Bit Manipulation

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Bitwise Operators:
- AND
- OR
- XOR

AND — Clear a bit 1→0, 0→0
— Check a bit

OR — Set a bit 0→1, 1→1

XOR — Invert a bit 0→1, 1→0

1 0 1 1 1 0 0 1 0

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a = 97
A = -65
32

128	64	32	16	8	4	2	1	Worth
0	1	1	0	0	0	0	1	350
0	1	0	0	0	0	0	1	
7	6	5	4	3	2	1	0	Position

Q. Load the register from memory location 350, it will have capital case alphabet, turn it to lower case equivalent alphabet letter.

```
LDD 350
OR #32
STO 351
END
```

ACC
65
97

OR
0 1 0 0 0 0 0 1
0 0 1 0 0 0 0 0 → MASK.
0 1 1 0 0 0 0 1

OR 1 → Set
OR 0 → Retain

```
LDD 350
AND #223
STO 350
END.
```

ACC
97
65

AND
0 1 1 0 0 0 0 1 a
1 1 0 1 1 1 1 1 → MASK.
0 1 0 0 0 0 0 1 A

AND 1 → Retain
0 → Clear.

AND #223
AND #B 11011111
AND #& DF

Two's Complement:

0 0 0 1 0 1 0 0 +20
1 1 1 0 1 1 0 0 -20

One's Complement:

0 0 0 1 0 1 0 0 +20
1 1 1 0 1 0 1 1 Invert
\+ 0 0 0 0 0 0 0 1 Add 1.
1 1 1 0 1 1 0 0

Q. Load from memory location 200 and apply One's Complement to it, store the result back to 201.

```
LDD 200
XOR #255
INC
STO 201
END.
```

Den	Bin
9	00001001
246	11110110
247	11110111

Unsigned

200	+9	00001001
201	-9	11110111

Signed.

1 | 1 1 1 0 1 1 1
-128 +119

-128
+119
-9

0 0 0 0 1 0 0 1
1 1 1 1 0 1 1 0
0 0 0 0 0 0 0 1
1 1 1 1 0 1 1 1

XOR 1 → invert 0→1, 1→0
0 → Retain.

XOR
0 0 0 0 1 0 0 1
1 1 1 1 1 1 1 1 → MASK 255
1 1 1 1 0 1 1 0

$2^8 = 256$ ⟨ 0, 255

Bit Shifting:

0 1 1 0 6
left 0 1 1 0 0 12
0 0 1 1 0 3 Right
drop

Left shift, right shift — logical shifting

left shift doubles the number and given bits only store numbers until they are in range. $2^8 = 256$ ⟨ 0, 255

0	0	0	1	0	1	0	0	20	$\times 2^3$
0	0	1	0	1	0	0	0	40	×2
0	1	0	1	0	0	0	0	80	×2
1	0	1	0	0	0	0	0	160	×2

2^3

Integer.

If number is even answer is correct. If number is odd answer will lose 0.5. Right shifting halves the number.

0	0	1	1	0	0	1	0	50	
0	0	0	1	1	0	0	1	25	÷2
0	0	0	0	1	1	0	0	12	÷2
0	0	0	0	0	1	1	0	6	÷2

LSL #n left shift.
LSR #n Right shift.

Cyclic Shift:

1 1 1 0 14
0 1 1 1 7

1 1 1 0 14
1 1 0 1 13

Arithmatic Shift:

Sign bit stays.

0 | 0 0 0 0 0 1 0
0 | 0 0 0 0 1 0 0 ? LS

1 | 1 1 1 1 1 1 0 LS
1 | 1 1 1 1 1 0 1