

CEK machine transition steps \rightsquigarrow

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$$\begin{aligned}\langle x \mid E \mid K \rangle &\rightsquigarrow \langle \text{lookup } x \text{ in } E \mid E \mid K \rangle \\ \langle M_1 M_2 \mid E \mid K \rangle &\rightsquigarrow \langle M_1 \mid E \mid (\bigcirc M_2 E), K \rangle\end{aligned}$$

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Example: $((\lambda x. \lambda y. x) 1) 2$ evaluates to 1

$\langle ((\lambda x. \lambda y. x) 1) 2 \mid \emptyset \mid \blacksquare \rangle$

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$$\begin{aligned} & \langle ((\lambda x. \lambda y. x) 1) 2 \mid \emptyset \mid \blacksquare \rangle \\ \rightsquigarrow & \langle (\lambda x. \lambda y. x) 1 \mid \emptyset \mid (\bigcirc 2 \emptyset) \rangle \end{aligned}$$

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Example: $((\lambda x. \lambda y. x) 1) 2$ evaluates to 1

$\langle ((\lambda x. \lambda y. x) 1) 2 \mid \emptyset \mid \blacksquare \rangle$
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 $\rightsquigarrow \langle 1 \mid \emptyset \mid (\text{clos}((\lambda x. \lambda y. x), \emptyset) \circ), (\circ 2 \emptyset) \rangle$

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 $\rightsquigarrow \langle \lambda y. x \mid x \mapsto 1 \mid (\circ 2 \emptyset) \rangle$
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 $\rightsquigarrow \langle x \mid x \mapsto 1, y \mapsto 2 \mid \blacksquare \rangle$

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 $\rightsquigarrow \langle 2 \mid \emptyset \mid (\text{clos}(\lambda y. x, x \mapsto 1) \circ) \rangle$
 $\rightsquigarrow \langle x \mid x \mapsto 1, y \mapsto 2 \mid \blacksquare \rangle$
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CEKgo extensions

$$\begin{aligned} M &::= \dots \\ &| \text{go } M \\ &| \text{here } M \end{aligned}$$
$$\begin{aligned} F &::= (W \bigcirc) \\ &| (\bigcirc M E) \\ &| \blacktriangleright \blacktriangleright \end{aligned}$$
$$K ::= F^*$$

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Example 1 of jumping with here and go

`< here ((λx.2) (go 5)) | ∅ | ■ >`

Example 1 of jumping with here and go

$\langle \text{here } ((\lambda x.2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 1 of jumping with here and go

$\langle \text{here } ((\lambda x.2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 1 of jumping with here and go

$\langle \text{here } ((\lambda x.2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle \text{clos}(\lambda x.2, \emptyset) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 1 of jumping with here and go

$\langle \text{here } ((\lambda x.2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) \mid \emptyset \mid (\bigcirc (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

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$\rightsquigarrow \langle (\text{go } 5) \mid \emptyset \mid (\text{clos}(\lambda x.2, \emptyset) \bigcirc), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 1 of jumping with here and go

$\langle \text{here } ((\lambda x.2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\lambda x.2) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle \text{clos}(\lambda x.2, \emptyset) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 5) \mid \emptyset \mid (\text{clos}(\lambda x.2, \emptyset) \circ), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle 5 \mid \emptyset \mid \blacksquare \rangle$

Example 2 of jumping with here and go

`< here ((go 2) (go 5)) | ∅ | ■ >`

Example 2 of jumping with here and go

$\langle \text{here} ((\text{go } 2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 2 of jumping with here and go

$\langle \text{here} ((\text{go } 2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 2) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 2 of jumping with here and go

$\langle \text{here} ((\text{go } 2) (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 2) (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle (\text{go } 2) \mid \emptyset \mid (\circ (\text{go } 5) \emptyset), \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle 2 \mid \emptyset \mid \blacksquare \rangle$

Example 3 of jumping with here and go

`< here ($\lambda x.$ (go 5)) | \emptyset | \blacksquare >`

Example 3 of jumping with here and go

$\langle \text{here } (\lambda x. (\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle \lambda x. (\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 3 of jumping with here and go

$\langle \text{here}(\lambda x.(\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle \lambda x.(\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

$\rightsquigarrow \langle \text{clos}(\lambda x.(\text{go } 5), \emptyset) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

Example 3 of jumping with here and go

$\langle \text{here}(\lambda x.(\text{go } 5)) \mid \emptyset \mid \blacksquare \rangle$

$\rightsquigarrow \langle \lambda x.(\text{go } 5) \mid \emptyset \mid \blacktriangleright\blacktriangleright, \blacksquare \rangle$

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$\rightsquigarrow \langle \text{clos}(\lambda x.(\text{go } 5), \emptyset) \mid \emptyset \mid \blacksquare \rangle$

Compare exceptions in OCaml

```
exception E;;

let f =
  try
    fun x -> raise E
  with E -> fun y -> "static"
in
  try
    f 0
  with E -> "dynamic"
;;
```