From Processor Model to Personal Computer
— An Odyssey in Design and Acronyms —

Comp 200, Fall 2004

Rice University

Houston, TX, USA

Moore's law

F117 Nighthawk

- Minimal radar & infra-red signatures (stealth)

- Looks like the shipping carton for a real plane

- Flies with extensive avionic assistance

- Designed 1978-1981

Moore's law

B2 Spirit

- Minimal radar & infra-red signatures (stealth)

- Sleek, rounded design

- Flies with extensive avionic assistance

- Designed <u>1986</u>-1989

Moore's law

Why is F117 angular & B2 smooth?

- In <u>1978</u>, F117 was best computable approximation to the curve

- By <u>1986</u>, computers were fast enough to compute the B2 surface

Change in computing power, over 8 to 10 years, is a visible effect!

$\Rightarrow$ Consequence of Moore's law

Fast Computers

Cray 1 (1976)

- 160 Million FLOPs
- 8 megabytes of RAM
- Liquid cooled
    - → Fluorinert
- $8.8 Million

Fast Computers

Cray 2 (1985)

- 1.9 Billion FLOPs
- 2 Gigabytes of RAM
- 4 processors
- Liquid cooled
- $23 Million

Fast Computers

Intel Touchstone Delta

- 32 Billion FLOPs
    - → 512 processors @ 60MF
- 16 Gigabytes RAM
- December 1993
- One of a kind system
    - → Fastest on earth, 1994
- Roughly $12 Million

Not as pretty as a Cray, but still set for pictures in the machine room!

(Rice's CRPC owned 1/8 of it)
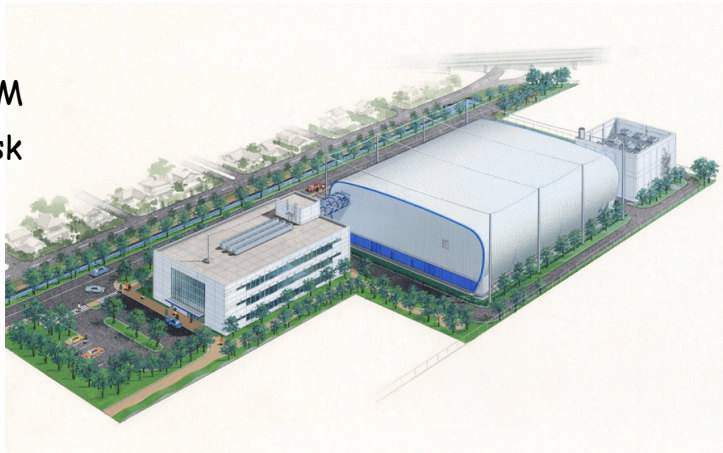
Fastest Computer on Earth   (today)

Japanese Earth Simulator

- 40 Trillion Flops
- 10 Terabytes RAM
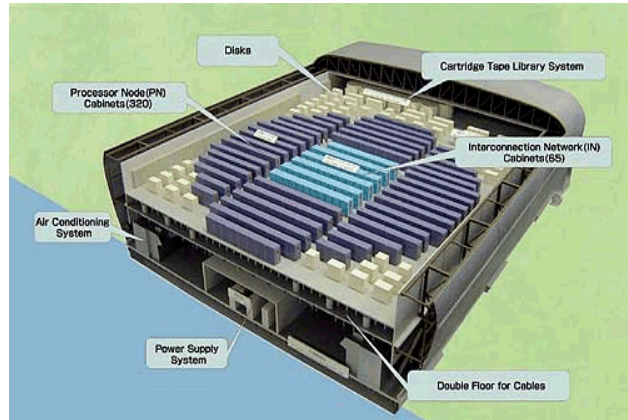- 600 Terabyes disk
- $450 Million

Dedicated to climate modelling

Fastest Computer on Earth

Japanese Earth Simulator

- 40 Trillion Flops
- 10 Terabytes RAM
- 600 Terabyes disk
- $450 Million

7 MegaWatts of power

Custom building & custom machine

Fast Computers

Rice TeraScale Cluster

- 1 Trillion FLOPs
  - → 264 Itanium-2's
- 500 Gigabytes RAM
- > 2 Terabytes disk
- $4 Million (list)

Owned by researchers in Science & Engineering

Stuck in a corner of the Mudd machine room - not a celebrity!

Moore's Law

1976: 160 Million Flops, $8.8 Million
1985:   1.9 Billion Flops, $23 Million
1993:   32 Billion Flops, $12 Million
2003:   1 Trillion Flops, $4 Million
            40 Trillion Flops, $450 Million

High-end
Supercomputers

On the desktop:

1983:   1 Million Ops,   2 MB RAM, no disk $4,500
2003: > 1 Billion Ops, 256 MB RAM, 40 GB disk $1,499
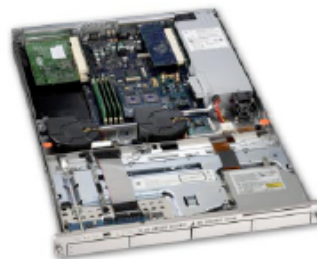
Costs change radically, too!

1985

2003

1.9 Billion FLOPs

2 Gigabytes RAM

$23,000,000

19 Billion FLOPs

2 Gigabytes RAM
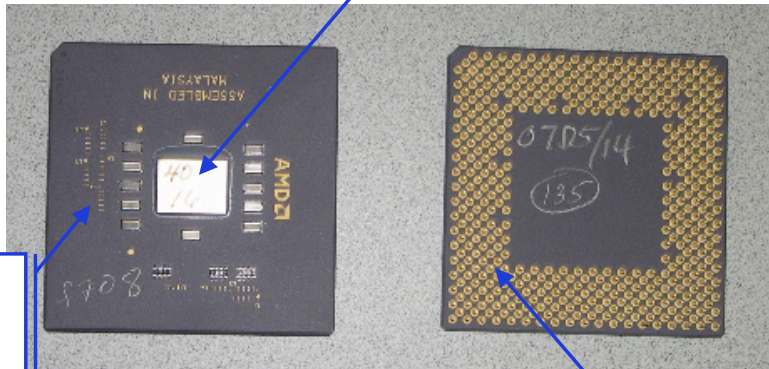
$4,600

Show and Tell

AMD Athlon Processor

- Cray 2 class machine (no RAM)
- Several billion FLOPs

Actual processor

Package size determined by # of pins

Connecting pins

Moore's Law Applied to Storage

Cray 1 had 8 megabytes of RAM

Cray 2 had 2,048 megabytes

RAM is semiconductor memory

What about other forms of storage?

Floppy disk ($1 to 2)

400 kilobytes
800 kilobytes
1.44 megabytes

Moore's Law Applied to Storage

Cray 1 had 8 megabytes of RAM
Cray 2 had 2,048 megabytes

} RAM is semiconductor memory

What about other forms of storage?

Zip disk ($10)
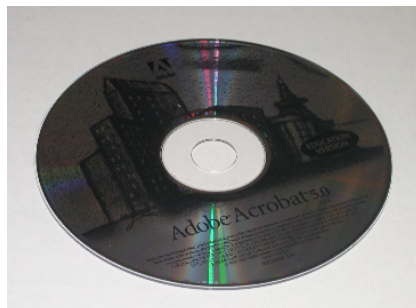
100 megabytes

Moore's Law Applied to Storage

Cray 1 had 8 megabytes of RAM
Cray 2 had 2,048 megabytes

} RAM is semiconductor memory

What about other forms of storage?

CD (< $1)

700 megabytes

200 CD Jukebox
$ 200 for stereo
$ 900 for computer

Moore's Law Applied to Storage

Cray 1 had 8 megabytes of RAM

Cray 2 had 2,048 megabytes

RAM is semiconductor memory

What about other forms of storage?

DVD ($ 3)

4.8 gigabytes

5 DVD Jukebox

$ 100 for stereo/video

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