

1 Cloud computing

1.1 What is cloud computing

A new computational **paradigm**. **Out-source** your computation and storage needs to a well-managed data center. No worries about the physical machines: power, cooling, maintenance. Virtualisation provides the necessary **isolation** to share multiple clients on a single physical machine

1.2 Characteristics

A number of characteristics define cloud data, applications services and infrastructure:

- Remotely hosted: services or data are hosted on remote infrastructure
- No-need-to-know in terms of the underlying details of infrastructure, application interface with the infrastructure via the APIs
- Ubiquitous: services or data are available from anywhere (**always on, anywhere and any place**)
- Flexibility and elasticity allow these systems to scale up and down at will
- Utilising resources of all kinds CPU, storage, server capacity, load balancing, and databases
- Commodified: the result is a utility computing model similar to traditional utilities, like gas and electricity - **pay as much as used and needed** !

1.3 Rapid elasticity

Rapid elasticity is currently one of the key challenges in Cloud Computing. Capabilities can be rapidly and elastically provisioned, in some cases **automatically**, to quickly scale out and rapidly released to scale in. To the consumer, resources often appear to be **unlimited** and can be purchased in any quantity at any time. Optimisation of the current usage will save energy! (e.g. putting unused machines to sleep). **Prediction techniques** may help alleviate the problem based on **historical data** (e.g. machine learning applied to cloud computing).

1.4 Migration

Non-live Migration:

- Instead of shutting down the computer, we could pause the VM (**checkpointing**)
- Then, copy over the memory pages used by the VM to the new hardware as quickly as possible meaning less downtime, but still noticeable

Live Migration:

- the idea is to start moving the virtual machine while it is still **operational** (pre-copy memory migration)

1.5 Cloud service models

Three main service models:

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)

More recently, new services are being defined. For example, Desktop as a Service (**Daas**)

1.5.1 IaaS

- IaaS provides resources of the **underlying** cloud infrastructure to customers
- Virtual machines (with different OSs) and other virtualised hardware, processing, storage, networks, etc
- Example of IaaS: Amazon EC2 (Xen hypervisor - paravirtualisation)
- End-user: typically a system administrator

1.5.2 Paas

- Paas provides service in the form of a platform on which the customers applications can run
- Tools to create your own applications (e.g. development environment, programming language tools)
- Examples: AppEngine, Microsoft Azure, Force.com, Heroku
- End-user: developers

1.5.3 Saas

- Saas provides service to customer in the form of software
- Applications that run on the Cloud
- Examples: G-mail, Microsoft 365, Dropbox
- End-user: regular users

Reference section

placeholder