

Question 1. True or False

Circle **T** if the statement is true, otherwise circle **F** if the statement is false.

- | | | |
|--|----------|----------|
| 1. A virtual function overloading an operator is an example of dynamic dispatch. | T | F |
| 2. Dynamically typed interpreted language cannot implement early binding. | T | F |
| 3. <code>decltype</code> in C++ is an example of static reflection. | T | F |
| 4. The instance variables specified in the <code>__slots__</code> special variable must be initialized before they can be referenced. | T | F |
| 5. You can call any method defined in the super class by replacing <code>self</code> with <code>super()</code> in the methods of a subclass. | T | F |
| 6. You can overload the assignment operator in Python. | T | F |
| 7. The <code>__str__</code> special method is an example of ad-hoc polymorphism. | T | F |
| 8. The <code>__dict__</code> special attribute is an example of attribute reification. | T | F |
| 9. A class method cannot be used to change instance variables. | T | F |
| 10. If an attribute name starts with an underscore, it can only be accessed by instance methods of the same class. | T | F |

Question 2. Multiple Choices

Pick all answer(s) that are correct.

a) Which of the following functions in Python are examples of introspection?

- i. `globals`
- ii. `getattr`
- iii. `setattr`
- iv. `delattr`
- v. `hasattr`

b) Given the following code snippet:

```
class A:
    foo = [1, 2]

x = A()
y = A()
```

Which one of the following statements are true? (Note: the previous statements do not affect the next)

- i. After running `x.foo.append(3)`, the value of `y.foo` is `[1, 2, 3]`.
- ii. After running `x.foo = [1, 2, 3]`, the value of `y.foo` is `[1, 2, 3]`.
- iii. After running `A.foo = [1, 2, 3]`, the value of `y.foo` is `[1, 2, 3]`.
- iv. After running `setattr(x, 'foo', [1, 2, 3])`, the value of `y.foo` is `[1, 2, 3]`.
- v. After running `getattr(x, 'foo').append(3)`, the value of `y.foo` is `[1, 2, 3]`.

Question 3. Short Questions

a) Describe type erasure, and its pros and cons.

b) Override the eat method in Animal so that the eat method in Dog will, *in addition to what Animal.eat already does*, print “Wags its tail” at the very end. Show the entire class definition for Dog.

```
class Animal:
    """
    # may change this function in the future
    def eat(self, food):
        print(str(food) + " is delicious")
```

c) Show that functions in Python are first-class citizens.

d) In Python, what is the difference between the class 'function' and the class 'method'?

Question 4. Programming Question

Create a `Sheet` class that works like a spreadsheet with a fixed dimension. The constructor should take 3 arguments, *width*, *height*, and *type*, which will create a *width* by *height* matrix filled with the default value of that type. For example:

```
>> sh = Sheet(3, 2, int)
>> print(sh)
0, 0, 0
0, 0, 0
```

The `Sheet` class must overload the index operator so that it takes a tuple of 2 elements in the form (x, y) . If the value being set is not the type specified in the constructor, a `TypeError` must be raised. E.g.:

```
>> sh[2,1] = 5
>> sh[0,0] = 7
>> print(sh)
7, 0, 0
0, 0, 5

>> print(sh[1,1])
0
>> sh[0,1] = 3.2
TypeError: type must be int
```

Lastly, printing a `Sheet` object should output the matrix in comma separated format (see first example).