Object-Oriented Programming: Exercises

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1. **Basic Questions**: Answer the following questions based on the concepts learned in the course. You are expected to explain your reasoning briefly.
   (a) (2 points) Polymorphism and Operator Overloading are closely related concepts. Can you briefly explain how the two concepts are similar and how Python supports them?
   (b) (2 points) What is the difference between a shallow copy and a deep copy in Python? Provide an example where a deep copy is necessary.
   (c) (2 points) In Python, what is the purpose of `__init__`? Explain the role of this method in object-oriented programming.
   (d) (2 points) Explain the difference between mutable and immutable data types in Python. Provide an example of each.
   (e) (2 points) What are list comprehensions in Python? Provide an example and explain how they can improve code readability.
2. **Basics of Class Implementation and Operator Overloading**: Implement a basic class in Python.
   (a) (6 points) Write a **class** `Vector` with `x`, `y`, and `z` coordinates, and a method to return the vector's magnitude.
   (b) (5 points) **Overload** the addition ($+$) operator for the `Vector` class, allowing two vectors to be added.
   (c) (5 points) Create a Python **module** `vector.py` with the `Vector` class and import it into another script to use vector addition.

3. **Basics of Inheritance**
   (a) (5 points) Create a base class `Animal` with a method `speak` and subclasses `Dog` and `Cat` that override the method.
   (b) (6 points) Create a new class `Vector3D` that inherits from the `Vector` class. The `Vector3D` class should include an additional method called `dot_product()` that computes the dot product of two vectors.
   (c) (4 points) Override the `str()` method in the `Vector3D` class to return a custom string representation of the vector in the form `'(x, y, z)'`.
4. **Reading Files (Basic and Pandas)**
   (a) (6 points) Write a Python program to read a text file and print its contents.
   (b) (6 points) Use Pandas to read a CSV file and print the first five rows.
5. (10 points) **Testing with Pytest**: Write a simple test using pytest for the `Vector` class, testing both magnitude and addition.