Introduction to Microcontroller

Lecture 1

Yeongpil Cho

Hanyang University

About me

- 조영필 (Yeongpil Cho)
  - A system security researcher
  - Designing new SW/HW techniques for better security
    - OS kernels
    - Hypervisor
    - Firmware
    - Applications
   - etc.

Course information

- Goal
    - **Microcontrollers**, widely found in embedded systems, are tiny computer systems, consisting of a CPU, memory and peripherals.
    - You will have a good understanding of microcontrollers and furthermore general computer systems.

- Class time & location
    - Theoretical classes
        - Mon. 11 am @ ITBT 508
    - Practical classes
        - Mon. 11 am @ ITBT 508

- Course materials
    - (main) Lecture notes
    - (auxiliary) Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C: Third Edition

Course information

- Grading policy
    - Midterm: 20%
    - Final: 20%
    - Lab assignments: 20%
    - Term project: 30%
    - Attentance:10%
        - 3 tardiness → 1 absence
        - 1/3 or more absence → grade 'F'
        - Using the Smart Attendance System
        - After the course registration modification period (9/6)
- Office hour
    - Make an appointment at any time
        - ypcho@hanyang.ac.kr
    - Location: ITBT 1208
- TA
    - Sangmin Lee (이상민) ozoesm@hanyang.ac.kr
    - Wonjun Ma (마원준) mawj09@hanyang.ac.kr

① Visit our course website through "**learning.hanyang.ac.kr**"
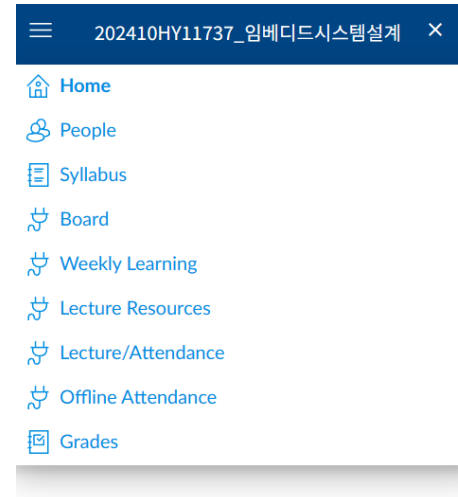
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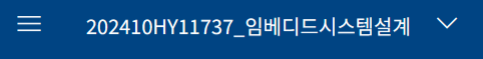
② Press the header to expand the menu and click the "Offline Attendance"

③ Entering the authentication number to check your attendance

⊙ You may try the mobile app, "Learning X Student"

Downloading Application → Find my school → Searching Hanyang University LMS → Enter ID/PW of Hanyang Portal and access the Course
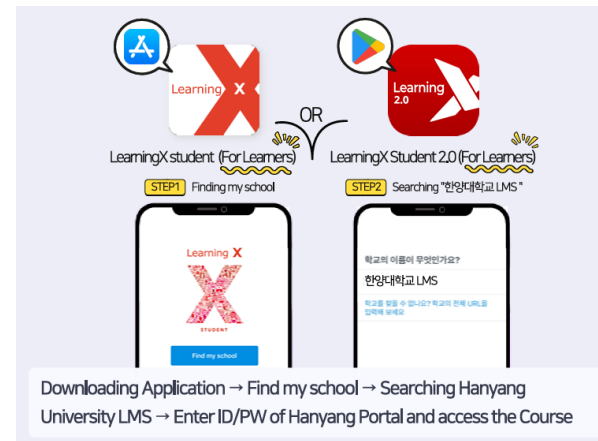
Tentative Syllabus (Theory Classes)

| Week	Date	Lectures
1	9/1	Course Introduction
2	9/8	Basics in Computer Architecture
3	9/15	Introduction to ARM Architecture & Overview of Cortex-M processors
4	9/22	Memory system in Cortex-M processors
5	9/29	ARM Assembly Language I
6	10/6	"Chuseok". No class
7	10/13	ARM Assembly Language II (Online Course)
8	10/20	Midterm Exam
9	10/27	ARM Assembly Language III
10	11/3	Cortex-M's subroutine mechanism
11	11/10	Cortex-M's interrupt mechanism I
12	11/17	Cortex-M's interrupt mechanism II
13	11/24	Cortex-M's timer and GPIO
14	12/1	Final Exam
15	12/8	Term Project
16	12/15	Term Project

What is a microcontroller?

# General Structure of Computer
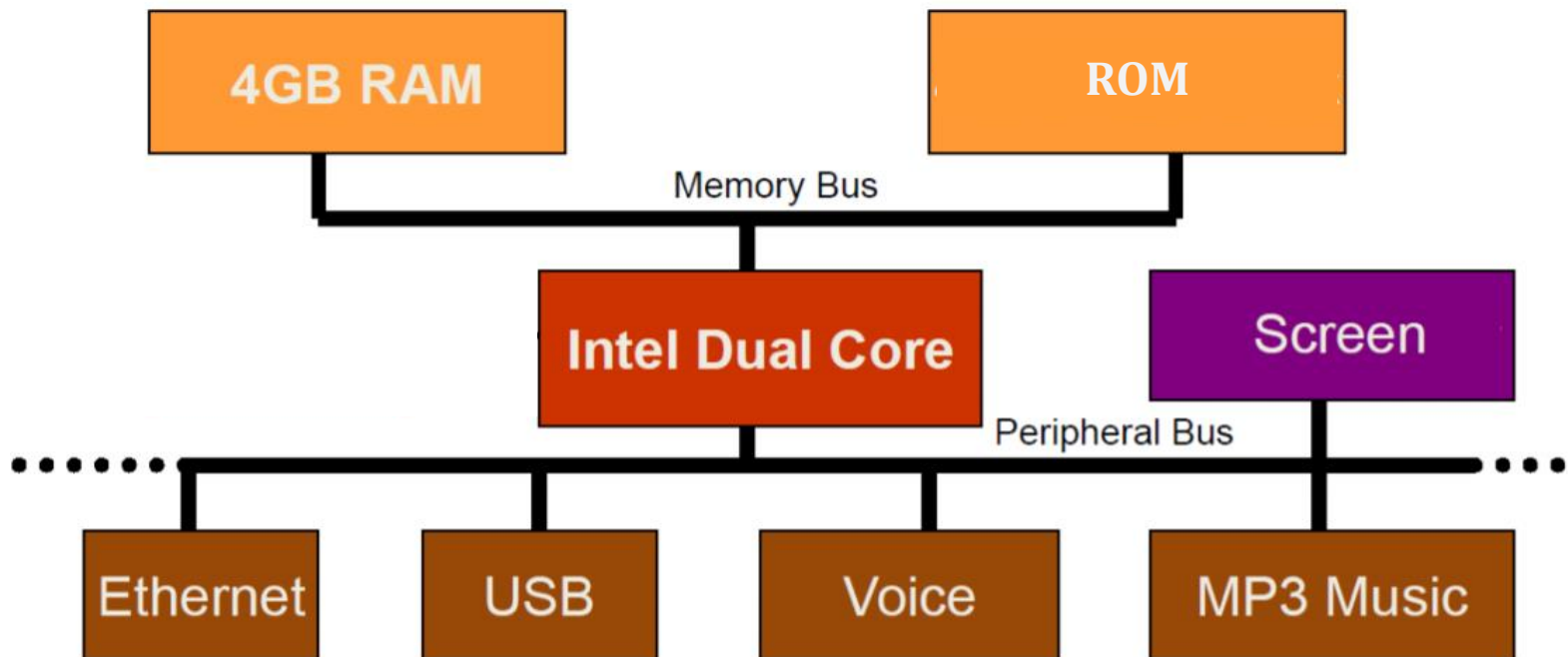
What is Microcontroller?

- Microprocessor vs. Microcontroller
    - **Microprocessor**: A CPU on a single integrated chip (IC)
        - The brain of computer
        - E.g.:
            - Intel/AMD's x86
            - ARM's Cortex
        - Contains no RAM, no ROM, no I/O devices
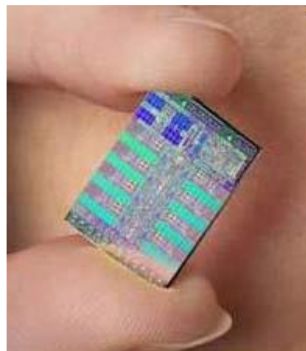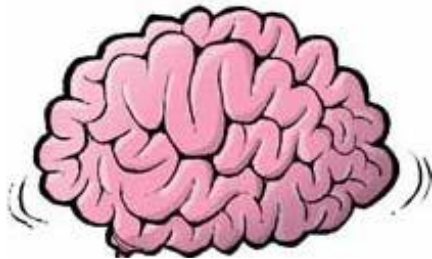
What is Microcontroller?

- Microprocessor vs. Microcontroller
  - **Microcontroller**: A CPU, and RAM, ROM, I/O devices, and timer on a single chip (Also called MCU)
    - "Computer on a chip"
    - Also called **MCU** (Micro-Controller Unit)
    - Usually not as powerful as a general-purpose microprocessor
    - But, **application specific**
      - The operation software ("firmware") is embedded in hardware (ROM)
    - So, low power consumption, small size, low cost
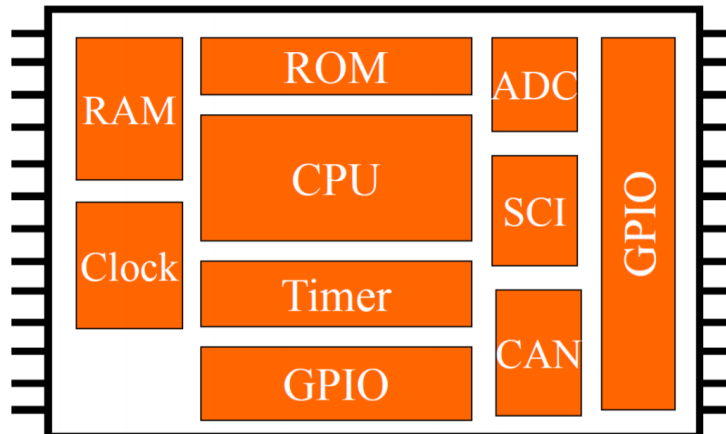
Applications

- Applications of Microcontroller
  - Home
    - Alarm clock, Wireless router …
  - Office
    - Scanner, Printer, Fax machine, Copier,, …
  - Industry
    - Machinery, Equipment, Instrumentation, Rocket, …
- Microcontroller is everywhere, particularly in embedded systems!

Course Contents

- What are we going to learn in this course?
    - We will explore Microcontrollers based on ARM Cortex-M processors

    - Theory classes
        - What are inside a microcontroller?
            - The basic structure of a microcontroller
        - How to program a microcontroller (Firmware)?
            - Assembly language
            - C language
        - How to build a system with a microcontroller?
            - I/O devices
            - Hardware connection
    - Practice Classes
        - Deal with various features of a Cortex-M based microcontroller
        - Developing a robot tracing lines with calibration capability