CS 221 **Programming Languages** **Handout 2**
Fall 2005 **Nov 23 , 2005**

E-machine

$$
\begin{array}{rrcl}
\text{States} & s & ::= & \mathtt{In}(K, E, e) \mid \mathtt{Out}(V, K) \\
\text{Stacks} & K & ::= & \mathtt{nil} \mid f :: K \\
\text{Frames} & f & ::= & \mathtt{Prim}_1(op, e_2, E) \\
 & & \mid & \mathtt{Prim}_2(op, V_1) \\
 & & \mid & \mathtt{App}_1(e_2, E) \\
 & & \mid & \mathtt{App}_2(V_1) \\
 & & \mid & \mathtt{If}_1(e_1, e_2, E)
\end{array}
$$

Analyze

$$\mathtt{In}(K, E, op(e_1, e_2)) \mapsto_E \mathtt{In}(\mathtt{Prim}_1(op, e_2, E) :: K, E, e_1) \quad (1)$$

$$\mathtt{In}(K, E, \mathtt{apply}(e_1, e_2)) \mapsto_E \mathtt{In}(\mathtt{App}_1(e_2, E) :: K, E, e_1) \quad (2)$$

$$\mathtt{In}(K, E, \mathtt{if}(e, e_1, e_2)) \mapsto_E \mathtt{In}(\mathtt{If}_1(e_1, e_2, E) :: K, E, e) \quad (3)$$

Return value

$$\mathtt{In}(K, E, x) \mapsto_E \mathtt{Out}(E(x), K) \quad (4)$$

$$\mathtt{In}(K, E, v) \mapsto_E \mathtt{Out}(v, K) \quad (5)$$

$$\mathtt{In}(K, E, \mathtt{fun}\ f(x)\ \mathtt{is}\ e) \mapsto_E \mathtt{Out}([\mathtt{fun}\ f(x)\ \mathtt{is}\ e; E], K) \quad (6)$$

Propagate value

$$\mathtt{Out}(V_2, \mathtt{Prim}_2(op, V_1) :: K) \mapsto_E \mathtt{Out}((V_1\ op\ V_2), K) \quad (7)$$

Move to pending

$$\mathtt{Out}(V_1, \mathtt{Prim}_1(op, e_2, E) :: K) \mapsto_E \mathtt{In}(\mathtt{Prim}_2(op, V_1) :: K, E, e_2) \quad (8)$$

$$\mathtt{Out}(V_1, \mathtt{App}_1(e_2, E) :: K) \mapsto_E \mathtt{In}(\mathtt{App}_2(V_1) :: K, E, e_2) \quad (9)$$

$$\mathtt{Out}(\mathtt{true}, \mathtt{If}_1(e_1, e_2, E) :: K) \mapsto_E \mathtt{In}(K, E, e_1) \quad (10)$$

$$\mathtt{Out}(\mathtt{false}, \mathtt{If}_1(e_1, e_2, E) :: K) \mapsto_E \mathtt{In}(K, E, e_2) \quad (11)$$

$$\mathtt{Out}(V_2, \mathtt{App}_2(V_1) :: K) \mapsto_E \mathtt{In}(K, E[f \mapsto V_1][x \mapsto V_2], e) \quad (12)$$

where $V_1 = [\mathtt{fun}\ f(x)\ \mathtt{is}\ e; E]$