

## ECE471: Embedded Systems – Homework 1

**Due: Friday 13 September 2024, 10:00am**

For this homework short answers will suffice. There isn't necessarily a right or wrong answer for some of the questions, but be sure to explain your reasoning.

To submit, create a document with your answers (text, pdf, libreoffice, MS Office if you must) and e-mail them to *vincent.weaver@maine.edu* by the homework deadline. Title your e-mail "ECE471 Homework 1" and be sure your name is included in the document.

1. For each of the following three cases, classify if you would consider the device described as an embedded system or not. For each case use at least 2 of the characteristics given in class for what defines an "embedded system" and say whether the device meets them.
  - (a) The iPhone 15. This phone has an Apple A16 Bionic processor in it. This processor is a six-core 64-bit CPU running at up to 3.4GHz. It also includes a 16-core neural network accelerator capable of 11 trillion operations per second. It has 6GB of RAM and a powerful 5-core GPU (graphics unit) with 2556x1179 resolution.
  - (b) You buy an electric toothbrush that has an 8-bit PIC16F1516 microcontroller (16MHz, 8k flash, 512 bytes RAM), an 8 LED display, an i2c pressure sensor, and a motor driven by an H-bridge.
  - (c) You open up a microwave and it has an 8-bit PIC processor in it. This processor runs at 10MHz and the only interface is an LED display, a keypad, and some circuitry to operate the fans and magnetron.
2. How many "bits" wide are the following systems? Why?
  - (a) An ARM Cortex A72 processor (found in a Raspberry Pi 4B). Its ALU and registers are 64 bits. Its address bus is 44 bits. Most instructions it executes are 32 bits long.
  - (b) An ARM 1176 found in the original Raspberry Pi 1B. Its registers, integer ALU, program-counter, and address bus are all 32-bits. It executes instructions that are 32 or 16 bits long.
  - (c) A MOS 6502 processor (found in older desktop and embedded systems). Its registers, data bus, and ALU are 8-bit while the instruction pointer and address bus are both 16-bit.
3. You are designing a small embedded system.
  - (a) Describe one reason why using an ASIC (application-specific integrated circuit) might be better than using a microcontroller.
  - (b) Describe one reason why using a microcontroller might be better than using an ASIC.