CSC104 fall 2012

Why and how of computing

week 3

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Text: Picturing Programs

Outline

Representing information

Notes

Some convergence

1970s, 1980s

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

Computers have converged on two general design ideas:

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

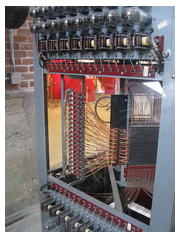
binary: Two states is the smallest, most easily designed

flash - not as fast

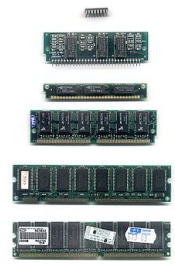
memory should be reliable

fast, and cheap

magnetic (left), transistor (right)



magnetic rings, arranged on grid of wires



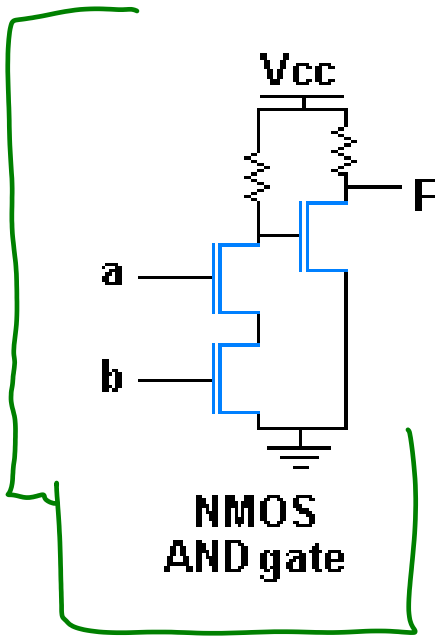
DRAM ✓

depend power source to support their state.

Boolean logic

simple operators

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



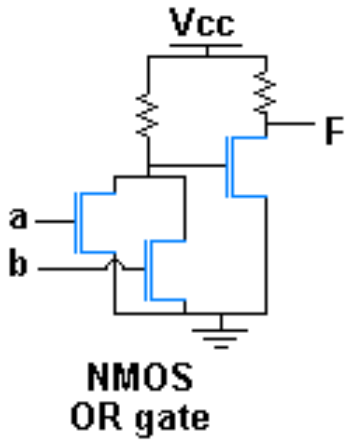
a	b	a and b
true	true	true
true	false	false
false	true	false
false	false	false

now semiconductor, voltage changes it insula from a conductor to an tor.

Boolean logic

more simple operators

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



a	b	a or b
true	true	true
true	false	true
false	true	true
false	false	false

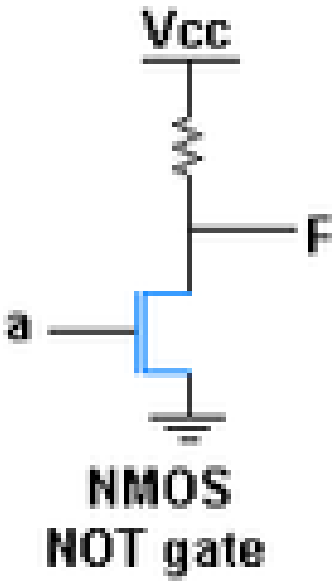
Boolean logic

one more simple operator

NOR
(not (a or b))

NAND
(not (a and b))

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



a	not a
true	false
false	true

all you need for any logical circuit
and
or
not

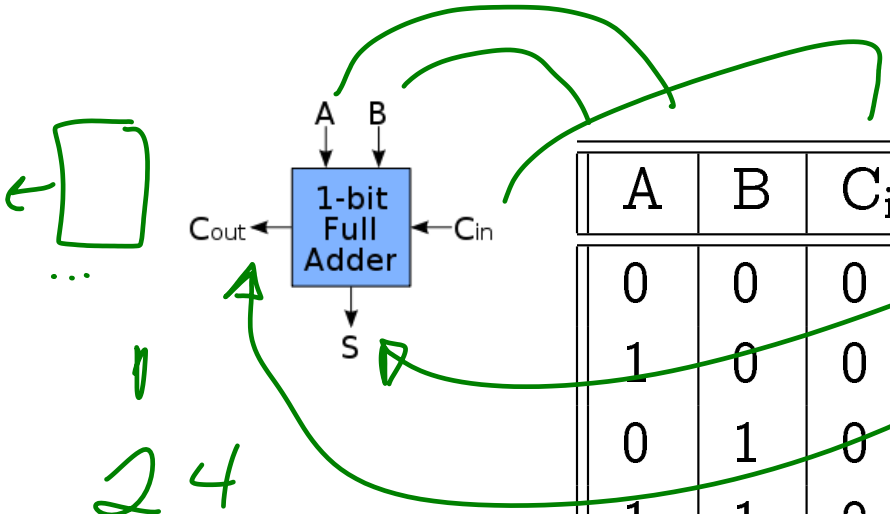
Boolean arithmetic

bitwise operator

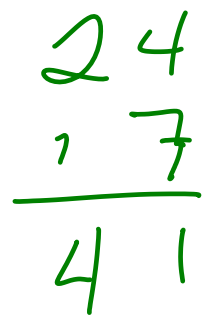
full-adder

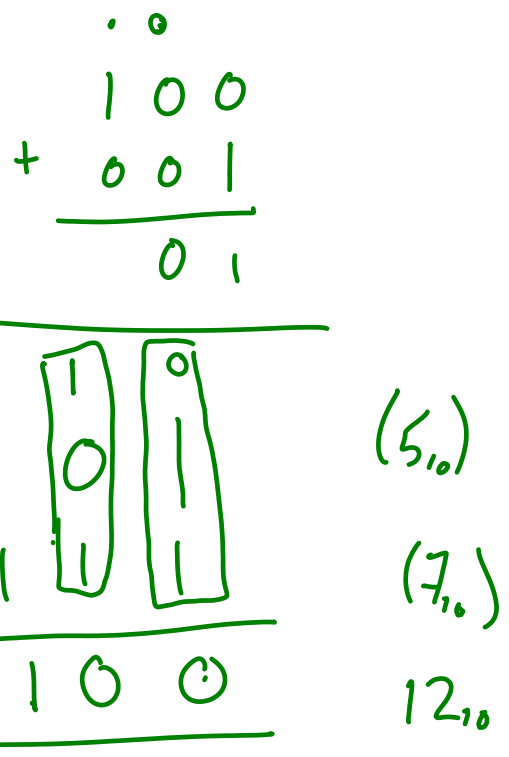
+	0	1
0	0	1
1	1	0

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



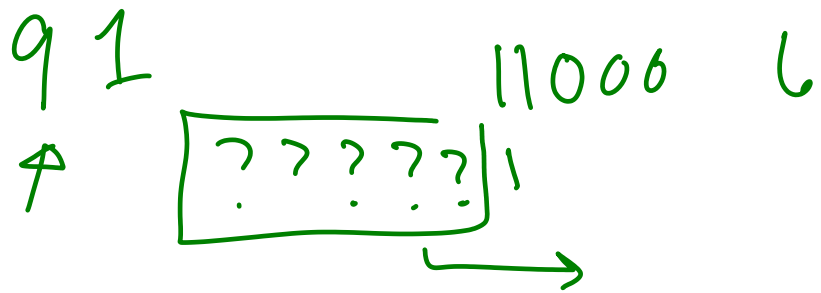
A	B	C_{in}	C_{out}	S
0	0	0	0	0
1	0	0	0	1
0	1	0	0	1
1	1	0	1	0
0	0	1	0	1
1	0	1	1	0
0	1	1	1	0
1	1	1	1	1





binary to decimal

. . . and back



Binary numbers are the same as decimal (base 10), only different:

5897 Multiply each digit by the appropriate power of 10

1011 Multiply each digit by the appropriate power of 2

Convert 37 Write down the parity, find the quotient by 2, and repeat...

Notes