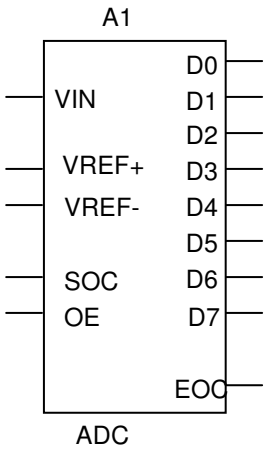
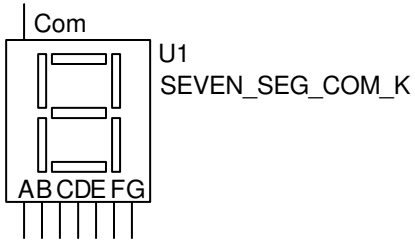
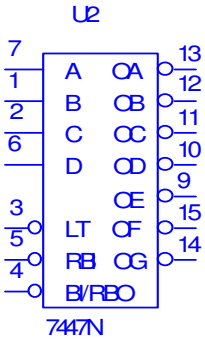


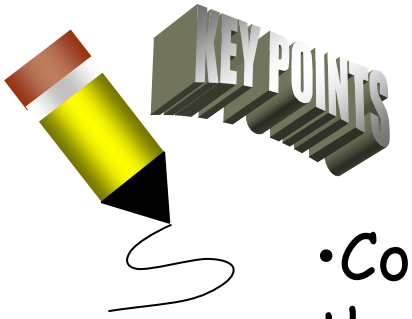





# CHAPTER 12 Part 1

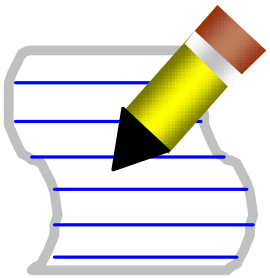
# MEMORY AND STORAGE

D.Wilcher



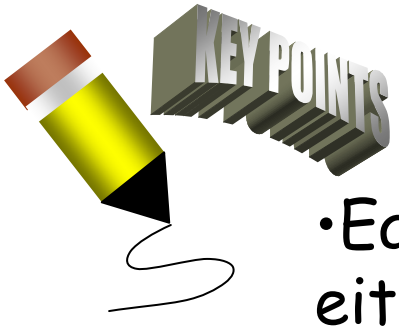

# WHY IS MEMORY AND STORAGE IMPORTANT?

- Computers and other Intelligent Devices require the permanent or semi-permanent storage of large amounts of binary data.
- Microprocessor and Microcontroller based systems rely on storage devices and memories for their operation.
- Memory is required for storing programs and retaining data during processing.



# Tech Definition

**MEMORY** – The portion of a system for storing binary data in large or small quantities.




# The Basic Semiconductor Memory Array

- Each storage element in a memory can retain either a 1 or 0 and is called a **cell**.
- Memories are made up of arrays of cells (See Slide 6).
- Each block in the memory array represents one storage cell and its location can be identified by specifying a row and column.
- A memory is identified by the number of words it can store times the word size.

  EX. 16K x 8 =16,384 words of eight bits each.

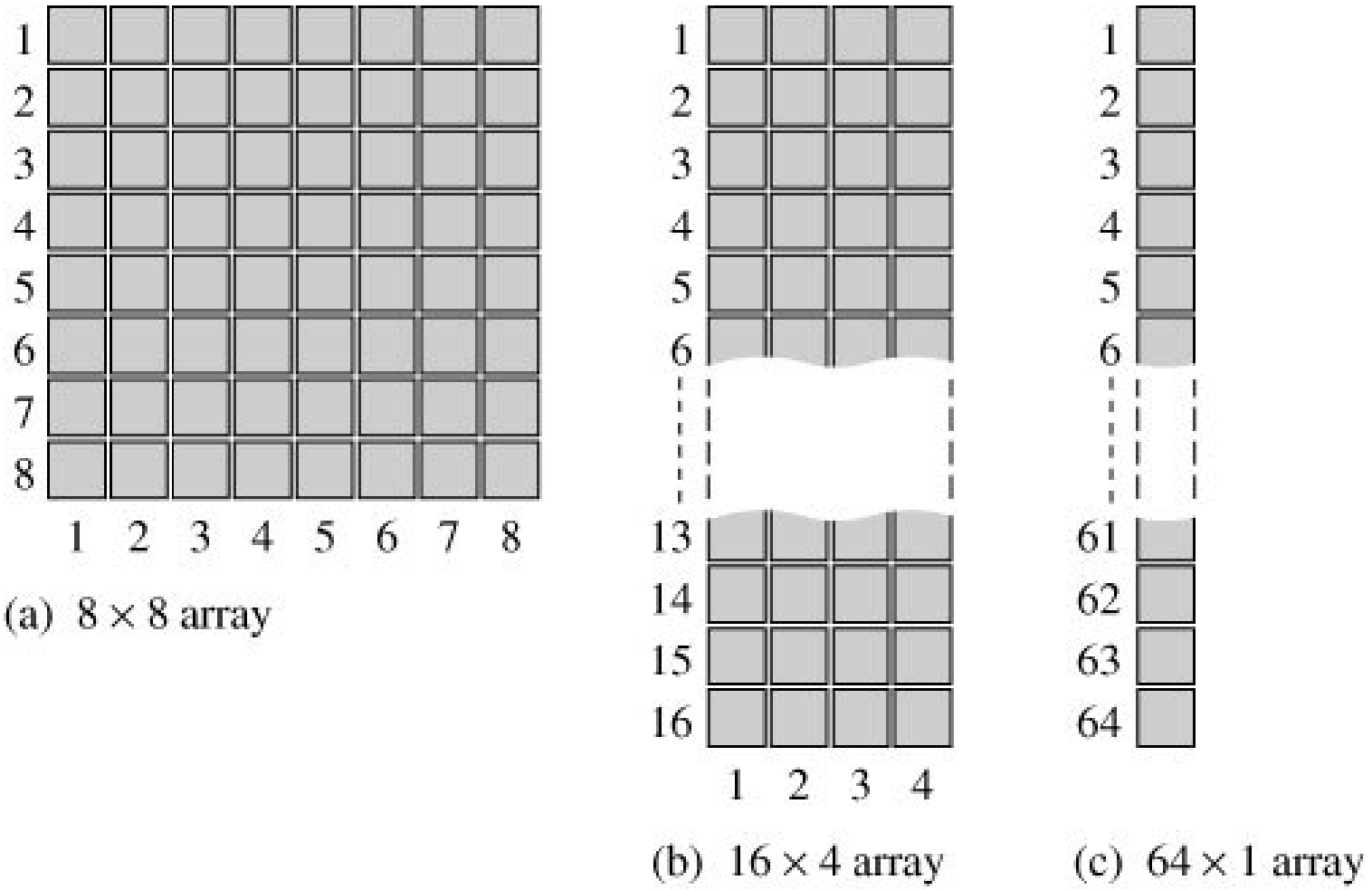
The number of words is always a power of 2

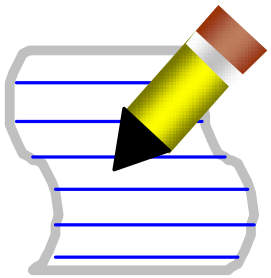

# The Basic Semiconductor Memory Array continue

- The number of words is always a power of 2→ $2^n$: $2^{14}$ =16,384.

- Common practice to state the number to the nearest thousand→16K.

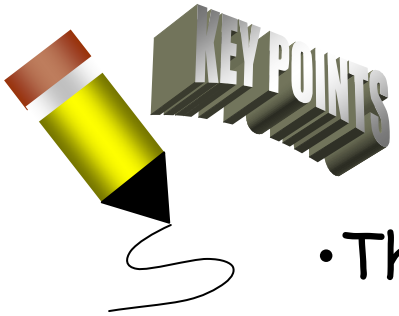
**Figure 12--1** A 64-cell memory array organized in three different ways.





## Tech Definition

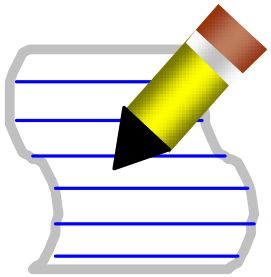
**ADDRESS** – The location of a unit of data in a memory array.




# Memory Address and Capacity continued

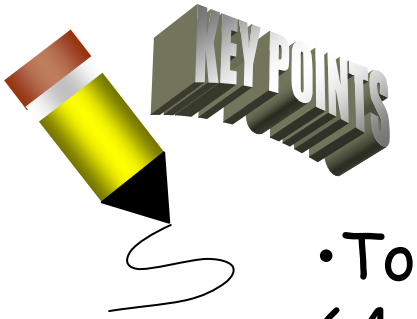
- The address of a memory array is represented by a row and column.
- The address depends on how the memory is organized into units of data.
- Personal or desktop computers and other Intelligent Devices (PDAs, Smart Phones, and calculators) have Random Access Memories (RAM) organized in bytes.
- The small group of bits that can be addressed is eight.

# Memory Address and Capacity continued



## Tech Definition

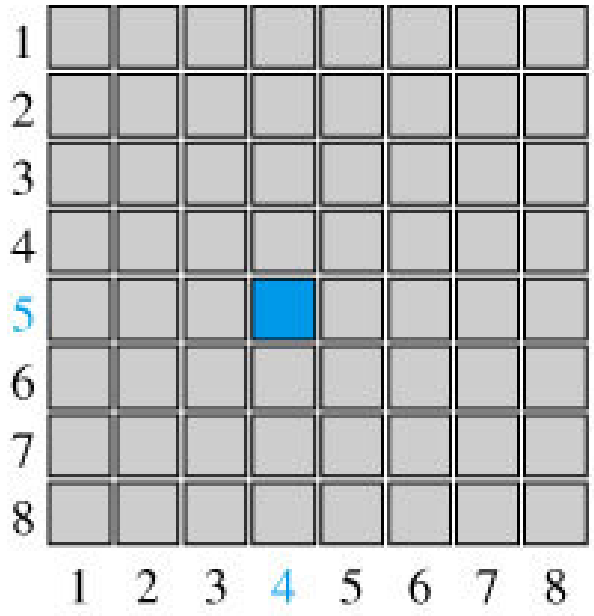
**CAPACITY** – The total number of data units that can be stored in memory.



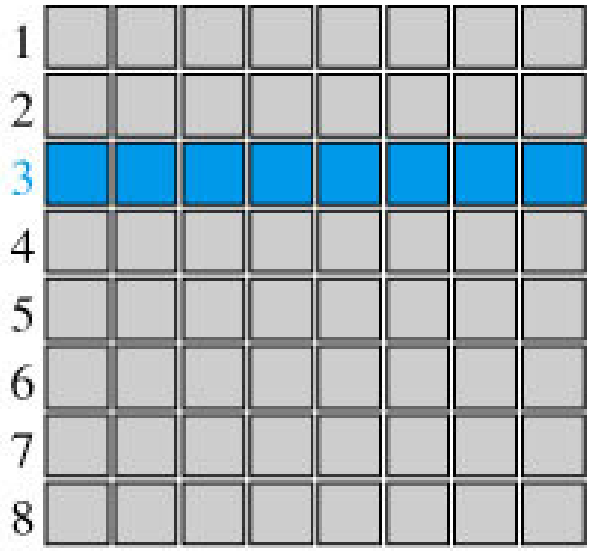

# Memory Address and Capacity continued

- To illustrate capacity an 8x 8 memory array has a 64 Bit capacity.
- Typical memories for Personal & desktop computers are 256MBytes (Mega Bytes), 512MBytes or more of memory capacity.

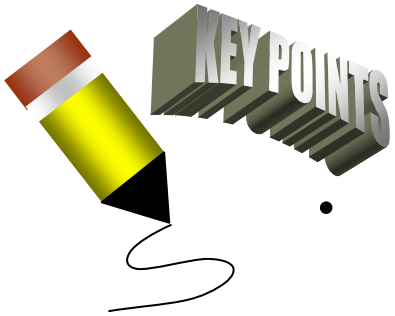
**Figure 12--2** Examples of memory address.




(a) The address of the blue bit is row 5, column 4.

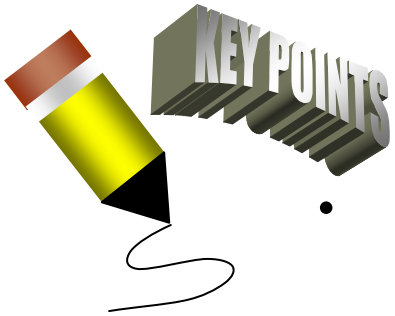



(b) The address of the blue byte in blue is row 3.




# Basic Memory Operations

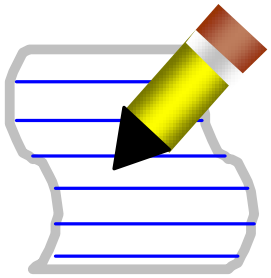
- The basic Memory Operations of a Personal or desktop computer and Intelligent Devices consist of
  1. Memory Stores Binary data
  2. Data must be put into the memory
  3. Data must be copied from memory when needed.
- The **write** operation puts data into a specified address in memory.
- The **read** operation takes data out of a specified address in the memory.




# Basic Memory Operations continued

- The addressing operation (consists of both write and read functions) selects the specified memory address.
- Data units go into the memory during a write operation and come out during a read function.
- Data is transferred during a read-write function using a **Data Bus**.
- When a read-write function occurs, selection of accessing memory uses an **Address Bus**.

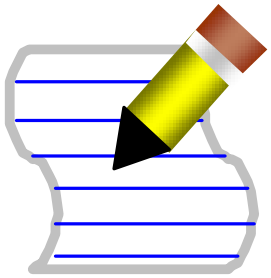
# Basic Memory Operations continued



## Tech Definition

**DATA BUS** –A set of hardwired lines within a personal or desktop computer and intelligent device that transfers binary information during a read – write function.

# Basic Memory Operations continued



## Tech Definition

**ADDRESS BUS** –A set of hardwired lines within a personal or desktop computer and an intelligent device that transfers binary information during a read – write function and makes the selection of a memory location.

**Figure 12--3** Block diagram of a memory showing address bus, address decoder, bidirectional data bus, and read/write inputs.

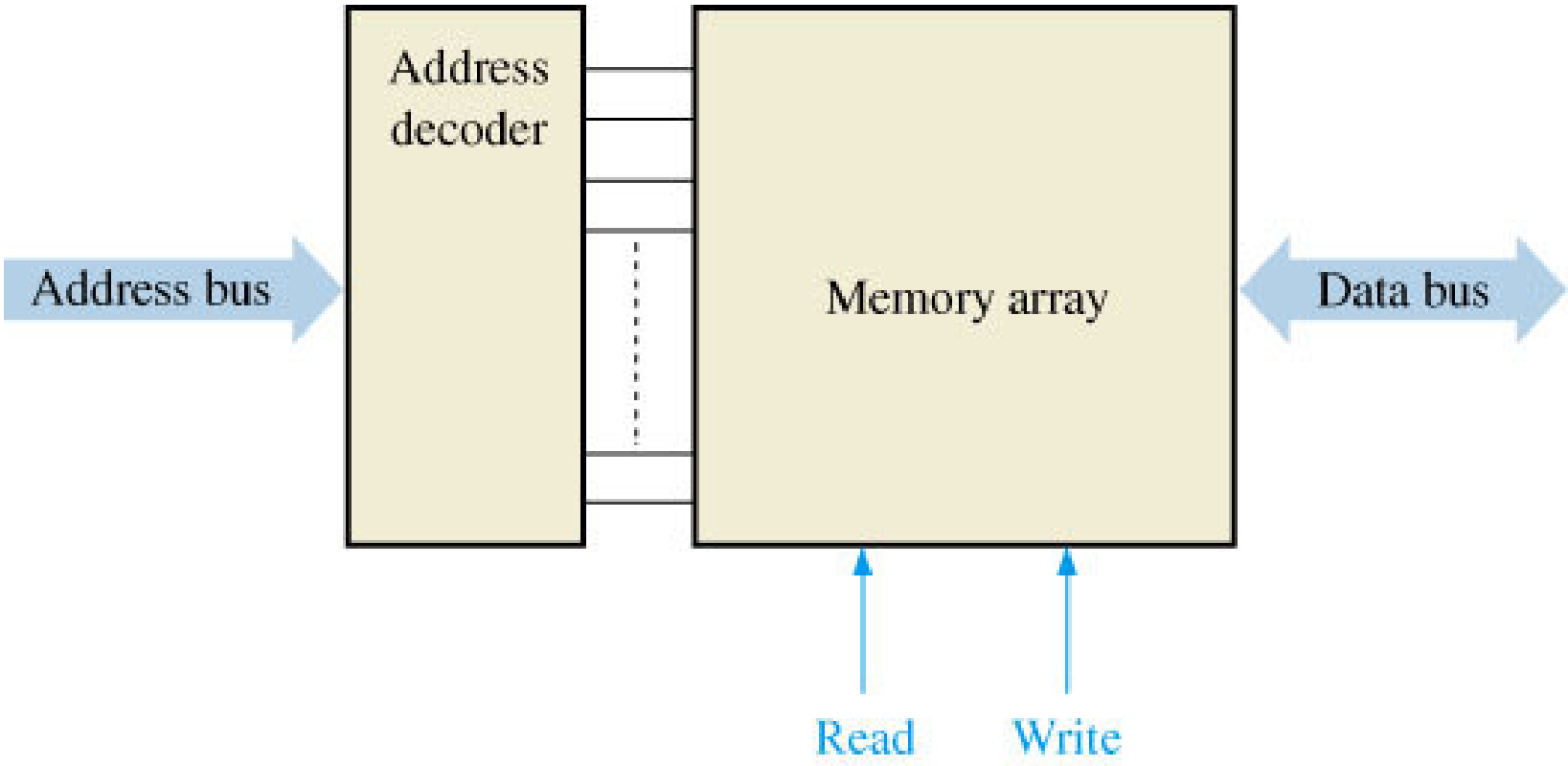
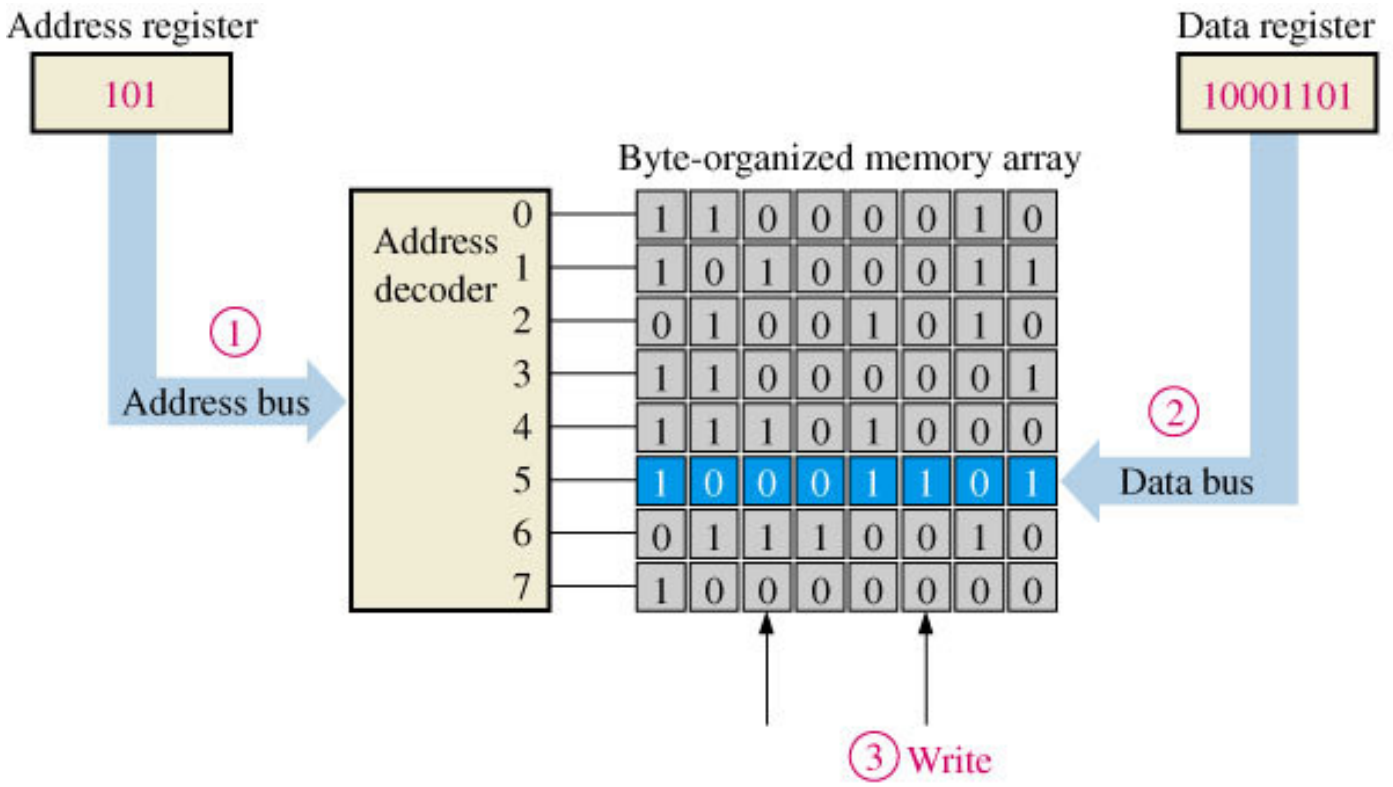
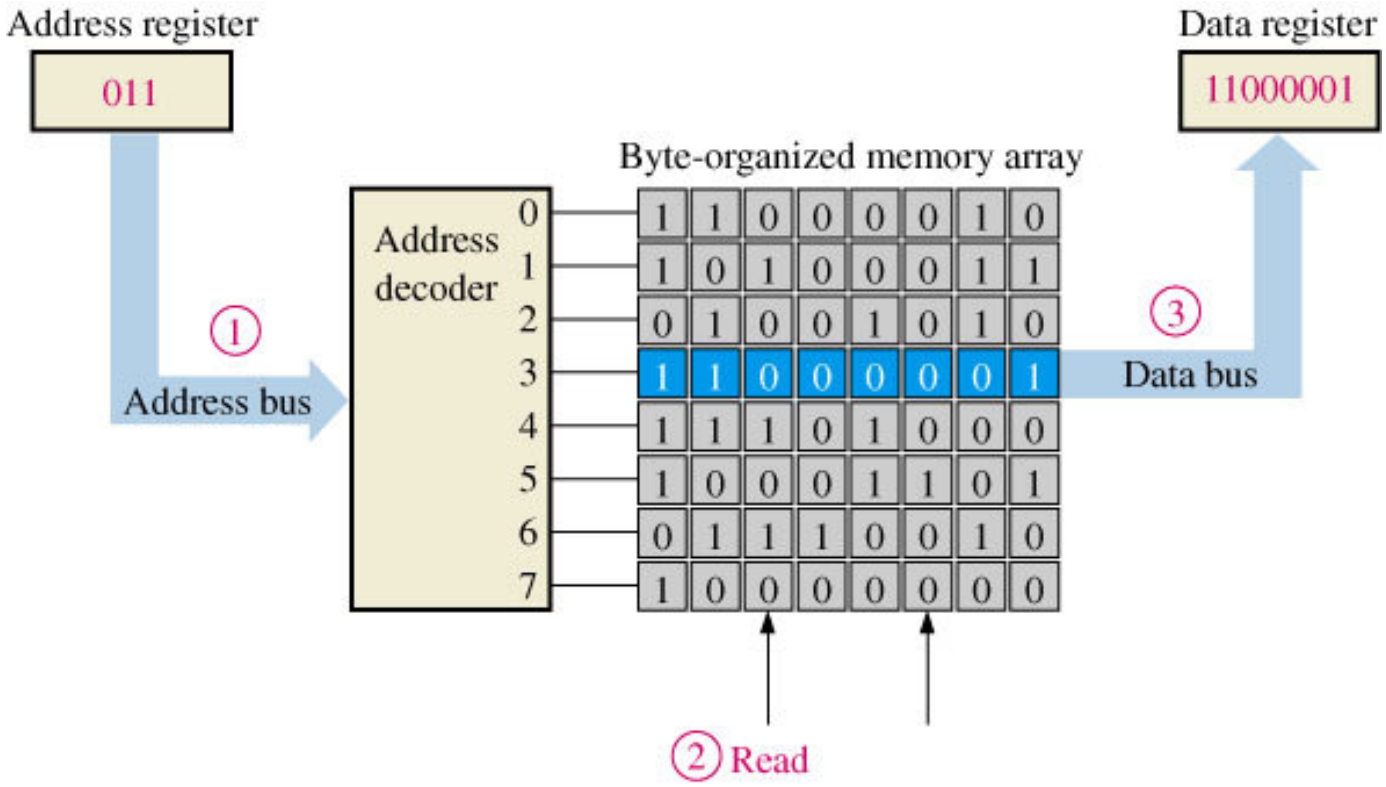


**Figure 12--4** Illustration of the write operation.




1. Address code 101 is placed on the address bus and address 5 is selected.
2. Data byte is placed on the data bus.
3. Write command causes the data byte to be stored in address 5, replacing previous data.

**Figure 12--5** Illustration of the read operation.




1. Address code 011 is placed on the address bus and address 3 is selected.
2. Read command is applied.
3. The contents of address 3 is placed on the data bus and shifted into data register. The contents of address 3 is not destroyed by the read operation.