Chapter 01

Fundamental Concepts

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Contents

- Units of data
  - bit, byte, word
- Number Systems
- Memory model

Units of data: bit

- A bit
  - A value that can be either “0” or “1”
- N bits
  - A sequence of N values, each can be either “0” or “1”
- Notations
  - bit
    - Example: 100 (bits)
  - b
    - Example: 100 b

Multiples of bits V·T·E

Decimal				Binary				
Value		SI		Value		IEC		JEDEC
1000	10^3	kbit	kilobit	1024	2^{10}	Kibit	kibibit	Kbit kilobit
1000^2	10^6	Mbit	megabit	1024^2	2^{20}	Mibit	mebibit	Mbit megabit
1000^3	10^9	Gbit	gigabit	1024^3	2^{30}	Gibit	gibibit	Gbit gigabit
1000^4	10^{12}	Tbit	terabit	1024^4	2^{40}	Tibit	tebibit	-
1000^5	10^{15}	Pbit	petabit	1024^5	2^{50}	Pibit	pebibit	-
1000^6	10^{18}	Ebit	exabit	1024^6	2^{60}	Eibit	exbibit	-
1000^7	10^{21}	Zbit	zettabit	1024^7	2^{70}	Zibit	zebibit	-
1000^8	10^{24}	Ybit	yottabit	1024^8	2^{80}	Yibit	yobibit	-

See also: Nibble · Byte · Orders of magnitude of data

https://en.wikipedia.org/wiki/Bit

Units of data: bit

- Related units (1)
  - **bps** : bits per second
    - Number of bits transmitted from A to B per a second
  - **kbps**: kilobit per second
  - …

Multiples of bits V·T·E

Decimal				Binary				
Value		SI		Value		IEC		JEDEC
1000	10^3	kbit	kilobit	1024	2^{10}	Kibit	kibibit	Kbit kilobit
1000^2	10^6	Mbit	megabit	1024^2	2^{20}	Mibit	mebibit	Mbit megabit
1000^3	10^9	Gbit	gigabit	1024^3	2^{30}	Gibit	gibibit	Gbit gigabit
1000^4	10^{12}	Tbit	terabit	1024^4	2^{40}	Tibit	tebibit	-
1000^5	10^{15}	Pbit	petabit	1024^5	2^{50}	Pibit	pebibit	-
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1000^7	10^{21}	Zbit	zettabit	1024^7	2^{70}	Zibit	zebibit	-
1000^8	10^{24}	Ybit	yottabit	1024^8	2^{80}	Yibit	yobibit	-

See also: Nibble · Byte · Orders of magnitude of data

https://en.wikipedia.org/wiki/Bit

Units of data: bit

- Related units (2)
  - **bit** is a **digit** in binary number
    - Example:
      - $39_{10} = 00100111_2$

8bits length

Multiples of bits V·T·E

Decimal				Binary					
Value		SI		Value		IEC		JEDEC	
1000	10^3	kbit	kilobit	1024	2^{10}	Kibit	kibibit	Kbit	kilobit
1000^2	10^6	Mbit	megabit	1024^2	2^{20}	Mibit	mebibit	Mbit	megabit
1000^3	10^9	Gbit	gigabit	1024^3	2^{30}	Gibit	gibibit	Gbit	gigabit
1000^4	10^{12}	Tbit	terabit	1024^4	2^{40}	Tibit	tebibit	-	
1000^5	10^{15}	Pbit	petabit	1024^5	2^{50}	Pibit	pebibit	-	
1000^6	10^{18}	Ebit	exabit	1024^6	2^{60}	Eibit	exbibit	-	
1000^7	10^{21}	Zbit	zettabit	1024^7	2^{70}	Zibit	zebibit	-	
1000^8	10^{24}	Ybit	yottabit	1024^8	2^{80}	Yibit	yobibit	-	

See also: Nibble · Byte · Orders of magnitude of data

https://en.wikipedia.org/wiki/Bit

Units of data: byte

- Group of **N** bits.
  - Popular: **N = 8bits**
  - Other cases: from 1 to 48 bits
- Notation
  - B or byte
  - Example:
    - Size of "int": 4B (4 bytes)
    - Capactiy of a USB: 2GB
    - Capactity of RAM: 8GB
    - A HDD: 3TB

Prefixes for multiples of bits (bit) or bytes (B)						
Decimal			Binary			
Value	SI		Value	IEC		JEDEC
1000	k	kilo	1024	Ki	kibi	K kilo
1000^2	M	mega	1024^2	Mi	mebi	M mega
1000^3	G	giga	1024^3	Gi	gibi	G giga
1000^4	T	tera	1024^4	Ti	tebi	–
1000^5	P	peta	1024^5	Pi	pebi	–
1000^6	E	exa	1024^6	Ei	exbi	–
1000^7	Z	zetta	1024^7	Zi	zebi	–
1000^8	Y	yotta	1024^8	Yi	yobi	–

https://en.wikipedia.org/wiki/Byte

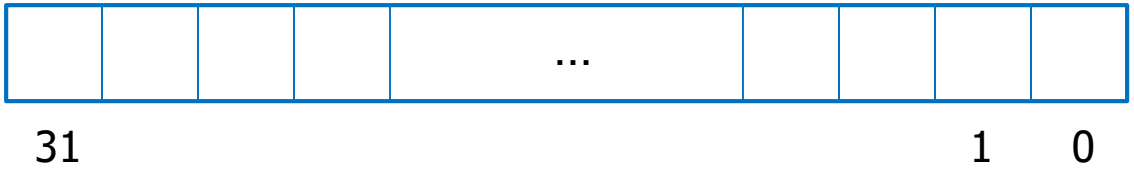
Units of data: word

- Group of **N** bits that can be handled as a unit CPU
  - Popular: **N = 8, 16, 24, 32, and 64**
  - **Modern CPU:**
    - **N = 32 (IA-32)**
    - **N = 64 (IA-64)**

  - **IA-32:** “Intel Architecture, 32-bit”
  - **IA-64:** “Intel Architecture, 64-bit”

Units of data: word

- **IA-32:** “Intel Architecture, 32-bit”



Address register

Number Systems

- See:
  - https://code.tutsplus.com/articles/number-systems-an-introduction-to-binary-hexadecimal-and-more--active-10848
- Binary System
- Octal System
- Decimal System
- Hexa System

Memory Model

- Physical devices
- Virtual memory
  - Virtual address