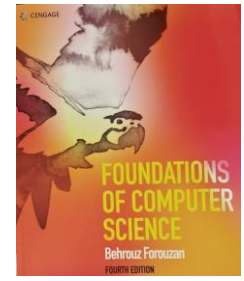


Chapter 1

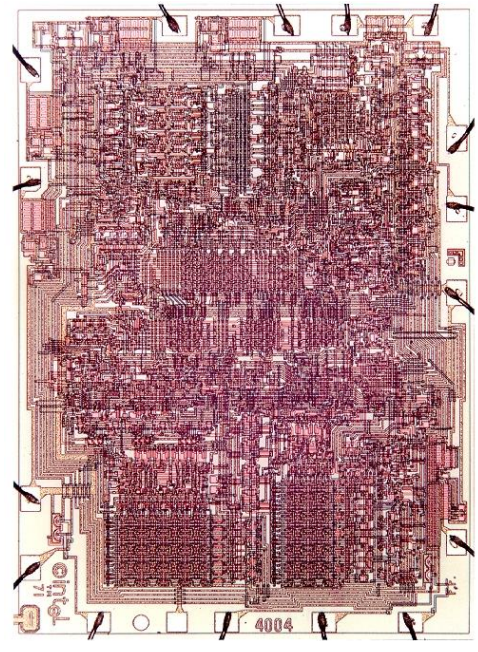
Introduction - Extension

1.1

Microprocessor Evolution微處理器演進

The First Microprocessor
Intel 4004

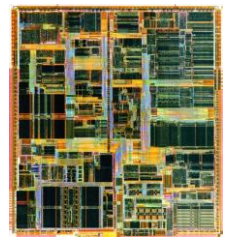
1000 transistors
1 MHz operation
4-bit CPU
1971



Courtesy, Intel

1.2

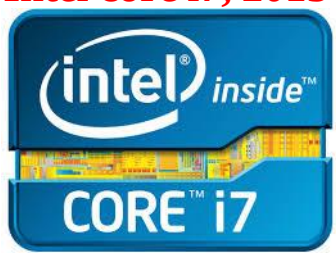
Intel Pentium IV Microprocessor, 2001



512GB SanDisk Extreme PRO SDXC UHS-I (Source：SanDisk)

2014

Intel core i7, 2013



source: google's web

1.3 Courtesy, Intel

Intel Core i7-6700K、Core 7-5775C、Core i7-4790K 規格比較表			
處理器型號	Core i7-4790K	Core i7-5775C	Core i7-6700K
微處理器架構	Haswell	Broadwell	Skylake
製程	22nm	14nm	14nm
總核心數 / 總執行緒	4 / 8	4 / 8	4 / 8
工作時脈	4.0GHz	3.3GHz	4.0GHz
外頻 x 倍頻	100 x 40	100 x 33	100 x 40
自動超頻	TurboBoost：4.4GHz	TurboBoost：3.7GHz	TurboBoost：4.2GHz
對外連結	DMI	DMI	DMI
記憶體支援	DDR3 / DDR3L	DDR3 / DDR3L	DDR3L / DDR4
L1 快取記憶體	(32KB+32KB) x4	(32KB+32KB) x4	(32KB+32KB) x4
L2 快取記憶體	256KB x4	256KB x4	256KB x4
L3 快取記憶體	共享 8MB	共享 6MB	共享 8MB
L4 快取記憶體	N/A	128MB eDRAM	N/A
封裝	LGA1150	LGA1150	LGA1151
內建繪圖晶片	HD Graphics 4600	Iris Pro Graphics 6200	HD Graphics 530
繪圖晶片基頻	350~1250MHz	300~1150MHz	300~1150MHz

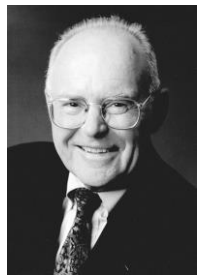
source: google's web

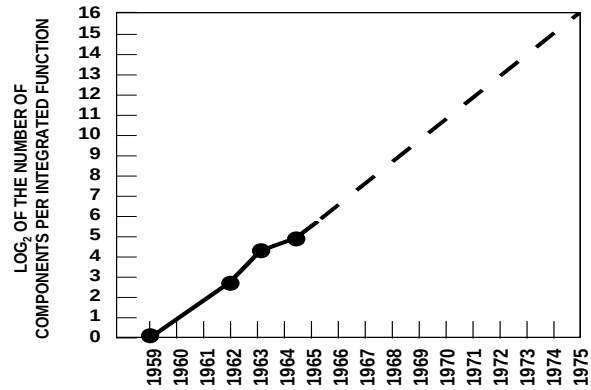
1.4 Courtesy, Intel

Moore's Law 莫爾定律

(*Electronics*, April 19, 1965)

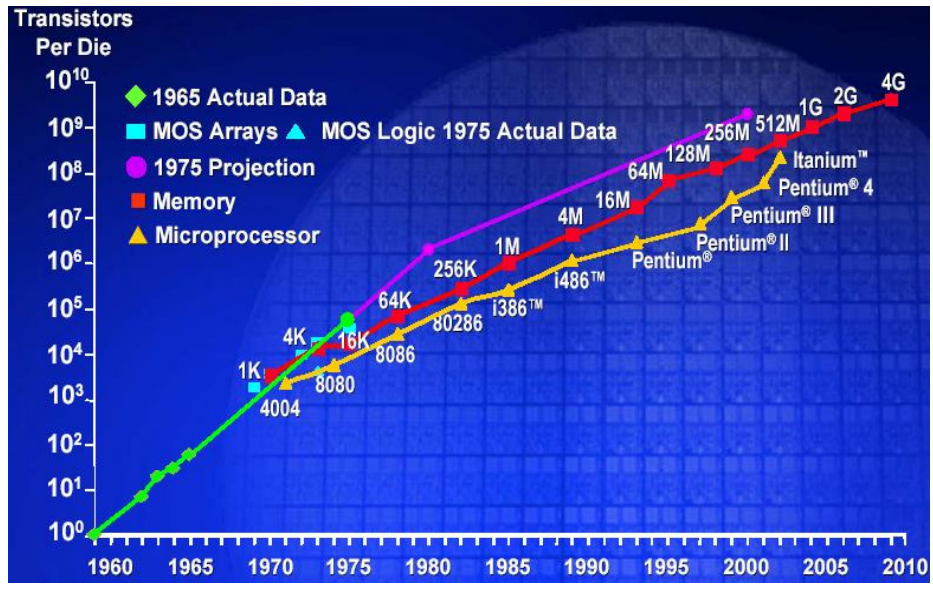
In **1965, Gordon Moore** noted that **the number of transistors on a chip doubled every 18 to 24 months**. He made a prediction that **semiconductor technology will double its effectiveness every 18 months.**





1.5

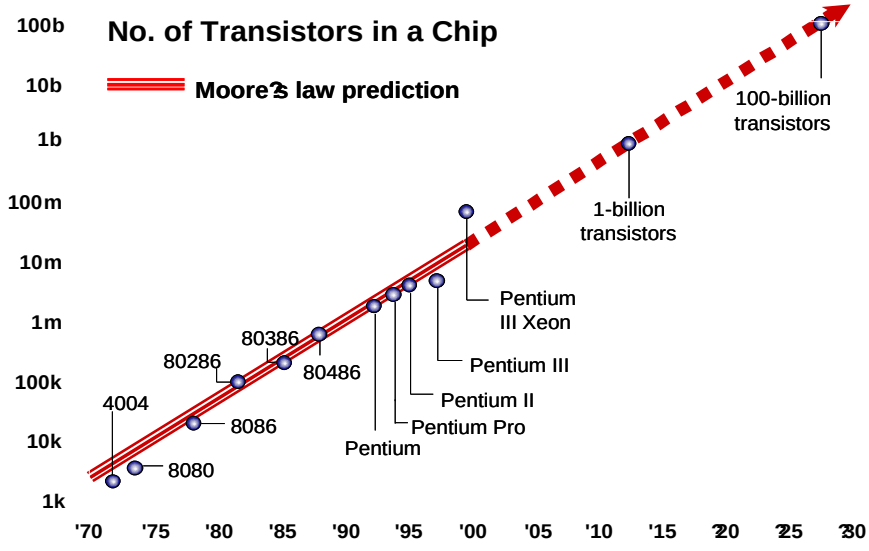
Exponent Growth指數成長 to follow Moore's Law



1.6

CPU Evolution CPU演進

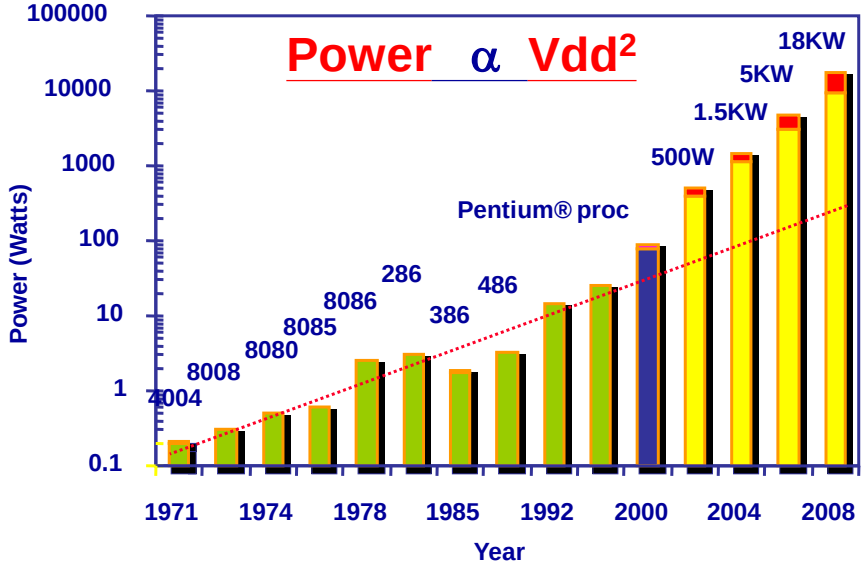
Die size grows by 14% to satisfy Moore's Law



1.7

Courtesy, Intel

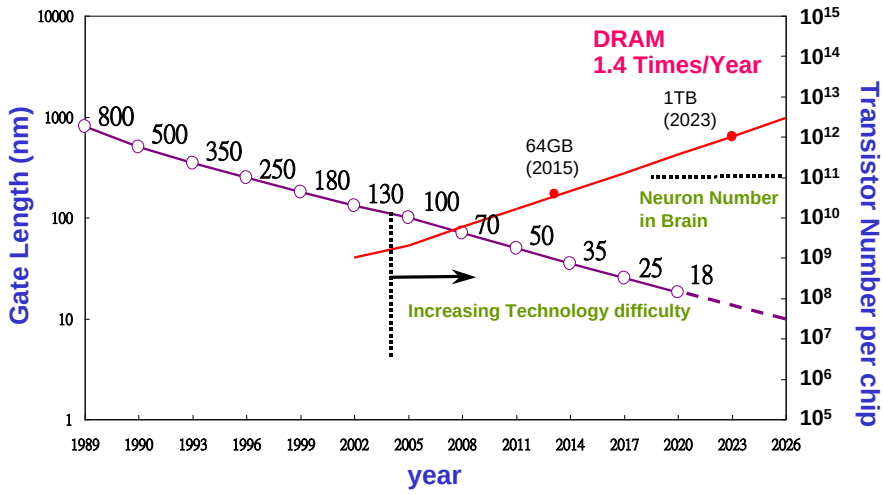
Power will be a major problem 功耗大問題



1.8

Courtesy, Intel

Process Technology Evolution 製程演進



1.9

Courtesy, Intel

Nano-Meter Scaling 奈米刻度

Human hair's diameter：70~100μm

Human felling cell：50~100 μm

Human ovum cell：100 μm

Plant cell：100 μm

Human red hemocyte：5 μm

Germ：1~8 μm

Virus：hundreds nm

Protein：number tens nm

DNA：2nm

Atom：0.1nm

$T = 10^{12}$

$G = 10^{9}$

$M = 10^{6}$

$k = 10^{3}$

$m = 10^{-3}$

$\mu = 10^{-6}$

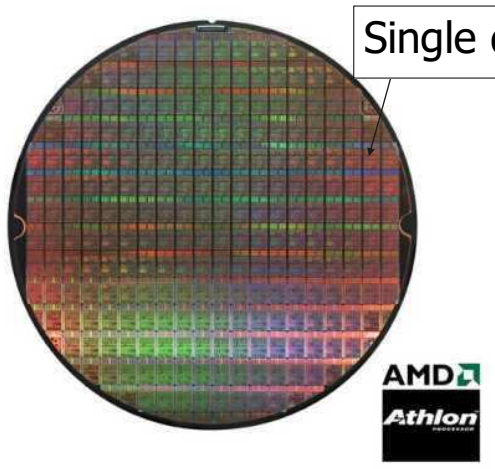
$n = 10^{-9}$

$p = 10^{-12}$

$f = 10^{-15}$

1.10

Wafer Size 晶圓大小



2”, 3”, and 5”

1987, 6” (150mm)

1991, 8” (200mm)

1999, 12” (300mm)

2007, 18” (450mm)

More dies per wafer, low cost

From http://www.amd.com

1.11

➢ iPhone XS/MAX **Apple: 2018 A12 Bionic**, six-core, 2.49GHz (**A11 2.39GHz**), 7-nm process (TSMC)；
A12晶片是全球首款7奈米製程處理器，效能比A11提升15%、GPU提升50%、功耗降低40%。

➢**Apple: 2019 A13 Bionic 剛出來，效能又再提升！**

➢安兔兔v7版本評測軟體中**A12為總分36萬3525**；
比**小米黑鯊手機**採**高通S845處理器高出7萬分**。
比**華碩ROG Phone**採用**高通S845處理器**(時脈最高可達**2.9GHz**，內建X模式超頻)**高出6萬分**。

➢ **Globalfoundries (格芯)** gives up the invention of 7-nm process

➢ **Intel postpones the schedule of 7-nm process.**

➢ **Samsung will have the schedule of 7-nm process in 2019.**

1.12

Key Terms

- Integrated Circuit (IC)
- Nano meter
- Wafer

Review Questions

- What is Moore's law?
- What is the mean of 7nm-processing technology.

1.13