$1\ 2\ 3\ \}$

$$
\begin{array}{c|c}
1 & 123 \\
\hline
1 & 61 \\
\hline
0 & 30 \\
\hline
1 & 15 \\
\hline
1 & 7 \\
\hline
1 & 3 \\
\hline
1 &
\end{array}
$$

$1 1 1 1 0 1 1$

$$-\underline{23}\Big\}$$

$$-23 \qquad 16 + 4 + 2 + 1$$

$$
\begin{array}{cccccccc}
\underline{0} & \underline{0} & \underline{0} & \underline{0} & \underline{1} & \underline{1} & \underline{1} & \underline{1} \\
32 & 16 & & 4 & & 2 & 2^0 \\
\end{array}
$$

1's comble

$$
\begin{array}{cccc}
0 & 0 & 0 & 0 \\
\end{array}
$$

2's complement

$$\boxed{1 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 1}$$

$$-9 \left\{ \begin{array}{c} +23 \\ \hline \end{array} \right.$$

$$-\quad \right\} \longrightarrow \text{signed} \ (-)^{ne} \ \underline{\text{atol}}$$

$-9 \begin{cases} \rightarrow \text{Binary} \end{cases}$

$$\boxed{0\ 1\ 1\ 1\ 1} \swarrow$$

$$1\times2^2 + 1\times2^1 + 1\times2^0$$

$$\boxed{-1\times2^4} + 0\times2^3$$

$$= 0\ 4+2+1+0$$

$$= -9\ -16$$

$$= -9$$

$\boxed{9} \longrightarrow 1\ 0\ 0\ 1$

$$\begin{array}{ccc} 8 & 4 & 2 \\ 1 & 0 & 0 \end{array}$$

$\downarrow$

1 compliment $\rightarrow$ $0\ 1\ 1\ 0$

$\downarrow$ $+1$

2 compliment $\rightarrow$ $\underline{1}\,|\,0\ 1\ 1\ 1 \longrightarrow -9$

MSB

$$\begin{array}{r} 1001 \\ 1 \\ \hline 1010 \end{array}$$

$4 \cdot 75$

4

$$4 \quad 2 \quad 1$$
$$1 \quad 0 \quad 0$$

$100 \cdot 11$

$\cdot 75 \times 2 = 1 \cdot 5 \rightarrow 1$

$0 \cdot 5 \times 2 = 1$

$$\underline{9.3}$$

$$\underline{9} \rightarrow 1001 \cdot 0100$$

$$8 \quad 4 \quad 2 \quad 1$$
$$0 \quad 0 \quad 1$$

$$\cdot 3 \times 2 = 0 \cdot 6 \mid 0$$
$$0 \cdot 6 \times 2 = 1 \cdot 2 \mid 1$$
$$0 \cdot 2 \times 2 = 0 \cdot 4 \mid 0$$

Repeat $\quad 0 \cdot 4 \times 2 = 0 \cdot 8 \mid 0$

$$0 \cdot 8 \times 2 = 1 \cdot 6 \mid 1$$

$$\times 0 \cdot 6$$

(−)ive

1 0 1 1 1 0 0 0 1

(+)ric

0 1 1 0 1 1 0

10.45 } $0.45 = 4 \times 10^{-1} + 5 \times 10^{-2}$

14.56
4 $\left(\dfrac{5}{10}\right)$
$\dfrac{8}{10}$

$8 \cdot 25$

8

$8 \quad 4 \quad 2 \quad 1$

$1 \quad 0 \quad 0 \quad 0$

⑧ $\rightarrow 1 0 0 0$

$0.25 \times 2 = 0.5 \rightarrow 0$

$0.6 \times 2 = 1 \rightarrow 1$

8.25 {

1000.01

1000

$= 0 \times 2^{0} + 0 \times 2^{1} + 0 \times 2^{2} + 1 \times 2^{3}$

$= 8$

Decimal No

0.01 { $0 \times 2^{-1} + 1 \times 2^{-2}$

$= 0 + \dfrac{1}{④} = 0.25$

⑤

4 2 1

2
0 1 1

[Binary]

5 8 3

[and]

1 0 1 & 0 1 1 → 0 0 1

①

$5 \mid 3$

$5 \wedge 3$ $\rightarrow$ XOR

$4 \mid 2$
0

$$5 \wedge 3 \{$$

$$\begin{array}{c|c|c} 0 & \wedge & 0 \end{array} \mid 1$$

$$\frac{1 \ 1 \ 0}{0}$$

$0 \times 2^0 + 1 \times 2^1 + 1 \times 2^2$

$= 6$

$$D \times Q + R = \text{Number}]$$

$$\Rightarrow 5 \times Q + R = -4$$

$$4 \% -5$$

$$\sim \quad -4 / 5$$

$$5 \overline{)-4}$$

$$\left. \begin{array}{c} -4 \\ /5 \end{array} \right\}$$

$$5 \times 1 + 1$$

$$-4$$

$$= \circled{6}$$

$$Q = -1$$
$$R = 1 \quad \underleftarrow{-4/4}$$

conditionals] ⟶ [if/else } Block]

Expression

True — False

(Truly) Falsely

if (expression) :
___
___
___
___

Boolean expression → True
→ False

{ if block code]

True	False

`if ( ! )` :
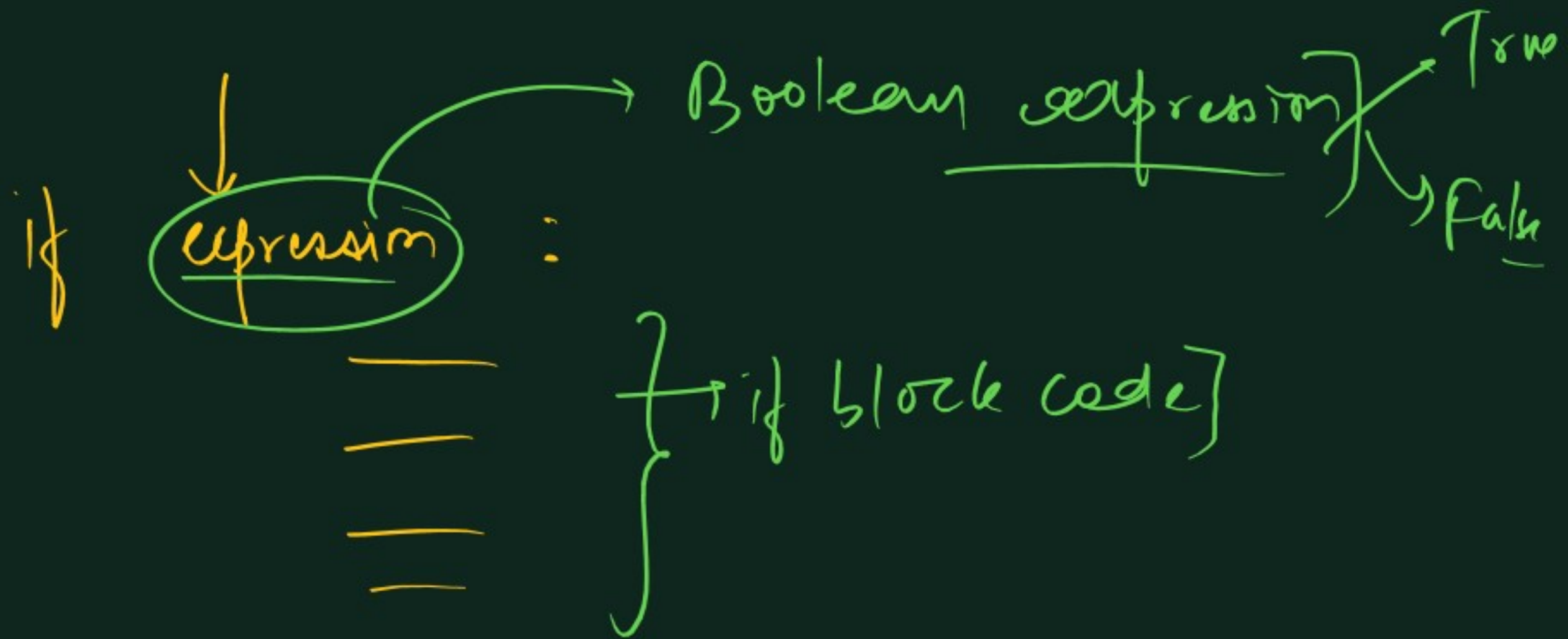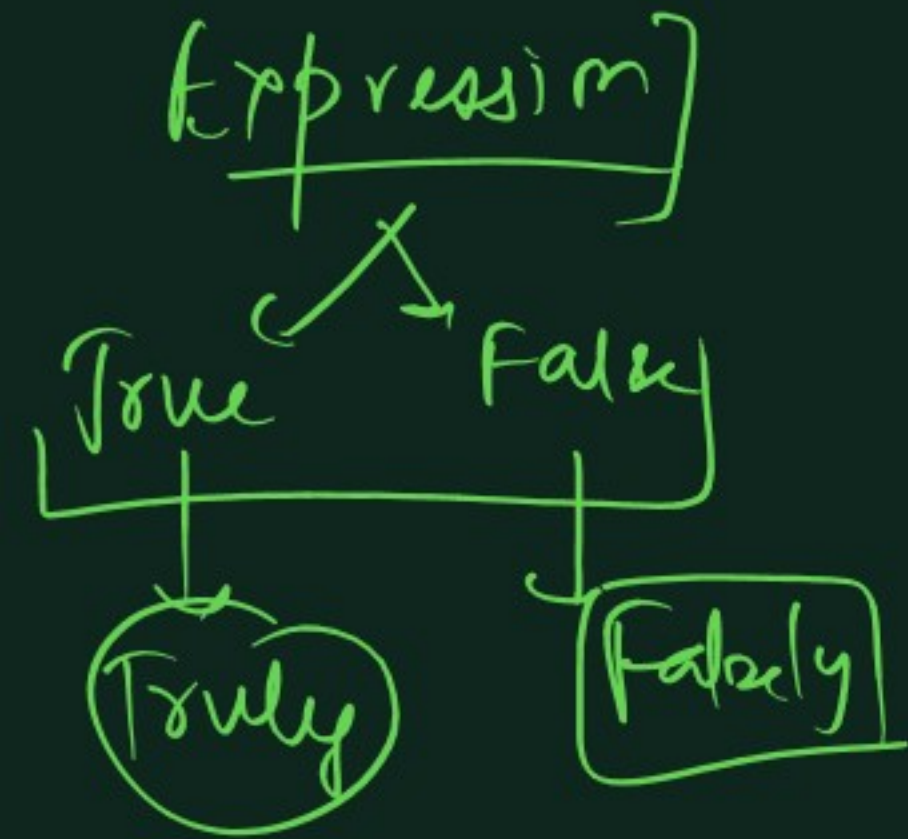
Truly {

`" x " | [ 2 ] | ( 1 ) | { ↓ }`

Falsely] `0 | 0.0 | " " | [ ]`

① range(5) → 0,1,2,3,4]

↳ [0,4]

② rang(2,7) → {2,3,4,5,6}

↳ [2,6]

③ rang $(2, 10, \overset{\rightarrow jump}{3})$

2, 5, 8

④   range (10, 1, $\overset{\text{revun}}{\overset{\curvearrowright}{-R}}$) No q jumps.

$$\{ 10, 9, 8 \quad\rule{3cm}{0.4pt}\quad 2 \}$$

rang (10, 1 -2)

10, 8, 6, 4, 2

```
for i in rang(5):
    print('α')
```

[0, 1, 2, 3, 4]

α
α
α
α
α
___

```python
for i in range(5):
    for j in range(5):
        print("α", end=" ")
    print()
```

α α α α α
α α α α α
α α α α α
α α α α α
α α α α α

α
α
α
α
α
α
α
α

```
for i in range(5):
    print(i*"*")
```

*

** **

* ** *

** ** * **

* * * * *

```python
for i in range(5):
    for j in range(5):
        print("*", end=" ")
    print
```

Call stack

Outer: $i=0$
$\quad\quad\quad\quad\quad\text{inner}$
$i=1$
$\quad\quad\quad\quad\quad j=0$
$\quad\quad\quad\quad\quad j=1$
$\quad\quad\quad\quad\quad j=2$
$\quad\quad\quad\quad j=4$

```
                            →
        ⋆
        ⋆   ⋆
        ⋆   ⋆       ⋆       for i in range(5):    ram(i)   [0]
Outer   ⋆       ⋆              for j in range(i+1):
  i=0
        ↳ (inner)→ 1                print("⋆", end=" ")

  i=1, inner→2                  print()
  i=2  inner=3

  i=3
```

Spiralprinting

of a matrix

$$
\begin{array}{cccc}
1 & 2 & 3 & 4 \\
12 & 13 & 14 & 5 \\
11 & 16 & 15 & 6 \\
10 & 9 & 8 & 7
\end{array}
$$