An Implementation of Transparent Migration on Standard Scheme

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Idea

$$\mathrm{go}_{\mathrm{rhost}} \cong \mathrm{shift}\,(\mathrm{reval}_{\mathrm{rhost}} \circ \mathrm{tdpe}_{()\to()})$$

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Delimited Continuation

\+ Type-Directed Partial Evaluation

\+ Remote Evaluation

$\rightarrow$ Transparent Migration

Outline

- What is transparent migration?
- What are
  - Delimited continuation
  - Type-directed partial evaluation

  and how do they enable transparent migration?

Transparent Migration (or "Strong Mobility")

A program moves from one host to another, *keeping its execution state*

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```
> (begin (system "hostname")
         (go "remotehost")
         (system "hostname"))
localhost
remotehost
```

Naive Approach

```
(define (go rhost)
  (call/cc (λk.
    somehow send k to rhost)))
```

Problem: Unnecessary Continuation

```
(let ([v (make-vector 100000)])
  (go "remotehost")
  (display "hello")
  (go "localhost")
  (display v))
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Delimited Continuation [Danvy & Filinski 89, 90]

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(+ 1 (reset (+ 2 (shift (λk.
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                  where k = (+ 2  )
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(+ 1 (reset (+ 2 (shift (λk.
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⇒ (+ 1 (k (k 3)))
                  where k = (+ 2  )
⇒ (+ 1 (+ 2 (+ 2 3)))
⇒ 8
```

Transparent Migration Using Delimited Continuations

```
(let ([v (make-vector 100000)])
  (reset (go "remotehost")
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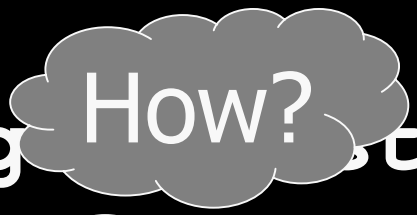

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Given a compiled value and its type,
"reconstruct" its source code
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```
> (define (f x)
    ((lambda (y) y) x))
> (tdpe 'α→α f)
(lambda (z0) z0)
```

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```
> (define (g x)
    (display (+ x 1)))
> (tdpe 'int→() g)
(lambda (z1)
  (display (+ z1 1)))
```

Transparent Migration Using TDPE

```
(define (go rhost)
  (shift (λk.
    (let ([e (tdpe '()→() k)])
      (reval rhost e)))))
```

Limitations

- "`go`" doesn't terminate if "`k`" has no normal form (e.g. because of recursion)
  - Workaround: use a special fixed-point operator
- "go" duplicates some data
  - ⇨ set!, set-car!, set-vector!, eq?, etc. may not work

Conclusion

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Scheme is so flexible!

- call/cc + set! $\Rightarrow$ shift & reset
- dynamic typing + set! $\Rightarrow$ TDPE with ease