Introduction to Data Types and Data Structures

Aims of the Lecture

- Learn and understand the different data types and data structures contained in Python.
- Exemplify practical uses of each type and structure.

Additional Reading and Sources

- Real Python (https://realpython.com/python-data-types/)
- Data Flair (https://data-flair.training/blogs/python-number-types-conversion/)

Number Types

- Integers
- Booleans
- Float

Integers

- The most basic data type in Python.
- A number by default is an integer if no decimal value is specified.
- The *type()* function can be used to discover the type of a variable or a number.
- You can use comparison operators to evaluate integer values.

In [44]:
```
type(3)
```

Out[44]:
```
int
```

In [10]:
```
## Writing exponential numbers
2e5
```

Out[10]:
```
200000.0
```

In [50]:
```
x=3
print(type(x))
```

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

In [29]:
```
# See if two ints are equal
3==5
```

Out[29]: True

In [31]:
```
# See if two ints are not equal
3!=5
```

Out[31]: True

In [65]:
```
# See if a number is smaller than another
3<5
```

Out[65]: True

In [66]:
```
# See if a number is smaller or equal to another
3<=5
```

Out[66]: True

In [68]:
```
# See if a number is larger than another
3>5
```

Out[68]: False

In [69]:
```
# See if a number is larger or equal to another
##3>=5
```

Out[69]: False

Booleans (logical operators)

- Notice that we have obtained *True* and *False* as results.
- These results are also data, and they belong to the *boolean* (bool in Python) type.

In [22]:
```
type(True)
```

Out[22]:
```
bool
```

In [70]:
```
z = True
print(type(z))
```

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

Float

- Is how we call decimals in Python.
- Up to 15 decimal places.

In [5]:
```
y=6.9128973981278474987298 7
```

In [6]:
```
type(y)
```

Out[6]:
```
float
```

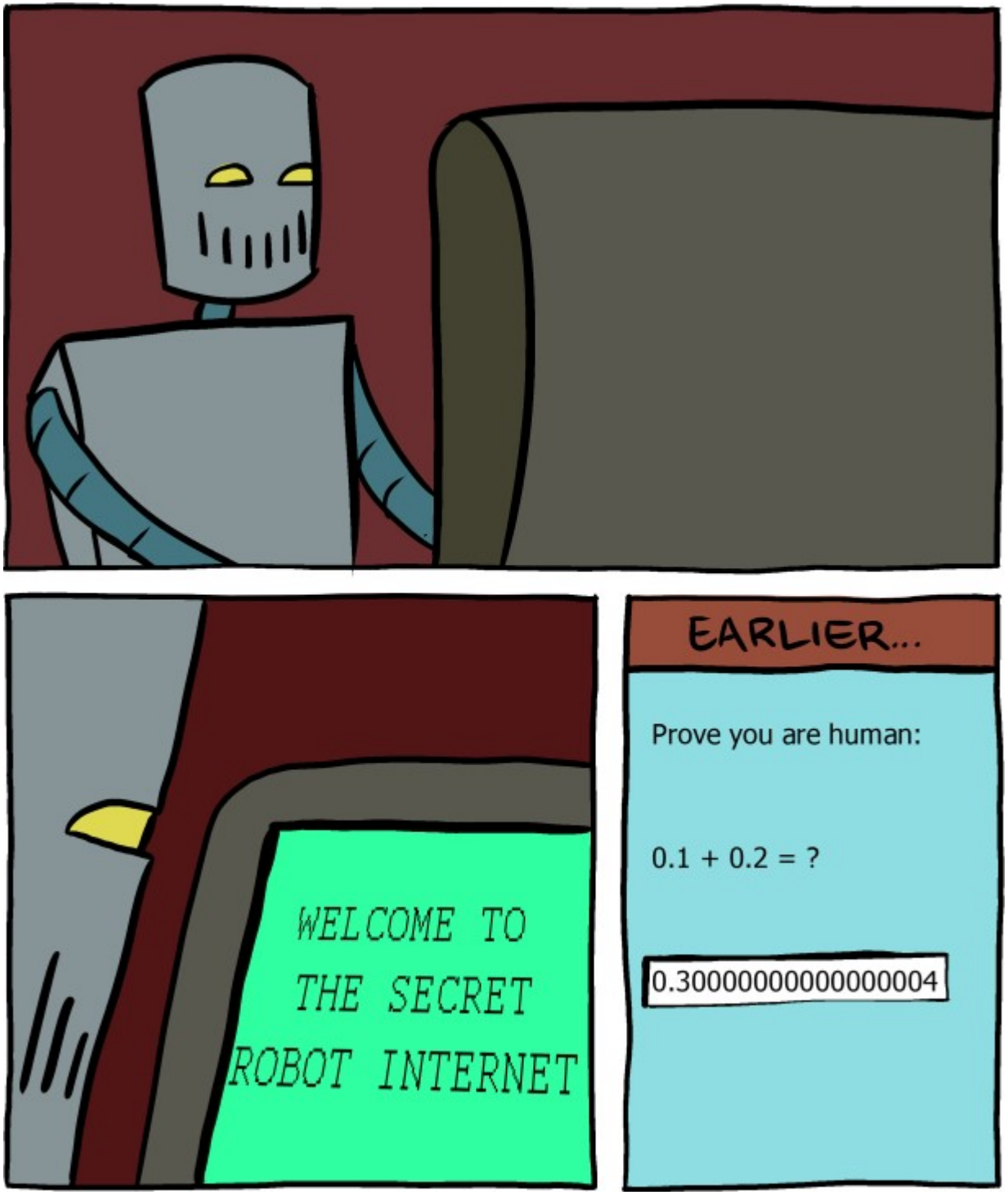
In [20]:
```
# If more than 15 decimal places are used, python truncates
7.07893492368947398473989723489742389 47
```

Out[20]:
```
7.078934923689474
```

In [32]:
```
# We can also compare floats, but funny things may happen!
1.1+2.2==3.3
```

Out[32]:
```
False
```

Do you know why?


WELCOME TO
THE SECRET
ROBOT INTERNET
EARLIER...
Prove you are human:
0.1 + 0.2 = ?
0.30000000000000004

The *isinstance()* function

- Now that we know (at least) two data types, we can see how this function works.
- The function takes two *inputs/arguments*, the variable containing the data and the type to be tested.
- Let's see if x and y contain integers.

In [21]:
```
isinstance(x,int)
```

Out[21]:
```
True
```

In [7]:
```
isinstance(y,int)
```

Out[7]:
```
False
```

You can also work with complex, binary, octal and hexadecimal numbers in Python, but no need to stress! (this is not a maths class...)

Strings

- You can store letters and words in a variable.
- Strings are defined using quotations (single or double).

In [34]:
```
a = 'Hi'
print(a)
```

```
Hi
```

In [48]:
```
# Any number inside quotations becomes a string
c = "45"
print(c)
```

```
45
```

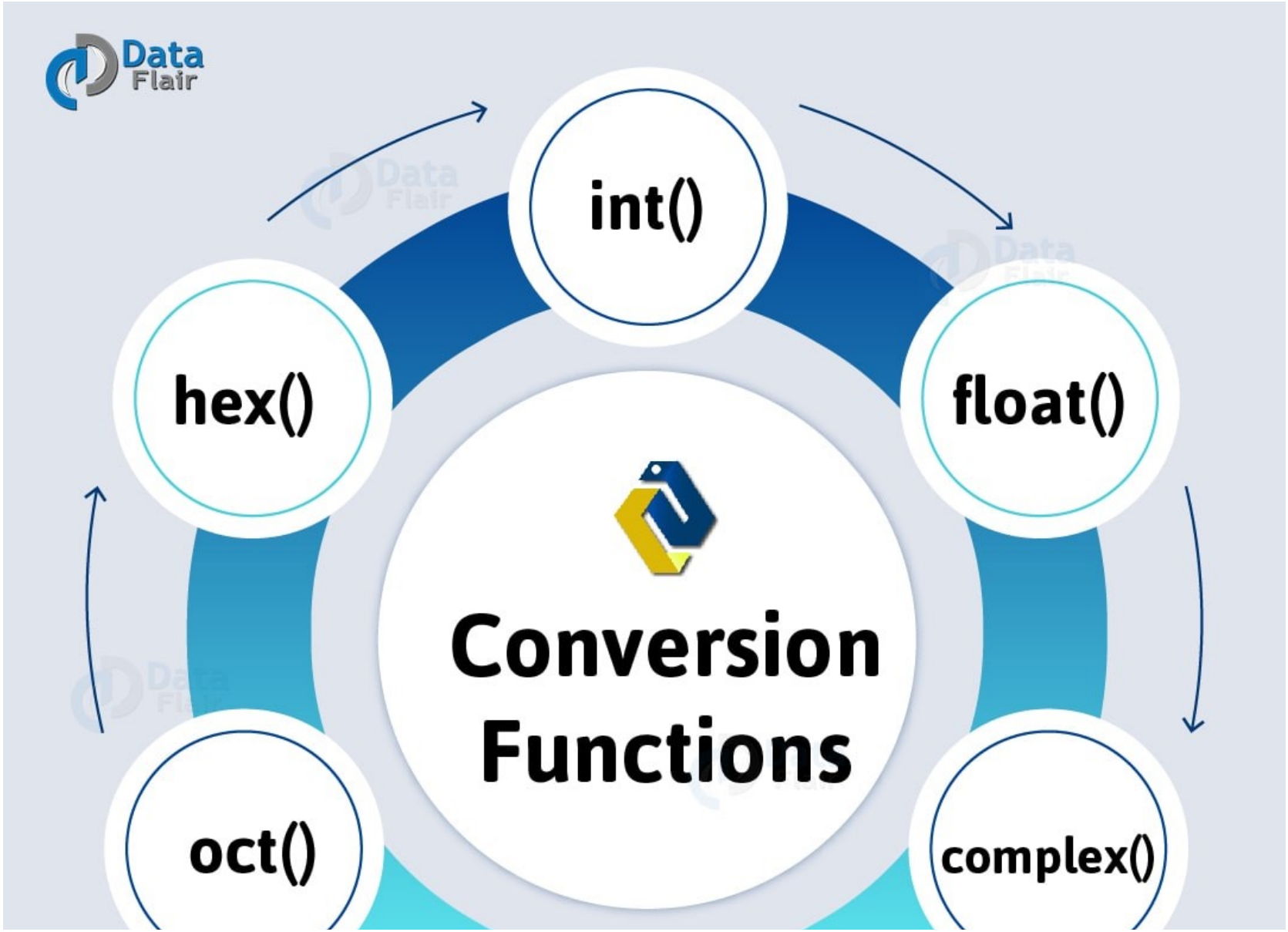
In [47]:
```
# A boolean inside quotations becomes a string
b = "True"
print(b)
```

```
True
```

In [49]:
```
print(type(a),type(a),type(a))
```

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

Conversion Functions


Data Flair
int()
float()
complex()
oct()
hex()
Conversion Functions

In [24]:
```
# the int() function can convert any number into an integer.
# Mostly used to round floats
int(7.8)
```

Out[24]:
```
7
```

In [13]:
```
# Converting booleans into ints
int(True)
```

Out[13]:
```
1
```

In [14]:
```
# float function adds a 0 decimal to an int
float(9)
```

Out[14]:
```
9.0
```

In [15]:
```
# bool() turns any number to TRUE (other than 0)
bool(8)
```

Out[15]:
```
True
```

In [16]:
```
bool(0)
```

Out[16]:
```
False
```

Data Structures

Tuples

- **IMMUTABLE** collection of elements.
- Defined using parenthesis and separating elements with commas.
- Not all elements in a tuple have to be of the same type.

In [52]:
```
tuple1 = (1,2,3)
tuple1
```

Out[52]:
```
(1, 2, 3)
```

In [57]:
```
tuple2 = (1,'g',4.4,True)
tuple2
```

Out[57]:
```
(1, 'g', 4.4, True)
```

Lists

- **MUTABLE** collection of elements.
- Defined using squared brackets and separating elements with commas.
- Not all elements in a tuple have to be of the same type.

In [54]:
```
list1 = [1,2,3]
list1
```

Out[54]:
```
[1, 2, 3]
```

In [59]:
```
list2 = [1,'g',4.4,True]
list2
```

Out[59]:
```
[1, 'g', 4.4, True]
```

The *len()* function

- We can learn how many elements are contained in a tuple or in a list by using this function.

In [56]:
```
len(tuple1)
```

Out[56]: 3

In [60]:
```
len(list2)
```

Out[60]: 4

Accessing an element in a tuple/list

- We can access to all positions in a tuple/list by using squared brackets **after** the tuple/list.
- **Indexes in Python begin in 0!**

In [62]:
```
print(list1)
# Access the first element of list1
list1[0]
```

```
[1, 2, 3]
```

Out[62]:
```
1
```

In [64]:
```
print(tuple2)
# Access the second element of tuple2
tuple2[1]
```

```
(1, 'g', 4.4, True)
```

Out[64]:
```
'g'
```

Why do we need two very similar structures such as tuples and lists?