BACKGROUND

Sometimes items cannot be shipped to certain zip codes, and the rules for these restrictions are stored as a series of ranges of 5 digit codes.
For example if the ranges are:

[94133,94133] [94200,94299] [94600,94699]
Then the item can be shipped to zip code 94199, 94300, and 65532, but cannot be shipped to 94133, 94650, 94230, 94600, or 94299.

Any item might be restricted based on multiple sets of these ranges obtained from multiple sources.

PROBLEM

Given a collection of 5-digit ZIP code ranges (each range includes both their upper and lower bounds),
provide an algorithm that produces the minimum number of ranges required to represent the same restrictions as the input.

NOTES

- The ranges above are just examples, your implementation should work for any set of arbitrary ranges
- Ranges may be provided in arbitrary order
- Ranges may or may not overlap
- Your solution will be evaluated on the correctness and the approach taken, and adherence to coding standards and best practices

EXAMPLES:

If the input = [94133,94133] [94200,94299] [94600,94699]
Then the output should be = [94133,94133] [94200,94299] [94600,94699]

If the input = [94133,94133] [94200,94299] [94226,94399]
Then the output should be = [94133,94133] [94200,94399]

Evaluation Guidelines:
Your work will be evaluated against the following criteria:
- Successful implementation
- Efficiency of the implementation
- Design choices and overall code organization
- Code quality and best practices

SOLUTION

Zip Codes

A ZIP Code is a postal code used by the United States Postal Service (USPS) in a system it introduced in 1963.
The term ZIP is an acronym for Zone Improvement Plan. It was chosen to suggest that the mail travels more efficiently
and quickly (zipping along) when senders use the code in the postal address. The basic format consists of five digits.

In some states (for example Maine, Massachusetts etc) the first digit in the Zip Code is 0. Even though the Zip Code is actually
a number but the best data type to represent a Zip Code is a String in Java. It is a Catagorical data because the sum
of two Zip Codes is not meaningful.

So, in order to validate you have to make sure that it is represented with 5 digits.

Assumptions

1. The input is entered as is, with spaces between square brackets and zip code groups separated by commas.

2. We are checking only the validity of the ZipCodes. In other words, there may some combination of Zip Codes which
are semantically correct by definition (5 digits) but they may not be real valid zip codes. For example Zip Code 00000 satisfies
the condition to be a valid Zip Code because it has 5 digits. But, there is no city that has that Zip Code.

3. In a pair of Zip Codes, the lower bound is always lower than than upper bound. In other words, the input is going to contain
Zip Codes [95760,95790] but not like this [95790,95760].

Test Cases

The following are examples of valid and invalid Zip Codes:

Valid ZipCodes

- 01060
- 16938
- 24534
- 35207
- 48529
- 56146
- 65077
- 71276
- 87418

- 96821

Invalid ZipCodes

- ABCDE
- !(@#*
- AB123
- 394$$
- -1029
- empty string ""
- blank string 1 or more characters " "
- 1234

The following test data is used to test the code:

Invalid ZipCodes Test Data

- ABCDE
- !(@#*
- AB123
- 394$$
- -1029
- empty string ""
- blank string 1 or more characters " "
- 1234

Valid ZipCodes Test Data

Types of input Strings (In valid data):

- **Disjoint Intervals**

Input String : [94133,94149] [94200,94299] [94600,94699]
Output String: [94133,94149] [94200,94299] [94600,94699]

- **Adjacent Intervals**

Input String : [95742,95743] [94226,94669] [95744,95760]
Output String: [94226,94669] [95742,95743] [95744,95760]

- **Overlapped Intervals**

Input String : [94133,94149] [94200,94299] [94226,94399]
Output String: [94133,94149] [94200,94399]

Input String : [95630,95742] [94226,94669] [95730, 99999] [94133,94133] [94200,94229]
Output String: [94133,94133] [94200,94669] [95630,99999]

- **Enclosed Intervals**

Input String : [95630,95742] [94226,94669] [95700, 95740] [94133,94133] [94200,94229]
Output String: [94133,94133] [94200,94669] [95630,95742]

- **Fully Enclosed Intervals**

Input String : [95630,95742] [94226,94669] [00000, 99999] [94133,94133] [94200,94229]
Output String: [00000,99999]

Input String : [95630,95742] [95742,95743] [95744,95744] [94226,94669] [94133,94133] [00000, 99999] [94200,94229] [01028,01034] [01007,01037] [01060,01065]
Output String: [00000,99999]

Sorting Method Type

- Java Collections.sort() method uses merge sort. The complexity of merge sort is ***O(nlogn)***

Data Structures (Linked List)

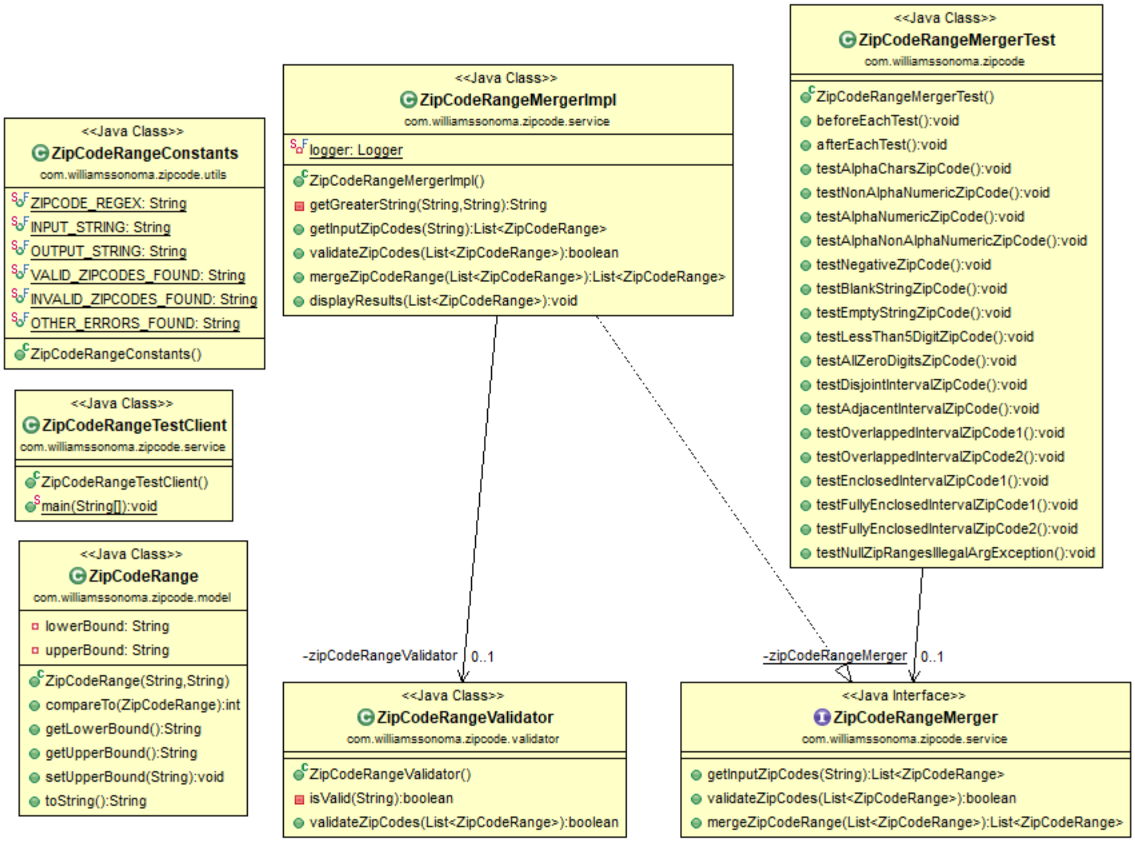
- Linked List data structure is used because the time complexity of accessing a node in the Linked List is ***O(n)***

Algorithm Complexity

- The complexity of the overall algorithm is ***O(nlogn)***

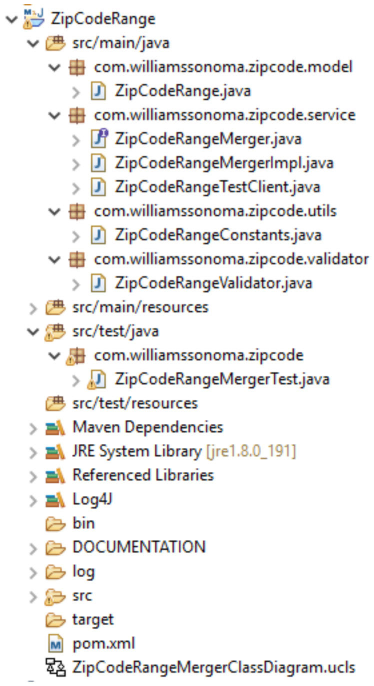
Design Description

The following is the class diagram of all the classes used in the code:


<<Java Class>>
ZipCodeRangeConstants
com.williamssonoma.zipcode.utils
ZIPCODE_REGEX: String
INPUT_STRING: String
OUTPUT_STRING: String
VALID_ZIPCODES_FOUND: String
INVALID_ZIPCODES_FOUND: String
OTHER_ERRORS_FOUND: String
ZipCodeRangeConstants()
<<Java Class>>
ZipCodeRangeMergerImpl
com.williamssonoma.zipcode.service
logger: Logger
ZipCodeRangeMergerImpl()
getGreaterString(String,String):String
getInputZipCodes(String):List<ZipCodeRange>
validateZipCodes(List<ZipCodeRange>):boolean
mergeZipCodeRange(List<ZipCodeRange>):List<ZipCodeRange>
displayResults(List<ZipCodeRange>):void
<<Java Class>>
ZipCodeRangeMergerTest
com.williamssonoma.zipcode
ZipCodeRangeMergerTest()
beforeEachTest():void
afterEachTest():void
testAlphaCharsZipCode():void
testNonAlphaNumericZipCode():void
testAlphaNumericZipCode():void
testAlphaNonAlphaNumericZipCode():void
testNegativeZipCode():void
testBlankStringZipCode():void
testEmptyStringZipCode():void
testLessThan5DigitZipCode():void
testAllZeroDigitsZipCode():void
testDisjointIntervalZipCode():void
testAdjacentIntervalZipCode():void
testOverlappedIntervalZipCode1():void
testOverlappedIntervalZipCode2():void
testEnclosedIntervalZipCode1():void
testFullyEnclosedIntervalZipCode1():void
testFullyEnclosedIntervalZipCode2():void
testNullZipRangesIllegalArgException():void
<<Java Class>>
ZipCodeRangeTestClient
com.williamssonoma.zipcode.service
ZipCodeRangeTestClient()
main(String[]):void
<<Java Class>>
ZipCodeRange
com.williamssonoma.zipcode.model
lowerBound: String
upperBound: String
ZipCodeRange(String,String)
compareTo(ZipCodeRange):int
getLowerBound():String
getUpperBound():String
setUpperBound(String):void
toString():String
-zipCodeRangeValidator
0..1
-zipCodeRangeMerger
0..1
<<Java Class>>
ZipCodeRangeValidator
com.williamssonoma.zipcode.validator
ZipCodeRangeValidator()
isValid(String):boolean
validateZipCodes(List<ZipCodeRange>):boolean
<<Java Interface>>
ZipCodeRangeMerger
com.williamssonoma.zipcode.service
getInputZipCodes(String):List<ZipCodeRange>
validateZipCodes(List<ZipCodeRange>):boolean
mergeZipCodeRange(List<ZipCodeRange>):List<ZipCodeRange>

Package Structure

The following is the package structure of the code:



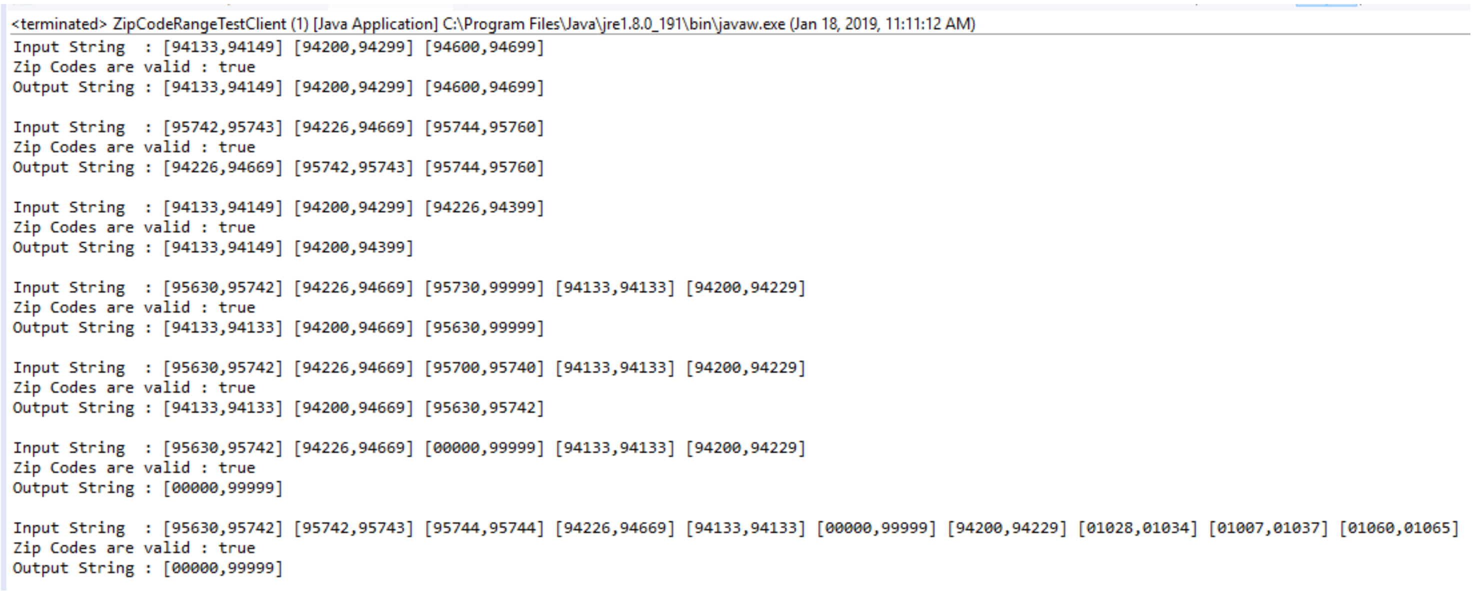
```
ZipCodeRange
  src/main/java
    com.williamssonoma.zipcode.model
      ZipCodeRange.java
    com.williamssonoma.zipcode.service
      ZipCodeRangeMerger.java
      ZipCodeRangeMergerImpl.java
      ZipCodeRangeTestClient.java
    com.williamssonoma.zipcode.utils
      ZipCodeRangeConstants.java
    com.williamssonoma.zipcode.validator
      ZipCodeRangeValidator.java
  src/main/resources
  src/test/java
    com.williamssonoma.zipcode
      ZipCodeRangeMergerTest.java
  src/test/resources
  Maven Dependencies
  JRE System Library [jre1.8.0_191]
  Referenced Libraries
  Log4J
  bin
  DOCUMENTATION
  log
  src
  target
  pom.xml
  ZipCodeRangeMergerClassDiagram.ucls
```

Design Patterns

- The design pattern that is used in the code is Strategy Pattern.

Test Client Results

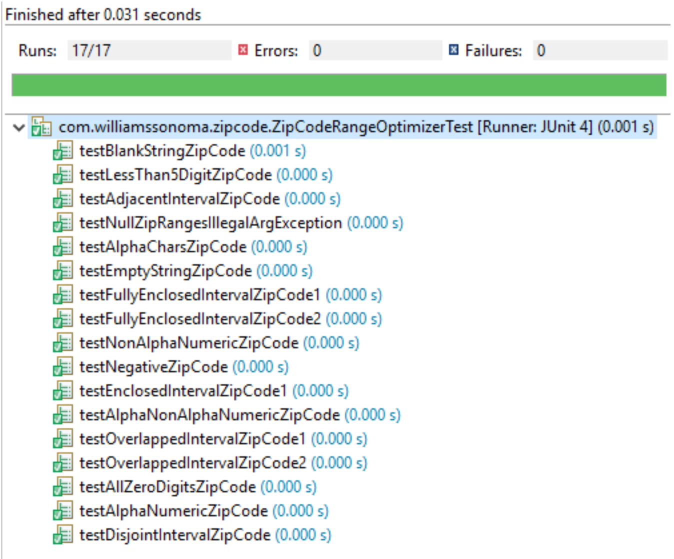
The following is the result of running the Test Client.



```
<terminated> ZipCodeRangeTestClient (1) [Java Application] C:\Program Files\Java\jre1.8.0_191\bin\javaw.exe (Jan 18, 2019, 11:11:12 AM)
Input String  : [94133,94149] [94200,94299] [94600,94699]
Zip Codes are valid : true
Output String : [94133,94149] [94200,94299] [94600,94699]

Input String  : [95742,95743] [94226,94669] [95744,95760]
Zip Codes are valid : true
Output String : [94226,94669] [95742,95743] [95744,95760]

Input String  : [94133,94149] [94200,94299] [94226,94399]
Zip Codes are valid : true
Output String : [94133,94149] [94200,94399]

Input String  : [95630,95742] [94226,94669] [95730,99999] [94133,94133] [94200,94229]
Zip Codes are valid : true
Output String : [94133,94133] [94200,94669] [95630,99999]

Input String  : [95630,95742] [94226,94669] [95700,95740] [94133,94133] [94200,94229]
Zip Codes are valid : true
Output String : [94133,94133] [94200,94669] [95630,95742]

Input String  : [95630,95742] [94226,94669] [00000,99999] [94133,94133] [94200,94229]
Zip Codes are valid : true
Output String : [00000,99999]

Input String  : [95630,95742] [95742,95743] [95744,95744] [94226,94669] [94133,94133] [00000,99999] [94200,94229] [01028,01034] [01007,01037] [01060,01065]
Zip Codes are valid : true
Output String : [00000,99999]
```

Test Case Results

There are 17 different Test cases to test the functionality of the Algorithm.



Finished after 0.031 seconds

Runs: 17/17 ☒ Errors: 0 ☒ Failures: 0

com.williamssonoma.zipcode.ZipCodeRangeOptimizerTest [Runner: JUnit 4] (0.001 s)
- testBlankStringZipCode (0.001 s)
- testLessThan5DigitZipCode (0.000 s)
- testAdjacentIntervalZipCode (0.000 s)
- testNullZipRangesIllegalArgException (0.000 s)
- testAlphaCharsZipCode (0.000 s)
- testEmptyStringZipCode (0.000 s)
- testFullyEnclosedIntervalZipCode1 (0.000 s)
- testFullyEnclosedIntervalZipCode2 (0.000 s)
- testNonAlphaNumericZipCode (0.000 s)
- testNegativeZipCode (0.000 s)
- testEnclosedIntervalZipCode1 (0.000 s)
- testAlphaNonAlphaNumericZipCode (0.000 s)
- testOverlappedIntervalZipCode1 (0.000 s)
- testOverlappedIntervalZipCode2 (0.000 s)
- testAllZeroDigitsZipCode (0.000 s)
- testAlphaNumericZipCode (0.000 s)
- testDisjointIntervalZipCode (0.000 s)

How to run/test the code?

- You can run the code as a Java Application (ZipCodeRangeTestClient.java).
- You can also test it using JUnit test cases (ZipCodeRangeMergerTest.java).