CSCI 112
Introduction to computer Science -I

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Memory Basics

Random Access Memory(RAM)

- A single byte of memory holds 8 binary digits (bits).
- Each byte of memory has its own address.
- A 32-bit CPU can address 4 gigabytes of memory.
- A 64-bit CPU can address way more (how much ?)

RAM

- Like a large array of bytes.
- Data stored in a byte of memory is **not typed.**
- The assembly language programmer must remember and **use the appropriate type** while using such data.

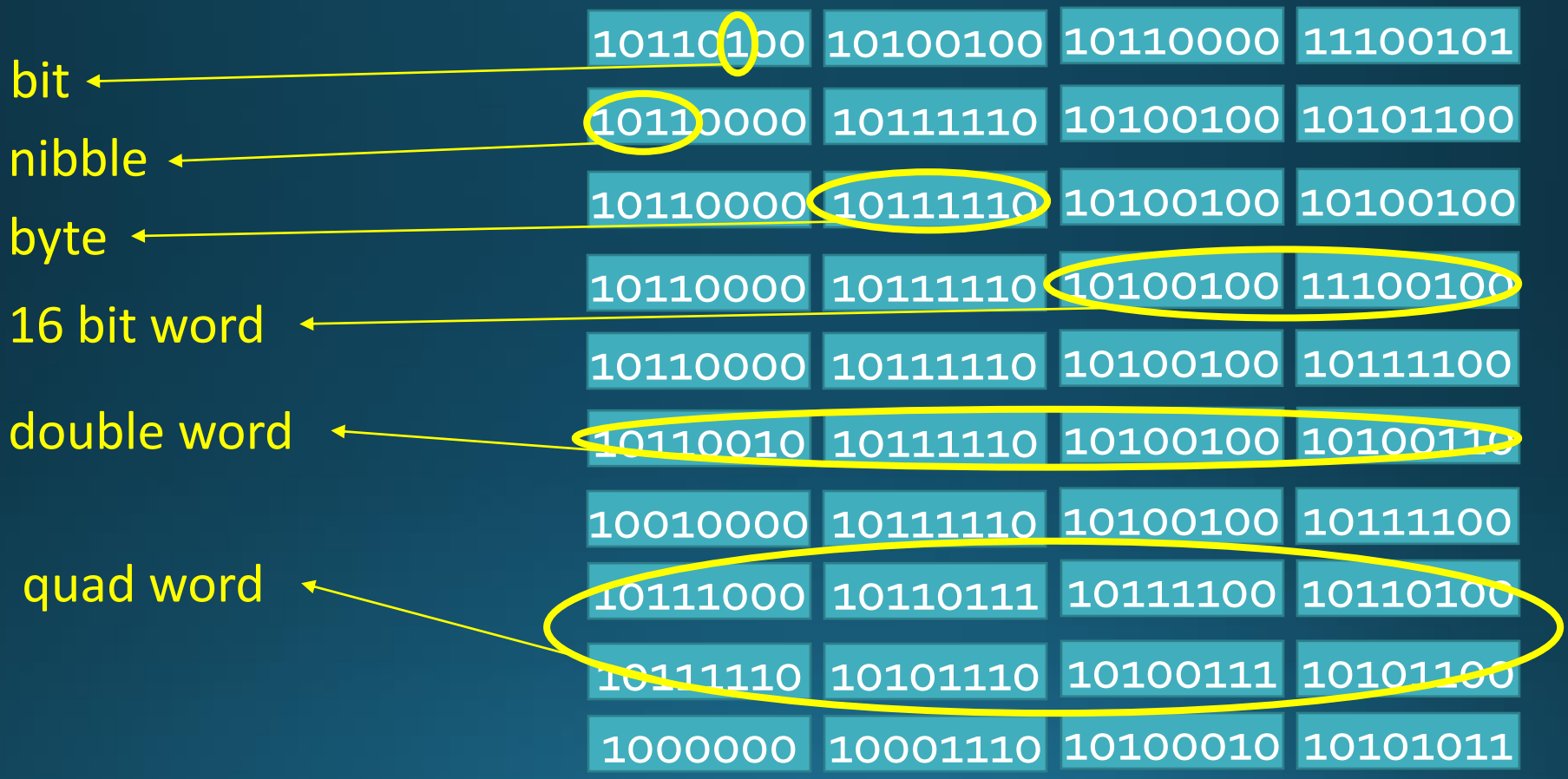
Random Access Memory(RAM)

- Each address corresponds to a byte (8 bits => 2 Hex)

2034	0	1	0	0	1	0	0	1
2035	0	0	1	1	1	0	0	1
2036	0	1	1	0	1	0	0	1
2037	0	0	0	1	1	0	0	1
2038	0	1	1	0	1	0	0	1
2039	0	0	0	1	1	1	1	1
2040	0	1	1	1	1	0	0	1

2039	1	F
2040	7	9

Common sizes



Contents in a Byte

Representation	Min								Max							
Octal**	0		0		0				3		7			7		
Binary	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Hexadecimal	0				0				F				F			
Decimal	0								255							

Storage format

- Byte ordering, or *endianness* – very important attribute of architecture
- If we have a two-byte integer, the integer may be stored so that the least significant byte is followed by the most significant byte or vice versa.
- In *little endian* machines, the least significant byte is followed by the most significant byte.
- *Big endian* machines store the most significant byte first (at the lower address).

Storage format

- Example: $90AB12CD_{16}$ is stored in memory

Address →	**10001**	**10010**	**10011**	**10100**	**10101**	**10110**
Big Endian	??	90	AB	12	CD	??
Little Endian	??	CD	12	AB	90	??

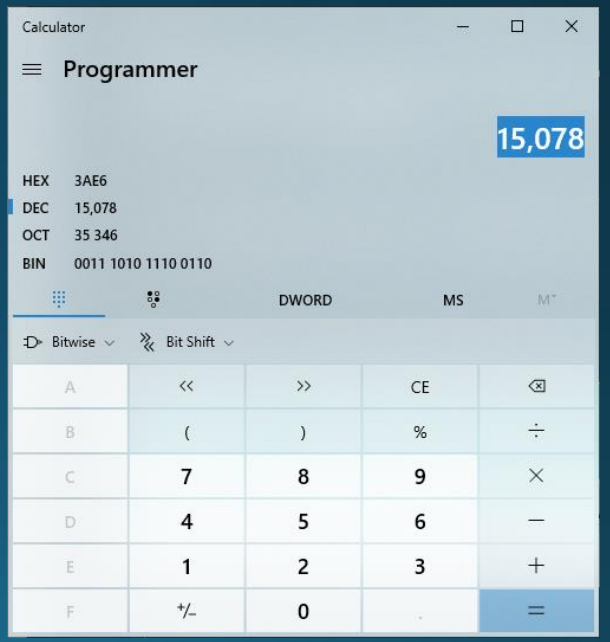
Storage format - Demo

- Store 15078_{10} in memory at address 10010

Address →	10001	10010	10011	10100	10101
Content	??	??	??	??	??

$15078_{10} => 3AE6_{16}$

3AE6 => | 3A | E6 | (2 bytes)



Address →	10001	10010	10011	10100	10101
Big Endian	??	3A	E6	??	??
Little Endian	??	E6	3A	??	??

Storage format - Compare

- Big endian:
  - Is more natural.
  - The sign of the number can be determined by looking at the byte at address offset zero..
  - Strings and integers are stored in the same order.
- Little endian:
  - Makes it easier to place values on non-word boundaries.
  - Conversion from a 16-bit integer address to a 32-bit integer address does not require any arithmetic.