SFU SIMON FRASER UNIVERSITY
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CMPT 120: Introduction to Computing Science and Programming 1

Object-oriented Programming

python™

Today's Topics

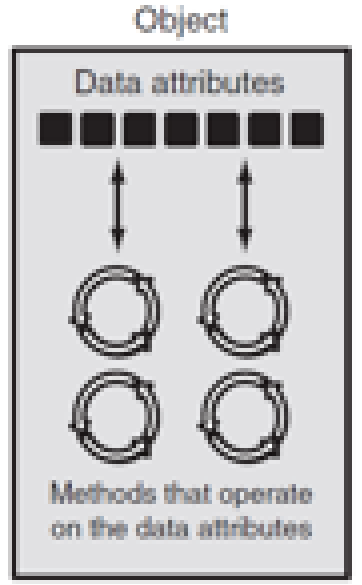
1. Procedural and Object-Oriented Programming
2. Classes
3. Working with Instances
4. Techniques for Designing Classes

Procedural Programming

- There are primarily two methods of programming in use today:
  1. **Procedural**
  2. **Object-oriented**
- **Procedural Programming**: Writing programs made of functions that perform specific tasks.
  - Data items commonly passed from one procedure to another.
  - Procedures typically operate on data items that are separate from the procedures.
  - **Focus:** to create procedures that operate on the program's data.

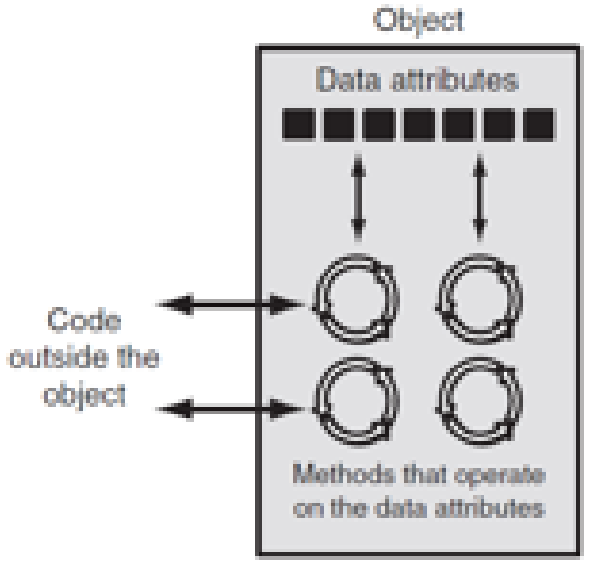
Object-Oriented Programming

- **Object-oriented Programming**: A method of programming focused on creating objects.
- **Object**: An entity that contains **data** and **procedures**.
  - Data is known as **data attributes** and procedures are known as **methods**.
    - Methods perform operations on the data attributes.
- **Encapsulation**: Combining data and code into a single object.



Object-Oriented Programming (cont'd.)

- **Data hiding**: Object's data attributes are hidden from code outside the object.
  - Access restricted to the object's methods
    - Protects from accidental corruption
    - Outside code does not need to know internal structure of the object
- **Object reusability**: the same object can be used in different programs
  - Example: 3D image object can be used for architecture and game programming.



An Everyday Example of an Object

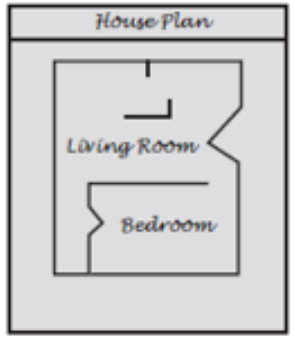
- **Data attributes**: define the state of an object
  - Example: clock object would have `second`, `minute`, and `hour` data attributes.
- **Public methods**: allow external code to manipulate the object.
  - Example: `set_time, set_alarm_time`
- **Private methods**: used for object's inner workings.

Classes

- **Class**: code that specifies the data attributes and methods of a particular type of object.
  - Similar to a blueprint of a house or a cookie cutter.
- **Instance**: an object created from a class.
  - Similar to a specific house built according to the blueprint or a specific cookie.
  - There can be many instances of one class.

Classes - 2

Blueprint that describes a house



Instances of the house described by the blueprint

Class Definitions

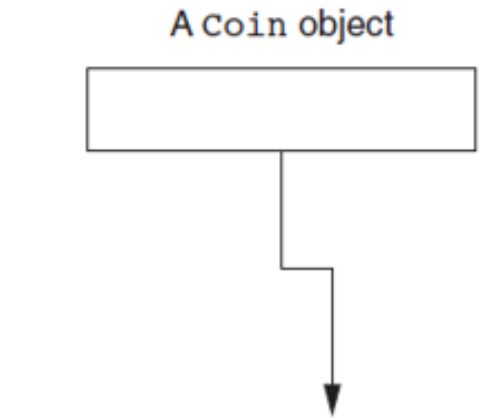
- **Class definition**: set of statements that define a class's methods and data attributes
  - **Format**: begin with `class Class_name:`
    - Class names often start with **uppercase** letter.
  - Method definition like any other python function definition.
    - **`self` parameter**: required in every method in the class – references the specific object that the method is working on.

Class Definitions - 2

- **Initializer method**: automatically executed when an instance of the class is created
  - Initializes object's data attributes and assigns `self` parameter to the object that was just created
  - **Format**: **`def __init__ (self):`**
  - Usually the first method in a class definition.

Class Definitions - 3

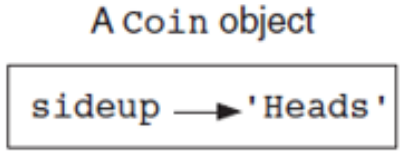
1. An object is created in memory from the `Coin` class.



2. The `Coin` class's `__init__` method is called, and the `self` parameter is set to the newly created object

```
def __init__(self):
    self.sideup = 'Heads'
```

After these steps take place, a `Coin` object will exist with its `sideup` attribute set to `'Heads'`.



Class Definitions - 4

- To create a new instance of a class call the initializer method
  - **Format**: ***My_instance = Class_Name()***
- To call any of the class methods using the created instance, use dot notation
  - **Format: *My_instance.method()***
  - Because the `self` parameter references the specific instance of the object, the method will affect this instance
    - Reference to `self` is passed automatically.

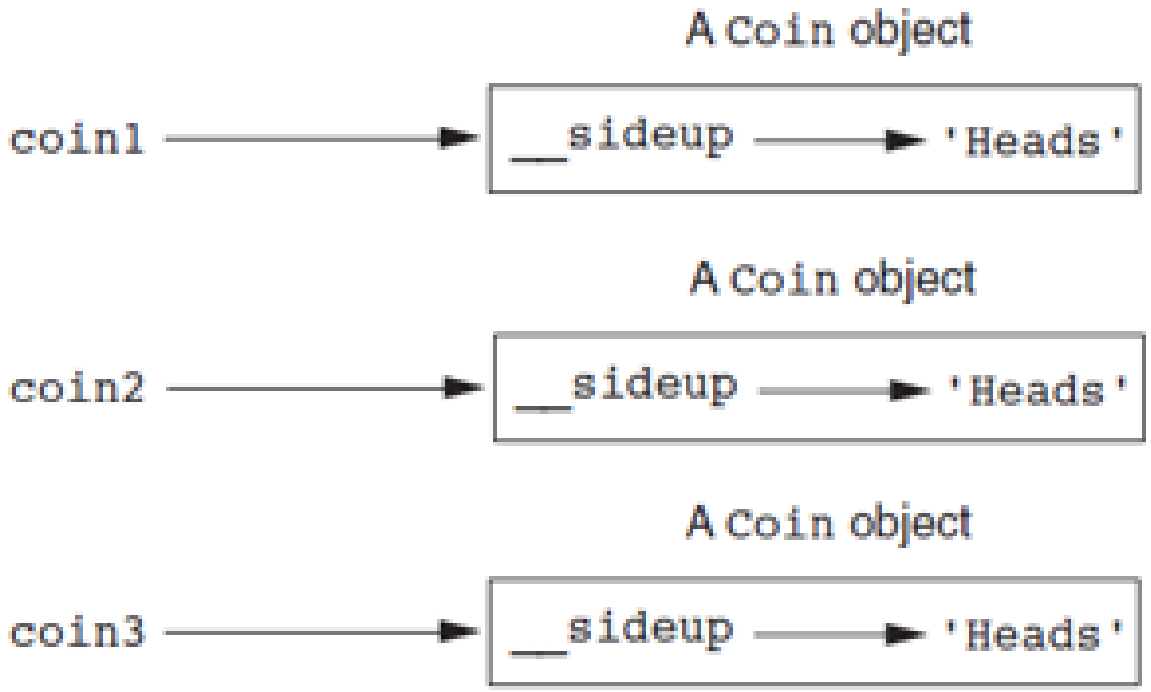
Hiding Attributes and Storing Classes in Modules

- An object's data attributes should be private.
  - To make sure of this, place two underscores (__) in front of attribute name
    - Example: `__current_minute`
- Classes can be stored in modules
  - Filename for module must end in .py
  - Module can be imported to programs that use the class

Working With Instances

- **Instance attribute**: Belongs to a specific instance of a class.
  - Created when a method uses the `self` parameter to create an attribute
- If many instances of a class are created, each would have its own set of attributes.

Working With Instances - 2



Accessor and Mutator Methods

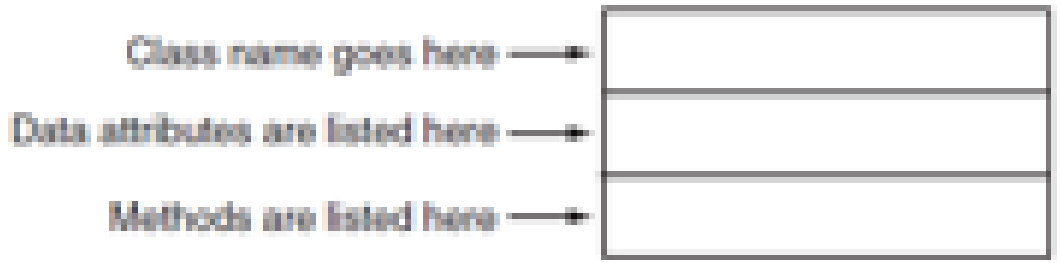
- Typically, all of a class's data attributes are **private** and provide methods to **access** and **change** them.
- **Accessor methods**: Return a value from a class's attribute without changing it.
  - Safe way for code outside the class to retrieve the value of attributes
- **Mutator methods**: Store or change the value of a data attribute.

Passing Objects as Arguments

- Methods and functions often need to accept objects as arguments
- When you pass an object as an argument, you are actually passing a reference to the object
  - The receiving method or function has access to the actual object
    - Methods of the object can be called within the receiving function or method, and data attributes may be changed using mutator methods

Techniques for Designing Classes

- **UML diagram**: standard diagrams for graphically depicting object-oriented systems
  - Stands for Unified Modeling Language
- **General layout**: box divided into three sections:
  - Top section: name of the class.
  - Middle section: list of data attributes.
  - Bottom section: list of class methods.



Finding the Classes in a Problem

- When developing object oriented program, first goal is to identify classes
  - Typically involves identifying the real-world objects that are in the problem
  - Technique for identifying classes:
    1. Get written description of the problem domain
    2. Identify all nouns in the description, each of which is a potential class
    3. Refine the list to include only classes that are relevant to the problem

Finding the Classes in a Problem - 2

1. Get written description of the problem domain.
   - May be written by you or by an expert.
   - Should include any or all of the following:
     - Physical objects simulated by the program.
     - The role played by a person
     - The result of a business event
     - Recordkeeping items

Finding the Classes in a Problem - 3

2. Identify all nouns in the description, each of which is a potential class
   - Should include noun phrases and pronouns.
   - Some nouns may appear twice.

Finding the Classes in a Problem - 4

3. Refine the list to include only classes that are relevant to the problem
   - Remove nouns that mean the same thing
   - Remove nouns that represent items that the program does not need to be concerned with
   - Remove nouns that represent objects, not classes
   - Remove nouns that represent simple values that can be assigned to a variable

Identifying a Class's Responsibilities

- A classes responsibilities are:
  - The things the class is responsible for knowing
    - Identifying these helps identify the class's data attributes
  - The actions the class is responsible for doing
    - Identifying these helps identify the class's methods
- To find out a class's responsibilities look at the problem domain
  - Deduce required information and actions.

Questions?