Technische Universität München | *Summer Semester 08*
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Virtual Machines

Exercise Sheet 4

Deadline: 13 Mai 2008, during lecture, by email, or in room 02.07.041

Exercise 1:

6 Points

Write the following functions in OCaml (without using OCaml library functions with the same names).

a) *filter*, which takes as argument a predicate p and a list l, and returns the list of elements from l for which p is true.

b) *fold_right*, such that
$fold\_right\ f\ e\ [x_1, \ldots, x_n] = f(x_1, f(x_2, \ldots, f(x_n, e)) \ldots)$.

c) *mapi*, such that
$mapi\ f\ [x_1, \ldots, x_n] = [f(x_1, 1), \ldots, f(x_n, n)]$.
For example, for $f(x, i) = x + i$ and $l = [3, 3, 3]$, *mapi* f l should return $[4, 5, 6]$.

Exercise 2:

4+4 Points

a) Give a formal definition of the function $free$ such that $free(e) \subseteq Vars$ is the set of global variables in e, where $Vars$ is the set of variables used for building expressions.

b) Determine the set of global variables for each of the following expressions.

- `(fn x => x y) (fn y => y)`
- `fn x,y => z (fn z => z (fn x => y))`
- `(fn x,y => x z (y z)) (fn x => y (fn y => y))`
-
```
((fn x => x) z) + let a = x;
                      x = f y;
                      y = z
                  in x+y+z
```

Exercise 3:

6 Points

Consider the expression $e \equiv$ `if x > 1 then x else x + y * x` along with the address environment $\rho = \{x \mapsto (L, 1), y \mapsto (L, -1)\}$ and stack distance $sd = 3$. Compute $code_V\ e\ \rho\ sd$. Annotate every instruction with the current stack distance like in the examples in the lecture.