COMPUTER
ARCHITECTURE

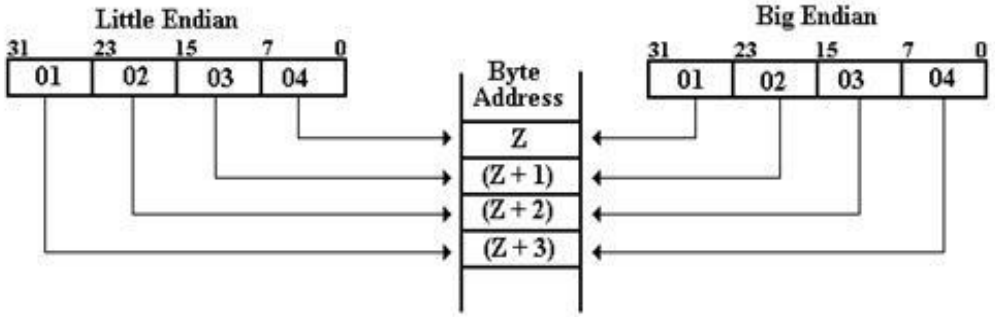
CS 10 Computer Architecture and Organization
Big-Endian vs. Little-Endian

Foothill College
Computer Science Department

Little-Endian vs. Big-Endian Representation of Integers

Little-Endian vs. Big-Endian

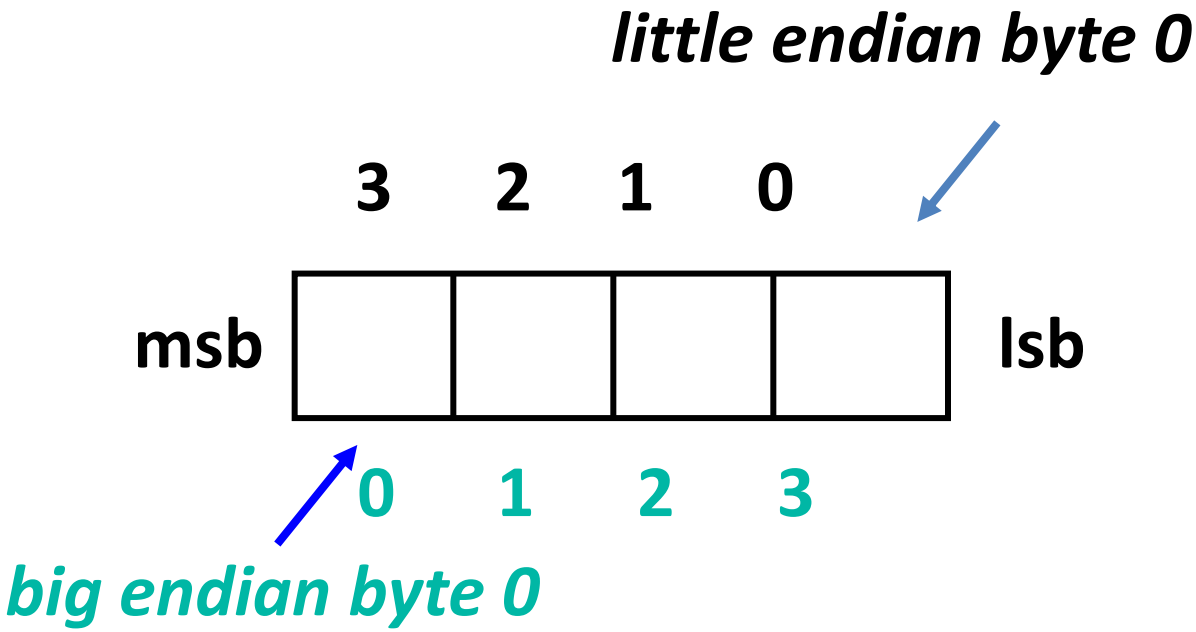
- Endianness: Ordering of bytes within a memory word
- Little-Endian vs Big-Endian
  - Little-Endian has least significant byte at lowest address
  - Big-Endian has most significant byte at lowest address



- Bi-Endian
  - processors that operate in either little-endian or big-endian mode

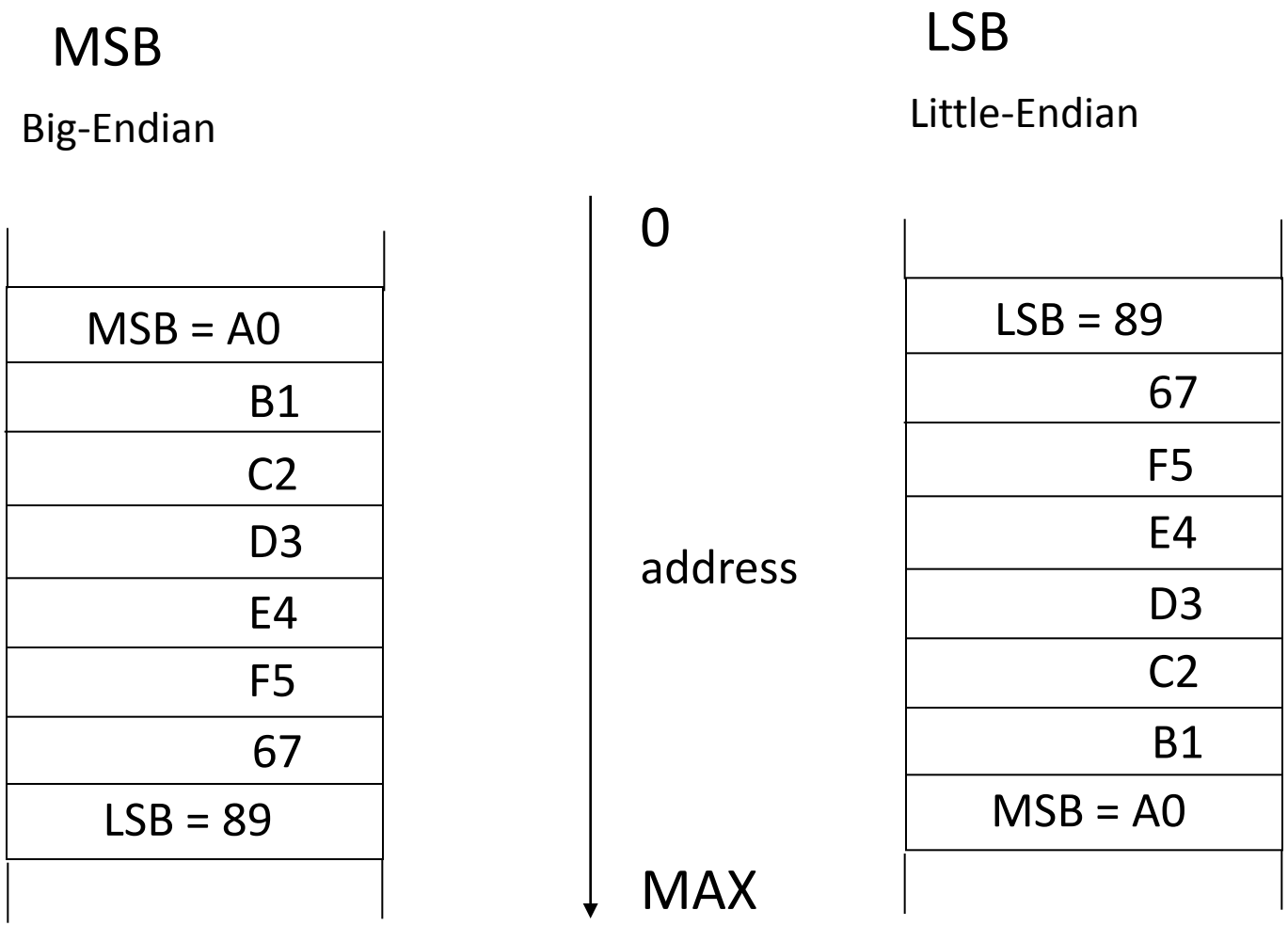
Byte Ordering

- How bytes are numbered in a word

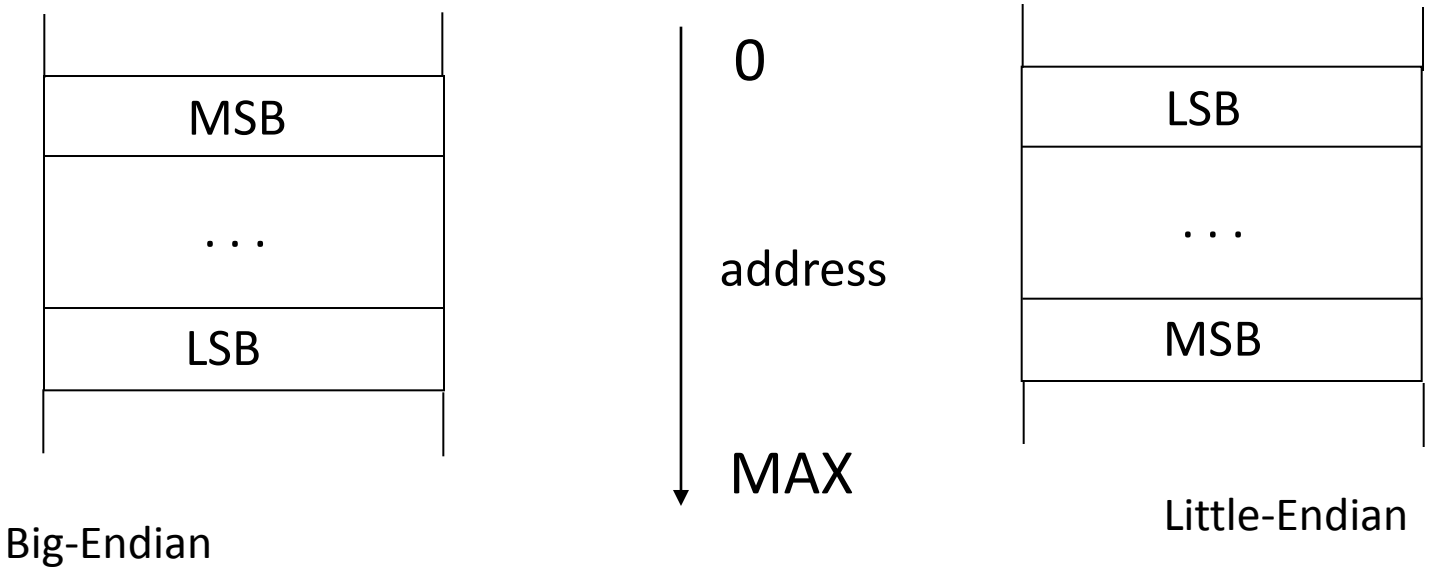


Little-Endian vs. Big-Endian Representation

$A0\ B1\ C2\ D3\ E4\ F5\ 67\ 89_{16}$



Little-Endian vs. Big-Endian Camps



Motorola 68xx, 680x0

IBM

Hewlett-Packard

Sun SuperSPARC

Internet TCP/IP

Bi-Endian

Motorola Power PC

Silicon Graphics MIPS

Intel

AMD

DEC VAX

RS 232

Little-Endian vs. Big-Endian

Advantages and Disadvantages

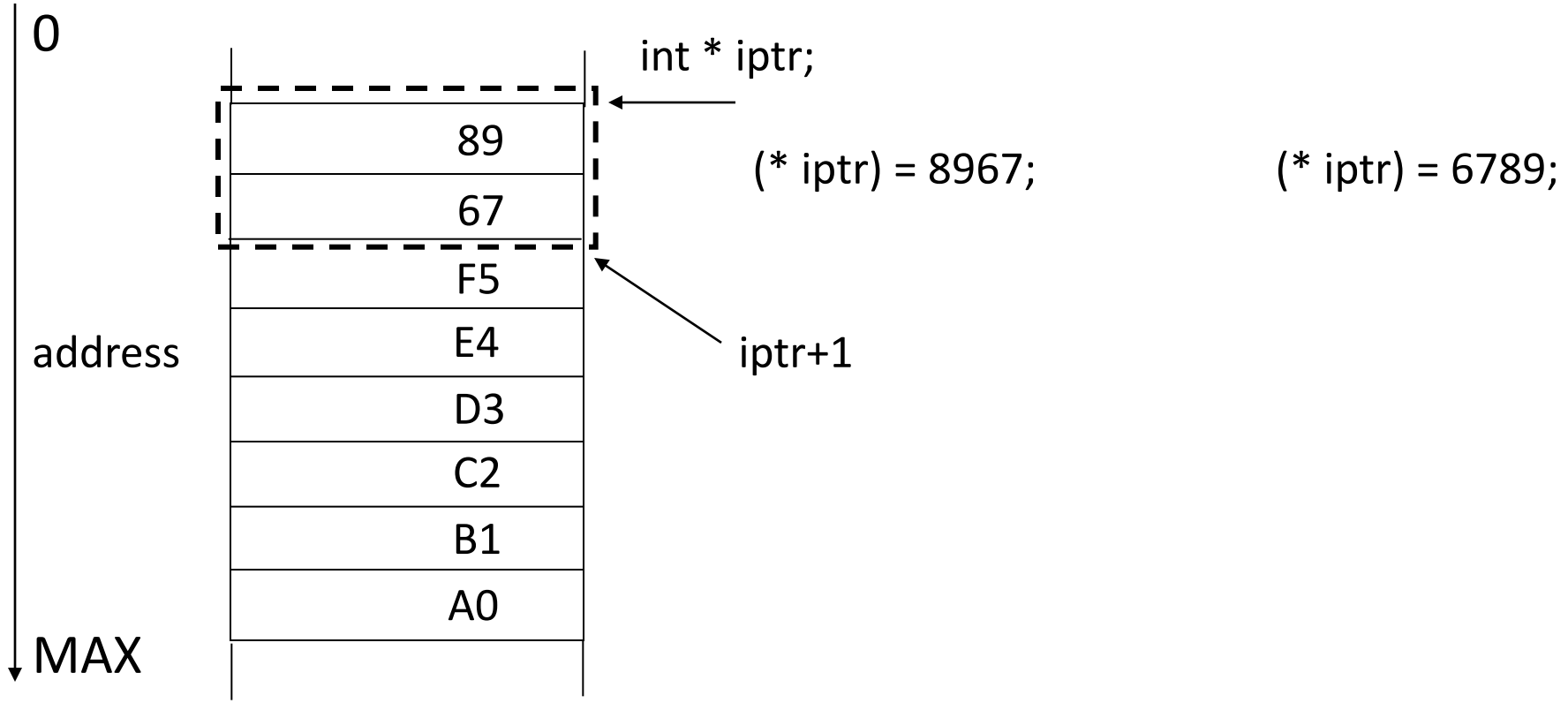
Big-Endian

- easier to determine a sign of the number
- easier to compare two numbers
- easier to divide two numbers
- easier to print

Little-Endian

- easier addition and multiplication of multi-precision numbers

Pointers


Big-Endian
Little-Endian
0
int * iptr;
89
67
(* iptr) = 8967;
(* iptr) = 6789;
F5
E4
address
iptr+1
D3
C2
B1
A0
MAX

Big Endian & Little Endian

- Example: 0x12345678—a long word of 4 bytes. It is stored in the memory at address 0x00000100
  - big endian:

Address	data
0x00000100	12
0x00000101	34
0x00000102	56
0x00000103	78

  - little endian:

Address	data
0x00000100	78
0x00000101	56
0x00000102	34
0x00000103	12

More on Endianness: Another Example

- Suppose we have the integer 258 in decimal
- Hex value (16 bits) is 0102h
- Suppose machine is byte addressable
- Value is stored at addresses 1000h and 1001h
- Little endian:
  - 1000h: 02h
  - 1001h: 01h
- Big endian:
  - 1000h: 01h
  - 1001h: 02h

Summary

- Endianness can be a confusing topic when you first learn it. Recall that memory is made of cells, which are the smallest addressable units in a computer. The endianness of a system refers to the order in which our data is stored in the memory cells of the computer.