Disc 9 - OpSem and Lambda Calculus

Thursday, November 4, 2021 11:09 AM

Operational Semantics

2. Using the rules given below, show: $1 + (2 + 3) \Rightarrow 6$

$$\frac{}{n \Rightarrow n} \qquad \frac{e_1 \Rightarrow n_1 \quad e_2 \Rightarrow n_2 \quad n_3 \text{ is } n_1 + n_2}{e_1 + e_2 \Rightarrow n_3}$$

4. Using the rules given below, show: $A;\ let\ y = 1\ in\ let\ x = 2\ in\ x \Rightarrow 2$

$$\frac{}{A;\ n \Rightarrow n} \qquad \frac{A(x) = v}{A;\ x \Rightarrow v}$$

$$\frac{A;\ e_1 \Rightarrow v_1 \quad A, x : v_1;\ e_2 \Rightarrow v_2}{A;\ \textbf{let}\ x = e_1\ \textbf{in}\ e_2 \Rightarrow v_2} \qquad \frac{A;\ e_1 \Rightarrow n_1 \quad A;\ e_2 \Rightarrow n_2 \quad n_3 \text{ is } n_1 + n_2}{A;\ e_1 + e_2 \Rightarrow n_3}$$

5) Recall last week we went over lexing and parsing:

type expr =
| Int of int
| Plus of expr * expr

Implement an expression evaluator, that takes an environment closure and an expression, and returns a value after evaluating it.

Key Notes (Taken from OpSem rules, which will be given on the project)

- Integers evaluate to themselves
- Plus works on integers (throw a TypeError otherwise)

let rec eval_expr env e =

Lambda Calculus

1) (λa. a) b

Make the parentheses explicit in the following expressions

2) a b c
3) λa. λb. a b
4) λa. a b λa. a b

Identify the free variables in the following expressions

1) λa. a b a
2) a (λa. a) a
3) λa. (λb. a b) a b

Apply alpha-conversions to the following

1) λa. λa. a
2) (λa. a) a b
3) (λa. (λa. (λa. a) a) a

Apply beta-reductions to the following

1) (λa. a b) x b
2) (λa. b) (λa. λb. λc. a b c)
3) (λa. a a) (λa. a a)