

# Homework 1 — APL (due Wednesday, May 1 2013)

Mayer Goldberg

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## 1 $\lambda$ -Definability

Solve two problem of the following exercises: 14, 21, 26, 30, 36, 37, or the following:

### 1.1 The Set of all Combinators

In this problem, you are asked questions that pertain to the *length* of a combinator. This is defined as follows:

$$\begin{aligned}|\nu| &= 1 \\ |(PQ)| &= 1 + |P| + |Q| \\ |(\lambda\nu.P)| &= 1 + |P|\end{aligned}$$

#### 1.1.1 List of all combinators

Write a procedure in Scheme or ML that take the number  $n$  and returns a list of all the combinators of length  $n$ .

### 1.1.2 The number of combinators of length $n$

Write a procedure in Scheme or ML that takes the number  $n$  and returns the *number* of combinators of length  $n$ . You can test your code by taking the length of the result of the previous question, for the same value of  $n$ , but this will only work for very small  $n$ . Please keep in mind that your code will be tested on input that is larger than that which is possible for the previous question, so the solution you hand in will need to use a different strategy. For example, the number of combinators of length 300 is

```
473477381975190304152771173386219140737139330572727481574
786077988437776485374930756297967309535888631641055198100
186060372310059690213121901539467263248370729333568234992
881170746462932742300417445775187087736611038605424576071
564968041698609452989548022519111112309976379200605183913
879075157976088494
```

## 2 Fixed points

Solve one problem of the following exercises: 42, 45, 46

## 3 Bases

Solve one problem of the following exercises: 74, 77, 80