Recent advances in software engineering 32039
Laboratory exercises: Week 4

Question 1 Perform the following substitutions by hand

$$\{3/x\}(y \to y\ x)$$
$$\{3/x\}(x \to y\ x)$$
$$\{y/x\}(y \to y\ x).$$

Question 2 Reduce the following terms of the static pattern calculus by hand. Show all steps (aside from arithmetic).

$(x \to y \to y\ x))\ 3$
$(x \to (x \to y\ x))\ 3$
$(x \to y \to y\ x)\ y$
$(\texttt{Leaf} \to 4)\ \texttt{Leaf}$
$(\texttt{Leaf} \to 4)\ \texttt{Nil}$
$(\texttt{Pair}\ x\ y \to x + y)\ (\texttt{Pair}\ 3\ 4)$
$(\texttt{Nil} \to \texttt{true} \mid \texttt{Cons}\ x\ y \to \texttt{false})\ (\texttt{Cons}\ 3\ \texttt{Nil})$

Question 3 Use **bondi** (without types) to define:

1. the projections of a pair
2. the head and tail of a list
3. `car` and `cdr`
4. the size of a data structure
5. the larger sub-tree of a tree of the form `Node` s t.

Question 4 Examine the code for `select` and `apply2all` in the preludes. Use them to

1. increase all integers by 1.
2. list all substructures whose size is at least 10.
3. list all substructures whose size is at least n where n is a parameter.

Test your solutions.

Question 5 Define a data type of employees in **bondi** by

```
datatype Employee = Employee of String * Int;;
```

where `Int` is used to represent the salary. Write a program that increments all employee salaries within an arbitrary structure, while leaving all other integers unchanged. Test your solution.