

CS383 Programming Languages

Quiz 6

1. What is the problem with T-Inl and T-Inr?

$$\frac{G \mid - e : t_1}{G \mid - \text{inl } e : t_1 + t_2} \quad (\text{T-Inl})$$

$$\frac{\Gamma \mid - e : t_2}{\Gamma \mid - \text{inr } e : t_1 + t_2} \quad (\text{T - Inr})$$

Given e of a fixed type, $\text{inl } e$ is of type $t_1 + t_2$, for any t_2 !

2. Which is the Evaluation Strategy of fix ?

$\text{fix} = \lambda f. (\lambda x. f (\lambda y. x x y)) (\lambda x. f (\lambda y. x x y))$

- a. Call-by-value
- b. Call-by-name
- c. Normal order
- d. Full beta-reduction

3. Write down the typing rule of fix

$$\frac{\Gamma \mid - e : t_1 \rightarrow t_1}{\Gamma \mid - \text{fix } e : t_1} \quad (\text{T - Fix})$$

4. What are the head and tail of list :
 $1::(2::(3::(4::\text{nil})))$?

Head: 1

Tail: $2::3::4::\text{nil}$

5. Which rule is **in**correct about list evaluation?

- a.
$$\frac{}{\text{case nil of nil} \Rightarrow e_1 \mid x_1 :: x_2 \Rightarrow e_2 \rightarrow e_1} \text{ (E - CaseNil)}$$
- b.
$$\frac{}{\text{case } v_1 :: v_2 \text{ of nil} \Rightarrow e_1 \mid x_1 :: x_2 \Rightarrow e_2 \rightarrow e_2[v_1 / x_1][v_2 / x_2]} \text{ (E - CaseCons)}$$
- c.
$$\frac{e_1 \rightarrow e_1'}{e_1 :: e_2 \rightarrow e_1' :: e_2} \text{ (E - Cons1)}$$
- d.
$$\frac{e_2 \rightarrow e_2'}{e_1 :: e_2 \rightarrow e_1 :: e_2'} \text{ (E-Cons2)}$$
- $$\frac{e_2 \rightarrow e_2'}{v_1 :: e_2 \rightarrow v_1 :: e_2'} \text{ (E-Cons2)}$$

6. Which one is not a list value according to the definition of list ?

a. Nil

b. $1::2::3$

c. $1::2::3::\text{nil}$

d. None of the above

7. Why use substitution to implement function application is **not** efficient?

Search through e_1 for free occurrences of x
during substitution

Go through e_1 again to evaluate it: $e_1 \rightarrow^* v_1$

That's double the work!

8. In environment model, we bind __ to __?

- a. Variable; type
- b. Variable; value
- c. Expression; type
- d. Expression; value

9. What is closures in environment model?

a pair of a function and its environment

10. Which rule is incorrect for the evaluation under the environment model?

a.
$$\frac{E(x) = v}{(E, x) \rightarrow^* v} \quad (\text{E - var})$$

b.
$$\frac{}{(E, \lambda x.e) \rightarrow^* \{\lambda x.e, E\}} \quad (\text{E - fun})$$

c.
$$\frac{(E, e_1) \rightarrow^* \{\lambda x.e, E_1\} \quad (E, e_2) \rightarrow^* v_2 \quad (E_1[x \mapsto v_2], e) \rightarrow^* v,}{(E, (e_1 \ e_2)) \rightarrow^* v} \quad (\text{E - app})$$

d.
$$\frac{(E, e_1) \rightarrow v_1 \quad (E[x \mapsto v_1], e_2) \rightarrow^* v_2}{(E, \text{let } x = e_1 \text{ in } e_2) \rightarrow^* v_2} \quad (\text{E-let})$$