CLOUD COMPUTING = CLIENTS + CLOUD

- Next computing platform
  - Functionality split between client and cloud
  - Multiplicity of devices
  - “Unlimited” compute and storage on demand in cloud
- Augmentation not substitution
  - Smartphone + tablet + PC
  - Many devices, some specialized
- Buy services, not bits
Challenges of Cloud Computing

- Inherently parallel and distributed
  - Many servers, possibly in multiple data centers
  - Diverse clients with disparate capabilities
- Unreliable, failure-prone platform
  - Commodity computers and communication links
  - Non-negligible failure rates with complex failure modes
- Services, not stand-alone applications
  - Varying and unpredictable loads
  - High availability and reliability
- And, historic challenges of constructing secure, reliable, scalable, elastic, and efficient software
**ORLEANS**

- Software framework and runtime to make cloud programming easier and more productive
  - Experimental system from Microsoft Research
- Shift burden of correctness and performance from developer to Orleans system
- Radically simplified, prescriptive programming model
Orleans is Actor Based

Message Queue

Grain (actor)

Customer Grain

Field | Value
--- | ---
Name | "John Doe"
Email | "john.doe@hotmail.com"
Address | "123 Main St., Anywhere UR 01234"

Methods

- Checkout
- AddProduct
- RemoveProduct

State

Grain ID₁

Grain ID₂

Message Queue
IN-GRAIN PROGRAMMING MODEL

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Name</td>
<td>“John Doe”</td>
</tr>
<tr>
<td>Email</td>
<td>“<a href="mailto:john.doe@hotmail.com">john.doe@hotmail.com</a>”</td>
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<tr>
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<td>Grain ID</td>
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</tbody>
</table>
SYSTEM IS COMPOSED OF GRAINS

Silo (process)
TRANSACTIONS

Isolation

Atomicity

Consistency
ADAPTIVE PERFORMANCE MANAGEMENT

Grain Placement

Grain Migration
PERSISTENCE
CONCLUSION

- Orleans provides explicit support for key aspects of cloud software
  - Communications
  - Concurrency
  - Data partitioning
  - Computation replication
  - Error handling
  - Performance monitoring and control
- Shifts burden from developer to Orleans
- Make the cloud accessible to everyone