

2007 Paper 1 Question 10

Programming in Java

(a) A restricted variant on ML has types that are such that a type either is denoted by a type variable, α , β , etc; or is a function type of the form $\tau_1 \rightarrow \tau_2$ where τ_1 and τ_2 are simpler types. Design a Java class or set of classes that can be used to represent ML type expressions. Ensure that you provide a static method `createNewTypeVar` that makes a new ML type variable that is different from all the ones you have had before. Rather than giving your type variables Greek letters for their names you may call them `t1`, `t2`, `t3`, ... [7 marks]

(b) Suppose that your types are represented by a class called `MLType`. Explain all the changes you need to make to your code so that any `MLType` object has a method with signature

```
public void mustNotDependOn(TypeVar a) throws ItDoesDependOn;
```

that will check whether the type variable passed as an argument is present within the type. If it is, then an exception must be thrown. For instance if you passed the `mustNotDependOn` method of (the representation of) $(\alpha \rightarrow \beta) \rightarrow (\beta \rightarrow \gamma)$ the type-variable δ the method would just return, while if you passed it α , β or γ there would be an exception. [9 marks]

(c) Give an implementation of a method

```
toString()
```

which returns a text representation of the `MLType` object concerned. [4 marks]