Introduction to Cloud Computing - Course Outline

Following is the proposed course topics and schedule. Instructors might tweak / re-order topics
according to the class needs.

Lecture No.	Topics
1	Setting the Stage – An Introduction What is / is not Cloud Computing (CC) Many faces of CC (e.g. Technical VS Marketing) Where CC lends itself naturally (Technology Strengths) Where CC is not ideal (Technology Weaknesses) Course logistics Amazon Web Services – An Introduction A QUIZ per Class Reading Assignments Writing Assignments
2	CC – Super Computer for the Masses What a typical computer offers – Compute & I/O facilities Types & range of 'computers' – Embedded Systems to Warehouse Scale Comp. Measuring the performance of computing Performance scalability with increasing users / user needs What kind of computers are ideal for CC use Understanding the CC model – Renting 1000 computers for an hour – Pay by hour Elasticity concepts of CC Case Study
3	Warehouse Scale Computing (WSC) A set of 50K to 100K computers placed together How are they organized How are they connected (i.e. Networking fabric and topologies) Combating the heating problems in innovative ways WSC performance metric – PUE Combating the power density problem Difference between a data center and WSC Case Study Reading Assignment Chapter 5 of Patterson and Hennessey's Computer Architecture 5th Edition User guide of S3

	Programming Assignment Out Remote reading and writing to different stores (ephemeral, EBS and S3)
4	Providing the service Infrastructure as a Service Platform as a Service Software as a Service Case Study
5	Distributed Computing – Tricks of the Trade Distribution – Load balancing, Fault tolerance Replication – Availability Consistency models Failure models How it all relates to CC Case Study Reading Assignment Synthesis lectures in Computer Architecture – Google's WSC (2nd Edition) AWS load balancer Programming Assignment Making a custom load balancer using EC2 Demonstrating EC2 elasticity
6	Security in CC Using multiple machines easily and securely Understanding the security threats National University of Computer & Emerging Sciences Page 7 of 10 Beefing up the security Understanding public and private key encryption Case Study
7	Using CC – The Client View The global Internet is the key Internet and security Virtual Private Networks CC for the large corporations Case Study Reading Assignment Security threats in the cloud
8	Era of Parallel Computing Why we need parallel computing Different models of parallel computing Which models lends naturally in CC infrastructure Multi-threading Helper Libraries e.g. Threading Building Blocks Multiple Processes Multiple Machines MPI OpenMP

	Case Study
9	Era of Parallel Computing Cluster computing GPU as GP-GPU MapReduce & Hadoop Case Study Reading Assignment Google MapReduce Paper
10	Mid Term 1 – No Lecture
11	Discussion of Mid Term Questions Virtualization – A cornerstone in modern CC What is virtualization Many forms of virtualization in computing National University of Computer & Emerging Sciences Page 8 of 10 Benefits Technology weaknesses XEN, LXC, Vmware, VirtualBox The concept of virtual appliances Case Study Reading Assignment Visualizing 'shape' of the WWW Mini Project 1 Reading common corpus of WWW and finding 'shape' of today's WWW
12	Virtualization Virtual networking options Performance as compared to native networking Para-virtualization VS Full Virtualization Migration of live virtual machines Case Study
13	Storage Types of cloud storage Availability Service Model Case Study
14	. Resource and Cost Estimation The cost factor Cost concerns for End users and Large Corporations Economies of Scale Case Study
15	Software Life Cycle for CC Development Mapping general SE concepts to CC software Similarities / Differences Case Study
16	Debugging CC Applications

	Challenges of debugging distributed applications Strategies to cope Case Study
17	Service Deployment Models Deployment and running of service successfully is crucial Using CC to combat software piracy and intellectual property violations Case Study
18	CC and Hand Held Devices – A Killer Combination Off loading complicated tasks to the Cloud The role of low delay cellular networks Case Study
19	. Non Technical Concerns Choosing a CC Vendor VS Making your own WSC Legal constraints and issues Copyright problems Software licensing issues and opportunities Software bundling in the cloud Case Study
20	Mid Term 2 – No Lecture Mini Project 1 Due
21	. Locality and Content Distribution Networks Right placement of data and its impacts on service Case Study
22	Continuous Monitoring & Automation Things can go wrong any time The need for automation Off loading mundane tasks to computer programs Human intervention only when absolutely necessary Case Study
23	Concept of Elastic IPs Live migration of IP addresses New programming abstractions around elastic IPs Case Study
24	. Instance types, spot instances and economics Bidding for 'spot' instances Optimally using your $ in cloud Case Study
25	Hybrid Clouds, Cloud on a Single System The good of both worlds Corporate Data Center and Cloud working together Case Study
26	Violating terms of use in Cloud How to manage your service customers What is / and what is not allowed inside a cloud Ignorance is no excuse
27	Political impact, Sanctions etc., Laws of the Land

	Risks of the cloud model and it mitigation Cloud is not a panacea! Case Study
28	GPUs and clusters of GPUs New dimension in cloud computing Future expansion and possibilities Case Study
29	Revision and Concluding Remarks Mini Project 2 Due
30	Final Exam

Case Study
Each lecture will include a small case study about a well known company utilizing CC effectively for its business and solving real world and scientific problems. Students will select a case study of their choice and after approving it from the instructors will present it in a 15 to 20 minutes in-class presentation.

Prerequisites:
Cloud Computing is a 'melting point' of many technologies. The official prerequisite is Operating Systems & Computer Networks only. A good proficiency of the following topics will be helpful.
(1) Computer Programming in C/C++ and Java
(2) Data Structures
(3) Analysis of Algorithms
(4) Familiarity with Linux / Unix based Operating Systems
(5) Basic understanding of TCP / IP based networking
(6) Sockets programming