CS1083 Assignment # 8 – Fall 2021

Due: Wednesday, November 17th before 11:00 pm (Atlantic time) in the Desire2Learn Assignment 8 submission folder. (See submission instructions below).

The purpose of this assignment is:

- Review and practice recursion.

Preparation:

- Review the textbook examples on recursion from Ch. 12.

This assignment is to be done individually. If you have questions, direct them to a tutor/assistant during a help session in the "Faculty of Computer Science Student Success Centre" team or to your course instructor

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Question 1: Converting Hexadecimal to Decimal:

Write a **recursive method** to convert a String representing a hexadecimal number to its decimal equivalent. For example, `hexToDecimal("7ADC")` should return the `int` value `31452`.

Remember Hexadecimal values are base 16, so F in hexadecimal is 15 in decimal, and

FAC (in Hexadecimal) is $15 \times 16^2 + 10 \times 16^1 + 12 \times 16^0 = 4012$ (in decimal).

Write a main method that allows your hexToDecimal method to be used as a command line utility, that is, if at the command line you write:

`>java HexToDecimal FAC`

The output would be:
`4012`

Your hexToDecimal method should handle uppercase and lowercase characters, and throw an IllegalArgumentException (this is a class that Java has available to you already, so you don't need to create it) if an invalid Hexadecimal character is included.

Your main method should catch any potential exceptions (that might arise (including from providing no argument or from providing an invalid argument). An appropriate and informative message should be displayed if a problem exists.

Test your application using a variety of test cases to show it can properly handle the exceptions that may be thrown and that it works correctly for both upper- and lower-case characters.

Question 2: Finding the Area of a Cavern Recursively

Note: this question is taken from Assignment 3 but requires a **recursive solution** for this assignment.

Given a 2D map represented by a 2D array of int values, write a **recursive method that returns the area of a cavern**. Consider a 2D model of an underground natural gas storage facility. In a 2D model, instead of the volume of a stored gas, we will be calculating the area of the cross-section of the cavern.

Assume the cross-section of the underground storage facility is modelled in a 2D array with all empty space (caverns) marked with zeroes (0) and the salt space (walls) marked with ones (1). Assume the gas can travel between adjacent array cells representing the empty spaces (caverns) only horizontally or vertically, and not diagonally. Also note that there may be multiple caverns underground but ONLY ONE has an opening to the ground level that can be used as an entry point (location of the valve). That is, assume that there is one zero in the top row of the array (row 0) marking the opening (the valve) to the cavern to which we have access.

Write a program that first reads the size of an array (rows, columns) representing the cross-section of the underground storage facility, then reads the 2D array representing the cross-section of the underground storage facility, and then calculates and prints the area of the cavern to which we have access (the one with the opening to the ground level). This area is equal to the count of array cells forming the cavern, including the cell representing the opening to the surface (the valve). To track or mark the spaces that have been counted, you can change the 0's to another value (ie: 3). Assume that the data that is input to this program is valid (as defined in the previous paragraph).

An example data set is shown on the following page (0's in the cavern are changed to 3's).

Sample Input

```
8 7
1 1 1 1 1 0 1
1 0 0 1 0 0 1
1 1 1 0 0 0 1
1 1 0 0 1 1 1
1 0 1 0 1 0 1
1 0 1 0 0 0 1
0 0 0 1 1 1 0
1 1 1 0 0 0 1
```

Sample Output

```
1 1 1 1 1 3 1
1 0 0 1 3 3 1
1 1 1 3 3 3 1
1 1 3 3 1 1 1
1 0 1 3 1 3 1
1 0 1 3 3 3 1
0 0 0 1 1 1 0
1 1 1 0 0 0 1

The area of the cavern is: 13
```

Your program should ask the user to enter the name of a file containing a map, and then display a message describing the area of the cavern in the file. If any exception occurs, then they should be caught and you should inform the user with a helpful message.

Create three different map files to include with your solution (named map1.txt, map2.txt and map3.txt).

Submission instructions are on the next page.

For this assignment, only an electronic submission is required.

Your electronic submission (submitted via Desire2Learn) will consist of two files:

i. a written report. This should begin with a title page. As always, your title page should include: the course (CS 1083), the assignment number (Assignment #8 in this case), your full name, and your UNB student number. That should be followed by each part clearly identified with a section heading. Include:

    a. the source code for Question 1 & 2 (with Javadoc comments included)
    b. the sample output for Question 1 & 2 and the three input map files

    This written report should be prepared using a word processor; we recommend using Microsoft Word (i.e. create a .docx file for your report). Copy & paste your java source code & required output into the report document. Add appropriate headings for each part. Fix up the formatting where necessary, adjusting line breaks & page breaks to ensure that your document is easy to read. Use a monospaced font for your code to maintain proper indentation.) Once the report is complete and you've checked it all over, save the .docx file for your own records, and then **save a second copy in pdf format for submission**. (Note: Be sure to open that file in a pdf viewer to verify that the pdf was generated correctly.) The **SINGLE pdf file** containing your report will be submitted to the appropriate assignment submission folder on Desire2Learn. (It is important that you submit a pdf file and NOT the original Word document. This pdf will allow the marker to write comments directly on your work to give you better feedback.)

    Note: Please name this report as follows:
    YourName_As8_Report.pdf

ii. an archive file (.zip) that contains all your work for this assignment. Make sure that your archive includes **all source code** (.java files, input and output files - in case the marker wishes to compile & run your code). This archive should be submitted as a single file to the appropriate submission folder on Desire2Learn.

    Note: Please name this archive file as follows:
    YourName_As8_Archive.zip