Master in Applied Computer Sciences and Engineering
Advanced Programming Concepts
Exercise Session 2, November 17th, 2021

1 Object Oriented Programming

1. In order to organize our digital music library, we rely on our implementation in Python.
   (a) A song is a music item with an artist, a title and a duration. Make a class to represent a song, with a constructor taking as arguments the artist (a string), its title (will be a string) and the duration (will be a number, for instance in seconds).
   (b) An album is a sequence of songs. The album also has a title. Make an album class, with a constructor takes the title as an argument. Add a method "addSong(song)" that takes a song as an argument and adds it to the end of the album.
   (c) Add a method that retrieves all the songs of a given artist in the library. This method should return a list of tuples. The first element in the tuple will be the song, the second element will be the album the song belongs to. On what class should this method be implemented?

2. In this question, we will build a super small tool for hospitals for managing appointments for their patients.
   (a) A patient is an object with a name and a date of birth. Make a patient class, with a constructor taking the name and the date of birth (choose a way to represent dates). Add the correct method to the class such that when a patient object is printed, it shows:
   "patient //name// born //date of birth//"
   (b) Similarly, a doctor is an object with a name and a n associated department. Make a class with a constructor taking these two pieces of information as arguments.
   (c) An appointment is an association between a date, a time, a patient, a doctor and a duration. Make a class for the appointment.
   (d) An agenda is a collection of appointments. Make a class for the agenda. Add a method to store an appointment for a given patient, doctor, date, time and duration. The method should only add the appointment when it does not overlap with any other appointment of the same doctor.

2 Inheritance - Polymorphism

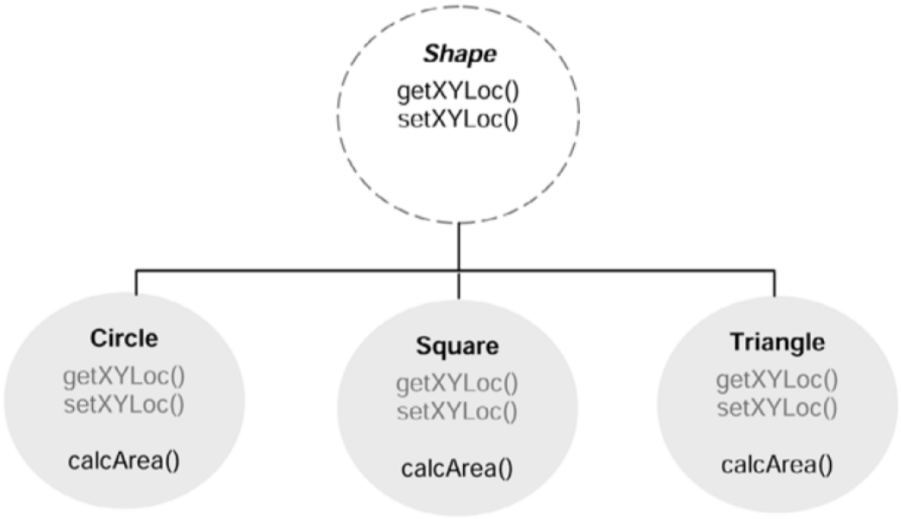
1. Imagine several animals: A Cat, a Dog, a Bird and a Cow. Although they differ in some ways (only a Dog might bark), they are likely to be similar in others (all having attributes color, name, weight).
   (a) Create the class Animal, which contains the shared functionality.
   (b) Create the subclasses: Cat, Dog, Bird and Cow. A cat can meow, a dog can bark, a bird can chirp and a cow can growl.

   Example:

   print (Missy) Output: "Missy is a cat. Missy is also an animal. Its color is black and weights 4kg." Missy.talk() Output: "Meow..."

2. Consider a class **Shape**. Shape objects can have x,y coordinates. In addition, Shape objects can also calculate their areas. How a shape's area is computed, however, depends on what shape it is. Thus it is not possible to define a calcArea method in the Shape class that serves the purposes of all types of shapes.
   (a) Create the class Shape and its methods *getXYLoc()*, *setXYLoc()*.
   (b) Create the subclasses Circle, Square, Triangle which can implement the calcArea() method.
   Useful formulas:
   - Circle: $A = \pi r^2$
   - Square: $A = a^2$
   - Triangle: $A = (s^2\sqrt{3})/4$

Figure 1: Polymorhic Shape Class.



3 Bonus Problem: A Vehicle Rental Agency Program:

Develop an object-oriented program capable of maintaining reservations for a vehicle rental agency. The agency rents out three (3) types of vehicles - cars, vans and moving trucks. The program should allow users to check for available vehicles, request rental charges by vehicle type, get the cost of renting a particular type of vehicle for a specified period of time and make/cancel reservations.

Some Tips:

The program must contain a group of specific model vehicles and some details for each customer and reservation:

(a) Vehicles: ...
(b) Cars: make/model, miles-per-gallon, number of passengers, num of doors, vehicle identification number (VIN).
(c) Vans: make/model, miles-per-gallon, number of passengers, VIN.
(d) Trucks: miles-per-gallon, length, number of rooms, VIN.
(e) Costs: (See Figure 2).
(f) Reservations: customer's name, address, credit card, VIN.

Figure 2: Rental Costs by Vehicle Type.

	Daily Rate	Weekly Rate	Weekend Rate	Free Miles Per Day	Per Mile Charge
Car	$24.99	$180.00	$45.00	100	0.15
Van	$35.00	$220.00	$55.00	0	0.20
Truck	$34.95	$425.00	$110.00	25	0.25