# BSc in Computer Science

## Year 3

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## Examination 2005

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## Network Programming I

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October 2005
2 Hours

Attempt **Question 1** and any **TWO** other questions

Question 1 is worth 40 marks.
All other questions are worth 30 marks.

## Section A (Compulsory)

1. Attempt all 8 parts.

(a) Consider the code shown below.

```
public class Q1a {
	private Transport transport[];
	public Q1a() {
		transport = new Transport[4];
		transport[0] = new Bus(100, true, 100);
		transport[1] = new Car(100000, "FORD", 50);
		transport[2] = new Train(150, 10);
		transport[3] = new Car(2000000, "FERRARI", 50);
		for(int i = 0; i < transport.length; i++) {
		}
	}
	public static void main(String args[]) { new Q1a(); }
}
class Transport {}
class PublicTransport extends Transport {
	protected int fare;
	public PublicTransport(int fare) {
		this.fare = fare;
	}
}
class PrivateTransport extends Transport {
	protected int purchaseCost;
	public PrivateTransport(int purchaseCost) {
		this.purchaseCost = purchaseCost;
	}
}
class Train extends PublicTransport {
	private int numberOfCarriages;
	public Train(int fare, int numberOfCarriages) {
		super(fare);
		this.numberOfCarriages = numberOfCarriages;
	}
}
class Bus extends PublicTransport {
	private boolean singleDeck;
	private int costForToll;
	public Bus(int fare, boolean singleDeck, int costForToll) {
		super(fare);
		this.singleDeck = singleDeck;
		this.costForToll = costForToll;
	}
}
class Car extends PrivateTransport {
	private String model;
	private int costForToll;
	public Car(int purchaseCost, String model, int costForToll) {
		super(purchaseCost);
		this.model = model;
		this.costForToll = costForToll;
	}
}
```

Show how to modify the above code so that, using an interface, it is possible to print out the total of all `costForToll` values (using all `Cars` and `Busses` but not `Trains`)

**(5 marks)**

(b) Consider the code shown below.

```
import java.io.*;
public class Q1b {
	public Q1b() {

		// WRITE TO FILE

		try {
			ObjectInputStream in =
			new ObjectInputStream(new FileInputStream("x"));
			Student student = (Student)in.readObject();
			System.out.println(student.name);
			System.out.println(student.id);
			in.close();
		} catch (IOException ioe) {
		} catch (ClassCastException cce) {
		} catch (ClassNotFoundException cnfe) {}
	}
	public static void main(String args[]) {
		new Q1b();
	}
}

// PROVIDE STUDENT CLASS
```

The code shown above will read an object that belongs to the `Student` class from a file and display the `name` and `id` attributes of the student.

Provide the code necessary to write the object to the file, and also provide the `Student` class.

**(5 marks)**

(c) Consider the code shown below.

```
import java.io.*;
public class Q1c {
	public Q1c() {
		new Thread1().start();
		new Thread2().start();
	}
	public static void main(String args[]) { new Q1c(); }
}
class Thread1 extends Thread {
	public void run() {
		for(int i = 0; i < 100; i++)
			System.out.println("A " + i);
	}
}
class Thread2 extends Thread {
	public void run() {
		for(int i = 0; i < 100; i++)
			System.out.println("B " + i);
	}
}
```

What output would you expect when this code is run on Windows XP? Explain clearly.

**(5 marks)**

(d) Consider the code shown below.

```
import java.io.*;
public class Q1d {
	public Q1d() {
		Stack s = new Stack(4);
		new Putter(s).start();
		new Getter(s).start();
	}
	public static void main(String args[]) {
		new Q1d();
	}
}
class Stack {
	private int values[];
	private int currentNumberOfElements = 0;
	public Stack(int size) {
		values = new int[size];
	}
	public void put(int element) {
		System.out.println("Putting " + element);
		values[currentNumberOfElements++] = element;
	}
	public int get() {
		System.out.println("Getting " +
			values[currentNumberOfElements - 1]);
		return values[--currentNumberOfElements];
	}
}
class Putter extends Thread {
	private Stack s;
	public Putter(Stack s) {
		this.s = s;
	}
	public void run() {
		for(int i = 0; i < 10; i++) {
			s.put(i);
		}
	}
}
class Getter extends Thread {
	private Stack s;
	public Getter(Stack s) {
		this.s = s;
	}
	public void run() {
		for(int i = 0; i < 10; i++) {
			s.get();
		}
	}
}
```

The code shown above implements a stack (a finite size array into which items are added and removed). It also implements two threads (`Putter` and `Getter`) which put elements on the stack, and take elements from the stack.

Using Java thread synchronisation, show how to change the code so that the `Putter` cannot put elements onto a full stack, and the `Getter` cannot take elements from an empty stack.

**(5 marks)**

(e) Consider the code shown below.

```
import java.io.*;
import java.net.*;
public class Q1eCLIENT {
	public Q1eCLIENT() {
		try {
			DatagramSocket datagramSocket =
				new DatagramSocket(10000);
			byte buffer[] = new byte[256];
			DatagramPacket packet =
				new DatagramPacket(buffer, buffer.length);
			while(true) {
				datagramSocket.receive(packet);
				System.out.println(new
					String(packet.getData()).trim());
			}
		} catch(Exception e) {}
	}

	public static void main(String[] args) { new Q1eCLIENT(); }
}
```

```
import java.io.*;
import java.net.*;
public class Q1eSERVER {
	public Q1eSERVER() {
		try {
			DatagramSocket datagramSocket =
				new DatagramSocket();
			while(true) {
				String time =
					new java.util.Date().toString();
				DatagramPacket packet =
					new DatagramPacket(
						time.getBytes(),
						time.length(),
						InetAddress.getLocalHost(),
						10000);
				datagramSocket.send(packet);
				Thread.sleep(1000);
			}
		} catch(Exception e) {}
	}
	public static void main(String[] args) { new Q1eSERVER(); }
}
```

The code shown above implements a client and a server. The server will send the current time to the client every second.

Provide the code changes that are necessary to allow *many* clients receive the packets that the server sends.

**(5 marks)**

(f) Consider the code shown below.

```
import java.net.*;
import java.io.*;
public class Q1f {
	public Q1f() {
		try {
			URLConnection connection = new
URL("http://www.somewhere.com/program?a=1&b=2").openConnection();
			BufferedReader in =
				new BufferedReader(new InputStreamReader(
				connection.getInputStream()));
			String line;
			while((line = in.readLine()) != null) {
				System.out.println(line);
			}
			in.close();
		} catch (Exception e) {}
	}
	public static void main(String args[]) { new Q1f(); }
}
```

The code shown above sends arguments to a server side program using HTTP GET. Modify the program so that is sends the same arguments (`a=1&b=2`) using HTTP POST.

**(5 marks)**

(g) Consider the code shown below.

```
import javax.xml.parsers.*;
import org.xml.sax.*;
import java.io.*;
import org.w3c.dom.*;
import javax.xml.transform.*;
import javax.xml.transform.dom.*;
import javax.xml.transform.stream.*;

public class Q1g {
	public Q1g() {
		DocumentBuilderFactory factory =
			DocumentBuilderFactory.newInstance();
		Document document = null;
		try {
			DocumentBuilder builder =
				factory.newDocumentBuilder();
			document = builder.newDocument();
		} catch (Exception e) {}

		// PUT CODE HERE

		document.getDocumentElement().normalize();
		writeXMLFile(document, "team.xml");
	}

	public void writeXMLFile(Document doc, String filename) {
		try {
			Source source = new DOMSource(doc);
			File file = new File(filename);
			Result result = new StreamResult(file);
			Transformer xformer =
		TransformerFactory.newInstance().newTransformer();
			xformer.transform(source, result);
		} catch (Exception e) {}
	}

	public static void main(String argv[]) { new Q1g(); }
}
```

**team.xml**

```
<?xml version="1.0" encoding="UTF-8" ?>
<team>
  <name>Chicago Bulls</name>
  <player>Michael Jordan</player>
</team>
```

Modify the above program so that it produces the XML document shown (`team.xml`).

**(5 marks)**

(h) Consider the code shown below.

```
import java.awt.*;
import java.io.*;
import java.applet.*;
public class Q1h extends Applet {
       public void paint(Graphics g) {
              try {
                     PrintWriter out = new PrintWriter(new
                            FileWriter("data"));
                     out.println("TODAY IS SUNDAY");
                     g.drawString("Data written to file", 10, 10);
                     out.close();
              } catch (Exception e) {}
       }
}
```

What problem will occur when this program is executed? Explain clearly how the problem can be solved.

**(5 marks)**

## Section B

## Attempt any TWO Questions

2. (a) Provide a brief outline of the advantages and disadvantages of implementing a Java program using multiple threads.

**(5 marks)**

(b) Clearly identify the various states that a Java thread can be in, and demonstrate clearly, using sample code, how a thread can enter and leave each state.

**(10 marks)**

(c) Using clear examples, code snippets and diagrams where appropriate, demonstrate clearly what is meant by each of the following terms in relation to concurrent programming:

- Thread safety
- Deadlock
- Starvation

**(15 marks)**

3. (a) When a web client contacts a web server, many protocols are involved in creating a connection between the two software processes.

With reference to this example, provide an account of *layering* and *encapsulation* as they apply to networked communication.

**(5 marks)**

(b) List and discuss five important aspects of a communications protocol, and for each, describe how that aspect is managed in the HyperText Transfer Protocol (HTTP) version 1.0.

**(10 marks)**

(c) Using pseudo-code and clear explanations, describe how you would implement a HTTP version 1.1 web server that supported

- Chunked Transfer Encoding
- Persistent Connections
- 100 Continue Response
- Caching

**(15 marks)**

4. (a) Outline, using clear examples, the address format for IP version 4, and identify one of the key shortcomings in this version of IP that was addressed in IPv6.

**(5 marks)**

(b) In relation to IP subnetting, distinguish clearly between static and variable length subnetting.

The administrator of a class B network wants to create 32 subnets. what subnet mask does (s)he use?

The administrator of a class C network wants to create 3 subnets. What subnet mask does (s)he use?

**(10 marks)**

(c) Give a detailed account of TCP and UDP as transport layer protocols. In your answer, you should distinguish clearly between the service provided by each protocol to higher layers, and demonstrate how reliability is provided by each of the protocols.

**(15 marks)**