Concepts in Programming Languages

(a) List three differences between the programming languages FORTRAN and LISP. [3 marks]

(b) Give an example of a weakness in the type system of a programming language of your choice, explaining how it leads to a run-time error. [3 marks]

(c) In the context of parameter-passing mechanisms, give one reason why pass-by-value is preferable to pass-by-reference or vice versa, from the point of view of the programmer. [2 marks]

(d) Give an example of the following constructs

(i) signature [3 marks]

(ii) functor [3 marks]

in the SML Modules language.

(e) (i) In the programming language Scala, a generic class like the following one

```scala
abstract class Stack[A] {
    def push( x:A ): Stack[A]
    def top: A
    def pop: Stack[A]
}
```

is non-variant by default. Why? [3 marks]

(ii) Modify the above abstract class to make it co-variant. [3 marks]