TIM 50

- Lecture 20
- March 15

Announcements

- Review sessions for final exam to be announced soon
- Final Exam: Thursday 3/22, 7:30-10:30 pm
- Electronic submission of business paper open until 3/16.

Cloud Computing

Cloud Computing: refers to both
- aka Software as a Service (SaaS)
- hardware / software in data centers providing those services -- a cloud

Cloud Computing

- 2 flavors:
  - Public Cloud, available to public
    - provides utility computing
  - Private Cloud
    - internal to company

Advantages

- SaaS
  - Control of Versioning
  - Users access anywhere
  - Ease of data sharing
  - Pay as you go
- Additional +’s of Cloud Computing
  - Deploy new services without building and provisioning data centers
    - E.g. Zynga Farmville
  - Scale up/down resources as needed

Context

- 2000’s
  - Large investments by web giants (e.g. Google, Amazon) in infrastructure
    - Giant data centers
    - Software Infrastructure for such data centers
      - MapReduce -- allows computations to be distributed to multiple machines “map”, and then results collected for further processing “reduce.”
      - Hadoop - open source version of above
  - Above pieces prerequisites to become a cloud provider
Reasons to be a cloud provider

- A big player enjoys economy of scale advantage
- Leverage existing investments for new revenue stream (e.g. Amazon)
- Defend existing markets (e.g. MS enterprise apps with Azure)
- Become a platform (facebook)
- Leverage relationships (IBM)

Why is the Cloud becoming big only now?

- Shift from large commitment models to contactless short term model
- Mobile interactive applications that need huge data sets
- Parallel batch processing - software like Hadoop makes it easier to do this
- Analytics - less growth in plain transaction processing, more growth in analyzing trends / predictions from large data sets

Types of Utility Computing

- Amazon EC2 - to programmer, each instance looks like physical hardware
  - Can control whole layer stack
  - Other managed services provided (e.g. SimpleDB)
- Application Domain specific platforms
  - Google AppEngine (software dev. platform for web applications)
  - Force.com (Salesforce.com) - platform for business apps that use salesforce.com DB
- MS Azure -
  - Provides developers a general purpose software framework .NET
  - Compiled to a managed environment (rather than to specific hardware)

Economics

- "pay as you go" model
- add and remove resources at a fine time scale
  - proprietary data centers have to provision for peak
  - hard to predict demand of new services
  - poor service quality can alienate customer
  - large data centers have significant eco. of scale advantage

Challenges

- Availability
  - Can actually be better than in-house data centers
  - More robust to DDOS (Distributed denial of service) attacks by being so large
- Lock-in
  - Data lock-in - online storage services have gone bust
  - application programming interfaces not common

Confidentiality and Audits

- Sarbanes Oxley, HIPPA
- Can use encryption
- Audibility can be added as layer

Data Transfer bottlenecks

- Slow transfer can offset faster processing
- Ship hard drives
- Upload once, use multiple times
Amazon Web Services

Genesis
- Associates Group
  - Business that advertised Amazon products on their websites
- Amazon releases product data to associates group
  - API
  - Associates determine how to present it
  - Successful

Amazon Technology
- Proprietary tech to run at their scale
- Services low in the stack
  - Computing, storage, messaging, database
- Experience in running large data centers
- Leverage in acquiring software/hardware at low prices

AWS Start
- Feedback from
  - Internal teams
  - Company leaders
  - External developers
- Feedback:
  - Requirements: Scalable, reliable, low-latency, simple to use

AWS First services
- Focus on Infrastructure
  - Simple Storage Service (S3)
  - Elastic Compute Cloud (EC2)
  - Simple Database (SimpleDB)
  - Simple Queue Service (SQS)

S3
- Launched March 2006
- Redundant copies
- .12 - .15 per GB per month
- .10 per GB uploaded, .17 per GB downloaded
- Usage
  - Small companies (SmuMug photo sharing)
  - Microsoft (Vista distribution)
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<thead>
<tr>
<th><strong>EC2</strong></th>
<th><strong>SQS</strong></th>
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| ▶ Launched August 2006  
▶ $0.10 - 0.80 per instance hour  
▶ 10 per GB uploaded, .17 per GB downloaded  
▶ Users:  
  - Powerset natural language search  
  - AideRSS news story filtering  | ▶ 2004  
▶ Messaging service  
▶ .01 per 10000 requests  
▶ .10 GB uploaded, .10 to .17 GB downloaded |

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<thead>
<tr>
<th><strong>Other services</strong></th>
<th><strong>Market</strong></th>
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| ▶ Flexible Payment Service  
  - August 2007  
  - Usable by developers  
  - More flexibility in when transactions take place than Paypal  
▶ Premium Support  
  - Silver: MAX[ $100 per month, .10Xservive bill]  
  - Gold: MAX[ $300 per month, .10-.20 X servive bill]  | ▶ Digital Infrastructure Market  
  ▶ AWS has potential for $200 million incremental revenue  
  ▶ Deutsche Bank |