CS116

LAB 2- 2 points

This lab is using material covered in CS115 and it is intended as a review. It also includes some new concepts. Lab. assignments function a straining for the concepts and to prepare you for the closed book exams.

It is due on February 12, on Blackboard time stamped by 10:00 p.m. If you need an extension up to two days you have to send an email requesting so.

Use EditPlus (or similar text editor, except Eclipse) to create source code.

Create 2 folders named Task1 and Task2 and place the appropriate files from each task described below in the appropriate folder.

Objectives:

1. Create a template (Service) class.
2. Using enumeration.
3. Using packages.
4. Create a client class for the service class.
5. Using static variables.
6. Use String pre defined class methods.
7. Using the Scanner object to receive input from the user.
8. Using Arithmetic Operations (precedence of arithmetic operators).
9. Reading data Command Line.
10. Reading data from the keyboard using the scanner object
11. Reading a text file for data using the scanner object.
12. Using arrays of objects.
13. Using the StringTokenizer or the split method of the String library class
    i.e An alteranative to using the StringTokenizer is to use the split method of the String class.
    If for instance the String to be tokenized is String str="12,the,2.3" and the dilimeter is comma (,)
    String [] mytokens= str.split(",")
    The tokens need to be retrieved from the array mytokens.

Brief Theory

Enumerations are classes. They are used to keep track (enumerate) a list of constant values that can be used by another class or classes. The data of the enumeration are not Strings or any other particular data type. They are objects of the class that represents the enumeration. As an example, suppose our program was to use the days of the week repeatedly. One option, of

course, is to create an array of Strings and enter the names of the 7 days as Strings in the array, then retrieve them from the array as needed. Another option is to create an enumeration class i.e

```
package myfolder;
public  enum  MyDays{SUNDAY,MONDAY,TUESDAY,WEDNESDAY,THURSDAY,FRIDAY,SATURDAY};
```

enum is a keyword. The data (names of the days) is called the “members of the enumeration”. Compile the class like a normal class using command line because of the package requirement in this example:

```
 >javac   -d .  MyDays.java
```

This command creates the folder myfolder and places inside the folder the file MyDays.class.

To use it in another class you can declare an instance of the enumeration class i.e

```
public class MyServiceClass
{
  MyDays md=null;
```

The reference md is now an instance variable of the class. As such, it needs its own accessor and mutator methods

i.e.

```
public  MyDays getMd()
{
        return md;
}

public void setMd(MyDays myda)
{
        md=myda;
}
```

The value of a member data of the enumeration can also be called by using for example:

MyDays.SUNDAY

You use the name of the enumeration followed by the particular member. Using the members of the enumeration as Strings is a mistake!!! i.e using “SUNDAY” with double quotation marls is a mistake. Enumeration member data ARE NOT STRINGS!

Please download and read the document : ConvertingStringsToEnumTypes.doc (go to the course ' s web site, posted under Date: 2/3 in the schedule).

Task 1 (1.0 points)

Physics Theory

Nearly all substances expand when they are heated and contract when they are cooled. Each material has a *coefficient of linear expansion* associated with it. Let us assume that we have rods of various materials.

The formula that gives the extended length (assuming a rod of a particular material) is:

1. **DL=a*L*DT**

Where **DL is the change in length** in inches, **a is the coefficient of thermal expansion** per degree Fahrenheit, L is the original length in inches of the material and DT is the change in temperature in degrees Fahrenheit

We could also calculate the amount of force that will achieve the same expansion at constant temperature using the material's Young's modulus expansion coefficient.

The formula for calculating the amount of force required to achieve an expansion in length DL is:

2. **F=Y*A*DL / L**

Where **F is the force** in lbs, **Y is Young's modules** coefficient in lbs/square inch at room temperature (although this coefficient is not constant we will assume that for relatively small variations in temperature the coefficient remains constant), **A is the cross-sectional area** of the rod in square inches, **DL is the expansion in inches and L is the original length in inches.**

Let us assume that in the program all the units are correct so that we don't have to worry about units (just numbers).

Program Description-

- Purpose of program
  We have categories of materials. Within each category there are materials whose thermal properties and sizes are recorded in a text file. Our program should calculate : 1) the expansion of a rod given the change in temperature 2) the force require dto achivethe same expansion at constant temperature 3) certain statistics based on the data.
- First create a folder called Task1. The required files described below should be placed in this folder.

- Create an enumeration and a template (service) class for Rod.

I. Create an enumeration class called: MaterialCategories. The enumeration has values: AluminumBased, Metals, Cellulose, Glass.
This enumeration is packaged in package **yourfirstname.yourlastname. (name the package with your actual first and last name)**. Notice that the package should be declared at the very top of the file before the enum is decalred.
Save the enumeration class in file MaterialCategories.java.
Compile it using the proper command line command so that the compiler will create the package (not you)!!

II. Develop a service class called Rod.
The class Rod (just like the enumeration above) should be placed in the **package yourfirstname.yourlastname**
(name the package with your first and last name). Notice that the package should be declared at the very top of the file before the start of the code for the Rod class.

The data type that we are going to represent in this program is a Rod.

Write a class that represents rods of various materials. The class has attributes (instance variables) that track: a) the category of the material (from the enumeration created above) , **the name of the material of the rod**, **the cross-sectional area** of the rod**, the length** of the rod.

1. Declare and initialize the instance variables **. You decide on the data types for the attributes. Include also the proper attributes so that the id number of each Rod object can also be tracked and displayed.**

2. Create a default and non default constructors.

   The default constructor initializes the instance variables of the class to values: null, "any", -0.1, -0.1 (in the order the instance variables are described above) and also sets the proper id value for the object.

   Create a non default constructor which takes **as arguments** the **name of the material**, the **cross sectional area** of the rod , and the **length** of the rod (nothing else- NOTICE THAT THE ENUMERATION IS NOT AN ARGUMENT NEITHER IS THE ID) and initializes the corresponding instance variables of the class to the values of the arguments (the enum attribute remains null, the client need sto call th emutator method to set its value). **The constructor also sets the proper value for the id of the object.**

3. Write all the accessor and mutator methods and the toString method **. Include the accessor and mutator for the instance variable representing the enumeration**

MaterialCategories. Make sure that the enumeration variable appears in the toString returned String.

4. Write an equals method. Two rods are equal if the name of the material and the category of the material **only** are the same.

5. Write a helper method called calculateExpansion. The method takes as argument a change in temperature value (**DT**) (double data type) and a value for the coefficient of thermal expansion (listed as **a** in formula 1 above). It calculates the change in length for the material (DL), and returns it. The expansion is calculated to the **fourth** decimal point only using DecimalFormat.

6. Write another helper method called calculateForce. The method takes as argument the Young's modules value (**Y)** and the value of length change (**DL**) and it returns the value of the force required to achieve the expansion of the rod. **Since the calculation of the force involves a fraction, the method makes sure first that the value of length is not zero or negative**. If the length is zero or negative the method returns the value -1.0 (which means that it can't finish the calculation). Else if the value of the length is positive then it calculates the force and sets the force and returns the value. The force is calculated to the second decimal place using **DecimalFormat** .

7. Use the proper command line command to compile this file and to have the compiler place it in the right package.

TASK 2 (1.0 points)

1. Write a class that uses the class Rod. The name of this class is: RodClient and it has a main method. This class should packaged in package *yourfirstname* (write your first name as used in the package for the service class).

2. This program reads a file by the name ***coefficients.txt*** that has information about different materials (data for the text file is provided below). Each line in the text file has the following data:

   The category the material belongs to, the **name of the material**, **the cross sectional area** of the rod (the **A in formula 2**), **the length** of the rod (**the L in formulas 1 & 2**), **the coefficient of thermal expansion per degree Fahrenheit (the a in formula 1), the Young's modulus coefficient** in Lbs/square inch (**the Y in formula 2**). You **can't** assume that you know in advance the number of lines in the text file, therefore DO NOT set the size of arrays to fixed values!

3. Create the text file with the data given below (Don't worry about the units):

   AluminumBased,Aluminum,1.25,2.5,0.000013,10000000

Metal,Brass,2.25,25.0, 0.00001,13000000

Metal,Copper,2.25,25.0,0.0000094,16000000

Cellulose,CelluloseAcetate,2.5,5.0,0.000130,20000000

Metal,Lead,2.25,25.0, 0.000017,2300000

Glass,Hard,0.4,3.0,0.0000059,90000000

Metal,Steel,2.25, 25.0,0.0000067,29000000

Metal,Iron,2.25,25.0, 0.0000067,13000000

AluminumBased,AlumAlloy,1.25,2.5,0.0000023,10200000

Cellulose,CelluloseNitrate,2.5,5.0,0.000100,50000000

Glass,Pyrex,0.4,3.0,0.000004,17000000

AluminumBased,Aluminum,0.25,3.5,0.000013,10000000

Metal,Lead,1.25,5.0, 0.000017,2300000

Metal,Iron,0.25,25.0, 0.0000067,13000000

Glass,Pyrex,1.4,3.0,0.000004,17000000

Cellulose,CelluloseAcetate,6.5,25.0,0.000130,20000000

4. The program reads the text file,it creates a Rod object for each line of data read (usingteh first 4 pieces of data) and stores the object into an array. The last two pieces of a data of a line should be saved in corresponding data type arrays, so that you can use them further down for calculations in the formulas when needed**.**

5. Next, the program uses the scanner object to obtain information from the user (keyboard) for the desired change in temperature number for each Rod object in the array of Rod objects. The program iterates through the array of Rod objects . For each object an input is required from the user. The program asks:

   System.out.println("Please enter the change in temperature for material+(place here the name of the material from the array of Rod objects));

   Use the change in temperature value, provided by the user, **to calculate the value of the expansion DL for the material and the value of the force required (by invoking the helper methods you created in the service class)**.

   Save the Force values in another array as they get calculated.

As you iterate through the loop that sustains user input from the keyboard, you might as well provide the first output described below.

6. **Program Outputs (display on screen)**

   - Output the calculated values **for DL (thermal expansion) and F (the force required)** for each input temperature provided by the user (while you are still within the loop that sustains user input). Also, make sure that there is code so that if you sense that the Force value returned was -1, a statement is outputted for that force value like : **This force could not be calculated because the length was zero or less.**

   In addition after the above calculations and output provide the following two outputs.

   - Output the value of the largest force of all forces calculated i.e **System.out.println("The highest force found is"+" "+…output the value here……..** +

     followed by the rod objects attribute values (the one that requires the largest force) using the toString method .

   - Next output the attributes of all the Rod objects from the array of Rod type by using toString().

7. Finally, there is one more functionality needed in this class. The program in order to provide output needs to know in advance that there is a text file with the data. The user of the program verifies that by typing the phrase textexists command line or the phrase notready. If the program senses the input textexists, it runs and provides the outputs described above. If the program senses notready it runs and provides the message "I can't provide data unless the text file is ready".

   i.e in order to start the program you will have to type command line:

   >java yourfirstname.RodClient textexists

   Or

   >java yourfirstname.RodClient notready

8. Compile the client class with the proper command line command in order for the compiler to place it in the proper package.

9. REMINDER: Since the enum and the service classes reside in a different folder than the client class, both of them need to be imported in the client class!!!!!

Example output of the program is listed below:

C:\CS116\SPRING2014\Labs\Lab2\Lab2Solution>**java firstname.RodClient notready**
I can't provide data unless the text file is ready

C:\CS116\SPRING2014\Labs\Lab2\Lab2Solution>**java firstname.RodClient textready**
C:\CS116\SPRING2014\Labs\Lab2\Lab2Solution>**java firstname.RodClient textready**
Please enter the temperature change for material: Aluminum
23
_____FIRST OUTPUT REQUIRED_____
The expansion is: 7.0E-4
The force is= 3500.0
Please enter the temperature change for material: Brass
40
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.01
The force is= 11700.0
Please enter the temperature change for material: Copper
37
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0087
The force is= 12528.0
Please enter the temperature change for material: CelluloseAcetate
89
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0578
The force is= 578000.0
Please enter the temperature change for material: Lead
100
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0425
The force is= 8797.5
Please enter the temperature change for material: Hard
150
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0027

The force is= 32400.0
Please enter the temperature change for material: Steel
10
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0017
The force is= 4437.0
Please enter the temperature change for material: Iron
26
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0044
The force is= 5148.0
Please enter the temperature change for material: AlumAlloy
56
_____FIRST OUTPUT REQUIRED_____
The expansion is: 3.0E-4
The force is= 1530.0
Please enter the temperature change for material: CelluloseNitrate
90
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.045
The force is= 1125000.0
Please enter the temperature change for material: Pyrex
36
_____FIRST OUTPUT REQUIRED_____
The expansion is: 4.0E-4
The force is= 906.67
Please enter the temperature change for material: Aluminum
22
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.001
The force is= 714.29
Please enter the temperature change for material: Lead
35
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.003
The force is= 1725.0
Please enter the temperature change for material: Iron

56
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0094
The force is= 1222.0
Please enter the temperature change for material: Pyrex
200
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.0024
The force is= 19040.0
Please enter the temperature change for material: CelluloseAcetate
250
_____FIRST OUTPUT REQUIRED_____
The expansion is: 0.8125
The force is= 4225000.0
_____SECOND OUTPUT REQUIRED_____
The greatest force required is: 4225000.0
The rod that requires the largest force is: The category is: Cellulose The name of the material is CelluloseAcetate The length is 25.0 The cross area
is 6.5 the object id is 16

--------THIRD OUTPUT REQUIRED_____
The category is: AluminumBased The name of the material is Aluminum The length is 2.5 The cross area is 1.25 the object id is 1
The category is: Metal The name of the material is Brass The length is 25.0 The cross area is 2.25 the object id is 2
The category is: Metal The name of the material is Copper The length is 25.0 The cross area is 2.25 the object id is 3
The category is: Cellulose The name of the material is CelluloseAcetate The length is 5.0 The cross area is 2.5 the object id is 4
The category is: Metal The name of the material is Lead The length is 25.0 The cross area is 2.25 the object id is 5
The category is: Glass The name of the material is Hard The length is 3.0 The cross area is 0.4 the object id is 6
The category is: Metal The name of the material is Steel The length is 25.0 The cross area is 2.25 the object id is 7
The category is: Metal The name of the material is Iron The length is 25.0 The cross area is 2.25 the object id is 8

The category is: AluminumBased The name of the material is AlumAlloy The length is 2.5 The cross area is 1.25 the object id is 9
The category is: Cellulose The name of the material is CelluloseNitrate The length is 5.0 The cross area is 2.5 the object id is 10
The category is: Glass The name of the material is Pyrex The length is 3.0 The cross area is 0.4 the object id is 11
The category is: AluminumBased The name of the material is Aluminum The length is 3.5 The cross area is 0.25 the object id is 12
The category is: Metal The name of the material is Lead The length is 5.0 The cross area is 1.25 the object id is 13
The category is: Metal The name of the material is Iron The length is 25.0 The cross area is 0.25 the object id is 14
The category is: Glass The name of the material is Pyrex The length is 3.0 The cross area is 1.4 the object id is 15
The category is: Cellulose The name of the material is CelluloseAcetate The length is 25.0 The cross area is 6.5 the object id is 16

C:\CS116\SPRING2014\Labs\Lab2\Lab2Solution>

Submission instructions

- In your submission you must include

    a. The source code file and the compiled file from Task 1 in the correct package. Place them in a folder named Task 1.
    b. The source code files and the compiled files required for Task 2 in the proper package. Place them in a folder Task2.

- Zip all files and folders and name the zip file using your first name followed by your last name followed by lab1.

    i.e. George_KayLab2.zip

- Upload the file to the proper **assignment folder** (Lab 2)on Blackboard by 10:00 p.m. on the due date (Blackboard time stamps automatically)