py4kids (https://github.com/wgong/py4kids)

Object and Class

In this lesson, we learn object-oriented programming in python. (Read Chapter 8 of textbook - Python for Kids)

Key concepts

- Object - how computer models / simulates a Thing (or everything) in the real world
- Class - how to generalize (abstract, or template) objects

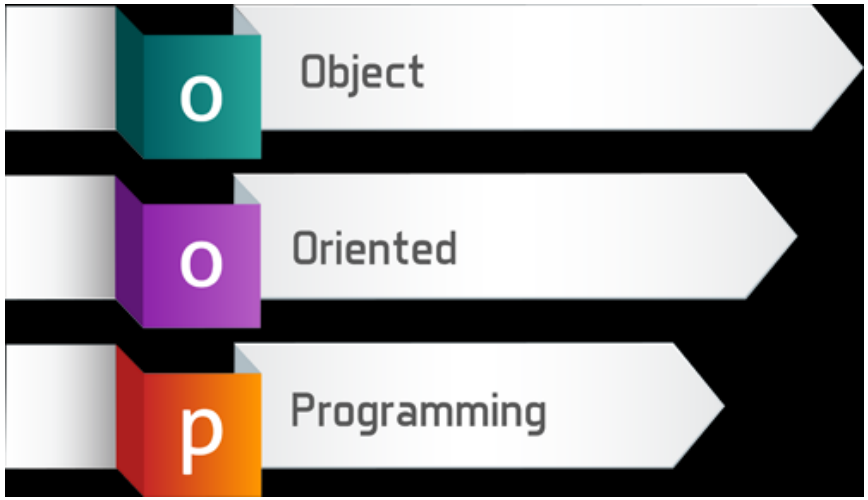
Object has Property and Method. In general, Property describes Form, Method describes Function.

Object to Class is like Cookie to Cookie Cutter. Class creates Object.

In [1]:
```
from jyquickhelper import add_notebook_menu
add_notebook_menu()
```

Out[1]:

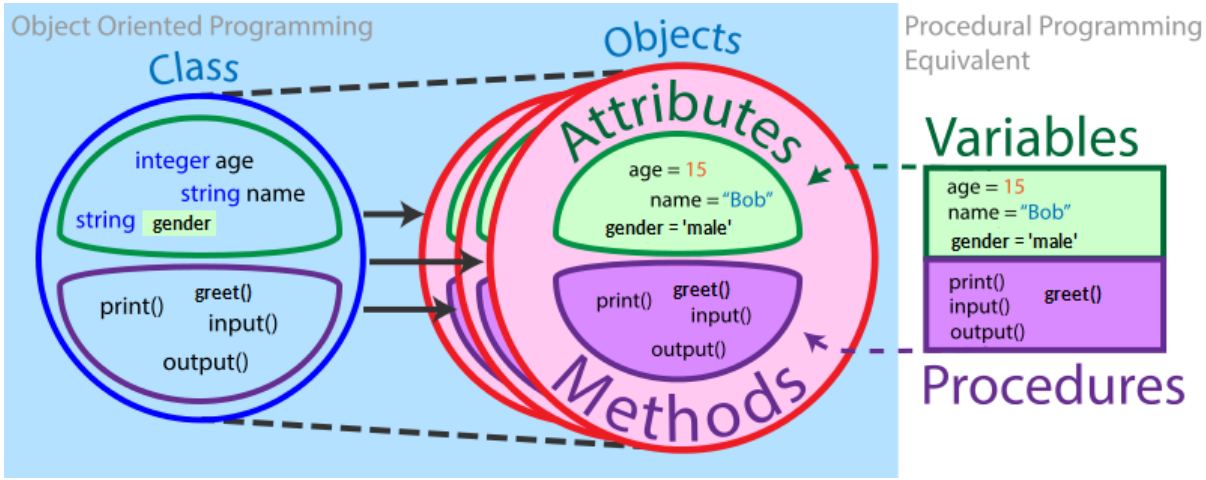
Why?



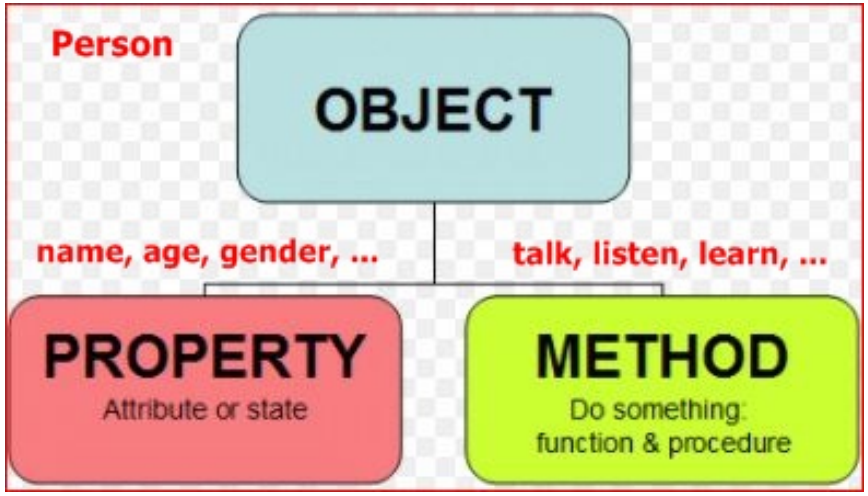
- Digital virtual world imitates how real world works - solve complex problems
- Modular and Component-based design - best engineering principal and practice
- OOP codes have better robustness, efficency, ease of use, maintainability and reusability.
- Article#1 (https://www.cs.drexel.edu/~introcs/Fa15/notes/06.1_OOP/Advantages.html?CurrentSlide=3)
- Article#2 (https://www.roberthalf.com/blog/salaries-and-skills/4-advantages-of-object-oriented-programming)

Object-oriented programming

procedural programming vs object-oriented programming

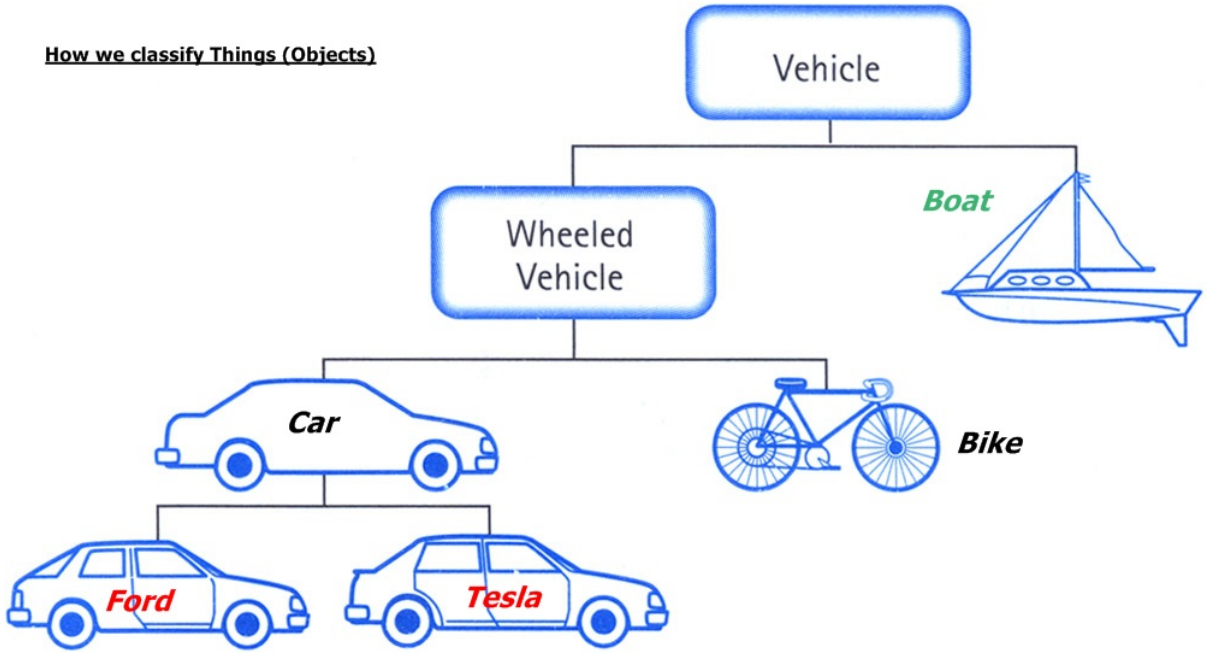


Object has properties and methods:



Object has hierarchy - parent and child relationship : child object inherits from parent object.

Base Class is parent, Derived Class is child.



In [2]:
```
# base class: vehicle
class Vehicle:
    pass    # fill in details later
    # vehicle is a machine that moves
```

In [3]:
```
# WheeledVehicle and Boat class inherit parent class=Vehicle
class WheeledVehicle(Vehicle):
    pass    # fill in details later
    # vehicle that runs on land

class Boat(Vehicle):
    pass    # fill in details later
    # vehicle that runs in water
```

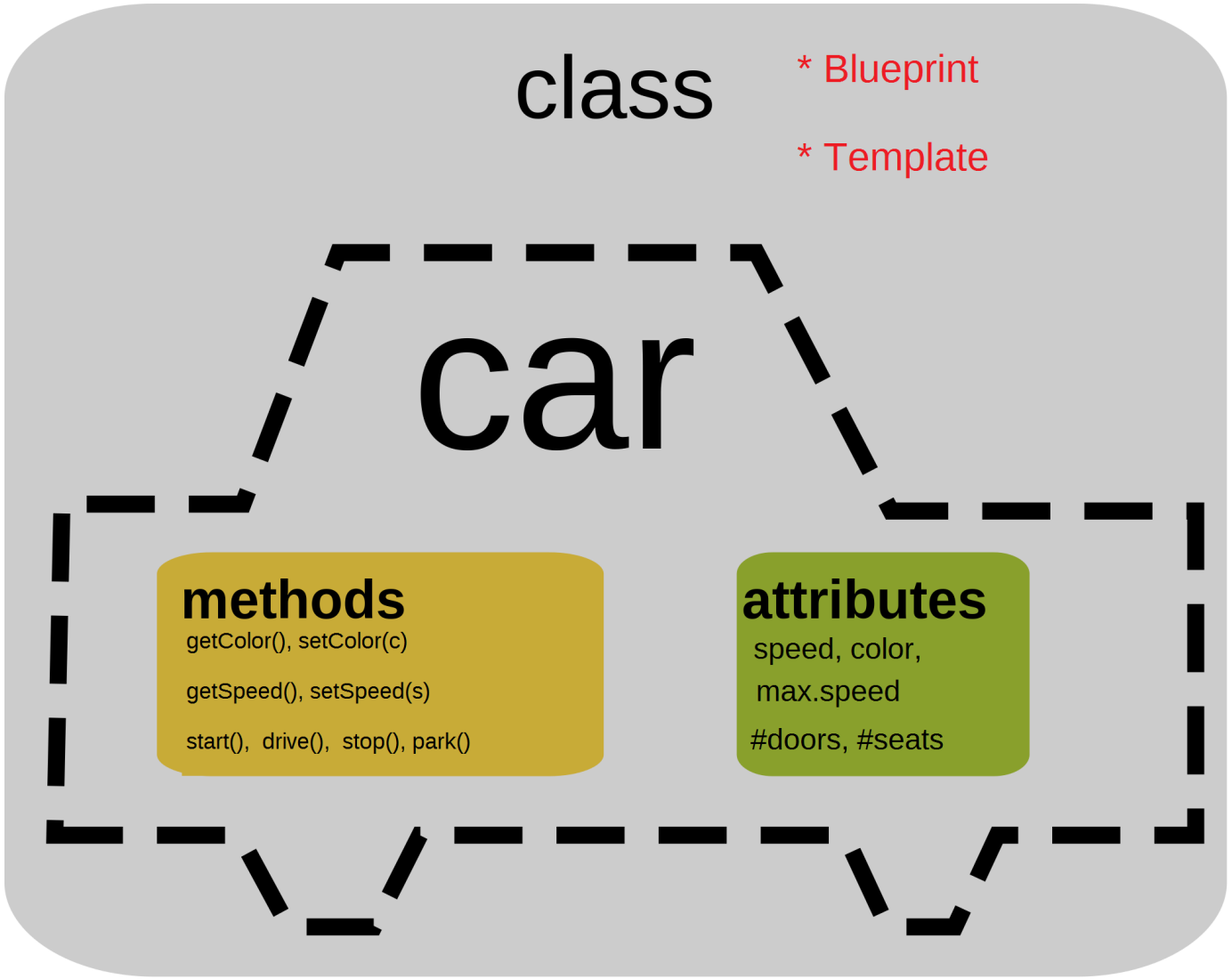
In [4]:
```
class Car(WheeledVehicle):
    pass
    # passenger vehicle wiht 4 wheels

class Bike(WheeledVehicle):
    pass
    # 2 wheels
```

In [5]:
```
class Ford(Car):
    pass
    # car made by Ford, burns gas

class Tesla(Car):
    pass
    # electrical car by Musk, uses electricity
```

Car Class


class
* Blueprint
* Template
car
methods
getColor(), setColor(c)
getSpeed(), setSpeed(s)
start(), drive(), stop(), park()
attributes
speed, color,
max.speed
#doors, #seats

In [6]:
```
class Car:
    # constructor: define properties and how object is created initially
    def __init__(self, number_of_wheels, number_of_doors, color, seating_capacity, maximum_speed):
        self.number_of_wheels = number_of_wheels
        self.number_of_doors = number_of_doors
        self.color = color
        self.seating_capacity = seating_capacity
        self.maximum_speed = maximum_speed
        self.speed = 0
        self.alarm = False

    # getters and setters
    def getColor(self):
        return self.color

    def setColor(self, color):
        self.color = color

    def getSpeed(self):
        return self.speed

    def setSpeed(self, speed):
        self.speed = speed

    # private method
    def _accelerate(self, target_speed, minutes_to_accelerate):
        delta_per_min = (target_speed - self.speed) / minutes_to_accelerate
        for tm in range(int(minutes_to_accelerate)):
            self.speed = self.speed + delta_per_min

    def _steer(self):
        pass

    def _brake(self):
        pass

    # utility
    def show_props(self):
        props = (self.number_of_wheels, self.number_of_doors, self.color, self.seating_capacity, self.maximum_spe
        print("""This Car object's properties: \n\tnumber_of_wheels=%s, \n\tnumber_of_doors=%s, \n\tcolor=%s, \n\

    # public methods
```

```
    def start(self, target_speed, minutes_to_accelerate=2):
        self._accelerate(target_speed, minutes_to_accelerate)
        pass

    def drive(self):
        self._steer()
        if self.alarm:
            self._brake()

    def stop(self):
        self._accelerate(0, 2)
        # turn off engine
```

Car Objects

In [7]:
```
# let us create a car in computer
# __init__(self, number_of_wheels, number_of_doors, color, seating_capacity, maximum_speed)

my_first_car = Car(4, 2, 'red', 4, 120)
```

In [8]:
```
type(my_first_car)
```

Out[8]:
```
__main__.Car
```

In [9]:
```
dir(my_first_car)
```

Out[9]:
```
['__class__',
 '__delattr__',
 '__dict__',
 '__dir__',
 '__doc__',
 '__eq__',
 '__format__',
 '__ge__',
 '__getattribute__',
 '__gt__',
 '__hash__',
 '__init__',
 '__le__',
 '__lt__',
 '__module__',
 '__ne__',
 '__new__',
 '__reduce__',
 '__reduce_ex__',
 '__repr__',
 '__setattr__',
 '__sizeof__',
 '__str__',
 '__subclasshook__',
 '__weakref__',
 '_accelerate',
 '_brake',
 '_steer',
 'alarm',
 'color',
 'drive',
 'getColor',
 'getSpeed',
 'maximum_speed',
 'number_of_doors',
 'number_of_wheels',
 'seating_capacity',
 'setColor',
 'setSpeed',
 'show_props',
 'speed',
```

```
 'start',
 'stop']
```

In [10]:
```
my_first_car.show_props()
```

```
This Car object's properties:
        number_of_wheels=4,
        number_of_doors=2,
        color=red,
        seating_capacity=4,
        maximum_speed=120,
        speed=0,
        Alarm?=False
```

In [11]:
```
my_first_car.getColor()
```

Out[11]:
```
'red'
```

In [12]:
```
my_first_car.color
```

Out[12]:
```
'red'
```

In [13]:
```
my_first_car.setColor('White')
```

In [14]:
```
my_first_car.color
```

Out[14]:
```
'White'
```

In [15]:
```
my_first_car.getSpeed()
```

Out[15]:
```
0
```

In [16]:
```
my_first_car.start(15,2)
```

In [17]:
```
my_first_car.getSpeed()
```

Out[17]:
```
15.0
```

In [18]:
```
my_first_car.drive()
```

In [19]:
```
my_first_car.getSpeed()
```

Out[19]:
```
15.0
```

In [20]:
```
my_first_car.stop()
```

In [21]:
```
my_first_car.getSpeed()
```

Out[21]:
```
0.0
```

Inheritance

In [22]:
```
class FordEscape(Car):
    def __init__(self, number_of_wheels, number_of_doors, color, seating_capacity, maximum_speed, style):
        Car.__init__(self, number_of_wheels, number_of_doors, color, seating_capacity, maximum_speed)
        self.manufacturer = 'Ford'
        self.style = style
```

Since FordEscape Car class is built from base Car class, it inherits Car class's properties and methods (for free)

In [23]:
```
my_2nd_car = FordEscape(4, 4, 'Blue', 6, 140, 'SUV')
```

In [24]:
```
my_2nd_car.getColor()
```

Out[24]:
```
'Blue'
```

In [25]:
```
my_2nd_car.style, my_2nd_car.manufacturer
```

Out[25]:
```
('SUV', 'Ford')
```

In [26]:
```
my_2nd_car.start(30,2)
my_2nd_car.getSpeed()
```

Out[26]:
```
30.0
```

In [27]:
```
my_2nd_car.drive()
my_2nd_car.getSpeed()
```

Out[27]: 30.0

In [28]:
```
my_2nd_car.stop()
my_2nd_car.getSpeed()
```

Out[28]: 0.0

Learn by example - the Open Source way

In the open source world, it is not only legal to copy open-sourced codes and programs as long as one credits the original source, it is also encouraged to develop and innovate.

Check out The Free Software Foundation (FSF) (http://www.fsf.org/), and its founding father Richard Stallman (https://www.wikiwand.com/en/Richard_Stallman), and GNU Project (https://www.gnu.org/)

Pygame (https://www.pygame.org/) sample program - Fist punches Chimp

It has the basic ingredients for a simple game with sound, image, object collision detection.

More examples can be found at C:\Anaconda3\Lib\site-packages\pygame\examples (for window installation)

To play chimp game, type

```
python chimp.py
```

Here are the Fist and Chimp classes/objects

```
#classes for our game objects
```

```
class Fist(pygame.sprite.Sprite):
    """moves a clenched fist on the screen, following the mouse"""
    def __init__(self):
        pygame.sprite.Sprite.__init__(self) #call Sprite initializer
        self.image, self.rect = load_image('fist.bmp', -1)
        self.punching = 0

    def update(self):
        "move the fist based on the mouse position"
        pos = pygame.mouse.get_pos()
        self.rect.midtop = pos
        if self.punching:
            self.rect.move_ip(5, 10)

    def punch(self, target):
        "returns true if the fist collides with the target"
        if not self.punching:
            self.punching = 1
            hitbox = self.rect.inflate(-5, -5)
            return hitbox.colliderect(target.rect)

    def unpunch(self):
        "called to pull the fist back"
        self.punching = 0


class Chimp(pygame.sprite.Sprite):
    """moves a monkey critter across the screen. it can spin the
       monkey when it is punched."""
    def __init__(self):
        pygame.sprite.Sprite.__init__(self) #call Sprite intializer
        self.image, self.rect = load_image('chimp.bmp', -1)
        screen = pygame.display.get_surface()
        self.area = screen.get_rect()
        self.rect.topleft = 10, 10
        self.move = 9
        self.dizzy = 0
```

```
    def update(self):
        "walk or spin, depending on the monkeys state"
        if self.dizzy:
            self._spin()
        else:
            self._walk()

    def _walk(self):
        "move the monkey across the screen, and turn at the ends"
        newpos = self.rect.move((self.move, 0))
        if self.rect.left < self.area.left or \
            self.rect.right > self.area.right:
            self.move = -self.move
            newpos = self.rect.move((self.move, 0))
            self.image = pygame.transform.flip(self.image, 1, 0)
        self.rect = newpos

    def _spin(self):
        "spin the monkey image"
        center = self.rect.center
        self.dizzy = self.dizzy + 12
        if self.dizzy >= 360:
            self.dizzy = 0
            self.image = self.original
        else:
            rotate = pygame.transform.rotate
            self.image = rotate(self.original, self.dizzy)
        self.rect = self.image.get_rect(center=center)

    def punched(self):
        "this will cause the monkey to start spinning"
        if not self.dizzy:
            self.dizzy = 1
            self.original = self.image
```

In [ ]:

In [ ]: