Recent advances in software engineering 32039
Laboratory exercises: Week 3

Question 1 Reduce the following terms of the compound calculus by hand.

`Leaf` $=_c$ `Leaf`
`Nil` $=_c$ `Leaf`
`Leaf` 3 $=_c$ `Nil`
`Leaf` 3 $=_c$ `Leaf` 3
`Nil` $=_c$ $(\lambda x.x)$ `Nil`
$\lambda x.x =_c \lambda x.x$
$x =_c x$

`pair?` `Leaf`
`pair?` `Nil`
`pair?` (`Leaf` 3)
`pair?` (`Cons` 3 `Nil`)
`pair?` (`Cons` 3 x)
`pair?` (`Cons` 3)
`pair?` (x 3)
`pair?` `true`

`car` (`Leaf` 3)
`car` (`Cons` 3 `Nil`)
`car` (`Cons` 3 x)
`car` (`Cons` 3)
`car` (x 3)

`cdr` (`Leaf` 3)
`cdr` (`Cons` 3 `Nil`)
`cdr` (`Cons` 3 x)
`cdr` (`Cons` 3)
`cdr` (x 3)

Question 2 Open "rase03.bon" in **bondi** to get definitions of `car, cdr`, etc. Use it to define select in the compound calculus style.
bondi supports list syntax, so that "[1,2,3]" is the list

```
Cons 1 (Cons 2 (Cons 3 Nil))
```

Define

```
let isEven x = (x/2) * 2 == x;;
```

Apply `select isEven` to the following data structures:
`[1,2,3,4,5,6,7]`
(3,4)
(3,4,5,6,7)
`Cons` 4
`Node` 6 (`Leaf` 2) (`Leaf` 3)

Question 3 Repeat Question 2 for `update` and test it using `isEven` and the function that adds one.

Question 4 Define `isList` in compound calculus style. Evaluate `select isList [1,2,3,4,5]` and `select isList ([1,2,3],[4,5])`.

Question 5 Modify `select` to yiled `select2` so that it looks at sub-structures even though the super-structure passes the test. For example `select2 isList` should produce a list of all sub-lists.

Question 5 Repeat Question 5 for `update`.