Operational Excellence in the AWS Cloud
Educause 2017
Seminar Speakers

Sarah Christen
Director, Community Platforms & Cloudification Services
Cornell University

Ryan Frazier
Director, Systems Engineering & Operations
Harvard Business School

Ron Kraemer
VP and Chief Information and Digital Officer
The University of Notre Dame

Sharif Nijim
Sr Director IT Service Delivery
The University of Notre Dame

Mike Kuentz
Senior Education Solutions Architect, AWS
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:45AM</td>
<td>Arrival and Check In</td>
</tr>
<tr>
<td>8:00AM</td>
<td>Welcome</td>
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<tr>
<td>8:15AM</td>
<td>Case Studies: Creating Operational Excellence in the Cloud</td>
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<tr>
<td>9:00AM</td>
<td>Break out Discussion</td>
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<tr>
<td>9:15AM</td>
<td>Break</td>
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<tr>
<td>9:30AM</td>
<td>Panel Discussion on Q&amp;A</td>
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<tr>
<td>10:30AM</td>
<td>Looking Forward: Ways the Cloud Enables Higher Ed Innovation</td>
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<tr>
<td>11:00AM</td>
<td>Innovations at HBS, Cornell, and Notre Dame</td>
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<tr>
<td></td>
<td>Overview to next generation of projects that utilize new cloud technologies</td>
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<tr>
<td>11:25AM</td>
<td>Closing</td>
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Operational Excellence in the Cloud

Agility

Innovation

Service Distinction

Stewardship
Cornell University

Sarah Christen
Cloud Services & Data Center Initiatives
## Cornell Stats

<table>
<thead>
<tr>
<th>Founded</th>
<th>1865</th>
<th>By Ezra Cornell and Andrew Dickson White</th>
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</thead>
<tbody>
<tr>
<td>Community</td>
<td>22,000 students</td>
<td>1648 professors</td>
</tr>
<tr>
<td>Identity</td>
<td>Private University, public mission</td>
<td>dedicated to its land-grant mission of outreach and public service.</td>
</tr>
<tr>
<td>Colleges and schools</td>
<td>14</td>
<td>7 undergrad colleges, 4 graduate and professional schools, 2 Medical schools (NYC and Doha), 1 Tech Campus (NYC)</td>
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About Cornell IT

**Extremely Distributed**
- 42 IT Directors outside of Central IT
- 85 AWS accounts

**No uniformity of platform adoption**
- Significant duplication of spend

**Developing Governance**
- Minimize duplication of effort
- Collaborate on contract negotiations and solution development
Our Cloud Journey

It's A Journey
Categories of cloud deployments

Wild West
- Central contract and onboarding
- Standard individual account set up
- Basic security measures
- Best practices/community collab

Managed Server in the Cloud
- Central shared account
- Managed services to replicate on prem environment
- In a hurry to move to the cloud

Next Gen
- Distributed AWS accounts
- Push service delivery across account boundaries
The 5 R’s of cloud migration

- **Rehost**: Lift and shift – Managed Server in the Cloud
- **Refactor**: Wild West or Next Gen
- **Revise**: Wild West or Next Gen
- **Rebuild**:
- **Replace**: 
Challenges

Supporting pets and cattle
Varying levels of technical expertise
Keeping up with pace of change
push to diminish on prem footprint
Fear of the unknown
Desire for autonomy/agility
Areas of influence

- Visibility
  - Vulnerabilities
  - Patch levels
  - Network traffic
- Patching service
- Logging Service
- Back-up & recovery service
Thank You!
Creating Notre Dame’s IT future CLOUD FIRST

WE NEED WHAT THE CLOUD OFFERS

- Demand for IT services will continue INCREASING
- Funding and staffing remain CONSTANT
- We must find NEW WAYS TO EXCEL in delivering IT services

agility
scalability
sustainability
flexibility
resiliency
cost savings

We will move 80% of Notre Dame IT services into the cloud by Dec 31 2017
Invest in People
Practice Value Engineering
Develop a Linked Account Strategy
Federate Access
Relentless Focus
Communicate with Campus
Enjoy the Journey
Can on-line learning deliver the rich, interactive experience of the case method?
HBX Overview

- Newest division at HBS, tasked with reimagining business education for the digital age
- First course opened in June 2014 to deliver HBS experience online
- Multiple Course Offerings
  - CORe (Business Analytics, Financial Accounting, Economics for Managers)
  - Disruptive Strategy with Clayton Christensen
  - Leading with Finance
  - Becoming a Better Manager
  - Negotiation Mastery
  - Entrepreneurship Essentials
  - Managing Your Career Development
  - Additional course in development

The teaching model sets HBX apart from many online learning options and is reflective of the HBS in-person classroom approach
HBX Course Platform (AWS)

- Mainly asynchronous online business education
- Engagement through student interaction in cohorts of ~400
- Case-based learning with highly interactive teaching elements and peer help
HBX Live (On-Premise)
HBX Launch Technology Principles

**Move Fast**
- 90 days to deliver application & registration system
- <1 year for complete course platform

**Run independent of HBS IT**
- Minimize impact on existing services
- Enable new approaches to new needs

**Be able to scale up—or down—rapidly**
- Prepare for success or failure of the experiment
AWS Service Mix

- 187 EC2 Instances
- 470 EBS Volumes
- 25 TB Instance Storage
- 27 RDS Databases
- 188 TB Object Storage
- 30+ TB Loaded via Snowball
- 36 VPCs
- 24 Elastic Load Balancers
- 4 Redshift Clusters
Service Costs

Monthly Cost 3/2014 – 9/2017

- Scaling
- Launch
- Optimizing (clean-up)
- Optimizing (RI Purchases)

Cost by Service September 2017

- EC2 59%
- RDS 20%
- S3 13%
- Data Transfer 2%
- Redshift 1%
- Other 4%
Instance Hours by Instance Type
2016 vs. 2017

Oct 2016

Eliminate m1

Grow use of t2
(migrate from m class)

Sept 2017
Tuning Autoscaling
Failure!!

AWS Service Limits: SES (50K/24 hrs)

Performance Test (>50K e-mails)

T2 Burst & Throttle + Unhealthy Instance Termination

Autoscale threshold (60% CPU)
Recent & Upcoming Projects

✓ AWS Config 3rd Party Security Audit
✓ Self-service QA environments (AWS Service Catalog)
✓ New Data Extract Process
  • I3 Instances with NVMe instance-store for DBs
  • DMS replication of MySQL
  • Non-voting MongoDB Replicas
  • Snap & replicate locally for reporting & batch ETL
✓ Scaling to support high-volume online event
Stage ➔ Production release automation
Blue-Green Phase II: support for database changes
Firehose for streaming data
Looking Forward: Ways the Cloud Enables Higher Education Innovation

Mike Kuentz – Senior Solutions Architect

October 31, 2017
AI and Deep Learning
UPMC (clinical) data sources inventory
A flywheel for data

More Data -> Better Analytics -> Better Outcomes -> More Uses

More Data:
- Click stream
- User activity
- Generated content
- Purchases
- Logs
- Likes
- Sensor data

Better Analytics:
- Object Storage
- Databases
- Data warehouse
- Streaming analytics
- BI
- Hadoop
- Spark/Presto
- Elasticsearch

Better Outcomes:
- Machine Learning
- Deep Learning
- AI

More Uses:
- Click stream
- User activity
- Generated content
- Purchases
- Logs
- Likes
- Sensor data
A flywheel for data

More Data → Better Analytics → Better Outcomes → More Uses → Big Data

Machine Learning & Artificial Intelligence
Amazon AI
Intelligent services powered by deep learning

AI Services
- Amazon Rekognition
- Amazon Polly
- Amazon Lex

AI Platforms
- Amazon Machine Learning
- Amazon EMR
- Spark & Spark ML

AI Engines
- Apache MXNet
- TensorFlow
- Caffe
- Torch
- Theano
- CNTK
- Keras
Operational Excellence
Topics

• Security
• Fraud detection
• Student success
• Alumni relations
Voice
Simplifying Access to Learning Resources
Fully managed application streaming service that provides users instant access to their desktop applications
A cost-effective, managed cloud desktop for flexible teaching and learning

- Managed Desktop-as-Service (DaaS) offering hosted in the AWS cloud
- Access to the desktop, applications, documents, and resources through integration with existing credentials & AWS Services
- Secure: MFA, no local data, centrally managed
- Fast, responsive user experience on any network
- Consistent experience across a wide range of devices including iPads, Android tablets, Macs, PCs, laptops, and Chromebooks
- Scale at your pace and only pay for what you use
Real-life Tools and Experience at Cornell

“Students get real hands-on experience, using real industry tools with Amazon WorkSpaces. They aren’t just taking notes in class, but following me in real time. It gets rid of traditional classroom barriers.”

Jeff Christen, Business Intelligence Instructor, Cornell University
Innovation at Notre Dame
Innovation @ HBX
HBX Live (On-Premise)

- Studio-based virtual classroom
- Synchronous audio/video with chat, polls, boards
- Up to 60 global students on studio wall, hundreds or more observers
Hardware!

- Cisco CUCM
- Web & DB Servers
- 60+ “student” PC’s w/capture cards
- Evertz Multiview Processors and Video Routing
- Switches, firewall, record decks, patch bays, etc
HBX Live QA Lab

Current Projects
- Twilio for video
- Cloud-based web, DB server

Upcoming Projects
- IP-based video routing
- Virtualize student PCs?
https://library.educause.edu/resources/2014/11/cloud-strategy-for-higher-education-building-a-common-solution