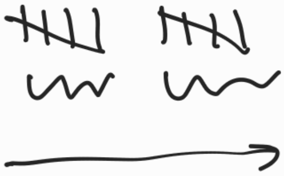
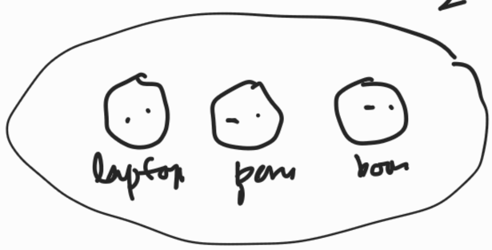
Representation of Numbers.

Bases → 2 → binary
→ 8 → octal
→ 10 → decimal
→ 16 → hexadecimal



2



positional number system.

645

$6 \times 10^2 + 4 \times 10 + 5$

Negative numbers in binary.

4 bit representation.

+5 → 0101

-5 — 1101

$\overset{8\;4\;2\;1}{0101}$

Most significant bit

least significant bit

Signed representation.

1111 → -7
1110
⋮
1010 → -2
1001 → -1
1000 → -0
0000 → +0
0001
0010
⋮
0111 → 7

Unsigned representation

0101
0010
0111

5+2

5+3
0101
0011
1000

+5
-5

0101
1101
$\cancel{1}$ 0010

Issue

① Two representations for 0s.

② → +2

Motivation: doing Subtraction using adder circuit.

$6 - 3 = 6 + (-3)$

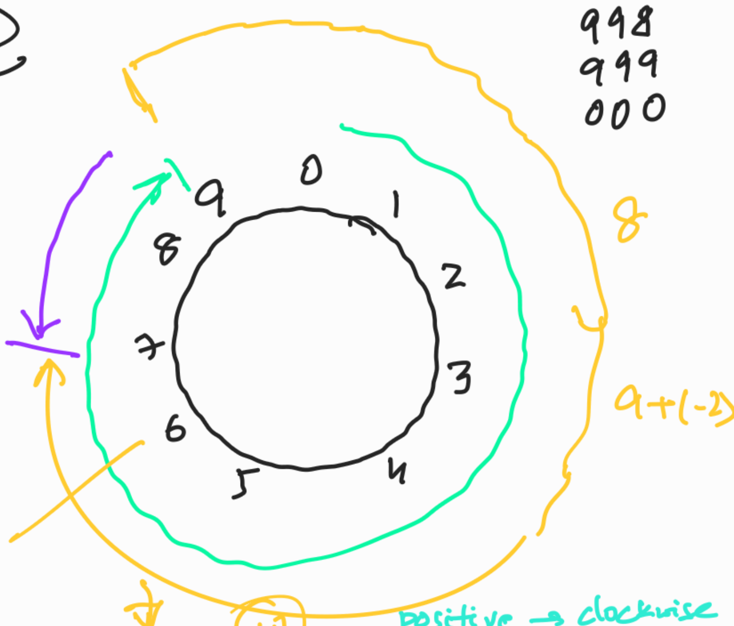
998
999
000

One's complement.

782
→ 217

1's complement ← | 9's complement
$-2 \rightarrow 7$

2's complement ← | 10's complement
$-2 \rightarrow 8$ (-2 ↓ 8)



positive → clockwise
negative → anticlockwise.

9-2

10

$\boxed{9+8}$ → 17

10's complement → $\boxed{9 + (10-2)} \rightarrow 17$

One's complement.

$-2^3 \quad 2^2 \quad 2^1 \quad 2^0$

1000	→	−7
1001	→	−6
⋮		
1110	→	−1
1111	→	−0
0000	→	+0
0001	→	+1
⋮		
0111	→	+7

+7 → 0111
+6 → 0110

3 + (−3)

```
  0011   → 3
  1100
  ----
  1111   → -0
```

```
 5     0101
-3     1100
--    -----
 2    10001  → 1
```

→ 2 0's → not elegant
→ add 1 to the result.
→

Two's complement

$-8 + 4 + 2 + 1$

1 0 0 0	−8
1 0 0 1	−7
1 0 1 0	−6
⋮	
1 1 1 1	−1
0 0 0 0	0
0 0 0 1	1
0 0 1 0	2
⋮	
0 1 1 1	7

only one representation for 0

1010
+ 1

5	0 1 0 1
+ (−5)	1 0 1 1
	$\boxed{1}$ 0 0 0 0

X

Elegant

Elegant

−8 to +7