

## 2006 Paper 5 Question 7

### Comparative Programming Languages

- (a) A naïve programmer writes the following Prolog program to implement a quicksort.

```
quicksort( [], []).

quicksort( [X|Tail], Sorted) :-
    split( X, Tail, Small, Big),
    append( SortedSmall, [X|SortedBig], Sorted),
    quicksort( Small, SortedSmall),
    quicksort( Big, SortedBig).

split( X, [], [], [X]).

split( X, [Y|Tail], [Y|Small], Big) :-
    X>Y, !,
    split( X, Tail, Small, Big).

split( X, [Y|Tail], Small, [Y|Big]) :-
    split( X, Tail, Small, Big).
```

Unfortunately, there are two mistakes that will prevent it running as expected. What are these mistakes and how can they be corrected? [6 marks]

- (b) Explain how the operator `!` in the `split` predicate works and why it is used here. [2 marks]
- (c) Our programmer now decides to improve the efficiency of the program by using difference lists. Explain how the technique works and modify the program to use difference lists by introducing a new predicate `quicksort2`

```
quicksort( List, Sorted) :- quicksort2( List, Sorted - [] ).
```

[6 marks]

- (d) Comment on the space and time complexity of the execution of the two versions of quicksort for the call `quicksort([2,5,7],X)`. [6 marks]