01 - Introduction

CEG 4330/6330 - Microprocessor-Based Embedded Systems

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Your Instructor

- Instructor
  - Max Gilson
  - BSEE - Wright State University 2018
  - MSEE - Wright State University 2019
  - 8+ years experience in industry in hardware and software development

Syllabus

- Lecture
- Lab
- Software
- Pilot
- Schedule
- Grading
- Late Assignments

AI Generative Work and Copied Work

- Using generative AI, like ChatGPT, to complete your quizzes, labs, or exams will result in a 0 for the course.
- You must be capable of writing your own code for your assignments without copying and pasting from other sources
- Copying work from others, online resources, or generative AI is an academic integrity violation

How to Get Help for Assignments Steps

Once you need help on an assignment:

1. Ask the TA during lab
2. Ask me during lecture
3. Come to my office hours
4. Ask question in email to TA
    a. TA will not review your code over email
5. Ask question in email to me
    a. I will not review your code over email

Note: The TA is taking their own courses too! The TA might not be able to help you the day the assignment is due!

Note: If asking for help 1 or 2 days before the lab is due don’t expect an immediate help!

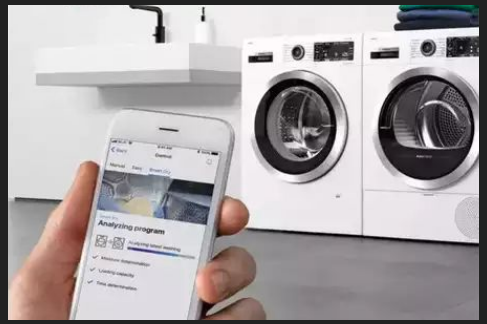
Lab

- No lab for first week
- Lab will start on second week

What is a “Microprocessor-based Embedded System”

- Microprocessor - any of a type of miniature electronic device that contains the arithmetic, logic, and control circuitry necessary to perform the functions of a digital computer’s central processing unit.
- Embedded system - a computerized system dedicated to performing a specific set of real-world functions, rather than to providing a generalized computing environment.

Embedded Systems in The Real World



The Reality of Embedded Systems

- They are everywhere
  - You most likely have one in your pocket right now
- They are use specific
  - The embedded system inside of a video drone has a very different use case and design compared to a smartwatch
- They can be very “simple”
  - Microwaves, dishwashers, dryers, etc. can all contain simple embedded systems
- Designing requires multidisciplinary knowledge
  - Operating systems, multi-language programming, circuit board design, computer organization, power systems, mechanical fitting, etc.
- Every design comes with constraints
  - Physical space, memory size, processing power, power limitations, cost, etc.

Memory Review

- Byte Addressable Memory
  - Every address contains one byte of data
- Word Addressable Memory
  - Every address contains one word of data
  - Word size is defined by the hardware
- All memory is stored in binary
  - All binary numbers can be represented as hexadecimal
  - All computers “understand” is 1’s and 0’s
- Memory Mapped I/O
  - Input and output devices can be accessed by a memory address

Memory Review

- Big Endian
  - Most significant byte/word has the lowest address
- Little Endian
  - Least significant byte/word has the lowest address
- How many bytes do we have in memory?
  - Address range: x0000 to xFFFF
  - Address range: x0000 to x0FFF
  - Address range: xA000 to xA7FF
  - Calculate for byte addressable and word addressable (2 byte words)

Programming Review

- C Programming Language
  - Source Code
  - Assembly Code
  - Machine Language
- Data type sizes
  - char - 1 byte - 8 bits
  - int - 2 to 4 bytes - 16 to 32 bits (short vs long)
  - float - 4 bytes - 32 bits
  - double - 8 bytes - 64 bits

Square Wave Review

- Amplitude
  - The maximum voltage/value of the signal (example shows 5V)
- Frequency
  - Number of cycles per second
- Period
  - Time of cycle in seconds
- Period vs Frequency
  - Frequency = 1 / Period
  - Period = 1 / Frequency
- Duty Cycle
  - Time high (sec) / Period (sec)
- Pulse Width Modulated (PWM)
  - The “width” or duty cycle of the wave is modulated as an input/output