 Computer Architecture and Design

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(Prereq: 2560 and 3567)

## ECE 5462 HDL Design and Verification

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## ECE 5465 Advanced Microcomputers

(Prereq: 5362)

## ECE 5466 Embedded Computer Systems

QQ: 749389476 (Prereq: 5362)

## ECE 3905 and ECE 4905 Capstone Design I and II

<https://tutorcs.com>

For more information: undergraduate academic advisor

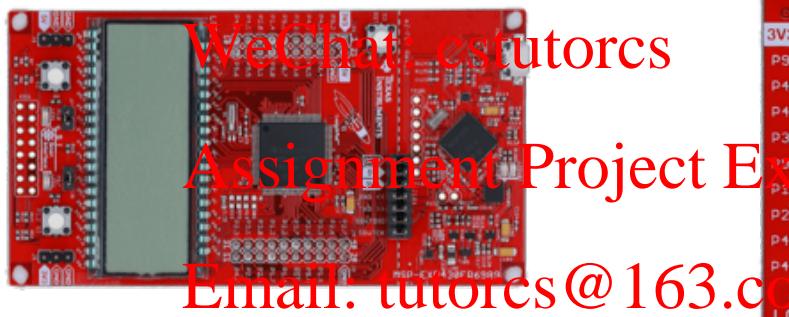


# Required Materials

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## Required Experimenter's Board

- MSP430FR6989 LaunchPad Development Kit



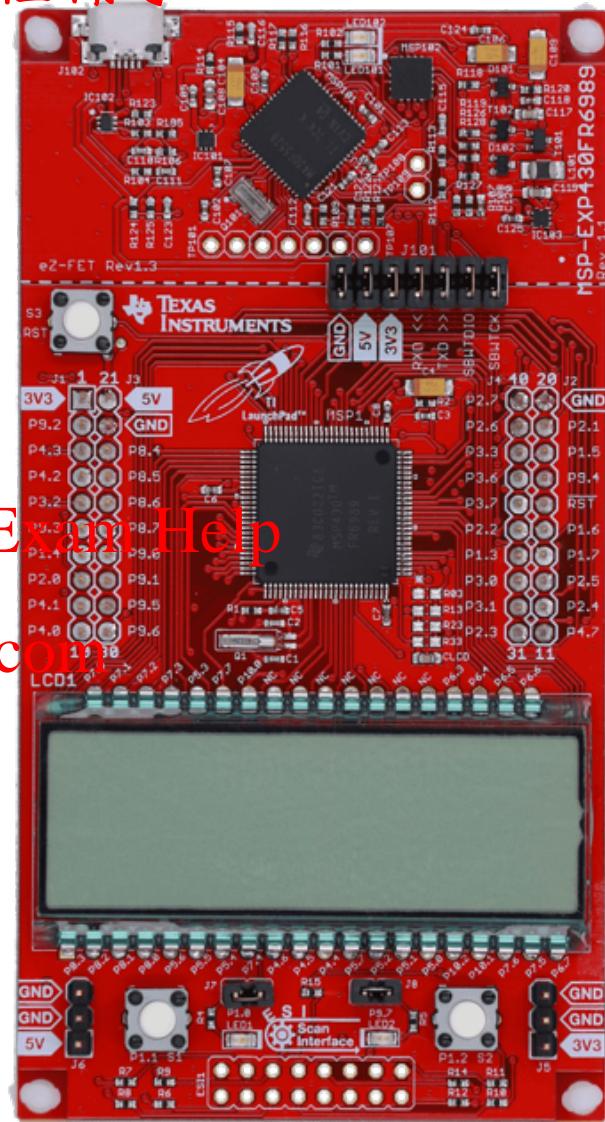
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Snap on  
ferrite bead



micro USB cable





# Required Materials

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## Required Experimenter's Board:

- MSP430FR6989 LaunchPad Development Kit



## Where to get it?

Order this hardware only



DEVELOPMENT KIT

MSP-EXP430FR6989 – MSP430FR6989 LaunchPad Development Kit

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[Log in to order](#)

\$20.00 (USD)

[Log in to view inventory](#)

[Buy from a distributor](#)

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digikey.com \$24 + ship – only 21 in stock!

mouser.com \$26.60 + ship - 508 in stock

amazon.com --\$\$\$\$



# What else do I need?

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## A computer with **Code Composer Studio (CCS)**

Integrated development environment (IDE) we will use to

- write code
- build
- upload to development board
- run, test, debug...
- grade almost all assignments for this class



Freely available from [ti.com](http://ti.com) for different platforms



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CCSTUDIO

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Code Composer Studio™ integrated development environment (IDE)

<https://tutorcs.com>

Overview

Downloads

Technical documentation

Related design resources

Support & training

ECE Windows computer labs have CCS up and running

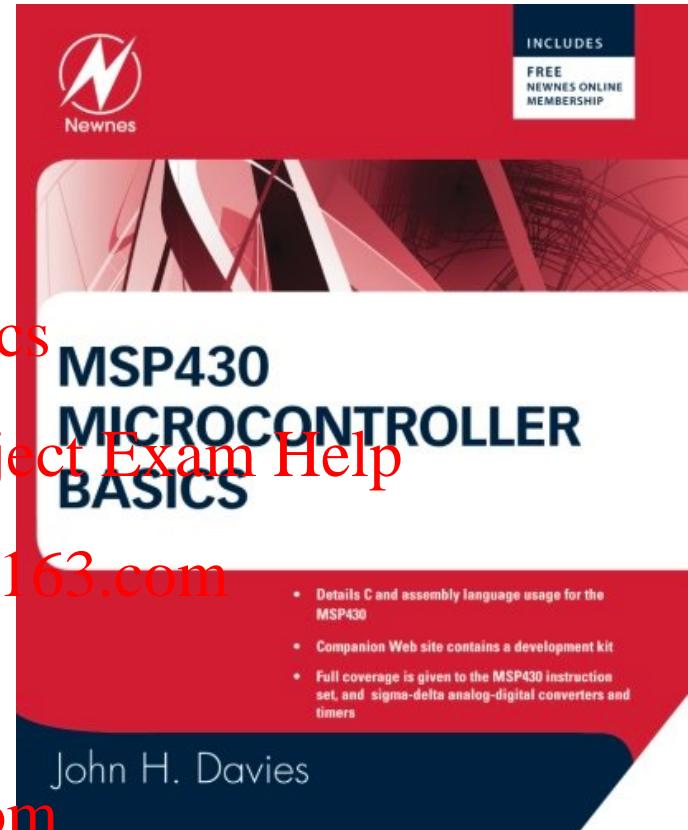


# Other Materials

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## Optional Reference Book:

- *MSP430, Microcontroller*  
John H. Davies, Newnes  
ISBN- 978-0-7506-8271-1
- No reading assignments
- No homework/quiz questions



Instead we will check TI user guides

- SLAU627A.pdf
- SLAS789D.pdf
- SLAU367O.pdf

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## Discord channel for discussions

- Link in Carmen, please join with your real name and keep the community going



# Assignments and Grading

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## Assignments and % of Class Grade

- Quizzes
- Midterms 1& 2
- Project
- Final Exam



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**Most assignments will be take home**

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- Last semester **all** assignments were take home and it worked fine
- Except many students ~~completely forgot their way into the classroom~~ Email: [tutorcs@163.com](mailto:tutorcs@163.com)

## Attendance

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- Still not mandatory, but highly encouraged
- Still plan to post lecture videos to Carmen – there might be delays/gaps <https://tutorcs.com>
- After the first two weeks we will do in class coding – bring your laptop
- If too many students forget their way into the classroom, might do some in class quizzes as a reminder



# Policies Around Assignments

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**You will have one week to work on your assignments**

- While the assignments can be done in a few hours



**This will give you a lot of flexibility with your timing**

- Quizzes cannot be made-up
- Midterm and final examination may be made-up only due to illness **that lasts the whole week of the assignment** (a doctor's note is required)

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**Re: SLDS accommodations** Email: [tutorcs@163.com](mailto:tutorcs@163.com)

- SLDS does not proctor take home exams
- Take home format already enables reduced distraction testing setting
- You can easily take 1.5x or 2x or 5x with your take home exam

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**Please reach out if you have any concerns**

# ECE 2560



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# Questions?

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# Microcontrollers

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## ECE 2560 Introduction to Microcontroller-Based Systems

- Hardware and software architecture of a typical **microcontroller**
- **Assembly / Machine** programming
- Interfacing peripheral devices and input-output programming
- Real-time computer applications



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What is a **microcontroller**?

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How is it different from a **microprocessor**? Is it even different?

What is **assembly language**? What is **machine language**?

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**Why do we bother learning all these things?**

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# Computers

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There are **two types of computers**



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**2. Embedded computers**



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# Two Types of Computers

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## 1. General-purpose computers

- Runs any type of SW
- Redundant resources
- Multiple peripherals
- Powerful processors
- Large data / program storage
- Operating system (OS)
- Multiple chips: e.g. CPU + RAM + hard drive
- **Distributed architecture**



## 2. Embedded computers

- Dedicated to one application
- Minimal resources needed
- Respond to some inputs: e.g., button press or sensor input
- Send **control** signals to subsystems
- Small data / program storage
- Mostly implemented on a single IC

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QQ 749389476 System on a Chip (SOC)

- \$\$\$\$
- ~400 million PCs sold a year

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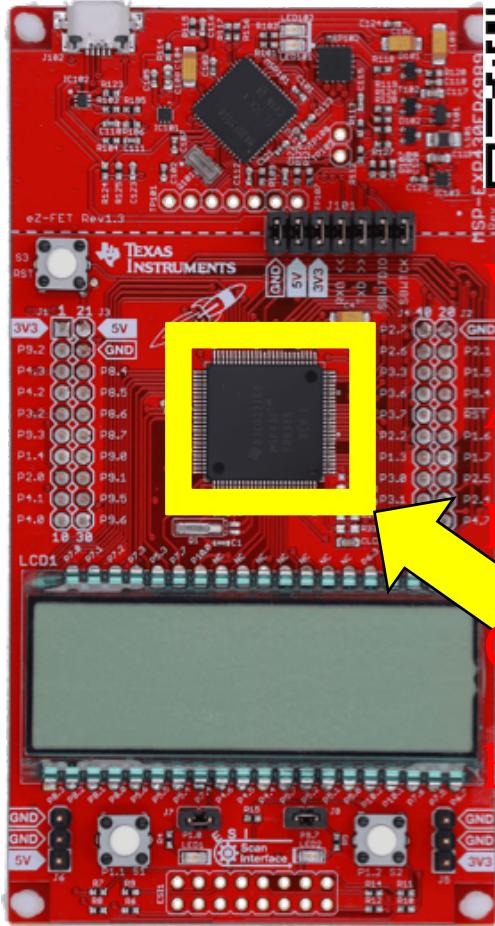
- 25 billion MCUs sold in 2018



# MCU

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i.e., Microcontroller Unit



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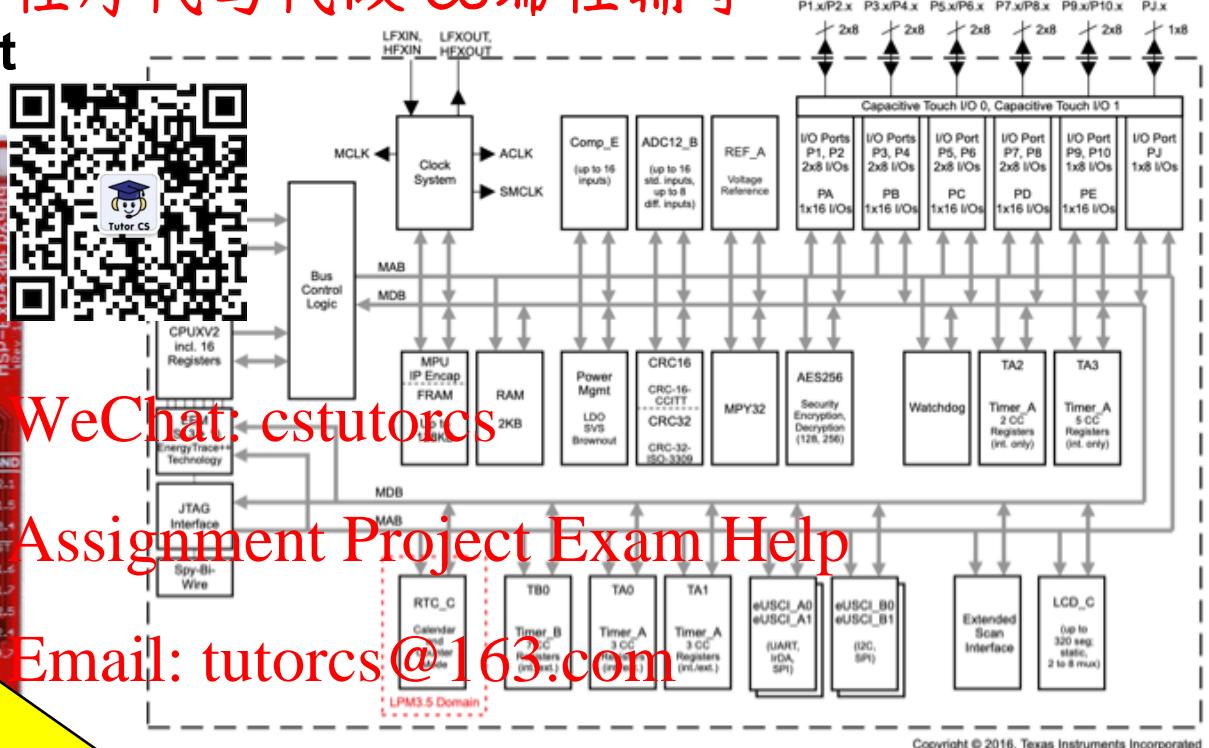
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This is the MCU on our development board

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**System on Chip:** It has the CPU, data and program memory, input/output and communication peripherals and more





# Assembly Language

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**Low-level language** that is closely tied to the **machine code** instructions of a processor



**Machine code:**

- Every processor has a set of instructions
- Each instruction is a numerical value composed of **opcodes** and **operand**

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mov.b #0001000b, \$P0OUT Email: tutorcs@163.com

[ ] [ ]

**Assembly**

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**Machine code**

Slightly more human  
readable **mnemonics**

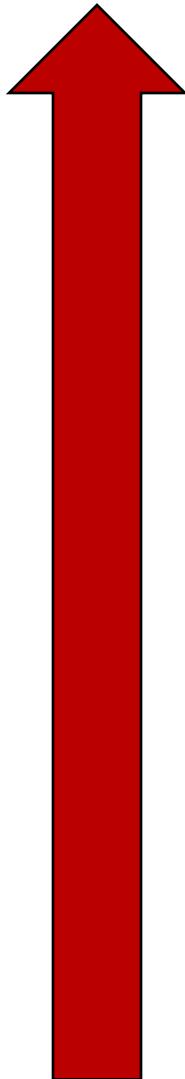
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Numerical values –  
**binary** for the processor  
**hex** for compact notation



# Levels of Languages

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High Level: Python



Increased  
Human  
Readability

Increased  
Portability

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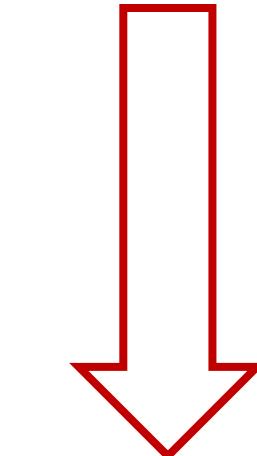
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Low (!?) Level: C/C++  
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Very Low Level: Assembly

Lowest Level: Machine Code



Increased  
Efficiency  
and control

Fast  
Small code

Decreased  
Portability



# Why Assembly?

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**Assembly** is

- not very human readable
- not portable: every processor has its own assembly

but

- allows for higher control over the resulting machine code
- faster
- smaller code



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Modern compilers are better in producing more efficient machine code from C

More MCU applications use C – embedded C

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ECE 3567 MCU Lab

Learning assembly is more than knowing another programming language – it allows you to understand how a processor works and allows you to write better programs even when using other languages

# Revisiting Learning Objectives



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## Official Course Goals

- Learn the architecture, timing, and interface requirements of a commercially used microcontroller or
- Learn to interface a microcontroller to memory, parallel & serial ports, etc.
- Learn to apply microcontroller systems to solve real-time problems



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## My Version of Course Goals

- Practice and develop problem solving skills
- Practice and develop clear thinking skills
- Learn to debug code
- Learn to test code

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# Some Student Outcomes

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- I had two things that stuck out to me the most: “The increase in my critical thinking to solve problems.”



- When I used to code, I would look at problems from more of a syntax point of view, now I look at it more from a logic point of view and it has made coding so much easier.

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- The most important thing I learned is how to properly debug code. This is the first class I have taken here that involves coding that actually went through a method on how to debug code.

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- In many other labs/classes in ECE we just follow instructions and copy code without needing to understand it. In this class, we write the code ourselves, which forces us to understand it. This made me feel a lot more accomplished when I was able to figure out the assignments, because it felt like I was doing something tangible on my own.