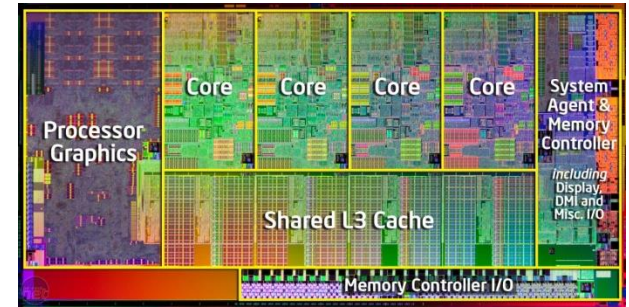




고려대학교
KOREA UNIVERSITY



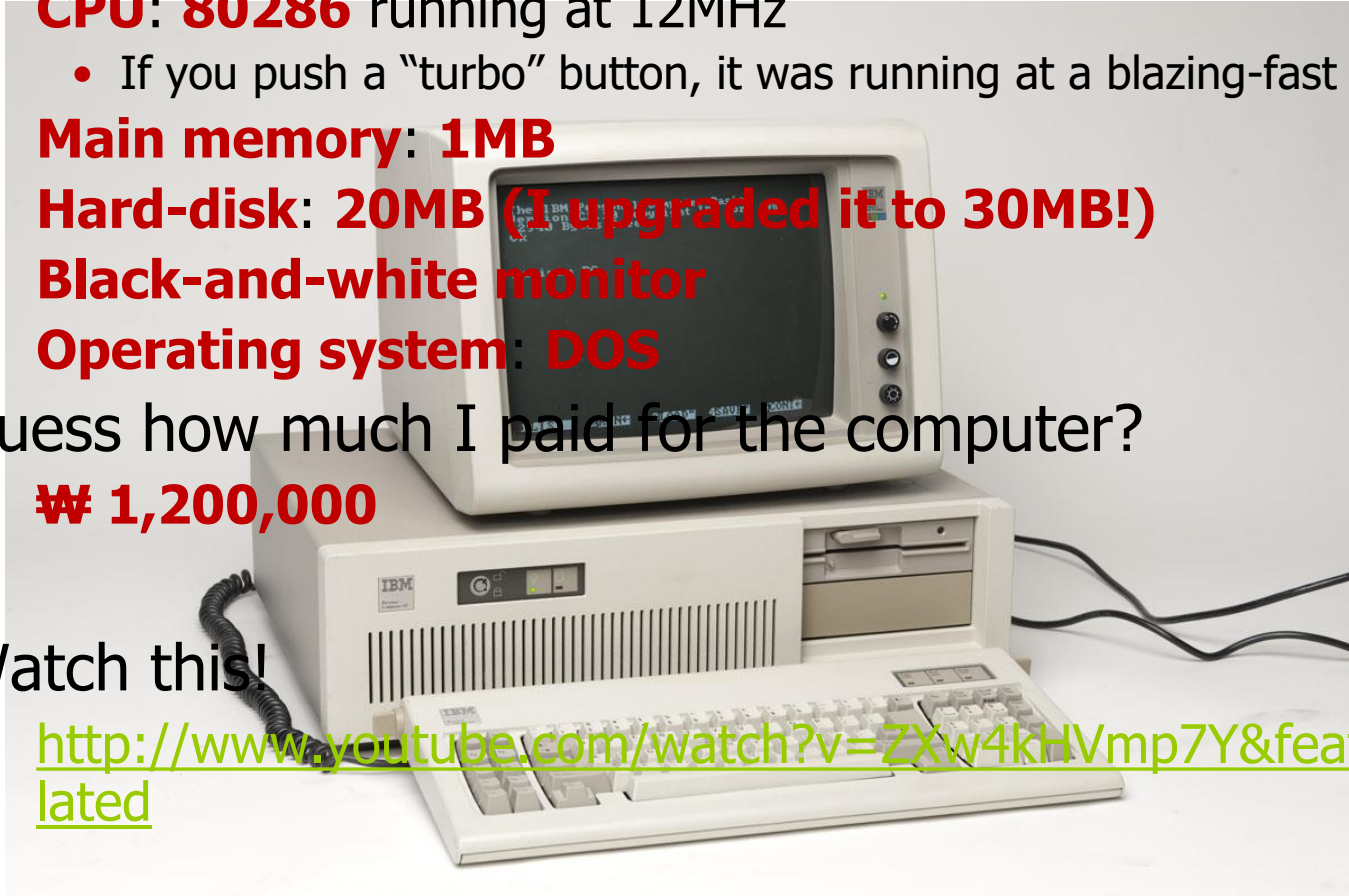
COSE222, COMP212, CYDF210 Computer Architecture

Lecture 1. Computer and Technology

Prof. Taeweon Suh
Computer Science & Engineering
Korea University

My First Computer in 1990

- I purchased my first computer in 1990
 - **CPU: 80286** running at 12MHz
 - If you push a “turbo” button, it was running at a blazing-fast 16MHz!
 - **Main memory: 1MB**
 - **Hard-disk: 20MB (I upgraded it to 30MB!)**
 - **Black-and-white monitor**
 - **Operating system: DOS**
- Guess how much I paid for the computer?
 - **₩ 1,200,000**
- Watch this!
 - <http://www.youtube.com/watch?v=ZXw4kHVmp7Y&feature=related>



Examples - 286



“으와, AT 컴퓨터가 80만원대라니!”
컴퓨터의 혁명이 다가오고 있습니다.

이것이 바로 우리가 기다렸던 컴퓨터!

80만원대 AT 컴퓨터의
기술혁명, 가격혁명!
삼성컴퓨터가 해냈습니다.

바야흐로 컴퓨터 대중화 시대 — 당신은 어떤 컴퓨터를 원하십니까? 호환성도 좋고, 용량·처리속도도 충분하고, 데이터도 깨지지 않게 안정성이 뛰어난 AT 컴퓨터라면 어떻습니까? 그것도 가격이 80만원대라면 / 국내 컴퓨터기술로는 혁명적 가격인 80만원대 AT 컴퓨터 — 드디어, 삼성컴퓨터가 해냈습니다. 삼성컴퓨터는 연구·개발의 집중 투자 및 기술혁신으로 파격적인 원가절감 및 품질향상에 성공했습니다. 지금이 바로 원하는 컴퓨터를 구입할 절호의 찬스 / 찬스를 놓치지 마십시오. 이제부터는 AT 컴퓨터 시대입니다.

80만원대 AT 컴퓨터, 삼성 알라딘 286은 이렇게 혁신적입니다.

EMI 자체 EMI 시험시설(제1부 공인 전자파장검정 지정시험기관)에서 철저한 테스트를 하여 유해전자파를 제거했습니다.

KS 완벽한 품질관리능력으로 공업진흥청으로부터 KS 규격을 획득했습니다.

원박한 한글지원 삼성조형 및 일반사용조형할 사용이 가능하며, 기본 1MB의 충분한 메모리용량을 갖추었습니다.

컬러 컬러의 보편화 추세에 따라 Hercules, MDA 등 모노는 물론 CGA 용 컬러모니터를 경제적으로 사용할 수 있습니다.

마우스 마우스 PORT가 기본으로 장착되어 데이터의 그래픽 입력이 용이해졌습니다.

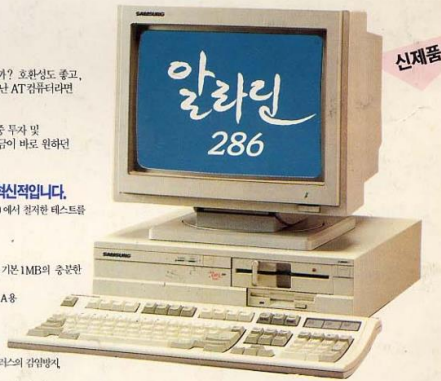
비메이스트 백신 총 37종의 바이러스 퇴치 프로그램이 들어있어 바이러스의 감염방지를 간단, 치료가 가능합니다.

일체화 CPU, FDC, PIO, SIO, RTC, HDC 등을 단일 보드화 하여 충분한 기능을 수용하면서 저렴한 비용으로 구입이 가능합니다.

SLIM 고집적 회로로 SLIM형의 콤팩트한 디자인을 실현하면서도 2개의 FDD (5.25" 및 3.5")와 1개의 HDD (20MB, 40MB)를 동시에 장착, 사용할 수 있습니다.

PORT RS-232C PORT를 사용하여 증권 및 각종 DB 정보의 검색이 가능합니다.

S/W 고급 OA S/W인 MY-김넷을 지원하여 자료의 교록을 위한 알라딘, CAP STUDY 등의 S/W를 사용할 수 있습니다.



신제품

■ 알라딘 286 모델별 권장소비자가격 (14" 모니터 포함, 부가세 별도)

모델 No.	권장소비자가격	주요 사양
SPC 4200P-CW200	₩ 890,000	● CPU : 80286 (12MHz) ● Memory : 1MB ● FDD : 5.25" (1.2MB) × 2, 3.5" (1.44MB)
SPC 4200P-CW102	₩ 1,050,000	● CPU : 80286 (12MHz) ● Memory : 1MB ● FDD : 5.25" (1.2MB) ● HDD : 20MB (3.5" IDE TYPE)
SPC 4200P-CW104	₩ 1,120,000	● CPU : 80286 (12MHz) ● Memory : 1MB ● FDD : 5.25" (1.2MB) ● HDD : 40MB (3.5" IDE TYPE)

삼성컴퓨터

■ 컴퓨터부품 영업본부
서울시 강남구 삼성동 170번지 대우빌딩 3층
559-2402 ~ 4, 559-2412 ~ 6

■ 강남고객센터 : 559-2620 ~ 2
■ 강북고객센터 : 927-5142 ~ 6
■ 강서고객센터 : 392-2545

■ 지방영업소 및 교육장
● 부산 : (051) 318-4451 ~ 2
● 대구 : (053) 629-1741 ~ 2
● 대전 : (042) 627-3925 ~ 6
● 광주 : (062) 526-9470 ~ 1
● 울산 : (055) 62-2550 ~ 3

삼성컴퓨터
삼성전자



제1부 공인 전자파장검정 지정시험기관

신제품

80만원대 AT 컴퓨터 탄생—삼성 알라딘 286

다른 컴퓨터와 비교해보세요.

지금 갖고 계신 컴퓨터나 사용해본 컴퓨터가 XT 아니에요? XT보다 한단계 높은 AT 컴퓨터를 한번 사용해보세요. 속도, 기억용량 등이 XT와 비교할 수 없지요. 대학생 형, 누나들이 쓰고 있는 컴퓨터가 바로 AT 컴퓨터예요. 지금까지 AT 컴퓨터는 100만원대 이상으로 좀 비싼 편이었지요. 그런데 삼성컴퓨터가 뛰어난 기술력으로 80만원대 AT 컴퓨터를 탄생시켰습니다. 바로 삼성 알라딘 286이요. 자 이제 삼성 알라딘 286으로 훨씬 빠르고 강력한 컴퓨터를 경험해보세요.

삼성 알라딘 286은 이렇게 놀랍습니다.

EMI 자체 EMI 시험시설(제1부 공인 전자파장검정 지정시험기관)에서 철저한 테스트를 하여 유해전자파를 제거했습니다.

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비메이스트 백신 총 37종의 바이러스 퇴치 프로그램이 들어있어 바이러스의 감염방지를 간단, 치료가 가능합니다.

- 일체화** CPU, FDC, PIO, SIO, RTC, HDC 등을 단일 보드화 하여 충분한 기능을 수용하면서도 저렴한 비용으로 구입이 가능합니다.
- SLIM** 고집적 회로로 SLIM형의 콤팩트한 디자인을 실현하면서도 2개의 FDD (5.25" 및 3.5")와 1개의 HDD (20MB, 40MB)를 동시에 장착 사용할 수 있습니다.
- PORT** RS-232C PORT를 사용하여 증권 및 각종 DB 정보의 검색이 가능합니다.
- S/W** 고급 OA S/W인 MY-김넷, MY-윈트를 지원하여 자료의 교록을 위한 알라딘, CAP STUDY 등의 S/W를 사용할 수 있습니다.

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SPC 4200P-CW104	₩ 1,120,000	● CPU : 80286 (12MHz) ● Memory : 1MB ● FDD : 5.25" (1.2MB) ● HDD : 40MB (3.5" IDE TYPE)

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● 울산 : (055) 62-2550 ~ 3

삼성컴퓨터
삼성전자

http://comandgame.tistory.com/

The Computer Revolution

- Computer technology has been advancing rapidly
- Progress in computer technology makes novel applications feasible. In the recent past, the following applications were “computer science fiction”
 - Computers in automobiles
 - Smartphones
 - Human genome project
 - World Wide Web
 - Search Engines
- Now, computers are pervasive
 - Computers are virtually everywhere in our every day life



Classes of Computers

- **Personal computers (PC)**

- General-purpose
- Desktop, notebook (laptop), netbook



- **Servers**

- Running larger programs from multiple users
- Usually accessed via network
- High capacity, performance, reliability
- Range from small servers to building sized
 - Low-end: Used for small business or Web serving
 - High-end: **supercomputers** or **datacenter** with hundreds to thousands processors with terabytes of memory and petabytes of storage



- **Embedded computers**

- A computer inside another device used for running predetermined applications
 - Example: smartphones, ipod,

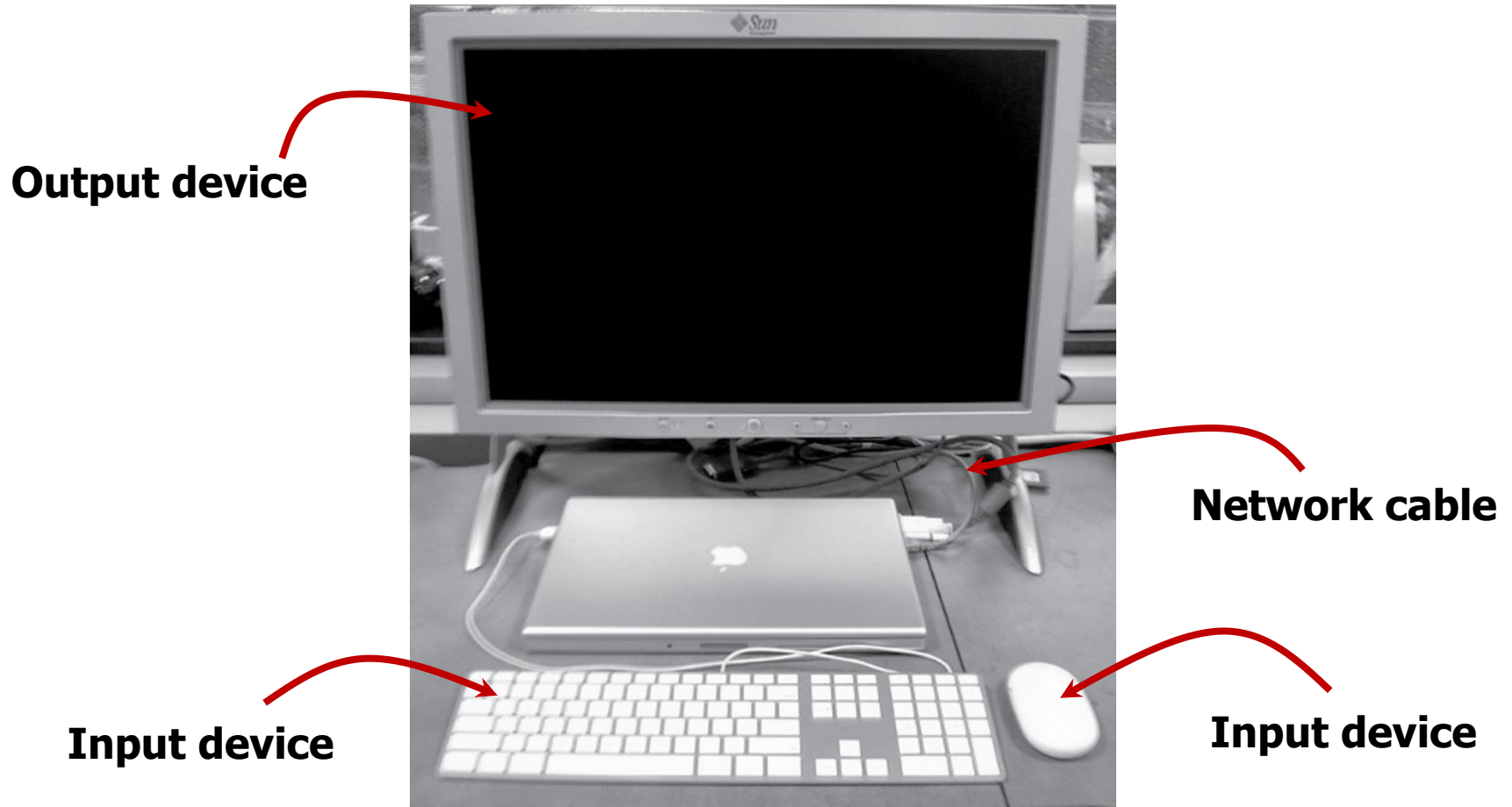


Components of a Computer

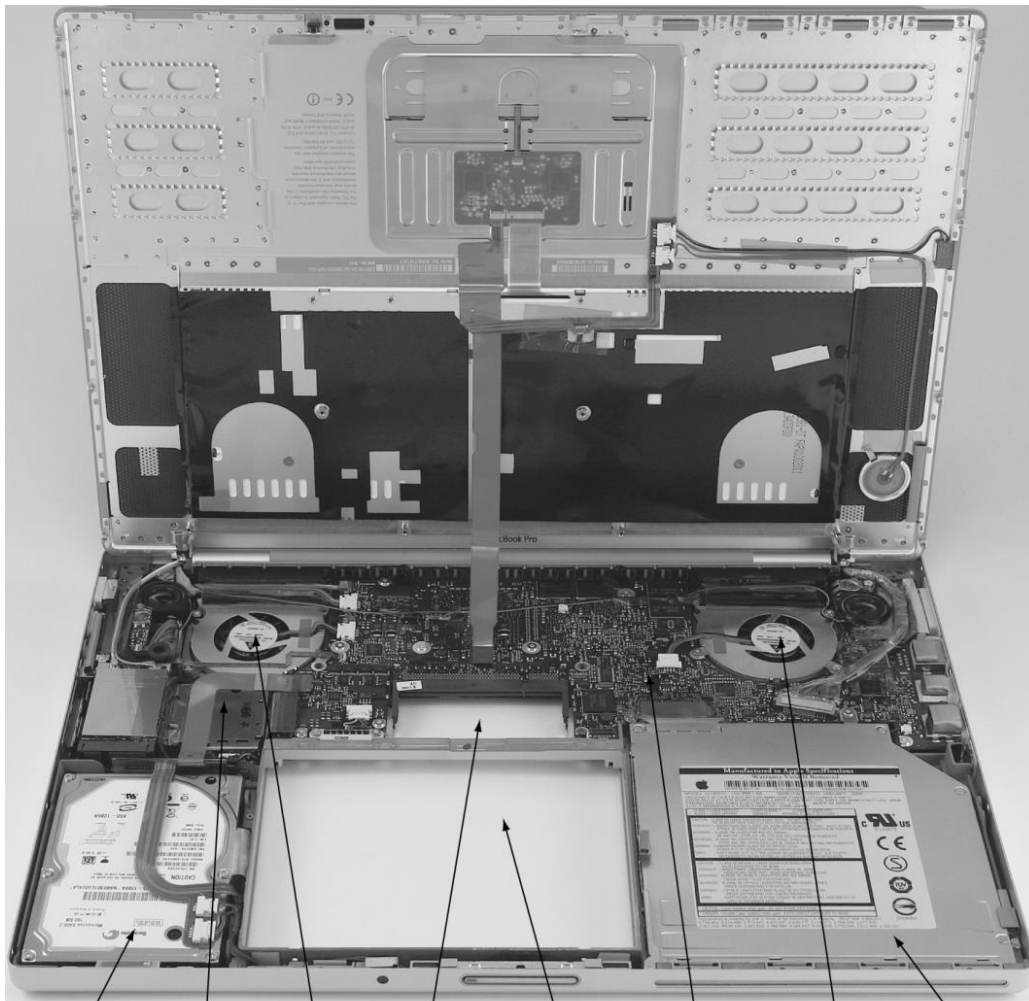
- Same components for all kinds of computer
 - Desktop, server, embedded
- Input/output includes
 - User-interface devices
 - Display, keyboard, mouse
 - Storage devices
 - Hard disk, CD/DVD, flash
 - Network adapters
 - For communicating with other computers



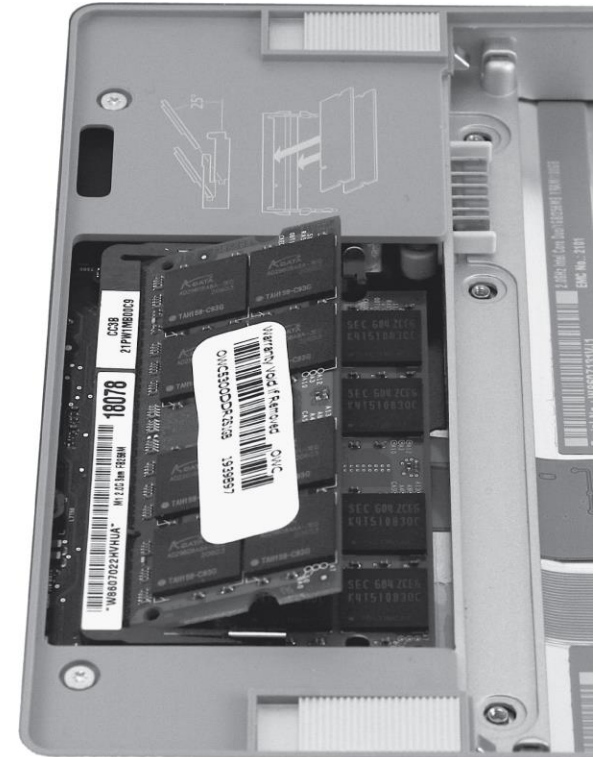
Anatomy of a Computer



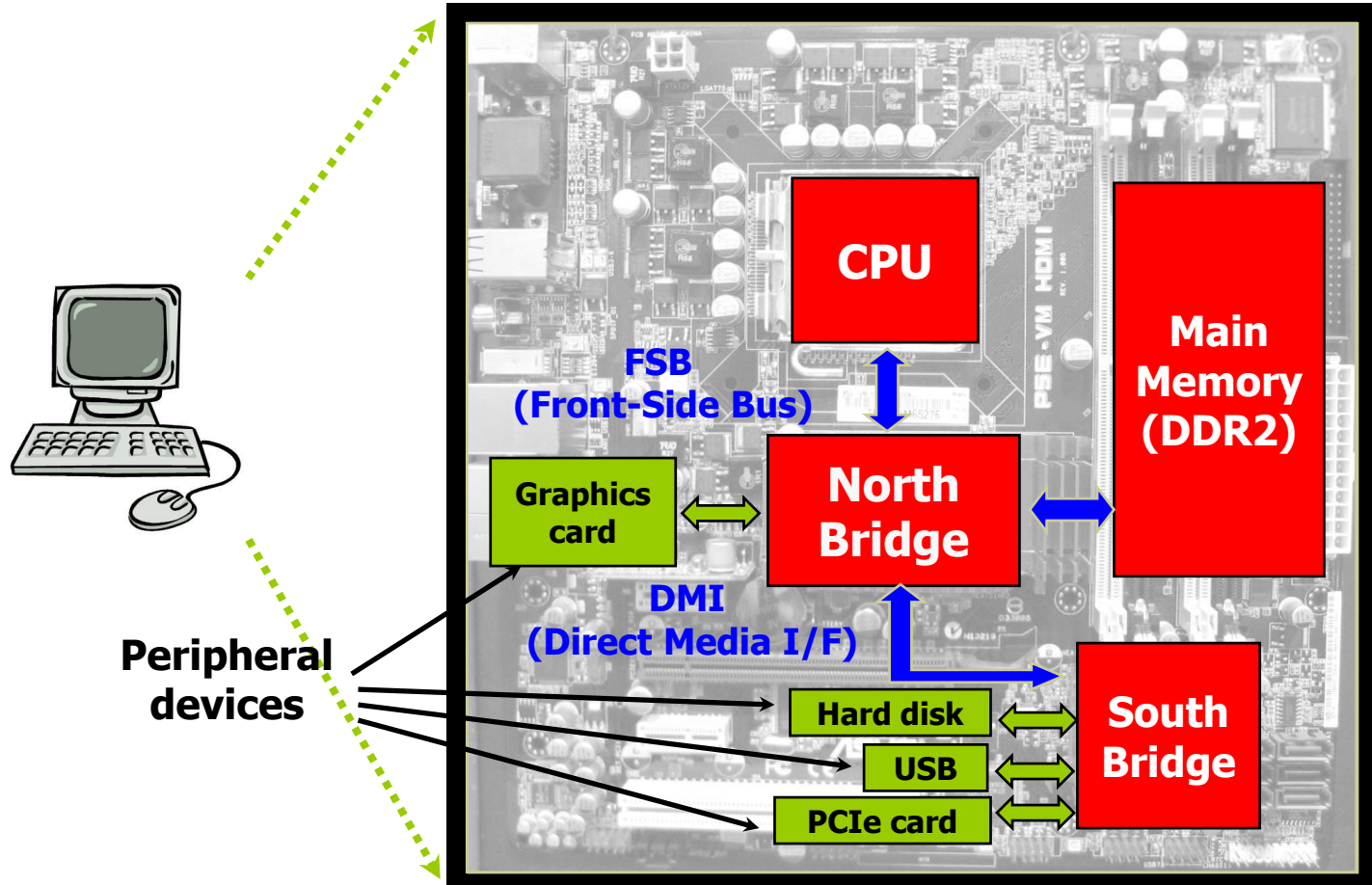
Opening the Box



Hard drive Processor Fan with cover Spot for memory DIMMs Spot for battery Motherboard Fan with cover DVD drive



A Desktop Computer System

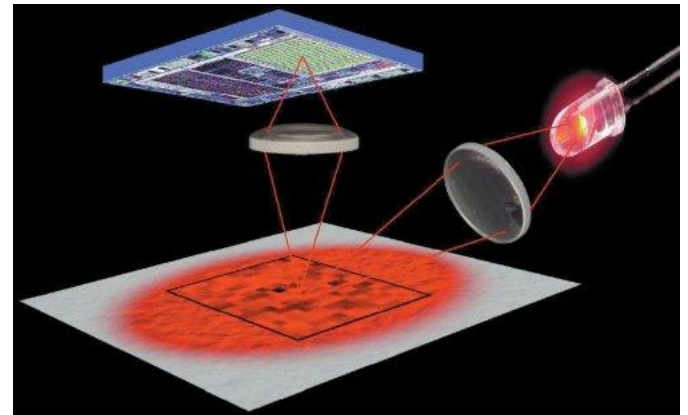


- The term “Processor” is used to refer to CPU

Mouse

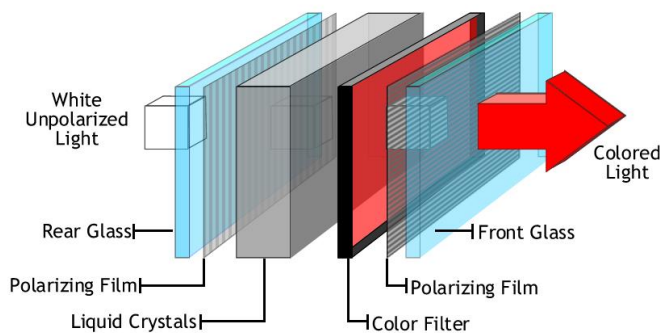
- Optical mouse

- Composed of LED for lighting, a tiny black-and-white camera, and a simple optical processor
 - Optical processor example: Agilent [ADNS2051](#)
- LED illuminates the surface underneath the mouse
- The camera takes 1500 sample pictures a second under the illumination
- Successive pictures are sent to the optical processor
- The processor compares the images and determines whether the mouse has moved and how far

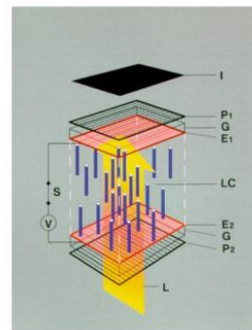
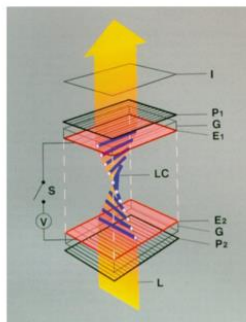


Display Devices

- Nowadays, LCDs (Liquid Crystal Displays) are used as display devices
 - LCD is not a source of light; It controls the transmission of light
 - Image is composed of pixels
 - Depending on the size of the screen and the resolution, the display matrix ranges in size from 640 x 480 to 2560 x 1600
 - A color display might use 8 bits for each of 3 colors (red, blue, and green)
 - The image to be displayed is stored in memory called **a frame buffer**

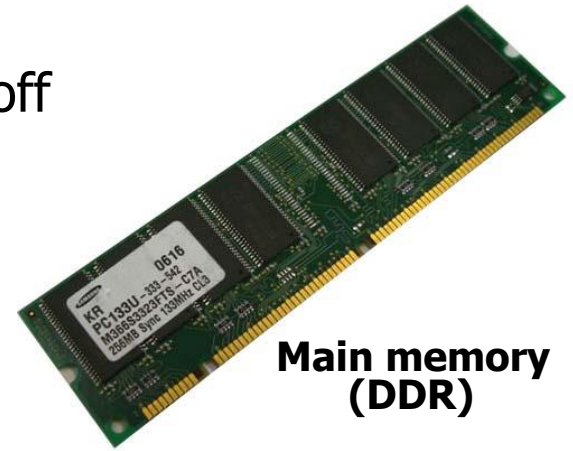


© Lon Koenig



Main Memory and Storage

- Main memory (Volatile)
 - Loses instructions and data when power off
- Secondary storage (Non-volatile)
 - Magnetic disk
 - Flash memory
 - Optical disk (CDROM, DVD)



**Main memory
(DDR)**



Magnetic hard-disk



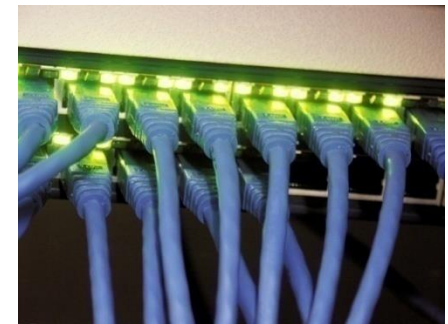
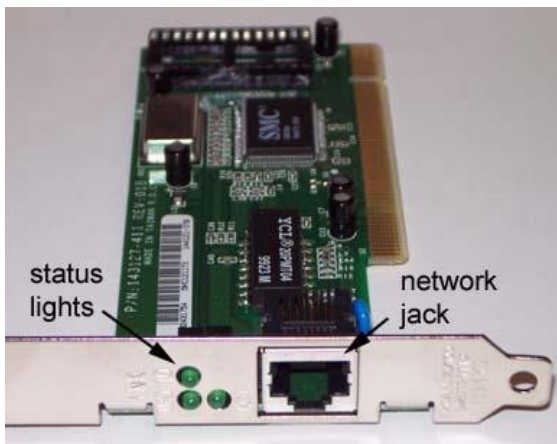
Flash memory



Optical disk

Networks

- Networks have become so popular that they are the backbone of current computer systems
 - Networks provide communication between computers, resource sharing of hardware components, and non-local access from users
- The most popular type of network is **Ethernet**
 - Ethernet can be up to a kilometer long and transfer at up to 10Gbits/sec
 - Useful to connect computers on the same floor of a building: **Local Area Network (LAN)**
- **Wide Area Networks (WANs)** cross continents
 - WANs are the backbone of the Internet, which supports the **World Wide Web(WWW)**



What Kinds of Processors (CPUs) Are There?

- x86
 - Used in PC
 - Intel (www.intel.com) , AMD (www.amd.com) , Via Technologies (www.via.com.tw)
- POWER, PowerPC
 - Used in Mac, but now it is replaced with Intel Processor
 - Freescale (formerly Motorola): www.freescale.com
- Sparc
 - Used in workstation
 - Sun Microsystems (Acquired by Oracle): www.sun.com
- ARM
 - Most popular in embedded world
 - ARM: www.arm.com
- MIPS
 - Used in embedded world
 - MIPS Technologies: www.mips.com
 - **We stick to MIPS architecture throughout this course**
 - **Because architecture is easy to understand**
 - **Because the book is based on MIPS**

x86?

- What is x86?
 - Generic term referring to processors from Intel, AMD and VIA
 - Derived from the model numbers of the first few generations of processors:
 - 80**86**, 802**86**, 803**86**, 804**86** → **x86**
 - Now it generally refers to processors from Intel, AMD, and VIA
 - x86-16: 16-bit processor
 - x86-32 (aka IA32): 32-bit processor * IA: Intel Architecture
 - x86-64: 64-bit processor
- Intel takes about 80% of the PC market and AMD takes about 20%
 - Apple has also been introducing Intel-based Mac from Nov. 2006



Power under the hood.

Inside the MacBook is a powerful 2.13GHz Intel Core 2 Duo processor based on advanced Core microarchitecture. MacBook provides a fast 1066MHz frontside bus and 3MB of shared L2 cache, so you'll have more than enough horsepower to get the job done.



x86 History (as of 2008)

40 years of changing the world

Since Intel's earliest days, we've harnessed the power of the transistor to transform what's possible for people around the world. In our first 40 years we've redefined how people live, work and play. Imagine what we can do together in the next 40.

Learn more at next40.intel.com

intel Leap ahead™

Year	Processor
1968	Intel 4004
1969	Intel 8008
1971	Intel 8080
1972	Intel 8085
1974	Intel 8088
1979	Intel 80286
1982	Intel 286
1985	Intel 386
1989	Intel 486
1993	Intel Pentium
1997	Intel Pentium Pro
1999	Intel Pentium 4
2000	Intel Pentium 4
2006	Intel Core 2 Duo
2008	Intel Core 2 Duo

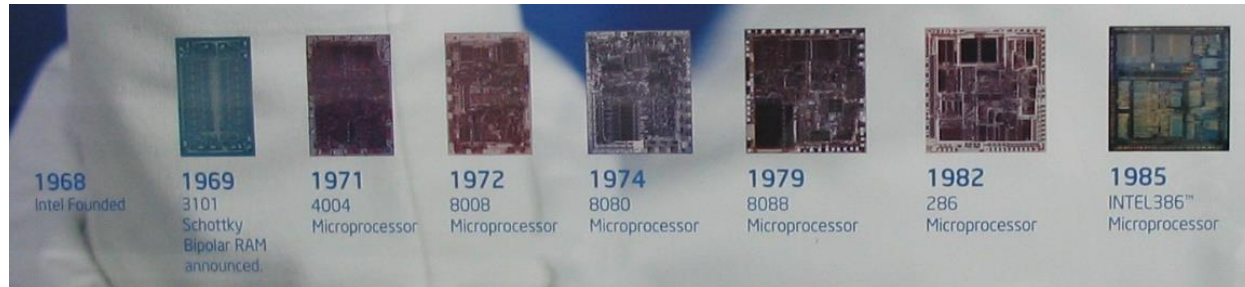
x86 History (Cont.)

4-bit

8-bit

16-bit

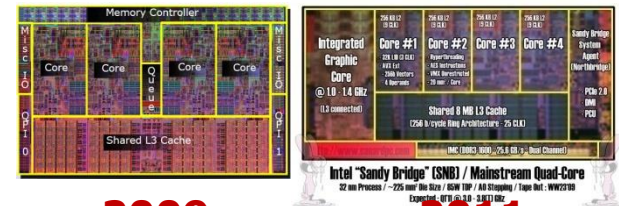
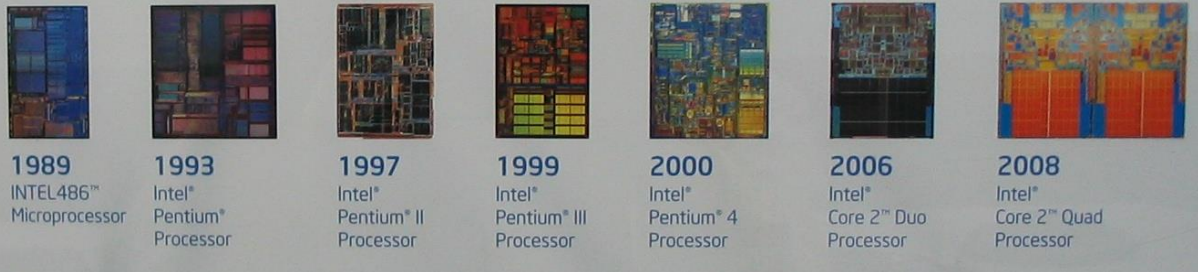
32-bit (i386)



32-bit (i586)

32-bit (i686)

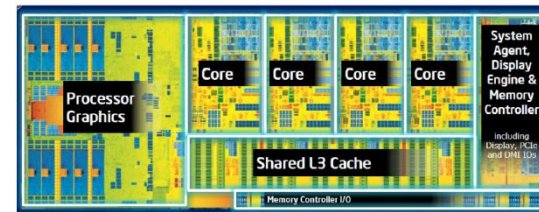
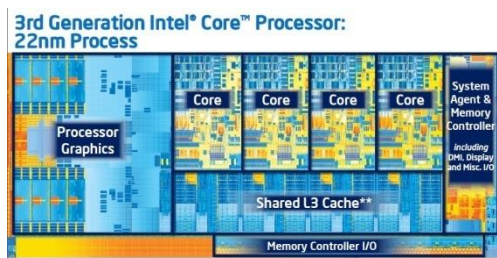
64-bit (x86_64)



2009
1st Gen. Core i7 (Nehalem)

2011
2nd Gen. Core i7 (Sandy Bridge)

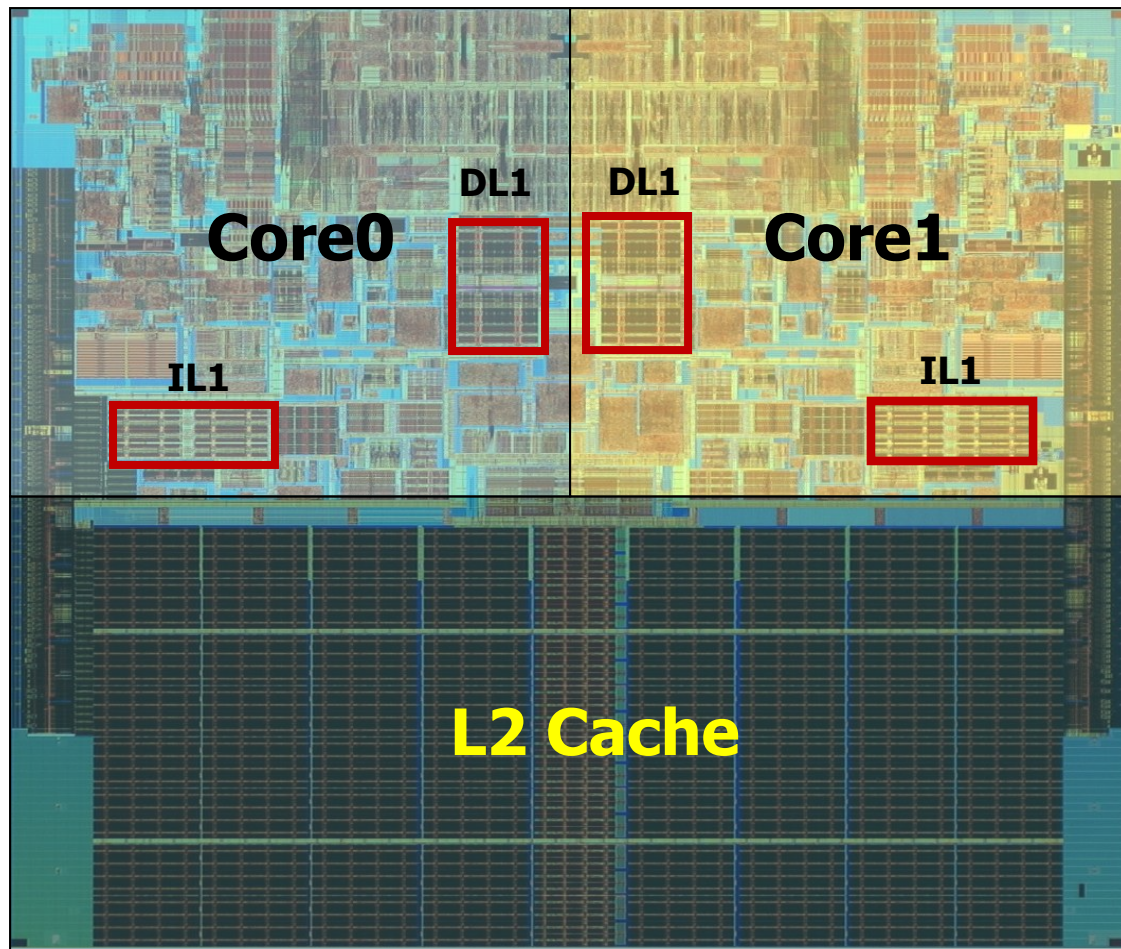
2012
3rd Gen. Core i7 (Ivy Bridge)



2013
4th Gen. Core i7 (Haswell)

Intel's Core 2 Duo

- 2 cores on one chip
- Two levels of caches (L1, L2) on chip
- 291 million transistors in 143 mm² with 65nm technology



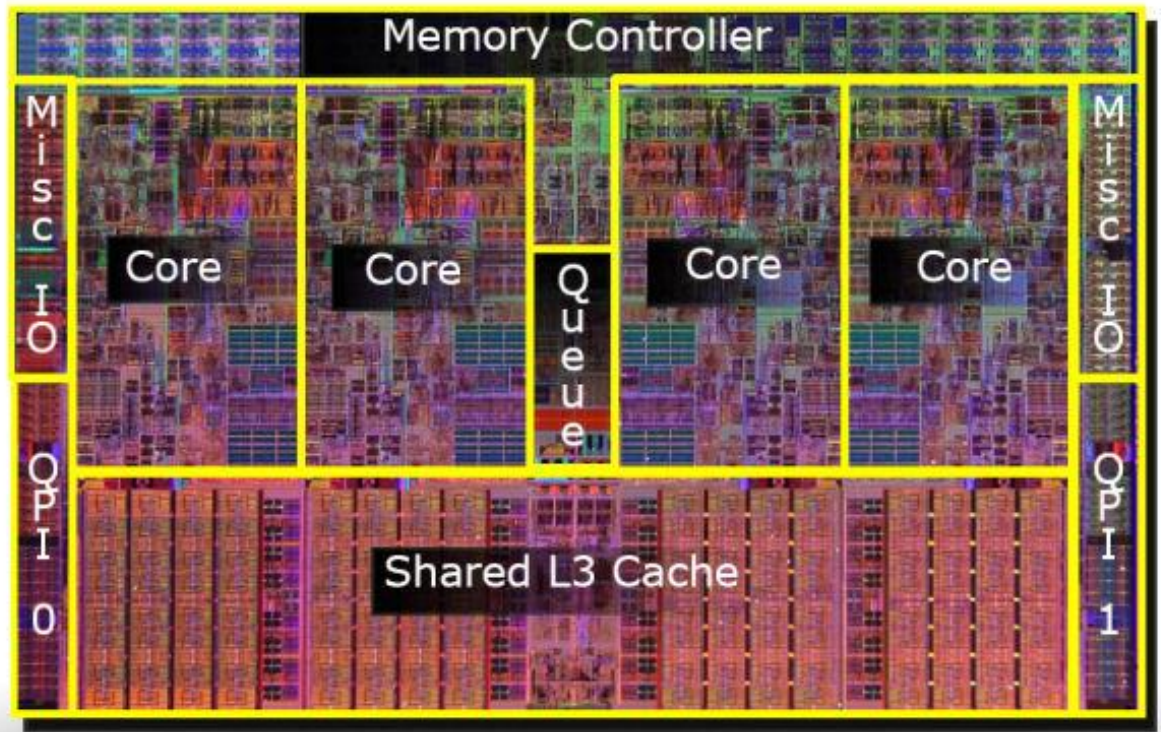
Source: <http://www.sandpile.org>

Intel's Core i7

- 4 cores on one chip
- Three levels of caches (L1, L2, L3) on chip
- 731 million transistors in 263 mm² with 45nm technology



The First Nehalem Processor

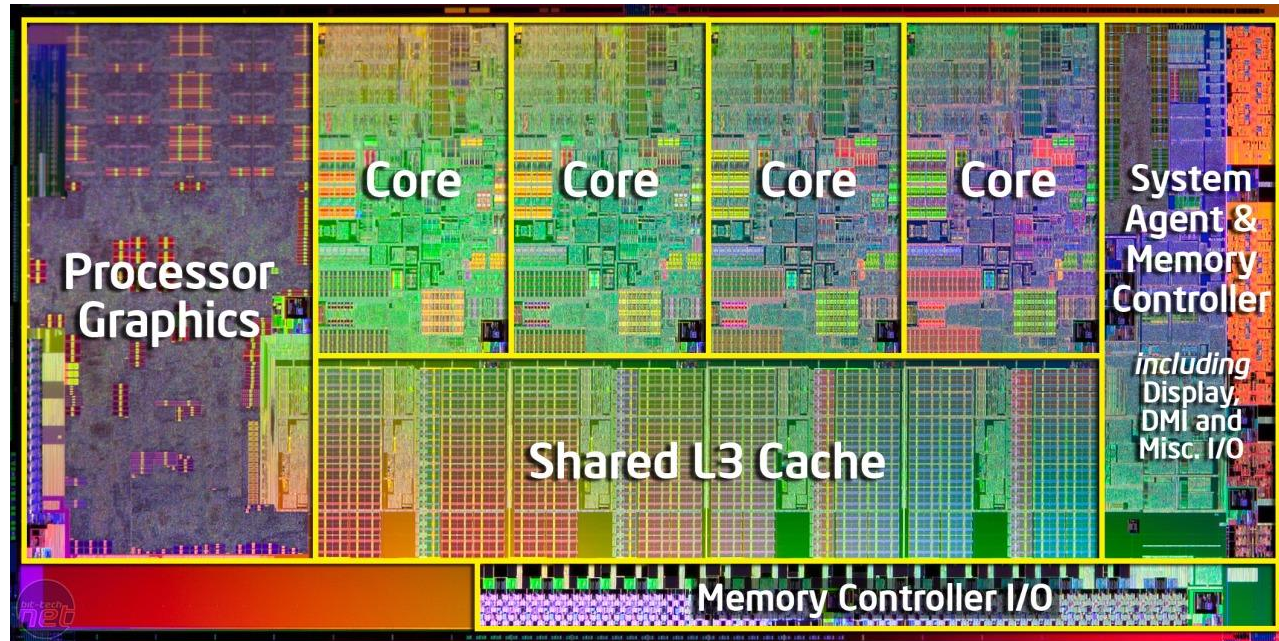


Intel's Core i7 (2nd Gen.)

2nd Generation Core i7

Sandy Bridge

L1	32 KB
L2	256 KB
L3	8MB



**995 million transistors
in 216 mm² with 32nm
technology**

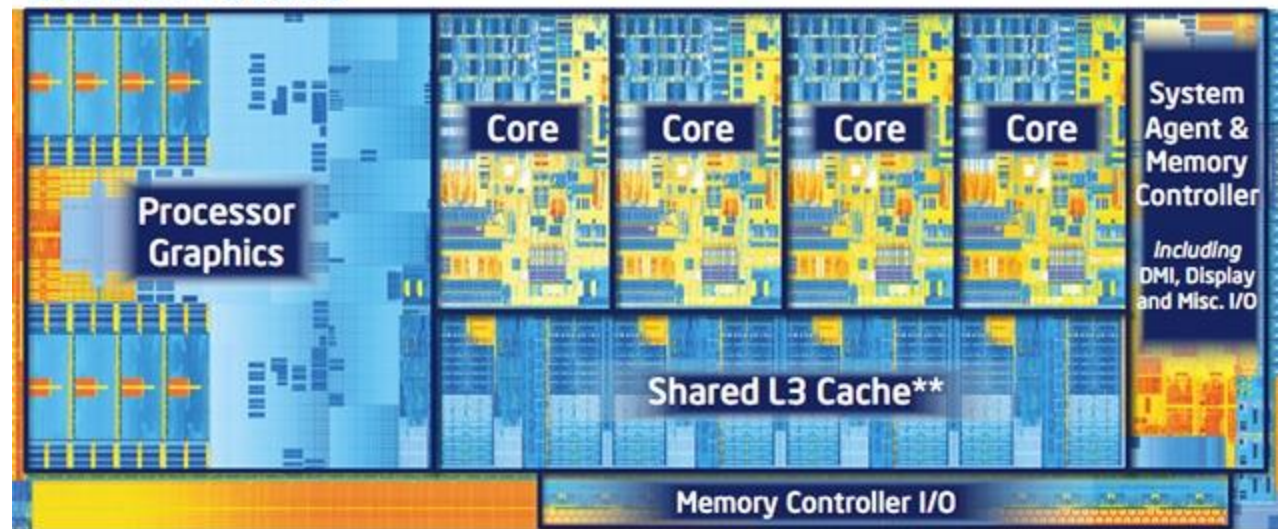
Intel's Core i7 (3rd Gen.)

3rd Generation Core i7

L1	64 KB
L2	256 KB
L3	8MB

**1.4 billion transistors
in 160 mm² with 22nm
technology**

3rd Generation Intel® Core™ Processor:
22nm Process

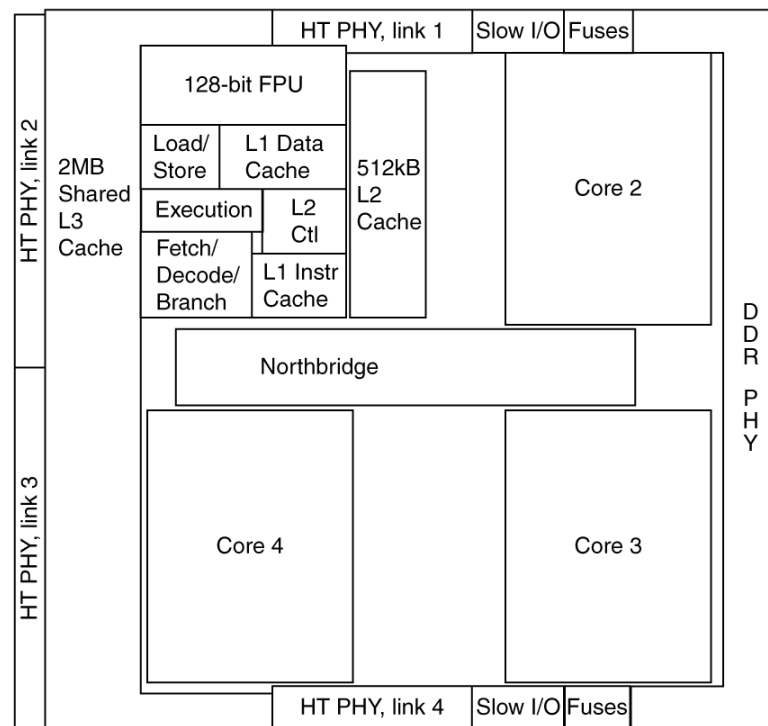
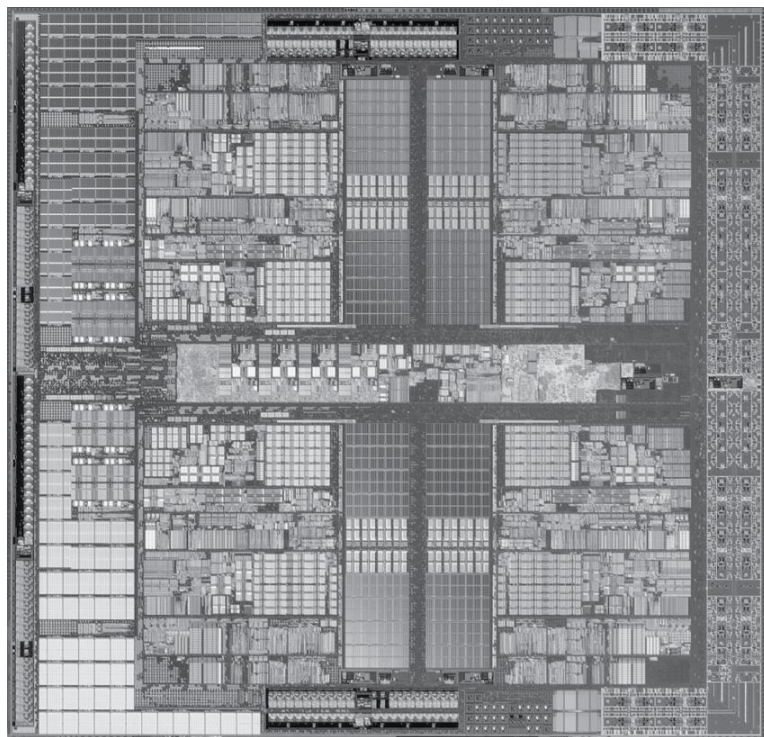


New architecture with shared cache delivering more performance and energy efficiency

Quad Core die with Intel® HD Graphics 4000 shown above
Transistor count: 1.4Billion Die size: 160mm²
** Cache is shared across all 4 cores and processor graphics

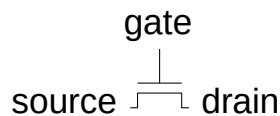
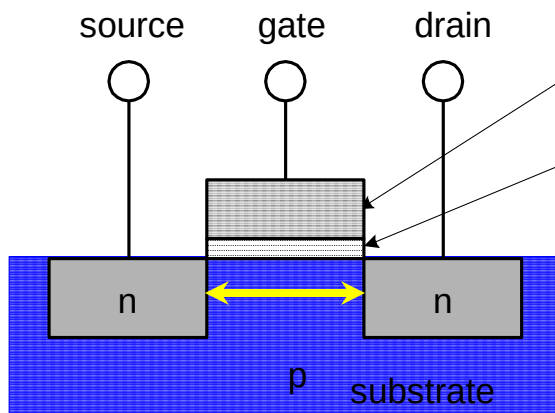
AMD's Opteron – Barcelona (2007)

- 4 cores on one chip
- 1.9GHz clock
- 65nm technology
- Three levels of caches (L1, L2, L3) on chip
- Integrated North Bridge

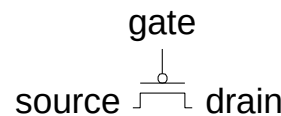
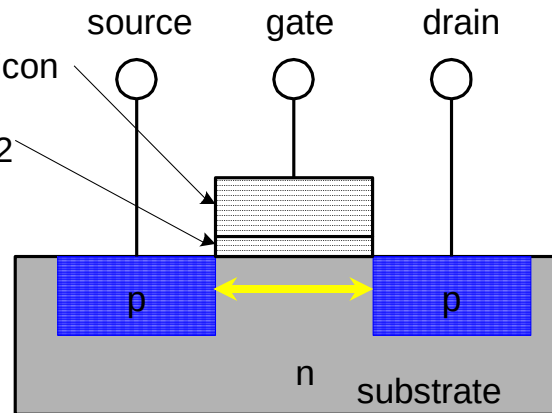


(Semiconductor) Technology

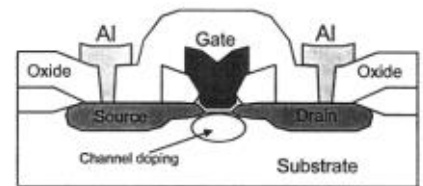
- **(Semiconductor) Technology**: How small can you make a transistor
 - **0.1 μm (100nm), 90nm, 65nm, 45nm, 32nm, 22nm technologies**
- **Transistor** is simply an on/off switch controlled by electricity
- **IC (Integrated Circuit)** combined dozens to hundreds of transistors into a single chip
- **VLSI (Very Large Scale Integration)** is used to describe the tremendous increase in the number of transistors in a chip



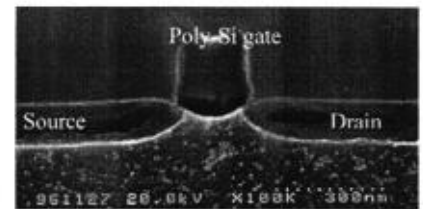
nMOS



pMOS

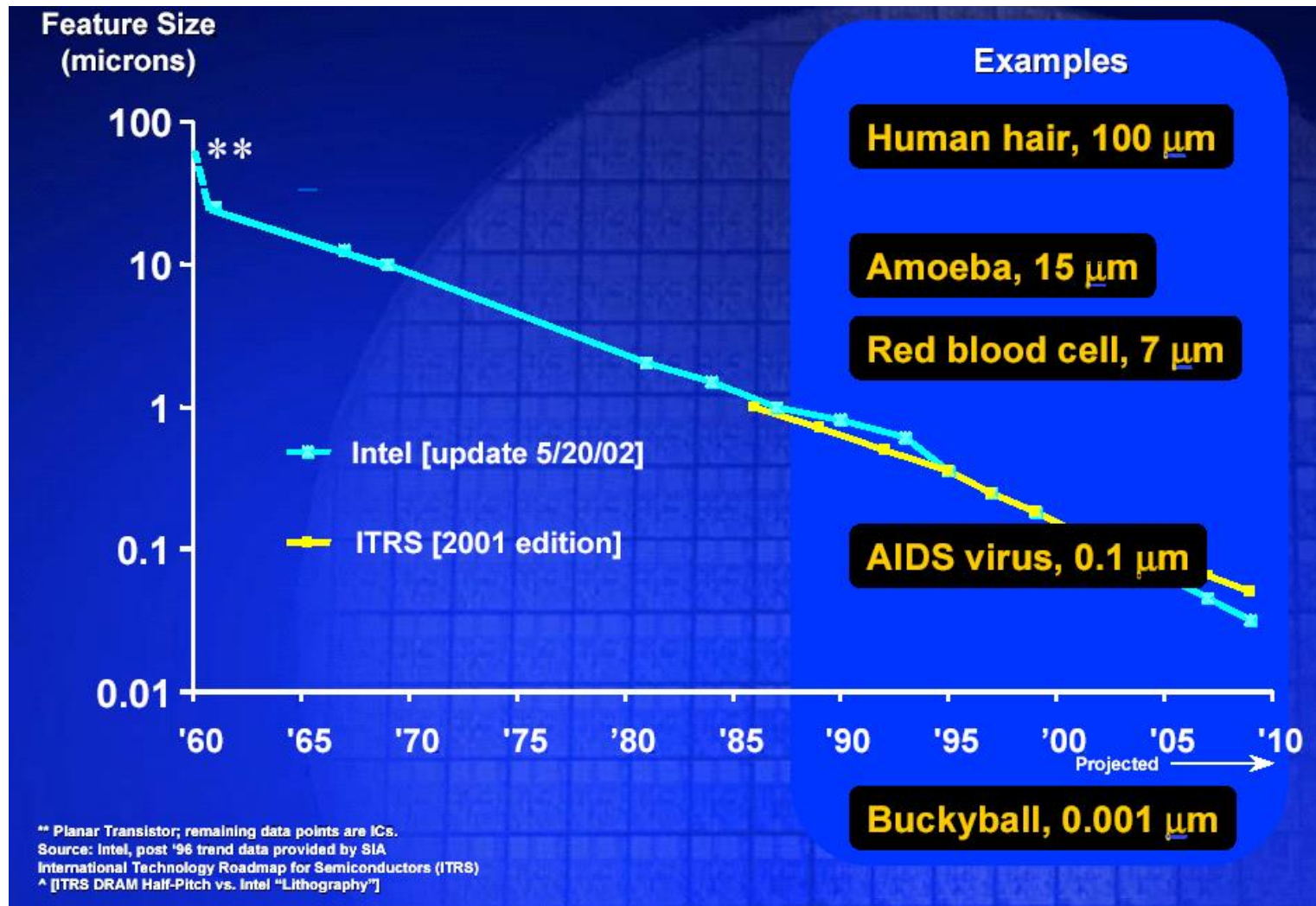


(a)



(b)

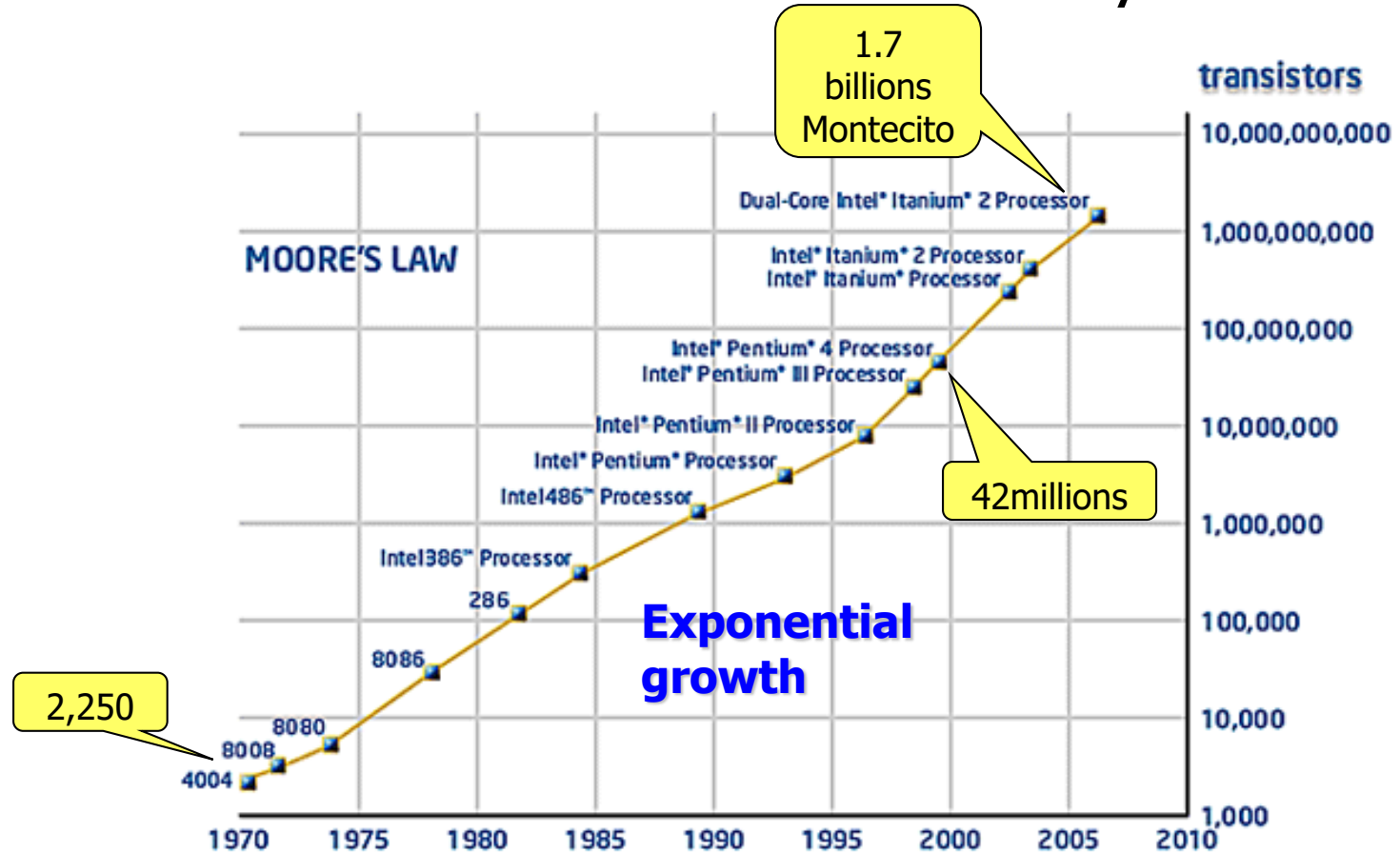
Feature Size (Technology) Trend





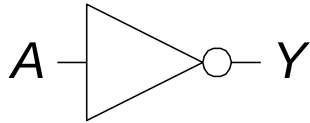
Moore's Law

- Transistor count will be doubled every 18 months



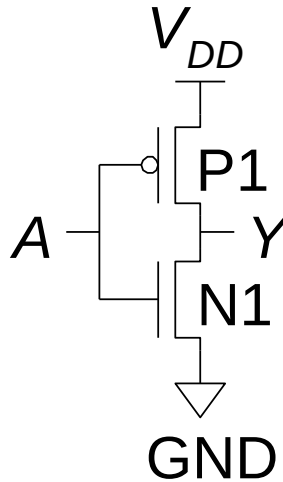
CMOS Gate Example: NOT Gate

NOT

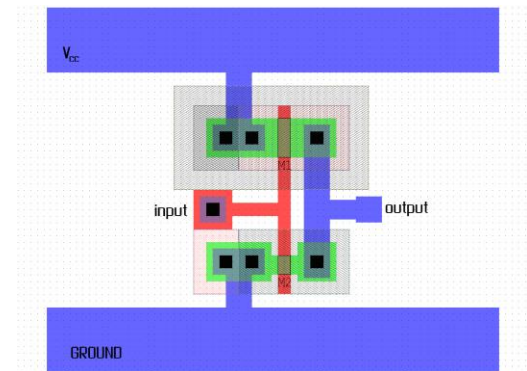


$$Y = \overline{A}$$

A	Y
0	1
1	0



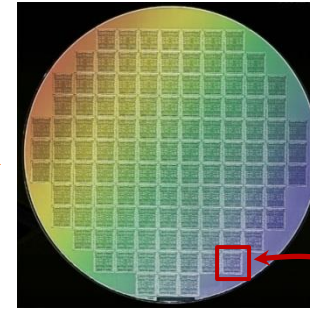
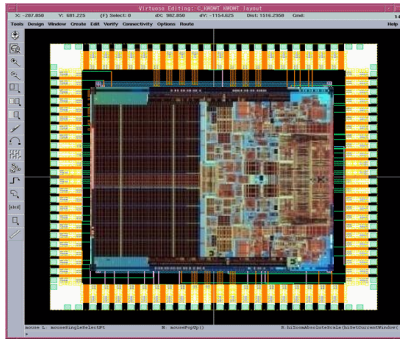
Layout (top view)



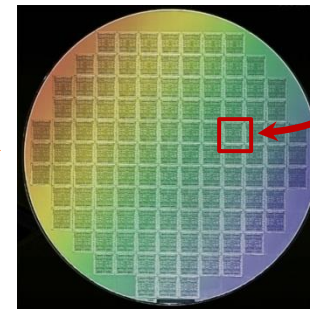
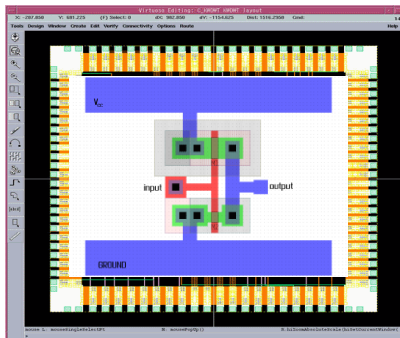
A	P1	N1	Y
0	ON	OFF	1
1	OFF	ON	0

Now, Let's Make an Inverter Chip

Core 2 Duo



Your Inverter chip

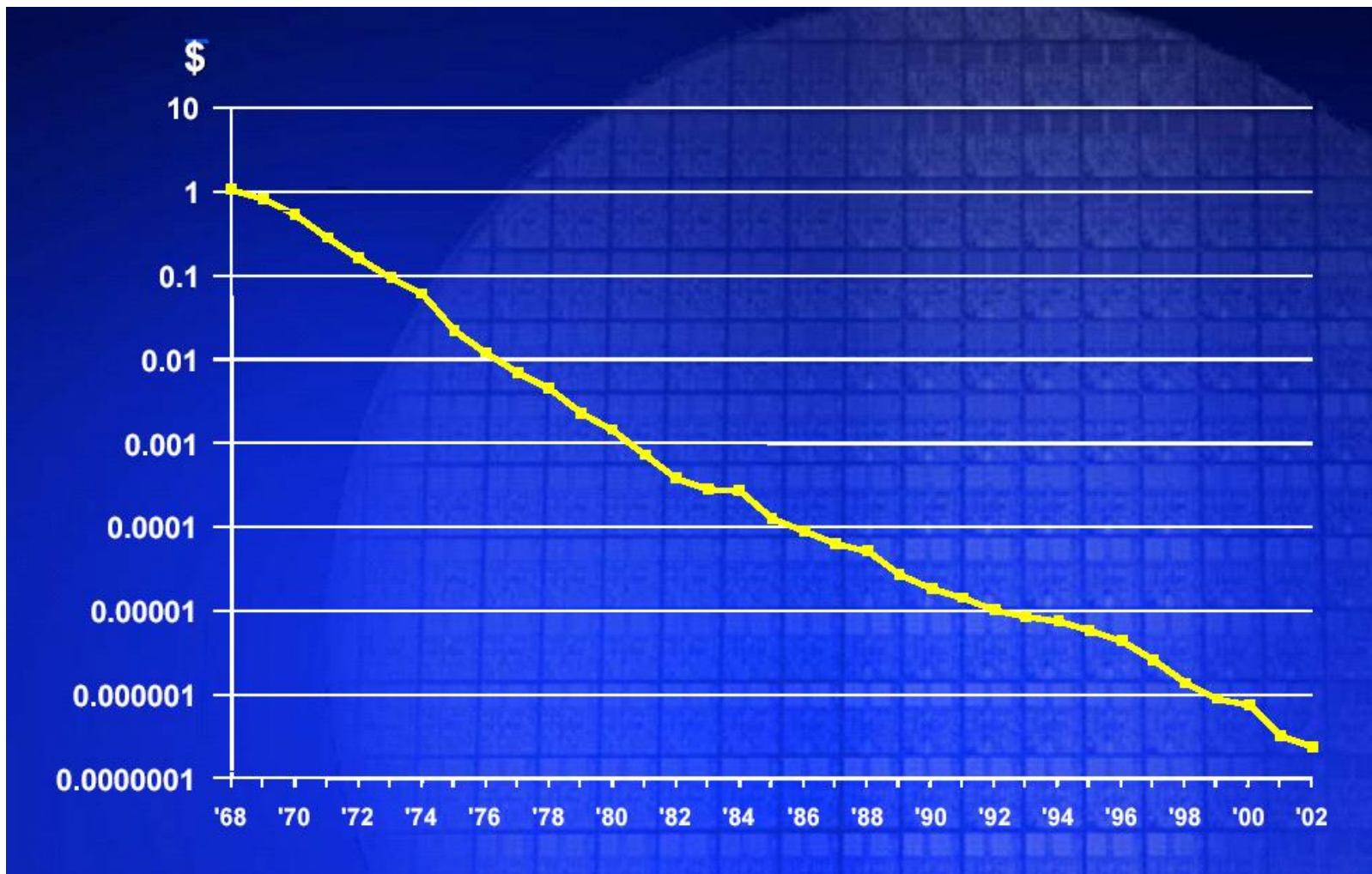


die

- **Yield** means how many dies are working correctly after fabrication

Backup Slides

Transistor Cost



The Processor Market

embedded growth >> desktop growth

