

Wireless Embedded Systems

Department of Radio & Information Communications Engineering
CHUNGNAM NATIONAL UNIVERSITY

김병관

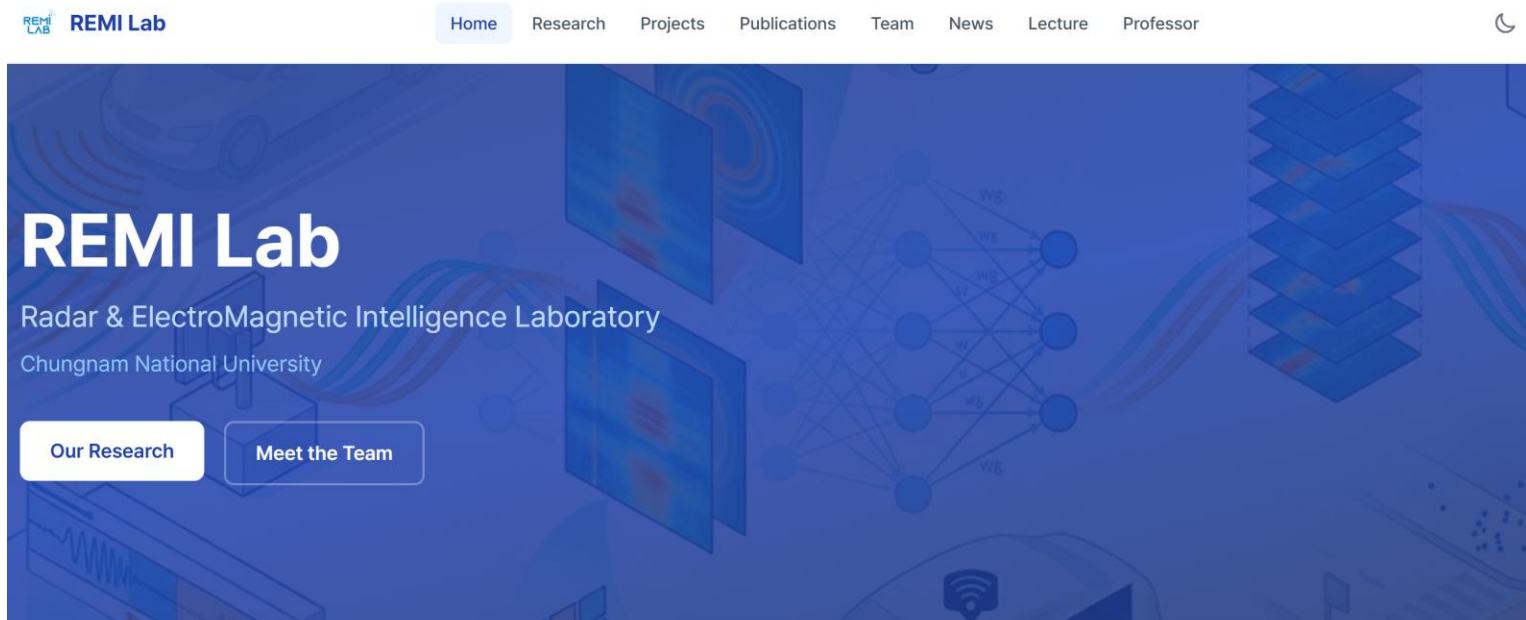
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Course Information

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Course Objectives

- In shortly,

Signals and Systems

Convolution

Complex
Number

Fourier Series
& Transform

Sampling

Wireless Embedded Systemss

Digital Signals
and Sampling

Software-
Defined Radio

Analog & Digital
Modulation

Wireless
Communication

Course Overview

- Tentative Schedule

#	Topic	Lab	Assignment
1	Introduction		
2	Review: Python Basics, Signal & Systems	#1, 2	#1
3			
4	Digital Signals and Sampling	#3	
5			
6	Analog & Digital Modulation		#2
7			
8	Midterm Exam		
9	Software-Defined Radio	Env. Setup	#3
10			
11	Wireless Communication Experiments (Spectrum Monitoring, Communication)	#4 #5 #6	
12			
13			
14			
15	Final Exam		

Grading Policy

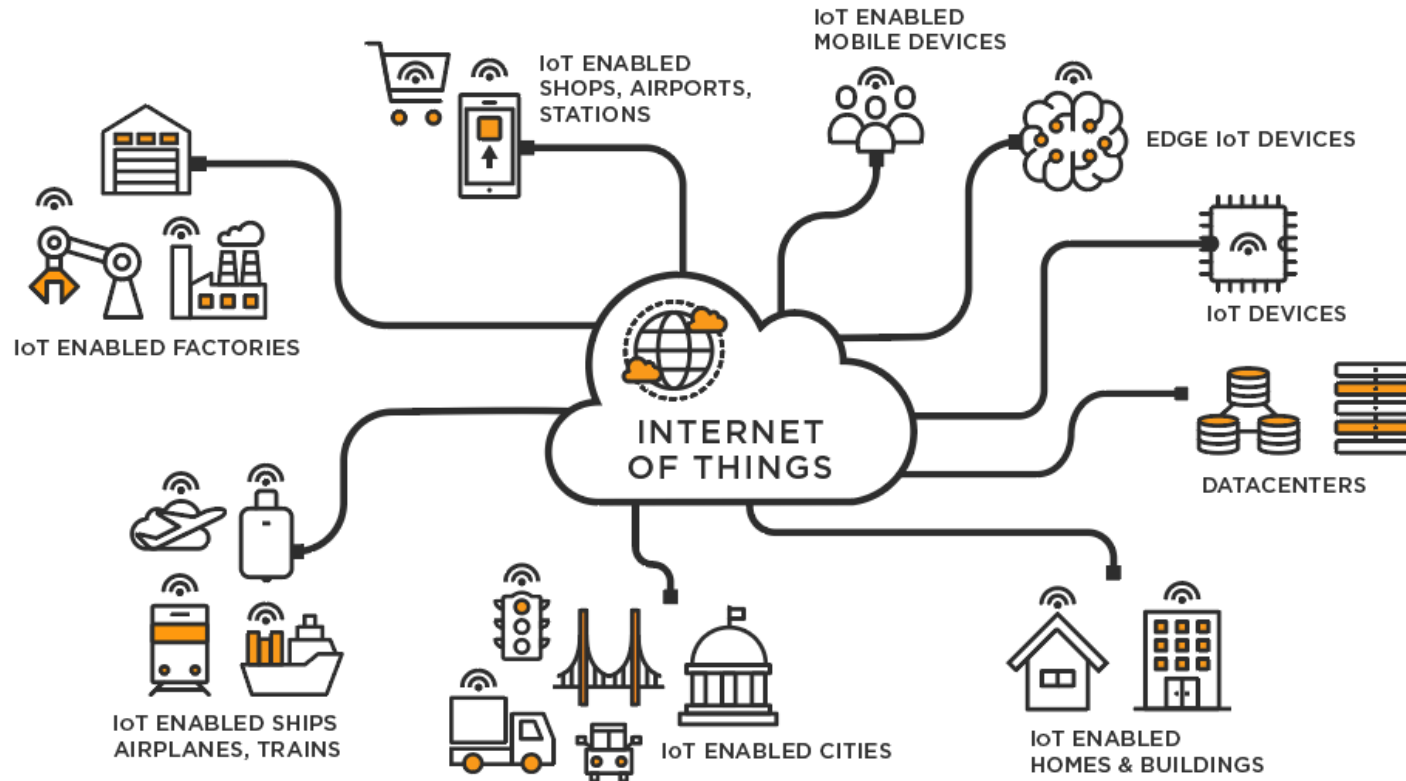
• Summary

출석	과제	중간고사	기말고사
5%	30%	30%	35%
대면 강의 출석	과제 보고서 3회 제출	자필 시험	자필 시험
주의사항	주의사항	주의사항	주의사항
• ¾ 이상 출결시 만점 • 단, ¾ 이하 수강 시 F	• 유사도 검증 프로그램 사용 • PDF 및 제출 형식 준수	• 1~7주차 강의 내용 • 시험 예시 문제 안내 예정	• 전체 강의 내용 • 시험 예시 문제 안내 예정

- Gradescope 를 통한 채점기준 및 결과 공개
- 부정행위 적발 시 예외 없는 F학점 부여

Course Objectives

- What is an "embedded system"
 - is a **computer system** that has a **dedicated function** within a larger mechanical or electronic system



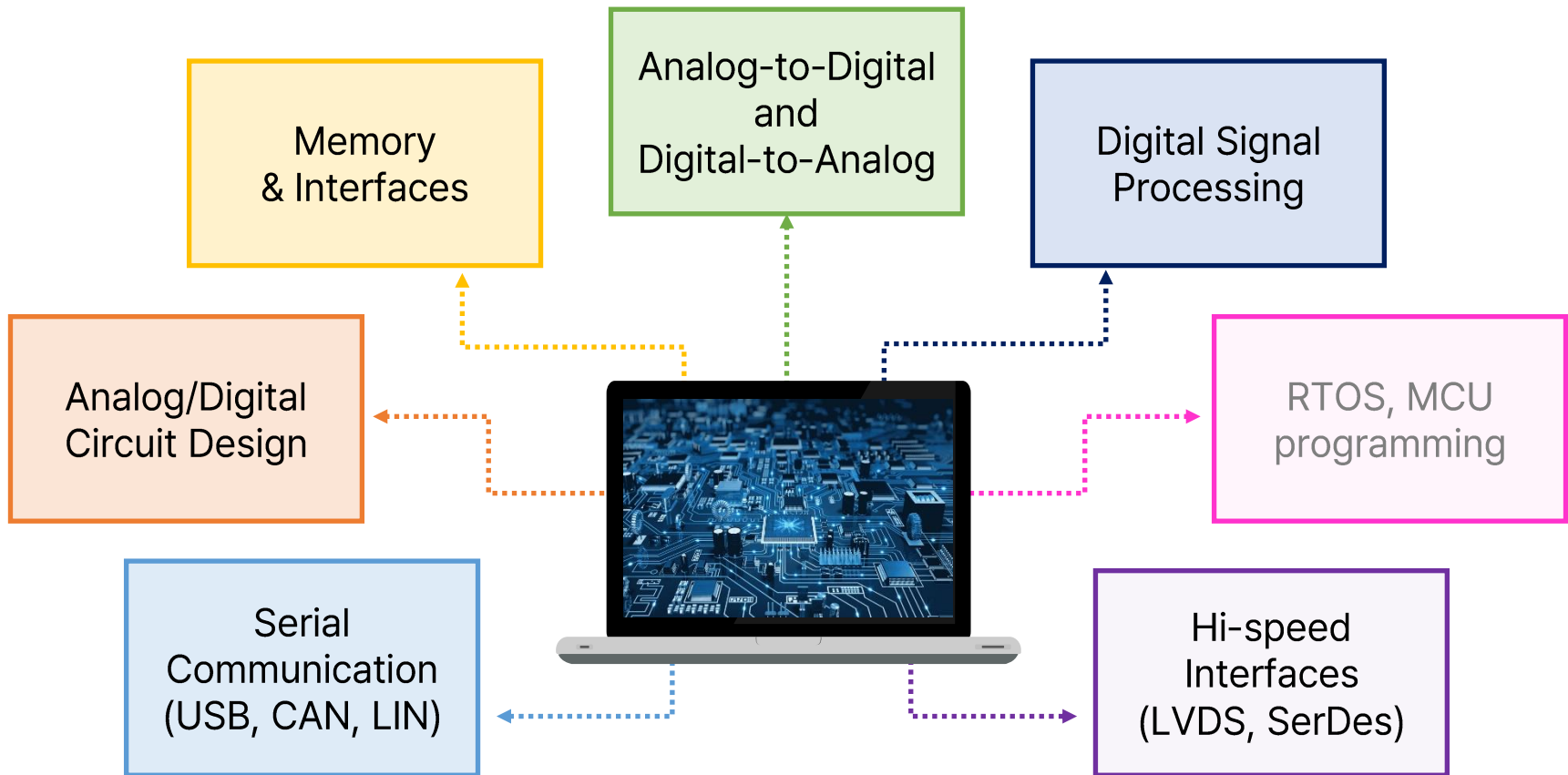
Course Objectives

- What is an "embedded system"
 - is a **computer system** that has a **dedicated function** within a larger mechanical or electronic system



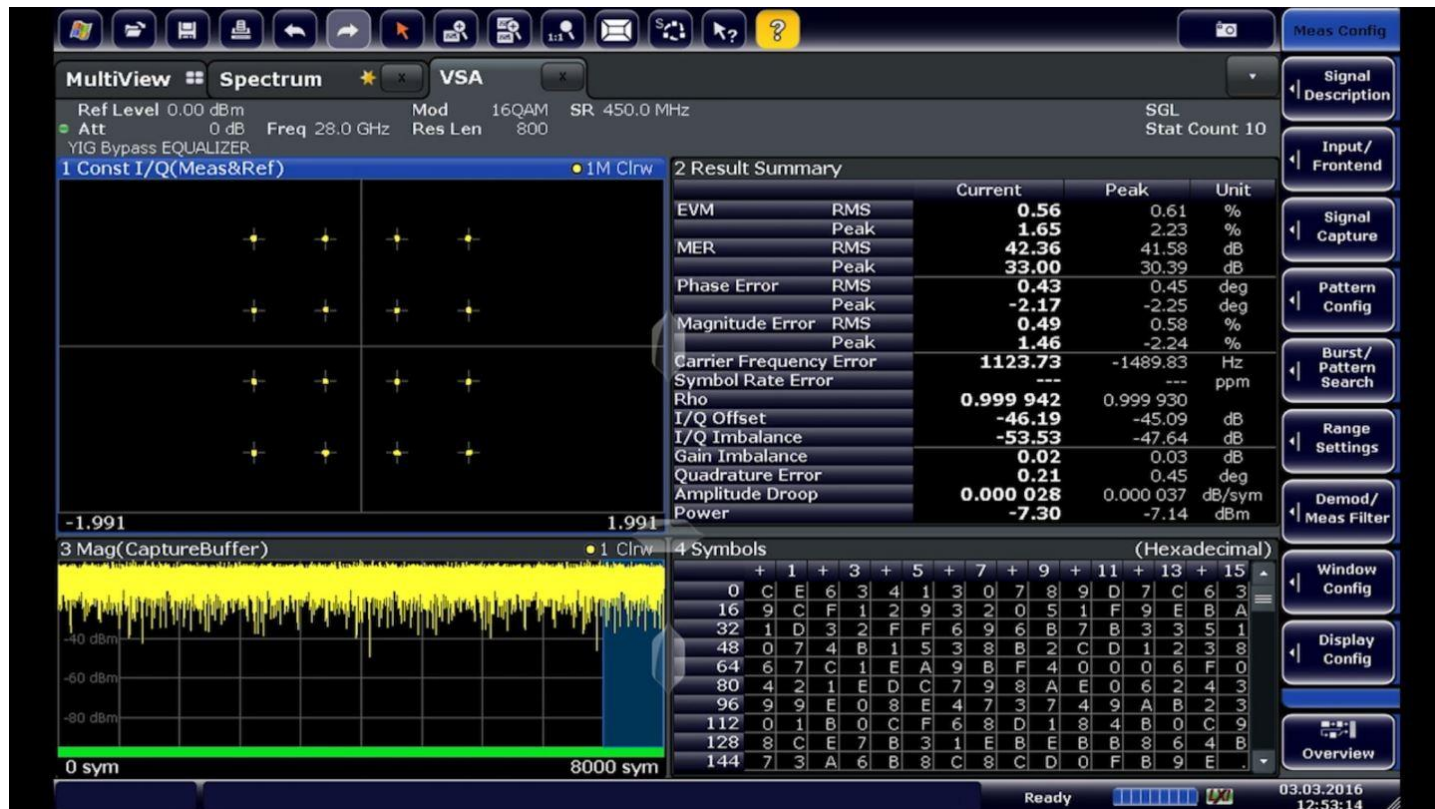
Course Objectives

- Scope of Embedded system



Course Objectives

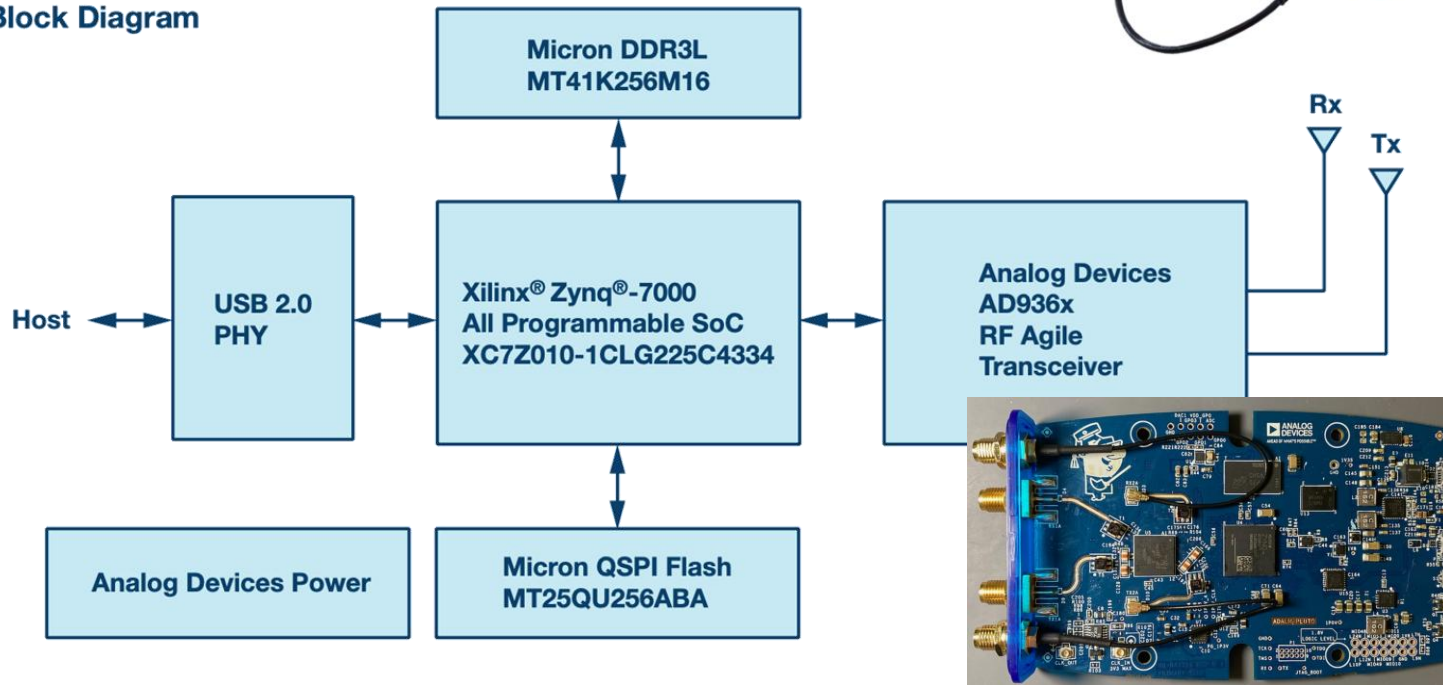
- What we will learn from this course
 - **What is a digital signal? (for wireless communication)**



Course Objectives

- What we will learn from this course
 - An example of embedded system: SDR
 - Transceiver, Memory, Power circuits

Simplified Block Diagram



Course Objectives

- What we will **not** learn from this course
 - How to control these?
 - Bitwise Operations, SPI, Serial Communications
 - Programming of Embedded Processor

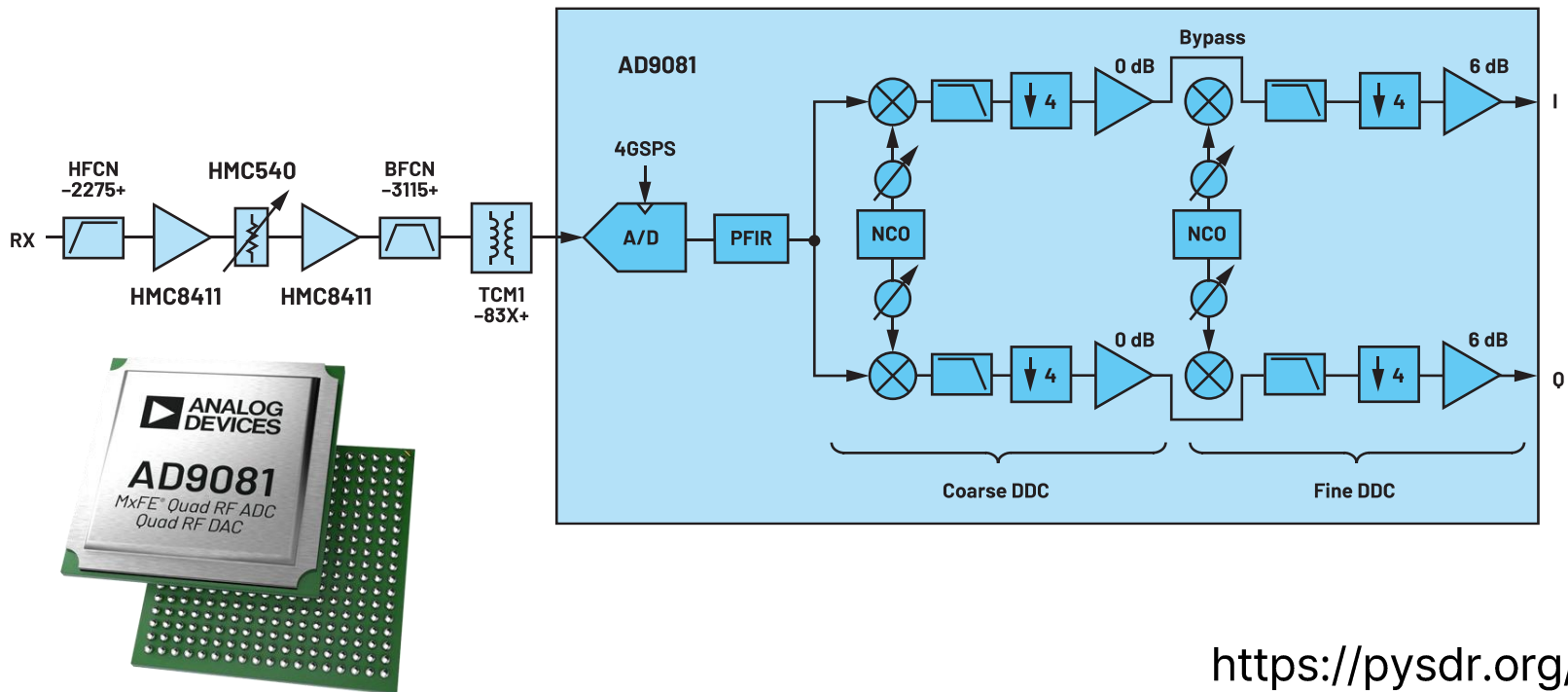
ENABLE STATE MACHINE (ENSM) REGISTERS (ADDRESS 0x013 THROUGH ADDRESS 0x017)

Table 12. ENSM Registers Summary Map

Register Address	Name	D7	D6	D5	D4	D3	D2	D1	D0	Default	R/W
0x013	ENSM mode	Open							FDD mode	0x01	R/W
0x014	ENSM Configuration 1	Enable Rx data port	Force Rx on	Force Tx on	ENSM pin control	Level mode	Force alert state	Auto gain lock	To alert	0x13	R/W
0x015	ENSM Configuration 2	FDD external control enable	Power down Rx synthesizer	Power down Tx synthesizer	TXNRX SPI control	Synthesizer pin control mode	Dual synthesizer mode	Rx synthesizer ready mask	Tx synthesizer ready mask	0x08	R/W
0x016	Calibration control	Rx base-band tune	Tx base-band tune	Must be 0	Tx quadrature calibration	Rx gain step calibration	Open	DC calibration RF start	DC calibration baseband start	0x00	R/W
0x017	State	Calibration sequence state[3:0]				ENSM state[3:0]					R

Course Objectives

- What we will learn from this course
 - Transmit & receive wireless signal.
 - Simple wireless communication.
 - In Python environment



<https://pysdr.org/>

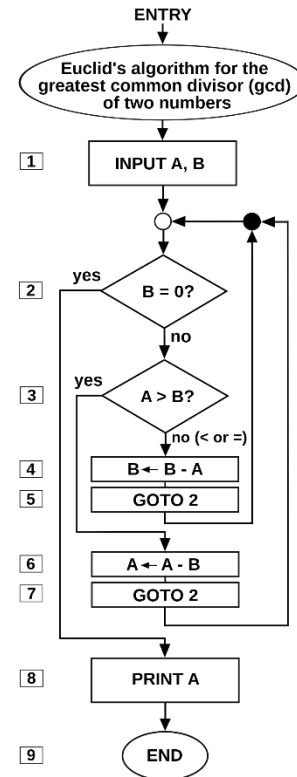
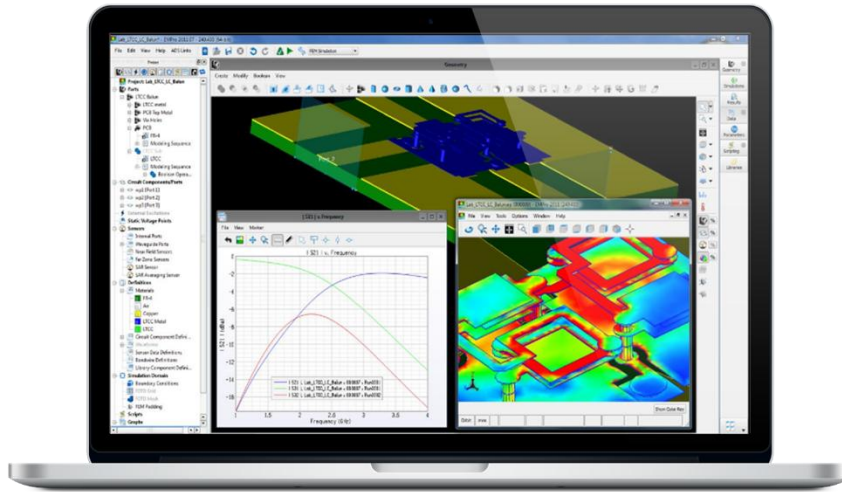
Course Overview

- Programming in Radio Engineering
 - 개발자 혹은 프로그래머 하면 떠올리는 것들
 - 컴퓨터공학, 인공지능, 웹서비스, 백엔드, 프론트엔드, ...
 - JS, Swift, Python, C++, C#, ...



Course Overview

- Programming in Radio Engineering
 - Computer : A machine that can be **programmed** to perform **sequences of arithmetic or logical operations automatically**.
- 계산을 도와주는 매우 훌륭한 공학적 도구
- 수치해석, 미분방정식, 행렬 연산 등



Course Overview

- 프로그래밍을 배워야 하는 이유?
 - 과학적 사고방식을 실천하기 매우 용이함
 - 작성 -> 실행 -> 분석 -> 개선
 - 에러 메시지를 관찰한다는 것은?
 - 될 때까지 계속 해보기 vs. 생각을 정리한 뒤 하나씩 해 보기

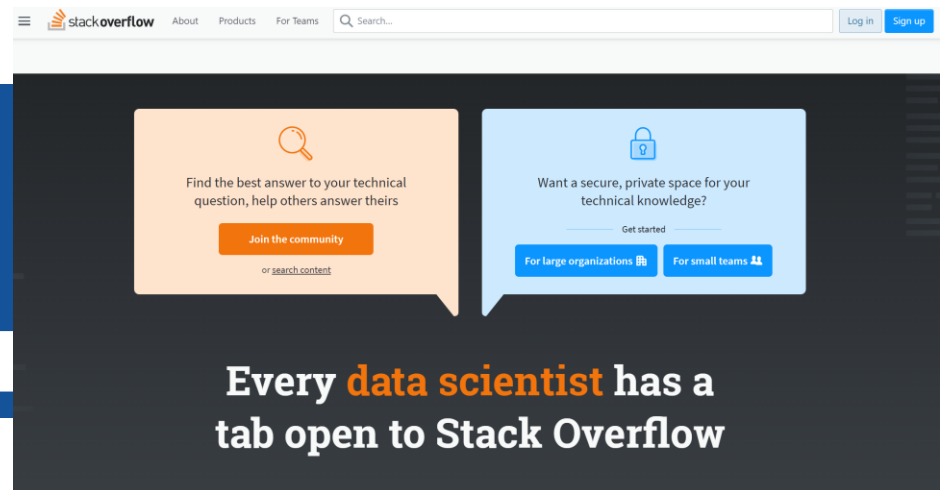


Course Overview

- Programming in Radio Engineering
 - 프로그래밍이 배우기 좋고, 비교적 쉬운 이유
→ 어디가, 어떻게 틀렸는지 적어도 알려준다.

⚠ "plt" is not defined Pylance([reportUndefinedVariable](#)) [Ln 1, Col 11]
⚠ "plt" is not defined Pylance([reportUndefinedVariable](#)) [Ln 4, Col 11]

→ 비슷한 메시지를 찾으려면?



Course Overview

- Programming in Radio Engineering
 - 코드(글) 작성하는 AI
 - 사용해야 할까?

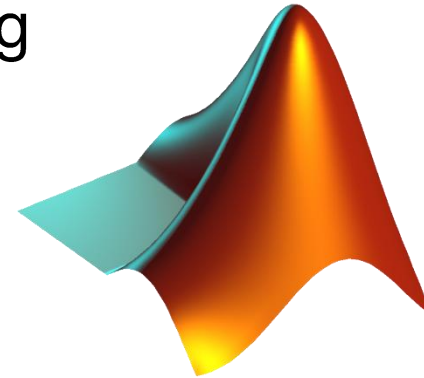
```
# please write down an sort algorithm for an array
# the list of sort algorithms are in https://en.wikipedia.org/wiki/Sorting\_algorithm
# choose three random algorithms and write down the code
```

```
import random
import time

def bubble_sort(array):
    n = len(array)
    for i in range(n):
        for j in range(0, n - i - 1): # Last i elements are already in place
            if array[j] > array[j + 1]:
                # swap
                array[j], array[j + 1] = array[j + 1], array[j]
```

Course Overview

- Programming in Radio Engineering
 - Python & MATLAB



	Python	MATLAB
비용	무료	유료
형태	인터프리터식 (스크립트 언어)	인터프리터식 (스크립트 언어)
특징	들여쓰기로 블록을 구분	하드웨어 테스트, 시뮬레이션 및 연동 (Simulink)
장점	빠르다, 쉽다, 널리 활용됨.	심화 기술을 빠르게 시작 가능

Course Overview

- Preview: Python Basics

- 추천 강의: <https://kooc.kaist.ac.kr/cs101>
- 알아야 하는 기본 개념들

Variable

- 실수 (Int, long, float, ...)
- 복소수 (Abs, angle, rad, deg)

Data Structure

- List
- Array
- Set/Tuple/Dictionary

Conditional Statements

- If, else
- While
- Break

Matrix Calculation

- Element-wise
- Matrix multiplication
- Vector/Matrix Size

Thank you

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