PCC-CS593: Object Oriented Programming Laboratory Assignments

Instructor: Kamalesh Karmakar, Assistant Professor, CSE, TINT.

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1 CLASS, OBJECTS, CONSTRUCTORS

1.1 Question

Design a class **Time** which contains hour, minute and second as instance variables. The class should have the methods to support the following:

1. A Constructor to initialize instance variables with values.
2. A Constructor to initialize instance variables with default values.
3. Take the time as input in 24-hour format.
4. Display the time in AM/PM format.

1.2 Question

Design a **Complex** class, which have two integer values for real and imaginary part ($c = x + iy$). The class should have the methods to support the following operations:

1. Addition to calculate $c1 = c1 + c2$
2. Addition to calculate $c3 = c1 + c2$
3. Subtraction to calculate $c1 = c1 - c2$
4. Subtraction to calculate $c3 = c1 - c2$
5. Multiplication to calculate $c3 = c1 * c2$

1.3 Question

Design a **Account** class with account number, balance and date of last updation. Consider a **Transaction** class with account number, date of transaction, amount and transaction type. Check whether the amount is available or not in case of a withdrawal. Transaction object will make necessary updation in the **Account** class.

1.4 Question

Design a class (**CarParking**) to calculate the car parking charge in a Multiplex. Design another class **Car** to keep car number, hours of booking etc. The parking charge is collected in hourly basis at a given rate. The system should have following functionalities:

1. Calculate parking charges of a car.
2. Receive parking charges.
3. Display number of cars present in the parking lot.
4. Display total number of cars parked in this parking lot.
5. Display total parking charge collection.

1.5 Question

Design an application for managing information of books, i.e. details of the books and number of copy of each book title. The application should support the following functions:

1. purchase of new book title, which is not purchased earlier (needs to be implemented using parameterized constructor),
2. purchase of existing book title (needs to be implemented using copy constructor).

1.6 Question

Design a **Student** class to store roll, name, course, and marks of 5 subjects. The application should support:

1. add, delete and modify information of any student,
2. calculate subject wise average of marks,
3. calculate student wise average of marks.

1.7 Question

Write a class, **Commission**, which has an instance variable, **sales**; an appropriate constructor; and a method, **getCommission()** that returns the commission.

Now write a demo class to test the **Commission** class by reading a sale from the user, using it to create a Commission object after validating that the value is not negative. Finally, call the **getCommission()** method to get and print the commission. If the sales are negative, your demo should print the message "Invalid Input".

1.8 Question

A small company dealing with transportation has just purchased a computer for its new automated reservations system. You have been asked to program the new system. You are to write a program called Reservation System to assign seats on a vehicle. Your class also requires the following:

1. a constructor method, which initialise the variables
2. method to assign the capacity of seating.
3. method for assigning seats.

2 INHERITANCE, PACKAGE

2.1 Question

Design an abstract class **Shape** having 2 methods **calculateArea()** and **display()**. Create **Rectangle** and **Triangle** classes by inheriting the **Shape** class and override above methods to suitably implement for **Rectangle** and **Triangle** class.

2.2 Question

You have to develop one application for managing **Student**s and **Teacher**s information. They have some common property, hence you have to define a class **Person**. Design the application maintaining hierarchy of classes. Override the **toString** method to print the values of an object. The students and teachers information should be kept using **array of objects**.

2.3 Question

Define a class **Employee** having **private** members – id, name, department, salary. Define default and parameterized constructors. Create a subclass called **Manager** with private member bonus. Define methods display in both the classes. Create n objects of the **Manager** class and display the details of the manager having the maximum total salary (salary+bonus)

2.4 Question

Write a Java program to create a super class **Vehicle** having members, company name and price. Derive two different classes **LightMotorVehicle** (members – mileage) and **HeavyMotorVehicle** (members – capacity-in-tons). Accept the information for n vehicles and display the information in appropriate form. While taking data, ask the user about the type of vehicle first.

Each vehicle should have an unique number starting from 100001. This number should be generated at the time of instanciation.

2.5 Question

Design an application to manage different types of Accounts (i.e. Savings, Demat, Home Loan etc.). Develop necessary methods to perform account related operations.

An user should be able to do the following:

1. add new account (at least customer's name, address, PAN and one address proof must be submitted to open an account)
2. update an account information (customer id can not be changed).

The customer should not able to open a Generic Account (like Account, Loan Account, Deposit Account etc)

3 INTERFACE

3.1 Question

An application requirement demands a **StringFilter** that filters out certain alphanumeric characters in an input string. This filter takes the string and returns resulting string removing the

characters that are passed as arguments. Hence, define two classes **NumberFilter** and **CharacterFilter**.

3.2 Question

SwathiDosaCorner is a famous restaurant and large number of people order various types of **Dosa**s. There are two types of Dosas available with the restaurant, namely **MasalaDosa** and **OnionDosa**. MasalaDosa is decorated with masala curry, whereas OnionDosa is decorated with onion scrap. Explain how interfaces can be used to simulate the scenario to pre different dosas on the request from the client. Illustrate polymorphism involved in this application.

3.3 Question

Design a Calculator having some basic functions like addition, subtraction, multiplication, division and modulo operations. Design another Calculator having scientific operations like exponential and logarithmic operations. If any relationship exists between the aforesaid classes build the relationship. To access the calculator, the user should enter first letter of his/her name. If user's name start with A, the user should get basic calculator having only addition and subtraction method. If user's name start with S, the user should get scientific calculator having only addition and subtraction and exponential operation. Rest of the users will get access to basic calculator having all the functionalities.

3.4 Problem Statement

[The following example will be discussed to make you understand a real application]

Design a Scientific Calculator having the aforesaid operations. Restrict the remote users to access only basic operations whereas the local user will get access to all the operations.

4 Exception Handling

4.1 Problem Statement

Define a class **Matrix** which contains **getElementAt**, **setElementAt** and **findItem** methods. Add one more method to add another matrix with this matrix. If dimension of other matrix does not match, throw an user defined exception **AdditionNotPossibleException**.

4.2 Problem Statement

Write a program that calls a method that throws an exception of type **ArithmeticExcepton** at a random iteration in a for loop. Catch the exception in the method and pass the iteration count when the exception occurred to the calling method by using an object of an exception class you define.

4.3 Problem Statement

A bank maintains two kinds of accounts - Savings Account and Current Account.The savings account provides compound interest, deposit and withdrawal facilities. The current account only provides deposit and withdrawal facilities. Current account holders should also maintain a minimum balance. If balance falls below this level, a service charge is imposed. Create a class Account that stores customer name, account number, and type of account. From this

derive the classes Curr-acct and Sav-acct. Include the necessary methods in order to achieve the following tasks.

1. Accept deposit from a customer and update the balance.
2. Display the balance.
3. Compute interest and add to balance.
4. Permit withdrawal and update the balance (Check for the minimum balance, impose penalty if necessary).

4.4 Problem Statement

Design an application to manage different types of Accounts (i.e. Savings, Demat, Home Loan etc.). Develop necessary methods to perform account related operations.

An user should be able to do the following:

1. *add new account (at least customer's name, address, PAN and one address proof must be submitted to open an account)*
2. *update an account information (customer id can not be changed).*

The customer should not able to create a Generic Account (like Account, Loan Account, Deposit Account etc)

Do the necessary changes to support the following features:

1. withdrawal of an amount more than the available balance from a savings account should through an exception and operation should not be accepted.
2. withdrawal of an amount that makes negative balance less the permissible over draft amount of a credit account should through an exception and operation should not be accepted.

4.5 Question

Design a **Student** class with roll, name and score. Support must be there to set the score. Score is non-negative and cannot exceed 100. For invalid score an exception has to be raised. User of set score method will decide about the measures to deal with the exception.

5 MULTI-THREADING

5.1 Question

Define a class, **MyClass**, by inheriting **Thread** class and create 4 threads with random priority in the range of 1...5. Update a counter for 10 mili-seconds in each of the threads. In these threads priority will be increased by 1, 2, 2, 1 respectively in every 30 millisecond. Print the priority and the value of counter for each threads in every 10 milliseconds.

5.2 Question

Design a class **Printer** that contains **print** method. The printer can print 1 page in 5 seconds. Design another class **UserRequests** which generate print requests in multiple threads. An user's print request is generated by a distinct thread. Maximum limit of a print request is 5 page.

Your design should ensure that the printer process the requests one after another in synchronized way. If a printing task has been started, next print task will be started after completion of the current task.

6 COLLECTIONS

6.1 Question

Create a list of **Student**s using **ArrayList**, **LinkedList** and **Vector**. Sort the list based on roll number and Name. Furthermore, display the students information department wise while the students are sorted by name within a department.

6.2 Question

A plain text file contains username and password of the users in individual lines. Read the content and store them in a Map. Finally, print the information by sorting them in alphabetical order.

6.3 Question

A plain text file contains few paragraphs. You have to read the file and keep distinct words in a set. Also, You have to print frequency of each word.

6.4 Question

Design a system for the following scenario:

1. An item list contains item code, name, rate, and quantity for several items.
2. Whenever a new item is added in the list uniqueness of item code is to be checked. Register a new product with its price.
3. Time to time rate of the items may change.
4. Whenever an item is issued or received existence of the item is checked and quantity is updated.
5. In case of issue, availability of quantity is also to be checked.
6. User may also like to know price/quantity available for an item.
7. Find how many items cost more than a given amount. The amount will be a parameter.
8. Remember that the methods have to return an error code if for example an invalid item code is given

6.5 Question

In social networking site, like Facebook, treat each user profile as a node on the graph and two nodes are said to be connected if they are each other's friends. Find number of connected profiles of a user, which can be visited using 5 intermediate profiles.

7 INPUT AND OUTPUT

7.1 Question

Write a Java program that takes a list of filenames on the command line and prints out the number of lines in each file. The program should create one thread for each file and use these

threads to count the lines in all the files at the same time. Use java.io.LineNumberReader to help you count lines. You'll probably want to define a LineCounter class that extends Thread or implements Runnable. Now write a variant of your program that uses your LineCounter class to read the files sequentially, rather than at the same time. Compare the performance of the multithreaded and single-threaded programs, using System.currentTimeMills( ) to determine elapsed time. Compare the performance of the two programs for two, five, and ten files.

7.2 Question

Write a program to implement *grep* command like utility (count frequency of words, chars, number of lines, and number of sentences in a text file). Name of the file should be taken as command line argument.

7.3 Question

Write a program that takes a filename from user and checks whether it exists or not. If it exists then check whether it is a directory or not. If it is a directory then show the list of files in it. If it is not a directory then show whether it can be read and/or written into.

7.4 Question

Student class contains roll, name and score. Write a program to store the objects in a file and thereafter read all the objects.

8 Database Connection

[Problem statements will be given in Class]
Design a class to perform CRUD operation for MySQL database.

8.1 Using Statement

8.2 Using PreparedStatement

8.3 Using CallableStatement

9 Additional Problems

9.1 Question

Write a program to find the continuous subarray in an array whose sum is equal to a given value.

9.2 Question

Design a TollTax class to store the number of cars that crossed the bridge and total amount collected. It must support the following activities.

1. Receiving toll.
2. Display number of cars that crossed the bridge.
3. Display the amount of toll collected.

9.3 Question

Write a program that reads in a text stream from standard input and uses a Queue (Using Linked List) to determine whether or not it's parentheses are properly balanced. For example, your program should print true for [()][()()]() and false for [(]).

9.4 Question

Write a program for stack ADT using linked list implementation The operations on the stack are:

1. PUSH data into the stack
2. POP data out of stack

9.5 Question

Write a program for Queue using array implementation

1. Define a array which stores queue elements
2. INSERT data into the queue
3. DELETE data out of queue

10 Design Patterns

10.1 Problem Statement (Singleton Design Pattern)

Design a class *Demo* for which only one object can be created (more than one object creation must be restricted).

10.2 Problem Statement

Design a class for which only **n** number of objects can be created (*n* will be provided by the user).

10.3 Problem Statement (Factory Pattern)

Create an interface **Product**, having the methods **computeArea**, **enlarge** and **shrink**. Define three classes **RectangularBrick**, **TriangularBrick** and **CircularBrick** which implement Product interface. Design a **BrickFactory** class having a method **factory**, which will receive brick type, number of brick as parameter and return instances of the bricks of respective type.

[More problems will be given.]

11 SMALL DEMO APPLICATION

11.1 Library Management

In a library, books, and journals are kept. Journals are issued to faculty members only. A student member can have 2 books issued at a time. For faculty members it is 10. For late return student members are charged Rs. 1 per day. Faculties are not charge. For journals additional information like issue no., date of publish, volume no., etc., are to be stored. For any transaction, members are supposed to place transactions slip. After necessary validations, transaction is carried out. Each transaction is to be noted into a register. Implement the system described above after designing the necessary classes.

11.2 Address Book

Write an address-book class that manages a collection of Person objects. An address-Book will allow addition, deletion, sorting or searching of Person objects in the address book. Make sure the add method does not add duplicate person objects to the address book. The sort and search methods return the list of persons matching the specified criteria. The sort and search can be done either by first name, last name, or person id.

11.3 Employee Payroll

Write a program using single inheritance, Prepare a Employee Payroll and calculate the Net Pay for multiple employees.

- Declare a base class emp and get the employee details
- Create a derived class salary to get the salary details and also to calculate the net pay
- Access the member functions of class emp and salary
- Get the values from the class members
- Calculate the net pay
- Generate the Employee Payroll in the required format

11.4 Course Management

Each Instructor has name and phone number. One can view instructor information and set the information. Textbook has a title, author name and publisher. One can set the data for a textbook and view the same. Each course has a course name, instructor and text book. One can set the course data and view the same. Design and implement the classes .

11.5 Hospital Information System

Design and create a hospital information system with the following scenarios.

1. Register a new patient.
2. Each patient is assigned to one doctor, but a doctor can have any number of patients. Patients check in to the hospital and assigned a doctor if they don't already have one.
3. While in the hospital, doctors record various observations about each patient at various times. Examples of observations are blood pressure and temperature. Record test results for a patient.
4. The hospital keeps track of all the observations for a given patient until they check out of the hospital. Obtain all of a patient's information given the social security number.