NATIONAL UNIVERSITY OF SINGAPORE
SCHOOL OF COMPUTING

SEMESTER II (2003-04)
EXAMINATION FOR

CS2103: SOFTWARE ENGINEERING

April 2004 Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper consists of **NINE (9)** questions and comprises of **TWELVE (12)** printed pages. Answer **ALL** questions.

2. Write your answers in the **blank space** provided in this answer book only.

3. This is an **OPEN BOOK** examination.

4. Please fill in your **Matriculation Number** below. Also write your matriculation number on the top right hand corner of every page.

Matriculation Number: | | | | | | | | | | |

For Official Use Only:

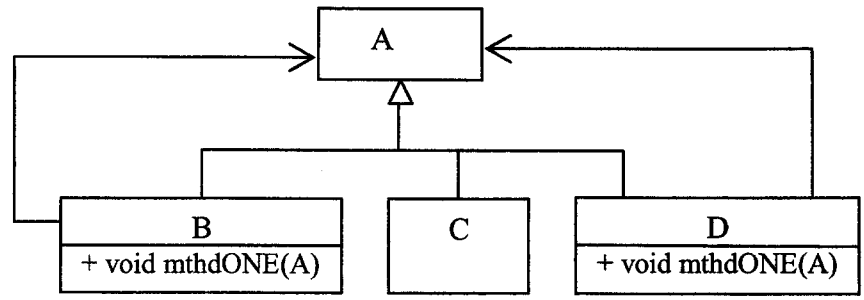
	Marks
Question 1 (max 10)	
Question 2 (max 15)	
Question 3 (max 10)	
Question 4 (max 10)	
Question 5 (max 10)	
Question 6 (max 6)	
Question 7 (max 10)	
Question 8 (max 9)	
Question 9 (max 20)	
TOTAL:	

Question 1. (10 marks)

Consider following code which makes use of the classes defined in class diagram shown along. Note that constructor methods are not shown in the class diagram.

```
public void test()

{
A  obj1 = new D( " ");
A  obj2 = new D("stringD");
A  obj3 = new C("stringC1");
obj1.mthdONE(obj2);
obj2 .mthdONE(obj3);
obj1.mthdONE(new B(obj3));
obj1.mthdONE(new C("stringC2"));
}
```



Draw an object diagram illustrating the objects and links that would be created when this code is executed . While illustrating the objects in the diagram you develop, write complete object specification i.e. object name: class name wherever possible.

Question 2: (15 marks)
Refer to the Video Rental Application requirement specification included in appendix at the end of this paper. It is same as specified in module teaching during the semester.

A description of the **reserveVideo use case** is given below :

reserveVideo use case is triggered by Clerk when he inputs memberId and title of the Video which the member wishes to reserve. reserveVideo use case first checks if the member has any overdue video or payment . If not, it searches all copies of requested video title for an available copy . If none are found , it adds member to a wait list for that video title.

Develop an interaction diagram (sequence or collaboration) corresponding to above description of the reserveVideo use case . Use meaningful object & class names, and message labels of your choice.

Question 3. (10 marks)

Draw a state chart to illustrate state dependent behaviour of the object corresponding to a class which captures a reservation (or Booking) of a table in the RTB system. Your state chart should **at least** show states and transitions corresponding to

- event where reservation has been made out but customer has not yet arrived;
- event when a customer has arrived
- event when a table is changed for an existing reservation
- event when a reservation is cancelled
- event when a customer leaves the table (after having food).

Use any reasonable and readable labels for states, transitions, and guards.

Question 4 (10 marks)

Consider following code and develop a UML class diagram corresponding to it. Class associations, and signatures of attributes and methods in your class diagram should correspond to the information available in the code.

```
abstract class A {
protected String var1;
protected int var2 ;

A(String s, int i) {
var1=s;
var2 =i;
}
abstract void mthdOne();
}
```

```
class B extends A {
B (String s, int i) {
super(s,i);
}
void mthdOne() {
// implementation omitted
}
}
```

```
public class C{

private Vector var3;
public C() {
var3 = new Vector();
}

public void mthdTwo(A objA) {
var3.addElement(objA) ;
}

public void mthdOne () {

Enumeration enum = var3.elements();
while (enum.hasMoreElements()) {
((A) enum.nextElement()).mthdOne();
}
}
```

Question 5. (a) (5 marks)
State if there is a difference between declaring a method with private modifier and declaring a method with private final modifiers. Support your answer explaining use of these two modifiers in method definition(s) in Java.

Question 5 (b) (5 marks)

Consider following code fragment. Note that parameter variable and object attribute have same name.
Improve the code (other than suggesting to use different names for these two) to resolve this ambiguity.

```
class Directory {
  protected int numberOfFiles;

  public Directory(int numberOfFiles)

  {
    numberOfFiles  = numberOfFiles;
  }

}
```

Question 6 (6 marks)
Consider following code fragment . Line numbers are stated for an easy reference later in the question.

```
1: public void sip(Soup soup) {
2: soup.make();
3: soup = new Soup();
4: soup.drop( );
5: }
```

What happens to objSoup when sip method is invoked for an object 'john' as follows :

john.sip(objSoup) // objSoup is an object of type Soup;

Select one or more correct choices from the following and list your choice(s) in the box below. (There will be negative marking for wrong choices.)

a) objSoup gets 'made' and 'dropped'
i.e. respective method invocations for objSoup at line 2 and 4.

b) objSoup gets 'dropped' , without getting 'made'
i.e. method invocation for objSoup at line 4 but not at line 2

c) it gets 'made' but not does not get 'dropped'
i.e. method invocation for objSoup at line 2 but not at line 4

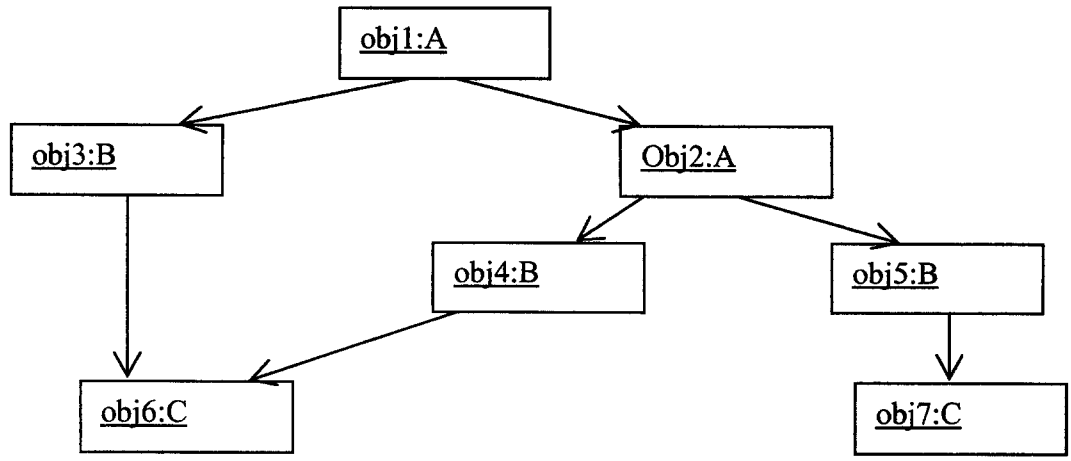
d) No methods are invoked for objSoup
since a copy of objSoup gets passed as a parameter , not the actual value pointed by objSoup.

e) when the sip method returns , objSoup refers to a different instance of the Soup class.

f) when the sip method returns , objSoup refers to the same instance of the Soup class.

Question 7 (10 marks)

Following is an object diagram illustrating a run time scenario involving objects of classes A,B, and C.



Use general hierarchy design pattern to draw a class diagram for which above can be a valid object diagram. You only need to show class name compartments in your class diagram.

Question 8 (9 marks)

Consider two classes SavingsAccount and FarmAnimal. FarmAnimal inherits from class Animal. SavingsAccount inherits from class Account. Both SavingsAccount and FarmAnimal are required to implement two methods getOwner () and setOwner(String name) with identical method signatures. Provide a skeletal code fragment which ensures to meet this requirement.

Question 9 (20 marks)

Draw a flow graph for the following code fragment. Also, list the basis paths and write test cases for each of these paths.

```
public static int getNumOfDaysInMonth(int month, int year) {

int numDays = 0;

if (year < 1) {
        System.out.println(" year out of bounds");
  }
else {
   if (month == 1 || month == 3 || month == 5 || month == 7 || month == 10 || month == 12) {
     numDays = 32;
   }
   else if ( month == 4 || month == 6 || month == 9 || month == 11) {
          numDays = 30;
         }
        else if (month == 2) {
                                  if (isLeapYear(year)) {
                                            // method invocation isLeapYear returs a Boolean
                                  numDays = 29;
                                  }
                                 else {
                                          numDays = 28;
                                  }
            }
           else {
                System.out.println(" month out of bounds");
           }
}
return numDays;
}
```

{ space for Question 9}

APPENDIX : Video Rental application requirements

Create a video rental tracking system that allows any member to rent any available video for a maximum of three days. Members can rent at most four videos at a time. When the member brings a video to the counter, the staff scans or types the video identifier and the member's identification. The video is then rented .If the video is returned late, the member must pay a 2 dollar per day late fee. Members with outstanding late fees or overdue videos cannot rent movies.
Customers should be able to browse the store's video catalogue via a kiosk in the customer floor area. This will allow them to make queries like "show me a list of films directed by Woody Allen " or "show me movies in which Tom Hanks appears".
The system must be able to administer the renting and returning of videos, using a reasonably friendly user interface. The staff should be able to find out if a copy of a video is available, rented, or missing(or lost). It should also be possible to determine when the title will become available, if it is rented. Each morning the system should print and flag all customers who have overdue movies, which movies they are and how overdue they are. The system should be able to provide how many times a movie has been rented and report on the most popular rentals and the "poor performers". It should be possible for customers to call and make reservations for movies, whether they are available or not. If the tape is available, staff should remove it from the shelf so that no one can rent it. If the tape is currently not available then the customer is added to the wait list for that tape. When the tape is returned, the system should check the reservation and notify the staff to call the customer who is first on the waiting list.
System should allow to add, delete and update customers. Customers must become members and are issued membership number. A customer who has not returned a movie that is due will not be allowed to rent or reserve additional movies until the overdue movies are returned and any late charges are paid.
System should allow to add new titles as they arrive and remove titles if they become damaged, lost or stolen. It should handle categories of movies. Each movie belongs to only one category. Each movie also has rating and an age limit. Anyone younger than the age limit is not allowed to rent that movie. Each tape is marked with a unique identification number for that copy of the movie. Each movie has a title and a retail price.

---- END OF PAPER----