1.5 Historical Development

• Moore’s Law (1965)
  – Gordon Moore, Intel founder
  – “The density of transistors in an integrated circuit will double every year.”

• Contemporary version:
  – “The density of silicon chips doubles every 18 months.”

But this “law” cannot hold forever ...

1.5 Historical Development

• Rock’s Law
  – Arthur Rock, Intel financier
  – “The cost of capital equipment to build semiconductors will double every four years.”
  – In 1968, a new chip plant cost about $12,000.

At the time, $12,000 would buy a nice home in the suburbs.
An executive earning $12,000 per year was “making a very comfortable living.”
1.5 Historical Development

- Rock’s Law
  - In 2012, a chip plant under construction cost well over $5 billion.
  
  
  $5 \text{ billion is more than the gross domestic product of some small countries, including Barbados, Mauritania, and Rwanda.}$

  - For Moore’s Law to hold, Rock’s Law must fall, or vice versa. But no one can say which will give out first.
1.8 The von Neumann Model

- This is a general depiction of a von Neumann system:

- These computers employ a fetch-decode-execute cycle to run programs as follows . . .
“Hello World” in Linux Assembly

- Use your favorite UNIX editor (vi, emacs, pico, ...)
- Assemble using NASM on
gl.umbc.edu nasm -f elf hello.asm
- NASM documentation is on-line.
- Need to "load" the object
  file ld hello.o
- Execute
  - a.out
- CMSC 121 Introduction to UNIX
x86 Addressing Modes

80x86 Addressing Modes

- We want to store the value 1734h.
- The value 1734h may be located in a register or in memory.
- The location in memory might be specified by the code, by a register, …
- Assembly language syntax for MOV

  - MOV DEST, SOURCE
Register from Register Indirect

MOV EAX, [ECX]

Addressing Modes

EAX
EBX
ECX
EDX
EBP
ESI
EDI
ESP

Code

MOV...

Data

Register from Memory

MOV EAX, [08A94068]
MOV EAX, [x]

Addressing Modes

EAX
EBX
ECX
EDX
EBP
ESI
EDI
ESP

Code

MOV...

08A94068

Data

Register from Immediate

MOV EAX, 1734

Addressing Modes

EAX
EBX
ECX
EDX
EBP
ESI
EDI
ESP

Code

MOV...

1734

Data
Notes on Addressing Modes

- More complicated addressing modes later:
  
  MOV EAX, [ESI+4*ECX+12]

- Figures not drawn to scale. Constants 1734h and 08A94068h take 4 bytes (little endian).
- Some addressing modes are not supported by some operations.
- Labels represent addresses not contents of memory.