Homework 10

Please email your solutions to Rongdi Huang (rh1424@nyu.edu). Solutions to programming exercises must be submitted electronically as plain text files. No exotic formats, please!

The deadline for Homework 10 is December 13, 8pm.

Problem 1 Generics and Variance (10 Points)

1. Write a generic Scala method middle that returns the middle element from any Iterable[T]. For example, middle("World") is 'r'. (3 Points)

2. The Scala compiler maps the type Int to the Java type int. In particular, this means that the Scala type Int also implements the Java interface Comparable[Int]. The Scala standard API then defines a type RichInt, which provides additional operations on integers using implicit conversions (following the Pimp my Library pattern we have seen in class). If you inspect the API documentation you will see that the type RichInt implements the interface Comparable[Int] rather than Comparable[RichInt]. What is the reason for this? (2 Points)

3. Consider the following two generic classes representing immutable and mutable pairs of values:

   class Pair[+T,+S](val fst: T, val snd: S) {
     def replaceFst[U >: T](newFst: U): Pair[U,S] =
       new Pair(newFst,snd)
     def replaceSnd[U >: S](newSnd: U): Pair[T,U] =
       new Pair(fst,newSnd)
   }

   class PairM[T,S](private[this] var _fst: T, private[this] var _snd: S) {
     def fst = _fst
     def snd = _snd
     def replaceFst(newFst: T) { _fst = newFst }
     def replaceSnd(newSnd: S) { _snd = newSnd }
   }

Define a generic method swap that takes an immutable pair and returns a new pair with the components swapped. Write a similar method for mutable pairs that performs the swap in-place instead of allocating a new object. How do the two methods differ in the type of their parameters (other than that the first one takes a Pair and the second a PairM)? (3 Points)

4. The type parameters T and S of class PairM cannot be declared covariant. If the class was covariant, we could construct a similar counterexample for type safety as for the class Cell. The parameters can also not be declared contravariant. Why is that? Construct an example of the problem. (2 Points)