



Tutorials for “Formal methods for Java”
Exercise sheet 4

Exercise 1: ESC/Java 2 installation

Download and install ESC/Java 2 from http://sort.ucd.ie/frs/?group_id=97.

Exercise 2: Insertion Sort

Consider the following (buggy) implementation of an insertion sort algorithm.

```
class InsertionSort {
    class Node
    {
        public int key;
        public Object value;
    }

    /*@ ensures (\forall int i; i >= 1 && i < arr.length;
        @          arr[i].key >= arr[i-1].key); @*/
    public static void sort2(Node[] arr) {
        for(int i = 1; i <= arr.length; i++) {
            for(int j = i; j > 0; j--) {
                if (arr[j].key >= arr[j-1].key) {
                    Node tmp = arr[j];
                    arr[j] = arr[j-1];
                    arr[j] = tmp;
                }
            }
        }
    }
}
```

Use ESC/Java 2 to eliminate all bugs in the implementation. You may need to strengthen the specification.