Distributed Places

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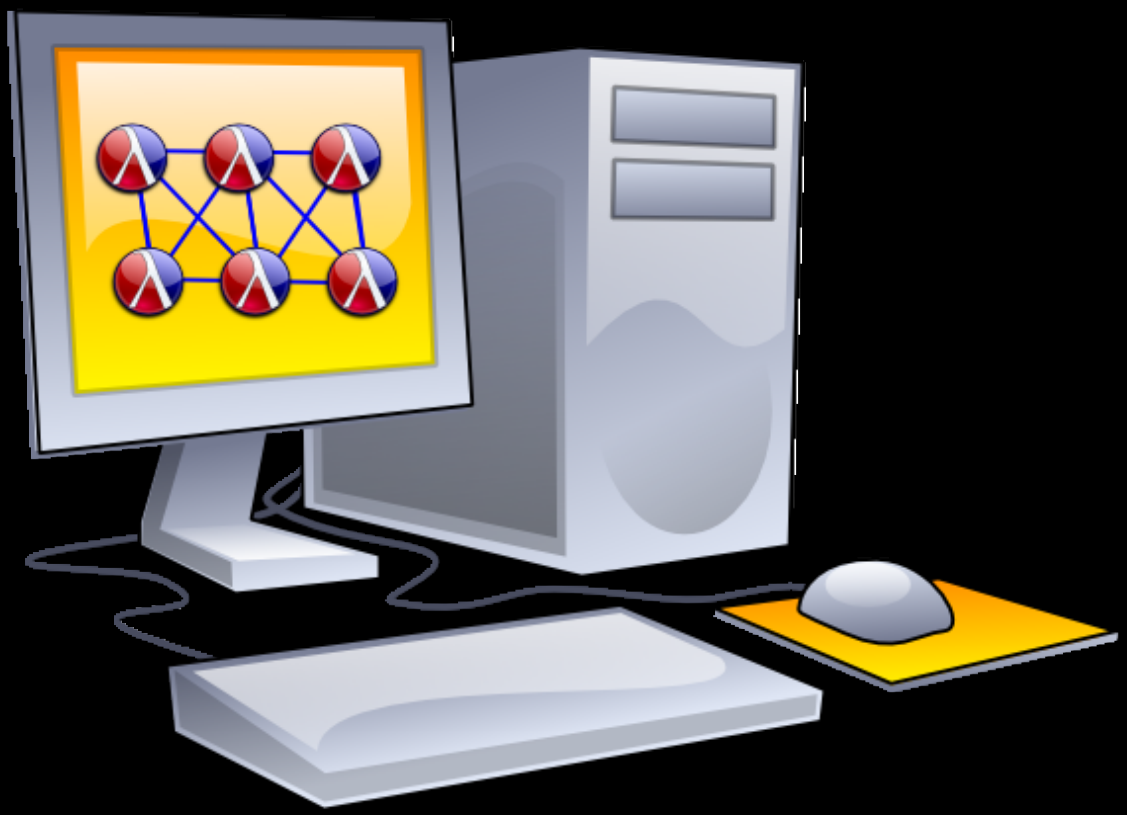

Places Example

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(provide hello-world)

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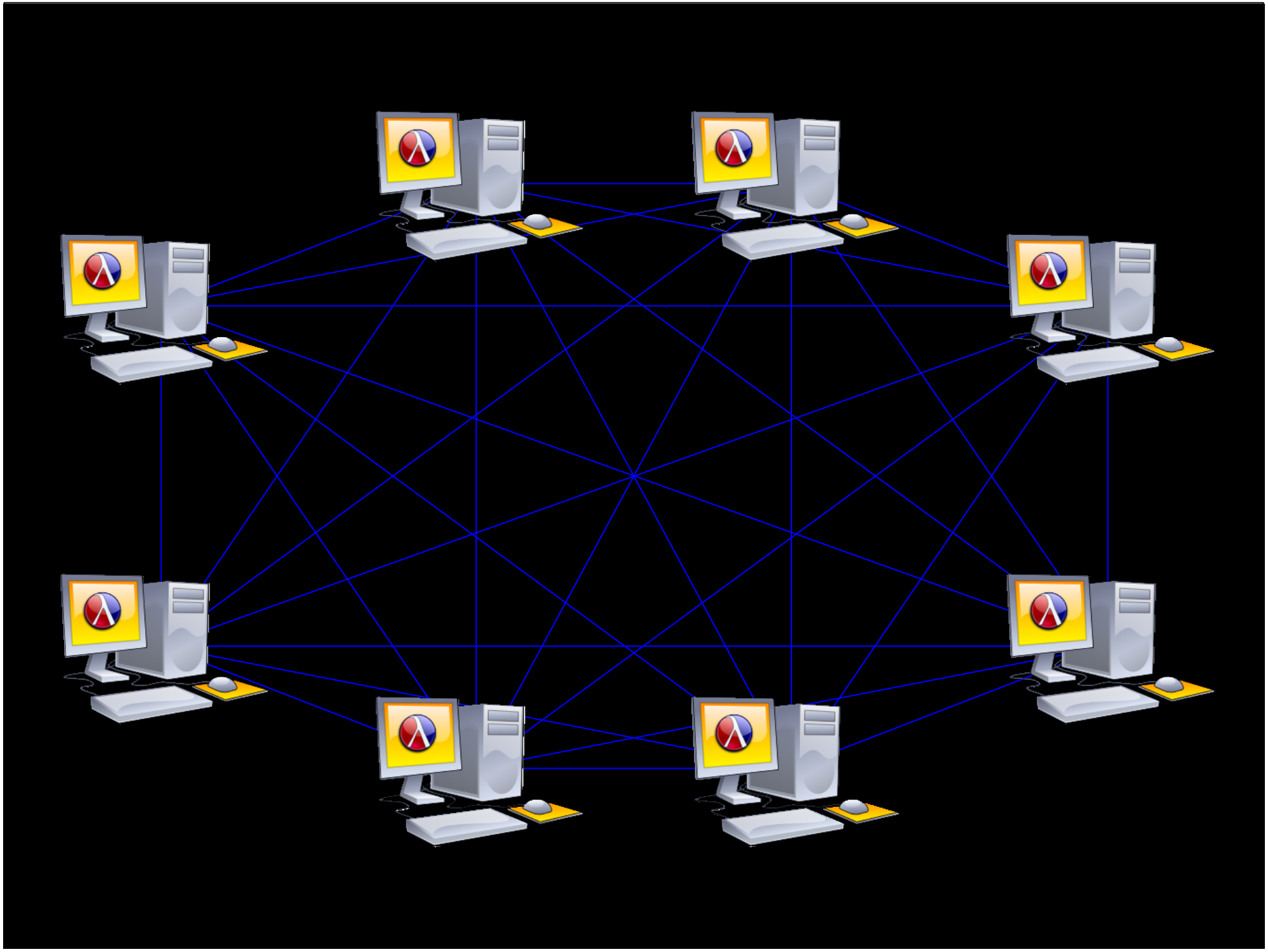

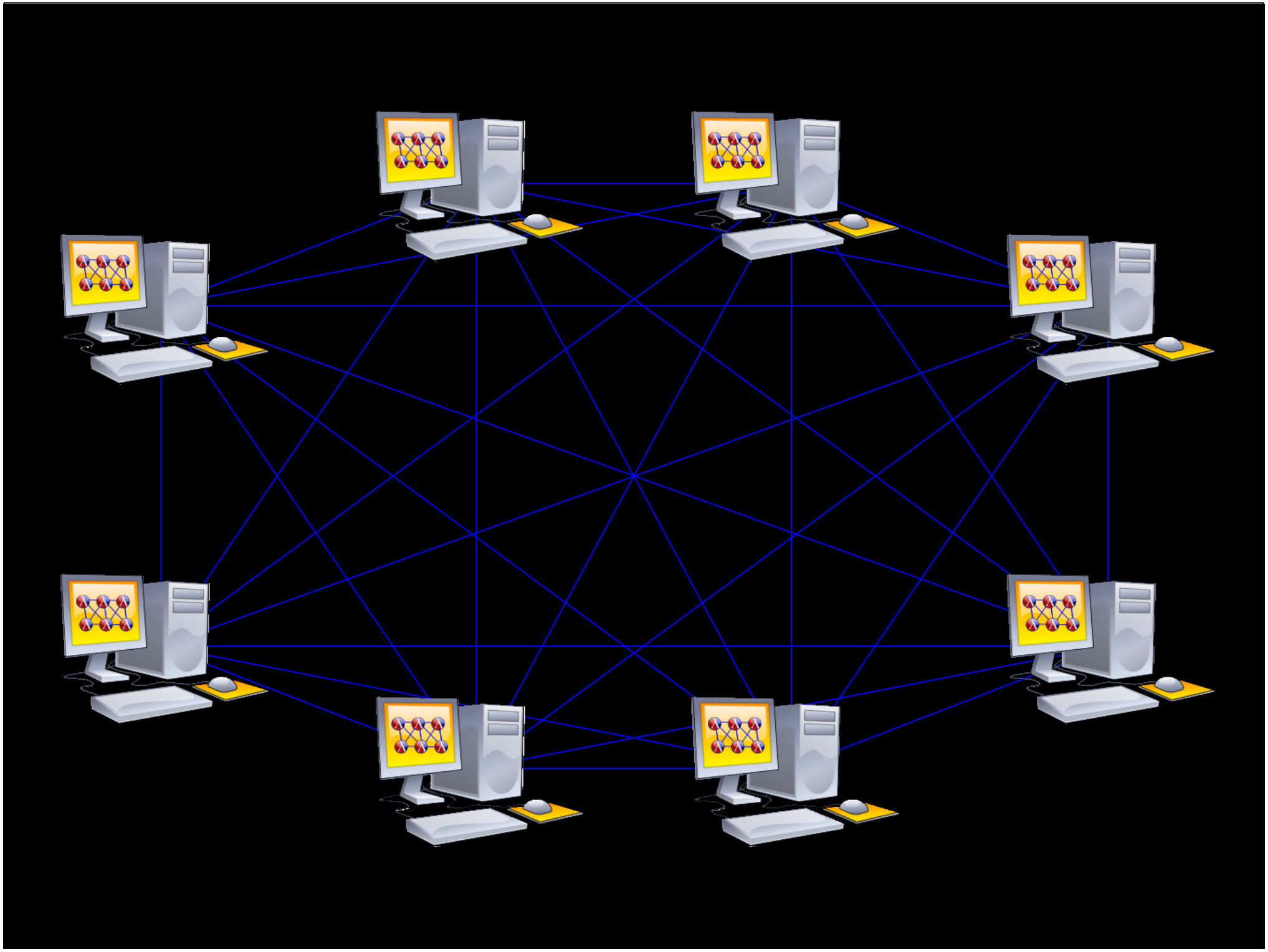


Distributed Places

Distributed Places

Pile of Functions

FFI

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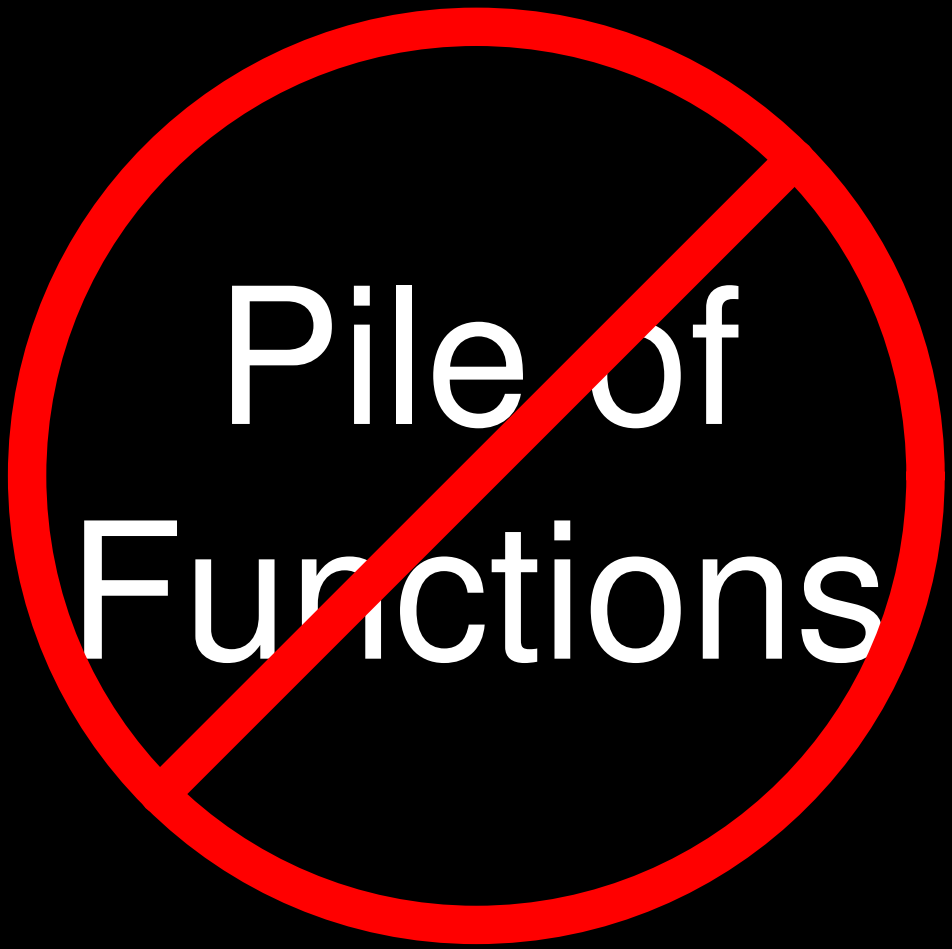

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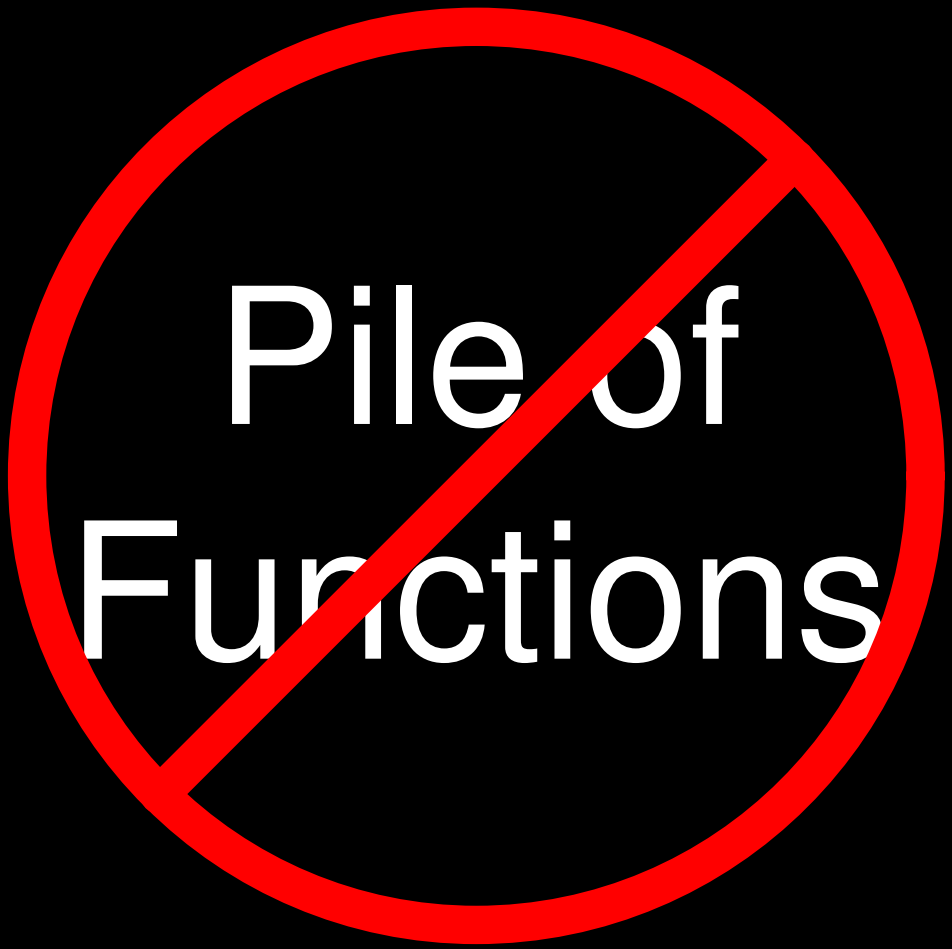

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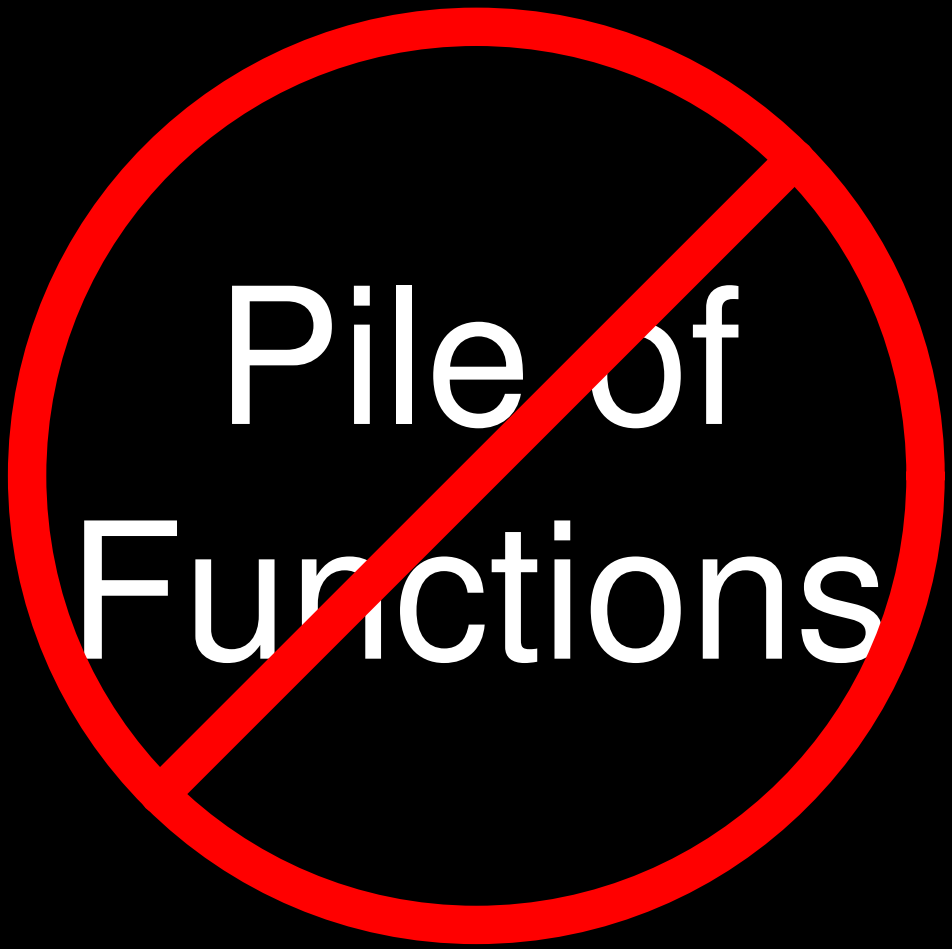

Language Extension

Distributed Places Example

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(module+ main
  (define n (create-place-node "host2"
                               #:listen-port 6344))
  (define p (dynamic-place #:at n
                           (quote-module-path "..")
                           'hello-world))
  (place-channel-put p "Hello")
  (printf/f "main received: ~a\n"
            (place-channel-get p))
  (place-wait p))
```

Distributed Places

API

create-place-node

```
(create-place-node
  hostname
  [#:listen-port port
   #:racket-path racket-path
   #:ssh-bin-path ssh-path
   #:distributed-launch-path launcher-path
   #:use-current-ports use-current-ports])
  → (is-a?/c remote-node%)
  hostname : string?
  port : port-no? = DEFAULT-ROUTER-PORT
  racket-path : string-path? = (racket-path)
  ssh-path : string-path? = (ssh-bin-path)
  launcher-path : string-path?
    = (path->string distributed-launch-path)
  use-current-ports : boolean? = #t
```

dynamic-place

```
(dynamic-place
  module-path
  start-name
  [#:at node
   #:named named]) → place?
    module-path : (or/c module-path? path?)
    start-name : symbol?
    node : (or/c #f remote-node%) = #f
    named : (or/c #f string?) = #f
```

Implementing Distributed Places

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Spawn Remote Processes

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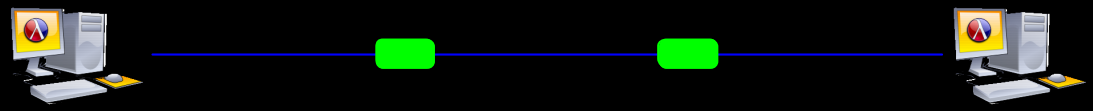
Send Place Messages Across TCP Sockets



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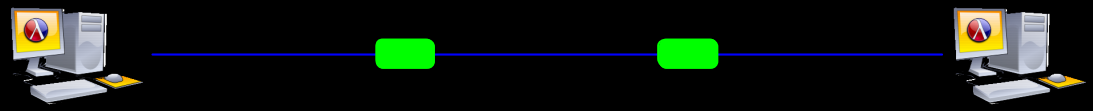
Spawn Remote Processes

Send Place Messages Across TCP Sockets



Integrate with Racket Concurrency Primitives

```
(sync place-channel-1 socket place-descriptor)
```

Higher-level Distributed Frameworks

RPC Server

Definition - tuple.rkt

```
(require racket/match
         racket/place/define-remote-server)

(define-named-remote-server tuple-server

  (define-state h (make-hash))

  (define-rpc (set k v)
    (hash-set! h k v)
    v)

  (define-rpc (get k)
    (hash-ref h k #f))

  (define-cast (hello)
    (printf "Hello from define-cast\n")
    (flush-output)))
```

Use

```
(require racket/place/distributed
         racket/place
         "tuple.rkt")

(module+ main
  (define c (connect-to-named-place remote-node
                                    'tuple-server))
  (tuple-server-hello c)
  (displayln (tuple-server-set c "user0" 100))
  (displayln (tuple-server-get c "user0")
  (tuple-server-hello)))
```

MPI

```
(require racket/place/distributed
         racket/place/distributed/rmpi)

(provide prod-id-place)

(define (prod-id-place ch)
  (define-values (comm args tc) (rmpi-init ch))
  (define sum (rmpi-allreduce comm
                              *
                              (+ 1 (rmpi-id comm))))
  (printf/f "~a - ~a\n" (rmpi-id comm) sum)
  (sleep 3)

  (rmpi-finish comm tc))
```

```
(module+ main
  (define args null)
  (time
    (rmpi-launch
      (rmpi-build-default-config
        #:mpi-module (quote-module-path "..")
        #:mpi-func   'prod-id-place
        #:mpi-args    args)

        (list (list "localhost" 6341 'kmeans0 0)
              (list "localhost" 6342 'kmeans1 1)
              (list "localhost" 6343 'kmeans2 2)
              (list "localhost" 6344 'kmeans3 3)
              (list "localhost" 6345 'kmeans4 4)
              (list "localhost" 6346 'kmeans5 5)
              (list "localhost" 6347 'kmeans6 6)
              (list "localhost" 6348 'kmeans7 7)))))
```

Map Reduce

```
(define/provide (mapper kvs)
  (for/first ([kv kvs])
    (match kv
      [(cons k v)
       (with-input-from-file
         v
         (lambda ()
           (let loop ([result null])
             (define l (read-line))
             (if (eof-object? l)
                 result
                 (loop (cons (cons l 1)
                             result))))))])))

(define/provide (reducer kvs)
  (for/list ([kv kvs])
    (match kv
      [(cons k v)
       (cons k (list (for/fold ([sum 0])
                               ([x v])
                       (+ sum x))))])))

(define/provide (outputer kvs)
  (displayln
    (for/fold ([sum 0]) ([kv kvs])
      (printf "~a - ~a\n" (car kv) (cadr kv))
      (+ sum (cadr kv)))))
```

```
(define config (list (list "host2" 6430)
                     (list "host3" 6430)))

(define tasks (list (list (cons 0 "/tmp/w0"))
                    (list (cons 1 "/tmp/w1"))
                    ...))

(define workers (make-map-reduce-workers config))

(map-reduce workers config tasks
            (list (quote-module-path "..") 'mapper)
            (list (quote-module-path "..") 'reducer)
            #:outputer (list (quote-module-path "..")
                             'outputer))
```

Conclusions

- Language extension enables concise implementation and use
- Reuses dynamic-place syntax and place channels
- Foundation for building higher-level parallel and distributed frameworks
- Roadmap for dynamic language implementers to follow