3 Hardware – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
logic circuit	逻辑电路			
Boolean	布尔			
truth table	真值表			
hard disk	硬盘			
solid-state drive	固态硬盘			
optical disc	光盘			

Recall

In **Part 1** you met the computer's parts, RAM and ROM, and the three basic logic gates. Keep these ready:

- A logic gate takes 0s and 1s in and gives a single 0 or 1 out; a truth table lists every case.
- **AND** is 1 only when both inputs are 1; **OR** is 1 when either is 1; **NOT** flips the input.

Part 2 adds three more gates, building them into circuits, and how data is stored long-term.

New ideas

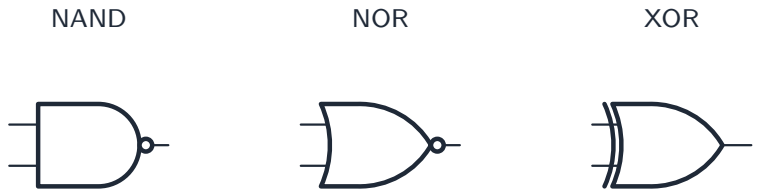
Read these first. Each idea has a short worked example. Then do the Practice.

1 Three more logic gates

Besides AND, OR and NOT there are three more, built from them:

inputs A, B	NAND (not AND)	NOR (not OR)	XOR (different?)
0, 0	1	1	0
0, 1	1	0	1
1, 0	1	0	1
1, 1	0	0	0

NAND and NOR are just AND and OR with the output flipped; **XOR** gives 1 only when the two inputs are **different**.

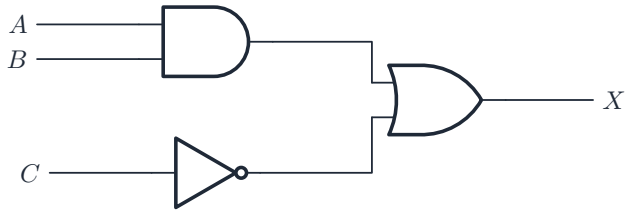


Worked example. XOR is the "are they different?" test: inputs $0, 1 \to$ output 1 (different); inputs $1, 1 \to$ output 0 (same).

Watch out: NAND is *not* "NOT then AND" — it is AND with its output flipped (do the AND first, then invert).

2 Logic circuits

Gates joined together make a **logic circuit** 逻辑电路. From a **Boolean** 布尔 expression you can draw the circuit, and from a circuit you can read off the expression and build its **truth table** 真值表.



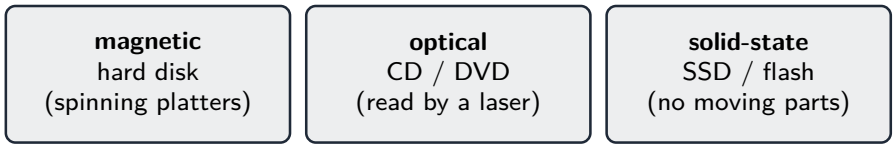
Worked example. For $X = (A$ AND $B)$ OR (NOT $C)$: AND-gate the inputs A, B; NOT-gate C; OR those two results to give X. X is 1 whenever A and B are both 1, **or** C is 0.

3 Storage devices

Secondary storage keeps data when the power is off. The main types:

- a **hard disk** 硬盘 (HDD): data on spinning magnetic disks (cheap, large, has moving parts);
- a **solid-state drive** 固态硬盘 (SSD): flash memory, no moving parts (faster, more robust);

- an **optical disc** 光盘 (CD / DVD): tiny pits read by a laser.



Worked example. A laptop often uses an SSD as its main drive (fast, silent, no moving parts) and a large external hard disk for backups (cheaper per gigabyte).

Practice

3.1 Which storage device is read using a laser? [1]

3.2 State one advantage of an SSD over a hard disk. [1]

3.3 Complete the output column of this truth table for a 2-input **NAND** gate. [2]

A	B	A NAND B
0	0	
0	1	
1	0	
1	1	

3.4 State the input combinations (of two inputs) for which an **XOR** gate outputs 0, and those for which it outputs 1. [2]

3.5 A circuit ANDs inputs A and B, then ORs that result with input C. Write the Boolean expression for the output X. [2]

3.6 Explain *why* a NAND gate always gives the opposite output to an AND gate. [2]

3.7 Challenge. Using only AND, OR and NOT, write a Boolean expression that is 1 only when A and B are *different* (i.e. build an XOR). [2]