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COPENHAGEN BUSINESS ACADEMY

Virtualization and x-as-a-Service

Infrastructure as a Service:
https://www.ibm.com/developerworks/cloud/library/cl-cloudservices1iaas/index.html

Platform as a Service
https://www.ibm.com/developerworks/cloud/library/cl-cloudservices2paas/index.html

Agenda

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- Why Virtualization
- Virtualization techniques
- The cloud
- X as a service
  - Infrastructure
  - Platform
  - Software

History of computing

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- Manual computing
- Mainframes
- Racks
- Virtualization

See also: Evolution of computing at CERN

Early mainframes

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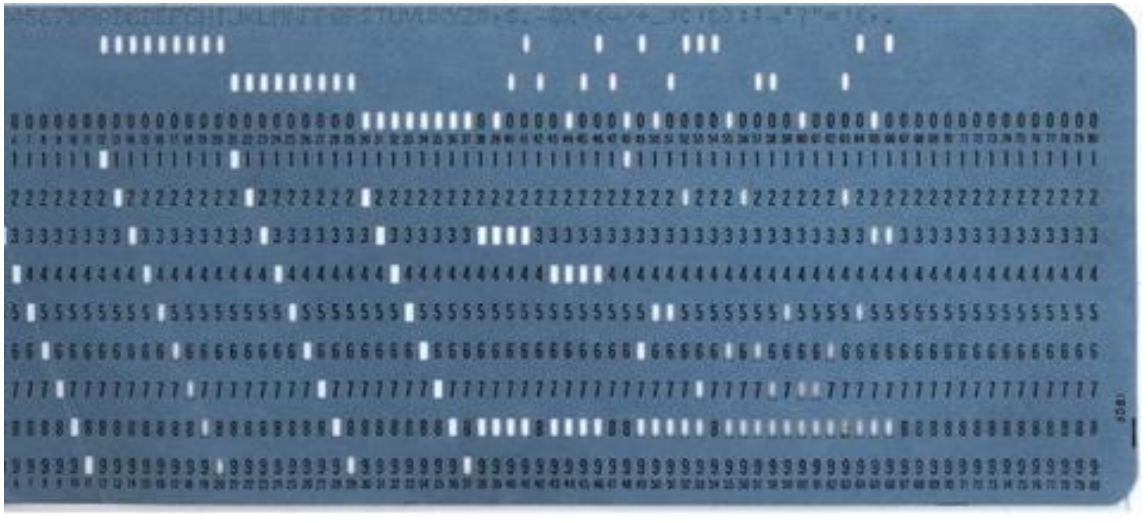
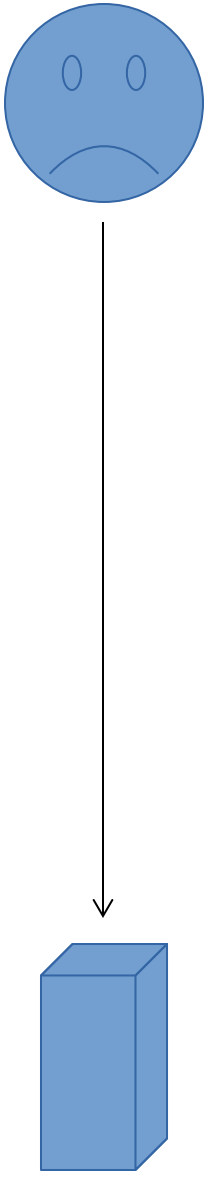
- One huge computer
- Humans wrote machine code
  - Punchcards and later consoles





Racks

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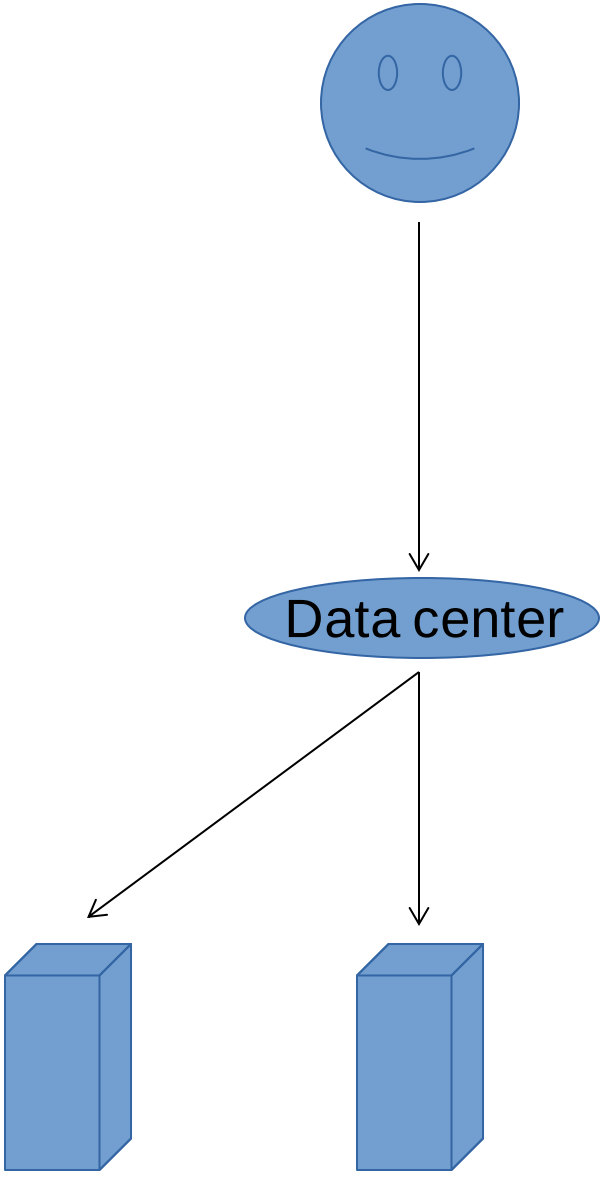
- Many computers in one place
- Stored in a data center
- Few jobs distributed to many machines

- How to interact with the racks?



Agenda

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- Layer interacts up and down
- We use the application layer
- We (rarely) care about others

- The application layer has to communicate with the OS

See also: [OSI model on Wikipedia]

Early operating systems

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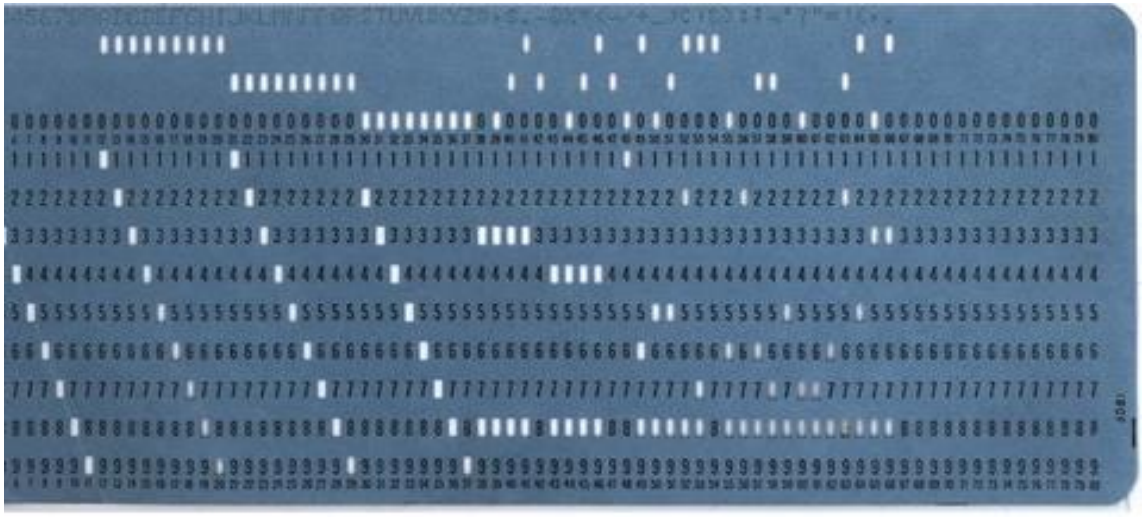
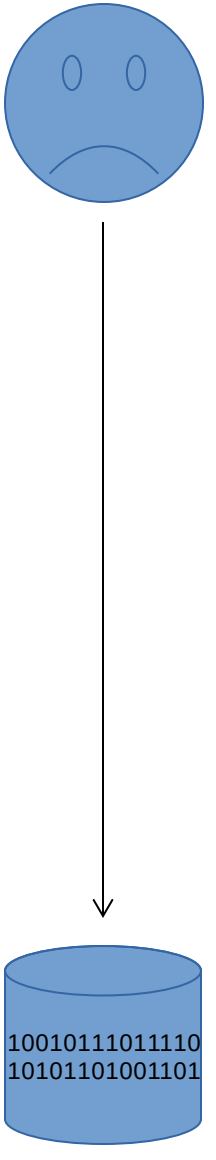
- Human inputs machine code
  - Punchcards





Later operating systems

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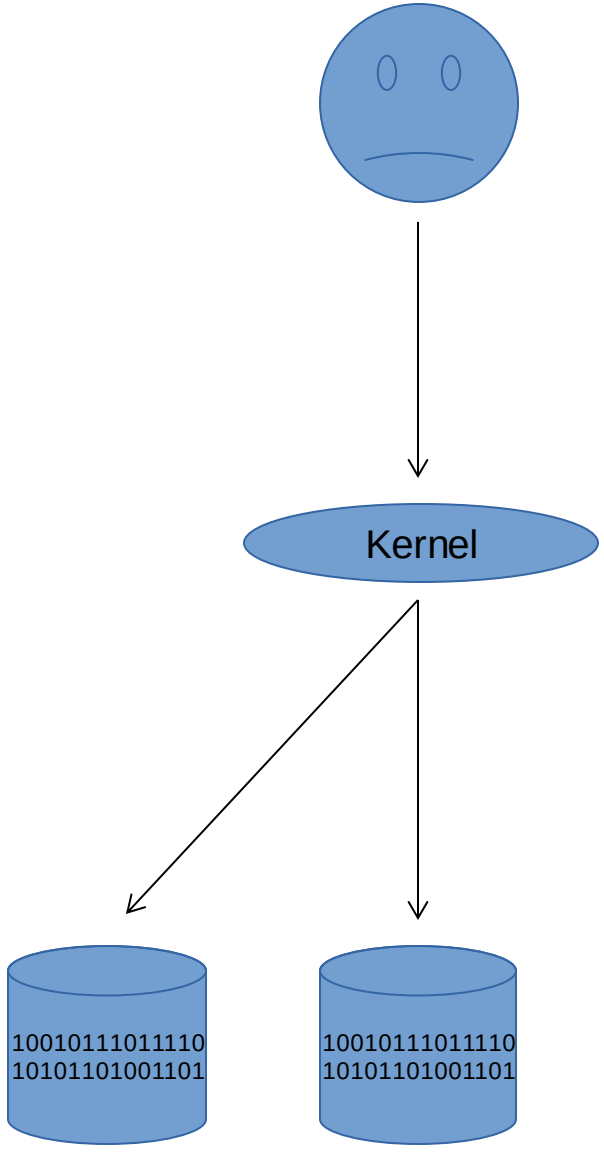
- Multiple resources, cores, users
- How to manage them?

- Operating system kernel
  - User space
  - Kernel space



Virtual machine

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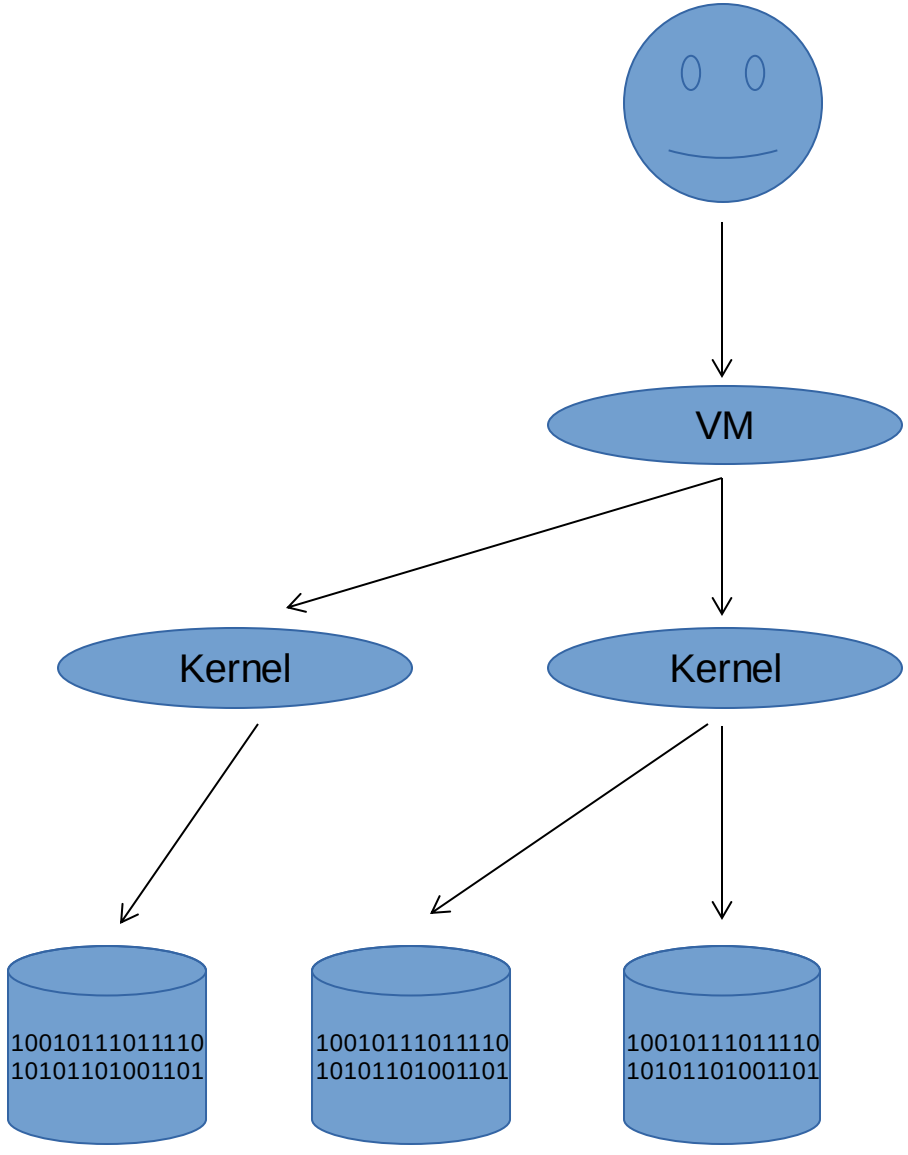
- Emulated operating systems
- Single entrypoint for the user
  - Not OS specific



See also: [Virtual machine on Wikipedia]

Virtual machine benefits

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- Write once, run everywhere
- Share resources
  - Exploit economies of scale
- Scaling
  - Elasticity
  - Resources provided on-demand

See also: Docker

Virtual machine disadvantages

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- Less efficient than bare-metal
- Centralization of data = security risk
- Putting data in someone else's computer

Virtualization

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- Abstraction of resources
- Implementation decides how and where
- Typically managed by a Hypervisor
  - Creates and runs virtual machines

- Similar to the OSI model of abstraction
  - When you interact with a layer, you don't care about the implementation

See also: Virtualisation on Wikipedia

The 'cloud'

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- Huge data centers running virtualised environments
- Examples: Amazon Web Services (AWS), Azure, Digital Ocean
  - Distributed across the entire world (fast!)
- 2011: Netflix migrated to AWS

Remember

- Always on someone else's computer

See also: Cloud computing on Wikipedia

X as a Service

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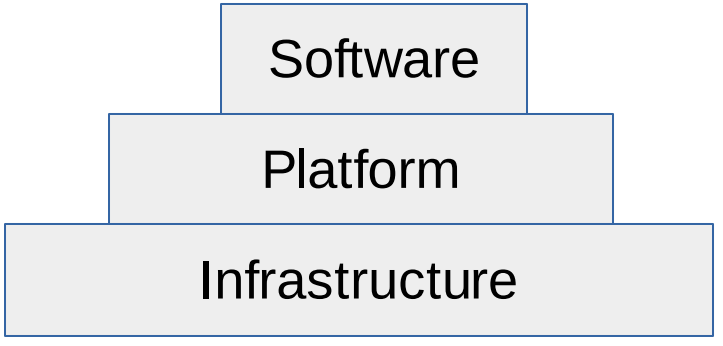
Three variants of the cloud:

- Infrastructure
- Platform
- Software



But there are many others

Backend as a Service, Function as a Service (Amazon Lamda) …….

Infrastructure as a Service

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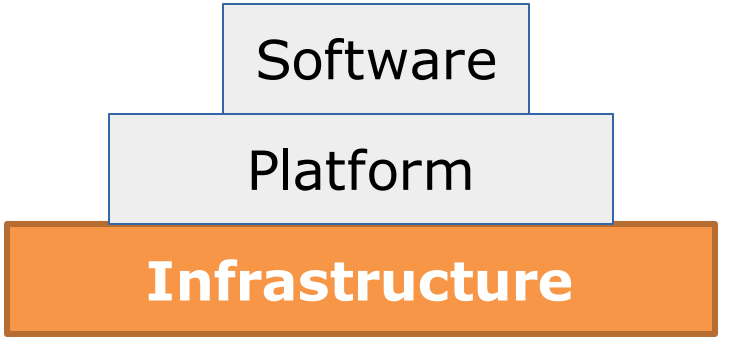
- Write software for VM, scale dynamically
- Examples
  - Digital Ocean, Amazon Web Service



Advantages

- Pay as you go
- **Low vendor lock-in**

Disadvantages

- Still need to interact with OS / VM
- Critical infrastructure out of your hands

Platform as a Service

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Full development environment

- Typically: Database, web-server, execution environment
- Example → Tomcat, MySQL, PphMyAdmin, SSL etc.

Examples

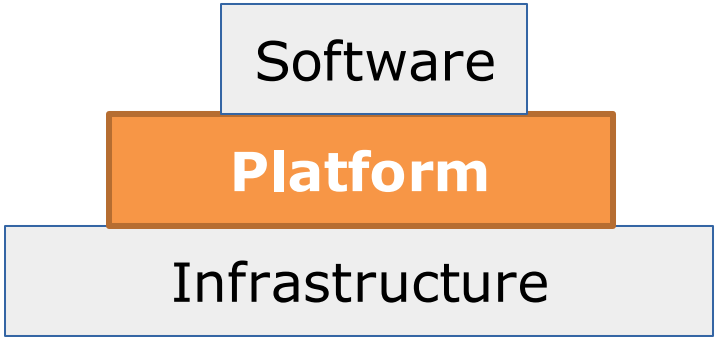
- Openshift, Heroku and many others

Advantages

- Pay as you go
- No need to know the VM environment
- Built-in scalability and availability

Disadvantages

- Medium vendor lock-in



Software as a Service

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Buy access to application or data

Examples

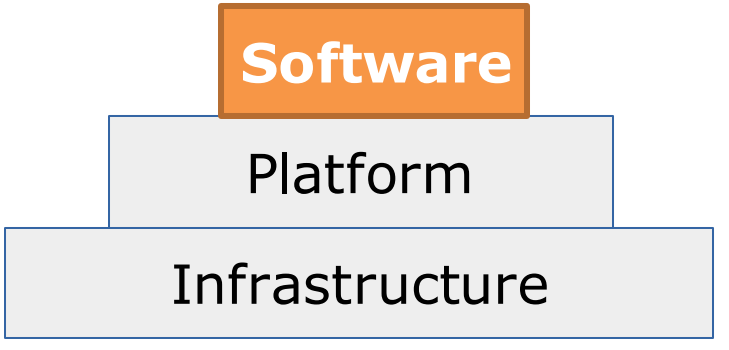
- Gmail, Facebook, Dropbox, GoogleDocs ….

Advantages

- Pay as you go
- Easy to use

Disadvantages

- High vendor lock-in
- No control over security



Private hosting

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Running software on local datacenter or in-house

Advantages

- Full control over hardware, OS, software and data
- Easier to secure
- Cheap in the long run

Disadvantages

- Expensive in the beginning
- Unused hardware
- Bad scaling
  - Slow and expensive
- Worse infrastructure