

Indian Institute of Technology Delhi
Department of Computer Science and Engineering

CSL302

April 22, 2014

Programming Languages

10 minutes

Quiz 5

Maximum Marks: 20

Assume we have a functional language with *call by name* i.e., lazy semantics for function call. The language has at least the following constructs:

$$e \in \text{Exp} ::= x \mid \dots \mid \lambda x. e_1 \mid e_1(e_2) \mid \dots \mid \text{let } x \stackrel{\text{def}}{=} e_1 \text{ in } e_2 \text{ end} \mid (e_1, e_2) \mid \text{proj}_i^{(2)} e$$

Q1. (10 marks) Big-step call-by-name semantics. Recall the Principle of Correspondence, and accordingly provide *big-step/Natural* semantics rules for the call-by-name semantics in a "closure transition style" for only the following constructs:

$$\text{let } x \stackrel{\text{def}}{=} e_1 \text{ in } e_2 \text{ end} \mid (e_1, e_2) \mid \text{proj}_i^{(2)} e$$

$$a \in \text{Answers} ::= \dots \mid \text{val closures} \quad \checkmark \quad 0.5$$

$$\gamma \in \text{Tables} = (x \rightarrow \text{Answer}) \Rightarrow (\text{variables to closures mapping}) \quad \checkmark \quad 0.5$$

$$cl \in \text{Closures} = (\text{Exp} \times \text{Table}) \text{ of the form } \langle e, \gamma \rangle \quad \checkmark \quad 0.5$$

$$\text{vcl} \in \text{ValueClosures} = \text{subset of closures} \\ = \langle n, \gamma \rangle \mid \langle \lambda x. e, \gamma \rangle \quad \checkmark$$

Big-step rules

$$\frac{\langle \text{let } x \stackrel{\text{def}}{=} e_1 \text{ in } e_2 \text{ end}, \gamma \rangle \Rightarrow \text{vcl}}{\langle e_2, \gamma[x \mapsto \text{vcl}] \rangle \Rightarrow \text{val}} \quad \checkmark \quad 3$$

$$\frac{\langle e_1, \gamma \rangle \Rightarrow \text{vcl}_1 \quad \langle e_2, \gamma \rangle \Rightarrow \text{vcl}_2}{\langle (e_1, e_2), \gamma \rangle \Rightarrow (\text{vcl}_1, \text{vcl}_2)} \quad \checkmark \quad 0.5$$

$$\frac{\langle e, \gamma \rangle \Rightarrow (cl_1, cl_2) \quad \langle cl_i \rangle \Rightarrow \text{vcl}_i}{\langle \text{proj}_i^{(2)} e, \gamma \rangle \Rightarrow \text{vcl}_i} \quad \checkmark \quad 1.5$$

only evaluate $\langle (e, e), \gamma \rangle$ is a value closure!