Assignment A3 - Number Sequence

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A sequence of real numbers can be represented like this:

$a_0, a_1, a_2, \ldots, a_{n-1}, a_n, n \geq 1$

A real number u is an upper bound for the sequence if and only if the following holds:

$u \geq a_i, \text{for } i = 0, 1, 2, \ldots, n-1, n$

A real number l is a lower bound for the sequence if and only if the following holds:

$l \leq a_i, \text{for } i = 0, 1, 2, \ldots, n-1, n$

The sequence is increasing if and only if the following holds:

$a_{i+1} > a_i, \text{for } i = 0, 1, 2, \ldots, n-2, n-1$

The sequence is decreasing if and only if the following holds:

$a_{i+1} < a_i, \text{for } i = 0, 1, 2, \ldots, n-2, n-1$

Files

The file `NumberSequence.java` contains the interface `NumberSequence`. This interface defines a sequence of real numbers.

The file `ArrayNumberSequence.java` contains the class `ArrayNumberSequence`. This class implements the interface `NumberSequence`. The real numbers are stored in an array.

The file `LinkedNumberSequence.java` contains the class `LinkedNumberSequence`. This class implements the interface `NumberSequence`. The real numbers are stored in a sequence of nodes.

The file `NumberSequenceTest.java` is a test program for the classes `ArrayNumberSequence` and `LinkedNumberSequence`. Objects of these classes are created and the methods in the interface `NumberSequence` are called in these objects.

The file `NumberSequenceTestData.txt` contains the printout which is generated on the standard output device when executing the program `NumberSequenceTest`.

The file `NumberSequenceObject.pdf` shows what objects of the classes `ArrayNumberSequence` and `LinkedNumberSequence` looks like.

Assignment

Make complete the classes `ArrayNumberSequence, LinkedNumberSequence,` and `NumberSequenceTest` so that they meet the given requirements.

Study the existing code. Consider the time and memory complexity during the implementation. In class `LinkedNumberSequence` the operations shall be formulated with nodes, and not by transforming the node sequence into an array and then manipulating the array. Use deep copy in method `asArray` in class `ArrayNumberSequence`.

The student shall be able to explain operations by referring to the figures in file `NumberSequenceObject.pdf`. Custom figures may support the explanations.

Comment

The given programs are not to be altered, only extended. Write your code in the places marked `add code here`.

During development, comment out the declaration `implements NumberSequence` in the classes `ArrayNumberSequence` and `LinkedNumberSequence`. Put the declaration back when all methods in the interface `NumberSequence` are implemented.

While developing, objects of the classes `ArrayNumberSequence` and `LinkedNumberSequence` shall be created in the test program accordingly: `ArrayNumberSequence sequence = new ArrayNumberSequence(realNumbers)` and `LinkedNumberSequence sequence = new LinkedNumberSequence(realNumbers)`.

When everything is implemented you switch to the given test program.

During development, test for different cases of an operation, including edge cases such as when an operation is applied to the first or last position in the sequence. Also test exceptional situations.

As a preparation for this assignment, the provided example program shall be studied. It consists of the following classes: `Queue`, `ArrayQueue`, `LinkedQueue`, and `QueueTest`.