Cloud Computing Deja Vu

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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
“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
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.
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
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

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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 respond 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
移动应用到云

开发应用到云

构建弹性和弹性的云应用

构建混合云应用

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

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

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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