COMP1021
Introduction to Computer Science

More on Operators

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Outcomes

- After completing this presentation, you are expected to be able to:
  1. Explain the use of the various kinds of Python operators
  2. Write code to represent `True` or `False` using numbers, lists, tuples or strings
  3. Understand operator precedence

Python Operators

- We already know we can do common mathematical things in Python, i.e. `+  –  /  *`

```
print(100 - 25 * 4 + 120 / 5)
```

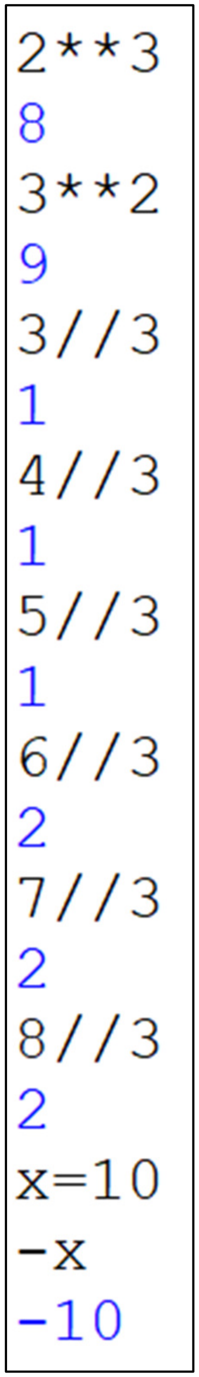
$\Rightarrow$

```
24.0
```

- These things are called *operators*
- This presentation gives you summaries of different types of operators
- You have already used some of them
- We will also look at some related things

Arithmetic Operators

- Basic operators you know:
  `+  -  /  *  %`
- ‘Advanced’ operators:
  `**` means ‘to the power of’
  `//` means ‘do division, return the integer result’
  `-x` means the same as ‘`-1 * x`’



```
2**3
8
3**2
9
3//3
1
4//3
1
5//3
1
6//3
2
7//3
2
8//3
2
x=10
-x
-10
```

Comparison Operators

Reminder

- For comparing two values:

`a < b`	returns `True`	if `a` is less than `b`
`a <= b`	returns `True`	if `a` is less than or equal to `b`
`a > b`	returns `True`	if `a` is greater than `b`
`a >= b`	returns `True`	if `a` is greater than or equal to `b`
`a == b`	returns `True`	if `a` is equal to `b`
`a != b`	returns `True`	if `a` is not equal to `b`

- All of them return `False` otherwise

Logical Operators

Reminder

- Logical operators work with Boolean values, i.e. `True` or `False`

`a and b`	if both condition *a* and condition *b* are True, the result is True; otherwise, it's False
`a or b`	if either condition *a* or condition *b* is True, the result is True; otherwise, it's False
`not a`	if *a* is True, then the result is False; if *a* is False, then the result is True

Summary

Reminder

- Here is a summary of the input and output:

a	**b**	**a and b**	**a or b**	**not a**
`True`	`True`	`True`	`True`	`False`
`True`	`False`	`False`	`True`	`False`
`False`	`True`	`False`	`True`	`True`
`False`	`False`	`False`	`False`	`True`

Using Other Things as True/False

- Any number other than 0 means `True`
- A non-empty list/ tuple/ string means `True`
- The number 0 means `False`
- An empty list `[]`, empty tuple `()` or empty string `""` means `False`

Using Other Things as True/False

This is not an empty string, so Python sees this as `True`

```
if "^o^":
    print("yes")
```

$\Rightarrow$

```
yes
```

Python sees this empty string as `False`

```
if "":
    print("yes")
```

$\Rightarrow$ *nothing is printed*

Using the Equals Sign

- You use the equals sign to put things into a variable, i.e. `age = 25`
- Sometimes you may want to do something like this (adding one to the variable `count`):

```
count = count + 1
```

- When you are doing something to the **same** variable Python has a shortcut, like this:

```
count += 1
```

Using Shortcuts with the Equals Sign

- You can use this method with most operators

- Long way
- Short way

`calories = calories + 800`	⇨	`calories += 800`
`marks = marks - 20`	⇨	`marks -= 20`
`pigs = pigs * 5`	⇨	`pigs *= 5`
`cakes = cakes / students`	⇨	`cakes /= students`
`pattern = pattern % 3`	⇨	`pattern %= 3`

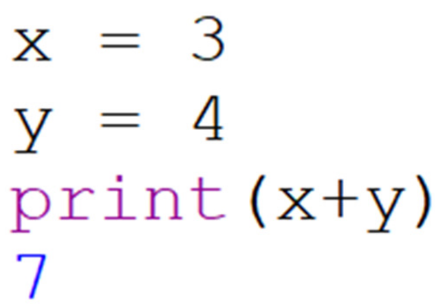
Using Shortcuts with the Equals Sign

• Long way		• Short way
`x = x ** 3`	➡	`x **= 3`
`y = y // 2`	➡	`y //= 2`

Addition

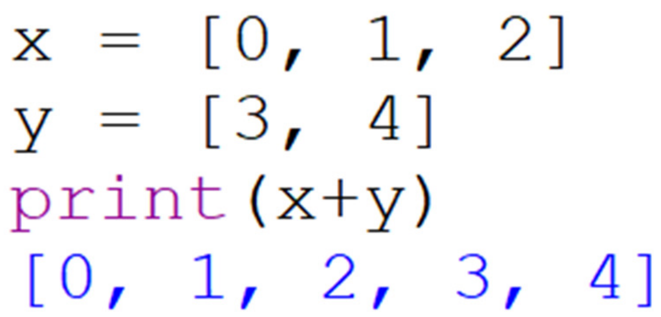
To use addition (+) both the left and right side must be the same type of data

`x + y` If x and y are numbers, the result is the addition of the two things



```
x = 3
y = 4
print(x+y)
7
```

`x + y` If x and y are lists/ tuples/ strings, the result is the concatenation of (=gluing together) the two things



```
x = [0, 1, 2]
y = [3, 4]
print(x+y)
 [0, 1, 2, 3, 4]
```

`in`

- `in` is used by lists/ tuples/ strings:

  `a in x`   returns `True` if `a` is in `x`
             returns `False` if it isn't

```
ages = [20, 19, 22, 19, 21]
print(19 in ages)
True
print(18 in ages)
False
```

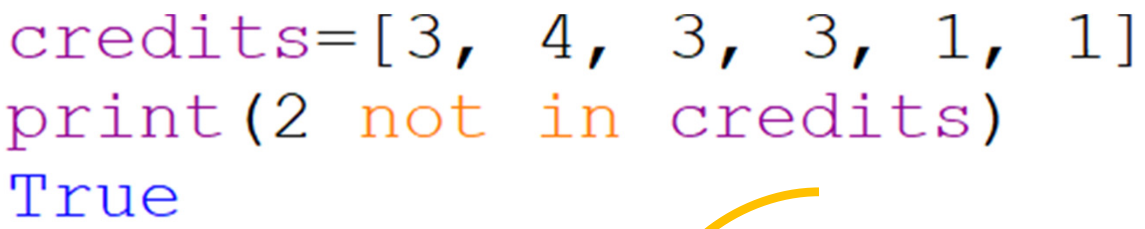
```
text = "baby shark dance"
print("shark" in text)
True
print("dog" in text)
False
```

- `in` also works in dictionaries, see that presentation

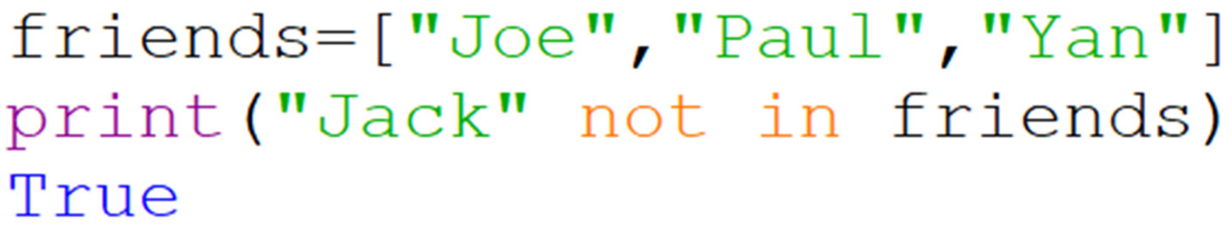
`not in`

- You can put `not` in front of `in`

`a not in x` returns `True` if `a` is not in `x`
returns `False` if it is



```
credits=[3, 4, 3, 3, 1, 1]
print(2 not in credits)
True
```



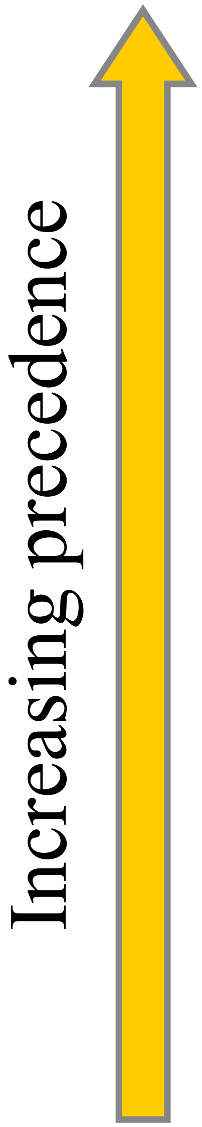
```
friends=["Joe","Paul","Yan"]
print("Jack" not in friends)
True
```

- `not in` also works in dictionaries, see that presentation

Operator Precedence

- If we ask Python to calculate `2 + 3 * 4` what will the result be?
  - You might think the answer is `5 * 4` which is 20
  - You are wrong!
  - This is because `*` has *precedence* over +
  - So `3 * 4` will be calculated first, then the result (12) will be added to 2, so the answer is 14
- If you always use brackets, e.g. `2 + (3 * 4)`, then you don’t need to worry about precedence, but you need to understand what happens when there aren’t any brackets

The Precedence Table



- Highest precedence -

`( )`

`**`

`-x, +x`

`*, /, %, //`

`+, -`

`<, >, <=, >=, !=, ==`

`in, not in`

logical `not`

logical `and`

logical `or`

- Lowest precedence -

So if you use brackets `()` *they override everything*

Precedence Example 1

```
x = 17 / 2 * 3 + 2
```

- / and * have higher precedence than +, so they are handled first
- / and * have equal precedence, so the one on the left (/) is evaluated first

- So the answer is:

```
=((17/2) * 3) + 2
= 27.5
```

Precedence Example 2

```
x = 19 % 4 + 15 / 2 * 3
```

- `%`, `/` and `*` have higher precedence than +, so they are handled first
- `%`, `/` and `*` have equal precedence, so the one on the left is evaluated first, which is `%`, then `/`, then `*`

- So the answer is:

```
=(19%4) + ((15/2)*3)
= 25.5
```

Precedence Example 3

```
x = 17 / 2 % 2 * 3**3
```

- `**` has a higher precedence than the others, so it is handled first
- `/`, `%`, and `*` have equal precedence, so the one on the left (`/`) is evaluated first, then `%`, then `*`

- So the answer is:

```
=((17/2)%2)*(3**3)

=((17/2)%2)*   27

= 13.5
```

Precedence Example 4

- Highest precedence -

. . .

logical `not`

logical `and`

logical `or`

- Lowest precedence -

```
english_is_spoken = True
need_visa = False
married_to_singapore_person = False
want_to_visit_singapore = True
visit_singapore = english_is_spoken \
  and not need_visa or married_to_singapore_person \
  and want_to_visit_singapore
print(visit_singapore)
```

- What is printed?

Precedence Example 4

- Highest precedence -

. . .

logical `not`

logical `and`

logical `or`

- Lowest precedence -

```
english_is_spoken = True
need_visa = False
married_to_singapore_person = False
want_to_visit_singapore = True
visit_singapore = (english_is_spoken \
   and (not need_visa)) or (married_to_singapore_person \
   and want_to_visit_singapore)
print(visit_singapore)
```

- Here brackets are added to indicate the structure

```
(True and (not False)) or (False and True)
```

Precedence Example 4

```
(True and (not False)) or (False and True)
   = (True and True) or (False and True)
                 = True or False
                      = True
```

```
english_is_spoken = True
need_visa = False
married_to_singapore_person = False
want_to_visit_singapore = True

visit_singapore = (english_is_spoken \
  and (not need_visa)) or (married_to_singapore_person \
  and want_to_visit_singapore)
print(visit_singapore)
```

- Here brackets are added to indicate the structure