

Cohesive Programming for Distributed Systems:

Matching the programming model
to the conceptual model

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Some distributed problems are *cohesive*

```
def attemptRegistration() =  
  username = askUser("Pick a username")  
  if isLegal(username)  
    and isUnique(username)  
  then  
    createNewUser(username)  
  else  
    displayError(username)
```

A *cohesive* distributed activity is conceptually an individual operation

Current techniques shatter cohesion

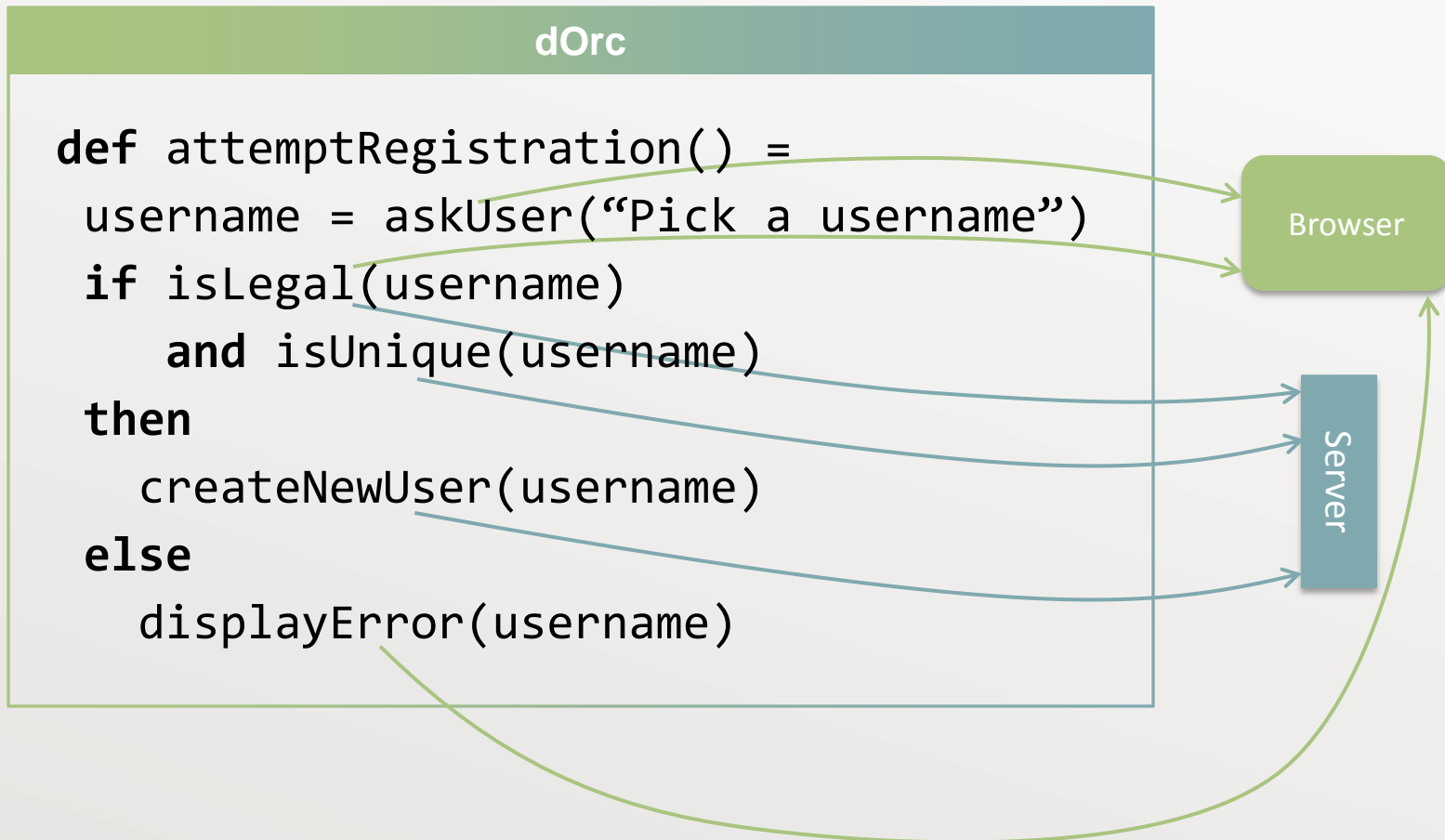
Browser

```
def attemptRegistration() =  
  username = askUser("Pick a username")  
  
  def callback(success) =  
    if not success  
    then  
      displayError(username)  
  
  if isLegal(username)  
  then  
    createIfUnique(username, callback)  
  else  
    callback(false)  
  
remote def  
  createIfUnique(username)
```

Server

```
remote def  
  createIfUnique(username) =  
  if isUnique(username)  
  then  
    createNewUser(username)  
    return true  
  else  
    return false
```

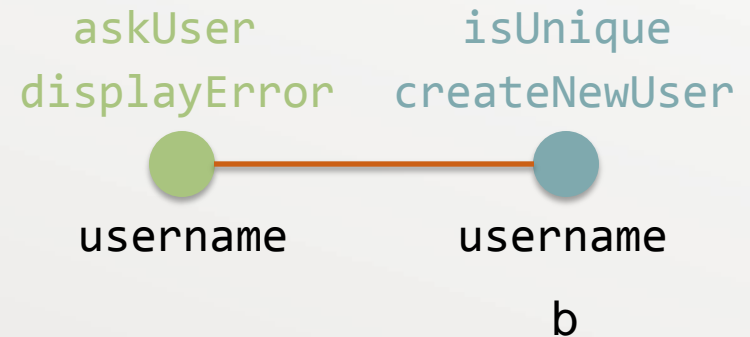
dOrc programs are cohesive



Distributed Orc = dOrc

Execution of dOrc example

```
username = askUser("Pick a username")  
b = isUnique(username)  
if b then  
  createNewUser(username)  
else  
  displayError(username)
```



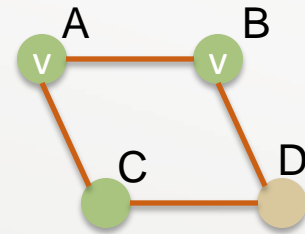
Values have location and policy sets

$$\ell_t(v) = \{ A, B \}$$

$$p(v) = \{ A, B, C \}$$

Invariant:

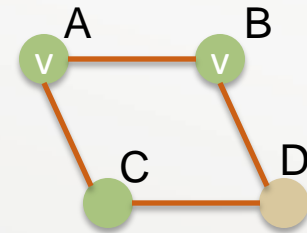
$$\forall v. \forall t. \ell_t(v) \subseteq p(v)$$



The call site rule uses policy sets

For a call: $M(x_1, \dots, x_n)$

$$P = p(M) \cap p(x_1) \cap \dots \cap p(x_n)$$



Move to any location in P and execute.

Fail if there is no such location.

Optimization opportunities abound

For a call: $M(x_1, \dots, x_n)$

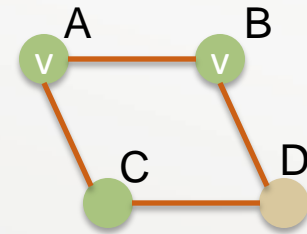
Avoid communication

$$L_t = \ell_t(M) \cap \ell_t(x_1) \cap \dots \cap \ell_t(x_n)$$

$\forall t. \ell_t(+)$ = All locations

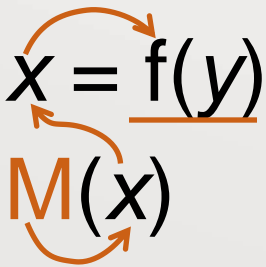
$transform.applyTo(image)$

$sizeof(transform) \ll sizeof(image)$



Optimization opportunities abound

```
x = 1 + 2  
displayError(x)
```



```
username = askUser("Pick a username")  
move to server with username  
b = isUnique(username)  
if b then  
    createNewUser(username)  
    move to browser  
else  
    move to browser  
    displayError(username)
```

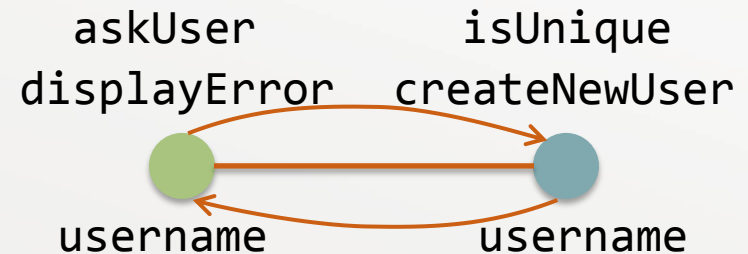
The right people and right place

Plan Phases	Semantics	Implementation	Demonstration
Resources	Existing Orc Token Semantics	Existing Orc Implementation and Optimizer	Building Wide Intelligence Project
Support	Jayadev Misra William Cook	Işıl Dillig Lorenzo Alvisi	Peter Stone

Personal experience in all three phases

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  then
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  else
    displayError(username)
```



$$P = p(M) \cap p(x_1) \cap \dots \cap p(x_n)$$

$$L_t = \ell_t(M) \cap \ell_t(x_1) \cap \dots \cap \ell_t(x_n)$$

