Chapter 1 Bits

Information is measured in bits, just the quantity not the content

the amount of information is $\log_2 N$, N — the number of equally likely outcomes.

Conveying: ① setup: what to communicate: what each sequence of bits means
code.

A → B

② outcome. actual sequences of 0 and 1 representing the outcomes
data.

Bob's uncertainty rises during the setup phase and then is reduced during the outcome phase

Information is subjective ("observer-dependent")

Boolean algebra

Boolean functions of a single variable → a single value: 4

x	f(x)			
Argument	identity	not	zero	one
0	0	1	0	1
1	1	0	0	1

two input variables → single value: $2^{2^2} = 2^4 = 16$.

most often used: AND, OR, XOR, NAND, NOR

x	f(x)				→ exclusive
arguments	AND	NAND	OR	NOR	XOR
0 0	0	1	0	1	1
0 1	0	1	1	0	0
1 0	0	1	1	0	0
1 1	1	0	1	0	1

A AND B written as AB or $A \cdot B$

A OR B written as $A + B$

NOT A written as $\bar{A}$

A XOR B written as $A \oplus B$

$A \wedge B$ denotes $A \cdot B$

$A \vee B$ denotes $A + B$

$\sim A$ or $\neg A$ denotes $\bar{A}$

a function is <u>reversible</u> if knowing the output, input can be determined

none of the $2 \to 1$ is reversible, since more input variables than output.

Some combinations of 2 or more such functions can be reversible if output same number input

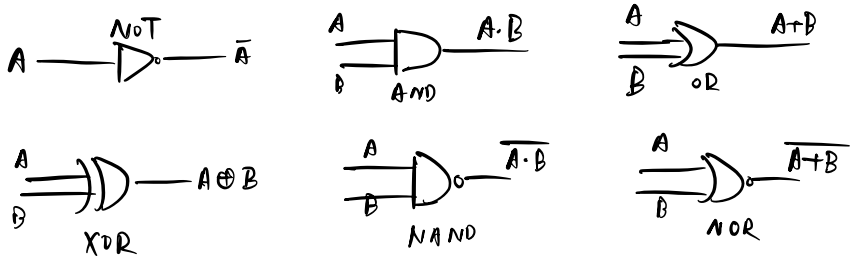
<u>EX</u>: $A, B \longrightarrow A \oplus B, A$ reversible

2 variables function is <u>commutative</u> if $f(A, B) = f(B, A)$

The Circuit Bit

<u>Combinational logic</u> represent Boolean expressions graphically.

Each Boolean function correspond to a "combinational gate" with 1/2 input and 1 output



Combinational circuits has no loops

Circuits with loops —— sequential logic Boolean Algebra is not sufficient

The Control Bit

the algebra of control bits is like Boolean algebra with one difference:

any part of the control expression that does not affect the result may be ignored

the program runs faster, and side effects of the ignored parts don't happen

The physical Bit & The Quantum Bit

Communication. memory forgotten

The quantum bit, or qubit, is a model of an object that can store a single bit

but is too small to the limitations quantum mechanics places on measurement.

The two values denoted $|0\rangle$ and $|1\rangle$ 3 features

① Reversibility: if one state can lead to another by transition, reverse is possible

interact with unknown environment / measuring is irreversible

② Superposition, combination or superposition of its two states i.e. a state between two

could only measure once, always either "true" or "false" answer

③ Entanglement: two qubits though travel to different places, have identical states

The Classical Bit

restoring logic: small deviation in voltage from ideal values are eliminated when processed

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the robustness of modern comp