

임베디드 시스템 C프로그래밍

핵심 노트

현대자동차 입문교육
박대진 교수

임베디드 시스템 C프로그래밍

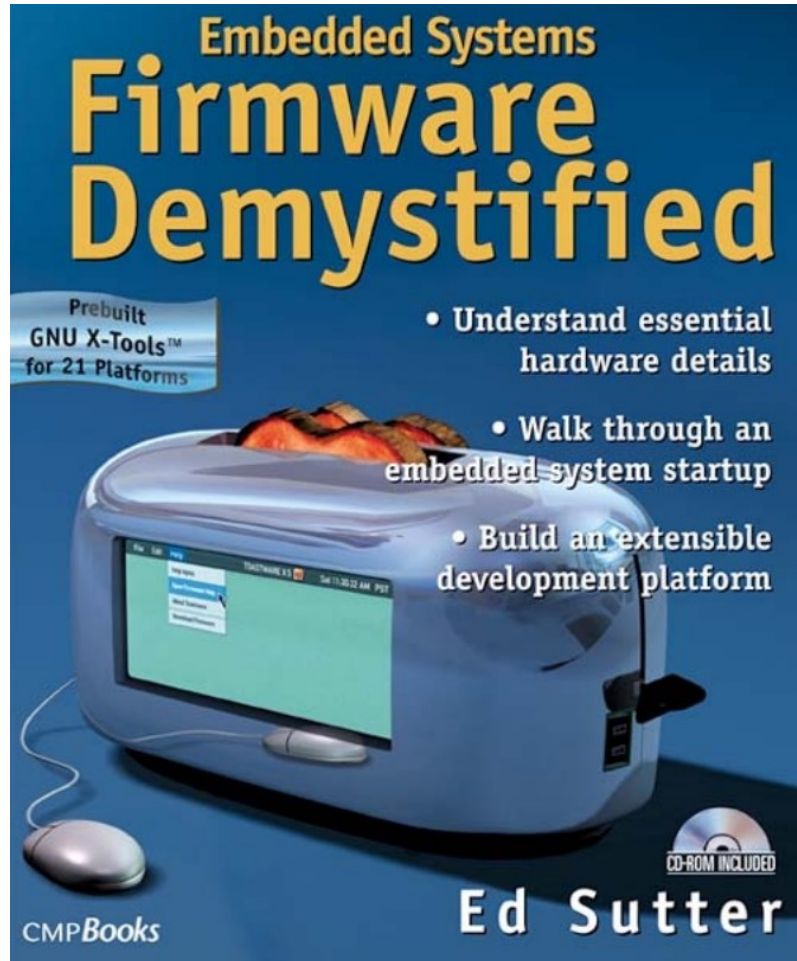
무엇을 배우는가 ? 그리고 배워야 하는 이유?

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강의 Overview

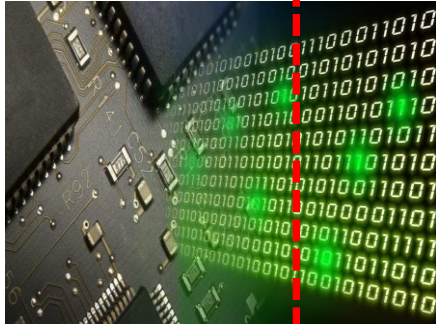
- 3개의 세션
 - Day 1 - Embedded Systems 및 System Programming
 - Day 2 - Embedded Systems Programming을 위한 C언어 실전
 - Day 3 - System Software를 타겟 프로세서에 Embedding

Everything is Powered by Software



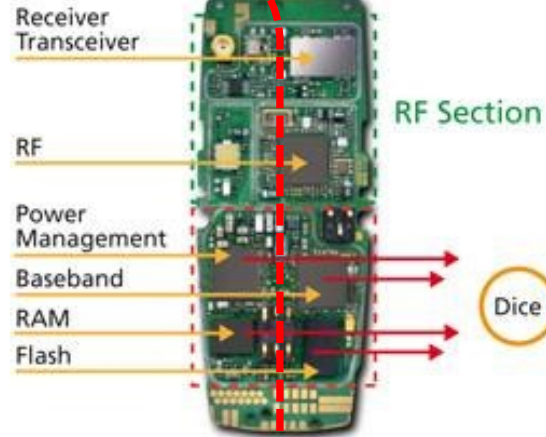
Things,
powered by
Software

EE/CS분야에서 시스템 프로그래밍의 영역



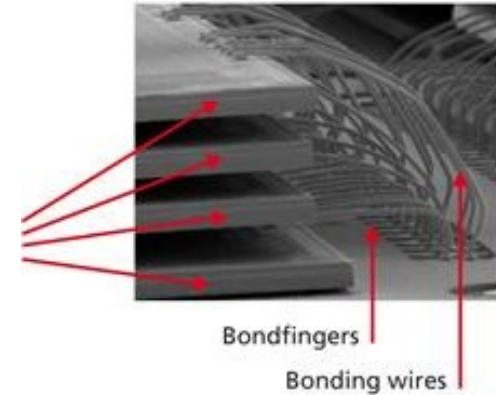
Connectivity & Intelligence

(Networks, Computer Archi., O/S, Embedded S/W, Platform)



Smart Systems

(VLSI, Control, Signal Processing, Robotics)

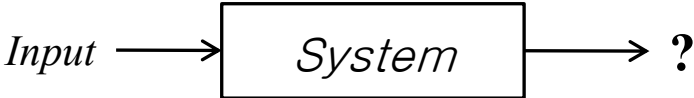
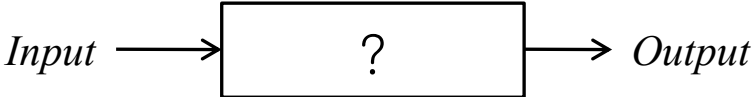
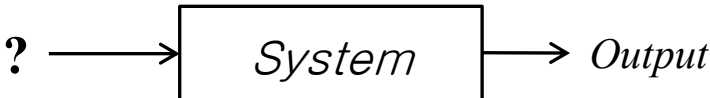


Emerging Device

(Semiconductor, Nano Technology, RF)

시스템 설계

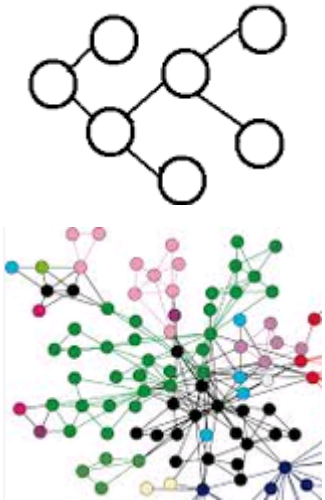
- Research objectives:
 - Given two out of {input, system, output} find the rest.

	Analysis — { Behavior , Performance }
	Design : Iteration of Plan-Generation-Analysis
	Control (Management): Goal-oriented Optimization

프로그래밍을 통한 시스템 설계

System-Software-on-Chip (MCU)

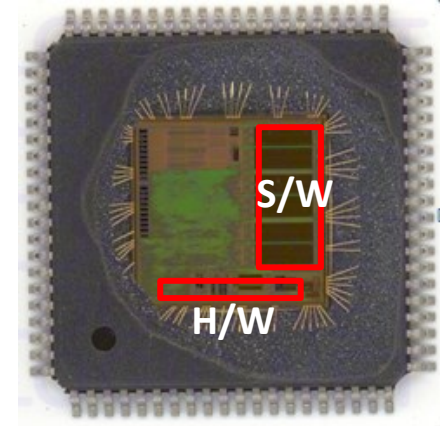
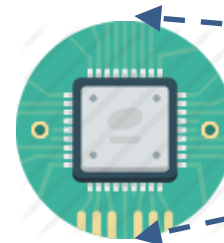
Designing Data
Structure



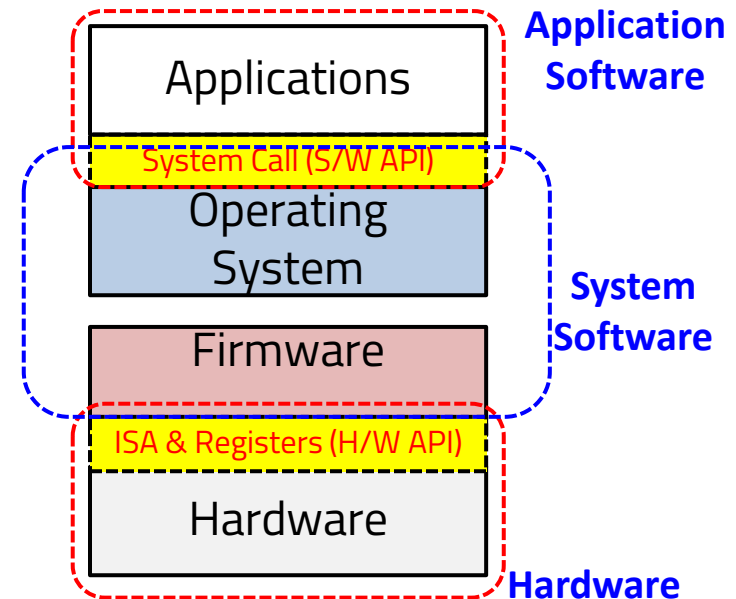
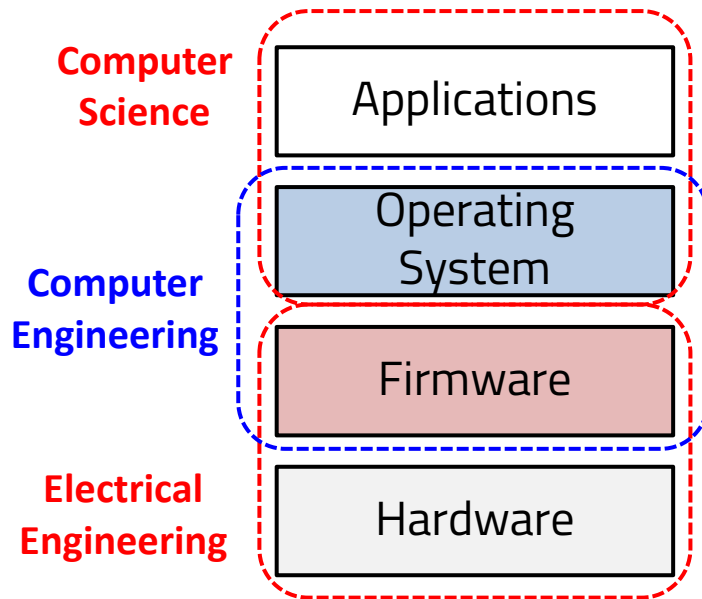
Programming
S/W



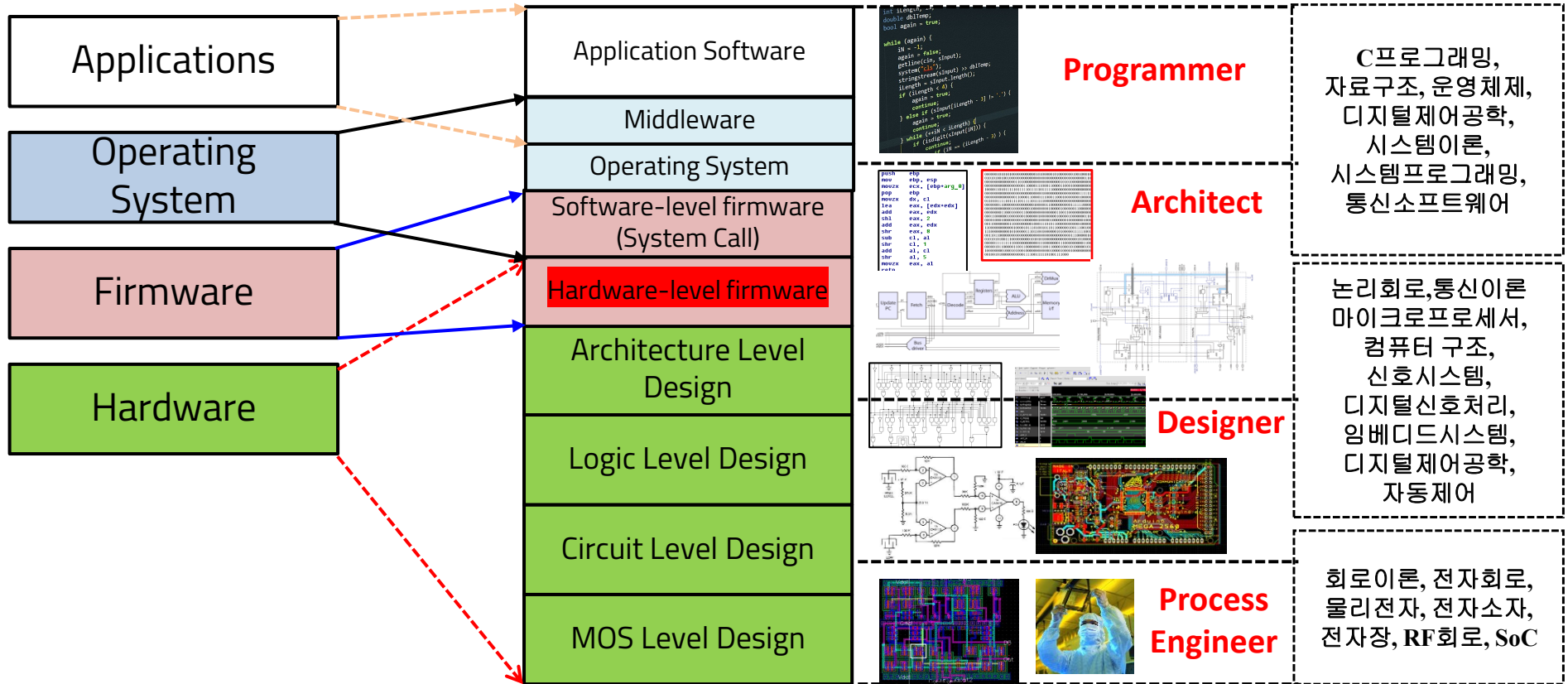
Programming
H/W



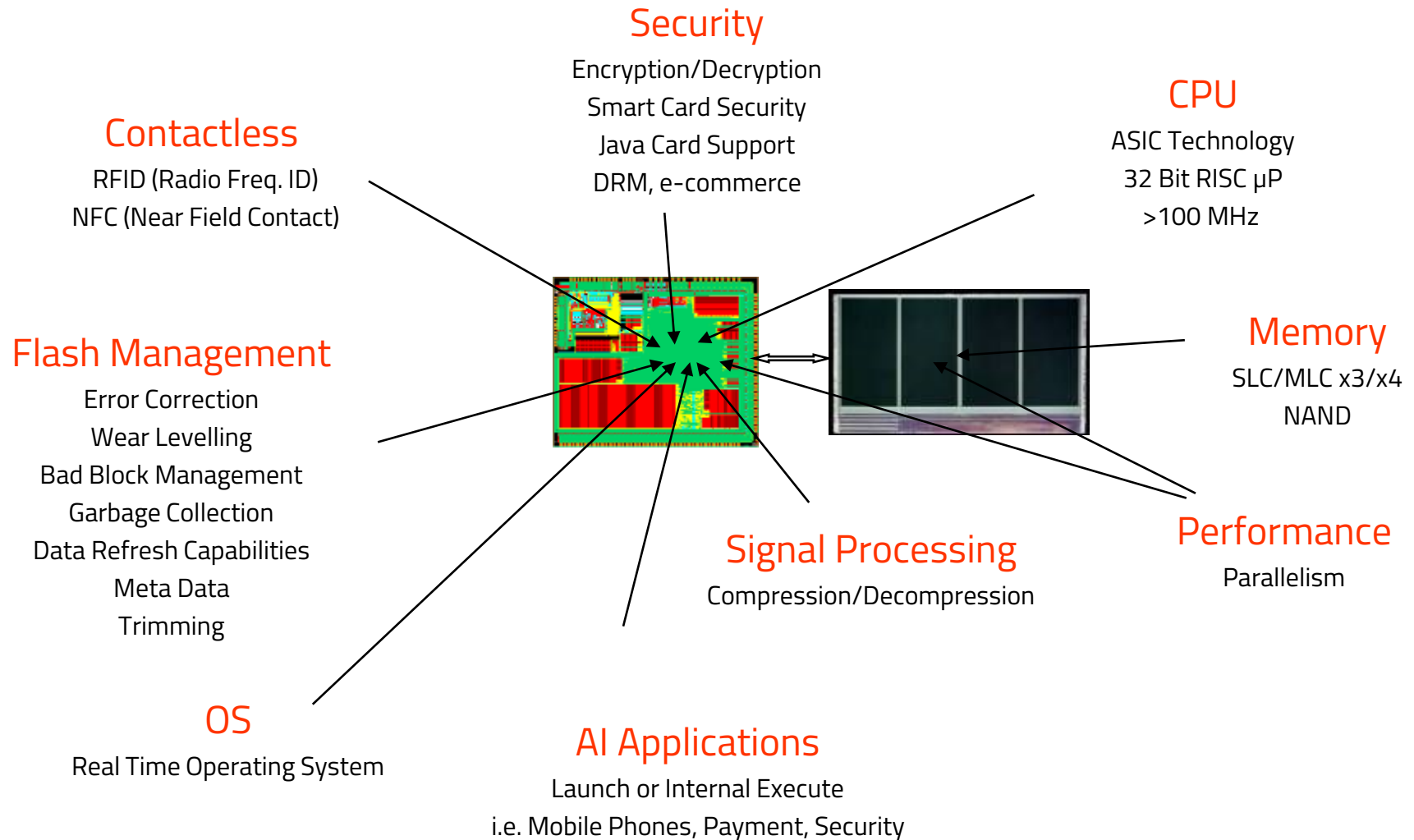
시스템 소프트웨어는 어디에 위치하나?



배워야할 많은 것들의 너무 많다~



하드웨어-소프트웨어 통합된 임베디드 시스템



임베디드 시스템 프로그래밍 → 0/1을 온칩에 임베딩

- Software is deeply injected into the hardware silicon
 - Your dirty software code ... is directly translated into the machine code.
 - So that performance degradation starts from inefficiency of my code.

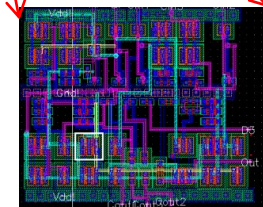
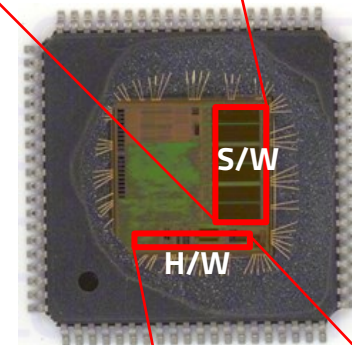
Compilation/Assembling/Linking/Downloaded

```
int main() {
    int s, y;
    s = 1;
    y = s + 2;
    return y;
}
```

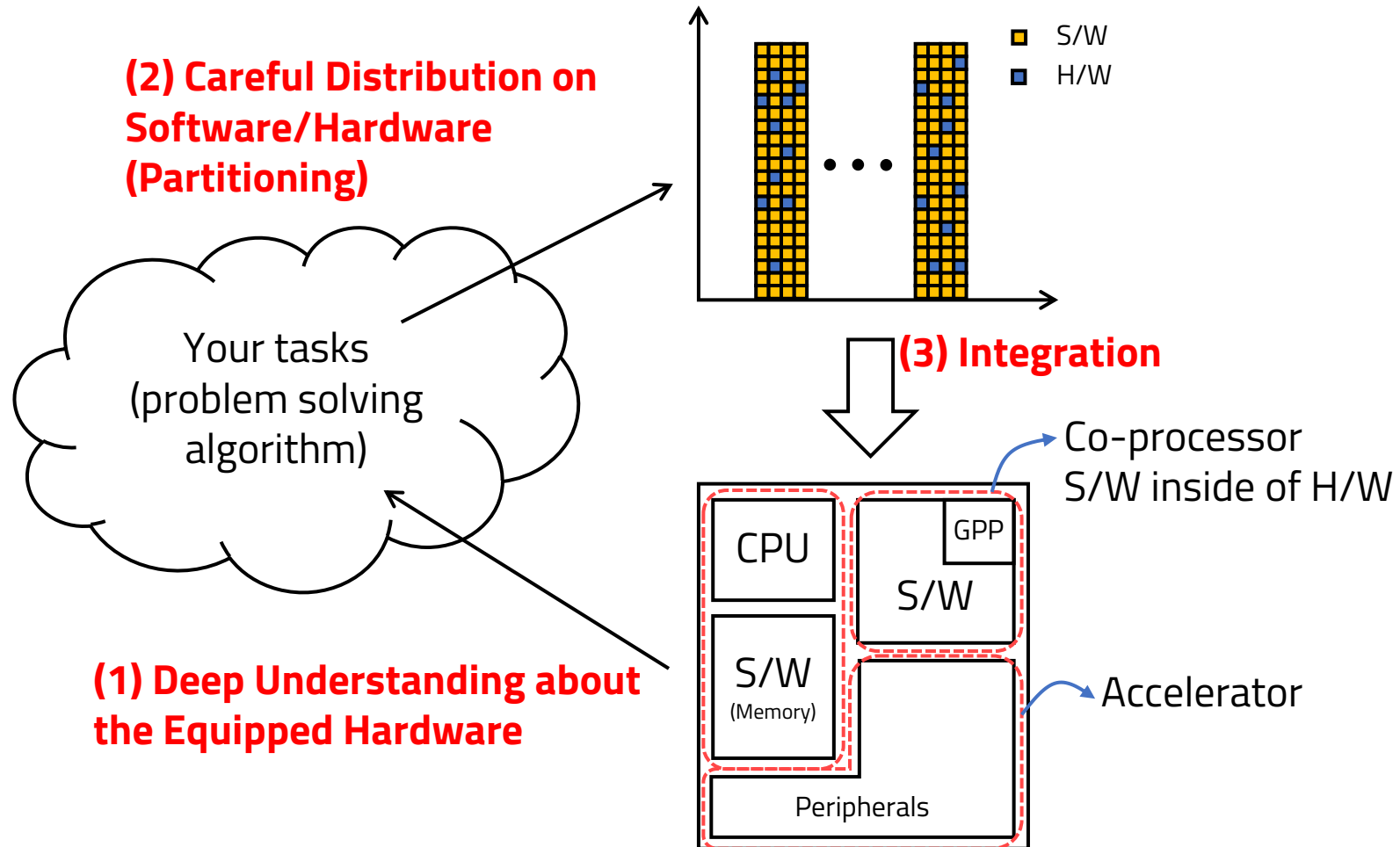
```

004013e0 <main>:
int main() {
    4013e0: 55                push    %ebp
    4013e1: 89 e5            mov     %esp,%ebp
    4013e3: 83 e4 f0        and     $0xfffffffff0,%esp
    4013e6: 83 ec 10        sub     $0x10,%esp
    4013e9: e8 a2 04 00 00  call   401890 <main>
        int s, y;
        s = 1;
    4013ee: c7 44 24 0c 01 00 00  movl    $0x1,0xc(%esp)
    4013f5: 00
        y = s + 2;
    4013f6: 8b 44 24 0c      mov     0xc(%esp),%eax
    4013fa: 83 c0 02        add     $0x2,%eax
    4013fd: 89 44 24 08      mov     %eax,0x8(%esp)
        return y;
    401401: 8b 44 24 08      mov     0x8(%esp),%eax
}

```

[illegible]

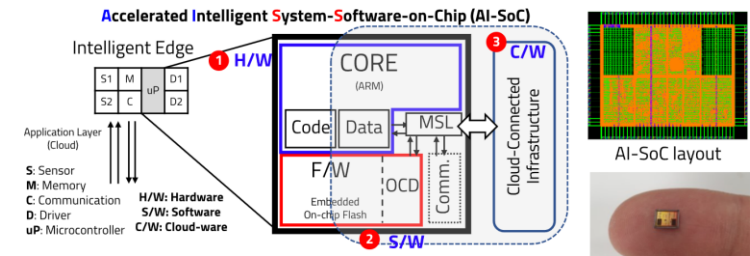
임베디드 S/W가 칩 내부의 H/W를 구동함



System On Chip (Latest Processor Architecture)

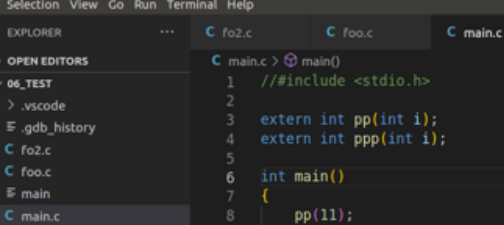
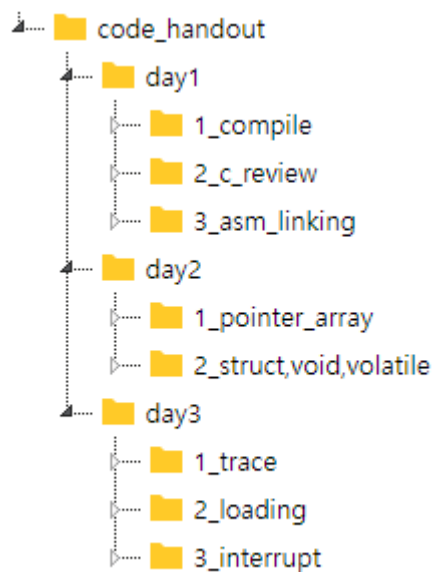
교수 소개 (박대진)

- 경북대학교 IT대학 전자공학부 부교수 (현)
- 2022년 과학기술진흥유공 국무총리표창 수상 (국가과학기술 유공자 선정)
- LG전자 역량평가 출제위원 (현)
- 경북대학교 융합소프트웨어학과 학과장 (현)
- 인공지능 임베디드 시스템온칩(SoC) 분야 다수의 국책연구과제 연구책임자
- 삼성전자/SK하이닉스 선임/수석연구원
- 국가기술고시(5급 사무관) 시험문제(자동제어) 출제위원
- 대통령 Postdoctoral Research Fellow 21인에 선정
- 한국과학기술원 (KAIST) 박사 Excellent Research Award 수상



강의 방식

- 메인교재 + 상세보충자료 + 실습 혼합
- 이론이 실제로 코드에서 어떻게 적용되는지 확인
- 직접 짜보는 Lab을 통해 학습하는 방식



The screenshot shows the Visual Studio Code interface. The Explorer panel on the left shows the file structure with 'main.c' selected. The Editor panel displays the following C code:

```

1  // #include <stdio.h>
2
3  extern int pp(int i);
4  extern int ppp(int i);
5
6  int main()
7  {
8      pp(11);
9      ppp(1);
10
11     return 0;
12 }
13

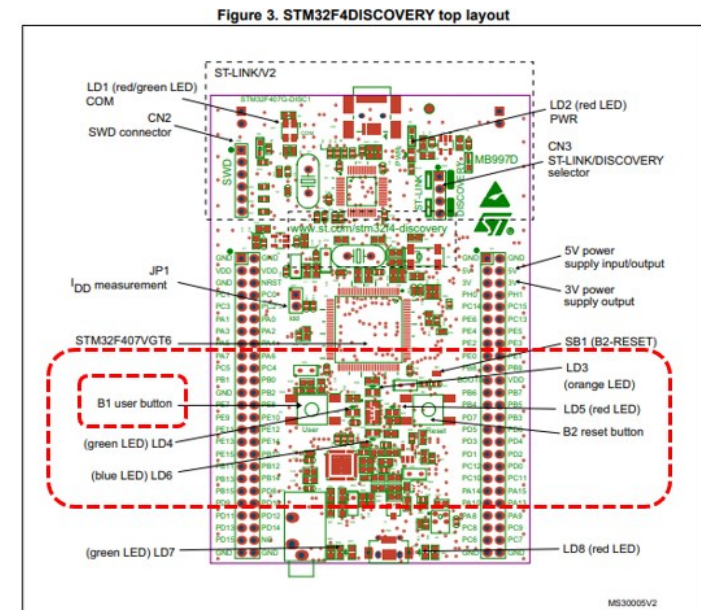
```

The Output panel at the bottom shows the execution results of the program:

```

jshwon@jshwon-VirtualBox:~/lecture/06_test$ cd "
0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, pppp
jshwon@jshwon-VirtualBox:~/lecture/06_test$

```



잊지 말자!

- 온칩에는 결국 1과 0만 존재 (디지털)
- 0과 1은 디지털 CMOS회로의 노드에서 관찰되는 전압 VDD GND임
- 0과 1은 C코드로부터 컴파일된 결과
- 컴파일된 코드는 온칩 코드 메모리에 적재됨
- 적재된 코드를 CPU가 실행하며 결과가 데이터 메모리 (RAM)에 읽고 쓰게 됨
- 결국은 온칩 하드웨어는 코드를 실행하는 껍데기
- 핵심은 온칩 소프트웨어에 있으며, 영혼과도 같다