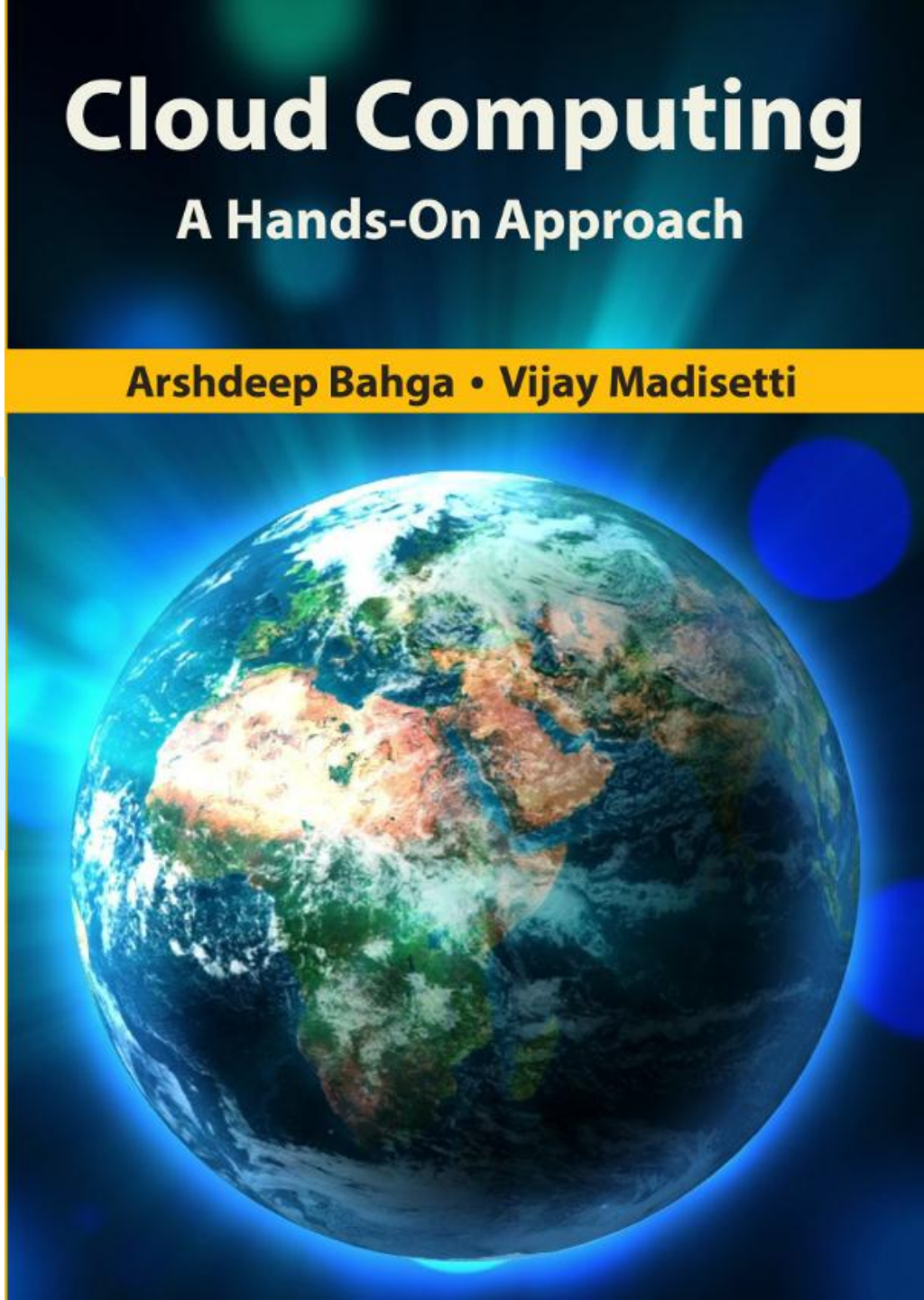
Suggested Course Outline

Cloud Computing



Objectives

- Understanding of Cloud Computing Technologies, Computation Models & Applications.
- Technical analysis & use of commercial cloud offerings – Amazon, Google & Microsoft
- Design Methodologies for Cloud Applications
- Use of Cloud-based Languages and Tools in developing advanced applications on Amazon, Google & Microsoft cloud platforms.
- Advanced case studies and team-based design & implementation on Amazon, Google & Microsoft platforms in the classroom
- Advanced topics – benchmarking, security, multimedia, big data with implementations

[Student Pre-requisites: A couple of programming courses (e.g., C++/Java) at the college-level]

Proposed Outline

- Part I: Weeks 1-4
  - Covers basic technologies that form the foundations of cloud computing including virtualization, load balancing, scalability & elasticity, deployment, replication. Real-world examples of cloud-based services and their characteristics will be described.
- Part II: Weeks 5-10
  - Covers programming aspects of cloud computing with a view towards rapid prototyping complex applications. Covers Python basics, Python packages and frameworks for that allow rapid prototyping of practical cloud applications on Amazon Web Services, Google Cloud and Windows Azure platforms.
- Part III: Weeks 11-16
  - Covers specialized aspects of cloud computing including cloud application benchmarking, multimedia cloud applications, cloud security and big data analytics. Case studies on the applications of the cloud in industry, healthcare, transportation systems, smart grids, and education will be examined.

Course Plan: Weeks 1-4

Week-1	Week-2	Week-3	Week-4

• Introduction to Cloud Computing
  • Cloud characteristics, service models, deployment models
• Cloud Applications & Case Studies
	• Cloud Concepts
	  • Virtualization, Load balancing, Scalability & elasticity, Deployment, Replication, Monitoring , Identity and access management, Service level agreements, Billing
		• Cloud Services & Platforms
		• Classification of cloud services, Computing, Storage, Database, Application, Analytics, Network, deployment services
			• Hadoop & MapReduce
			  • Hadoop ecosystem, MapReduce architecture, MapReduce job execution flow, MapReduce schedulers
			• MapReduce Examples/Applications

Chapter-1	Chapter-2	Chapter-3	Chapter-4

Course Plan: Weeks 5-8

Week-5	Week-6	Week-7	Week-8

• Cloud Application Design
  • Design Considerations for Cloud Applications, Reference Architectures, Design Methodologies, Model View Controller, SQL & No-SQL Data Storage Approaches, RESTful Web Services
	• Service Oriented Architecture
	• Cloud Component Model
		• Python Basics
		  • Data types & data structures, Control flow, Functions, Modules, Packages, File input/output, Data/time operations, Classes
		  • Python Packages
			• Python for Cloud
			  • Python for Amazon Web Services
			  • Python for Google Cloud Platform
			  • Python for Windows Azure
			  • Python for MapReduce

Chapter-5	Chapter-5	Chapter-6,7	Chapter-7

Course Plan: Weeks 9-12

Week-9	Week-10	Week-11	Week-12

• Python web application framework (Django)
• Developing cloud applications with Django
• Taking Django to production
	• Design methodologies for IaaS and PaaS service models
	• Case Studies
	  • Autoscaling on cloud, load balancing on cloud, storage in cloud, SQL & No-SQL databses in cloud, writing MapReduce apps, aggregagting & analyzing social media data in cloud
		• Big Data Analytics
		  • Big data analytics approaches
		  • Clustering big data
		  • Data Analytics with Mahout
			• Big Data Analytics
			  • Classification of big data
			  • Recommendation systems
			  • Real-time data analytics with Apache Storm

Chapter-7	Chapter-8	Chapter-9	Chapter-9

Course Plan: Weeks 13-16

Week-13	Week-14	Week-15	Week-16

• Multimedia Cloud
  • Reference architectures for multimedia cloud, Case studies on live video streaming & video transcoding apps
	• Cloud Application Benchmarking & Tuning
	• Cloud application workload characteristics, Performance metrics for cloud applications, Cloud application testing, Performance testing tools,
	• Case studies on benchmarking cloud applications
		• Cloud Security
		  • Cloud security considerations, Authorization, Authentication, Identify & access management, Data security, Data integrity, Encryption, Key management
		• Integrating OAuth & Encryption based security into cloud apps
			• Cloud Case Studies
			  • Cloud for healthcare, energy systems, smart grids, manufacturing industry, transportation systems, education

Chapter-10	Chapter-11	Chapter-12	Chapter-13

Suggested Labs & Exams

- Lab-1: Weeks 2-3 (Chapters 2,3)
  - Student account setups on AWS, Google Cloud, Windows Azure
  - Deploying multi-tier e-Commerce benchmark app on these clouds with load balancing
  - Performance comparison with horizontal and vertical scaling
- Lab-2: Week 4-5 (Chapter 4)
  - MapReduce programming assignment
  - Comparison of Hadoop schedulers
- Lab-3: Week 6-7 (Chapters 5,6,7)
  - Designing a REST-ful web service with Python & Django

Labs & Exams

- Midterm Exam: Weeks 8
- Lab-4: Week 9-10 (Chapter 8)
  - Lab assignment on social media sentiment analysis
- Lab-5: Week 11-12 (Chapter 9)
  - Lab assignment on Big Data analytics with Python & Mahout
- Lab-6: Week 13-14 (Chapter 11)
  - Lab assignment on cloud benchmarking
- Project (for Graduate-level): Weeks 9-16
- Final Exam: After Week 16

Suggested Grading Scheme

- Undergraduate-level
  - Lab assignments – 40%
  - Midterm – 30%
  - Final – 30%
- Graduate-level
  - Lab assignments – 25%
  - Midterm – 25%
  - Project – 25%
  - Final – 25%

New labs, exercises and additional information will be updated to support instruction at http://www.cloudcomputingbook.info