University of Innsbruck — Institute of Computer Science
Test 2B — 11 January 2008

Functional Programming — WS 2007/2008 — LVA 703018

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This test consists of three exercises. *Explain your answers.* The available points for each item are written in the margin.

[7] 1. Consider the λ-term $t = (\lambda uv.u)\ ((\lambda w.w)\ (\lambda xy.y))\ (\lambda z.z)$. Use the leftmost innermost reduction strategy to reduce t as far as possible.

[8] 2. Consider the functions:

```
let rec prod = function
  | [] -> 1
  | x :: xs -> x * prod xs
;;
```

and

```
let rec fold f b = function
  | [] -> b
  | x :: xs -> f x (fold f b xs)
;;
```

Prove by induction over xs that for all integer lists xs it holds that

$$\mathsf{prod}\ xs = \mathsf{fold}\ (\times)\ 1\ xs.$$

3. For each of the following functions, decide whether it is tail recursive. If yes, justify your answer. Give a tail recursive implementation otherwise.

[5] (a) Consider the mutually recursive functions `e` and `o`

```
let rec e = function
  | [] -> true
  | x :: xs -> o xs
and o = function
  | [] -> false
  | x :: xs -> e xs
;;
```

[5] (b) Consider the function `prod` from Exercise 2.