Cloud Computing Deja Vu

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Time Is Late

- An auto company need to know the price of front bumper
  - And want it right now
- So it reconfigures some server to run e-commerce software
  - (to automatically confirm price and availability with suppliers)
- The reconfigured server need to access databases to get the price
  - which requires connection with suppliers' computers
- Company only have 2 days stock, and it takes 1 day to reconfigure the server and to get the necessary information
- **Thus, the company does not have much time left**

Out and Gone

"If you don't become educated about cloud computing and the potential it has for expanding your business and lowering operating costs, you will be at a significant competitive disadvantage."

Embrace cloud computing, or be swept into history's dust bin

Cloud Perplex

- But what is cloud computing exactly? Confusions abound.
- Some say it is Map/Reduce
- Some say it is Hadoop
- Some say it is business applications
- Some say supercomputing centers are cloud computing
- Some say IDC, Call Center, Big Data
- Some say software as a service or software deployed on the cloud

- None of these is precise, some is completely off the mark.

Outlines

- Why need a cloud computing course
- Curriculum Development
- Course synopsis
- Course objectives
- Teaching approach
- Course topics
- Course projects
- Recommended readings
- Thoughts and feedbacks

Why Cloud Computing Course?

- The importance of cloud computing
- The misconception is wide-spread
- The desire of students to learn cloud computing

- The meaning of Cloud Computing is very rich
  - Its connotation is multi-dimensional
- The explanation of what cloud computing is needs a full course

- Our development of “Cloud déjà vu” is based on the above rational

Curriculum Development

- The development commenced at March 2011
- Funded by a grant from Microsoft Research Asia
- With technical support from Microsoft China Cloud Innovation Center
- Major development work completed at the end of 2011
- First course offered in spring 2012 to students at school of software

Course Synopsis

- Name: Cloud Computing Deja vu
- Level: First year graduate students
- Credits: 3 (51 credit hours)
- Prerequisite: Operating systems, programming, data structures
- First offered: Spring 2012
- Enrollment: 53 (highest among all elective courses at SE)

A Glimpse into the Current State and the Way of Cloud Computing

Course Objectives

- Imbue students with the philosophy, power, practical use of cloud.
- Present fundamental principles, technology, and techniques of CC.
- Discuss common problems that can be best solved with/in cloud.
- Eliminate misconceptions about cloud computing
- Get hands on experience in building, deploying, and monitoring cloud-based applications using Windows Azure.

- Upon completion, students will have obtained a deep understanding of cloud computing paradigm, master the methodology and thinking, be able to engage in cloud-related research, development and service.

Teaching Approach

- Systematic discussion of cloud computing paradigm, technology model, programming framework, and unintended consequence
- Use Windows Azure to demonstrate the commercial use of cloud computing, other cloud platforms will also be mentioned.
- The course follows the pattern of theories→ experiment→ mastering
  - Instructor introduces important topics of cloud computing
  - Instructor and students propose various hypotheses
  - Hypotheses are verified or invalidated with experiment
  - Cloud eco-system is inferred

Course Topics

- Cloud Déjà vu
- Cloud Ontology
- Cloud Software Architecture
- Virtualization
- Windows Azure
- Other Main IaaS/PaaS
- Cloud Construction and Integration
- Open Issues

Cloud Déjà vu:

- Old Things Gone Like a Smoke
- Cloud Computing in the News
- Evolution of Computing Paradigms
- What Is Cloud Computing
- Benefit of Cloud Computing
- Cloud Misconceptions
- The Cloud Way
- Example Applications

Cloud Ontology

- Cloud Stack
- Cloud Classification
- Workload Patterns for the Cloud
- Big Data
- IT as a Service
- Cloud Controller
  - The Operating System for the Cloud

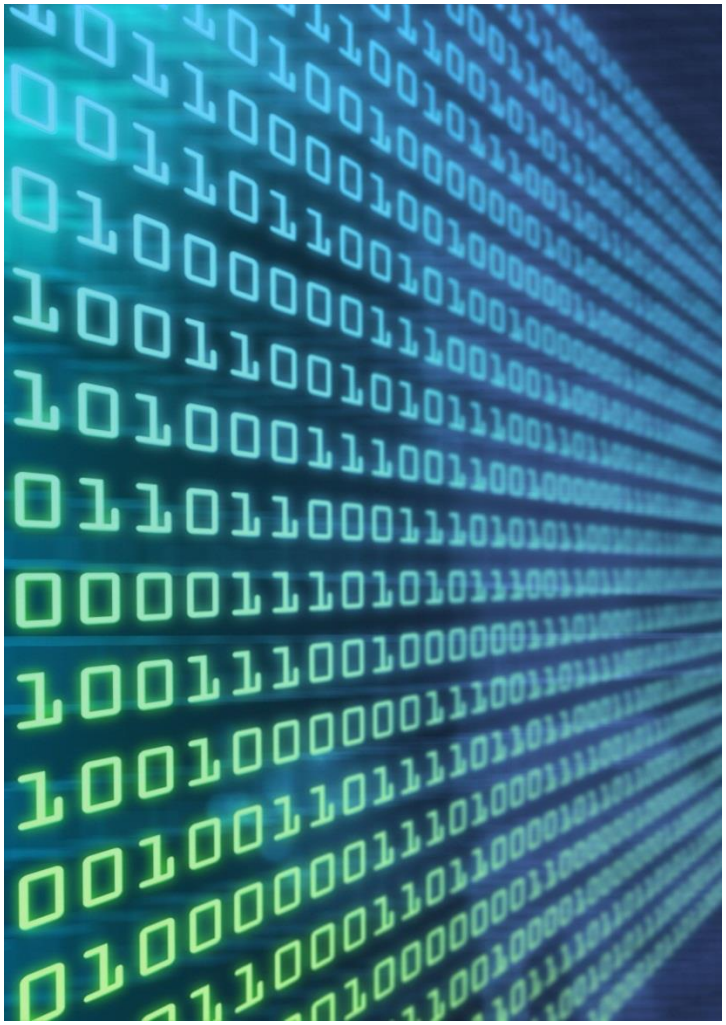
Cloud Software Architecture

- Cloud Computing Layers
- Common Cloud Building Blocks
  - Virtualization
  - Web Services (computing and storage)
  - Service Bus
  - Clients UI/CLI
- Cloud Application Structure
  - Application, instances, services
  - Comparison with traditional OS concepts

Virtualization

- Why virtualization?
- Virtualization Challenges
- Virtualization Technologies
  - CPU Virtualization
  - Memory Virtualization
  - I/O Virtualization
  - Storage Virtualization
- Commercial VMMs

- This part is optional



Windows Azure Platform

- Fabric, storage, services
- Azure architecture:
  - Service isolation, fault domain, update domain
- Services management:
  - Service deployment, scaling, monitoring, and recovery.
- Azure Development:
  - Azure SDK
  - Roles, Role APIs; Role Implementation
  - Communication
- Build Scalable and Elastic Application for Cloud.

App Engine and AWS

- Google App Engine
  - Feature, Sandbox, Workflow, Services
  - Architecture, Storage, Security, Development
- Amazon Web Services
  - Computing, Storage, Queue services
  - S3 and EC2
- Comparison of App Engine and Azure

Google™

CloudFoundry and OpenStack

- VMware vCloud and Cloud Foundry
  - Architecture of vCloud and Cloud Foundry
  - vSphere and vCenter
  - vFabric and Data Director
  - Cloud Foundry Eco-System
- OpenStack (NASA and Rackspace)
- Citrix's CloudStack

Cloud Construction and Integration

- Consideration in building a cloud
  - Business requirement analysis
  - Service module interoperability
- General guidelines for constructing a private cloud
  - Load distribution between cloud and node
  - Use of public cloud services
  - Bandwidth consideration
  - Selection of components/technology
  - Migration to cloud
- Connecting cloud applications with on-premises systems

Open Issues

- Cloud migration
- Cloud security
- Cloud ethics
- Unintended consequence of the cloud
- Cloud singularity

Course Project

- Azure-based Cloud FTP Server
- Take fullest advantages of the features and benefits offered by Azure
- This FTP server should support the following operations:
  - Connecting: accept connection from across a network;
  - Listing: list current active connections;
  - Upload: accept data/file transfer from across a network;
  - Download: transfer data/file to a network destination;
  - Quit: terminate the FTP connection.
- Students can support additional commands to receive extra credits

Project Requirement

- Must track the performance of applications
  - Must develop a benchmark program to monitor the ftp server
  - Should provide real-time performance data using Azure's API.
  - Should provide a list view interface to show the result.
- The captured information could contain but are not limited to
  - processor time, memory size, machine name, threads, handles etc.
  - Should clearly state which information to capture in final report
- Manual adjustment to responds to changes in workload variations

Additional Requirement

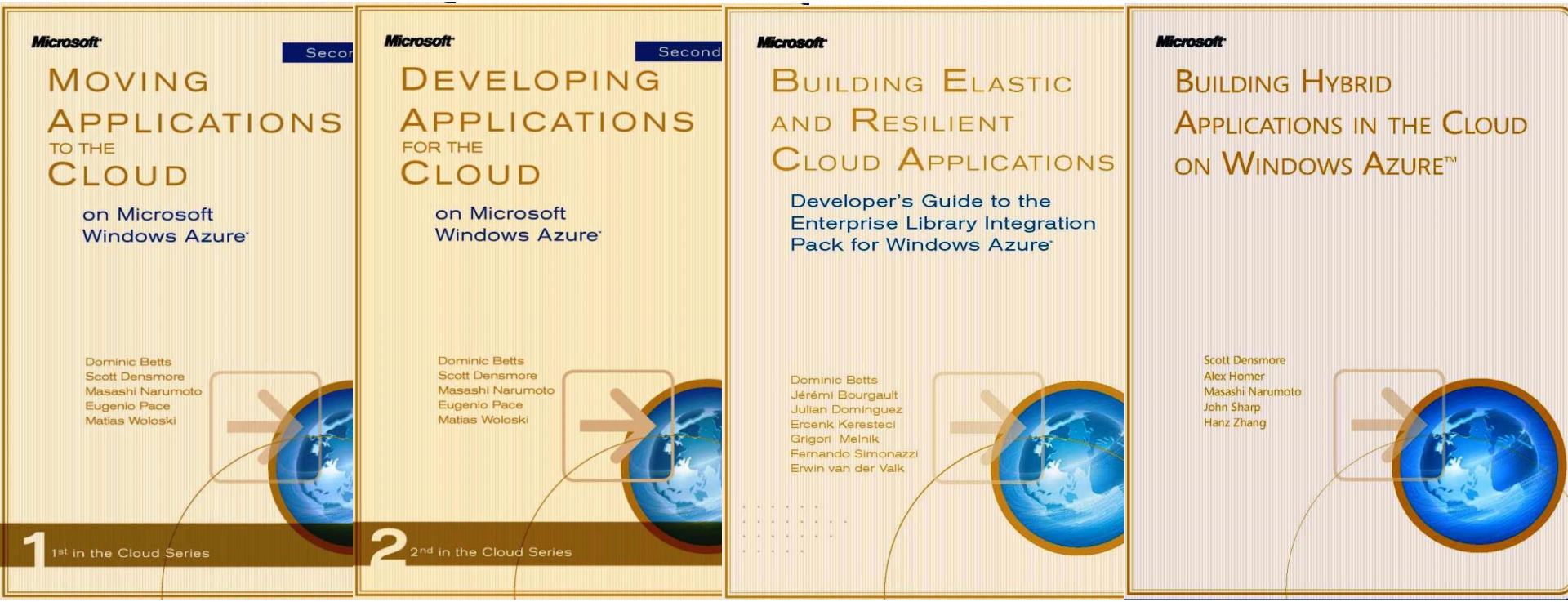
- **FTP server should automatically adjust the # of app instances**
  - according to (or based on) benchmark results
- A simple idea is to increase the number of instances
  - when more users attempt to connect
- C# is recommended for the project
  - But node.js, java and php are also accepted.

Recommended Readings

- Moving Applications to the Cloud, 2E, Microsoft Press
- Developing Applications for the Cloud, 2E, Microsoft Press
- Building Elastic and Resilient Cloud Applications, Microsoft Press
- Building Hybrid Applications in the Cloud, Microsoft Press

- The Big Switch: Rewiring the World, from Edison to Google
  - Nicholas Carr
- Programming Windows Azure, Sriram Krishnan, Oreilly
- Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, by Jack Dongarra, 2011

Microsoft Cloud Computing Series



- 云迁移、云应用开发、构建弹性云应用、构建混合云应用
  - 译者：邹恒明；出版社：清华大学出版社，时间：2012年底

Thoughts and Feedbacks

- Students give very positive feedbacks
- The course achieved its objective of clearing away misconceptions
- Students have gained a holistic view of cloud computing
- Students' interests in cloud computing increased dramatically
  - a number of students want to switch advisors

Excellent !

Outstanding !

Thoughts and Feedbacks

Category	A	B	C	D	E
Teaching Altitude	43	5	1	0	1
Teaching Methodology	45	3	1	0	1
Homework/Project	43	4	2	0	1
Content	43	3	3	0	1
Order	45	3	2	0	0
Question/Answers	45	3	2	0	0

- Final evaluation score: 96.10/100
- Reference: about 6.7% of SJTU courses receive a score of 95+%

Conclusion

- The key of cloud computing is software, not hardware
- Cloud computing is both computing paradigm and business model
- Cloud requires a lot of technologies to work together
- Cloud provides services at several layers of abstractions
- Develop apps for cloud is quite different than for other platforms
- **Cloud is the Future.**

Contact

Putting Computing Power on Tap

让计算能力流

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With cloud, the possibilities are infinite