

pomp's  
**Computer Science**  
cheat sheet

git revision: fbf103e  
made with Typst





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# 1. CS math

## 1.1. Units

| Name      | Size |
|-----------|------|
| Bit       | 1    |
| Nibble    | 4    |
| Byte      | 8    |
| Half-word | 16   |
| Word      | 32   |

| $2^x$ |          |
|-------|----------|
| Name  | Size     |
| kibi  | $2^{10}$ |
| mebi  | $2^{20}$ |
| gibi  | $2^{30}$ |
| tebi  | $2^{40}$ |
| pebi  | $2^{50}$ |
| exbi  | $2^{60}$ |
| zebi  | $2^{70}$ |

| $10^x$ |           |
|--------|-----------|
| Name   | Size      |
| kilo   | $10^3$    |
| mega   | $10^6$    |
| giga   | $10^9$    |
| tera   | $10^{12}$ |
| peta   | $10^{15}$ |
| exa    | $10^{18}$ |
| zetta  | $10^{21}$ |
| yotta  | $10^{24}$ |

## 1.2. Binary number

### 1.2.1. Endianness

if data is 0x11223344

| Address       | 1  | 2  | 3  | 4  |
|---------------|----|----|----|----|
| Little Endian | 11 | 22 | 33 | 44 |
| Big Endian    | 44 | 33 | 22 | 11 |

- Big Endian: LSB comes first
- Little Endian: MSB comes last

## 1.3. Boolean Algebra

### 1.3.1. Operations

- NOT
  - in boolean algebra ( $\boxtimes$ ):  $x', \bar{x}$
  - in symbolic logic ( $\boxtimes$ ):  $!x, \sim x$
- AND ( $+$ )
- OR ( $\cdot$ )

### 1.3.2. complete sets

- AND, OR, NOT
- AND, NOT
  - $\text{OR} = (x' y')'$
- OR, NOT
- NAND
- NOR

### 1.3.3. Properties

duality:  $0 \leftrightarrow 1$  and  $\times \leftrightarrow +$

$$x + (\sim x \times y) = x + y$$

$$x \times (\sim x + y) = x \times y$$

#### 1.3.3.1. Commutative ( $\boxtimes$ )

$$x \times y = y \times x$$

$$x + y = y + x$$

#### 1.3.3.2. Associative ( $\boxtimes$ )

$$(x \times y) \times z = x \times (y \times z)$$

$$(x + y) + z = x + (y + z)$$

### 1.3.3.3. Distributive (☒☒)

$$x \times (y + z) = (x \times y) + (x \times z)$$

$$x + (y \times z) = (x + y) \times (x + z)$$

### 1.3.3.4. Absorption (☒☒)

$$x + (x \times y) = x$$

$$x \times (x + y) = x$$

### 1.3.3.5. Combining (☒☒)

$$(x \times y) + (x \times \sim y) = x$$

$$(x + y) \times (x + \sim y) = x$$

### 1.3.3.6. DeMorgan's Law

$$\sim (x \times y) = \sim x + \sim y$$

$$\sim (x + y) = \sim x \times \sim y$$

### 1.3.3.7. Consensus (☒☒)

$$(x \times y) + (y \times z) + (x' \times z) = (x \times y) + (x' \times z)$$

$$(x + y) \times (y + z) \times (x' + z) = (x + y) \times (x' + z)$$

### 1.3.4. Axioms

1.  $0 \times 0 = 0$

$$1 + 1 = 0$$

2.  $1 \times 1 = 1$

$$0 + 0 = 0$$

3.  $0 \times 1 = 1 \times 0 = 0$

$$1 + 0 = 0 + 1 = 1$$

4.  $\sim 0 = 1$

$$\sim 1 = 0$$

### 1.3.5. Theorems

1.  $x \times 0 = 0$

$$x + 1 = 1$$

2.  $x \times 1 = x$

$$x + 0 = x$$

3.  $x \times x = x$

$$x + x = x$$

4.  $x \times \sim x = 0$

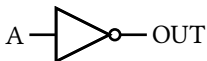
$$x + \sim x = 1$$

5.  $\sim \sim x = x$

## 2. Logic circuit

### 2.0.1. Logic gates

NOT



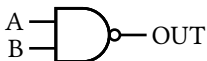
| A | OUT |
|---|-----|
| 0 | 1   |
| 1 | 0   |

AND



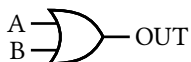
| A | B | OUT |
|---|---|-----|
| 0 | 0 | 0   |
| 0 | 1 | 0   |
| 1 | 0 | 0   |
| 1 | 1 | 1   |

NAND



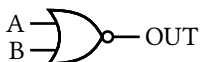
| A | B | OUT |
|---|---|-----|
| 0 | 0 | 1   |
| 0 | 1 | 1   |
| 1 | 0 | 1   |
| 1 | 1 | 0   |

OR



| A | B | OUT |
|---|---|-----|
| 0 | 0 | 0   |
| 0 | 1 | 1   |
| 1 | 0 | 1   |
| 1 | 1 | 1   |

NOR



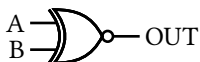
| A | B | OUT |
|---|---|-----|
| 0 | 0 | 1   |
| 0 | 1 | 0   |
| 1 | 0 | 0   |
| 1 | 1 | 0   |

XOR



| A | B | OUT |
|---|---|-----|
| 0 | 0 | 0   |
| 0 | 1 | 1   |
| 1 | 0 | 1   |
| 1 | 1 | 0   |

XNOR



| A | B | OUT |
|---|---|-----|
| 0 | 0 | 1   |
| 0 | 1 | 0   |
| 1 | 0 | 0   |
| 1 | 1 | 1   |

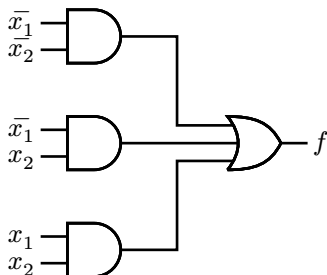
## 2.0.2. Equivalent Circuit (☒☒☒☒)

Truth table

| $x_1$ | $x_2$ | $f$ |
|-------|-------|-----|
| 0     | 0     | 1   |
| 0     | 1     | 1   |
| 1     | 0     | 0   |
| 1     | 1     | 1   |

Canonical sum of product

$$f(x_1, x_2) = \bar{x}_1\bar{x}_2 + \bar{x}_1x_2 + x_1x_2$$



minimal cost

$$f(x_1, x_2) = \bar{x}_1 + x_2$$



minimal cost (NAND)

$$\begin{aligned} f(x_1, x_2) &= \bar{x}_1 + x_2 \\ &= (\bar{x}_1 + x_2)'' \\ &= (x_1\bar{x}_2)' \end{aligned}$$



### 2.0.3. karnaugh map

$$f(w, z, y, z)$$

$$= \Sigma m(0, 3, 6, 7, 8, 11, 14, 15)$$

$$= \bar{w}\bar{x}\bar{y}\bar{z} + \bar{w}\bar{x}y\bar{z} + \bar{w}x\bar{y}\bar{z} + \bar{w}x\bar{y}z + w\bar{x}\bar{y}\bar{z} +$$

$$w\bar{x}y\bar{z} + wxy\bar{z} + wxyz$$

$$= \bar{x}\bar{y}\bar{z} + xy + yz$$

| wx \backslash yz |    |    |    |    |
|------------------|----|----|----|----|
|                  | 00 | 01 | 11 | 10 |
| 00               | 1  |    | 1  |    |
| 01               |    |    | 1  | 1  |
| 11               |    |    | 1  | 1  |
| 10               | 1  |    | 1  |    |

#### 2.0.3.1. Gray code

|   |   |   |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 0 | 1 | 0 |
| 1 | 1 | 0 |
| 1 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 0 | 0 |

← 3-bit gray code

- mirroring of bits
- each row only differs by 1 bit

### 3. ISA

### 3.1. x86-64

## 3.2. ARM

### 3.3. RISC-V

Base:

- RVWMO - Weak Memory Ordering
- Base Integer Instruction Sets
  - RV32I - 32-bit 32 registers
  - RV32E - 32-bit 16 registers (embedded)
  - RV64I - 64-bit 32 registers
  - RV64E - 64-bit 16 registers (embedded)

<https://projectf.io/posts/riscv-cheat-sheet>



<https://en.wikipedia.org/wiki/RISC-V>



<https://lhtin.github.io/01world/app/riscv-isa>



## **4. DSA**

### **4.1. Analysis of algorithms**

### **4.2. Graph**

#### **4.2.1. Tree**

### **4.3. Sorting algorithm**

## 5. Cryptography

### 5.1. RSA

## 6. Networking

### 6.1. OSI Model

OSI: Open Systems Interconnection

| # | Name         | Protocol Data Unit |
|---|--------------|--------------------|
| 1 | Physical     | Bit                |
| 2 | Data Link    | Frame              |
| 3 | Network      | Packet             |
| 4 | Transport    | Segment/Datagram   |
| 5 | Session      | Data               |
| 6 | Presentation | Data               |
| 7 | Application  | Data               |

| # | Example           |
|---|-------------------|
| 1 | Signal upsampling |
| 2 |                   |
| 3 | IP                |
| 4 | TCP               |
| 5 | browser waterfall |
| 6 | HTML              |
| 7 | HTTP              |

## 6.2. TCP

## 6.3. HTTP

### 6.3.1. Status codes

### 6.3.2. HTTPS

## 6.4. CAT cable

| Cable  | Max Data Rate |
|--------|---------------|
| CAT 1  | 1 Mbps        |
| CAT 2  | 4 Mbps        |
| CAT 3  | 10 Mbps       |
| CAT 4  | 16 Mbps       |
| CAT 5  | 100 Mbps      |
| CAT 5e | 1 Gbps        |
| CAT 6  | 1 Gbps        |
| CAT 6a | 10 Gbps       |
| CAT 7  | 10 Gbps       |
| CAT 8  | 40 Gbps       |

## 7. Programming methodologies

### 7.1. SOLID

- **S** - Single Responsibility:  
One class, one job
- **O** - Open-Closed:  
Open for extension, closed for modification
- **L** - Liskov Substitution:  
Subtypes replace base without breaking
- **I** - Interface Segregation:  
Small interfaces over large ones
- **D** - Dependency Inversion:  
Depend on abstractions, not details