UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2012

COMPUTER SCIENCE

IS52025A Internet and Distributed Programming

Duration: 2 **hours 15 minutes**

Date and time:

There are five questions in this paper. Full marks will be awarded for complete answers to a total of THREE questions. If you answer more than three questions your best three will count. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.

There are 75 marks available on this paper.

No calculators should be used.

THIS EXAMINATION PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

QUESTION 1

(a) (i) The `java.net.Socket` class has a constructor with two parameters. What are the types of these two parameters?

(ii) Given two variables `a` and `b` what is the effect of `new Socket(a,b)`?

(iii) Give a reason why `new Socket(a,b)` could throw an Exception.

(iv) The `java.net.ServerSocket` class has a constructor with one parameter. What is the type of this parameter?

(v) Given a variable `a` of the correct type, what is the effect of `new ServerSocket(a)`?

(vi) Give a reason why `new ServerSocket(a)` could throw an Exception.

[6 Marks]

(b) Consider the following Java code, with 4 missing fragments:

```
import java.io.*;
import java.net.*;

class client
{
 public static void main(String[] argv) throws Exception
  {
   Socket s = /*missing 1*/;
   OutputStreamWriter p =/*missing 2*/;
   InputStreamReader i = /*missing 3 */;
   InputStreamReader b = /* missing 4 */;
   int c;
   while(true)
    {
     c=b.read();
     p.write((char)c);
     p.flush();
     System.out.print((char)i.read());
    }
  }
}
```

Complete the missing fragments so that the above program acts as a client which sends data one character at a time to a server running on the localhost listening at port 8000. It sends whatever is typed on the console one character at a time to the server and prints out on the console whatever characters it receives back from the server.

[4 Marks]

(c) Write a client with two threads, one which continuously accepts input from the keyboard a character at a time and sends them to a server listening on localhost port 5000 and another which continuously waits for input from the server and prints it at the console.

[**8 Marks**]

(d) Write a complete single threaded server that listens on port 8011 for characters, converts them to upper case and sends them back to the client.

[**7 Marks**]

QUESTION 2

(a) (i) Briefly explain the difference between a *client* and a *server*.

(ii) What are the disadvantages of a single-threaded server.

(iii) What is the return type of the `accept()` instance method of the `java.net.ServerSocket` class.

(iv) Briefly describe the behaviour of the `accept()` method.

(v) Briefly explain the purpose of *Object Serialization*.

(vi) What is the return type of the `readObject()` instance method of the class: `java.io.ObjectInputStream`?

(vii) The `writeObject()` instance method of the class: `java.io.ObjectOutputStream` has one parameter. What is its type?

[10 Marks]

(b) Given the following class definition:

```
import java.io.*;
public class Person implements Serializable
{
    String name;
    int age;

    public Person (String n, int a)
    {
       age=a;name=n;
    }

    public String toString()
    {
      return name+" "+age;
    }
}
```

Write a complete single-threaded client that repeatedly reads names and ages from the console, constructs Persons objects from them, and sends these Person objects to a server listening on port 5000 on “localhost”.

[7 Marks]

(c) Write a complete single-threaded ‘Object’ server that listens on port 5000 for Objects and prints them out on the console if they are `Person` Objects and otherwise sends an ’!’ back to the client and terminates.

[8 Marks]

QUESTION 3

(a) Consider the following Java program:

```
class p
{
  void f()
  { while (true) System.out.println("hello");}

  void g()
  { while (true) System.out.println("goodybye");}
}

class t1 extends Thread
{ p x;
  t1(p y)
  {x=y;}

  public void run()
  {x.g();}
}

class t2 extends Thread
{ p x;
  t2(p y)
  {x=y;}

  public void run()
  {x.f();}
}

class z
{
 public static void main(String[] argv)
 {
    p it= new p();
    new t2(it).start();
    new t1(it).start();
 }
}
```

(i) Explain what is output when it is executed.

(ii) What would happen if we declared the methods `f()` and `g()` as synchronized? What common problem in concurrent programming is this an example of?

[9 Marks]

(b) (i) By referring to class `Counter` below, briefly explain the *Thread Interference Problem* caused by shared data in concurrent programming.

```
class Counter {
    private int c = 0;

    public void increment() {
        c++;
    }

    public void decrement() {
        c--;
    }

    public int value() {
        return c;
    }

}
```

and briefly explain how this problem is overcome in Java by using Synchronization.

[8 Marks]

(c) Write a complete multi-threaded server that repeatedly receives data from arbitrarily many clients. It then broadcasts this data to all the clients apart from the one that sent it. It does this by maintaining a list of the `outputStreamWriter`s of all the clients to which it is connected. This list is shared between the different threads so you must use synchronization to make sure that it can only be accessed by one thread at a time.

[8 Marks]

QUESTION 4

(a) Assuming the existence of a method:

```
static ArrayList <String> listLinks(String url)
```

which returns the list of all the links in a URL url, write a method whose heading is

```
static HashSet <String> links(String url)
```

which returns the set of all links in the url corresponding to its pararmeter. Do this by first writing a method which converts ArrayLists to HashSets.

[9 Marks]

(b) Given a method `HashSet <String> links(String url)` write a method who heading is

```
static void Spider (String url, int n)
```

which finds n distinct links in a page whose url is given by the first parameter. It should find *all* links if there are less than n of them.

To do this, the spider should maintain two sets:

```
HashSet<String> alreadyVisited = new HashSet <String> ();
HashSet<String> toVisit = new HashSet <String> ();
```

[8 Marks]

(c) Rewite your `Spider` method so that the spider stays within a particular domain. Write a `main` method which calls you `Spider` method. Very briefly explain how your `Spider` method works.

[8 Marks]

QUESTION 5

(a) Briefly explain what the following program does:

```
public class seb5
{
  public static void main(String[] args) throws Exception
  {
    Class.forName("com.mysql.jdbc.Driver");
    Connection c=
    DriverManager.getConnection("jdbc:mysql://localhost/bla","mas01sd","sebastian");
    Statement st = c.createStatement();
    st.executeUpdate("INSERT INTO one VALUES(’" + args[0] +"’,’" + args[1] + "’);");
    ResultSet resultSet = st.executeQuery("SELECT *  from one");
    while (resultSet.next())
    {
      for (int i=1;i<3;i++)System.out.print(resultSet.getString(i) + " ");
      System.out.println();
    }
   }
}
```

[5 Marks]

(b) Given the class `Pair`

```
class Pair
{
  String first;
  String second;
  Pair (String f,String s)
  {
   first=f;second=s;
  }
}
```

Write a method, `makeSetFromTable` which takes a `ResultSet` resulting from a query like

```
ResultSet resultSet = st.executeQuery("SELECT *  from one");
```

and returns a HashSet of Pairs, each pair corresponding to a row of the table (which we assume has two String fields).

[8 Marks]

(c) Write a complete simple multi-threaded proxy server which listens on port `args[2]` and then sends this data to and receives data from a server which is listening on port `args[1]` of host `args[0]`.

[8 Marks]

(d) Suppose `ma323.gold.ac.uk` is behind a firewall but `igor.gold.ac.uk` has port 5000 open. Explain how your proxy server can be used to connect to a webserver listening on port 80 of `ma323.gold.ac.uk`.

[4 Marks]