

Memory Hierarchy & Data Locality

CSE 373
Data Structures & Algorithms
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11/10/2010

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Today's Outline

- **Admin:**
 - HW #5 Partner Selection - due TONIGHT, Nov 10 at 11:45pm – send email to Chris
 - Midterm #2, Wed Nov 17th.
 - HW #5 due Monday, Nov 22 at 11:45pm
- **Memory Hierarchy and Locality**

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Why do we need to know about the memory hierarchy/locality?

- One of the assumptions that Big-Oh makes is that all operations take the same amount of time.
- Is that really true?

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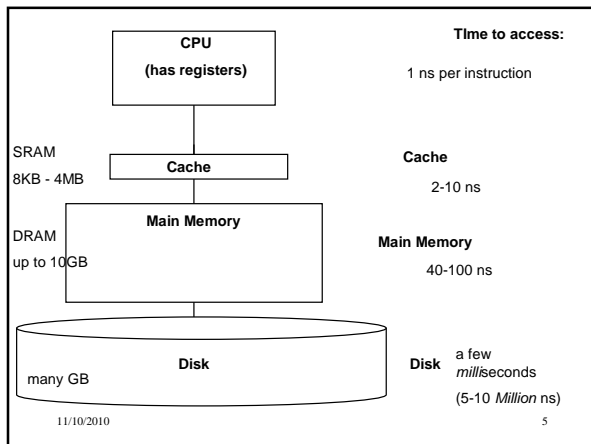
Definitions

Cycle – (for our purposes) the time it takes to execute a single simple instruction. (ex. Add 2 registers together)

Memory Latency – time it takes to access memory

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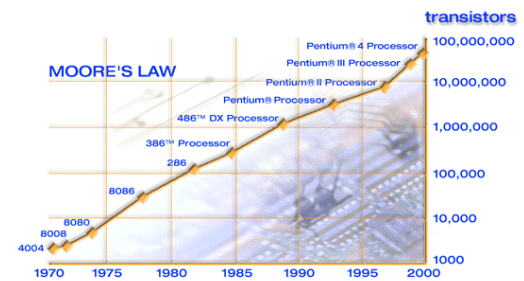
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Moore's Law

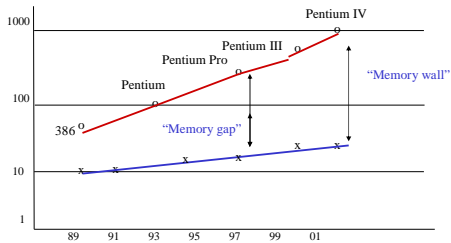


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Processor-Memory Performance Gap

- x86 CPU speed (100x over 10 years)



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What can be done?

- **Goal:** Attempt to reduce the number of accesses to the slower levels.
- **How?**

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Locality

Temporal Locality (locality in time) – If an item is referenced, it will tend to be referenced again soon.

Spatial Locality (locality in space) – If an item is referenced, items whose addresses are close by will tend to be referenced soon.

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Caches

- Each level is a **sub-set** of the level below.

Cache Hit – address requested is in cache

Cache Miss – address requested is NOT in cache

Cache line size (chunk size) – the number of contiguous bytes that are moved into the cache at one time

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Examples

```
x = a + 6;      x = a[0] + 6;
y = a + 5;      y = a[1] + 5;
z = 8 * a;      z = 8 * a[2];
```

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Locality and Data Structures

- Which has (at least the potential for) better spatial locality, arrays or linked lists?

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