COMP1021
Introduction to Computer Science

More on Operators

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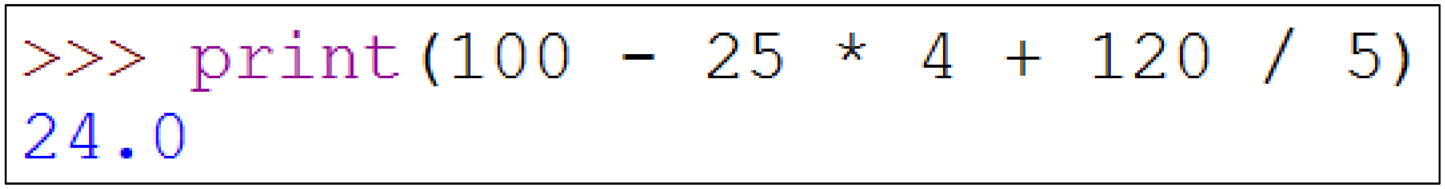
Outcomes

- 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. Apply operator precedence in expressions

Python Operators

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



```
>>> print(100 - 25 * 4 + 120 / 5)
24.0
```

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

Arithmetic Operators

- Basic operators:

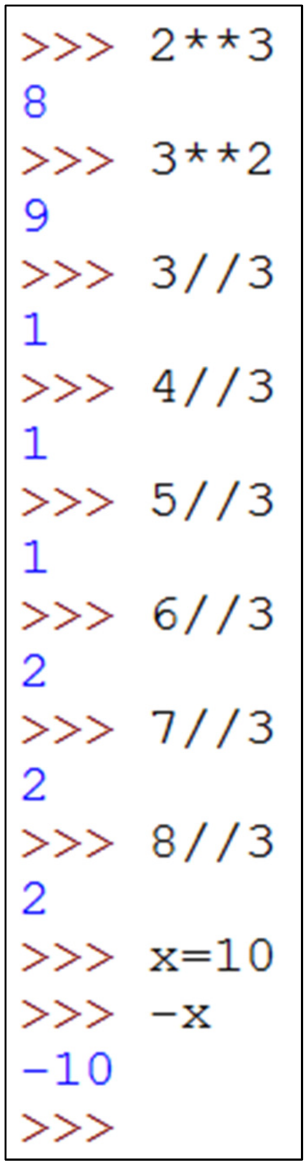
  `+ - / * %`

- '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

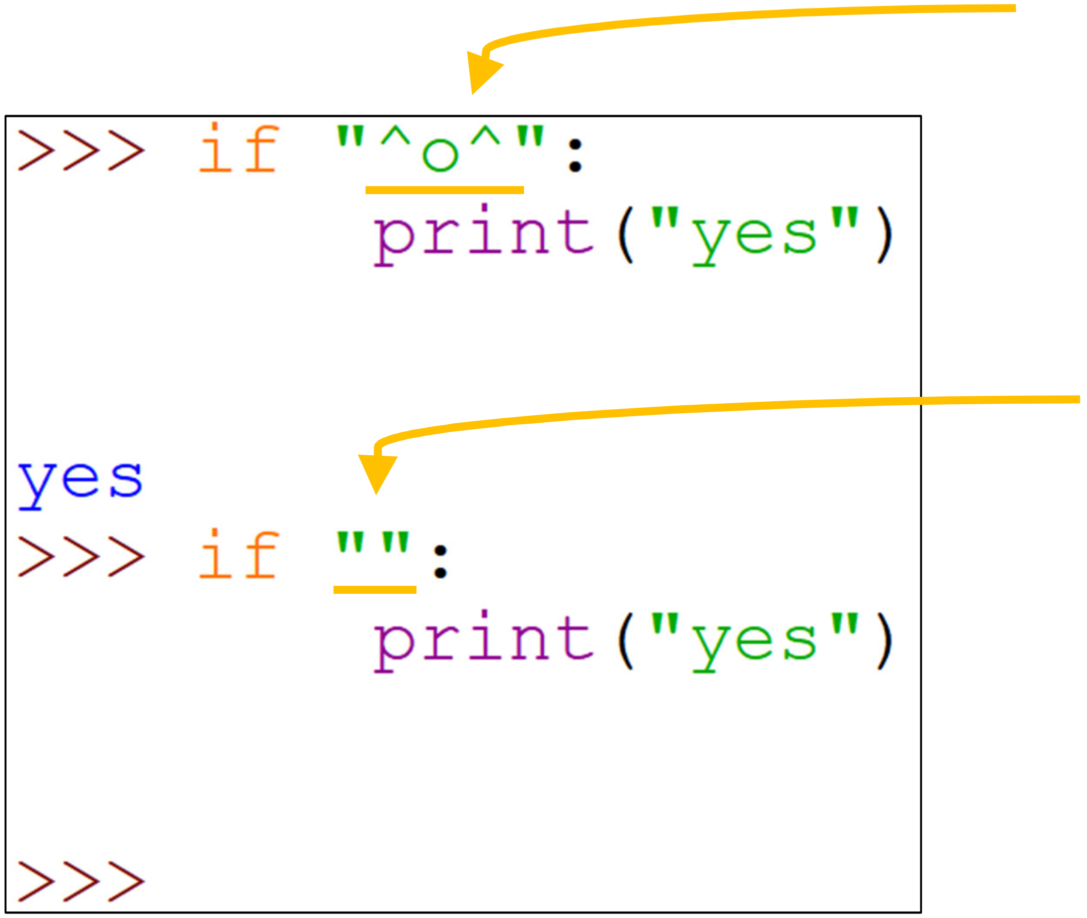
- Here is a summary of the input and output:

`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

- In Python:
  - Any number other than 0 means `True`
  - 0 means `False`
- An empty list `[]`, tuple `()` or string `""` means `False`
  - Non-empty means `True`

Using Other Things as True/False



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


yes
>>> if "":
        print("yes")



>>>
```

Python sees this as `True`

Python sees this empty string as `False` *so 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 the equals sign with most arithmetic operators, for example:

```
calories = calories + 800     ➡   calories += 800
pigs = pigs * 5               ➡   pigs *= 5
cakes = cakes / students      ➡   cakes /= students
marks = marks - 20            ➡   marks -= 20
hello = hello + "!"           ➡   hello += "!"
```

As you can see, this works for strings too, not just numerical values

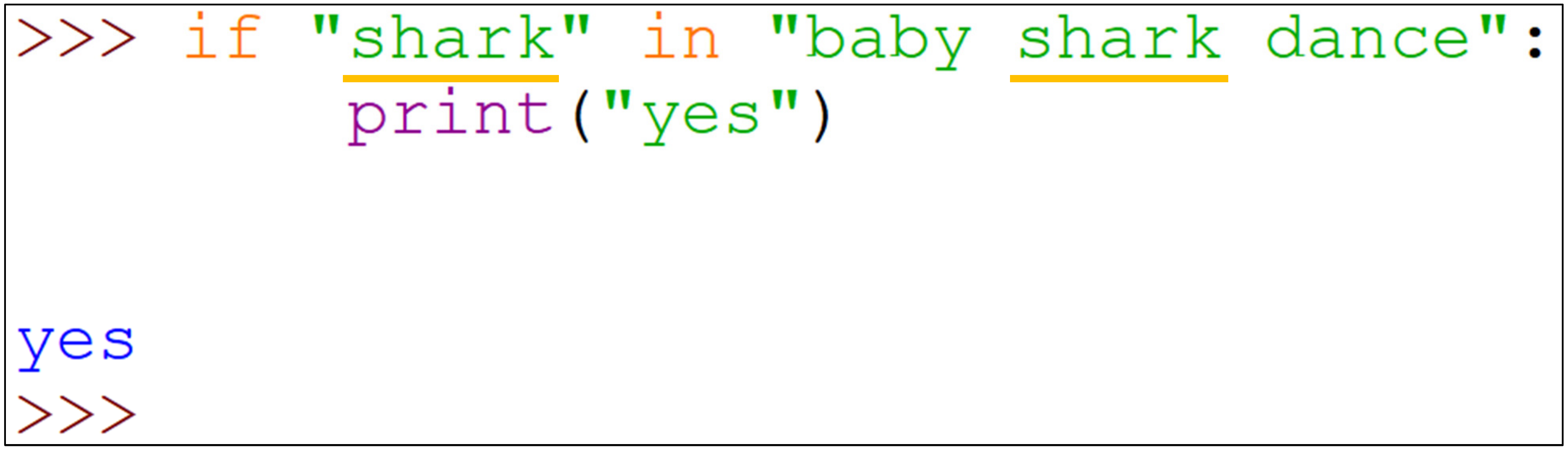
Operators for Lists, Tuples and Strings

- These operators are used by lists, tuples and strings:

`x + y`	concatenates (=put together) two lists, tuples or strings
`x * n`	concatenates `n` copies of `x`
`a in x`	returns `True` if `a` is in collection `x` and `False` otherwise
`a not in x`	returns `False` if `a` is in collection `x` and `True` otherwise

Using ‘in’ with Strings

- Using the `in` operator you can test for a string inside another string, like this:



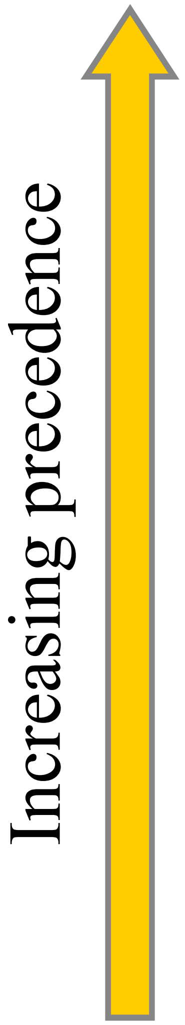
```
>>> if "shark" in "baby shark dance":
        print("yes")


yes
>>>
```

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

```
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)
```

- Highest precedence -

. . .

logical `not`

logical `and`

logical `or`

- Lowest precedence -

- What is printed?

Precedence Example 4

```
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)
```

- Highest precedence -

. . .

logical `not`

logical `and`

logical `or`

- Lowest precedence -

- Here brackets have been added to indicate the order

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

Precedence Example 4

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

```
(True and (not False)) or (False and True)
   = (True and True) or (False and True)
                = True or False
                      = 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 have been added to indicate the order