CSC104 fall 2012

Why and how of computing

week 6

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Text: Picturing Programs

Outline

Representing information

Notes

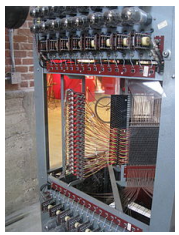
Some convergence

digital, binary, small, fast, cheap...

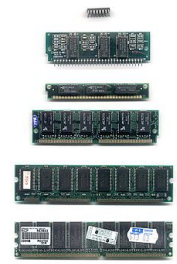
Computers have converged on two general design ideas:

digital: Using discrete, sharply-changing, rather than analog, smoothly-changing states

binary: Two states is the smallest, most easily designed



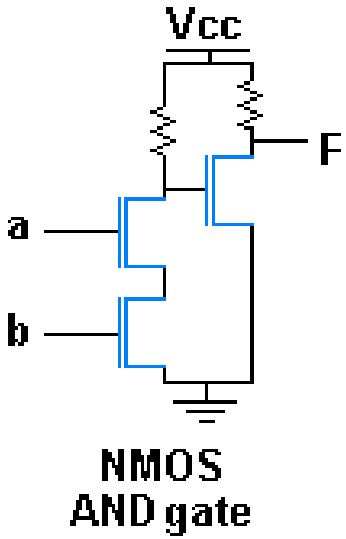
memory should be reliable
fast, and cheap
magnetic (left), transistor (right)



Boolean logic

simple operators

Two values, **true** and **false** can be combined:

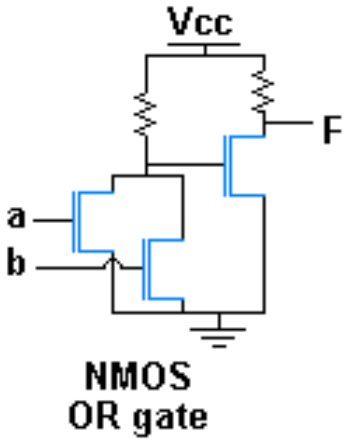


a	b	(and a b)
true	true	true
true	false	false
false	true	false
false	false	false

Boolean logic

more simple operators

Two values, **true** and **false** can be combined:

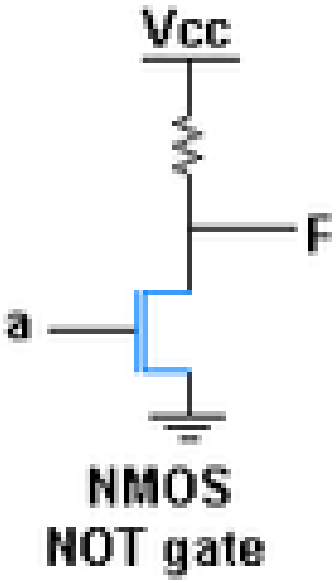


a	b	(or a b)
true	true	true
true	false	true
false	true	true
false	false	false

Boolean logic

one more simple operator

Single value, **true** or **false** can be transformed:

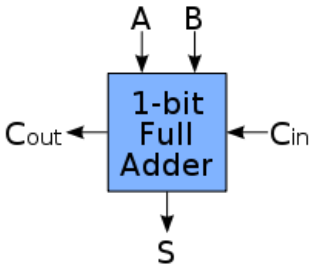


a	(not a)
true	false
false	true

Boolean arithmetic

bitwise operator

Two values, **0** or **1**, can be combined:



A	B	C_{in}	C_{out}	S
0	0	0	0	0
1	0	0	0	1
0	1	0	0	1
1	1	0	1	0
0	0	1	0	1
1	0	1	1	0
0	1	1	1	0
1	1	1	1	1

binary, decimal...

5897 — multiply each digit by the appropriate power of 10

$$5 \times 1000 + 8 \times 100 + 9 \times 10 + 7 \times 1$$

- What happens when you add zeros on the right —- 58970 589700?
- What happens when you drop digits from the right — 589, 58?
- Can you guess at a general rule?

binary, decimal...

1011 multiply each digit by the appropriate power of 2

$$1 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1$$

- What happens when you add zeros on the right — 10110, 101100?
- What happens when you drop digits from the right — 101, 10?
- Can you guess at a general rule?

number to binary

How do you write 37 in binary?

- Suppose you knew it had six **bi**nary digits (bits), ??????. Does the fact that 37 is odd help you know whether the bit on the right is a 0 or 1?

- Suppose you know what the digit on the right is. What connection is there between the remaining bits, ?????, and 37/2 (rounded down)?

Notes