Programming and Data Structures
Active Learning Activity 2: Exception Handling and File IO

Activity Objectives

At the end of this activity, students should be able to:

1. Use regular expressions to validate user input
2. Create new Exception classes that extend Java class exceptions
3. Use Java Exception Handling mechanisms to throw and catch exceptions
4. Access text files for reading and writing

Activity

You are asked to write a program that allows the passengers to reserve seats in an airplane. An example of an airplane seat map is shown in figure 1 (9 rows numbered from 1 to 9, and 8 seats per row labeled 'A' to 'H'). The program displays the seat map with an '**`X`**' for the reserved seats and a '**`.`**' for the free seats. The program should allow the user to perform one of the following operations: `reserve a seat`, `free a seat`, or `quit` the program.

The program prompts the user to enter a seat number and reads it as a string, for example "1A" or "7C". A seat is reserved by assigning an 'X' to the seat location. If the seat has already been reserved, the program should display the error message "**`Seat unavailable`**". A seat is freed by assigning a '.' to its location. If the seat is already free, the program should display the error message "**`Seat already free`**". Your program must check if a seat number is valid (one digit, from 1 to 9, followed by a letter from 'A' to 'H') and should display the message "**`Invalid Seat number`**" if the seat number is invalid.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  X  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  .  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Figure 1: Simple airplane seat map

Your program should include the following classes:

1. Class **`InvalidSeatException`** that inherits Java class **`Exception`**. The class must have two constructors, a default constructor and one with a String parameter for the message of the exception.

2. Class **`Airplane`** described by the UML diagram below.

Airplane	
`-seatMap : char[][]`	2D array of characters holding '**`X`**' for occupied seats and '**`.`**' for free seats
`+Airplane()`	Creates the array **`seatMap`** with size 9 x 8 and initializes all the elements to **`'.'`**
`+Airplane(String filename)`	Creates the array **`seatMap`** with size 9 x 8 and calls the method **`readMap`** to initialize the array with the data in **`filename`**
`-readMap(String filename)`	Reads the data from the text file **`filename`** to initialize the array **`seatMap.`** If the file is not found, the elements of **`seatMap`** are all initialized to the character **`'.'`**
`-checkSeat`[1]`(String seat): Boolean throws InvalidSeatException`	Returns **`true`** if **`seat`** is valid, otherwise it throws an exception of type **`InvalidSeatException`**. The method should use regular expressions to check the seat number
`+reserveSeat`[2]`(String seat): Boolean throws InvalidSeatException`	Returns **`true`** if **`seat`** is reserved successfully (character '**`X`**' assigned to the seat), or **`false`** if the seat is already occupied, or throws the **`InvalidSeatException`** thrown by **`checkSeat()`**
`+freeSeat(String seat): Boolean throws InvalidSeatException`	Returns **`true`** if the seat is freed successfully (character '.' assigned to the seat), **`false`** if the seat is already free, or throws the **`InvalidSeatException`** thrown by **`checkSeat()`**
`+saveMap(String filename): void`	writes the contents of the array **`seatMap`** to the file `filename` (one row on each line)
`+toString(): String`	Returns the content of the array **`seatMap`** in the printable format shown in figure 1

[1] `checkSeat()` follows the declare rule for the exception `InvalidSeatException`

[2] `reserveSeat()` and `freeSeat()` follow the declare rule for the exception `InvalidSeatException`

3. A class **`SeatReservation`** with a main method to perform the following operations:

    a. Create the instance **`myAirplane`** of the class **`Airplane`** using the second constructor and passing the filename "`seatsmap.txt`" as the argument.
    b. Display the seat map of **`myAirplane`**
    c. Display a short menu to select one of the three operations: 1 to reserve a seat, 2 to free a seat, and 3 to quit the program.
    d. If the user selects the operation 1 or 2, prompt the user to enter a seat number
    e. In a try block, call the methods `reserveSeat()` for operation 1 or `freeSeat()` for operation 2. Display appropriate messages depending on the return value of each method. If the user enters an invalid seat number, the methods `reserveSeat` and `freeSeat` throw an `InvalidSeatException`. Your program should handle the exception and return to the menu of operations.
    f. If the user selects operation 3, call the method `saveMap()` to write the content of the seat map array to the file 'seatsmap.txt'.

Once your program runs correctly for all the cases (see sample runs below), submit the files **`InvalidSeatException.java`**, **`Airplane.java`**, and **`SeatReservation.java`** on Github. Make sure all your java files contain Javadoc comments.

Here are three consecutive sample runs of the program to use as a guide for testing your program.

---------- Run #1 ----------

```
    A  B  C  D  E  F  G  H
1   .  .  .  .  .  .  .  .
2   .  .  .  .  .  .  .  .
3   .  .  .  .  .  .  .  .
4   .  .  .  .  .  .  .  .
5   .  .  .  .  .  .  .  .
6   .  .  .  .  .  .  .  .
7   .  .  .  .  .  .  .  .
8   .  .  .  .  .  .  .  .
9   .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

2B

Seat 2B successfully reserved.

```
  A B C D E F G H
1 . . . . . . . .
2 . X . . . . . .
3 . . . . . . . .
4 . . . . . . . .
5 . . . . . . . .
6 . . . . . . . .
7 . . . . . . . .
8 . . . . . . . .
9 . . . . . . . .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

6F

Seat 6F successfully reserved.

```
  A B C D E F G H
1 . . . . . . . .
2 . X . . . . . .
3 . . . . . . . .
4 . . . . . . . .
5 . . . . . . . .
6 . . . . . X . .
7 . . . . . . . .
8 . . . . . . . .
9 . . . . . . . .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

4K

Invalid seat number (row[1-9]column[A-H]). Please try again.

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

4H

Seat 4H successfully reserved.

```
  A B C D E F G H
1 . . . . . . . .
2 . X . . . . . .
3 . . . . . . . .
4 . . . . . . . X
5 . . . . . . . .
6 . . . . . X . .
7 . . . . . . . .
8 . . . . . . . .
9 . . . . . . . .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

6F

Seat 6F already reserved.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  X  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  .  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

2

Enter a seat number:

2B

Seat 2B successfully freed.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  .  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

2

Enter a seat number:

3D

Seat 3D already freed.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  .  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

3

Thank you for using my airplane seat reservation program

---------- Run #2 ----------

(Note how the seat map from run #1 is read from the file seatsmap.txt)

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  .  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

8D

Seat 8D successfully reserved.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  X  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

4C

Seat 4C successfully reserved.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  X  .  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  X  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

1

Enter a seat number:

4D

Seat 4D successfully reserved.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  X  X  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  X  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

3

Thank you for using my airplane seat reservation program

---------- Run #3 ----------

(Note how the seat map from run #2 is read from the file seatsmap.txt)

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  X  X  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  X  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

2

Enter a seat number:

4C

Seat 4C successfully freed.

```
   A  B  C  D  E  F  G  H
1  .  .  .  .  .  .  .  .
2  .  .  .  .  .  .  .  .
3  .  .  .  .  .  .  .  .
4  .  .  .  X  .  .  .  X
5  .  .  .  .  .  .  .  .
6  .  .  .  .  .  X  .  .
7  .  .  .  .  .  .  .  .
8  .  .  .  X  .  .  .  .
9  .  .  .  .  .  .  .  .
```

Please select an operation:

1: Reserve a seat

2: Free a seat

3: Quit

3

Thank you for using my airplane seat reservation program