UC BERKELEY EXTENSION

X436.2 Java: Discovering Its Power

Final Project
"Compliance Application for the Monitoring and Control of Waste Water Discharges to Receiving Bodies of Water in Mexico".

Student: Dante Guillermo Ruiz Martínez
Student ID: X067892

Instructor: Carl T. Limsico

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Program Description

Context:

I work for the National Commission of Water (CONAGUA) in Mexico doing economic analysis about the collection of duties coming from water abstraction and waste water discharges. In 2013, I participated in the design of a new methodology to price the water abstraction and the waste water discharges. Such pricing methodologies served to reform the National Duties Law, and since 2014 I have been participating in the implementation of this mechanics.

With respect to the compliance of the waste water discharges regulation, industries shall pay a duty for each cubic meter they dispose to a receiving body of water such as a river, a lake, an aquifer or the ocean. The duty is calculated in pesos per cubic meter. However, the law allows industries to exempt the payment of the duty, as long as, they provide a treatment to improve the quality of their waste waters. In order to do so they shall contract the services of an official laboratory that will obtain samples of their waste waters, which will also analyze them with special tests and equipment in the lab. A laboratory analysis of waste waters will comply with the environmental regulation, as long as, it demonstrate that the pollutants' concentrations remain below the maximum limits outlined in an official norm named NOM-001-SEMARNAT-1996.

Problematic:

Bearing this in mind, the results of the laboratory analysis of waste waters are captured in a system called SIRALAB that runs the tests of the maximums limits of pollutant concentration in a Web Serivce, which throws a boolean result that will enable or impede the industries to exempt the payment of duties in another system. However, the team of analysts, that audit such laboratory results to verify that the analysis comply with the regulation, requires a computer application that will allow them to input the laboratory results, and verify that each of the pollutants concentrations are under the maximum concentrations allowed by the environmental norm. Moreover, if one of such parameters exceeds such limits, they want to know which ones exceeded the limits and by how much. Finally, they need an application that can check the compliance of each laboratory analysis with the NOM-001-SEMARNAT-1996, and if necessary a mean to calculate the total amount of duties to be paid in a quarterly fiscal year.

Program name:

“Compliance Application for the Monitoring and Control of Waste Water Discharges to Receiving Bodies of Water**”.**

Program objective:

Simulate the monitoring and control activities that the Mexican National Commission of Water (CONAGUA) performs to enforce the regulation of industrial water pollution.

Program description:

The “Compliance Application for the Monitoring and Control of Waste Water Discharges to Receiving Bodies of Water” is a console program that was written in Java. The main purpose of this application is to model the activities that CONAGUA does to enforce the regulation of water quality in receiving bodies, and to encourage waste water treatment to diminish the water pollution generated by industries. In general, this program features the following functions:

- **Laboratory Results**. Stores in memory the laboratory results of waste water samples obtained from the discharges of a given industry.
    - Allows to input laboratory results for 9 concentrations of heavy metals according to the Mexican norm of quality of water in receiving bodies of waste water named NOM-001-SEMARNAT-1996.
    - Allows to generate a laboratory result in which the 9 concentrations of heavy metals are generated using random numbers.
    - Allows to load in the program existing laboratory results stored in XML documents.
- **Compliance Tests.** Performs a test that compares the laboratory results against the maximum levels of concentration of heavy metals in bodies of water according to the NOM-001-SEMARNAT-1996.
    - Compares maximum limits against observed results and generates a compliance result per parameter: complies or exceeds maximum limits.
    - Generates an overall compliance result (satisfactory/unsatisfactory).
    - Stores laboratory and compliance results by creating an XML document.
- **Interpretation documents.** For each laboratory results where a compliance test is performed, the program allows to generate a summary of the results in a text file. This is intended to provide analysts and top management with a document with relevant information for the decision making processes.
- **Duties payment estimations.** Calculates the total amount of duties in dollars to be paid by each industry that fails to comply with the regulation of water quality of waste waters in cubic meters. For such calculations the compliance test results, waste water discharged volume, industry classification and receiving bodies of water classifications are considered.

Finally, it is worth to point out that for purposes of this final project, the regulation model was simplified in order to build an easy and an understandable Java program, so that peers could understand its primary functions without any previous knowledge on Mexican waste water discharges and fiscal regulations.

Instructions

The following instructions are intended to help the new user to review all the features of this program for the first time.

I. Setting up

Running the program:

1. Import the archive package into your IDE (Eclipse, NetBeans, etc).
2. Open the waste water application folder.
3. Under the default package you will find the main class named App.java.
4. Run the main class to execute the program.

```
=================================== NATIONAL COMMISSION OF WATER ===================================

                        COMPLIANCE APPLICATION FOR THE MONITORING AND CONTROL
                       OF WASTE WATER DISCHARGES TO RECEIVING BODIES OF WATER


============================================== MAIN MENU ==============================================
Please select an option from the menu:

1. Add the results of a new laboratory analysis of waste water discharges.
2. Add the results of a new laboratory analysis of waste water discharges from an XML file.
3. Run a compliance analysis against the norm of quality of water in receiving bodies of waste water
4. Print laboratory and compliance results of an analysis to a text file.
5. Calculate waste water discharges duties.
6. List of registered analysis.
7. Display the maximum levels allowed of pollutants in receiving bodies of waste water.
0. Quit
Enter number option:
```

II. Adding a new analysis from scratch

In order to start using the the Compliance Application For The Monitoring and Control of Waste Water Discharges To Receiving Bodies of Water, a new analysis containing the laboratory results must be created.

1. Add a new analysis of waste water discharges to the program by typing option number **1** in the main menu.
2. Enter the name of the industry that generated the waste water discharge (e.g. **AT&T**)
3. Enter the name of the laboratory that performed the analysis of the waste water sample (e.g. **CHEM LABS**)
4. Enter the 4 character number that identifies the sample from the rest samples of the laboratory. (e.g. **1004** or **XY04**)

5. Enter the date when the sample was obtained from the point of discharge to the waste water receiving body. The date should be entered in the format DDMMYYYY (e.g. **25022015**)

To enter the laboratory results you may choose between two options: NEW or DEMO

- Entering NEW will prompt the user to enter each of the 9 heavy metals one by one. The data should be a number with decimals if required.
- Entering DEMO will allow the user to create an analysis whose 9 parameters will be created with random numbers. This option is encouraged in order to test the functionality of the application.

6. Enter **NEW** for our first case.
7. Start entering each of the 9 concentrations of heavy metals in mg/L.
    a. Arsenic: e.g. **0.1**
    b. Cadmium: e.g. **0.15**
    c. Cyanides: e.g. **0.9**
    d. Copper: e.g. **5.4**
    e. Chromium: e.g. **0.9**
    f. Mercury: e.g. **0.009**
    g. Nickel: e.g. **3.2**
    h. Lead: e.g. **2.9**
    i. Zinc: e.g. **17.0**

```
========================================== ADD ANALYSIS ==============================================

Instructions: To add a new analysis please enter the name of the industry that discharged the waste water
to a receiving body of water, then enter the name of the laboratory that obtained the sample of waste water,
then enter the identifier of the sample according to the laboratory management system.

Enter the industry name: AT&T
Enter the laboratory name: CHEM LABS
Enter sample number (4 character ID): 1004
Enter the date of the sample extraction (DDMMYYYY): 25022015

How do you wish to add the new analysis:
1. Type NEW to enter the result of each of the 9 pollutants.
2. Type DEMO to create the results of each of the 9 pollutants with random numbers.
NEW
Start entering pollutants' concentration:
Enter arsenic (mg/L): 0.1
Enter cadmium (mg/L): 0.15
Enter cyanides (mg/L): 0.9
Enter copper (mg/L): 5.4
Enter chromium (mg/L): 0.9
Enter mercury (mg/L): 0.009
Enter nickel (mg/L): 3.2
Enter lead (mg/L): 2.9
Enter zinc (mg/L): 17.0

New analysis was added to the system.
```

After entering the results of the 9 concentrations of heavy metals an analysis will be created and stored during the execution of the program. After that the program will return to the main menu.

Now we will add a second analysis using the **DEMO** option:

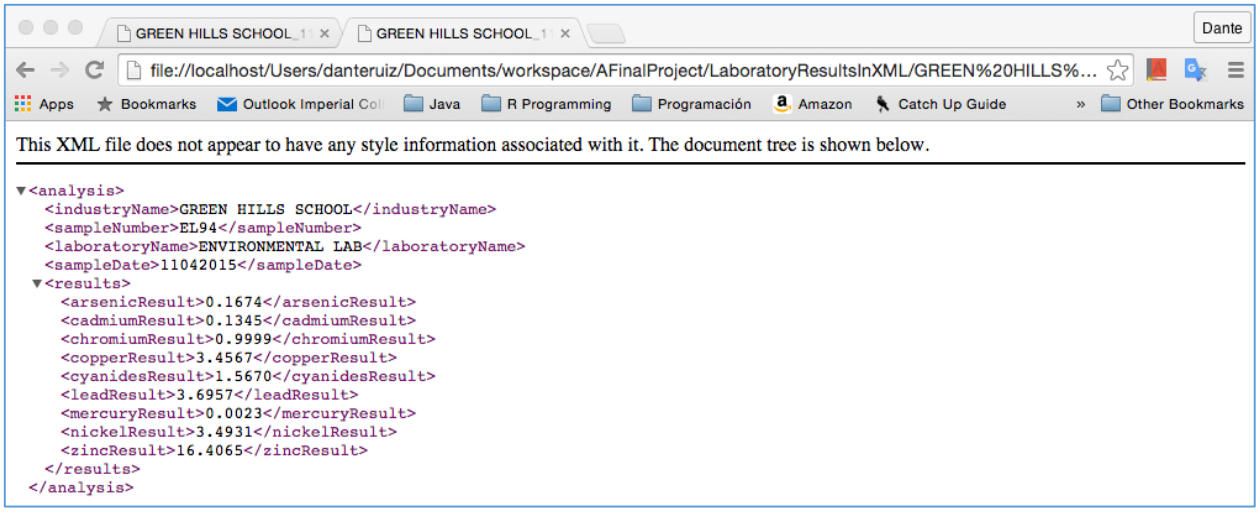
1. Add a new analysis of waste water discharges to the program by typing option number **1** in the main menu.
2. Enter the name of the industry that generated the waste water discharge (e.g. **BRITISH PETROLEUM**)
3. Enter the name of the laboratory that performed the analysis of the waste water sample (e.g. **ABC LABORATORIES**)
4. Enter the 4 character number that identifies the sample from the rest samples of the laboratory. (e.g. **1000**)
5. Enter the date when the sample was obtained from the point of discharge to the waste water receiving body. The date should be entered in the format DDMMYYYY (e.g. **25022015**)

```
========================================== ADD ANALYSIS ==============================================

Instructions: To add a new analysis please enter the name of the industry that discharged the waste water
to a receiving body of water, then enter the name of the laboratory that obtained the sample of waste water,
then enter the identifier of the sample according to the laboratory management system.

Enter the industry name: BRITISH PETROLEUM
Enter the laboratory name: ABC LABORATORIES
Enter sample number (4 character ID): 1000
Enter the date of the sample extraction (DDMMYYYY): 25022015

How do you wish to add the new analysis:
1. Type NEW to enter the result of each of the 9 pollutants.
2. Type DEMO to create the results of each of the 9 pollutants with random numbers.
DEMO

New analysis was added to the system.
```

A new analysis will be created whose concentrations will be set to random values. It is worth to point out that this feature is solely for demonstration purposes.

III. Adding a new analysis from an XML file

With the purpose of reading analysis from a database that contains XML documents the program supports a DOM parser that will read the laboratory results and will add them to the program, instead of entering one by one the concentration of each laboratory analysis. In this sense, for purposes of demonstration this Java Project has been populated with three XML laboratory results stored in the root of the project under the directory LaboratoryResultsInXML.



To load a new analysis:

1. Add a new XML file by entering option number **2** in the main menu.
2. The program will check the LaboratoryResultsInXML directory and will list all the available laboratory results stored in XML documents.
3. Copy the file name of the laboratory result of your interest, and then paste it in the console where it asks to enter the file name. (e.g. **GREEN HILLS SCHOOL_11042015_EL94.xml**)

```
============================ LOAD A NEW LABORATORY RESULT FROM AN XML DOCUMENT ============================
The following is a list of all XML documents containing laboratory results in the default directory:

File name:
1. CEDAN_25022015_EL01.xml
2. GREEN HILLS SCHOOL_11042015_EL94.xml
3. SOCIAL SECURITY HOSPITAL_11092015_EL23.xml

Choose the XML file that you want to parse and add to the Laboratory Results in the system:
Enter the file name: GREEN HILLS SCHOOL_11042015_EL94.xml
The document was successfully loaded into the system.
Starting to parse results...

The new laboratory results were successufully created. You may now see them in the list of analysis.
```

The program will display a message that the laboratory results have been successfully created, and the program will return to the main menu.

IV. Listing all the available laboratory results loaded to the program

In order to verify which analysis has been uploaded, the program supports an option in the main menu that allows to display this information.

1. Choose the option number **6** to list all the registered analysis.

```
This is a list of all laboratory analysis stored in inverntory:

                Industry        Date        Sample No.          Laboratory        Compliance Test

                    AT&T    25022015              1004          CHEM LABS                  false
       BRITISH PETROLEUM    25022015              1000      ABC LABORATORIES               false
      GREEN HILLS SCHOOL    11042015              EL94     ENVIRONMENTAL LAB               false
```

You will see a table that will show all of the analysis uploaded to the program by their industry name, date, sample number, laboratory name and compliance test. Then the program will return to the main menu.

V. Displaying the maximum limits allowed of heavy metals in receiving bodies of waste water

This application was designed with the purpose of helping CONAGUA to validate the results of the laboratory analysis against the maximum levels allowed in the NOM-001-SEMARNAT-1996. The analyst will verify that each of the 9 heavy metals concentrations in each laboratory analysis comply with the maximum levels allowed of concentrations. That means that in order for an industry to comply with this norm each of its 9 heavy metals should remain under the maximum limits allowed.

To display the maximum levels of heavy metals according to the NOM-001-SEMARNAT-1996:

1. Choose option **7** from the main menu to display the maximum limits allowed of concentrations of heavy metals in mg/L.

```
=============== MAXIMUM LEVELS ALLOWED OF POLLUTANTS IN RECEIVING BODIES OF WASTE WATER ===============

According to the Mexican Official Norm of Quality of Water in Receiving bodies of waste water
NOM-001-SEMARNAT-1996 the maximum concentrations in (mg/L) of heavy metals are:

 Pollutant      Concentration   Units
   Arsenic              0.2     mg/L
   Cadmium              0.2     mg/L
  Chromium              1.0     mg/L
    Copper              6.0     mg/L
  Cyanides              2.0     mg/L
      Lead              4.0     mg/L
   Mercury             0.01     mg/L
    Nickel              4.0     mg/L
      Zinc             20.0     mg/L
```

The program will display the information and return to the main menu.

VI. Running a compliance test of a laboratory analysis results against the NOM-001-SEMANRANT-1996.

The program will verify the laboratory results of an analysis that the user will indicate. It will check each of the concentrations of the pollutants against its maximum levels allowed and will store a compliance result for each pollutant. Such result may contain a “exceeds” or “complies” tag. Furthermore, this test will assign an overall tag to the total result of the analysis. That means that if all pollution parameters are under the maximum levels allowed, then the overall result of the laboratory analysis will be assigned a “satisfactory” tag.

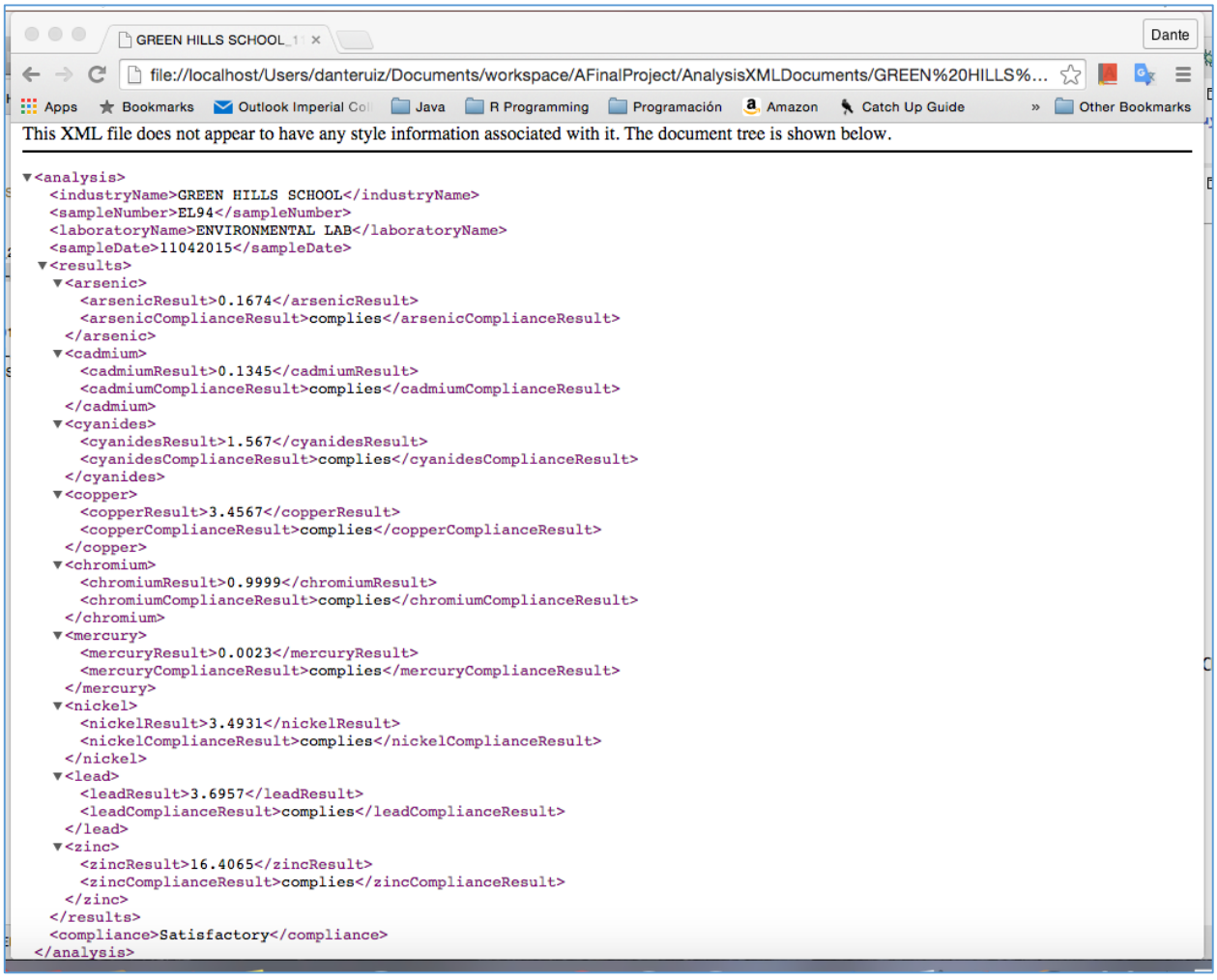
1. Choose option number **3** from the main menu
2. The program will display all the available laboratory results that have been uploaded, as in option **6**.
3. Choose a laboratory analysis by entering the industry name (e.g. **GREEN HILLS SCHOOL**)
4. Choose the corresponding sample number (e.g. **EL94**)

```
================ RUN A COMPLIANCE TEST AGAINST THE MAXIMUM LEVELS ALLOWED OF POLLUTANTS ================

This is a list of all laboratory analysis stored in inverntory:

                Industry            Date        Sample No.           Laboratory        Compliance Test

                    AT&T        25022015              1004           CHEM LABS                  false
       BRITISH PETROLEUM        25022015              1000      ABC LABORATORIES                false
      GREEN HILLS SCHOOL        11042015              EL94     ENVIRONMENTAL LAB                false

Select the analyisis to verify its compliance against the laws.
Enter industry name: GREEN HILLS SCHOOL
Enter sample number: EL94
Compliance of the Maximum Pollution Concentration Levels
=======================================================
Laboratory name: ENVIRONMENTAL LAB
Industry name: GREEN HILLS SCHOOL
Sample number: EL94
Sample date: 11042015

 Pollutant          Result
  Arsenic:        complies
  Cadmium:        complies
 Cyanides:        complies
   Copper:        complies
 Chromium:        complies
  Mercury:        complies
   Nickel:        complies
     Lead:        complies
     Zinc:        complies

Overall Result: Satisfactory
Validating analysis: EL94       GREEN HILLS SCHOOL
```

The information provided by the user will be validated. If the information is correct it will display the final result of the compliance test. This will show each pollutant and its compliance result. Moreover, it will provide the Overall Compliance Result.

```
An XML document has been created to store the results of this waste water sample analysis
The path of the file is: /Users/danteruiz/Documents/workspace/AFinalProject/AnalysisXMLDocuments/GREEN HILLS SCHOOL_11042015_EL94.xml

The analysis was stored in an XML file.
```

It is worth to point out that these results will be stored in an XML document in the directory named AnalysisXMLDocuments located in the root directory of the Java Project. You will need to refresh your directory so the XML document may be displayed. Finally, it will mark the laboratory analysis Compliance Test variable as **TRUE**. This is important because it will enable to use this analysis.



VII. Printing the laboratory and compliance results to a text file

The program supports the functionality of printing the results of both laboratory results and the compliance test so it could be easily read by analysts or decision makers. The results are printed to a text file that will be stored in the directory named AnalysisTextResults in the root of the Java Project.

To print the results to a text file:

1. Choose option number **4** from the main menu
2. The program will display all the available laboratory results that have been uploaded and the compliance test has value **true.**
3. Choose a laboratory analysis by entering the industry name (e.g. **GREEN HILLS SCHOOL**)
4. Choose the corresponding sample number (e.g. **EL94**)

```
======================== PRINT ANALYSIS AND COMPLIANCE RESULTS TO A TEXT FILE ========================

This is a list of all waste water analysis compliance results:

                Industry            Date        Sample No.           Laboratory        Compliance Test

      GREEN HILLS SCHOOL         11042015              EL94     ENVIRONMENTAL LAB                   true

Enter industry name: GREEN HILLS SCHOOL
Enter sample number: EL94
The analysis was successuflly written to a textfile
Path: /Users/danteruiz/Documents/workspace/AFinalProject/AnalysisTextResults/GREEN HILLS SCHOOL_11042015_EL94.txt
```

The text file will be printed and you may be able to open it in the directory specified. However, before you will need to refresh your directory so the new analysis may appear.

GREEN HILLS SCHOOL_11042015_EL94.txt

```
National Commission of Water
Waste Water Discharges Compliance Results

  Industry name:        GREEN HILLS SCHOOL
  Sample number:                    EL94
Laboratory name:        ENVIRONMENTAL LAB
    Sample date:               11042015

 Pollutant      Concentration Compliance
   Arsenic      0.167400          complies
   Cadmium      0.134500          complies
  Cyanides      1.567000          complies
    Copper      3.456700          complies
  Chromium      0.999900          complies
   Mercury      0.002300          complies
    Nickel      3.493100          complies
      Lead      3.695700          complies
      Zinc      16.406500         complies

Overall compliance result: Satisfactory
```

VIII. Calculating the total amount of duties for using bodies of water to discharge waste water.

Most of the time analysts want to know how much will an industry pay for duties in the case that the discharges do not comply with the maximum limits allowed of heavy metals indicated in the NOM-001-SEMARNAT-1996. That is why this application features a duties calculator. Only analysis that have been tested for compliance may be able to use this feature.

1. Choose option **5** in the main menu to go to the Waste Water Discharges Duties Calculator.
2. Choose an analysis whose compliance test is marked as **true**, and enter the industry name (e.g. **GREEN HILLS SCHOOL**).
3. Enter the sample number (e.g. **EL94**)
4. Enter the industry classification (e.g. **services**)
5. Enter the classification of the body of water (e.g. **river**)
6. Enter the waste water discharged (eg. **1000**).

```
============================ WASTE WATER DISCHARGES DUTIES CALCULATOR ==============================

is is a list of all laboratory analysis stored in inverntory:

               Industry            Date        Sample No.           Laboratory        Compliance Test

                   AT&T        25022015              1004            CHEM LABS                  false
      BRITISH PETROLEUM        25022015              1000      ABC LABORATORIES                 false
     GREEN HILLS SCHOOL        11042015              EL94     ENVIRONMENTAL LAB                  true

lect the analyisis to run the economic analysis
ter industry name: GREEN HILLS SCHOOL
ter sample number: EL94
ter the industry classification (services, food, heavy industry, petroleum): services
ter the classification of the body of water (river, lake, ocean, aquifer): river
ter the volume of waste water discharged (cubic meters) to the body of water during the quarter of the year: 1000

scharged volume (m3): 1000.00
ties rate ($/m3): 1.00

EEN HILLS SCHOOL has to pay 0.00 dollars for this quarter fiscal year.
```

The program will display the duties rate by cubic meters, the volume discharged in cubic meters and the total amount of duties to be paid by the industry. In the case that the industry complies with all parameters of the NOM-001-SEMARNAT-1996 the total amount will be zero dollars because the fiscal benefit that clean industries are granted is the exemption of the payment of duties. Finally, since the frequency of sampling waste water is quarterly during the year, the waste water discharged volume to be reported should correspond to a quarter, and therefore the total amount of duties to be paid corresponds to a fiscal quarter.

Now we will repeat the same process and we will calculate the duties for another analysis. However, first we need to run a compliance test.

1. Choose option number **3** from the main menu
2. The program will display all the available laboratory results that have been uploaded.
3. Choose a laboratory analysis by entering the industry name (e.g. **BRITISH PETROLEUM**)
4. Choose the corresponding sample number (e.g. **1000**)

```
=============== RUN A COMPLIANCE TEST AGAINST THE MAXIMUM LEVELS ALLOWED OF POLLUTANTS ===============

This is a list of all laboratory analysis stored in inverntory:

                Industry            Date        Sample No.           Laboratory        Compliance Test

                    AT&T        25022015              1004           CHEM LABS                  false
       BRITISH PETROLEUM        25022015              1000      ABC LABORATORIES                false
      GREEN HILLS SCHOOL        11042015              EL94     ENVIRONMENTAL LAB                 true

Select the analyisis to verify its compliance against the laws.
Enter industry name: BRITISH PETROLEUM
Enter sample number: 1000
Compliance of the Maximum Pollution Concentration Levels
=====================================================
Laboratory name: ABC LABORATORIES
Industry name: BRITISH PETROLEUM
Sample number: 1000
Sample date: 25022015

 Pollutant          Result
  Arsenic:         exceeds
  Cadmium:         exceeds
 Cyanides:        complies
   Copper:         exceeds
 Chromium:        complies
  Mercury:         exceeds
   Nickel:         exceeds
     Lead:         exceeds
     Zinc:         exceeds

Overall Result: Unsatisfactory
Validating analysis: 1000       BRITISH PETROLEUM
```

Now run the Waste Water Discharges Duties Calculator.

1. Choose option **5** in the main menu to go to the Waste Water Discharges Duties Calculator.
2. Choose an analysis whose compliance test is marked as true, and enter the industry name (e.g. **BRITISH PETROLEUM**).
3. Enter the sample number (e.g. **1000**).
4. Enter the industry classification (e.g. **petroleum**).
5. Enter the classification of the body of water (e.g. **ocean**).
6. Enter the waste water discharged in cubic meters (eg. **2000**).

```
============================== WASTE WATER DISCHARGES DUTIES CALCULATOR ==============================

This is a list of all laboratory analysis stored in inverntory:

                Industry            Date        Sample No.           Laboratory        Compliance Test

                    AT&T        25022015              1004            CHEM LABS                  false
       BRITISH PETROLEUM        25022015              1000      ABC LABORATORIES                   true
      GREEN HILLS SCHOOL        11042015              EL94     ENVIRONMENTAL LAB                   true

Select the analyisis to run the economic analysis
Enter industry name: BRITISH PETROLEUM
Enter sample number: 1000
Enter the industry classification (services, food, heavy industry, petroleum): petroleum
Enter the classification of the body of water (river, lake, ocean, aquifer): ocean
Enter the volume of waste water discharged (cubic meters) to the body of water during the quarter of the year: 2000

Discharged volume (m3): 2000.00
Duties rate ($/m3): 15.00

BRITISH PETROLEUM has to pay 30000.00 dollars for this quarter fiscal year.
```

The compliance test showed that the industry's waste water discharges do not comply with the maximum limits allowed of concentrations of heavy metals of the NOM-001-SEMARNAT-1996. Therefore, BRITISH PETROLEUM will pay duties for the first fiscal year of 2015 for a total amount of 30,000 dollars.

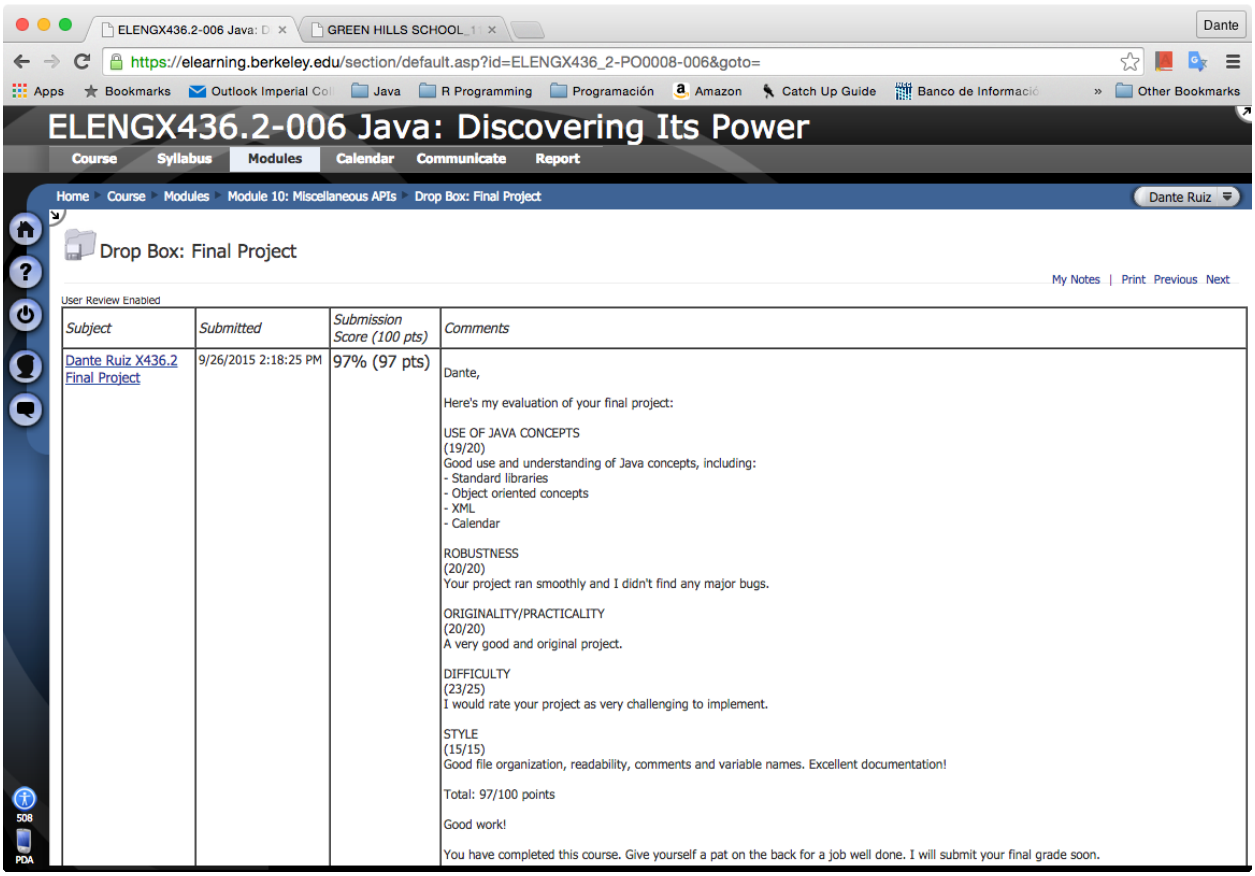
Documentation

The classes, methods, fields and constants of this program were properly documented throughout the code, and the appropriate Java Documentation was generated using the Eclipse IDE.

Software

This project was coded using Java SE 8 JDK and the Eclipse IDE for Java Developers version Mars Release (4.5.0)

FINAL GRADE


ELENGX436.2-006 Java: D
GREEN HILLS SCHOOL_1
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R Programming
Programación
Amazon
Catch Up Guide
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Syllabus
Modules
Calendar
Communicate
Report
Home
Course
Modules
Module 10: Miscellaneous APIs
Drop Box: Final Project
Dante Ruiz
Drop Box: Final Project
My Notes | Print Previous Next
User Review Enabled
Subject
Submitted
Submission Score (100 pts)
Comments
Dante Ruiz X436.2 Final Project
9/26/2015 2:18:25 PM
97% (97 pts)
Dante,
Here's my evaluation of your final project:
USE OF JAVA CONCEPTS
(19/20)
Good use and understanding of Java concepts, including:
- Standard libraries
- Object oriented concepts
- XML
- Calendar
ROBUSTNESS
(20/20)
Your project ran smoothly and I didn't find any major bugs.
ORIGINALITY/PRACTICALITY
(20/20)
A very good and original project.
DIFFICULTY
(23/25)
I would rate your project as very challenging to implement.
STYLE
(15/15)
Good file organization, readability, comments and variable names. Excellent documentation!
Total: 97/100 points
Good work!
You have completed this course. Give yourself a pat on the back for a job well done. I will submit your final grade soon.
508
PDA