HKUST Future-Ready Scholars

Introduction to Game Programming using Python

Part 1: Number Guessing Game

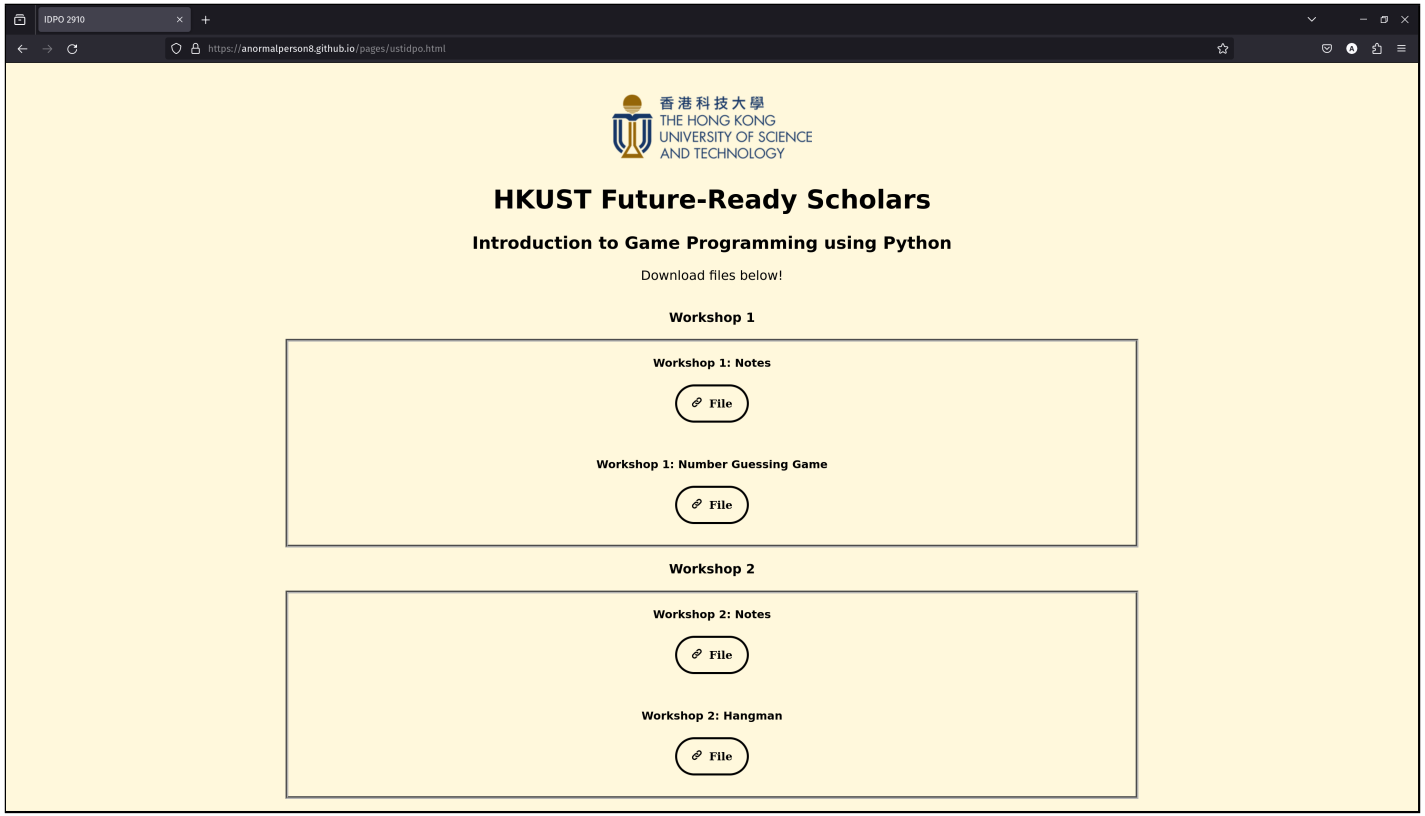
20 April 2024

Google Colab

We will use Google Colab for the workshops.
https://colab.research.google.com/
You must have a Gmail account for it, create one if you do not.

Files

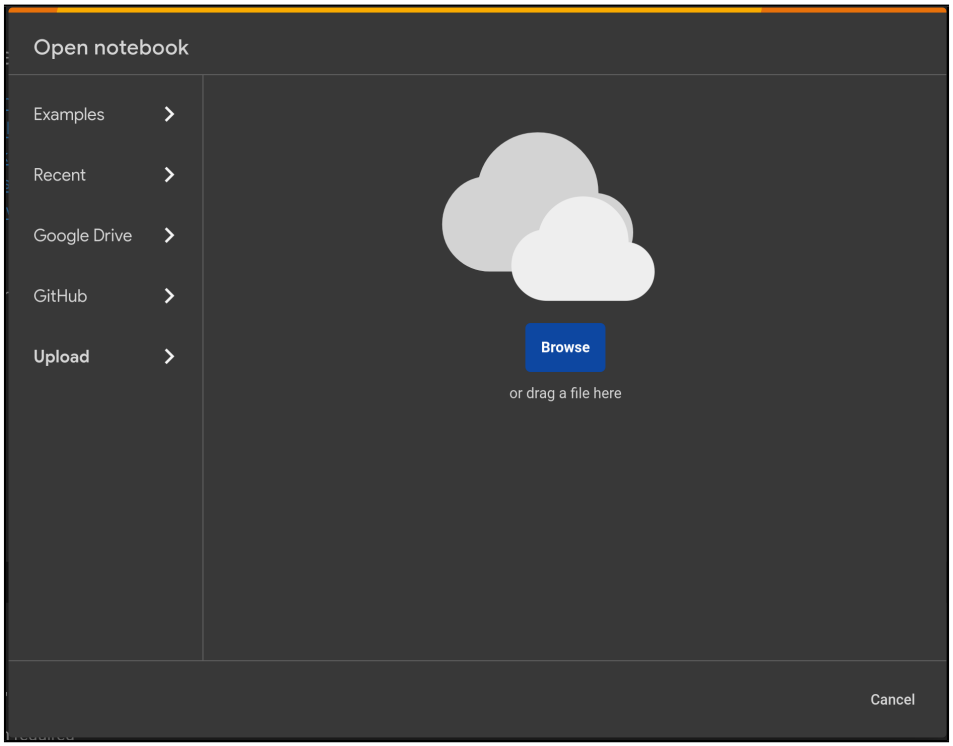
All materials today are at:
https://bit.ly/ustidpo



Download all files that belong to **Workshop 1** today.

Jupyter Notebook

Now upload your Jupyter Notebook file with **Files** → **Open Notebook**.



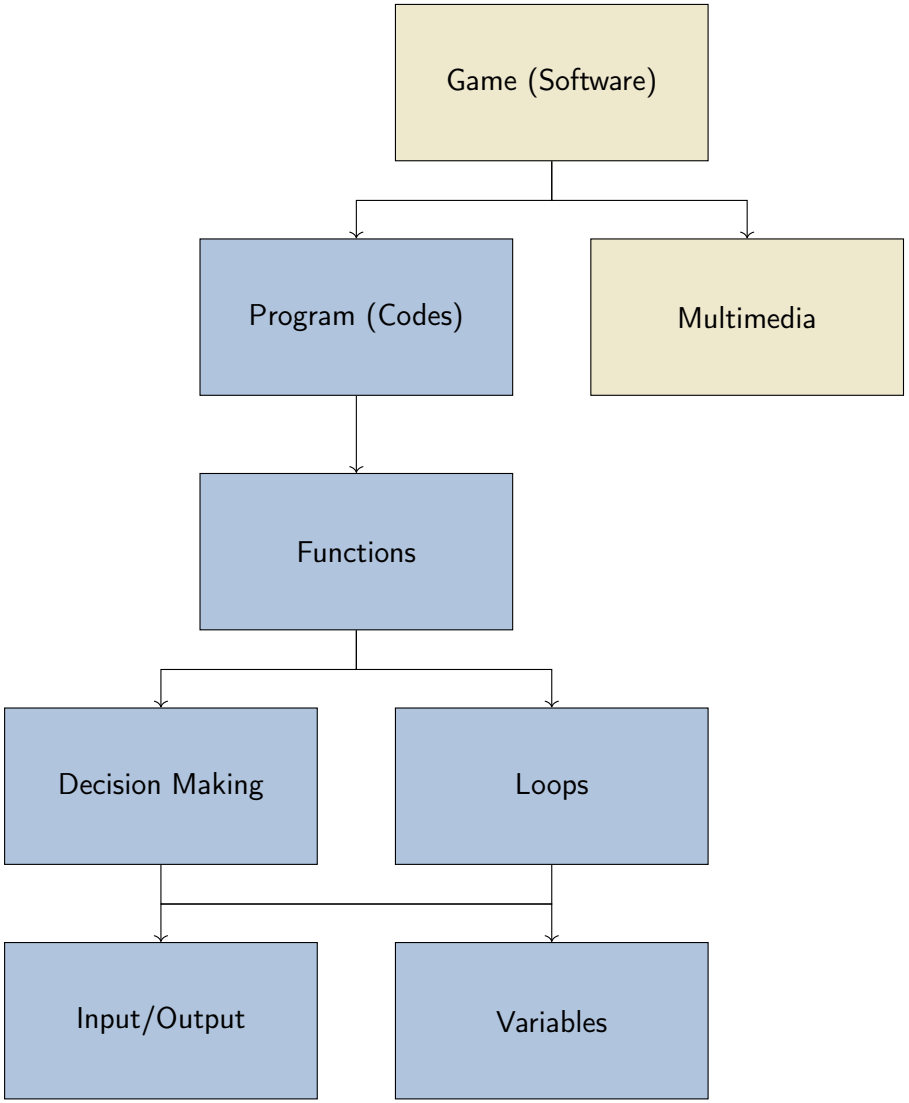
Upload the file **Number-Guessing.ipynb**.

Using Jupyter Notebook

You can type your code in these blocks. We call these blocks code cells.

You can run a code cell with the button on the left.

World of Game Coding

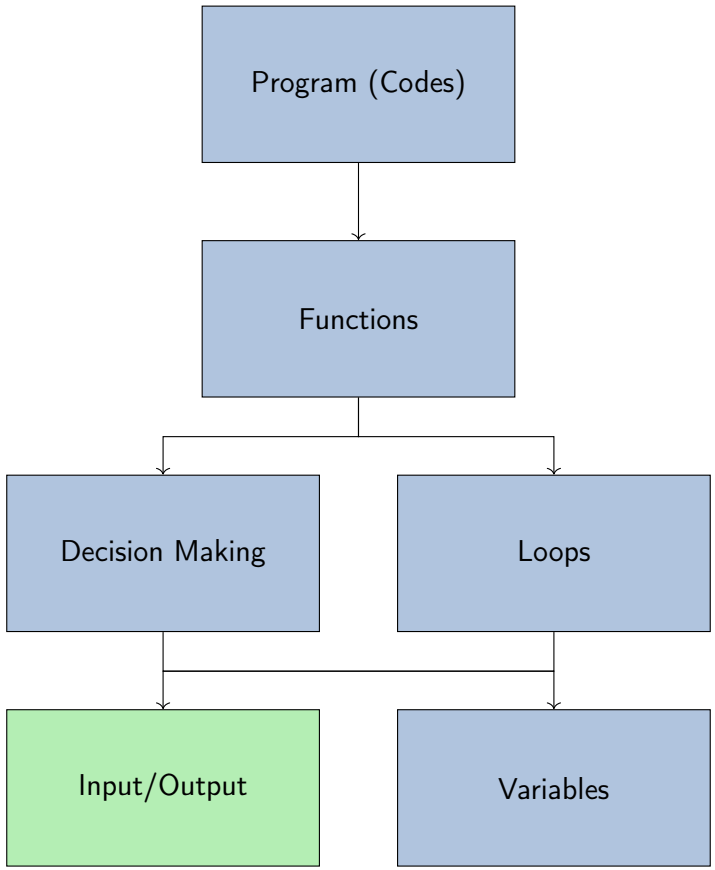


What is Python?

Did you know? Python was made by someone who was bored.
It's a language designed to be almost as understandable as English.
You will be using Python 3. Why? Because Python 1 are 2 are too old.

This is the logo of Python.

Contents


Program (Codes)
Functions
Decision Making
Loops
Input/Output
Variables

The first thing in Python - `print()` function

```
print("This is the print function.")
```

The first thing in Python - `print()` function

`print()` is a function that lets you print something, also known as text output.

```
print("Word") # This prints the word "Word".
```

Examples:

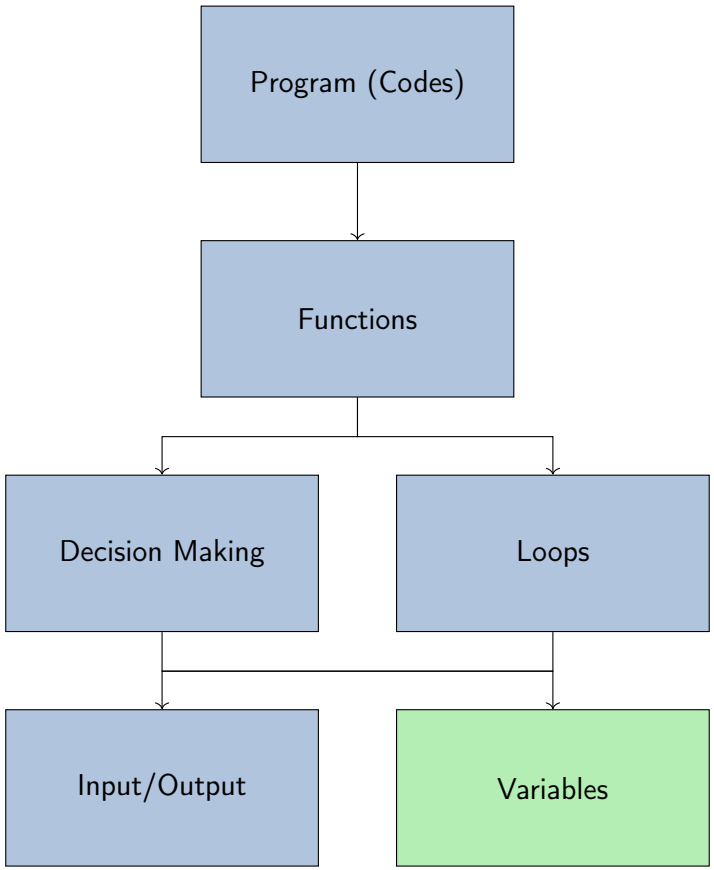
```
>>> print("Hello World")
Hello World
>>> print("Haha hehe")
Haha hehe
```

Printing multiple things

You can use a comma (,) to separate different things with a space.

```
>>> print("Alpha", "Beta", "Gamma")
Alpha Beta Gamma
>>> print("Haha", "hehe")
Haha hehe
```

Contents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Variables

Imagine you borrow a box from the computer.

Give it a name and a value, you can now recall this value with the name!

Variables

The code usually goes:
`variable_name = data`
This means whatever `data` is, it is now stored in a variable with name `variable_name`.

Some basic variable types:

```
a = 5       # This is an integer (int) stored in a
b = True    # This is a boolean (bool) stored in b
c = 3.2     # This is a float (float)  stored in c
d = "abc"   # This is a string (str)   stored in d
e = 'abc'   # This is also a string    stored in e
```

Variables - Integers

What are integers?
Integers are just like what you've learnt in Maths, numbers without decimal points. Are the following valid?

```
a = 5          # Valid
b = 12         # Valid
c = 69420      # Valid
d = -1984      # Valid
e = 32.5       # This would become a float instead
f = '5'        # This would become a string instead
```

Variables - Integer Arithmetic Operations

You can do normal operations on integers:

```
a = 1 + 2   # a stores the integer 3
b = 80 - 52 # b stores the integer 28
c = 69 * -2 # c stores the integer -138
d = 6 / 4   # d stores the float 1.5
e = 18 / 2  # e stores the float 9.0
```

Division in Python

Whether a number can be precisely divided or not, division returns a `float`.

Variables - Integer Arithmetic Operations

Operations with variables:

```
a = 100
b = 12
c = a + b    # c stores the integer 112
d = b - a    # d stores the integer -88
e = a * -b   # e stores the integer -1200
f = a / b    # f stores the float 8.333333333333334
```

Variables - Integer Arithmetic Operations

Then how do we get an integer output?

```
a = 100
b = 12
c = a // b  # c stores the integer 8
            # // operator takes the closest and smaller
            # integer from the division operation
d = a % b   # d stores the integer 4
            # % operator takes the remainder of a
            # division operation
```

Variables - Integer Arithmetic Operations

Also, the power (exponent) operation:

```
a = 2
b = 5
c = a ** b  # c stores the integer 32
            # ** operator means power
```

Variables - Floats

What are floats?
Floats are numbers with decimal points.
Arithmetic operators we learnt can be applied as well.

```
a = 0.2      # a stores the float 0.2
b = 3.0      # b stores the float 3.0
c = a + b    # c stores the float 3.2
d = b / a    # d stores the float 15.0
e = a ** b   # e stores the float 0.008000000000000002
```

Inaccuracies

Inaccuracies happen with decimals in Python. Be careful when dealing with floats.

Variables - Floats

What happens when you combine floats and integers?

```
a = 0.2      # a stores the float 0.2
b = 3        # b stores the integer 3
c = a + b    # c stores the float 3.2
d = b / a    # d stores the float 15.0
e = a ** b   # e stores the float 0.008000000000000002
```

Arithmetic operations between `int` and `float`

Arithmetic operations between integers and floats converts the integer into a float first before operating.

Variables - Boolean values

What are boolean values?
There are only 2 boolean values in existence: `True` and `False`.

```
a = True
b = False
```

We will elaborate more on boolean values later.

Variables - Strings

What are strings?

```
a = "word"  # a stores the string "word"
b = 'word2' # b stores the string "word2"
c = '5.20'  # c stores the string "5.20"
d = 'abc"   # error
```

Quotes

In Python you must use corresponding quotation marks for strings.

Variables - Strings

How do I put the symbols ' and " into a string?
For ":

```
a = "word\"" # a stores the string "word""
b = 'word"'  # b stores the same string as a
```

Same goes for single quotes ':

```
a = 'word\'' # a stores the string "word'"
b = "word'"  # b stores the same string as a
```

Variables - Strings

There are additional symbols in strings.

```
a = "word\n" # \n represents the newline character
b = "word\t" # \t represents the tab character
```

Variables - Strings

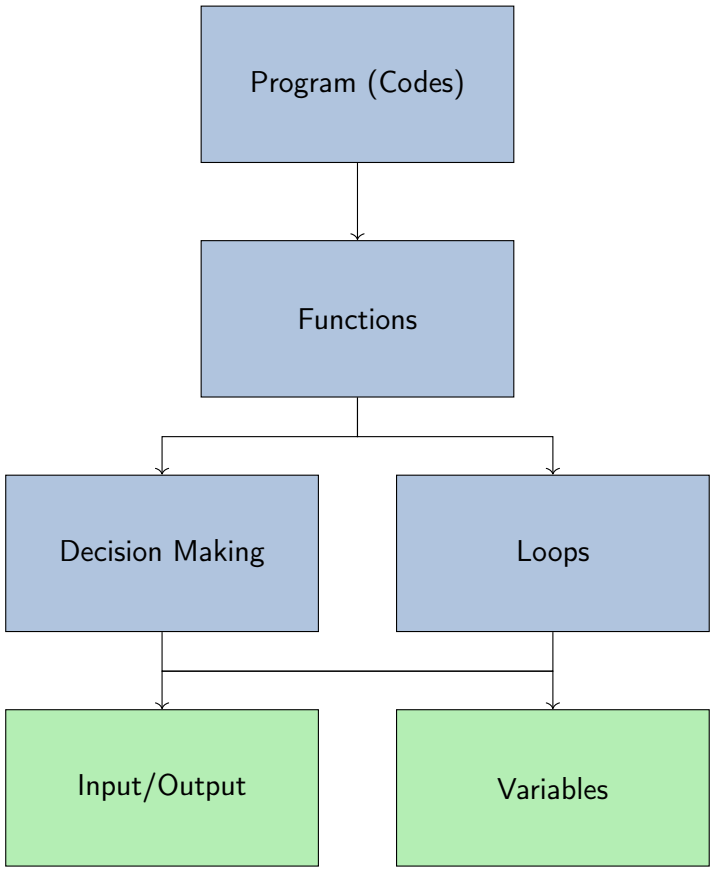
Example:

```
a = "haha"
b = "hehe"
c = a + b     # c stores the string "hahahehe"
```

Concatenation of strings

You can concatenate (add) strings together with the addition symbol.

Contents


Program (Codes)
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Variables in output - Revisiting the `print()` function

How do we print variables?

```
a = 5
print(a)          # 5
b = "haha"
print(b)          # haha
print(a + 2)      # 7
print(b + "a") # hahaa
```

Calculation

We can calculate expressions inside the `print()` function.

Variables in output - Revisiting the `print()` function

How do we print variables?

```
a = 5
print(a)          # 5
b = "haha"
print(a, b)       # 5 haha
print(b, b)       # haha haha
```

The comma

Using `,` in `print()` would add a space in between the 2 items.

Variables in output - Revisiting the `print()` function

How do we print variables?

```
a = 5
print(a)          # 5
b = "haha"
print(b)          # haha
print(a + "5") # error
print(b + 2)    # error
print(a + b)    # error
```

Addition

You cannot use addition to print things of incompatible types.
`int` and `float` types are not incompatible because all `int` are converted to `float` if needed during operation.

Variables in output - Revisiting the `print()` function

How do we print variables?

```
a = 5
b = 32
c = 32.0
print(a * b)     # 160
print(a * c)     # 160.0
```

Takeaway

`print()` function evaluates the expression inside the brackets first before actually printing.

Task 1

Now go to your Number Guessing Game file's task 1.

All lines you have to do is marked with "`# TODO:`".
Try to finish the `print()` statements!

`input()` function

We know how to output (`print`), what about input?

```
input("This is the input function.")
```

input() function

input() is a function that outputs a prompt and lets the user enter something.

```
>>> input("Enter a number: ")
Enter a number: 5
```

Simply inputting doesn't do anything, but we can print it.

```
>>> print(input("Enter a number: "))
Enter a number: 100
100
```

input() function

Some more examples:

```
>>> input("Enter something: ")
Enter something: I am in HKUST
```

Simply inputting doesn't do anything, but we can print it.

```
>>> print(input("Enter a number: "))
Enter something: I am in HKUST
I am in HKUST
```

Converting the type of an input

How do we convert the data type of variables?

```
>>> number = input("Enter your number: ")
Enter your number: 50
>>> print(number)
50
>>> print(number + 1000) # Error occurs. Why?
```

Explanation

`number` is a string type while 1000 is an integer.

Converting the type of an input

How do we convert the data type of variables?

```
>>> number = input("Enter your number: ")
Enter your number: 50
>>> print(number)
50
>>> print(int(number) + 1000) # 1050
```

Type conversion

`input()` returns the input as string. We need to convert the input to the suitable type when needed.
We use `int()` to convert something into an integer.
This will be useful in the number guessing game.

Task 2

Now go to your Number Guessing Game file's task 2.

All lines you have to do is marked with "`# TODO:`".
Try to finish the code to get the user's input.

The End

Made in LaTeX

Last updated: 29 Mar 2024

Additional content

Here are some additional content that we didn't have time to mention in the workshop.

More on `print()` function

In Python, the `print()` function automatically adds a new line after execution. We, however, can stop that.
The `end=` tag allows us to define the character added when `print()` is executed.

```
print(5, end="")
print(4)
print("a", end="abc")
print("d", end=" ")
print("e")
# What is the output?
# Output: 54
#         aabcd e
```

End of line

Remember to include a new line `\n` in the last line of a printed string. Else it may mess up the future outputs from other lines of the code or the computer terminal.

More on `print()` function

We mentioned that whenever `,` is used in `print()`, the items would be separated by a space.
This can actually be changed using the `sep=` tag.

```
>>> print("100", 100, end="\n3\n")
>>> 100 100
    3
>>> print("100", 100, sep="a", end="\n3\n")
>>> 100a100
    3
```

More on `print()` function

Another example:

```
>>> a = 5
>>> b = 10
>>> print(a, b, a + b, end="20\n")
>>> 5 10 1520
>>> print(a, b, a + b, sep="", end="20\n")
>>> 5101520
>>> print(a, b, a + b, end="20\n", sep="")
>>> 5101520
```

Command Parameters

As long as you mark `sep` and `end` clearly **and** after the things you want to print, the ordering doesn't matter!

Converting between types

You can convert between types with their type names in Python.

Data Type	Command
Integer	`int()`
Float	`float()`
String	`str()`
Boolean	`bool()`

int()

`int()` tries to convert a variable into an integer.

```
a = 10          # int
print(int(a)) # 10
                # Nothing occurs

b = 3.7         # float
print(int(b)) # 3
                # Discards values to the right of
                # the decimal point

c = True        # boolean
print(int(c)) # 1

d = False       # boolean
print(int(d)) # 0
                # For boolean: 0 if False, True otherwise
```

int()

```
i = "123abc"  # string
print(int(i)) # Error

j = "123"     # string with ONLY numbers
print(int(j)) # 123
              # Only integers in strings would be
              # successfully converted

k = "123.123" # string with ONLY numbers, but with
              # a number that represents a float
print(int(k)) # Error
```

float()

The concepts of `int()` and `float()` are quite similar.

```
a = 10              # int
print(float(a)) # 10.0
                    # From int -> float

b = 3.7             # float
print(float(b)) # 3.7
                    # Nothing happens

c = True            # boolean
print(float(c)) # 1.0

d = False           # boolean
print(float(d)) # 0.0
```

float()

```
i = "123abc"     # string
print(float(i)) # Error

j = "123"        # string with ONLY numbers
print(float(j)) # 123.0

k = "123.123"    # string with ONLY numbers, but with
                 # a number that represents a float
print(float(k)) # 123.123
```

str()

All of the 3 data types below can be transformed into strings.

```
a = 10          # int
print(str(a)) # 10

b = 3.7         # float
print(str(b)) # 3.7

c = True        # boolean
print(str(c)) # True

d = False       # boolean
print(str(d)) # False
```

str()

```
e = "abcdef"    # string
print(str(e))   # abcdef
                # Nothing happens
```

bool()

```
a = 0              # int
print(bool(a)) # False
                   # 0 means False

b = 3.7            # float
print(bool(b)) # True
```

True and False values

Any integers or floats, if they are not zero, then `bool()` returns `True`, `False` otherwise.

```
c = True           # boolean
print(bool(c)) # True

d = False          # boolean
print(bool(d)) # False
                   # Nothing happens for the 2 above
```

bool()

`bool()`, when applied to a string, checks whether it has content:

```
e = "abcdefg"
print(bool(e)) # True
f = "False"
print(bool(f)) # True
g = " tRuE "
print(bool(g)) # True
h = "0"
print(bool(h)) # True
i = ""
print(bool(i)) # False
```

Strings

If the string has a length > 0, then `bool()` returns `True`, `False` otherwise.

Example of input and type conversion

```
age = int(input("How old are you? "))
print("You are", age, "years old.")
```

Running the program:

```
How old are you? 69
You are 69 years old.
```

Invalid input

If the input does not contain *only* an integer, then the program would throw an error.

Example of input and type conversion

```
age = int(input("How old are you? "))
print("You are", age, "years old.")
```

Running the program with an invalid input:

```
How old are you? 69.420
Traceback (most recent call last):
    File "<stdin>", line 1, in <module>
ValueError: invalid literal for int() with base 10: '69.420'
```

Invalid input

This also applies to data types like boolean values and strings.