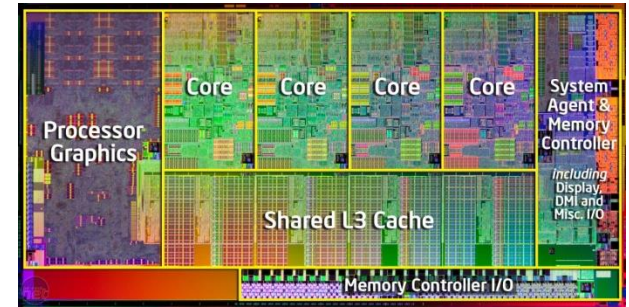




고려대학교
KOREA UNIVERSITY



COSE222, COMP212, CYDF210 Computer Architecture

Lecture 0. Course Introduction

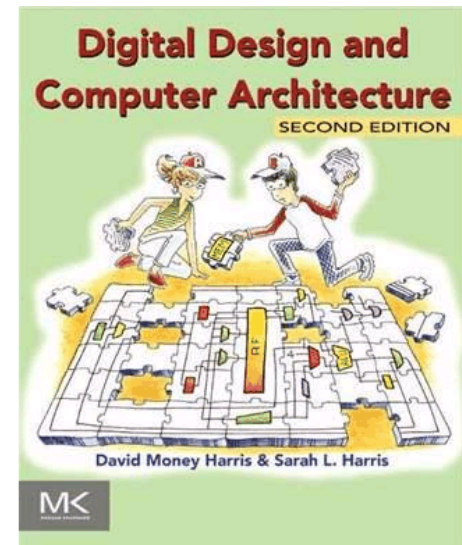
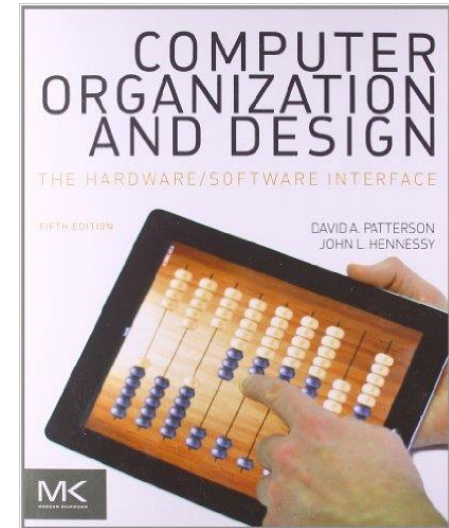
Prof. Taeweon Suh

Computer Science & Engineering

Korea University

Course Information

- Instructor
 - Prof. Taeweon Suh
- Textbook
 - **Computer Organization and Design** by David Patterson and John Hennessy, 5th Ed., Morgan Kaufmann, 2013 (Required, **No Korean-translated** version)
- Reference
 - **Digital Design and Computer Architecture** by David Money Harris and Sarah L. Harris, Morgan Kaufmann, 2012
- **Prerequisites**
 - **COSE221, COMP211 Digital Logic Design**
 - **COMP169 C Programming**
- Office hours
 - After class as needed
 - By appointment at Lyceum 307
- Class web
 - <http://esca.korea.ac.kr>
- Contact Information
 - suhtw@korea.ac.kr
 - 02-3290-2397



Your Computers?

- You have spent 1.5 years as a computer science major
- Your computers?



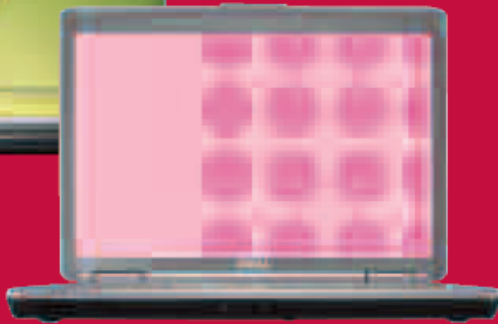
- How is the computer able to execute all those applications?

Your FAQ

전화 구매 대비 11만원 저렴

₩999,000

(온라인 구매시, 부가세 별도)



1GB 메모리로 무료 업그레이드

Inspiron™ 1420 노트북

제품코드 : Q541042N

14.1형으로 누리는 강력한 멀티미디어!
인텔 최신 프로세서로 더 자유롭게!

- 인텔® 센트리노® 듀오 프로세서 기술
인텔® 코어™2 듀오 프로세서 T7250
(2.0GHz/2MB L2 캐시/800MHz FSB)
- 한글정품 Windows Vista® Home Premium
- 512MB DDR2 SDRAM 메모리 / 160GB SATA HDD
- 128MB NVIDIA® GeForce® 8400M GS
- 14.1형 Wide XGA

2GB 하드로 무료 업그레이드

Inspiron™ 530s 데스크탑

제품코드 : Q241024N



22형 와이드로 더 넓게! 더 실감나게!
파워가 다른 생생한 엔터테인먼트!

- 인텔® 코어™2 듀오 프로세서 E6550
(2.33GHz/4MB 캐시/1333MHz FSB)
- 한글정품 Windows Vista® Home Premium
- 2GB DDR2 SDRAM 메모리
- 250GB SATA HDD
- 최대 128MB ATI Mobility™ Radeon® X1300 Hypermemory
- 22형 Wide LCD

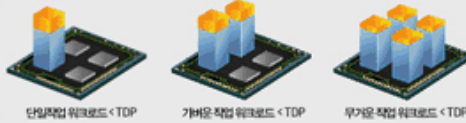
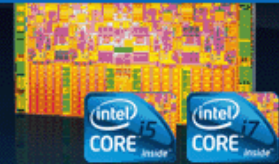
Your FAQ

강력한 멀티코어의 이름

인텔 코어 i 시리즈 프로세서!

인텔 코어 i 프로세서는 향상된 터보 부스트 기술, 하이퍼스레딩 기술(only i7) 증가된 인텔 스마트 캐시, 저비용 저전력 플랫폼이 특징입니다. 강력한 성능과 높은 3D 게임 체감지수를 느끼고 싶다면 i5, i7 탑재 시스템을 준비하세요.

코어 i 시리즈 시스템 더 보러가기



인텔 코어 i5, i7 런필드 프로세서는 터보부스트 기술을 강화하였습니다.

터보부스트 기술은 기존 프로세서의 쓰레드 처리 방식과 달리 처리가 필요한 코어에 나머지 코어 쓰레드를 집중함으로 최적화된 성능 향상과 에너지 효율을 제공합니다.

BEST HIT!!
런필드 시스템
인기상품



인텔 코어 i5 런필드 750

[2.66GHz | 8MB | 쿼드코어 | 40nm 공정]

지포스 GT220 512MB / DDR3 3기가
인텔 순정 DH55TC 마더보드
S-ATA2 320GB / DVD멀티 광드라이브
6채널 HD오디오 | 기가비트랜 포트 | 400W 정격파워
스타일리쉬 명품 케이스 | 2채널 스피커

₩ 709,000

구매하기



인텔 펜티엄 듀얼코어 클락데일 G6950

[2.8GHz | 3MB | 듀얼코어 | 32nm 공정]

지포스 GT240 1GB / DDR3 3기가
인텔 순정 DH55TC 마더보드
S-ATA2 320GB / DVD멀티 광드라이브
6채널 HD오디오 | 기가비트랜 포트 | 450W 정격파워
명품 저안 최고급 케이스 | 2채널 스피커

₩ 629,000

구매하기



21.5인치 FULL HD + 인텔 코어 i3 클락데일 530

[무결정 | 10000:1] [2.93GHz | 4MB | 쿼드코어 | 32nm 공정]

지포스 GT240 512MB / DDR3 3기가
인텔 H55칩셋 고급형 마더보드
S-ATA2 500GB / DVD멀티 광드라이브
6채널 HD오디오 | 기가비트랜 포트 | 450W 정격파워
3R 고급 케이스 | 2채널 스피커 | 키보드&마우스

₩ 899,000

구매하기

Your FAQ

막강한 4세대 하스웰을 탑재한 최강의 데스크탑 DELL XPS 8700을

11번가에서 **막강한 혜택**으로 만난다!

혜택
1

게이밍 PC의 절대지존! 하스웰 NEW데스크탑 신상특가!

DELL XPS 8700 - W240554KR

- 4세대 인텔®코어™ i7-4770프로세서
(3.40GHz, 터보 부스트 작동 시 3.90GHz)
- NVIDIA GeForce GTX 650 Ti GDDR5 1GB
- 16GB 듀얼채널 DDR3 SDRAM 1600MHz 메모리
- 대용량 2TB 7200 RPM SATA 하드 드라이브 6.0 Gb/s
- 사용 편의성과 내구성을 고려한 독특한 커브 디자인
- 16배속 DVD+/-RW 슈퍼 드라이브
- 1년 프리미엄 서비스
- 정품 Windows7 홈프리미엄 SP1 한국어(64비트)



→ 1,499,000원 →

1,349,000원

Abstraction

- Abstraction helps us deal with complexity
 - Hide lower-level detail

Abstraction Analogies

Driver



**Abstraction
layer**



**Machine
Details**



**Combustion
Engine in a car**



**Break system
in a car**

Customer



**Abstraction
layer**



**Machine
Details**



**Hardware board in a
vending machine**

Abstractions in Computer

Programming using APIs



facebook



Operating Systems

Provides APIs (Application Programming Interface)

Instruction Set Architecture (ISA)

Hardware Implementation
(x86)

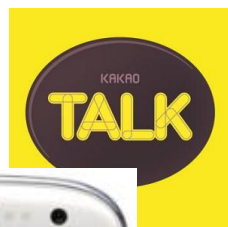


Assembly language
or
Machine language



Abstractions in Smartphones

Application Programming
using APIs



facebook



Operating System



Instruction Set Architecture
(ISA)

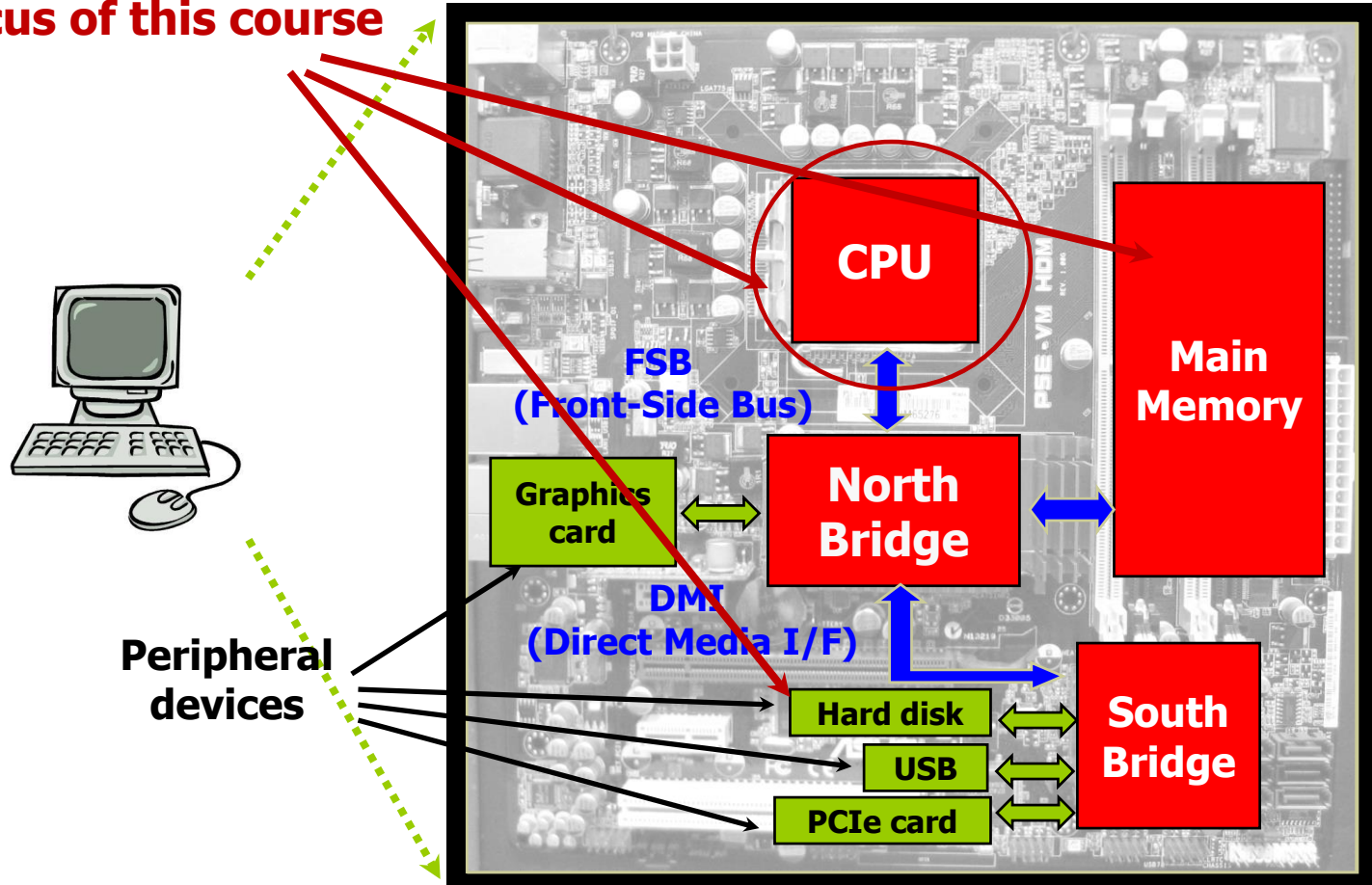


Hardware
Implementation
(ARM)



A Computer System ($\sim$ 2010)

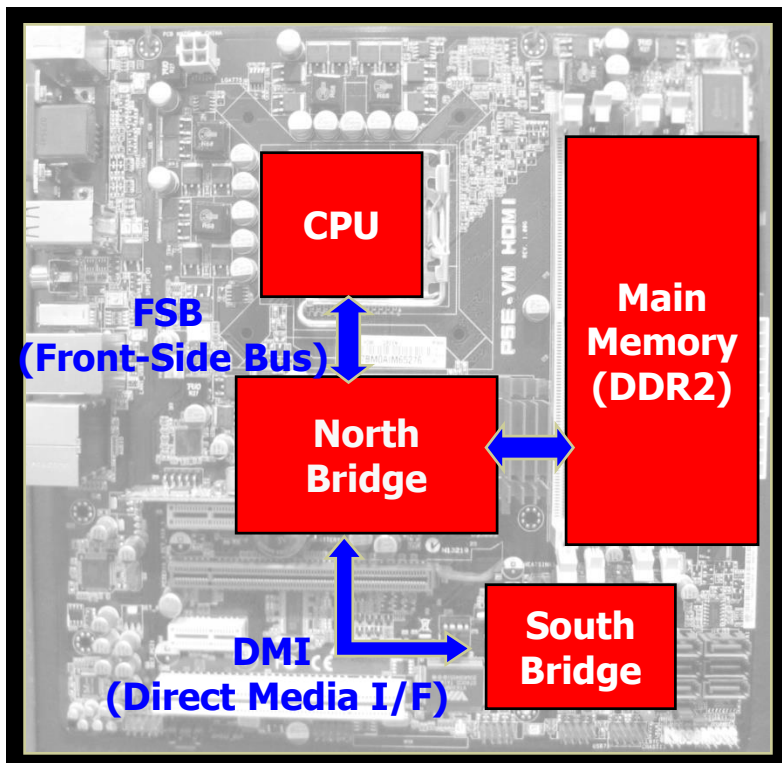
Focus of this course



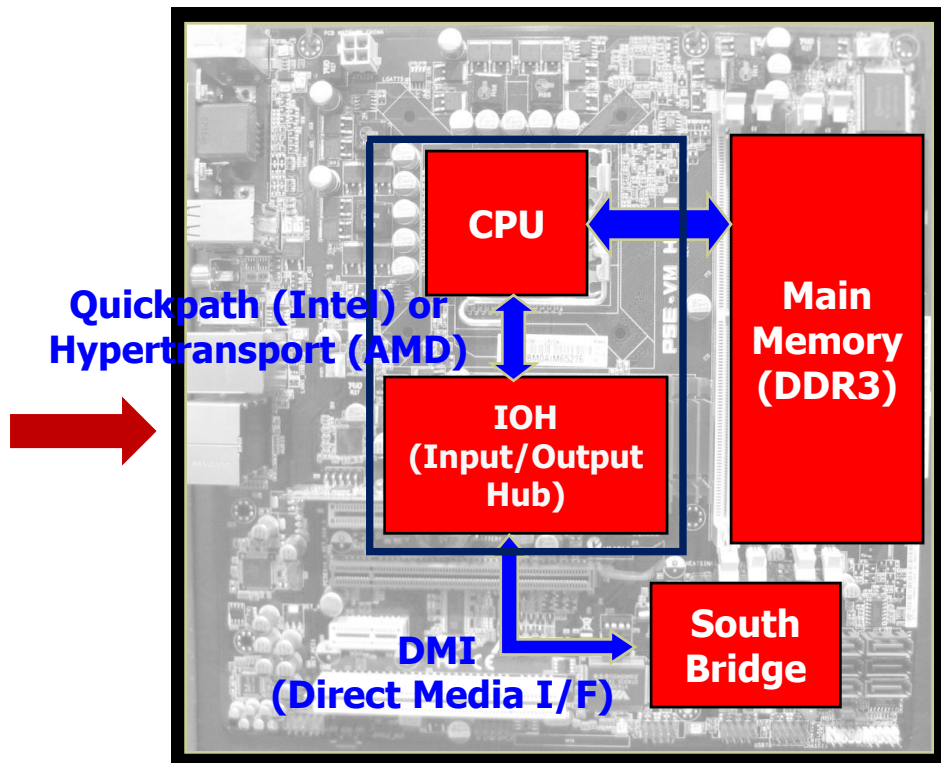
But, don't forget the big picture!

Evolution of Computer Systems

- Core 2 Duo – based Systems

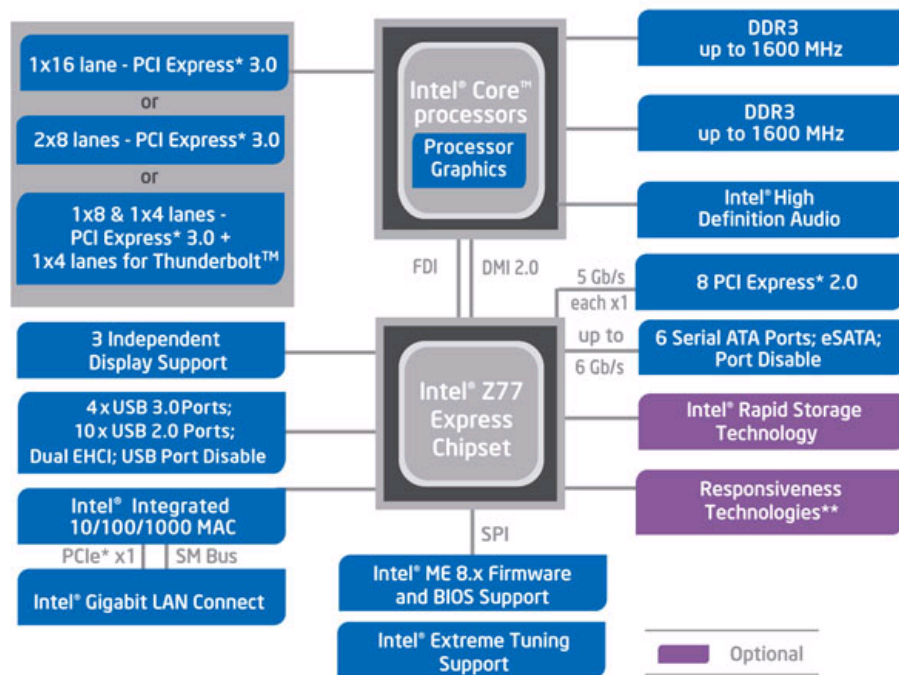


- Core i7– based Systems



Keep in mind that CPU and computer systems are evolving at a fast pace

Core i7 (Ivy Bridge)-based Systems



- FDI: Flexible Display Interface
- SPI: Serial Peripheral Interface
- SMBus: System Management Bus

Ultimate Goal

**Understand How Your Computer
Works Really!**

Digital Logic vs Computer Architecture

- **COSE221 (COMP211): Digital Logic Design**

- We learned digital logic
- What you can do with it?
 - Combinational logic design
 - 7 segment logic, multiplexer etc
 - Sequential logic design
 - Vending machine logic
 - Digital clock logic
 - **But, what you have designed does NOT provide any programmability to users**



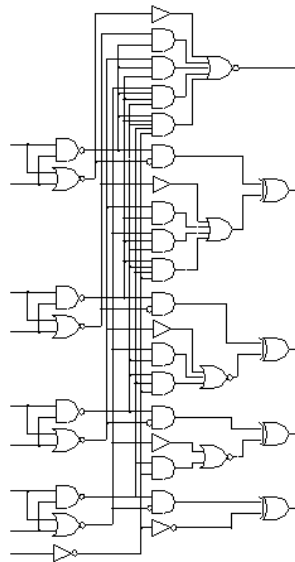
- **COSE222 (COMP212): Computer Architecture**

- We study and design computers, focusing on CPU (processor)
- **Processor provides programmability to users**

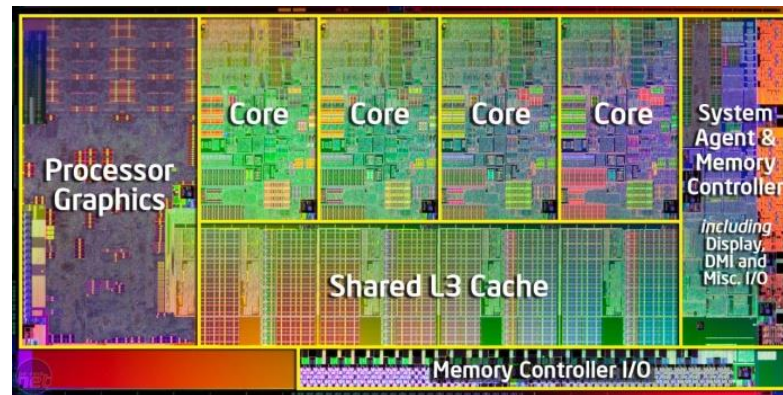


Hardware in Computer

- Computer architecture course mainly covers how to build a CPU with the basic elements

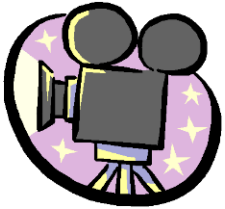


Digital Logic
(COSE221,
COMP211)



2nd Generation Core i7 processor
995 million transistors in 216mm² (32nm technology)
(COSE222, COMP212)

Computer Architecture



```
int main()
{
    int a, b, c;
    a = 3;
    b = 9;
    c = a + b;
    return c;
}
```

- **COMP169 C Programming**
- **COMP166 Computer Programming**
- **And Java, C++, C# ...**



- **COSE222, COMP212, CYDF210**
Computer Architecture course is
where software meets hardware



- **COSE221, COMP211 Digital Logic**
Design

COSE222, COMP212, CYDF210

Computer Architecture

- Modern x86-based computers are very complicated; It is covered in advanced computer architecture course in graduate school
- Our goal is to learn and understand the basic operation and mechanism of computers, so we focus on
 - Commercially successful yet simple CPU (32-bit MIPS) (<http://www.mips.com/products/cores/>)
 - Memory hierarchy (cache, main memory, and hard-disk)

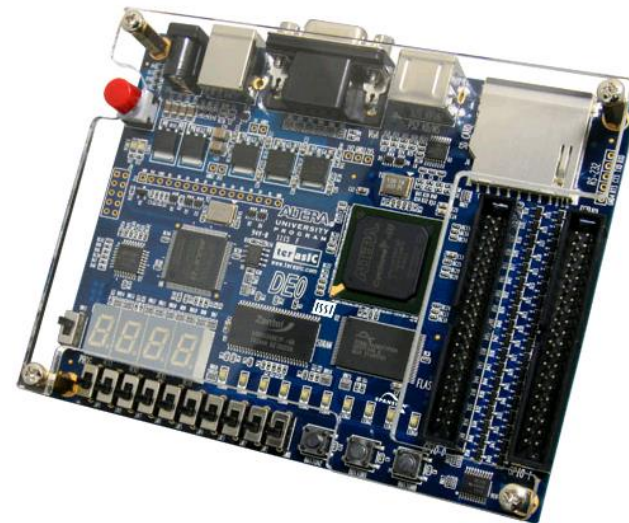


Objectives

- **Understand how computer works**
 - How the code in high-level language is translated to machine code and gets executed in CPU
 - Learn machine language (assembly language)
 - MIPS instructions
 - Learn microarchitecture
 - CPU implementation
 - Learn memory hierarchy in computer
 - Register, Cache, Main memory, and Hard-disk
- **Design CPU with Verilog-HDL (individual class project)**

Grading Policy

- Exams (50%)
 - Midterm Exam: 20%
 - Final exam: 30%
- Quizzes: 10%
- Assignments: 10%
- **Term Project (CPU Design): 30%**
 - **Your CPU should be able to run Prof. Suh's program on DE2 board**
- **Fail rules**
 - You will be given an "F" if you miss classes more than 3 times
 - 2 late show-ups will be counted as 1 absence



Warning

- Don't take this course if you don't know
 - what the combinational and sequential logic is
 - what clock is
 - what latch and flip-flop are
 - FSM (Finite State Machine)
 - Verilog-HDL
- Please take "COSE221 Digital Logic Design" next spring and come back!

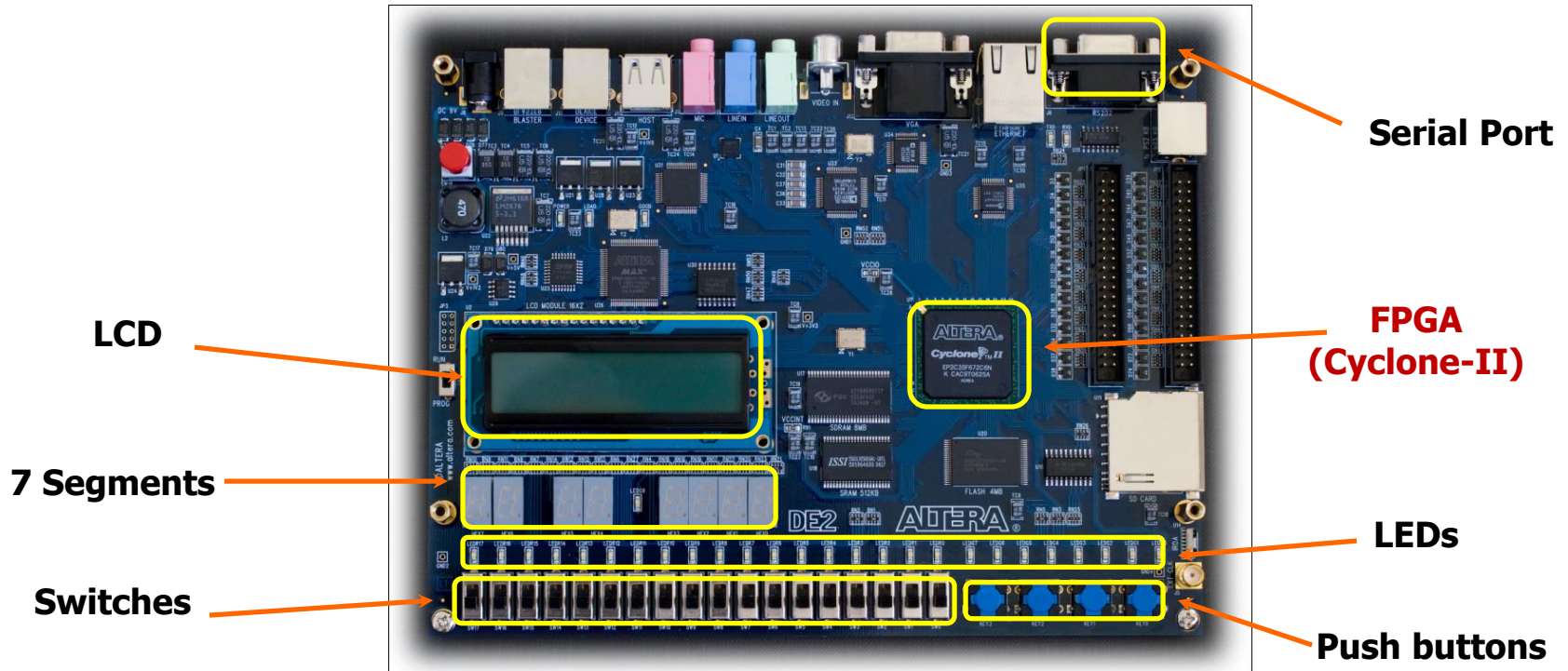
Expectations

- You will have a lot of fun throughout this class
 - But, it could **take a lot of time** to finish your term project
- After successfully completing this course, you will have a lot of confidence in computers and how computer works!

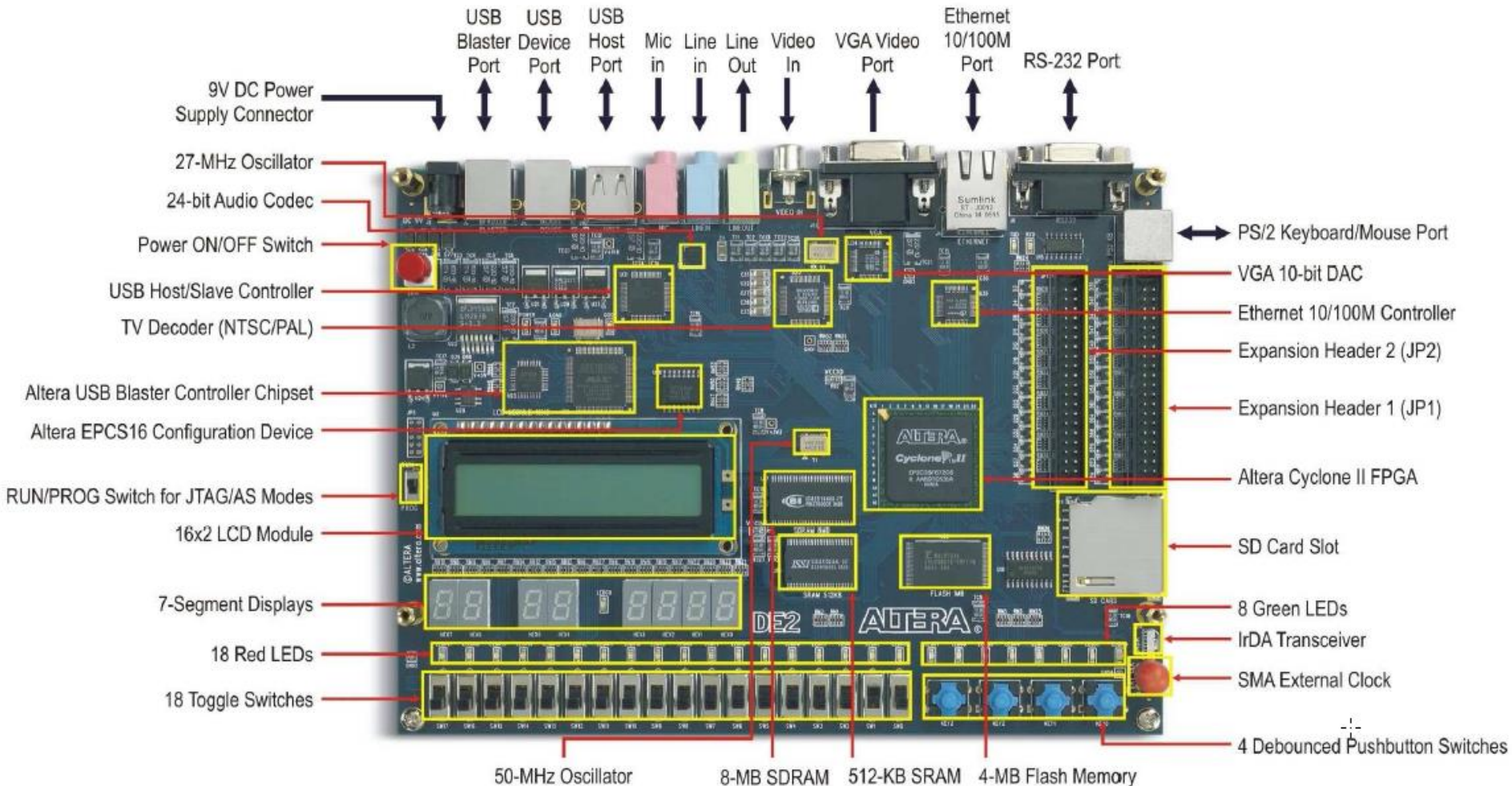


Backup Slides

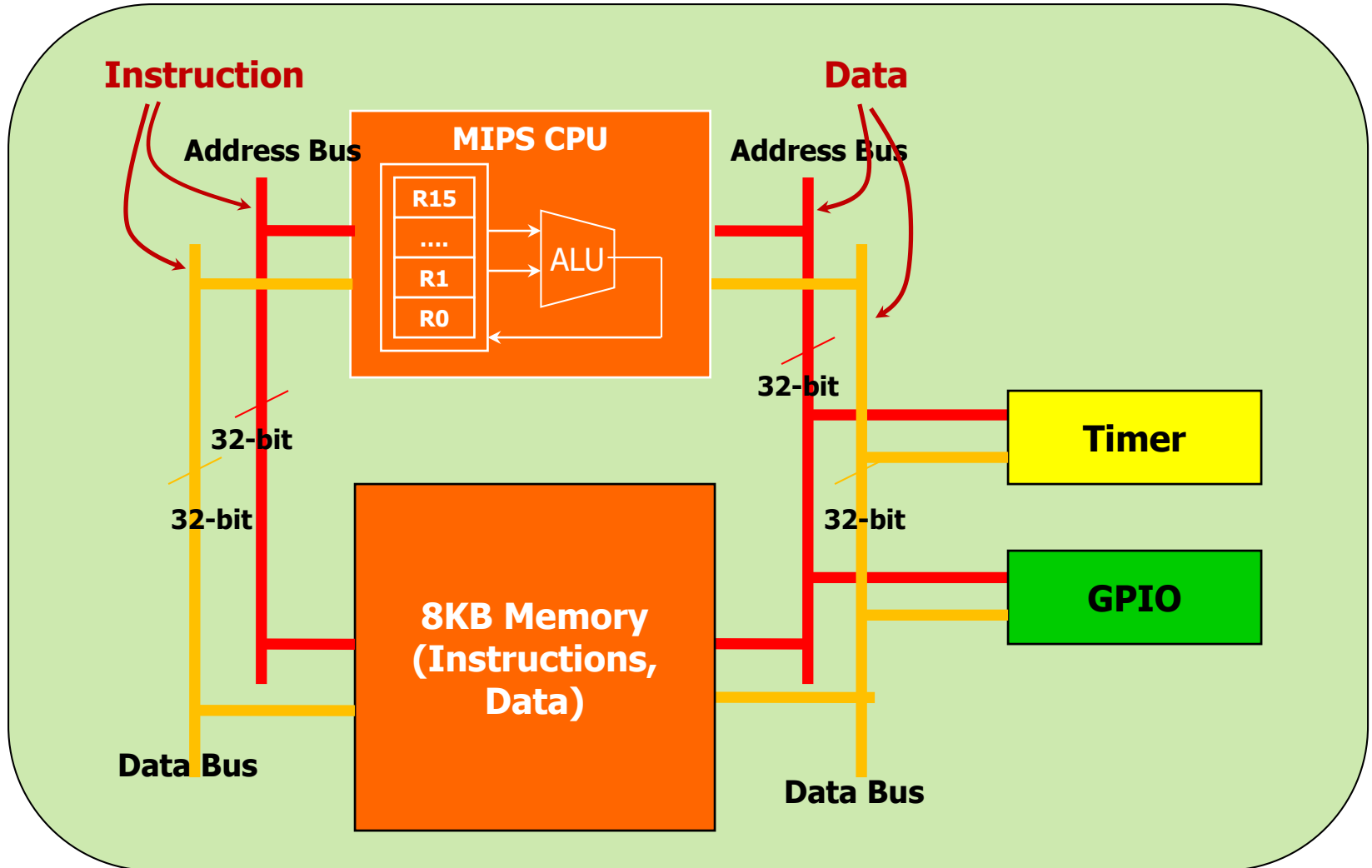
DE2 Board



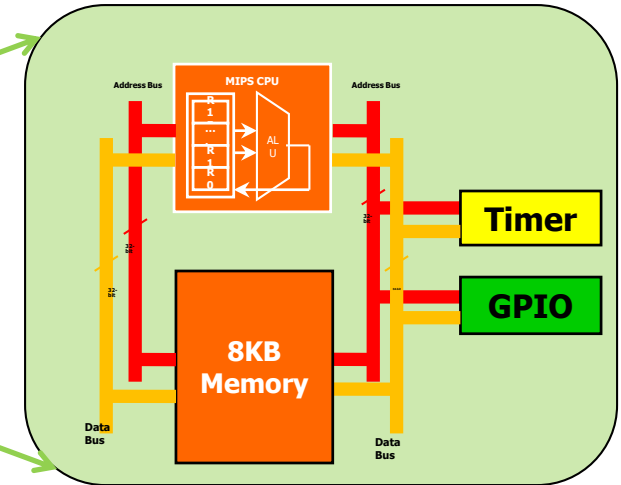
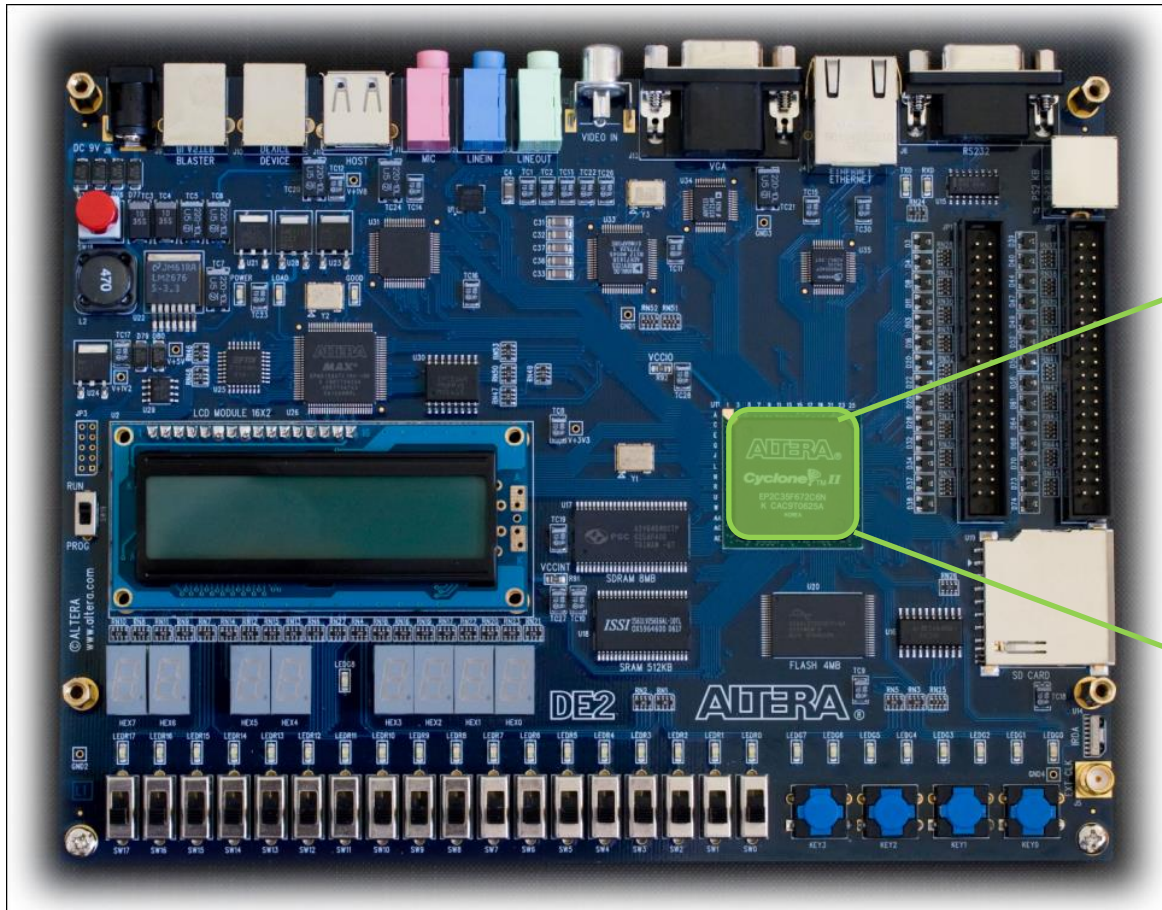
More Detailed Info



Computer System for Final Project



Our Computer System in FPGA



iPhone 4 Teardown

<http://www.ifixit.com/Teardown/iPhone-4-Teardown/3130/1>



http://news.cnet.com/8301-13924_3-20006904-64.html

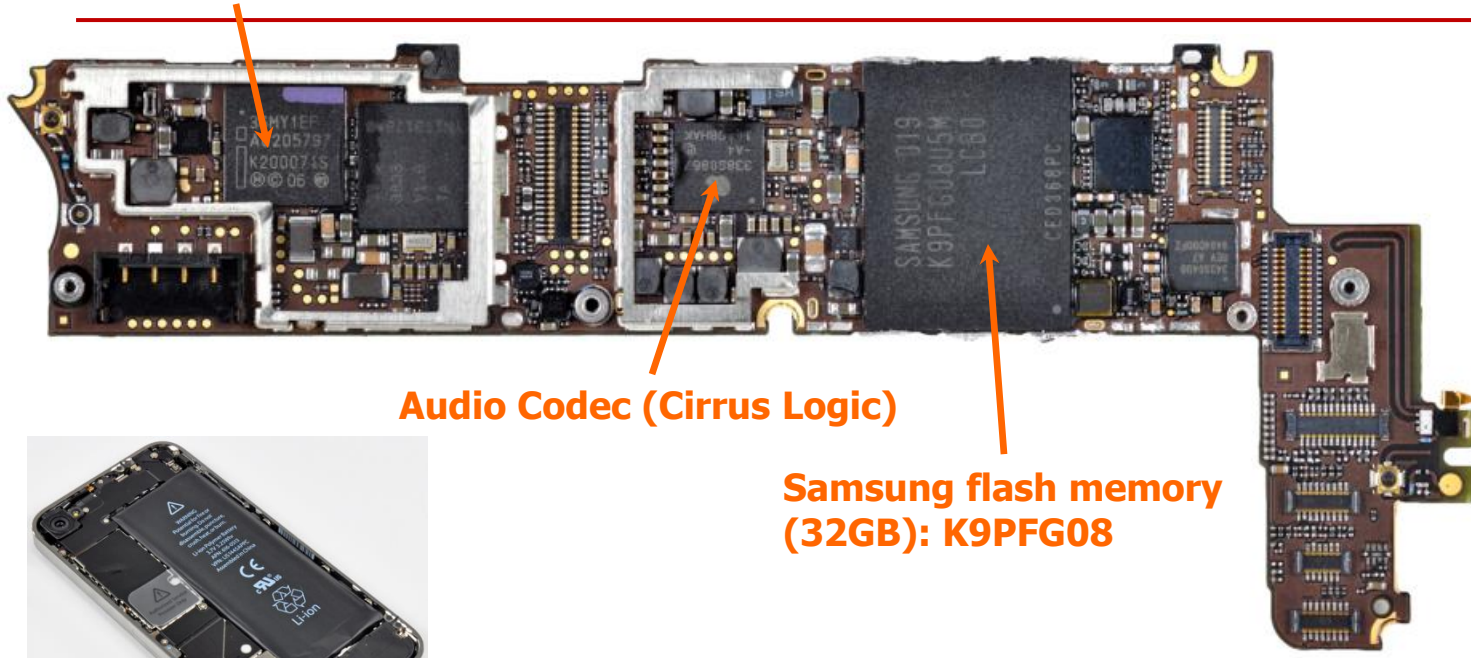


GSM (Global System for Mobile communications): 2G, 3G, 4G .. 30

UMTS (Universal Mobile Telecommunications Systems): one of 3G technologies being developed into 4G

iPhone 4 Teardown

512MB Mobile DDR



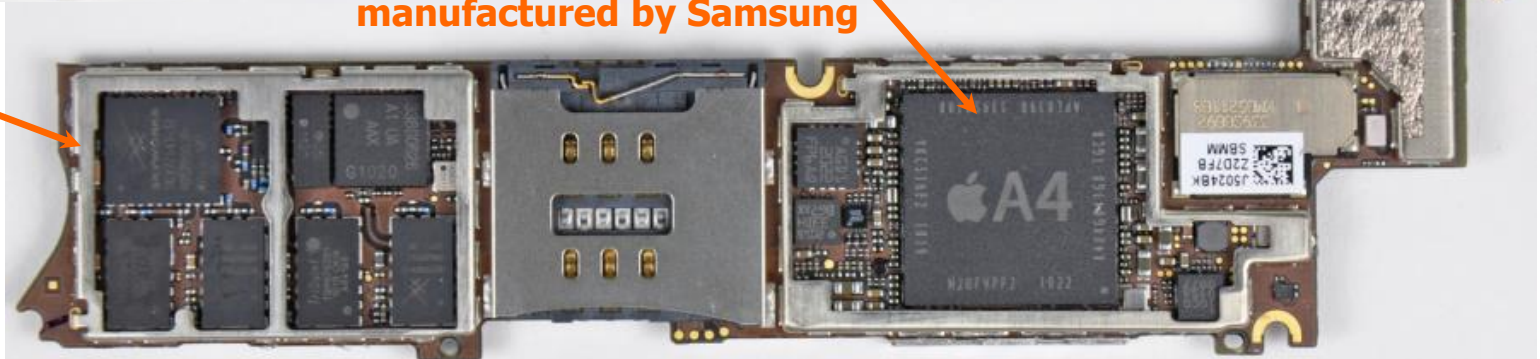
Audio Codec (Cirrus Logic)

Samsung flash memory (32GB): K9PFG08



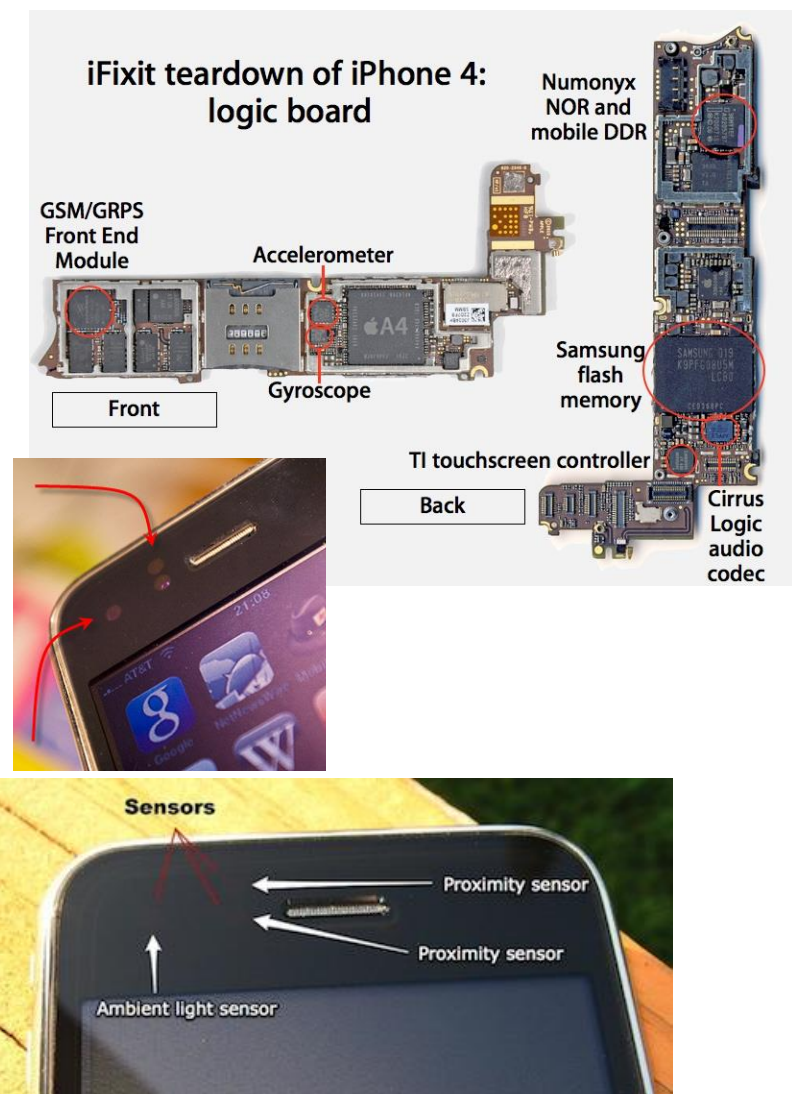
A4 Processor (ARM Cortex A8)
designed by Apple
manufactured by Samsung

GSM and
more

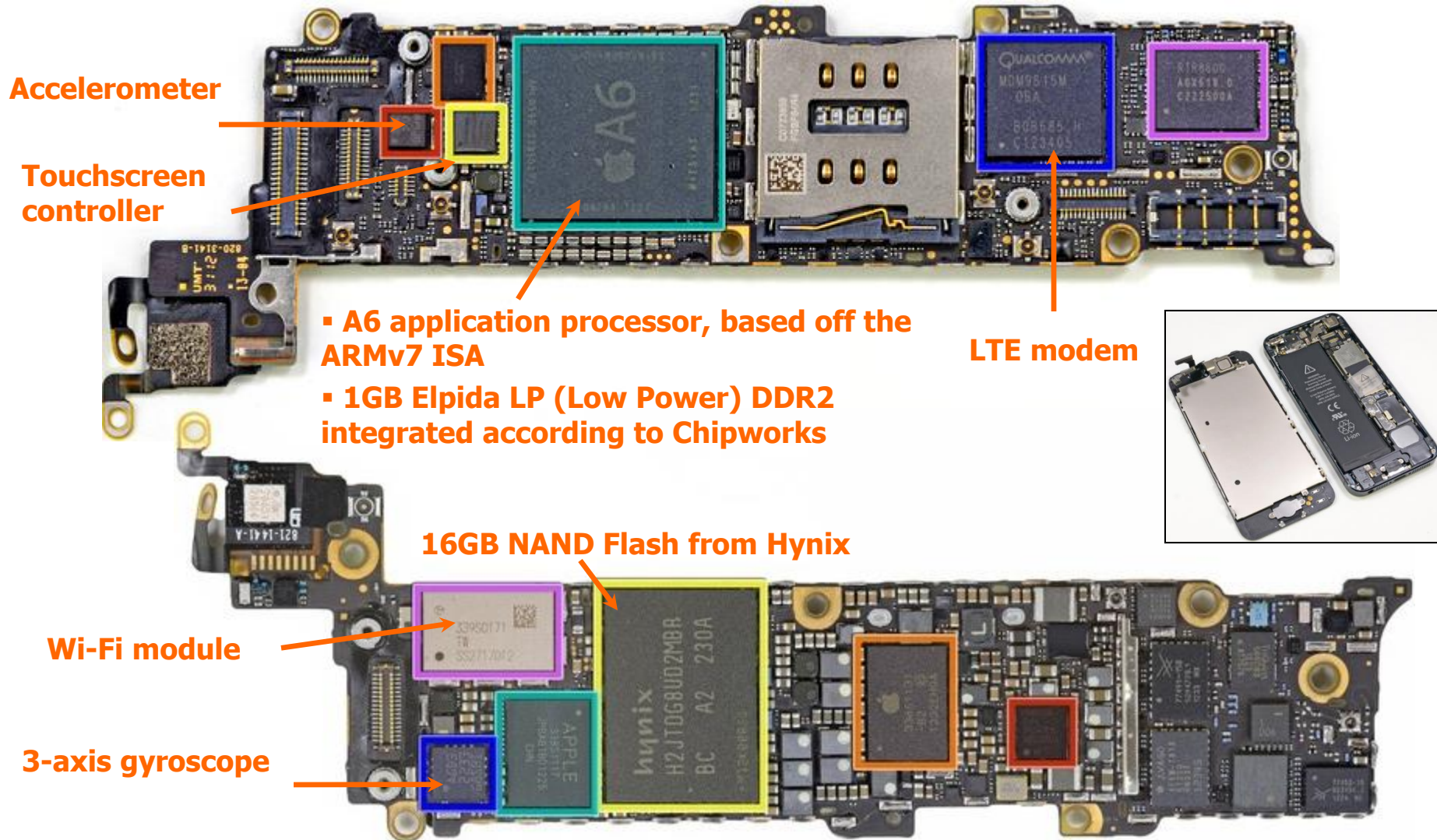


iPhone 4 Teardown

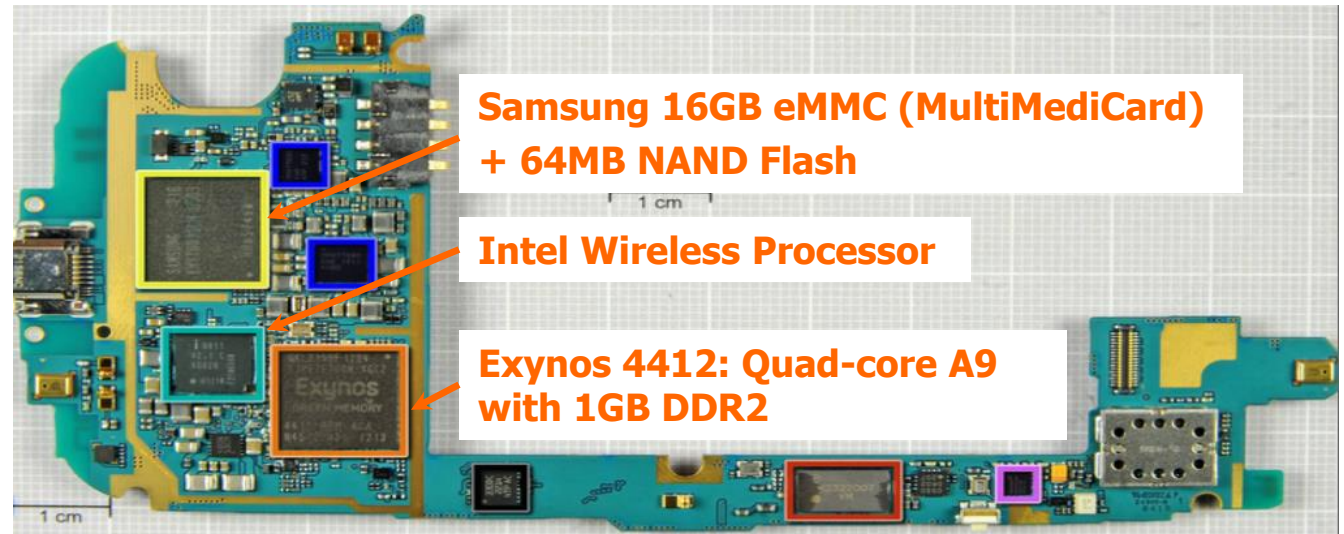
- **Accelerometer** detects when the user has rotated the device from portrait to landscape, then automatically changes the contents of the display accordingly
- **Proximity sensor** detects when you lift iPhone to your ear and immediately turns off the display to save power and prevent inadvertent touches until iPhone is moved away
- **Ambient light sensor** automatically adjusts the display's brightness to the appropriate level for the current ambient light, enhancing the user experience and saving power at the same time



iPhone 5 Teardown



Galaxy S4 Teardown

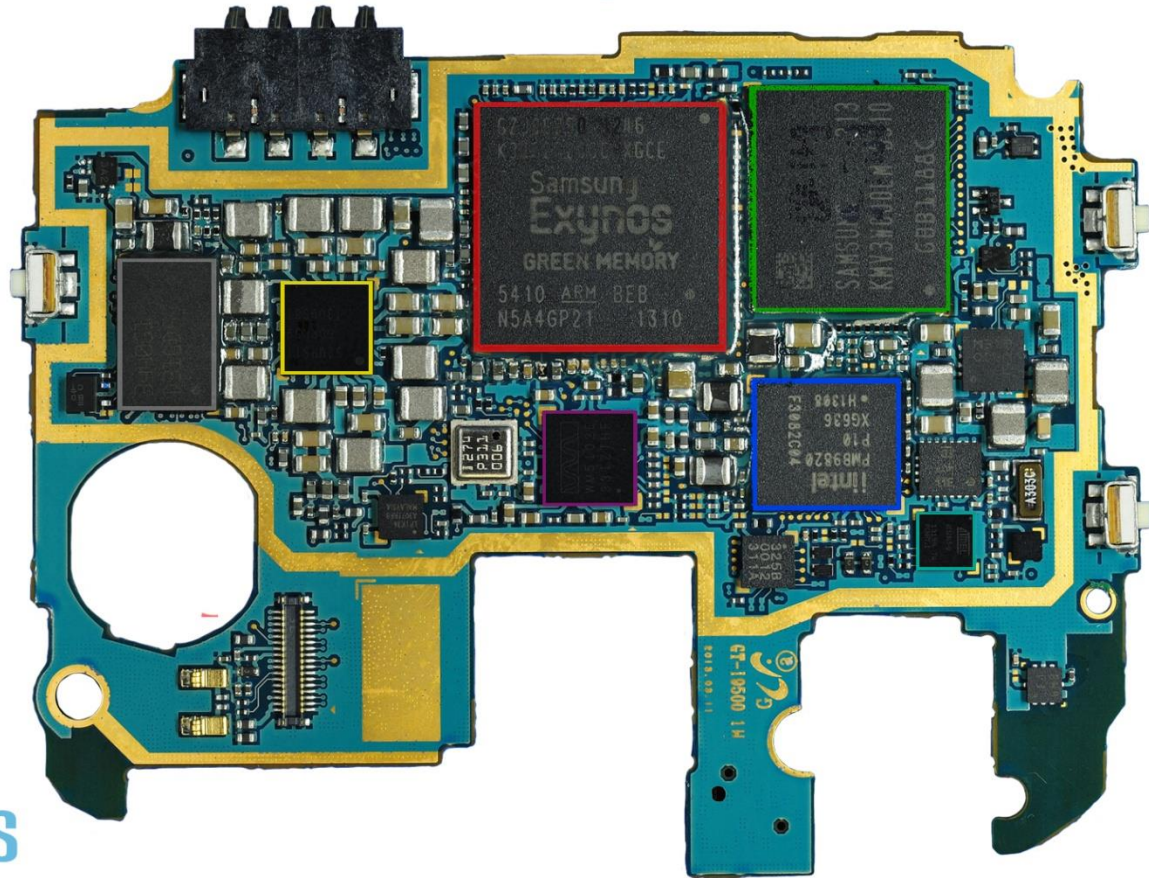


Galaxy S4 Teardown

COMPONENTS

Samsung Galaxy S4 COMMUNICATIONS BOARD, FRONT

- Samsung Exynos 5410
Exynos Octa Eight-Core processor
- Samsung K3QF2F200C-XGCE
2GB LP DDR3 (K4E4E324EB die) mobile DRAM
- Intel PMB9820
X-GOLD 636 Baseband Processor
- Samsung KMV3W000LM-B310
Multichip Memory - 64 MB Mobile DDR SDRAM, 16 GB MLC NAND Flash, Controller
- Samsung S2MPS11
Power Management IC
- Wolfson Micro WM5102E
Audio Hub CODEC with Voice Processor DSP
- Atmel UC128L5-U
32 bit Microcontroller with 128KB Flash (custom package)
- Broadcom BCM4335
Wi-Fi 802.11 a/b/g/n/ac, dual-band, DLNA, Wi-Fi Direct, Wi-Fi hotspot all-in-one IC



TECHINSIGHTS

■ Exynos 5 Octa (Exynos 5410): quad-core Cortex-A15 and quad-core Cortex-A7 -- Wikipedia