CT216 SOFTWARE ENGINEERING 1

CLOUD COMPUTING

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What is cloud computing?

- "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (NIST, May 2011)

What is cloud computing

- Back in the early 00's there was this bookseller called Amazon, who made their money by shipping books (and everything else) around the world.

- To support their web app (Amazon.com) they had built up some neat hosting infrastructure and software to manage it at scale with a couple of data centers

- The centers were somewhat underutilised and Amazon decided to start selling this spare capacity.

Server room

- At that time most businesses/organisations maintained a server room on premises. In it they would have separate rack mounted PCs/servers.
  - Data would be stored on large Storage Networks
  - Backups would be run on this data
  - Multiple machines (servers) would run business critical software

- There were challenges to this
  - Maintenance
  - Upgrading machines
  - Upfront purchasing costs
  - Hire staff to manage it (Sysadmins)

What is cloud computing

☐ Started with storage

- Simple Storage Service launched on **March 14 2006** marking the beginning of Amazon Web Services

- This allowed users to store documents, files, data on an S3 bucket without having to manage, purchase, maintain the underlying disk hardware.
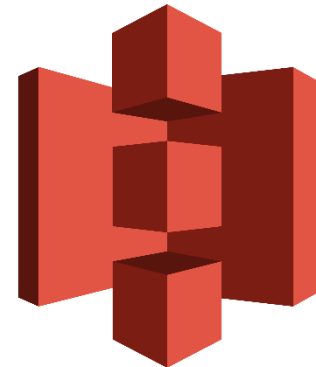
What is cloud computing

□ Then came computing

   ◘ It followed up its successful storage launch of S3 with EC2 or Elastic Compute Cloud in August 2006

   ◘ This allowed you to have access to a remote server accessible via the internet!

Demand was strong…

History of cloud computing

□ Computing may someday be organized as a public utility just as the telephone system is a public utility," Professor John McCarthy said at MIT's centennial celebration in 1961. "Each subscriber needs to pay only for the capacity he actually uses, but he has access to all programming languages characteristic of a very large system … Certain subscribers might offer service to other subscribers … The computer utility could become the basis of a new and important industry."

https://www.technologyreview.com/2011/10/03/190237/the-cloud-imperative/
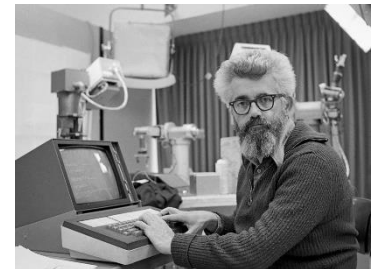
Cloud computing growth

□ The growth in cloud computing over the past decade has been phenomenal.

□ In April 2011, Forrester projected that it would be worth $160bn dollars by 2020, in reality it was 27% larger at $219bn.

□ In 2022 it hit over $480bn in value and is projected to exceed $1tn by 2029.

https://www.fortunebusinessinsights.com/cloud-computing-market-102697

Where is the cloud?

Amazon US-East N. Virginia

Cloud types – Public cloud

- Amazon, MS Azure, Google Cloud are examples of public clouds.

- Any member of the public can sign up and start provisioning compute resources within minutes

- They are highly scalable and allow an organisation to grow its infrastructure rapidly

Cloud types – Private cloud

- Private cloud
  - Computing resources are dedicated to a single customer and not shared with other customers. Considered to be more secure.
  - AWS do offer a virtual private cloud
  - https://aws.amazon.com/vpc/
  - Organisations can also host their on cloud on-prem using software such as OpenStack.

Cloud types - Hybrid

☐ Finally a hybrid cloud is simply a mix of public cloud resources and private resources. An organisation may choose this option if there is a mixture in the criticality of their data or computational requirements.

☐ Data that doesn't require heightened security can be pushed on to the public cloud whereas that which does can be hosted on the private cloud.

Cloud services

- **Software as a Service** (SaaS) **-** provides users with—essentially—a cloud application, the platform on which it runs, and the platform's underlying infrastructure.

- **Platform as a Service** (PaaS) - provides users with a platform on which applications can run, as well as all the IT infrastructure required for it to run.

- **Infrastructure as a Service** (IaaS) - provides users with compute, networking, and storage resources.

Virtual Servers

- Infrastructure as a Service (IaaS)
  - Amazon, Google, Microsoft
- Create virtual machines
  - t1.micro, m1.small, c1.medium, m1.large…
- Customise instances and add greater amounts of storage.
- Each instance can be booted up with a different AMI, you can even create your own!
- Xen Hypervisor (Sun, AMD, IBM, Dell, Intel)
- Storage area networks provide the storage

Advantages/Disadvantages of cloud computing

- When compared to hosting in-house cloud computing has a number of benefits
  - Elasticity – if your application becomes very popular you can procure new resources in minutes
  - Reduced capital expenditure
  - Economies of scale
- There are also some drawbacks
  - Security/privacy
  - Cost
  - Migration issues