CMSC22100 HW #7

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15.5.2

(a) Considering the case where:

$$\frac{T_1 \ <: \ S_1}{Ref \ S_1 \ <: \ Ref \ T_1}$$

suppose we have:

$$\frac{\{x : Nat, y : Bool\} \ <: \ \{x : Nat\}}{Ref\{x : Nat\} \ <: \ Ref\{x : Nat, y : Bool\}}$$

Then this program gets stuck:

$$(\lambda z : Ref\{x : Nat, y : Bool\}.\ not(!z.y)) \ \ (Ref\{x : 2\})$$

(b) In the opposite case where:

$$\frac{S_1 \ <: \ T_1}{Ref \ S_1 \ <: \ Ref \ T_1}$$

suppose we have:

$$\frac{\{x : Nat, y : Bool\} \ <: \ \{x : Nat\}}{Ref \ \{x : Nat, y : Bool\} \ <: \ Ref \ \{x : Nat\}}$$

Then this program gets stuck:

$$\begin{array}{ll} let & x \ = Ref \ \{x : 1, y : true\} \\ & x \ = (\lambda z : Ref\{x : Nat\}.\ z := \{x : 5\}) \ \ x \\ in & \\ & !x.y \end{array}$$

18.6.2

Syntax:

$$t ::= ... \mid t \ with \ \{l_i = t_i \ ^{i \in 1..n}\}$$

Evaluation Rules (ommiting $i \in 1..n$) in records:

$$\frac{t_1 \to t_1'}{t_1 \ with \ \{l_i = t_i\} \to t_1' \ with \ \{l_i = t_i\}}$$

$$\frac{t_i \to t_i'}{v \ with \ \{l_i = t_i\} \to v \ with \ \{l_i = t_i'\}}$$

$$v' \ with \ \{l_i = v_i\} \longrightarrow v$$

Typing Rules (ommiting $i \in 1..n$) in records:

$$\frac{\Gamma \vdash t_1 : \{l_i : T_i\} \quad \Gamma \vdash t_2 : \{j_k : T_k\}}{\Gamma \vdash \ t_1 \ with \ t_2 : \{l_i : T_i\} \vee \{k_i : T_k\}}$$

Where "$\vee$" stands for the concatenation of two records (without duplicating labels).

22.2.3

1. $([X \mapsto Z \to \alpha \to \beta, \ Y \mapsto Z \to \alpha], \ \beta)$

2. $([X \mapsto \alpha \to \beta \to \gamma, \ Y \mapsto \alpha \to \beta, \ Z \mapsto \alpha], \ \gamma)$

3. $([X \mapsto Nat \to Nat \to Bool, \ Y \mapsto Nat \to Nat, \ Z \mapsto Nat], \ Bool)$