CS3101-2 Scala, Fall 2014: Problem Set 5

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Total points: 20
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Submission instructions:
Place the files for all problems in a directory named `[your_uni]_week[`X`]`, where X is the number of the problem set. For instance if your uni is xy1234 and you are submitting the problem set for the first week, the directory should be called `xy1234_week1`. Either zip or tar and gzip the directory (using `tar -c xy1234_week1 | gzip > xy1234_week1.tgz`) and upload it to your directory in the drop box for this class on Courseworks.

Part 1 - Maps (8pts)

The package `scala.collection` [1] in the Scala standard library defines a number of data structures that represent different collections of objects. So far we have seen `List`, `Array`, and `Map`. There are usually two different versions for each collection, an immutable version (once an object is created it cannot be changed) and a mutable version.

In this problem we will work with mutable `Maps`. We will discuss a solution with immutable `Maps` in class. To make sure you use the right version of `Map` import

```
import scala.collection.mutable.Map
```

Assume we have the following `Map`:

```
val fruit_to_color: Map[String,String] = Map("banana"->"yellow",
                                             "blueberry"->"blue",
                                             "cherry"->"red",
                                             "lemon"->"yellow",
                                             "kiwi"->"green")
```

In the file `Part1.scala`, write a function `reverse[A,B](map: Map[A,B]) => Map[B,List[A]]` that returns a `Map` that maps each value in the original `map` to a list of keys.

The function should behave as follow:

```
scala> reverse(fruit_to_color)
res0: scala.collection.mutable.Map[String,List[String]] =
    Map(yellow -> List(lemon, banana), green -> List(kiwi),
        red -> List(cherry), blue -> List(blueberry))
```

Hints:

- Mutable maps have a method `put(key, value)` to add a (key,value) pair.
- `Map` is a trait. To create a new mutable `Map` you need to instantiate a concrete implementation such as `HashMap`.

[1] `http://www.scala-lang.org/api/2.11.1/index.html#scala.collection.package`

Part 2 - Aquarium Simulator Revisited (12pt)

In this problem we will modify the Aquarum Simulator from Problem Set 2. You can base your solution on your own code, or you can use the sample solution for Problem set 2 [2].

In Problem 2, you added functionality (moving and eating) to the abstract class `BaseFish` by repeatedly extending the class (first to `Fish` then to `BaseFish`). Other `LifeForms` in the aquarium should be able to eat and move as well, so it makese sense to provide this functionality as traits.

(a) - 4 pts Refactor your classes for `Fish` and `HungryFish` in the following way. Move the `eat` and `move` methods into their own traits `Moving` and `Eating`. Then mix in `Moving` into the definition of `Fish` and `Eating` into the definition of `HungryFish`. `HungryFish` should still extend `Fish`. Note that the `Eating` trait needs to extend `LifeForm` or `AquariumElement`.

(b) - 4 pts In Problem Set 2, the only purpose of the class `BaseFish` was to provide a default implementation for the `eat` method required by the abstract class `AquariumElement`. Remove the declaration for `eat` and `move` from `AquariumElement` and get rid of the `BaseFish` class. This won't compile because the `Aquarium` class' `attemptMove` and `handleCollision` methods call `eat` and `move` for any `AquariumElement`.

Modify the `attemptMove` to only call `move` on objects of type `Moving`. Use pattern matching for the type checks (patterns can contain type restrictions). Modify `handleCollision` to only call `eat` on objects of type
Eating.

(c) - 2pts Create a class `Crab` that supports both `Eating` and `Moving` and is represented by the symbol `C`.

(d) - 2pts Draw a class diagram indicating the inheritance relations between different `AquariumElements`. Indicate mixins using dashed lines and class inheritance using solid lines.

[2] `http://www.cs.columbia.edu/~bauer/cs3101-2/weeks/2/solution_week2.tgz`