Sofia University
Department of Mathematics and Informatics

Course : **AOOP part 1**
Date: **18/03/ 2024**
Student Name:

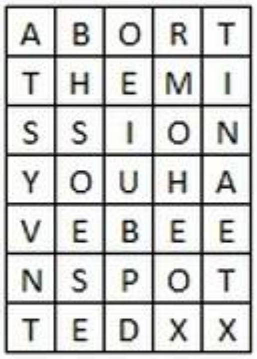
Assignment No. 3

Problem 1.

The **Route Cipher** is a transposition cipher where the key determines which route to follow when reading the ciphertext from the block created with the plaintext. The plaintext is written in a grid of size equal to the absolute value of the key, and then read off following the route chosen.

Encryption

First we write the plaintext in a block of reasonable size for the plaintext. Part of your key is the size of this grid, so you need to decide on either a number of columns or number of rows in the grid before starting. Once the characters of the plaintext are written out sequentially out in the grid, you use the Route assigned. This could be spiraling inwards starting from the top left corner in a counterclockwise direction in case the key is positive, or spiraling inwards starting from the bottom right corner in a counterclockwise direction in case the key is negative. Thus, the key absolute value determines the number of the columns in the grid, while the sign of the key determines the orientation of the route for encryption and decryption. As an example, lets encrypt the plaintext "ABORT THE MISSION, YOU HAVE BEEN SPOTTED". Assume the key is a signed integer value, whose absolute value defines the number of the columns. For clarity, let's say –5. The absolute value of the key determines that cipher will use a grid with 5 columns. The above figure shows how the sample plaintext is written in a grid of five columns, where the number of the rows depends on the length of the plaintext. The above figure shows how the plaintext is written in such a grid. Notice how we have filled the last cells of the grid with the single 'X' character to make a nice rectangle.



A	B	O	R	T
T	H	E	M	I
S	S	I	O	N
Y	O	U	H	A
V	E	B	E	E
N	S	P	O	T
T	E	D	X	X

Next, we choose which route we want to use to encrypt the message. The assigned key is negative, and the spiral starts from the lower right corner of the grid and continues counterclockwise. Therefore, the encrypted text will be "XTEANITROBATSYVNTEDXOEHOMEHSOESPBUI". If it were a positive number, the spiral starts from the top left corner of the grid and continues counterclockwise. In such a case the ciphertext would be : "ATSYVNTEDXXTEANITROBHSOESPOEHOMEIUB".

Decryption

To decrypt a message received that has been encoded with the Route Cipher, we need to know the route used and the width or height of the grid. We then start by constructing a blank grid of the right size, and then place the ciphertext letters in the grid following the route specified.

For example, to decrypt the ciphertext "TIEIXTXXEAHSIHSPNTLT" with the route spiral inwards counterclockwise from the top right, with a grid width of 4, we follow the process shown above to obtain the text THISISTHEPLAINTEXT.

Programming assignment

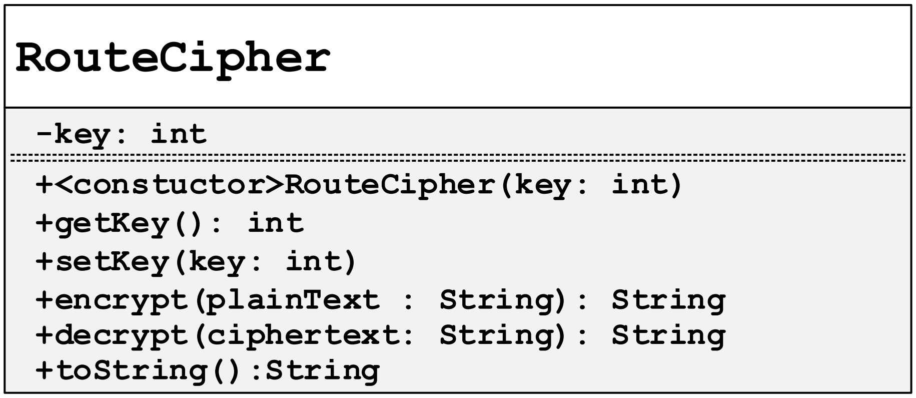
Write a **Java application** to **implement the encryption and decryption process for the Route Cipher using** the ***String.toCharArray()*** method and arrays of ***char*** datatype as in the following example

```
String cipherText = “abort the mission, you have been spotted";
char [] cipherTextChars = cipherText.toCharArray();  // to char array
String text = new String(cipherTextChars);            // to string
```

DO NOT USE ANY OTHER String METHODS!

The cipher key should be a signed integer number, whose absolute value is equal to the number of the columns in the grid used in the Route cipher. In case the key is positive then route for encrypting and decrypting starts from the first cell in the upper left corner of the grid. Otherwise, the route for encrypting and decrypting starts from and the lower right corner.

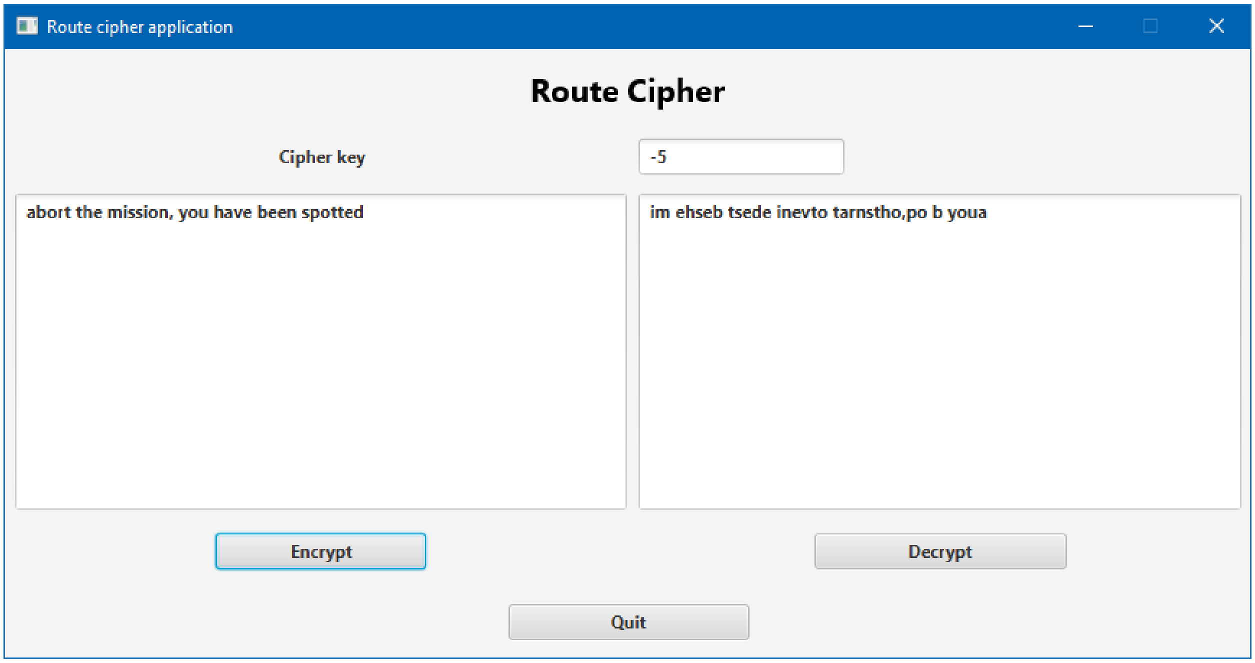
Use **OO design** and define a **class RouteCipher** with respective data, constructors and methods, allowing you to implement the above encryption/ decryption functionality. In particular use the following OO model for **class RouteCipher**



```
RouteCipher
-key: int
+<constuctor>RouteCipher(key: int)
+getKey(): int
+setKey(key: int)
+encrypt(plainText : String): String
+decrypt(ciphertext: String): String
+toString():String
```

Test encryption / decryption of a string using different cipher keys with a **class RouteCipherTest** . Use the above given examples for encryption and decryption to test your solution.

Finally, create a FXML interactive application to test the application. Use the following design for the Scene



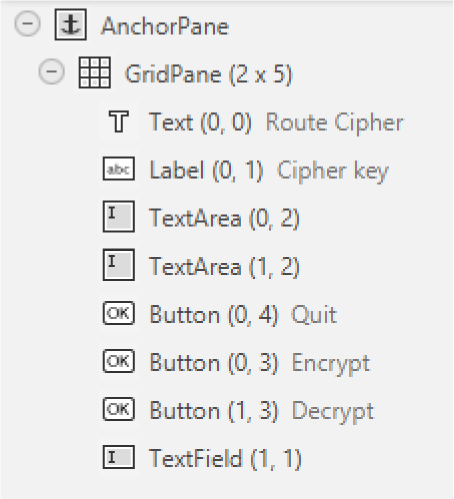
-5

abort the mission, you have been spotted

im ehseb tsede inevto tarnstho,po b youa

Hint: Read https://stackoverflow.com/questions/726756/print-two-dimensional-array-in-spiral-order and implement an algorithm to iterate through the elements of a rectangular array in a spiral pattern.

Sample structure of the GUI



- AnchorPane
  - GridPane (2 x 5)
    - Text (0, 0) Route Cipher
    - Label (0, 1) Cipher key
    - TextArea (0, 2)
    - TextArea (1, 2)
    - Button (0, 4) Quit
    - Button (0, 3) Encrypt
    - Button (1, 3) Decrypt
    - TextField (1, 1)

Submit the IntelliJ project with the problem solution, where comments inside the source code explain clearly the logic of the program