COMPSCI 3MI3 : Assignment 5 Fall 2021 Nicholas Moore

1. (8 points) Fibonacci Sequence

The Fibonacci numbers can be defined as follows:

$$Fib(n) = \begin{cases} 0 & n = 0\\ 1 & n = 1\\ Fib(n-1) + Fib(n-2) & n > 2 \end{cases}$$
 (1)

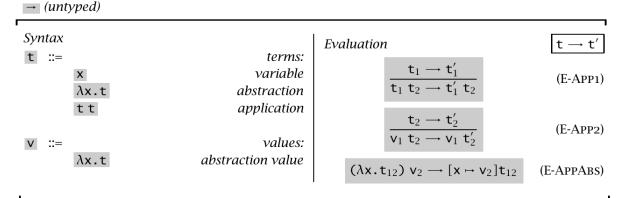
Create a λ expression in the enriched λ -Calculus which, when input to the Fixed Point Combinator, takes in a position in the Fibonacci sequence, and outputs the corresponding Fibonacci number.

Demonstrate your function works by evaluating the 4^{th} number in the sequence.

2. (6 points) **Determinacy of** λ -Calculus

In UAE, we discussed the property of determinacy at some length. Is the call-by-value evaluation strategy of λ -Calculus determinate? If yes, provide a (traditional) proof of determinacy. If no, provide a (traditional) proof of non-determinacy.

The operational semantics of the call-by-value strategy are given below.



3. (6 points) Termination of λ -Calculus

A language is said to terminate if a finite set of terms will always result in a finite evaluation chain. This property does not hold in λ -Calculus, but no rigorous proof of this fact was provided in lecture.

Create a rigorous (traditional) proof that the Termination property does not hold for λ -Calculus.

HINT: Examining the proof of termination for UAE, as well as the section from slide set 6 on computability may help you structure this proof.