1007 Principles of Programming

2005 Exam

2.5 Hours

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Answer ALL questions from Part I and TWO questions from Part II
(Note that in all questions the Java or Prolog code given in your answers does not have to be syntactically perfect but should, at least, be a good approximation.)

Part I

Q1.
a) Outline how the following statement is evaluated and state what value `n` is initialised to.

```
int n = 8 / 2 * 3 * 4 + 3 - 2 / 2;
```

[5 marks]

b) Write a method with this signature:

```
public int[] create(int n, int x)
```

that creates an array with `n` elements, all initialised to the value of `x`.

[6 marks[

c) Write a method with this signature:

```
public boolean f(int[] a, int b)
```

that returns true if the value of `b` is stored in *any* element of array `a`. For example, when called with the array 1,2,3,4,5 and the value 3 the method returns `true`, when called with 1,2,3,4,5 and the value 6 the method returns `false`.

[6 marks]

d) Write a method with this signature:

```
public boolean g(int[] a, int[] b)
```

that returns true if all the values stored in array `b` are also stored at some index in array `a`. For example if `a` holds 1,2,3,4,5 and `b` holds 2,3,2,1,1 then the method returns true, as all the values in `b` are stored somewhere in `a`.

[8 marks]

[Total 25 marks]

TURN OVER

Q2. a) For each of the following state whether it is a legal data object in Prolog. If it is, state whether it is an atom, number, variable or structure.

```
nil

x25

'Sarah Jones'

Tom

date(1,feb,2005)

[tennis,football,[swimming,climbing]]

_23

5(X,Y)

100

happy(cat)
```

[10 marks]

b) Given a set of predicates in the form of `parent(X,Y)`, indicating `X` is the parent of `Y`, write a predicate `ancestor(X,Z)` that is true if `X` is the ancestor of `Z`.

[5 marks]

c) Assume that a rectangle is represented by the term `rectangle(P1,P2,P3,P4)` where the `P`s are the four points of the rectangle. Write the predicate `regular(R)` that is true if `R` is a rectangle whose sides are vertical and horizontal.

[5 marks]

d) Define a predicate `max(X,Y,Max)` so that `Max` is the greater of the two numbers `X` and `Y`.

[5 marks]

[Total 25 marks]

End of Part I

CONTINUED

Part II Answer TWO Questions from this Part

Q3. a) Explain each of the following:

operator, encapsulation, compound statement, void, break

[2 marks each, total of 10 marks]

b) State the scope and lifetime rules for local, parameter and instance variables.

[5 marks]

c) Write a method to display filled right-hand triangles using characters. The height of the triangle and the character used to display a triangle should be passed as method parameters. Note that your code can only output one character at a time.

Two examples are:

filledTriangle(4,'*')

```
   *
  **
 ***
****
```

filledTriangle(6,'#')

```
     #
    ##
   ###
  ####
 #####
######
```

[10 marks]

[Total 25 marks]

TURN OVER

Q4.

a) Consider this method:

```
public int g(int n)
{
  if (n < 1)
  {
    return 1;
  }
  else
  {
    return (n + 1) + g(n - 1);
  }
}
```

Write down the values returned by the following method calls:

g(1), g(2), g(4), g(g(2)), g(-1)

[10 marks]

b) Explain what an `ArrayList` is and how it differs from an array.

[5 marks]

c) Write a method with the following signature:

```
public ArrayList f(ArrayList a, String s)
```

that returns a new `ArrayList` containing any `String` stored in the parameter a that comes alphabetically before the `String s`. If no strings are found an empty `ArrayList` is returned. Assume the parameter `ArrayList` contains only strings.

For example, given an `ArrayList` containing “the”, “and”, “you” and the string “it”, the method would return a new `ArrayList` containing “and”.

[10 marks]

[Total 25 marks]

CONTINUED

Q5.

a) Write a predicate `sorted(List)` that is true if `List` is a sorted list of integers.

[5 marks]

b) Write the predicate `maxlist(List,Max)` so that `Max` is the greatest number in the list of integers `List`.

[5 marks]

c) Write a predicate `count(List,N)` so that `N` is the number of elements of the list `List`.

[5 marks]

d) Write a predicate, using `append`, to delete the last three elements from a list `L` producing another list `L1`.

[5 marks]

e) Define the predicate `last(Item,List)` so that Item is the last element of a list `List`.

[5 marks]

[Total 25 marks]

TURN OVER

Q6.

a) The following relation classifies numbers into three classes: positive, zero and negative:

```
class(Number,positive) :- Number > 0.

class(0,zero).

class(Number,negative) :- Number < 0.
```

Define this relation in a more efficient way using cuts.

[5 marks]

b) Write a predicate `translate(Number,Word)` so that `Number` and `Word` are mutual translations of each other for numbers from 1 to 5. For example, in `translate(Number,two)` `Number` is 2; in `translate(2,Word)` `Word` is 'two'.

[5 marks]

c) Write a predicate `showelement(List)` that displays every element of a list `List`.

[5 marks]

d) Define the predicate `sumlist(List,Sum)` so that `Sum` is the sum of a given list of numbers `List`.

[5 marks]

e) Given a list

```
List=[jan,feb,march,april,may,june,july,aug,sept,oct,nov,dec]
```

define a predicate that returns all the months before june and all the months after june.

[5 marks]

[Total 25 marks]

END OF PAPER