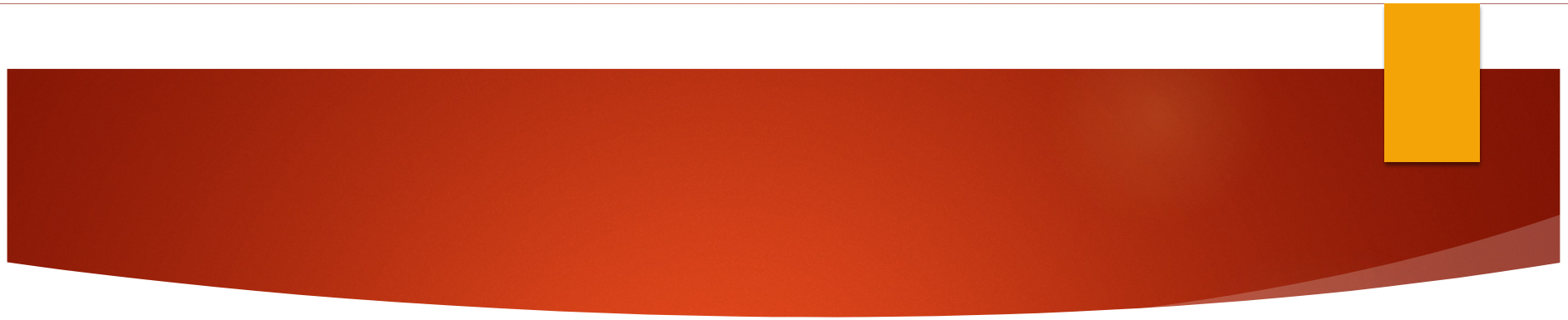

CCF501 Cloud Computing Fundamentals

Subject Descriptor

- This subject provides a fundamental understanding of cloud computing.
- Students will explore how cloud computing infrastructure has evolved from traditional IT infrastructure and the business advantages this brings.
- Additionally, the different cloud segments and cloud deployment models and the key players in the market will be covered.
- The subject also provides knowledge of cloud services and cloud security.

No.	Type and Description	Assessment due	Weighting	Subject Learning Outcome(s) assessed
1.	**Title:** Technology Report and Presentation **Delivery type**: Individual **Outcome**: Presentation and Written Report **Volume of Assessment:** Presentation (5-7 minutes +/- 10%) and 1,200 words (+/- 10%).	Module 4 (Week 4)	30%	a), b)
2.	**Title:** Case Study Report **Delivery type**: Individual **Outcome**: Written Report **Volume of Assessment:** 2,900 words (+/- 10%).	Module 8 (Week 8)	30%	a), b), d)
3.	**Title:** Cloud Application Deployment **Delivery type**: Individual **Outcome**: Application and written report **Volume of Assessment:** 1,500 words (+/- 10%), including screenshots and URL link to application.	Wednesday, Module 12 (Week 12)	40%	c), d), e)

Computing

- Computing—computation, storage, communication—is relatively free, scales up or down as needed, scales as much as needed, operates itself, and always works.
- For most of computing history the costs of infrastructure have dominated decisions about what to deploy when: How much will those servers cost? How about that storage farm? That network.
- Now, however, we can start thinking about those costs being “within epsilon of zero”; that is, over time the computing infrastructure comes closer and closer to being free. That leaves other costs as the new, more significant considerations

Three Ages of Computing

First Age

- At the beginning of the first age the focus was on big infrastructure—mainframes, big point-to-point networks, centralized databases, and big batch jobs.
- Toward the end, terminals evolved into personal computers, networks went from hierarchical (with the mainframes at the center of each network) to decentralized, with a broader, generally more numerous collection of servers and storage scattered throughout an organization.
- While batch work still existed, many programs became interactive through this first age, eventually gaining much more visual interfaces along the way.

Three Ages of Computing

Second Age

- The second age of computing is really the story of the rise of the Internet—Sun, Cisco, Mosaic (which became Netscape), web 1.0, eBay, Yahoo, , and the first Internet Bubble.
- While many advances contributed to the beginning of the second age, the two most crucial were the development of the Internet itself, and the development and near-ubiquity of easy-to-use, visually attractive devices that could be used by nearly everyone.
- It is hard to overestimate the importance of two fundamental realities: (1) with the Internet it was now true that everyone was connected to everyone else, anytime, anywhere; and (2) with the ubiquity of visually attractive devices, the data and services available over that pervasive network could actually be used by mere mortals.

Three Ages of Computing

Second Age

- 1970s and 1980s—most computing was done on relatively mundane, large-scale individual computers, or perhaps in small clusters of relatively big machines.
- Whereas an early (circa 1994) Yahoo index might have had less than a hundred, or at most a few hundred entries, and could be manually created, by the beginning of 1995 the number of web sites was doubling every 53 days and was passing anyone's ability to manually index. This growth then created the need for computing infrastructures that could scale at the same rates or faster, as well as application and data storage architectures that could also scale apace.
- Of course one drive that remains true in every age and in every domain is the drive to reduce costs—cost to acquire, cost to deploy, cost to operate, cost here, cost there, cost anywhere—just reduce them all.

Three Ages of Computing

Third Age

- Early in the second age Yahoo had made a name for itself by “indexing the Internet,” which for some time was mostly manually done.
- Several other indexing efforts began, including AltaVista, Google, and others, but it was Google that brought everything together.

Others offered public cloud services that made certain unique contributions, including , which Salesforce.com was probably the first public cloud service that was targeted at the enterprise customer and required those customers to store very sensitive data outside of their own facilities.

Three Ages of Computing

Third Age

- Several key factors can be easily understood.
- First, the collection of data about the current state of the Internet, and the processing of that data had to be as absolutely automated as possible.
- In order to save as much money as possible, the infrastructure would be constructed out of commodity components, out of “cheap stuff that breaks.”
- Data storage needed to be done in a simple, yet fairly reliable manner to facilitate scaling (the Google File System, or GFS—notice the lack of a traditional database, but more on that later).

Three Ages of Computing

Third Age

- Several key factors can be easily understood.
- New types of application development architecture(s) would be required, which came to include the so-called map-reduce family (which inspired open source descendants such as Hadoop) among others.
- Operations needed to be as automatic and dependable as possible.
- Outages in the application were tolerable; after all this was search, and who would miss a few results if an outage occurred?

Broad Enablers

- Over the course of the 1980s and 1990s there were key advances that came together to enable the transition to the cloud computing, these are some of the more notable enablers:
- Commodity Hardware. etc.): In the three basic areas of computing components—chips (processors, memory, etc.), storage (mostly disc drives), and network (both within a datacenter, wide area, and wireless)—there have been large strides made in the capabilities of what is by historical standards throw-away equipment.
- Network Speed. While network performance has not increased at the same rate as either processor or storage performance huge strides have been made in both the connections within a datacenter and those outside.

Broad Enablers

- Virtualization: Virtualization started as a way to share the use of very expensive mainframes among otherwise incompatible operating systems.
- Application Architectures: Software architectures have made many strides toward the eternal goal of software reusability, itself driven by the desire to make it easier to construct software.
- Pervasive High Quality Access: The reality—quality, variety, quantity—of high quality, visually attractive, widely available devices has had a tremendous impact on the development of cloud computing. high quality, pervasive, always-connected devices has greatly increased the number of customers for services and content—the data and applications sold on the cloud—and has also increased each customer's appetite for even more services and data.

BUILDING ROI FROM CLOUD COMPUTING

- By examining the benefits that cloud computing offers organisations and by showing the potential return it can provide from the beginning, companies may find it easier to gain buy-in for cloud initiatives from the executive team, as well as from the IT department.
- But how do organisations go beyond the initial capacity and utilisation benefits described in cloud computing? In particular it is orientated around two areas:
  - IT capacity – As measured by storage, CPU cycles, network bandwidth or workload memory, capacity is an indicator of performance.
  - IT utilisation – As measured by uptime availability and volume of usage, utilisation is an indicator of activity and usability.

BUILDING ROI FROM CLOUD COMPUTING

- IT capacity refers to the amount of IT resources available, defined by units of that resource which may be a physical capacity or virtual capacity. This typically includes storage volume, compute power (gigahertz), memory size, database size, number of disk input/output operations, network bandwidth, type of chip set and operating system.
- IT utilisation refers to the level of planned and actual use of IT resources that may be physical or virtual. This is different to availability, which is the level of planned or actual uptime an IT resource capacity is available for use. Utilisation refers to the level of use of the IT resource capacity during the uptime period.

BUILDING ROI FROM CLOUD COMPUTING

- Eight business metrics that translate the indicators of the capacity–utilisation curve to direct and indirect benefits to the business.
- Speed and rate of change – The speed and rate of change of cost reduction can be much faster using cloud computing than traditional investment and divestment of IT assets because the responsibility is transferred to the service provider. While there are challenges today in the portability of cloud service providers, users do have greater flexibility to adopt and remove the service either at the point of use (to scale up and down) or to make choices to use new services or change service provider.
- Optimising total cost of ownership (TCO) – A key aspect of moving to cloud computing is the ability to select hardware, software and services from defined design configurations to run in production. Cloud computing bridges the design time and run-time divide and optimises service performance

BUILDING ROI FROM CLOUD COMPUTING

- Rapid provisioning – Elastic provisioning to scale up and down to actual demand creates a new way for enterprises to match their IT to enable business to expand. The provisioning time compression from a week to hours, for example, demonstrated by cloud computing providers is a means to rapid provisioning that is not just about saving time, but is also defining a new business operating model.
- Increase margin and cost control – Cloud computing offers the opportunity for cost, revenue and margin advantages. It also allows organisations the potential to enter and exploit new markets through rapid deployment of low-cost cloud services.
- Access to business skills and capability improvement – Cloud computing enables access to new skills and solutions through cloud sourcing on-demand systems.

BUILDING ROI FROM CLOUD COMPUTING

- Dynamic usage – Elastic computing and service management targets real end users and real business needs for functionality as the scope of users and services evolves seeking new solutions. With either fixed usage volumes or variable functional usage, new innovative consumption models enabled by cloud computing allow businesses to consider using IT in a flexible and agile way.
- Risk and compliance improvement – Cloud computing green capabilities can be leveraged through shared services.
- Enhanced capacity utilisation – IT avoids over- and under-provisioning of IT services to improve smarter business services.

FIVE MAIN BENEFITS ATTACHED TO CLOUD SERVICES

- Cost efficiency – Shared infrastructure means shared costs. You also pay only for what you use, because most pricing models are consumption-based. This can be ‘per user’, ‘per device’, ‘per server’ or ‘per instance’.
- Easy to use – Basic cloud services work ‘out of the box’. For more complex software and database solutions, cloud computing allows you to skip the hardware procurement and capital expenditure phase and just get on with the implementation.
- Up to date – Most providers constantly update their software offering, adding new features as they become available.
- Scalability – Depending on business growth, you can grow or contract quickly as cloud systems are built to cope with sharp increases and reductions in workload. Pricing models are built to support software reductions should businesses need to scale down, which removes the business pressures associated with fixed costs

FIVE MAIN BENEFITS ATTACHED TO CLOUD SERVICES

- Mobile – Cloud services are designed to be used from a distance, so if you have a mobile workforce, staff can access most of your systems ‘on the go’, increasing productivity.

CLOUD

- The core difference between cloud and traditional IT is that in a true cloud model you don’t own the IT: you don’t buy a server and an application licence, but instead the IT gets delivered to you as a service via the internet when you need it.

In class activity: Timeline Exploration of Computing Evolution

- **Duration:** 45-60 minutes
  Objective: To understand key events in the evolution of computing, focusing on Web 1.0 and the emergence of cloud computing.
  Instructions:

1. Timeline of major milestones in the evolution of computing:
    1. Early Internet (1990s): The launch of the Internet and early browsers like Mosaic and Netscape transformed the web into a tool for mass communication and information sharing.
    2. Web 1.0 (Static Websites): The Internet evolved with technologies like HTML, CSS, and early JavaScript, creating simple websites focused on information delivery.
    3. Cloud Computing Emergence (2000s): The shift towards cloud computing began with the launch of AWS, Salesforce, and other services that moved businesses away from traditional on-site IT infrastructure.
    4. Growth of Cloud Computing (2010s and beyond): The 2010s saw the expansion of cloud services, with major players like AWS, Microsoft Azure, and Google Cloud dominating the market, transforming business operations.
2. Analyze this timeline and answer these guiding questions:
    1. What were the primary technological advancements during Web 1.0 that set the stage for Web 2.0 and cloud computing?
    2. How did early web browsers like Mosaic and Netscape contribute to the evolution of the Internet?
    3. What were the limitations of traditional IT infrastructure before the advent of cloud computing?
3. **Deliverables:**

   A brief group discussion or presentation summarizing the timeline events and their significance to the evolution of cloud computing.