Chapter 9

Memory and Storage
Topics

• Introduction
• Definition
• Key Aspects Of Memory
• Characteristics Of Memory Technologies
• Memory Volatility
• Memory Access Paradigm: Random Or Sequential Access
• Persistence Of Values
• Primary And Secondary Memory
Topics

- Memory Hierarchy
- Instruction and Data Store
- The Fetch-Store Paradigm
- Summary

Dr. Rajesh Subramaniam, 2005
Introduction

This part discusses:

- processor, a major component of any computer
- memories, a major component of any computer
- physical memory, virtual memory, caches

Part 2 covered
Definition

- Architect's view of memory

- Values

- Solid-state digital device that provides storage for data
Key Aspects Of Memory

• Technology
  - Properties of the underlying hardware mechanisms used

• Organization
  - Way technology is used to form a working system

  - Properties of the underlying hardware mechanisms used
Characteristics Of Memory Technologies

- Volatile or non-volatile
- Read-write or read-only
- Random or sequential
- Primary or secondary
Memory Volatility

- Volatile
  - Contents of memory disappear when power is removed.
  - Example: main memory of computer

- Non-volatile
  - Contents remain even after power is removed.
  - Example: memory used in digital camera.

- Volatile
  - Contents of memory disappear when power is removed.

- Non-volatile
  - Computer is shut, running applications are lost.
  - Example: main memory of computer is volatile.

---

Mémoire Volatilité

- Volatile
  - Contenu de la mémoire disparaît lorsque l'alimentation est retirée.
  - Exemple: mémoire principale du ordinateur

- Non-volatile
  - Contenu reste même après que l'alimentation est retirée.
  - Exemple: mémoire utilisée dans une caméra numérique.

- Volatile
  - Contenu de la mémoire disparaît lorsque l'alimentation est retirée.

- Non-volatile
  - Ordinateur est éteint, les applications en cours d'exécution sont perdues.
  - Exemple: mémoire principale de l'ordinateur est volatile.
Memory Access Paradigm: Random Or Sequential Access

- Random access
  - Any value in the memory can be accessed at any time.

- Sequential access
  - Also called First-in-First Out (FIFO)
  - Values are read in the same order they were inserted

- Random access
  - Any value in the memory can be accessed at any time.

Sequential Access

Memory Access Paradigm: Random Or
Permanence Of Values

Values are burned into the memory – data values is entered once and then accessed many times

- Permanent Read Only Memory (PROM)
  - Data values is entered once and then accessed many times
  - Values are burned into the memory

- Read Only Memory (ROM)
  - Read and write access is not possible

Memory can be read from, written to, or allow both operations at any time. Some memories do not allow both.
Permanence Of Values

- Intermediate permanence
  - EEPROM Electrically Erasable Programmable Read only (EEPROM) takes longer to store image.
    - Flash memory
      - Reading a value needs special circuits and takes longer than changing.
        - Nonvolatile memory that permits values to be written only once.
  - Flash memory
    - Reading a value.

Dr. Rajesh Subramaniam, 2005

CS250 -- Part III
Primary And Secondary Memory

• Primary - example, fast volatile internal main memory

• Secondary - example, slower non volatile memory on external disk
Memory Hierarchy

- For a given cost, optimal performance is not achieved by using one type of memory.

Observation

- Cost and performance of memory is considered.

CS250 -- Part III

Dr. Rajesh Subramanian, 2005
Although most modern computer systems (Von Neumann’s Instruction And Data Store) place programs and data in a single memory, it is possible to separate the instruction store from data store. Doing so allows an architect to select memory performance appropriate for each activity.
The Fetch-Store Paradigm

- Fetch is also called read or load, store is also called write.
- Fetch a value from memory, or storing a value in memory
- Memory use Fetch-store paradigm
Technology and memory are key aspects of memory. Technologies can be classified as volatile or non-volatile, random or sequential, permanent or non-permanent, and primary or secondary. To achieve maximal performance at a given cost a memory hierarchy is used.

Memory supports two operations, fetch to retrieve a value from memory, and store to store a value in memory.

Summary