LAB 3

Topics: Booleans, Boolean Operators, Extra topic - Binary / Op.

Booleans — They are essentially <u>True, False</u>.
In Python they are represented as follows:

$$True \longrightarrow x = True$$
$$False \longrightarrow y = False$$

Boolean Operators — There are three Boolean operators
   And, Or, Not
   In Python, rep. as follows:
      and
      or
      not

Boolean Truth tables — The and, or, not ops. have the
   following truth tables

AND

	a	b	a & b
0	0	0	0
1	0	1	0
2	1	0	0
3	1	1	1

Both a,b must be <u>1</u> (True) for the output
   to be True

OR

	a	b	a | b
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	1

Either a,b must be 1 for the output
   to be true

NOT

a	¬a
0	1
1	0

} Reverses the boolean value.

Extra Topic - Read if interested

Binary - Represented in base 2 ie 0,1

Example - 0000, 0101, ...

Converting from base 2 to base 10 can be done easily

Note: $\overset{2^n}{000}.....\overset{2^2 \, 2^1 \, 2^0}{000}$

The general formula is as follows:

$$Answer_{10} = \sum_{i=0}^{n} k * 2^i$$

↑ Indicates whether a bit is 0 or 1

Example: 0101 $\longrightarrow \sum k * 2^i = (1*2^0) + (1*2^2) = 1 + 4 = \underline{5}$

Always starts at least significant bit (rightmost) and moves left

Bitwise Operators

There are a few bitwise operators:

$\&, |, \wedge, <<, >>$

& (bitwise and)

```
   0100
&  0000
   ----
   0000
```

| (bitwise or)

```
   0100
|  0000
   ----
   0100
```

∧ (exclusive or)

```
   0100
∧  0000
   ----
   0100
```

} output 1 if at least 1 bit is True, but if both are True the output is False!

```
   0100
∧  0100
   ----
   0000
```

<< (Shift logical left) – Moves bits left ($*$)

$1 << 0001 \rightarrow 0010 \ (2^1 * 1)$

>> (Shift arithmetic right) – moves bits right ($//$)
and sign extends

$1 >> 0010 \rightarrow 0001 \ (2/2^1)$

If statements – rep. as follows

if condition: ← Condition must evaluate to True for code to be [r]
   code

If elif (else if) – Identical to if but with elif

if condition:
   code   If if statement is false, then the elif
elif condition: conditional is checked
   code

If elif else – Else statement executed if no condition is True

if condition:
   code
elif condition:
   code
else: } else statement has no conditional statement to eval.
   code }

Examples

```
x = 3
y = 5
if x > 5:
    print("...")
else if x > y:
    print("ok")
else:
    print("ok")
```

```
x = 3
y = 5
if 5 > 3:              ⎫  Both if
    print("...")       ⎬  are executed
if y > 3:              ⎭
    print("ok")
else:
    print("2")
```

```
if 3 > 5:        →   if 3 > 5 and 5 != 6:
    if 5 != 6:              ﹏﹏﹏﹏
        ﹏﹏﹏
```