TeachEngineering

STEM Curriculum for K-12

What is Python?

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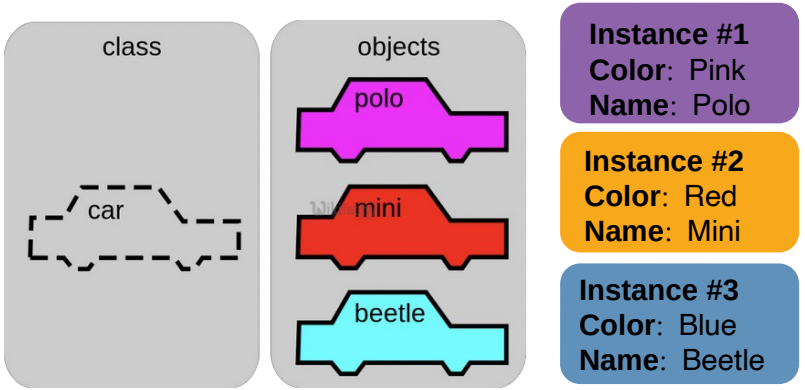
- Python is a popular high-level programming language used in various applications
  - Python is an easy language to learn because of its simple syntax
  - Python can be used for simple tasks such as plotting or for more complex tasks like machine learning

Variables, Objects, and Classes

- A **variable** is a reference to a value stored in a computer's memory.
- Variables can be sorted into a variety of categories (or **data types**) such as **numbers (int/float etc), Boolean values (true/false),** and **sequences (strings, lists etc)**.
- An **object** is a collection of data from a computer's memory that can be manipulated.
    - **ALL VARIABLES ARE OBJECTS** although some objects can be defined by data referred to by multiple variables.
    - **Methods** are the functions used to act on/alter an object's data. They describe what your object can "do."

Variables, Objects, and Classes (cont.)

- A **class** is a collection of objects who share the same set of variables/methods.
  - The definition of the class provides a blueprint for all the objects within it (**instances**).
  - Instances may share the same variables (color, size, shape, etc.), but they do **NOT** share the same values for each variable (blue/red/pink, small/large, square/circular etc.)



Basic Syntax Rules

- The name of your variable (**myInt** etc.) is placed on the left of the "=" operator.
    - Most variable names are in **camel case** where the first word begins with a lowercase letter and any subsequent words are capitalized
    - Variable names may also appear in **snake case** where all words are lowercase, with underscores between words
- The assignment operator (**"="**) sets the variable name equal to the memory location where your value is found.
- The value of your variable (**"Hello, World"**) is placed on the right of the "=" operator.
    - The type of this value does **NOT** need to be stated but its format must abide by a given object type (as shown).

```
myString = "Hello, World" myInt = 7
myFloat = 7.0
myList = [7, 8, 9] myBoolean = true
```

Basic Syntax Rules

- Function Syntax
  - **def...:** indicates that you are defining a new function.
  - **function()** refers to the name of your function. By convention, this name is typically lowercase and represents a verb/action.
  - **a,b** refers to **parameters** (values or variables) that can be used within the statements of your function's definition (.....). If your function has no parameters, an empty parenthetical () is used.
  - The **return** statement is an optional statement that will return a value for your function to your original call.

```
def function(a, b):
        ......
        return a + b
```

Basic Syntax Rules (cont.)

- Calling a function
  - Call the function by referring to its name (**function()**) and by placing any necessary arguments (**1, 2**) within the parenthesis separated by commas. myValue = function(1, 2)
  - If you wish, you can set your function call equal to a variable (**myValue**). The value returned by the function will be assigned to your variable name.

```
myValue = function(1, 2)
```

Common Data Types and Operators

- A **data type** is a means of classifying a value and determining what operations can be performed on it. All objects have a data type.
- **Operators** are symbols used carry out specific functions/computations.
- https://www.youtube.com/watch?v=v5MR5JnKcZI

Operator	Description
**	Exponentiation (raise to the power)
~ + -	Ccomplement, unary plus and minus (method names for the last two are +@ and -@)
* / % //	Multiply, divide, modulo and floor division
+ -	Addition and subtraction
>> <<	Right and left bitwise shift
&	Bitwise 'AND'
^ |	Bitwise exclusive `OR' and regular `OR'
<= < > >=	Comparison operators
<> == !=	Equality operators
= %= /= //= -= += *= **=	Assignment operators
is is not	Identity operators
in not in	Membership operators
not or and	Logical operators

Class	Description
bool	Boolean value
int	integer (arbitrary magnitude)
float	floating-point number
list	mutable sequence of objects
tuple	immutable sequence of objects
str	character string
set	unordered set of distinct objects
frozenset	immutable form of set class
dict	associative mapping (aka dictionary)

Input/Output

- **Input functions** (**input()**) allow users of a program to place values into programming code.
    - The parameter for an input function is called a **prompt**. This is a string (this can be indicated by “” or ‘) such as **“Enter a number: “**
    - The user’s response to the prompt will be returned to the input statement call as a string. To use this value as any other data type, it must be converted with another function (**int()**).
- **Print functions** (**print()**) allow programs to output strings to users on a given interface.
    - The parameter of this function is of any type. All types will automatically be converted to strings.

```
xString = input(“Enter a number: “)
x = int(xString)
y=x+2
print(y)
```

If-else Statements

- **If-else statements** allow programmers to adapt the function of their code based on a given condition.
- If a given condition (i.e. **x % 2 == 0**) is true, then the statements following the if statement (**if**) will be executed. If the condition is false, the statements following the else statement (**else**) will be executed.
    - The condition is tested using the Boolean operators **==** (is equal to), **!=** (is not equal to), **and** (used to test multiple conditions), and **or** (used to test if **AT LEAST ONE** condition is true).
    - Additionally, **else-if statements** (**elif**) can be used to provide unique coding statements for multiple conditions.

```
xString = input("Enter a number: ")
x = int(xString)
if x % 2 == 0:
    print("This is an even number")
elif x == 0:
    print("This number equals 0")
else:
    print("This is an odd number")
```

For Loops

- **For loops** perform the same task (iterate) for the number of times specified by an **iterable** (something that can be evaluated repeatedly such as a list, string, or range).
- **for** defines the for loop
- **x** is the variable defining the number of times the statements within the loop (**print(myInt)**) are executed.
- The **range(start, stop, step)** function is often used to define x.
    - The starting value is defined by **start**, the final value is defined by **stop – 1**, and the magnitude at which x changes between loops is defined by **step**.
- **in** is a Boolean operator that returns true if the given value (x) is found within a given list, string, range etc.

```
myString = input("Enter a number: ")
myInt = int(myString)

for x in range(0, 5, 1): print(myInt)
```

While Loops

- **While loops** are statements that iterate so long as a given Boolean condition is met.
    - x (the variable determining whether or not the condition is met) is defined and manipulated **OUTSIDE** of the header of the while loop (**while**)
    - The condition (**x < 5**) is a statement containing a Boolean variable.
    - **break** is a statement used to exit the current for/while loop.
    - **continue** is a statement used to reject all statements in the current for/while loop iteration and return to the beginning of the loop.

```
myString = input("Enter a number: ")
myInt = int(myString)
x = 0
while x < 5:
    print(myInt)
    x= x +1
```

```
1   # Prints out 0,1,2,3,4
2
3   count = 0
4   while True:
5       print(count)
6       count += 1
7       if count >= 5:
8           break
9
10  # Prints out only odd numbers - 1,3,5,7,9
11  for x in range(10):
12      # Check if x is even
13      if x % 2 == 0:
14          continue
15      print(x)
```