6 Concepts in Programming Languages (MPF)

(a) Write a LISP program for detecting whether a LISP interpreter treats the language as being dynamically scoped (as was the case in historical LISP) or as being statically scoped (as is the case in modern LISP). You may use pseudo-code and should explain your answer in detail. [4 marks]

(b) You manage two junior programmers and overhear the following conversation:

A: “I don’t know why anyone needs a language other than Java, it provides clean thread-based parallel programming.”
B: “Maybe, but I write my parallel programs in a functional programming language because they are then embarrassingly parallel.”

Discuss the correctness of these statements and the extent to which they cover the range of languages for parallel programming. [6 marks]

(c) Explain why the SML interpreter accepts the declarations

```sml
datatype 'a FBtree = node of 'a * 'a FBtree list;

fun dfs P (t: 'a FBtree) = let exception Ok of 'a;
  fun auxdfs( node(n,F) ) = if P n then raise Ok n
                          else foldl (fn(t,_) => auxdfs t) NONE F;
  in auxdfs t handle Ok n => SOME n end;
```

while it does not accept the declaration

```sml
exception Ok of 'a;
```

[4 marks]

(d) Consider the declarations

```sml
structure Z = struct type t = int; val z = 0 end;
structure A = Z : sig type t ; val z: t end;
structure B = Z :> sig type t = int ; val z: t end;
structure C = Z :> sig type t ; val z: t end;
```

in the SML Modules language.

Explain the behaviour of the SML interpreter on inputting each of the expressions

```sml
Z.z = A.z; Z.z = B.z; Z.z = C.z;
```

[6 marks]