

Exercise sheet 10

Exercise 1 (14 points)

Implement a class *BinarySearchTree* with a binary search tree, such that the keys are of type *int* (integer) and the elements of type *str* (string).

Please note that only *insert* (6 points) and *lookup* (4 points), but not *remove* needs to be implemented. This means that you can omit the doubly linked lists between the nodes in your tree.

As usual, write some (useful) tests for your methods. For this purpose write one *to_string* method (4 points) which outputs a string representation of your binary tree (see Figure 1 for illustration).

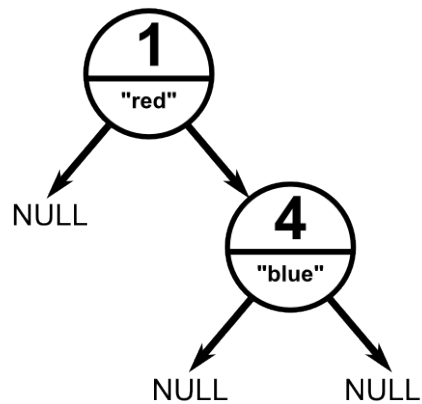
Exercise 2 (6 points)

Write a program that inserts the numbers $1, 2, \dots, n$ in this order in a (at the beginning) empty *BinarySearchTree*.

Next, insert in a (again, at the beginning) empty *BinarySearchTree* the same n numbers in random order.

Measure the runtime and the depth of the tree for both cases (after each n insertions) for $n = 2^{10}, 2^{11}, 2^{12}, \dots$. Increase n so that the runtime is still bearable on your machine. Shortly discuss the results in your *erfahrungen.txt*.

Tree diagram:



tree.to_string() returns:

```
[(1, "red"), left: null, right: [(4, "blue"), left: null, right: null]]
```

Figure 1: example tree diagram and corresponding output string of the to_string method.