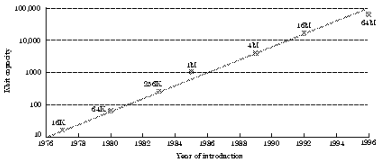
Origins of Speed and Power In Computer Architecture

It is not simply the technology. Design, that is, the ingenuity of computer architects is critical for today's computer performance.

(c) Copyright Larry Snyder 1998

Moore's Law

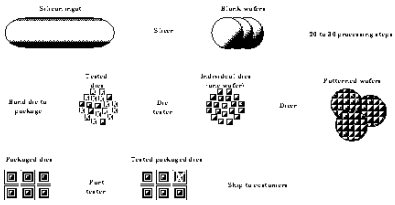
- It's not a law, but a prediction



- For processors, density improvements are augmented by speed and power improvements

(c) Copyright Larry Snyder 1998

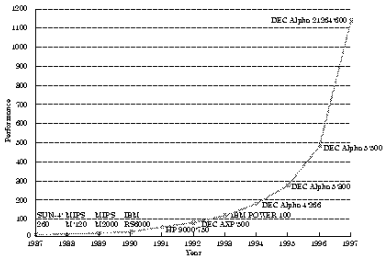
Chip Fabrication



- The enabling ideas of chip technology are
  - Integration -- active elements + interconnect from the same material
  - Photolithography

(c) Copyright Larry Snyder 1998

Processor Performance



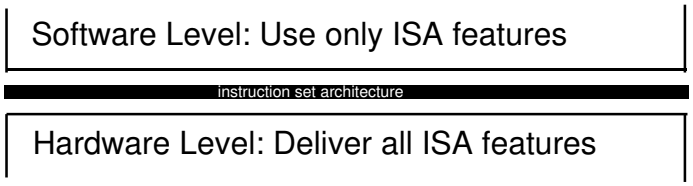
Processor performance doubles every 1.6 years

- Critical components to the improvements
  - Technology
  - Internal Design
  - System Design
- Advances come with greater effort

(c) Copyright Larry Snyder 1998

Instruction Set Architecture

Separating language and operating characteristics of a computer from its implementation is critical to giving hardware and software engineers full design freedom



- IBM S/360 Series Was First; x86 Series Present Example

(c) Copyright Larry Snyder 1998

Properties of Commercial Computers

Machines since 1950, in 1996 dollars

Year	Name	Size	Power-W	+/sec	Mem KB	Price	Pr/Perf	Adj Price	Adj P/Perf
1951	UNIVAC	1000	124,500	1,900	48	$1M	1	$5.0M	1
1964	IBM360	60	10.000	500,000	64	$1M	263	$4,1M	318
1965	PDP-8	8	500	330,000	4	$16,000	10,855	$66,071	13,135
1976	Cray-1	58	60,000	166M	32,768	$4M	21,842	$8.5M	51,604
1981	IBM-PC	1	150	240,000	256	$3,000	42,105	$4,081	154,673
1991	HP9000	2	500	50M	16,384	$74,000	3.5M	$8,156	16.1M
1996	PentP200	2	500	400M	16,384	$4,400	47,8M	$4,400	239.0M

Notes: IBM360 Model 50, HP-9000 Model 750
Size is in cubic feet

(c) Copyright Larry Snyder 1998

Architectural Terminology

abstraction	DRAM
assembler	implementation
binary number	instruction
bit	instruction set architecture
cache	integrated circuit
central processing unit	memory
chip	operating system
compiler	processor
computer family	semiconductor
control	supercomputer
data path	transistor
defect	VLSI
die	yield

(c) Copyright Larry Snyder 1998