Birkbeck
UNIVERSITY OF LONDON

Cloud Computing Workshop
Session 1: Introduction

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Welcome to Cloud Computing Workshop

- Explore the Cloud Computing technology and its tools
- Explore the Google Cloud Platform (GCP)
  - Virtualisation
  - Containerisation
  - Orchestration systems
  - Deployment methods and version control software

Tools to focus

- Virtual Machines (VMs) on GCP
- GitHub
- Docker containers
- Google Kubernetes Engine
- DevOps with Terraform and GCP and GitHub actions

Workshop administration

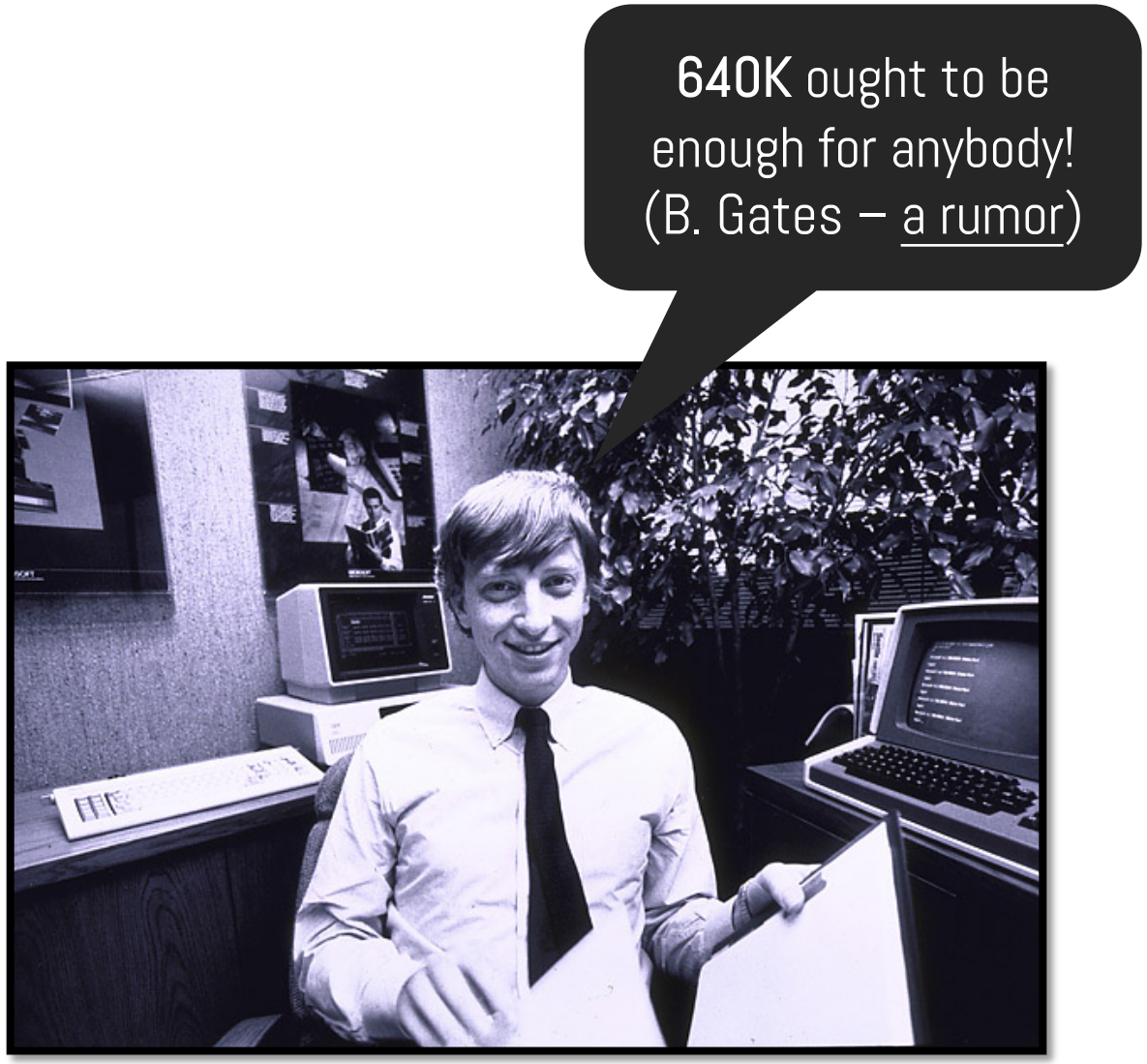
Plan for Session 1

- Short lecture (15 minutes): Cloud computing and Virtualisation
- Demo:
  - Redeem GCP coupons
  - Introduction to GCP, create VMs, connect from SSH, connect using pub key, open port, what is VPC, init script
  - GitHub: Push/Pull code from laptop to GitHub to VM
- Practical session:
  - Create VM, setup pub/key, connect from laptop
  - Install Python, run Hello World
- Tutorials:
  - Intro to Linux, Linux user management, GCP tutorial, Exercise on Python

Session 1: Cloud intro

Some facts!

- How much data is generated every minute?
  - YouTube users search 5M videos per day
  - Netflix users spent a combined **164 million** hours per day watching content
  - Amazon ships 306 items per second
  - In the fourth quarter of 2020, Uber's ridership worldwide reached 1.4 billion trip, it was 1.9 in 2019…
  - Instagram users post 49.380 photos
  - Google conducts 5.9M searches per day, it was 3.9 two years ago…
  - Everyday, we create roughly **2.5 quintillion bytes** of data.



Essential questions?

- Where is such humongous data stored?
- How is data managed?
- Do we have enough resources to accommodate data, if data size is growing every day?
  - That is called **data scaling**
- How fast a software can analyze such data?
  - Computational intensive applications:
    - Need a lot of CPU and memory
  - Data intensive applications
    - Big data software solutions
    - Need CPU, memory and access to huge storage

Where data is stored?

- In a Cloud datacenter…
  - A building, dedicated space within a building, or a group of buildings used to house computer systems and associated components, such as telecommunications and storage systems. [Source]

Apple (Maiden, N.C.)

NSA (Utah)

Switch SUPERNAP Campus (Las Vegas)
Size: 7 football fields…

SUPERNAP at a glance

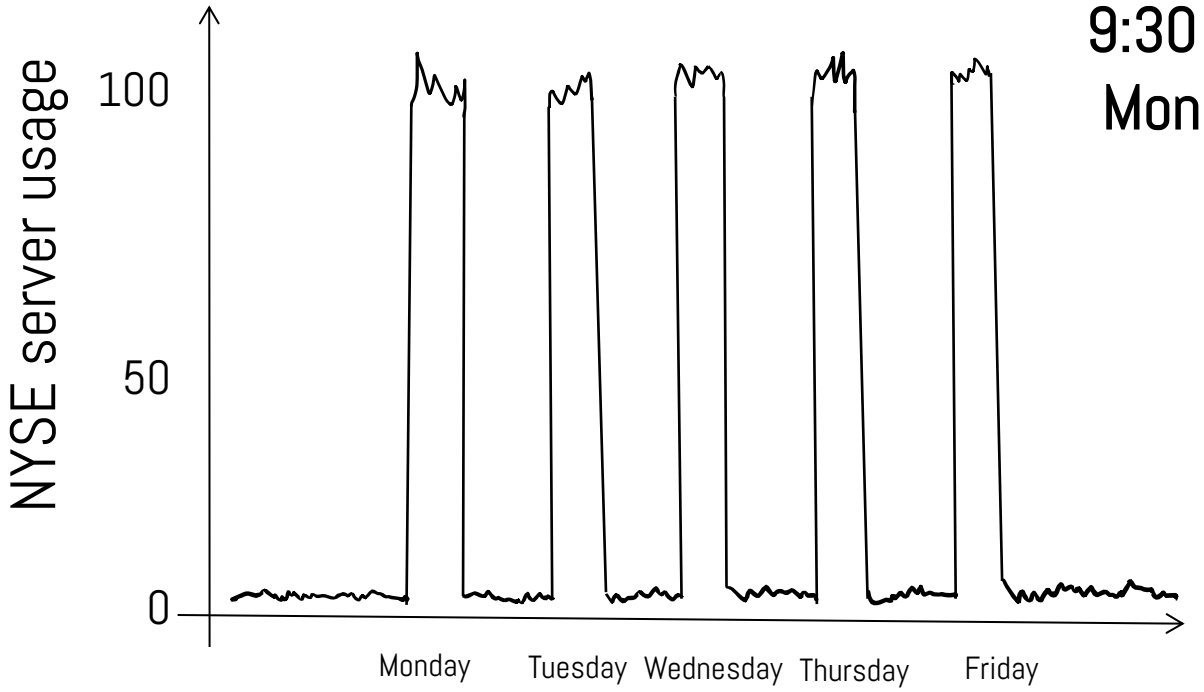
- SUPERNAP
  - A big building with a lot of electricity and air conditioning.
- It uses renewable power sources, the Nevada desert is an ideal place for solar panels
- From the street, though, all you see is a high concrete wall – to innocent bystanders, it could be a prison or military base back there
- SUPERNAP clients include eBay, AWS, Marvel, Cisco, PS4, MGM, Verizon, Salesforce, HP, Deutsche Bank…
  - [Source]

What is Cloud Computing?

- Example of New York stock exchange market
  - www.nyse.com
- NYSE is the largest equities-based exchange in the world, according to the total market capitalization of its listed securities
  - Data is generated on huge volumes
- Core Trading Session: 9:30 a.m. TO 4:00 p.m. ET
  - NYSE calendar

NYSE system

- On-line real time stock market data system resource utilization
  - Example of NYSE workload



9:30 AM - 4 PM,
Monday-Friday

all other days and times

- Why to pay for resources and capacity for evening-early morning and weekends?
- Why to run the servers if there aren't any workloads?

What is provision?

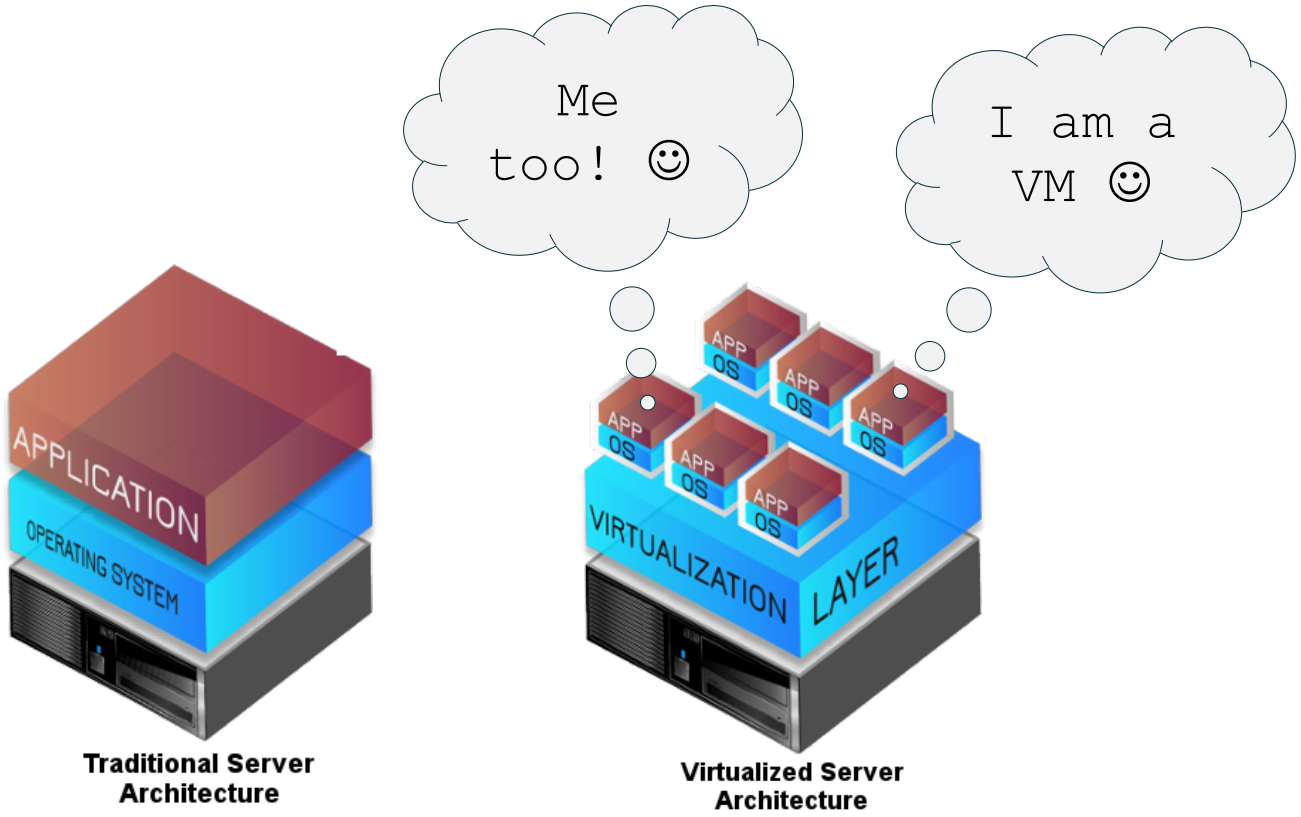
- Provision of resources:
  - Create a virtualized environment with resources
    - Resources: CPU, memory, hard disk, virtual networks etc.
  - Cloud environments are virtualized, this means it is easy to scale up in size
    - Scale up means:
      - From 2 cores, 4GB RAM, 100GB disk to move to
      - 4 cores, 64GB RAM, 250GB disk

What is deprovision?

- Deprovision of resources:
  - Freeing up resources
  - In some case refer to changing the configuration of a virtualized environment
  - Deprovision also refers: turning off a virtual server
    - More cheap!

Virtualization

- Act of creating a virtual (rather than actual) version of something
  - Something: HW + SW
- It includes virtual computer hardware platforms, storage devices, and computer network resources. [Wikipedia]



Traditional Server Architecture

Virtualized Server Architecture

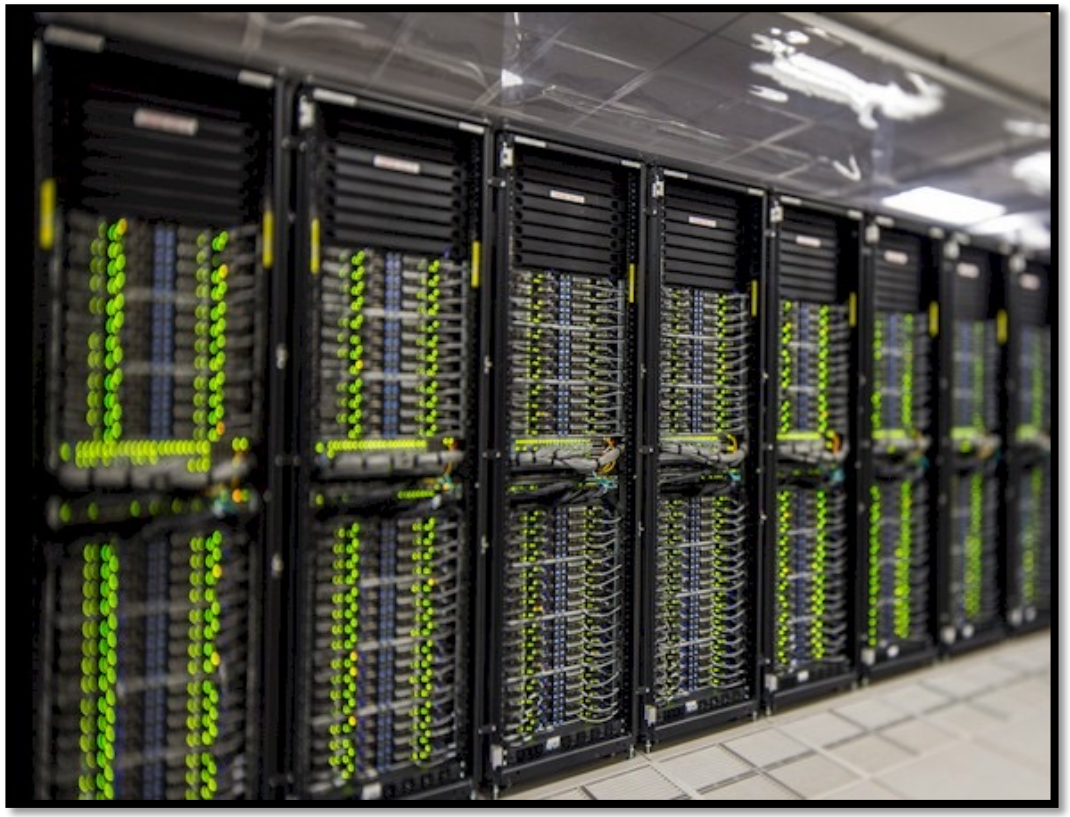
Virtual machine (VM)

- Preferred definition:
  - A virtual machine is a computer file, typically called an image, that behaves like an actual computer
- Each virtual machine provides its own virtual hardware, including CPU, memory, hard drive, network interface, and other devices.
- Multiple virtual machines can run simultaneously on the same physical computer.
- The virtual machine is sandboxed from the rest of the system.
  - A VM provides isolation from the rest of the environment

[Source: MS Azure]

Characteristics of virtualization

- Multi tenancy in one bare metal server
  - Bare metal?
    - A 'Single-tenant physical server'
    - Cloud administrators creates several virtual machines (multi-tenancy).
  - Run multiple VMs of same or different operating systems in same hardware
- Isolation:
  - Each VMs is isolated from each other
    - This means that users have access to only their own data and applications



Let us summarize what we just learned

- Cloud Computing:
  - A fancy name for a very cool technology
  - Pay as you go for online services (HW and SW)
  - On demand hardware resources over the network

- Virtualization
  - Process of creating a virtual version of a computer
  - Virtual machines (VMs) are “seating” on top of a bare metal
    - Easy to manage!
    - Hard to alter (e.g. scale up and down)

What is Cloud deployment?

- **Cloud deployment** refers to the enablement of:
  - SaaS (**s**oftware as a service)
  - PaaS (**p**latform as a service)
  - IaaS (**i**nfrastructure as a service)
- Models are delivered to end users over the Internet
- **A key technical skill** for a modern computer engineer, application developer and data engineer
  - Understanding the complexity of a deployment will give you intuitions to develop a better software

Demo: Welcome to GCP

Connecting to GCP

- Intro to GCP and interface
- Create a VM
- Connecting (ssh) and running commands
- Optional: Connecting (ssh) from your laptop
- Installing software
- GitHub (push/pull code)

Practical Session

Connecting to GCP

- Run the tutorials:
  - Introduction to Linux
  - User Linux management
  - GCP Tutorial
- Exercises:
  - Create VM
  - GitHub push-pull code from your laptop