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.

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

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

A Coin object

coin1 → __sideup → 'Heads'

A Coin object

coin2 → __sideup → 'Heads'

A Coin object

coin3 → __sideup → 'Heads'
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 class’s 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.

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Questions?