COMP1021
Introduction to Computer Science

Handling of Data Types

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Outcomes

- After completing this presentation, you are expected to be able to:
  1. Explain the various data types in Python
  2. Write code to check the data types of variables
  3. Convert between some of the data types

Data Types in Python

- Data types mean the 'type' of things that you store inside variables
- For example, if you run this line of code:

```
mynumber = 5
```

we say that the variable has an *integer* data type because it stores an integer value (5)

Data Types You Have Used So Far

- You have used the following data types:
  - Numbers
    - Integers, a number with no decimal place e.g. `1` and `5`
    - Floats (=floating point numbers), a number with a decimal place e.g. `1.2` and `3.14`
  - Sequences
    - Lists, e.g. `[1, 0, 2, 1]`
    - Tuples, e.g. `(200, 100)`
    - Strings, e.g. `"I am a piece of text!"`
  - Booleans, i.e. `True` or `False`
    - (Later we will see another data type, a *dictionary*)

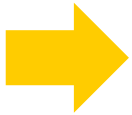
A Float

- A float (=floating point number) is called that because it contains a decimal place which can ‘float’ (move around)
- For example, you could say these are all the same number, it is only the decimal place which has moved:
  - 10.458
  - 1045.8
  - 1.0458
- Even if the digit after the decimal place is a zero it is still a float e.g. this is a float: 2.0

Knowing the Data Type

- You can use `type` to tell you the data type of the thing stored in a variable, some examples:

```
number_of_dogs = 1
print(type(number_of_dogs))
```



```
<class 'int'>
```

An integer

```
age_of_my_dog = 1.5
print(type(age_of_my_dog))
```

```
<class 'float'>
```

A float

```
name_of_my_dog = "Toffee"
print(type(name_of_my_dog))
```

```
<class 'str'>
```

A string

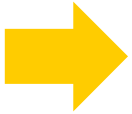
More Data Types

```
i_am_a_frog = False
print(type(i_am_a_frog))
```

```
<class 'bool'>
```

A boolean

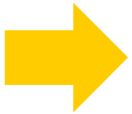
```
my_cats = ("Charlie", "Popcorn", "Kitty")
print(type(my_cats))
```



```
<class 'tuple'>
```

A tuple

```
cat_ages = [2.5, 9, 5]
print(type(cat_ages))
```



```
<class 'list'>
```

A list

Checking Data Type

- Sometimes it is useful to make sure the data type is correct before you run some code
- Here is an example function `double()`

Checking the data type of variable `x`

```
def double(x):
    if type(x) == int or type(x) == float:
        print( 2 * x )
    else:
        print("Hey, give me a number!")
```

- The function doubles the given number but prints an error if the input `x` is not a number

Running the Example

- You can test the function in the previous slide by using different input values

```
double(5)                  ➡  10
double(7.2)                ➡  14.4
double("flower")           ➡  Hey, give me a number!
double([200])              ➡  Hey, give me a number!
```

A list

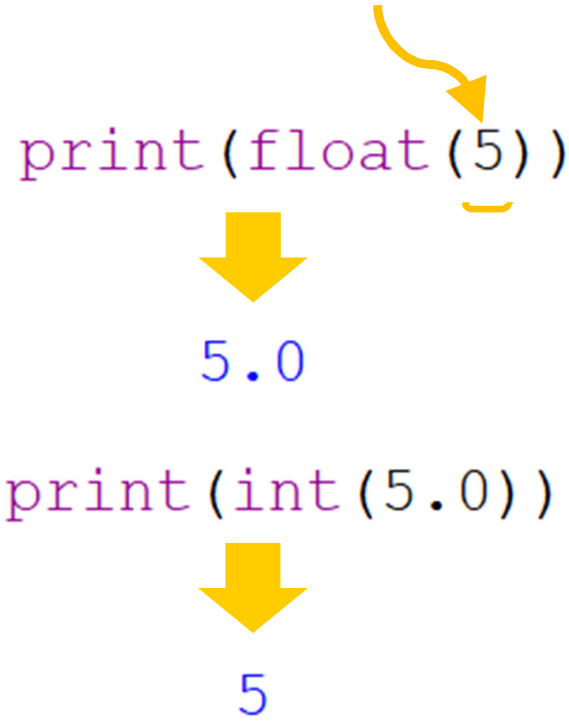
Data Type Conversion

- Some code may generate errors when the correct data type is not being used
- Some Python code may have a different behaviour when it is used with different data types
- E.g. using '+' with two numbers means addition; using '+' with two lists/tuples/strings means 'gluing' the two things together
- So sometimes it's wise to check that the data types are appropriate before the data is used
- You may need *data type conversion*

Converting Between Numeric Data Types

- You have used two types of numeric data: integers and floats (=floating point numbers)
- To convert from an integer to a floating point number you use `float()`
- To convert from a floating point number to an integer you use `int()`

Python thinks a number is an integer if it doesn't have a decimal point; otherwise it's a float

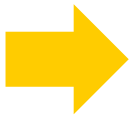


Storing as an Integer or a Float

- For a numeric value 5, Python displays it as '5' when it is stored as an integer
- For the same value 5, Python displays it as '5.0' when it is stored as a float

The number is stored as an integer

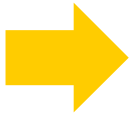
```
mynumber = int(5)
print(mynumber)
```



```
5
```

The number is stored as a float

```
mynumber = float(5)
print(mynumber)
```



```
5.0
```

Converting from Numbers to Strings

- When you need to display a number you typically need to convert the number to a string before you can put the number together with other text
- You use the `str()` function to convert a number to a string, for example:

```
age = 21
print("I am " + str(age) + " years old!")
```

```
I am 21 years old!
```

Converting from Numbers to Strings

```
print("Just like 1+1 is", 1+1, "my heart for you is", True)
```

```
Just like 1+1 is 2 my heart for you is True
```

- `print()` is clever, it can print almost anything
- However, `turtle.write()` is not so clever
- For example, this doesn't work:

```
turtle.write("Just like 1+1 is", 1+1, "my heart for you is", True)
```

- You can fix it like this:

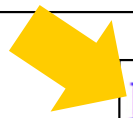
This means the code continues on the next line

```
turtle.write("Just like 1+1 is "+str(1+1) \
             +" my heart for you is "+str(True))
```

Converting From Strings to Numbers

- You can use the `int()` function to convert a string to an integer
- You can use the `float()` function to convert a string to a floating point number
- For example, you need to do that after you ask a user for number input using the `input()` function:

```
age = input("How old are you? ")
age = int(age)
print("You look like a "+ str(age*2) + "-year-old to me!")
```



```
How old are you? 21
You look like a 42-year-old to me!
```

Possible Problem When You Convert a Number to an Integer

- You need to be careful when you convert a string to an integer
- In Python you will get an error if the string contains a decimal point and you use `int()`

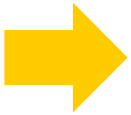
```
age = "21.5"
age = int(age)
```

```
Traceback (most recent call last):
  File "C:/Users/dross/OneDrive/Documents/00_teaching/1021/datatype1.py", line 56, in <module>
    age = int(age)
ValueError: invalid literal for int() with base 10: '21.5'
```

A Safer Approach

- A safer approach to convert a string to an integer is:
  - First, convert the string to a floating number
  - Then, convert the floating number to an integer
- Here is an example:

```
age = "21.5"
age = int(float(age))
print(age)
```



```
21
```

When a Float is Converted to a String

- Sometimes when converting a number to a string the result may not be what you expect
- For example, if the number is stored as a floating point number you will have a decimal place in the resulting string:

Because there is a '.0' at the end it means this is a floating point number

```
age = 21.0
print("I am " + str(age) + " years old!")
```

```
I am 21.0 years old!
```