Maynooth University
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OLLSCOIL NA hÉIREANN MÁ NUAD

THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

JANUARY 2016 EXAMINATION

CS424

Programming Language Design & Language Semantics

Dr. D. Charles, Dr. A. Winstanley, Prof. B. Pearlmutter

Time allowed: 2 hours

Answer at least four questions
Your mark will be based on your best ***four*** answers

All questions carry equal marks

[25 marks]

1 Define a Scheme function reverse-with-count which takes two lists, the second of which is a list of non-negative integers the same length as the first list, and returns a list of elements from the first list, in reverse order, each repeated a number of times as specified by the corresponding element of the second list.

Examples:

```
(reverse-with-count '(a b c) '(1 2 3)) => (c c c b b a)
(reverse-with-count '(d c b a) '(3 0 0 1)) => (a d d d)
```

[25 marks]

2 Define a Haskell function revCount which takes two lists, the second of which is a list of non-negative Ints the same length as the first list, and returns a list of elements from the first list, in reverse order, each repeated a number of times as specified by the corresponding element of the second list.
Be sure to include a type declaration for revCount.

Examples:

```
revCount ['a','b','c'] [1,2,3] => ['c','c','c','b','b','a']
revCount ['d','c','b','a'] [3,0,0,1] => ['a','d','d','d']
```

[25 marks]

3 Define a Prolog predicate noah/3 which is true of three lists when corresponding elements of the first two lists, which are of the same length are lined up two-by-two on the third list.

Examples:

```
noah([ ],[ ],[ ]).
noah([a,b,c,d],[aye,bee,sea,dee],[a,aya,b,bee,c,sea,d,dee]).
```

[25 marks]

4 Can the expression lambda v:T . v v be well-typed in the simply-typed lambda calculus by giving an appropriate type for T?
If so, give such a type. If not, explain why not.

[25 marks]

5 Assuming you brushed up on both languages, which would it be easier for you to write a Prolog interpreter in: Scheme or Haskell? Explain.