Digital IC & Sytems Design

Iain McNally

≈ 15 lectures

Koushik Maharatna

≈ 15 lectures

Digital IC & Sytems Design

- Assessment

10%	Coursework	L-Edit Gate Design (BIM)
90%	Examination	

- Books

Integrated Circuit Design

a.k.a. Principles of CMOS VLSI Design - A Circuits and Systems Perspective

Neil Weste & David Harris

Pearson, 2011

Digital System Design with SystemVerilog

Mark Zwolinski

Pearson Prentice-Hall, 2010

Iain McNally

Integrated Circuit Design

- Content
  - Introduction
  - Overview of Technologies
  - Layout
  - CMOS Processing
  - Design Rules and Abstraction
  - Cell Design and Euler Paths
  - System Design using Standard Cells
  - Pass Transistor Circuits
  - Latches and Flip-Flops
  - PLAs, ROMs, RAMs
  - Wider View
- Notes & Resources

`https://secure.ecs.soton.ac.uk/notes/bim/notes/icd/`

History

1947 First Transistor

John Bardeen, Walter Brattain, and William Shockley (Bell Labs)

1952 Integrated Circuits Proposed

Geoffrey Dummer (Royal Radar Establishment) - *prototype failed...*

1958 First Integrated Circuit

Jack Kilby (Texas Instruments) - *Co-inventor*

1959 First Planar Integrated Circuit

Robert Noyce (Fairchild) - *Co-inventor*

1961 First Commercial ICs

Simple logic functions from TI and Fairchild

1965 Moore's Law

Gordon Moore (Fairchild) observes the trends in integration.

Moore's Law

Predicts exponential growth in the number of components per chip.

1965 - 1975 Doubling Every Year

In 1965 Gordon Moore observed that the number of components per chip had doubled every year since 1959 and predicted that the trend would continue through to 1975.

Moore describes his initial growth predictions as "ridiculously precise".

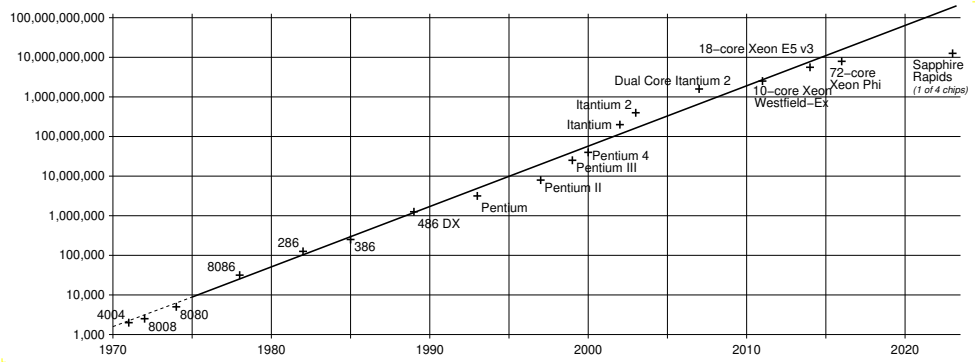
1975 - 20?? Doubling Every Two Years

In 1975 Moore revised growth predictions to doubling every two years.

Growth would now depend only on process improvements rather than on more efficient packing of components.

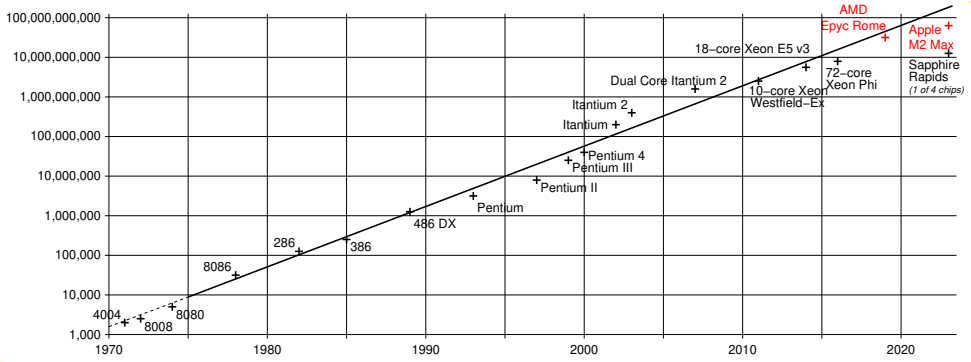
In 2000 he predicted that the growth would continue at the same rate for another 10-15 years before slowing due to physical limits.

Moore's Law at Intel[1]



[1]Intel was founded by Gordon Moore and Robert Noyce from Fairchild

Moore's Law at Intel[2] + Apple/TSMC, AMD/TSMC



[2]Intel has had some hiccups recently - Apple/TSMC and AMD/TSMC appear to be in front

Moore's Law; a Self-fulfilling Prophesy

The whole industry has used the Moore's Law curve to plan new fabrication facilities.

Slower - wasted investment

Must keep up with the Joneses[3].

Faster - too costly

Cost of capital equipment to build ICs doubles approximately every 4 years.

Moore's law is not dead (at least not quite). As transistor dimensions approach the size of a few tens of molecules, new techniques are needed. Recent developments include the stacking of transistors in V-NAND Flash memory to achieve higher densities.

[3]or the Intels