MET CS 755 – Cloud Computing

Instructor
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Course Description
Computing clouds—essentially digital-service factories—are the first truly global utility, accessible from all corners of the planet. They allow individuals and enterprises to leapfrog traditional IT and benefit from advanced computing services without having to build expensive infrastructure. The clouds allow computing to be removed from metal boxes under the desk and in firms’ basements to remote data centers that resemble Star Trek® “Borg” alcoves. These remote data centers are the world’s biggest energy hogs. What is the computing they do, and how to participate? We will explore this in class.

The “cloud of clouds” has three distinct layers. The outer one is “software as a service” (SaaS) and includes Web-based applications such as Gmail and Salesforce.com, which helps firms keep track of customers. The underlying idea is to package computing resources such as applications and storage as a metered service similar to a utility and to deliver it through the Internet, supplanting the traditional mechanism of desktop computing. Forrester research estimates that these services generated $11.7 billion in 2010 alone. One level deeper, “platform as a service” (PaaS) consists of operating systems living in the cloud. Offered by Amazon, Microsoft, and Google, such services allow developers to write applications for the Web and mobile devices. Forrester pins PaaS revenues at $311 million. The most intricate layer is the deepest one: “infrastructure as a service” (IaaS), the purest kind of cloud computing, offers essential computing services that Wall Street, big pharma, big advertising agencies, and big science cannot live without. Market leaders are Rackspace, Yahoo, and Amazon. A challenge to estimate, the latest projections about IaaS revenues recouped in 2010 exceed $1 billion.

How big will the cloud be in 10 years? Forrester predicts it will grow to $56 billion in 2020. On the other hand, Larry Ellison, the boss of Oracle, says that the cloud is “water vapor”. Learn and judge for yourself. There is Open Source and there are proprietary clouds; there are private clouds and there are public clouds. Amazon was a founding company for cloud computing. Google was one of the first to achieve commercial success with internet-scale computing through their PageRank algorithm, based on their MapReduce morphisms. Google is now making waves with a new graph-based language called Pregel. Microsoft was foremost in introducing an entire operating system (Azure) and relational database (SQLAzure) for the Cloud.
This course will cover history, theory, enabling technology, and hands-on labs for key concepts in Cloud computing, the algorithmic approach to Big Data problem sets, as well as the hardware approach to elastic computing. This is a technical hands-on class, with programming labs to help students familiarize themselves with key concepts. Half of the class is dedicated to the algorithms that are used to compute on Big Data. The other half is a safari on the primary public Clouds, with applications. Students will accomplish the following: (1) Learn the unique set of problems and challenges in developing cloud computing applications compared with desktop and Web applications; (2) learn the platform, tools, technology and processes for developing cloud computing applications; (3) propose, develop, and run applications for the platforms covered; and (4) work with fellow students on Cloud projects. On top of architecture and theory, the course will compare and contrast private VMWare-based cloud systems and three public cloud systems: Amazon, Google, and Microsoft.

Course Grading Policy
The course grade will be based on active class participation (10%), assignments (30%), mid term exam (30%), and final project (30%). Assignments and projects are expected to be submitted by their respective due dates. Late submission grades will be scaled with respect to the minimum grade of those submitted on time.

Prerequisite Courses
1. CS 673 (Software Engineering) or the equivalent and
2. One of the following, or equivalent:
   - CS 565 (Advanced Java Programming) or the equivalent –OR–
   - MET CS 564 Advanced C++ Programming or the equivalent –OR–
   - MET CS 503 Windows .NET Application Programming with C# or the equivalent

Course Web Site
All course materials will be posted using BU's Blackboard site. This requires all students to have an account with the BU computer system.

Textbooks

Student Conduct Code
Please review the academic conduct code

Guest Speakers
Bill Wilder: Published author, Microsoft MVP, and speaker at Microsoft’s New England Research and Development (NERD) Center in Cambridge, MA
Speaking TBD
Tentative Course Schedule

Module 1 Introduction: Morphisms and Architectures
Module 2 Concepts: Google’s MapReduce and Yahoo’s Hadoop
Module 3 Preparing for the Cloud: Hypervisors and Virtual Machines
Module 4 Deploying: VMWare-based Private Clouds and Eucalyptus
Module 5 Amazon Elastic Cloud
Module 6 Microsoft Azure
Mid Term Week 7
Module 8 Microsoft Azure (continued)
Module 9 Google App Engine
Module 10 Google App Engine (continued)
Module 11 Security, the Federal Cloud, and other topics in Cloud Computing
Module 12 Final Project presentations