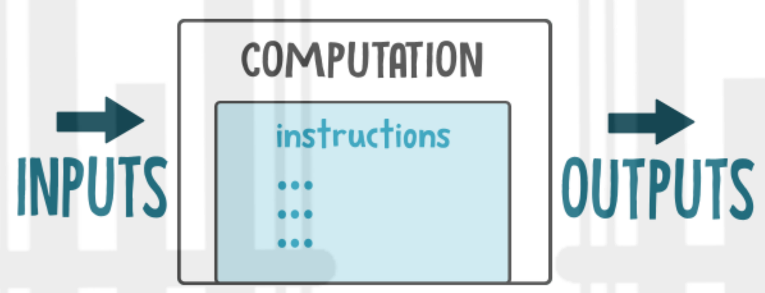
QC CLASSICAL COMPUTING

HISTORY OF CLASSICAL COMPUTING

What is COMPUTATION

A mathematical calulation that maps inputs to an output based on a set of instructions

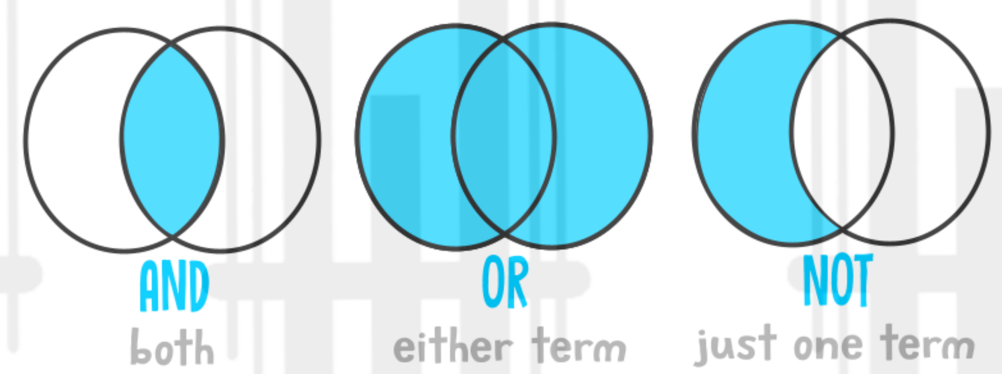


BIT-SIZED history of computing

- ★1939 Turing machine
- ★1946 the Eniac
- ★1949 the Modem
- ★1957 Fortran, Hard-drive, Ramac
- ★1961 the Mouse
- ★1968 RAM
- ★1969 the Arpanet
- ★1970 Mp 911
- ★1971 Intel 1001, Floppy
- ★1972 Pong, {C}
- ★1973 Ethernet cable
- ★1975 8800 Altair
- ★1977 the Apple 2
- ★1979 C++

BOOLEAN LOGIC

Boolean Logic: maps input bit(s) to output bit(s)



Logic gates + Truth tables

Logic: maps input bit(s) to output bit(s)

Tables: tells us the output of a logical operation

GATES 1 BIT

GATES: NOT

Flips the bit

INPUT	OUTPUT
0	1
1	0

GATES: FANOUT

Copies the bit

a	OUTPUT
0	00
1	11

GATES 2 BIT

GATES: AND

Outputs 1 if both are 1, outputs 0 otherwise

a	b	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

GATES: OR

Outputs 1 if either of the inputs bits is 1 outputs 0 if neither of the inputs bits is 1

a	b	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

GATES: XOR

Outputs 1 if either input bits are 1, but not both outputs 0 if neither or both bits are 1

a	b	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	0

BASE-REPRESENTATIONS

"Learning to think like a computer"

DECIMALS

- ★Decimal number system is based on numerical digits 0-9
- ★Base determines how numbers get represented and how we perform arithmetic operations

Example:

$6 = 6$
$= (6 \cdot 10^0)$

$36 = 30+6$
$= (3 \cdot 10^1)+(6 \cdot 10^0)$

$536 = 500+30+6$
$= (5 \cdot 10^2)+(3 \cdot 10^1)+(6 \cdot 10^0)$

BINARY

- ★We can describe any number with BITS

- ★Base-2 is one of the most important bases for performing computation
- ★It is binary, only 0 and 1
- ★Also reffered to as a BIT

- ★We can still do operations; all of the operations in a classical computer happen by manipulating BITS

Converting:

1010 → decimal
$= (1 \cdot 10^3)+(0 \cdot 10^2)+(1 \cdot 10^1)+(0 \cdot 10^0)$

1010 → binary
$= (1 \cdot 2^3)+(0 \cdot 2^2)+(1 \cdot 2^1)+(0 \cdot 2^0) = 8 \quad 2 = 10$

BITS: ARITHMETIC OPERATIONS

"How computers compute"

BINARY ADDITION

- ★Similar to the decimal we are used to
- ★BITS carry over when the sum becomes larger than 2

$0 + 0 = 0$
$0 + 1 = 1$
$1 + 0 = 1$
$1 + 1 = 10$

MULTIPLYING BITS

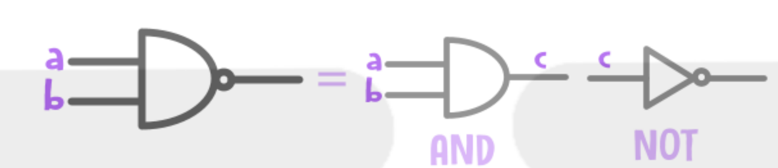
- ★It is the same as binary multiplication
- ★It's like "normal" (the decimal one)

$0 \cdot 0 = 0$
$0 \cdot 1 = 0$
$1 \cdot 0 = 0$
$1 \cdot 1 = 1$

UNIVERSALITY

Any computation operation can be made by using a combination of {NOT, AND, OR, FANOUT}

GATES: NAND (NOT + AND)



a	b	c
0	0	0
0	1	0
1	0	0
1	1	1

c	OUT
0	1
1	0

a	b	OUT
0	0	1
0	1	1
1	0	1
1	1	0

"Let's make a binary adder with the gates we have" $a+b=$

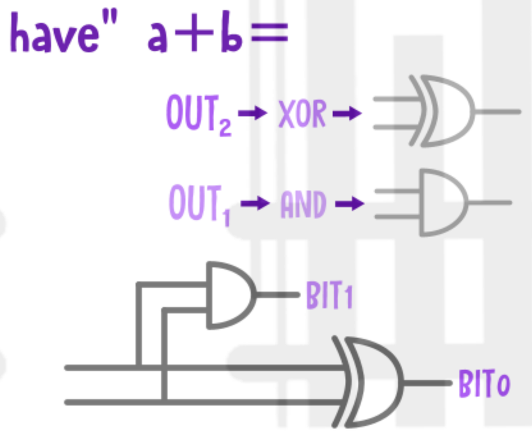
a	b	OUT_1	OUT_2
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

a	b	BIT_0
0	0	0
0	1	1
1	0	1
1	1	0

OUT_2

a	b	BIT_1
0	0	0
0	1	0
1	0	0
1	1	1

OUT_1



REVERSIBILITY

Given the output of a gate, we can determine what the inputs are

REVERSIBLE GATE preserves all the information

NON-REVERSIBLE GATE loses some information