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
  - applications delivered as services over internet
    - 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
Challenges

- **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)
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)
EC2

- 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
SQS

- 2004
- Messaging service
- .01 per 10000 requests
- .10 GB uploaded, .10 to .17 GB downloaded
Other services

- **Flexible Payment Service**
  - August 2007
  - Usable by developers
  - More flexibility in when transactions take place than Paypal

- **Premium Support**
  - Silver: MAX[ $100 per month, .10Xservice bill]
  - Gold: MAX[ $300 per month, .10-.20 X service bill]
Market

- Digital Infrastructure Market
    - Deutsche Bank
- AWS has potential for $200 million incremental revenue
  - Deutsche Bank