SYSTEM RESEARCH LAB
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**Faculty Information**

- B.B.A, Information Management, National Taiwan University
- MS and Ph.D., Computer Science & Engineering, University of Michigan, Ann Arbor
- Two years of industry research experience at NEC Labs American in Princeton, New Jersey
- Assistant professor at NTU CSIE since August 2010

- New lab located in Rm 524
CURRENT RESEARCH PROJECTS

- Cloud computing
  - Performance prediction and debugging
  - Service selection for clients
  - Pricing: collaboration with professors from business school

- Mobile computing
  - Leverage cloud computing to support mobile device
  - Collaborative mobile applications
  - Performance debugging for smart phones
CLOUD COMPUTING

- A new model to deliver and consume IT services
  - No upfront IT cost and infinite scale-up
  - Delivering models: infrastructure, platform, software

- New service model = new challenges for users to use such service
  - Limited visibility into the infrastructure layer
  - Many cloud computing offerings to choose from

  - Elasticity
  - Pay-as-you-go
  - Illusion of Infinite resources, etc
Challenges to Adapt to Cloud Computing

- Users face many decisions before migrating legacy applications to cloud
  - Shall we migrate to cloud?
    - What are the benefits
    - What are the risks
  - How to migrate to cloud?
    - Which application, which part to migrate
    - Which cloud provider
  - After migration,
    - Is my application performing well
    - Is the provider giving me adequate resources
HOW TO CHOOSE A CLOUD PROVIDER

Some many cloud providers, which one to choose?
- Types: IaaS, PaaS, Web hosting services,
- Example providers: Amazon EC2, GoGrid, Google AppEngine, RackSpace. Microsoft, etc.

Which cloud provider is best suited for our application?

<table>
<thead>
<tr>
<th>Provider</th>
<th>Service type</th>
<th>Services provided</th>
<th>Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon AWS</td>
<td>IaaS</td>
<td>EC2, S3, ...</td>
<td>Small/big instance,</td>
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<tr>
<td>Google AppEngine</td>
<td>PaaS</td>
<td>Datastore, memcache, ...</td>
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UNDERSTAND APPLICATION PROPERTIES

- Which part of the applications to migrate
  - Application are composed of multiple components

- Application operation mode:
  - Cloud mode: run the whole application in the cloud V.S.
  - Hybrid mode: split between cloud and local
MATCH APPLICATION REQUIREMENTS TO PROVIDERS

- List provider services
  - Benchmark results for each service
  - Useful tool: CloudCmp\textsuperscript{[1]}

- Calculate price according to application need

<table>
<thead>
<tr>
<th>Provider</th>
<th>Service type</th>
<th>Services provided</th>
<th>Comp $</th>
<th>Network $</th>
<th>Storage $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon AWS</td>
<td>IaaS</td>
<td>EC2, S3, ...</td>
<td>Small: $/hr, Big: $$/hr</td>
<td>Internal: free</td>
<td>External: $/GB</td>
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<tr>
<td>Microsoft Azure</td>
<td>Mixed</td>
<td>...</td>
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<td>RackSpace</td>
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\textsuperscript{[1]} “CloudCmp: Shopping for a Cloud Made Easy”, Li et al, HotCloud 2010
RESEARCH DIRECTIONS

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  - Performance debugging for smart phones
**Motivation**

- Mobile computers are everywhere
  - Smartphone Sales Increased 96 Percent in 2010 3\textsuperscript{rd} quarter
  - Connected mobile consumer electronics will reach 102 million units in 2010. By 2014, media tablets will represent 58\% of this market

- Users have mobile computations at hand
  - Local: computing, sensing, storage, and network
  - Remote: scalable cloud services

**OPPORTUNITIES: COLLABORATIVE MOBILE APPLICATIONS**

- Ad-hoc multi-user mobile applications are useful
  - Games: multi-party distributed gaming
  - Social applications: recommendation, group coordination
  - Learning: virtual classroom participations
  - Multimedia: distributed video editing

- No good support for such collaborative applications

Alice’s iPad
- Video history
- Purchase history
- Browse history

Bob’s phone
- Call history
- Purchase history
- Location history

Recommendation

Charlie’s netbook
- Browse history
- Purchase history
Performance debugging for smart phones

- Smart phones are like your desktop computer
  - Apps may hang, slow, not able to reach network

- How can we help users to determine when an app is having performance problem?

- Develop a tool to help user find out the problem is
OTHER POTENTIAL RESEARCH TOPICS

- Wireless sensor network
- Data center management
- Multi-core issues