

# Enumerations

Complete the following java code in the file “Enumerations.java”

1. Complete the functions **integers** and **integersRec** to follow the bijection  $\mathbb{N} \cup \{0\} \rightarrow \mathbb{Z}$  from homework10, Q2.

The functions take an integer n, and enumerates the integers up to index n.

- **integers** - iterative (no recursion!)
- **integersRec** - recursive (no loops!)

2. Complete the functions **rationalRec** and **rationalBijection** to follow the bijection  $\mathbb{N} \cup \{0\} \rightarrow \mathbb{Q} \cup \{0\}$  from homework10, Q7.

**rationalRec** takes a number n, and enumerates the 2-dimensional table up to index n (see illustration in hw10)

**rationalBijection** takes a number n, and enumerates the 2-dimensional table up to index n, skipping duplicated rationals (the red pairs)

write both **rationalRec** and **rationalBijection** as recursive functions (no loops!).

When implemented, the test cases should print the results:

```
c:\examples>java Enumerations.java
0 -> 1 -> -1 -> 2 -> -2 -> 3 -> -3 -> 4 -> -4 -> 5 -> -5 -> 6 -> -6 -> 7 -> -7 -> 8 -> End
0 -> 1 -> -1 -> 2 -> -2 -> 3 -> -3 -> 4 -> -4 -> 5 -> -5 -> 6 -> -6 -> 7 -> -7 -> 8 -> End
(1,1) -> (2,1) -> (1,2) -> (1,3) -> (2,2) -> (3,1) -> (4,1) -> (3,2) -> (2,3) -> (1,4) -> End
(1,1) -> (2,1) -> (1,2) -> (1,3) -> (3,1) -> (4,1) -> (3,2) -> (2,3) -> (1,4) -> End
```

\*The type 'pair' is implemented to use as a return type for the recursive functions

\*Helper functions can be used for the recursive implementations.

**Example for a simple recursive sequence can be found in “Triangular.java**