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THE NATIONAL UNIVERSITY OF IRELAND, CORK

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SAMPLE PAPER

B.Sc. Honours in Computer Science

CS4983 Object-Oriented Design

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Answer **all** questions.

Time allowed: One-and-a-half hours

1. (*5%*) State briefly what is meant by *defensive programming.*

2. (*15%*) What problem is the *command* design pattern supposed to solve?

   What are the *consequences* of using this design pattern (i.e. the advantages/benefits and disadvantages/costs)?

3. (*35%*) Look at the `Thesaurus` class definition at the end of this exam paper. A thesaurus is a book which lists words and, for each word, it gives a list of its synonyms, i.e. words that mean the same. This class definition uses `Hashtable` from the Java library to associate words (`String`s) with lists of synonyms (`Vector`s).

   There is a method in the class definition for determining whether two words are 'connected'. Two words in a thesaurus are connected if a 'path' can be found between them. For example, if the synonyms of "alienate" are "disaffect" and "estrange", and the synonyms of "disaffect" are "estrange" and "disdain", then "alienate" and "disdain" are connected by a path of length two.

   a) Criticise the way the program accesses the `Vector` data structures.

   b) Rewrite the class definition to make it more defensive. (Just give method headers and Java statements for the parts that change; for parts that remain unchanged, just write 'SAME'.) (Note that, as written at the moment, the `getSynonyms` method returns `null` if its parameter is not in the hash table.)

4. (*45%*) At the end of this paper, we describe a card game called Eights.

   Design a program to play this game.

   Present the structure of your design using text and one or more UML Class Diagrams. (If you cannot remember exact UML notation, invent your own, but include comments to explain the intention of your invented notation.)

   Your design should be detailed enough that a programmer could begin coding in Java from it. This means that you should discuss and/or show on your diagram such things as attributes, operations, data structures, the main GUI classes, interfaces, packages, etc., in addition to classes and relationships from the problem domain. (Your diagrams can be accompanied by pseudocode and/or fragments of Java but only if you think these will help to explain your design to me and to make the design more detailed.)

   There will be extra credit for designs that make proper use of design patterns.

   It is anticipated that further card games will be implemented in future. Your design should not include any of these, but there will be extra credit for designs that are general enough that they could relatively easily be extended to other games in the future.

   Important: The examiners will not answer questions about the rules of the Eights game during the examination. If you feel that there are problems with the description of the game (e.g. vagueness, ambiguity or incompleteness), resolve them yourself by stating assumptions in your answer.

Thesaurus class definition (Question 3)

```java
import java.util.*;
public class Thesaurus
{  public Thesaurus()
   {  table = new Hashtable();
   }

   public void addEntry(String aWord, Vector itsSynonyms)
   {  table.put(aWord, itsSynonyms);
   }

   public void addSynonym(String aWord, String newSynonym)
   {  Vector synonyms = getSynonyms(aWord);
      synonyms.addElement(newSynonym);
   }

   public Vector getSynonyms(String aWord)
   {  return (Vector) table.get(aWord);
   }

   public void displayEntry(String aWord)
   {  Vector synonyms = getSynonyms(aWord);
      System.out.print(aWord + ": ");
      for (int i = 0; i < synonyms.size(); i++)
      {  System.out.print((String) synonyms.elementAt(i) + " ");
      }
      System.out.println();
   }

   public boolean hasConnectionUpToLengthN(String word1, String word2, int n)
   {  boolean found = false;
      Vector synonyms = getSynonyms(word1);
      if (synonyms.contains(word2))
      {  found = true;
      }
      else
      {  int i = 0;
         while (i < synonyms.size() && ! found)
         {  String aSynonym = (String) synonyms.elementAt(i);
            if (n - 1 > 0)
            {  found = hasConnectionUpToLengthN(aSynonym, word2, n - 1);
            }
            i++;
         }
      }
      return found;
   }
   private Hashtable table;
}
```

The Game of Eights (Question 4)

Eights is played by two players (the computer and the user), with a normal pack of 52 cards. The computer shuffles the deck and deals seven cards to each player.

The remainder of the deck is placed face down between the players, and is referred to as the stock. The top card of the stock is turned up and placed face-up in a separate pile, called the starter pile. However, if this is an 8, it is buried back into the stock and another card is turned up to form the starter pile.

Players take alternate turns. In a turn, a player tries to discard a card from his/her hand to the starter pile. But s/he can only place onto the starter pile a card that is the same suit or the same denomination as the one currently on top of the starter pile. (For example, s/he can place any Club from his/her hand onto the pile if the top is a Club; or s/he can place any King onto the pile if the top is a King.) Eights are 'wild': they can be placed onto the starter pile irrespective of what the top card is. When discarding an Eight, the player announces a suit, and the next player must discard either a card from that suit or another Eight.

If at any time a player cannot discard a suitable card onto the starter pile, s/he must take cards from the stock until s/he is able to discard.

The winner is the first player to have an empty hand or, if the stock is exhausted and neither player can discard, the winner is the player with fewest cards in his/her hand.