Byte Order
(A portion of chips?)

- What order do we read numbers that occupy more than one byte
- e.g. (numbers in hex to make it easy to read)
- 12345678 can be stored in 4x8bit locations as follows

Byte Order (example)

Address	Value (1)	Value(2)
184	12	78
185	34	56
186	56	34
186	78	12

- i.e. read top down or bottom up?

Byte Order Names

- The problem is called Endian
- The system on the left has the most significant byte in the lowest address
- This is called big-endian [Motorola]
- The system on the right has the least significant byte in the lowest address
- This is called little-endian [Intel]

Example of C Data Structure

```
struct{
   int      a;     //0x1112_1314                    word
   int      pad;   //
   double   b;     //0x2122_2324_2526_2728          doubleword
   char*    c;     //0x3132_3334                    word
   char     d[7];  //'A','B','C','D','E','F','G'   byte array
   short    e;     //0x5152                         halfword
   int      f;     //0x6161_6364                    word
} s;
```

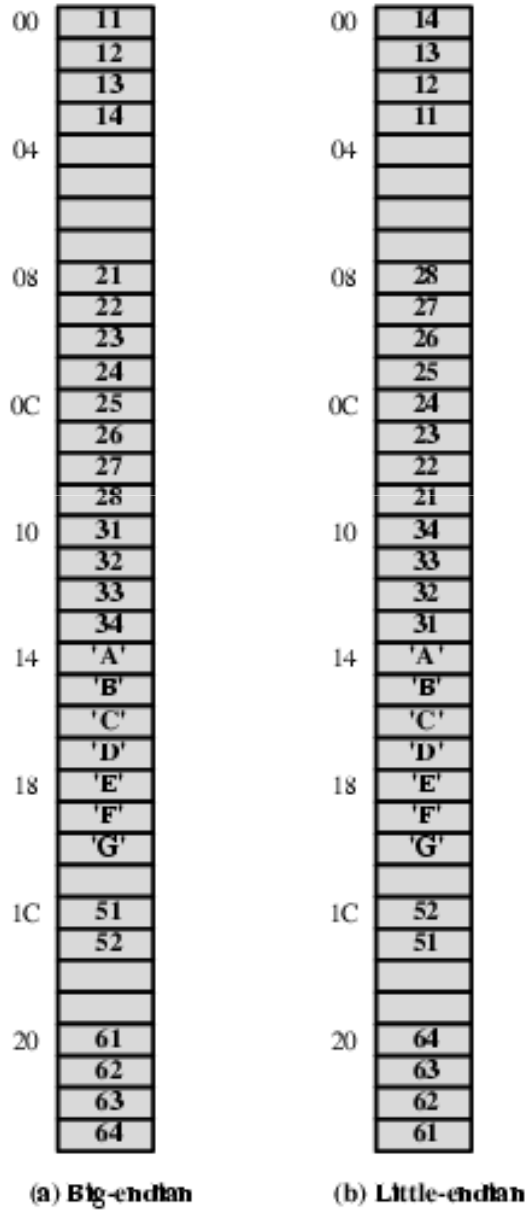
Big-endian address mapping

Byte Address								
00	**11** 00	**12** 01	**13** 02	**14** 03	04	05	06	07
08	**21** 08	**22** 09	**23** 0A	**24** 0B	**25** 0C	**26** 0D	**27** 0E	**28** 0F
10	**31** 10	**32** 11	**33** 12	**34** 13	**'A'** 14	**'B'** 15	**'C'** 16	**'D'** 17
18	**'E'** 18	**'F'** 19	**'G'** 1A	1B	**51** 1C	**52** 1D	1E	1F
20	**61** 20	**62** 21	**63** 22	**64** 23				

Little-endian address mapping

								Byte Address
				11 03	**12** 02	**13** 01	**14** 00	00
21 0F	**22** 0E	**23** 0D	**24** 0C	**25** 0B	**26** 0A	**27** 09	**28** 08	08
'D' 17	**'C'** 16	**'B'** 15	**'A'** 14	**31** 13	**32** 12	**33** 11	**34** 10	10
		51 1D	**52** 1C	1B	**'G'** 1A	**'F'** 19	**'E'** 18	18
				61 23	**62** 22	**63** 21	**64** 20	20

Alternative View of Memory Map



(a) Big-endian (b) Little-endian

Standard...What Standard?

- Pentium (80x86), VAX are little-endian
- IBM 370, Moterola 680x0 (Mac), and most RISC are big-endian
- Internet is big-endian
  - —Makes writing Internet programs on PC more awkward!
  - —WinSock provides htoi and itoh (Host to Internet & Internet to Host) functions to convert