Programming Languages and Types

Homework 11

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1 λ-Calculus vs. λ-Based Language

1. Summarize the differences between λ-calculus and functional programming languages based on it.

2 Nameless λ-Calculus

1. Implement a function `removeNames` that takes a naming context and a named λ-term and returns the corresponding nameless term.
2. Implement a function `regainNames` that takes a naming context and a nameless λ-term and returns a named term.
3. [*optional*] Implement the `shift` and `subst` function.
4. [*optional*] Implement the evaluation semantics for λ_{bv} using de-Bruijn indices.

Note that your implementations for `removeNames` and `regainNames` should be inverse of each other.

3 Substitution vs. Environment

1. Implement the substitution-based evaluation semantics for λ_{ao} using de-Bruijn indices.
2. Implement the environment-based evaluation semantics for λ_{bn} using de-Bruijn indices.

4 Computational λ-Calculus

1. Implement the type-checking algorithm for the simply-typed λ-calculus with booleans.

2. [*optional*] Add support for monads to your type-checking algorithm.