UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2002

BEng Honours Degree in Computing Part III
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
BSc Honours Degree in Mathematics and Computer Science Part III
MSci Honours Degree in Mathematics and Computer Science Part III
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute
This paper is also taken for the relevant examinations for the Associateship of the Royal College of Science

PAPER C302=I3.8

SOFTWARE ENGINEERING - METHODS

Friday 26 April 2002, 14:30
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators required

Part A – please answer in separate answer booklet

1a Name and briefly define the four main elements of a Design Pattern description.

b Briefly describe the purpose of the Composite Design Pattern and draw a class diagram showing the relationships between its participants.

c An item of consumer electronics consists of a printed circuit board on which are mounted components. Components are resistors, integrated circuits, and printed circuit board sub-assemblies. Each component consumes power. The power consumption of a circuit board is the sum of the consumption of the components mounted on that board. Assuming the use of Composite, identify the set of classes required to represent circuit boards and give an implementation in Java for each of these classes. Include a method `power()`, which computes power consumption. For resistors and integrated circuits this method returns some integer constant power.

d Use a design pattern to rewrite the following class so that the conditional statement is not required:

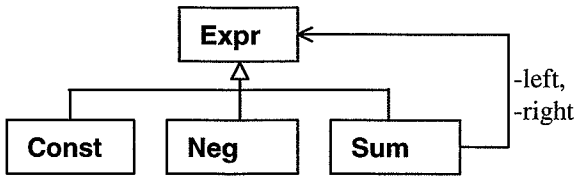
```
class Car {

     boolean started = false;

     void setState(boolean b) {started = b;}

     void printState() {
        if (started)
           System.out.println("Car is Started");

       else
         System.out.println("Car is Stopped");
     }
  }
```

Give the name of the design pattern that you have used.

The four parts carry, respectively, 10%, 25% , 40%, 25% of the marks.

2a Briefly describe the purpose of the Visitor Design Pattern.

b Simple arithmetic expressions of the form (1 + (3 + -4)) can be represented by the following classes.




```
public abstract class Expr {
}

class Const extends Expr {
  private int value;
  Const(int v) { value = v;}
  int getValue() {return value;}
}
```

```
class Neg extends Expr {
  private Expr arg;
  Neg(Expr a) {arg = a;}
  Expr getArg() {return arg;}
}

class Sum extends Expr {
  private Expr left, right;
  Sum(Expr l, Expr r) {left = l; right = r;}
  Expr getLeft() {return left;}
  Expr getRight(){return right;}
}
```

Modify the above classes to support the visitor pattern such that the `PrintVisitor` when applied to an expression as follows:

```
Expr e =  new Sum(new Const(44), new Neg(new Const(2));
e.accept(new PrintVisitor());
```

will output "(44 + -2)" to the system output stream .
Provide an implementation for the `PrintVisitor` class.
(Note:- for output use `System.out.print("some string");`)

c Give the implementation of a class `EvalVisitor` which when applied to an expression as follows leaves the result of evaluating the expression in the integer variable `res`.

```
Expr e =  new Sum(new Const(44), new Neg(new Const(2));
EvalVisitor ev = new EvalVisitor();
e.accept(ev);
int res = ev.getValue();  //for "(44 + -2)", res == 42
```

(Hint:- include a private `int` field in `EvalVisitor` which holds the result of evaluated expressions.)

The three parts carry, respectively, 15%, 60% , 25% of the marks.

Part B – please answer in separate answer booklet

3 Intellectual Property Rights and Software; Bias in Computer Systems Design: In our lectures we discussed various forms of legal protection for intellectual property and potential bias in the design of computer systems.

a Name six different forms of legal protection for intellectual property and give an example for each kind. In your opinion, which of these forms are best suited for the protection of software?

b Name three necessary conditions for a successful patent application. For each category, give an example that meets that condition and an example that fails that condition.

c Define "bias" in computer system design and give examples of three different categories of such bias, justifying their membership in the respective category.

d Suggest strategies in software engineering practice that can detect or avoid such bias.

The four parts carry, respectively, 30%, 30% , 30%, 10% of the marks.

4 Accountability in a computerized society: In our lectures, we discussed that Nissenbaum worries about the erosion of accountability in computerized societies. She identifies four barriers to accountability in this context.

a Name and define, in your own words, each of these barriers.

b For each of these barriers, come up with a brief example.

c For each example in (b), justify why it is such a barrier.

d Describe some suggested strategies for restoring accountability.

The four parts carry, respectively, 25%, 25% , 25%, 25% of the marks.