

Introduction to Embedded Systems

EHB326E

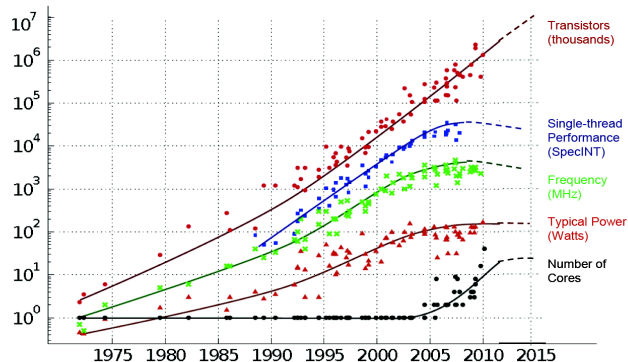
Lectures

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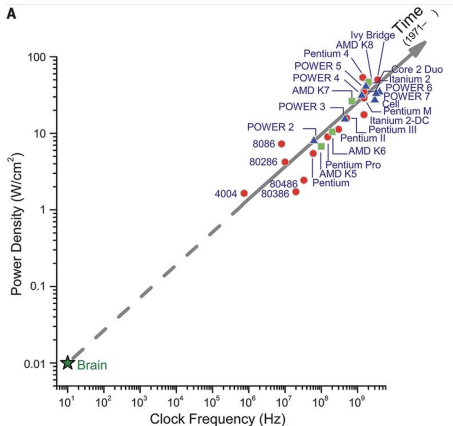
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35 YEARS OF MICROPROCESSOR TREND DATA

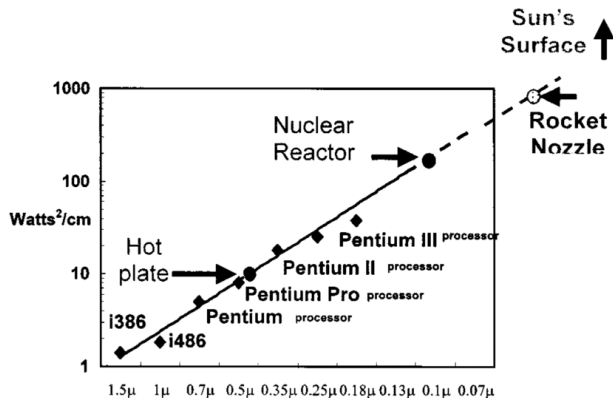


Original data collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond and C. Batten
Dotted line extrapolations by C. Moore

“When Stephen Hawking was asked what are the fundamental limits to microelectronics, Gordon Moore said the speed of light and the atomic nature of matter” [▶ Link](#)



Merolla et al. Science 08 Aug 2014, Vol. 345, Issue 6197, pp. 668-673



Ronen et al. Proceedings of the IEEE (Volume: 89, Issue: 3, Mar 2001)

A processor is a digital circuit designed to perform computational tasks.

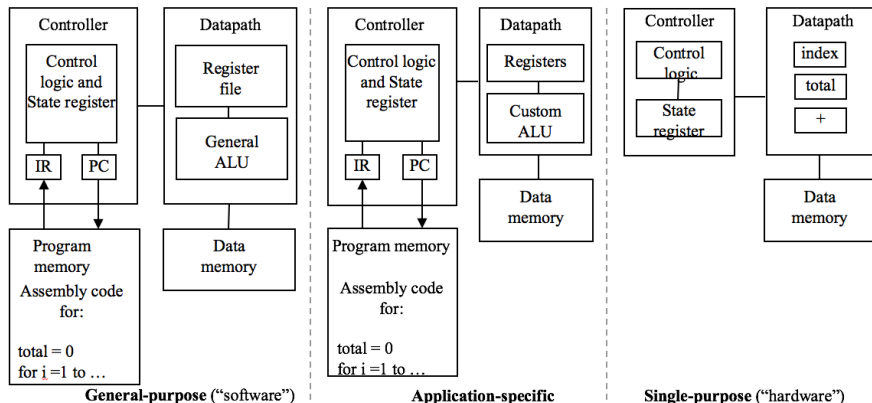
A processor consists of

- a datapath: storing and manipulating data
- a controller: moving data through the datapath

A general-purpose proc. can carry out a wide variety of computational task.

A single-purpose proc. can only carry out particular computational task.

Three key technologies for embedded systems



The architecture of the computation engine used to implement a system's desired functionality

General-purpose processors: Software

- Programmable device used in a variety of applications (“microprocessor”)
- Features
 - Program memory
 - General datapath with large register file and general ALU
- User benefits
 - Low time-to-market and NRE costs
 - High flexibility



Intel® 4004 processor
Introduced 1971
Initial clock speed
108 KHz
Number of transistors
2,300
Manufacturing technology
10μ



Intel® 8088 processor
Introduced 1979
Initial clock speed
5 MHz
Number of transistors
29,000
Manufacturing technology
3μ



Intel486™ processor
Introduced 1989
Initial clock speed
25 MHz
Number of transistors
1,200,000
Manufacturing technology
1μ

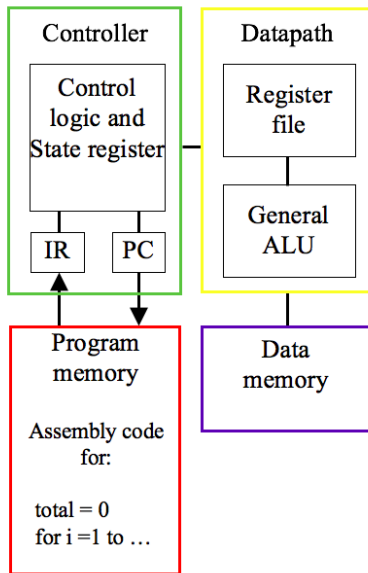


Intel® Pentium® 4 processor
Introduced 2000
Intel® Xeon® processor
Introduced 2001
Initial clock speed
1.5 GHz
Number of transistors
42,000,000
Manufacturing technology
0.18μ



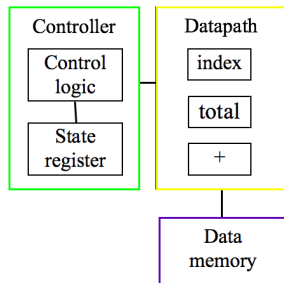
Quad-Core Intel® Xeon® processor
Introduced 2006
Quad-Core Intel® Core™2 Extreme processor
Introduced 2007
Number of transistors
582,000,000
Initial clock speed
2.66 GHz
Manufacturing technology
65nm

General-purpose processors



Single-purpose processors : Hardware

- Digital circuit designed to execute exactly one program
- Features
 - Contains only the components needed to execute a single program
 - No program memory
- Benefits
 - Fast
 - Low power
 - Small size



Application-specific processors

- Programmable processor optimized for a particular class of applications having common characteristics
- Features
 - Program memory
 - Optimized datapath
 - Special functional units
- Benefits
 - Some flexibility
 - good performance
 - size and power

