

# **Microprocessor Performance**

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## Architecture books

- ✓ **Gerry Blaauw and Fred Brooks, Jr., *Computer Architecture: Concepts and Evolution*, Addison-Wesley (1997), ISBN 0-201-10577-8**
- ✓ **John L. Hennessy and David A. Patterson, *Computer Architecture*, Morgan-Kaufman (2002), 3rd edition, ISBN 1-55860-596-7**
- ✓ **Peter Markstein, *IA-64 and elementary functions: speed and precision*, Prentice-Hall (2000), ISBN 0-13-018348-2**

## Architecture reports and talks

- ✓ **Nelson H. F. Beebe, *The Impact of Memory and Architecture on Computer Performance* (1994),**  
<http://www.math.utah.edu/~beebe/memperf.pdf>
- ✓ **Nelson H. F. Beebe, *Microprocessor overview* (2001),**  
<http://www.chpc.utah.edu/cc/talks/beebe>

## **Bibliographies at <http://www.math.utah.edu/pub/tex/bib>**

- ✓ **cool-chips**
- ✓ **dectechj**
- ✓ **hot-chips**
- ✓ **fparith**
- ✓ **hpj**
- ✓ **ibmjrd and ibmsysj**
- ✓ **intel-ia-64**
- ✓ **intel-tech-j**
- ✓ **microchip**
- ✓ **visual-instruction-set**

## Benchmark Web sites

✓ **LINPACK report:**

<http://www.netlib.org/benchmark/performance.ps>

<http://www.netlib.org/utk/people/JackDongarra/faq-linpack.html>

✓ **LINPACK selections:**

<http://performance.netlib.org/performance/html/PDSbrowse.html>

✓ **Standard Performance Evaluation Corporation (SPEC):**

✓ <http://www.spec.org/>

✓ **Utah Mathematics Department:**

<http://www.math.utah.edu/pub/benchmarks>

## Recent developments

- ✓ **AMD Athlon (1.53GHz)**
- ✓ **Compaq Alpha 21264 EV68 (1.0GHz)**
- ✓ **HP PA-8700 (750MHz)**
- ✓ **HP/Intel IA-64: McKinley (1GHz)**
- ✓ **HP/Compaq merger**
- ✓ **IBM Power4 (1.3GHz)**
- ✓ **Intel Pentium 4 Xeon Foster (2.2GHz) with hyperthreading**

## Recent developments

- ✓ **Intel Pentium 4 (5GHz)**
- ✓ **Intel Xeon (2.2GHz)**
- ✓ **GNU/Linux watch commercially available**
- ✓ **Compaq cancels Alpha**
- ✓ **Cray cancels MTA-2, and CEO resigns**
- ✓ **SGI MIPS R14000 (500MHz)**
- ✓ **Sun Linux product line**

## Recent developments

- ✓ **Sun UltraSPARC III Cu (1.05GHz)**
- ✓ **Sun UltraSPARC III performance like II, sigh...**



**Credit: Hammond & Naffziger, ISSCC 2002**

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**Figure omitted for copyright reasons: see page 7 of  
[http://cpus.hp.com/technical\\_references/McK-IDF-2001.pdf](http://cpus.hp.com/technical_references/McK-IDF-2001.pdf)**

**Credit: Hammond & Naffziger, ISSCC 2002**

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**Figure omitted for copyright reasons: see page 11 of  
[http://cpus.hp.com/technical\\_references/McK-IDF-2001.pdf](http://cpus.hp.com/technical_references/McK-IDF-2001.pdf)**

## CPU vs memory: performance gap

**Credit: Boncz et al, Proc. 25th VLDB Conference, Edinburgh, Scotland, 1999, p. 54**

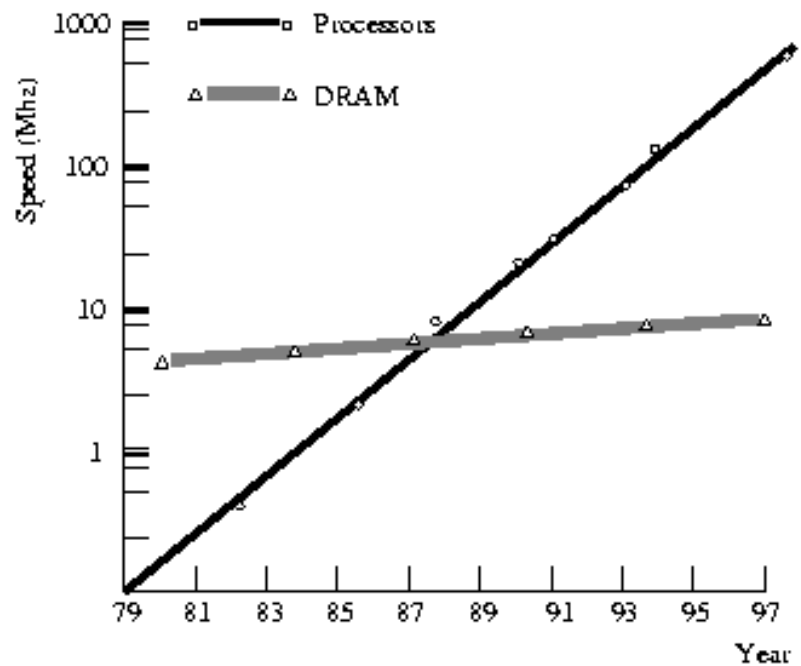


Figure 1: Hardware trends in DRAM and CPU speed

## **CPU vs memory: performance growth**

**[Credit: H&P CA/2e, Fig 5.1]**

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**Figure omitted for copyright reasons**

## DRAM access [Credit: H&P, CA/2e, Fig 5.30]

<b>Year</b>	<b>Size</b>	<b>Slowest(ns)</b>	<b>Fastest(ns)</b>	<b>Cycle time</b>
<b>1980</b>	<b>64Kb</b>	<b>180</b>	<b>150</b>	<b>250</b>
<b>1983</b>	<b>256Kb</b>	<b>150</b>	<b>120</b>	<b>220</b>
<b>1986</b>	<b>1Mb</b>	<b>120</b>	<b>100</b>	<b>190</b>
<b>1989</b>	<b>4Mb</b>	<b>100</b>	<b>80</b>	<b>165</b>
<b>1992</b>	<b>16Mb</b>	<b>80</b>	<b>60</b>	<b>120</b>
<b>1995</b>	<b>64Mb</b>	<b>65</b>	<b>50</b>	<b>90</b>

## *Imbench* memory performance on Sun SPARC models

<b>CPU</b>	<b>MHz</b>	<b>Register</b>	<b>L1</b>	<b>L2</b>	<b>RAM</b>
<b>10/412</b>	<b>40</b>	<b>1</b>	<b>2.0</b>	<b>15.7</b>	<b>16.2</b>
<b>20/512</b>	<b>50</b>	<b>1</b>	<b>2.0</b>	<b>8.2</b>	<b>55.8</b>
<b>LX</b>	<b>50</b>	<b>1</b>	<b>2.0</b>	<b>9.8</b>	<b>10.2</b>
<b>US170</b>	<b>167</b>	<b>1</b>	<b>2.0</b>	<b>8.0</b>	<b>47.3</b>
<b>E250</b>	<b>300</b>	<b>1</b>	<b>1.8</b>	<b>9.9</b>	<b>79.5</b>
<b>E5500</b>	<b>400</b>	<b>1</b>	<b>1.6</b>	<b>10.0</b>	<b>102.8</b>

## **Cache miss rates vs cache size**

**[Credit: H&P CA/2e, Fig 5.23]**

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**Figure omitted for copyright reasons**

[http://cpus.hp.com/images/die\\_photos/mckinley\\_arrows.jpg](http://cpus.hp.com/images/die_photos/mckinley_arrows.jpg)

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**Figure omitted for copyright reasons**



[http://cpus.hp.com/images/die\\_photos/pa8700.jpg](http://cpus.hp.com/images/die_photos/pa8700.jpg)

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**Figure omitted for copyright reasons**



## **Silicon zoo: MIPS R12000**

**<http://micro.magnet.fsu.edu/creatures>**

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**Figure omitted for copyright reasons**

## LINPACK data

<b>CPU</b>	<b>MHz</b>	<b>N=100</b>	<b>N=1000</b>	<b>Peak</b>
<b>IBM Power4</b>	<b>1300</b>	<b>1074</b>	<b>2894</b>	<b>5200</b>
<b>Itanium</b>	<b>800</b>	<b>n/a</b>	<b>2282</b>	<b>3200</b>
<b>HP PA-8750</b>	<b>750</b>	<b>669</b>	<b>2099</b>	<b>3000</b>
<b>AMD Athlon</b>	<b>1400</b>	<b>705</b>	<b>n/a</b>	<b>2800</b>
<b>Intel P4</b>	<b>2200</b>	<b>1033</b>	<b>1911</b>	<b>2200</b>
<b>Alpha</b>	<b>1000</b>	<b>824</b>	<b>1542</b>	<b>2000</b>
<b>IBM Power3</b>	<b>450</b>	<b>503</b>	<b>1451</b>	<b>1800</b>

## LINPACK data

<b>CPU</b>	<b>MHz</b>	<b>N=100</b>	<b>N=1000</b>	<b>Peak</b>
<b>UltraSPARC</b>	<b>450</b>	<b>208</b>	<b>607</b>	<b>900</b>
<b>MIPS R12K</b>	<b>360</b>	<b>170</b>	<b>n/a</b>	<b>720</b>
<b>Intel P2 Xeon</b>	<b>450</b>	<b>98</b>	<b>295</b>	<b>450</b>
<b>Intel P2</b>	<b>333</b>	<b>69</b>	<b>n/a</b>	<b>333</b>

## Floating-point developments

- ✓ **IEEE 754 committee working on revision of floating-point arithmetic standard**
- ✓ **IEEE 754 test software site at <http://www.math.utah.edu/~beebe/software/ieee>**
- ✓ **extended high-order calculator (hoc v7) with IEEE 754 functions**
- ✓ **Java floating-point model relaxed**

A graphic of a spiral-bound notebook with a yellow page and a brown cover. The spiral binding is on the left side. A horizontal line is drawn across the page, and the text "The End" is written in a large, bold, brown font below it.

# The End