Homework Assignment 5

Any automatically graded answer may be manually graded by the instructor. Submissions are expected to only use functions taught in the course. If a submission uses a disallowed function, that exercise can get zero points. Excluding promises, *all functions that mutate values are disallowed* (mutable functions usually have a `!` in their name).

Language λ_S

Note: This section must use the AST defined in file `hw5-util.rkt` whose functions are prefixed with `s:`.

1. *Your goal is to implement the substitution operation, notation $e[x \mapsto v]$.* Implement function `(s:subst exp var val)` where `exp` is an expression `s:expression`, `var` is a variable `s:variable`, and `val` is a value `s:value`. Function `s:subst` must return an expression of type `s:expression`. Test cases are included in the template file.

2. *Your goal is to implement the evaluation of expressions using substitution, notation $e \Downarrow v$.* Implement function `(s:eval subst exp)`, where `subst` is a variable substitution function given by the system,[1] and `exp` is an expression of type `s:expression`. Function `s:eval` must return a value of type `s:value`. Test cases are included in the template file.

Language λ_E

Note: This section must use the AST defined in file `hw5-util.rkt` whose functions are prefixed with `e:`.

3. *Your goal is to implement the evaluation of expressions using environments, notation $e \Downarrow_E v$.* Implement function `(e:eval env exp)` where `env` is a hash-table of type `e:environ`, whose keys have a type `e:variable` and values have a type `e:value`, and expression `exp` has type `e:expression`. Function `e:eval` must return a value of type `e:value`. Test cases are included in the template file.

Manually graded questions

4. **Manually graded.** Describe one situation where implementing λ_S is a better alternative than λ_E. Conversely, describe one situation where λ_E is a better alternative than λ_S.

5. **Manually graded.** Describe two benefits of using a formal specification to help with the implementation of a software system.

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[1]We choose to make variable substitution a parameter of evaluation so that Exercise 2 can be graded independently from Exercise 1.