

Science Park, Amsterdam

HPC Cloud at SURFsara

— Offering computing resources as a service



Webinar

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The SURF family



What is cloud computing?

Do we have a common ground?

Wikipedia:

“Cloud computing is a jargon term **without** a commonly accepted non-ambiguous scientific or technical definition”

(July 2013)



A definition: cloud computing

Essential characteristics:

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

Service models:

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

Agenda

1.- SURFsara's HPC Cloud **service**

2.- **User** experience

3.- Demo

SURFsara's HPC Cloud service

The logo consists of the word "SURF" in white capital letters inside a dark green rounded rectangle, followed by the word "SARA" in dark green capital letters to its right.

SURF SARA

What do we (SURFsara) want to offer?

Services for **scientists**

...scientists \nRightarrow systems gurus

... complex users' problems

- **Data:** big, dirty, non-structured...
- **Computation:** complex (e.g.: modeling, simulation)
 - Libraries nightmare
 - 3rd party, incompatibility, maintenance...

... cooperate

... share

... trial and error

... show

... test

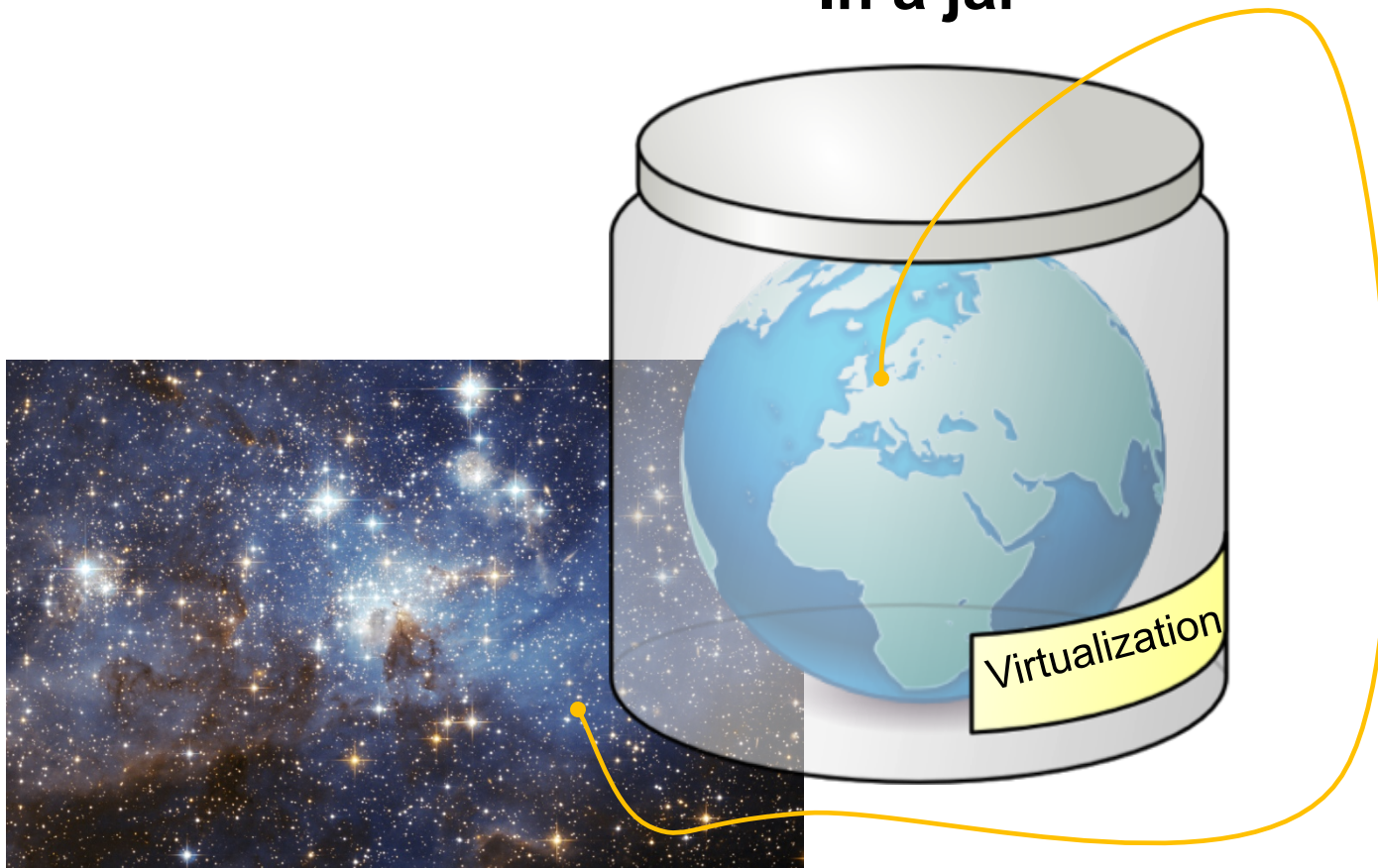
... scratch

... flexibility

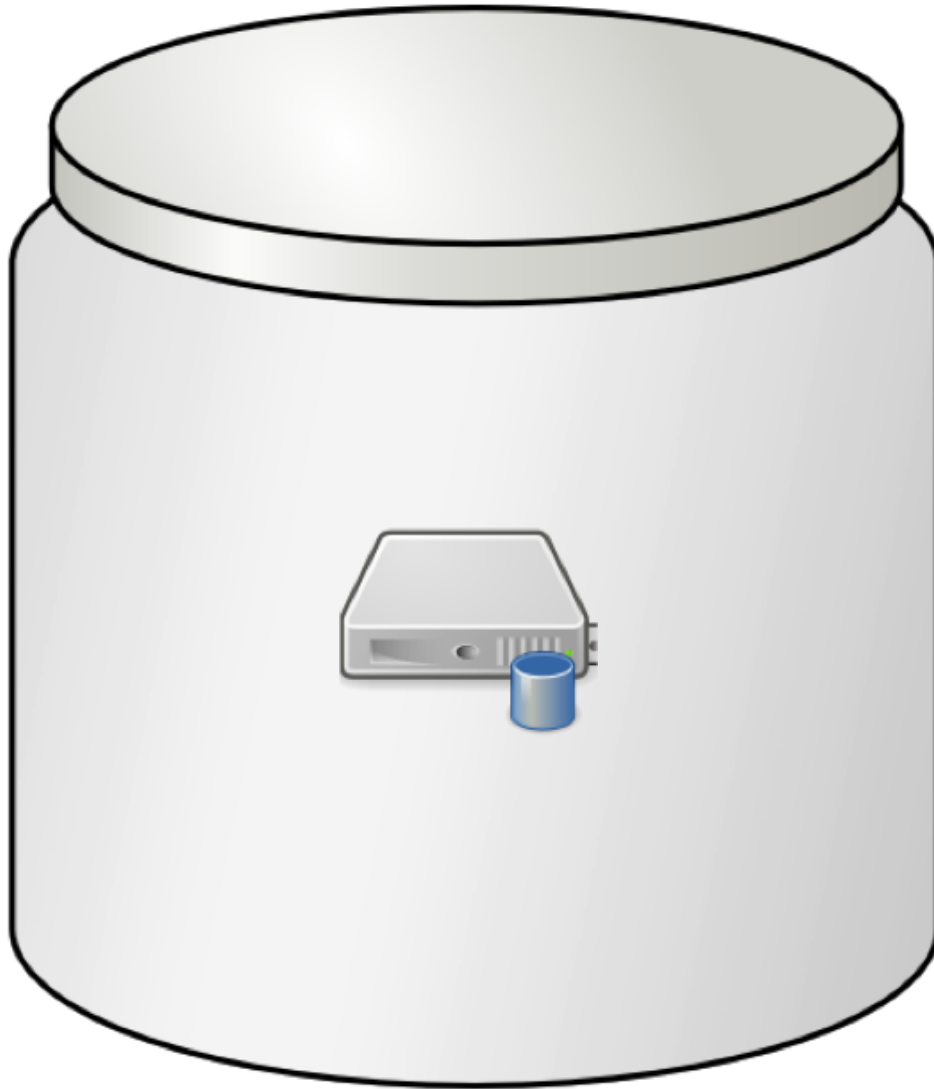
... privacy

What does our HPC Cloud offer?

In a jar



What do you see, as a user?

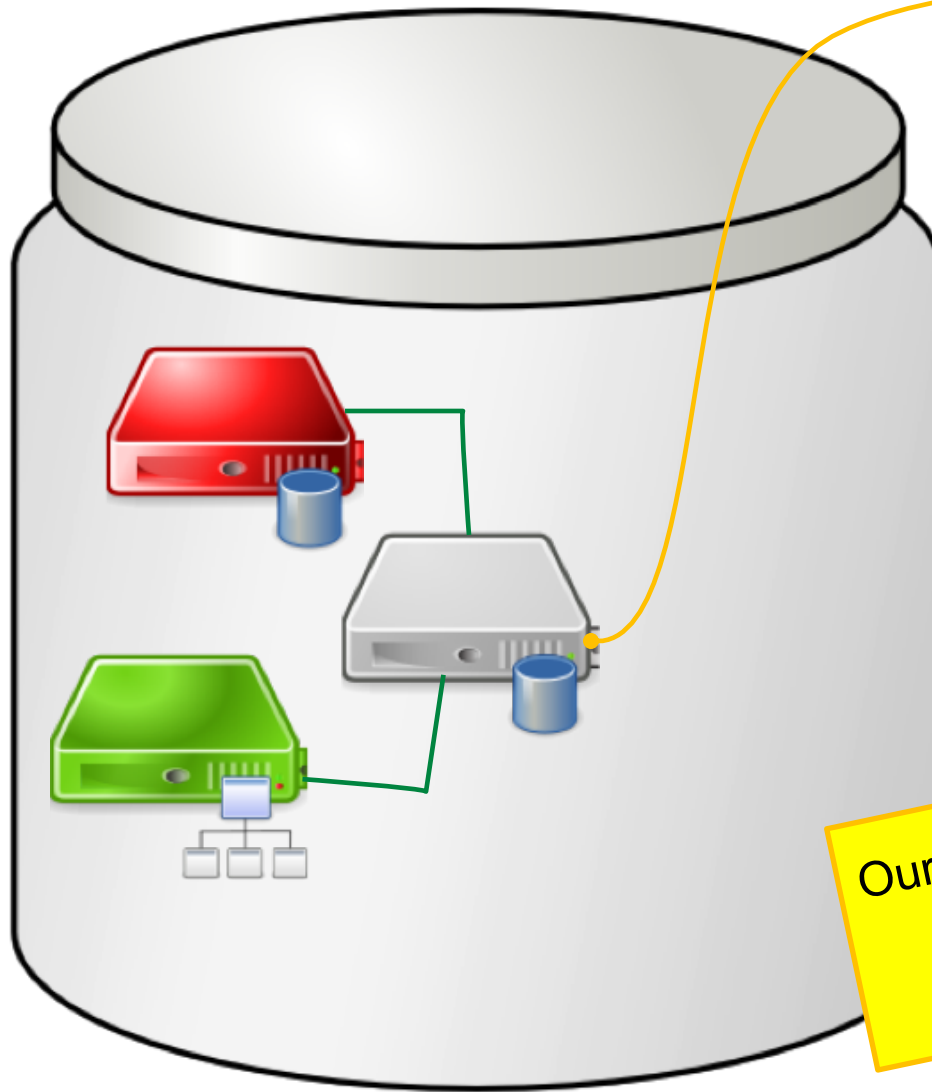


A place to build a running system

Build your own (virtual) machine:

- Hardware
 - CPU
 - Memory
 - Input/Output
 - Disk
 - Network interfaces
- Software
 - Operating System
 - Programs
 - Libraries

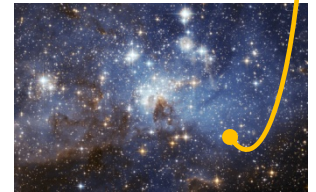
What do you see, as a user? (and II)



A place to build a bunch of systems

Build your own cluster:

- Private network
- Internet access



Our say:

IaaS

Powered by...
OpenNebula

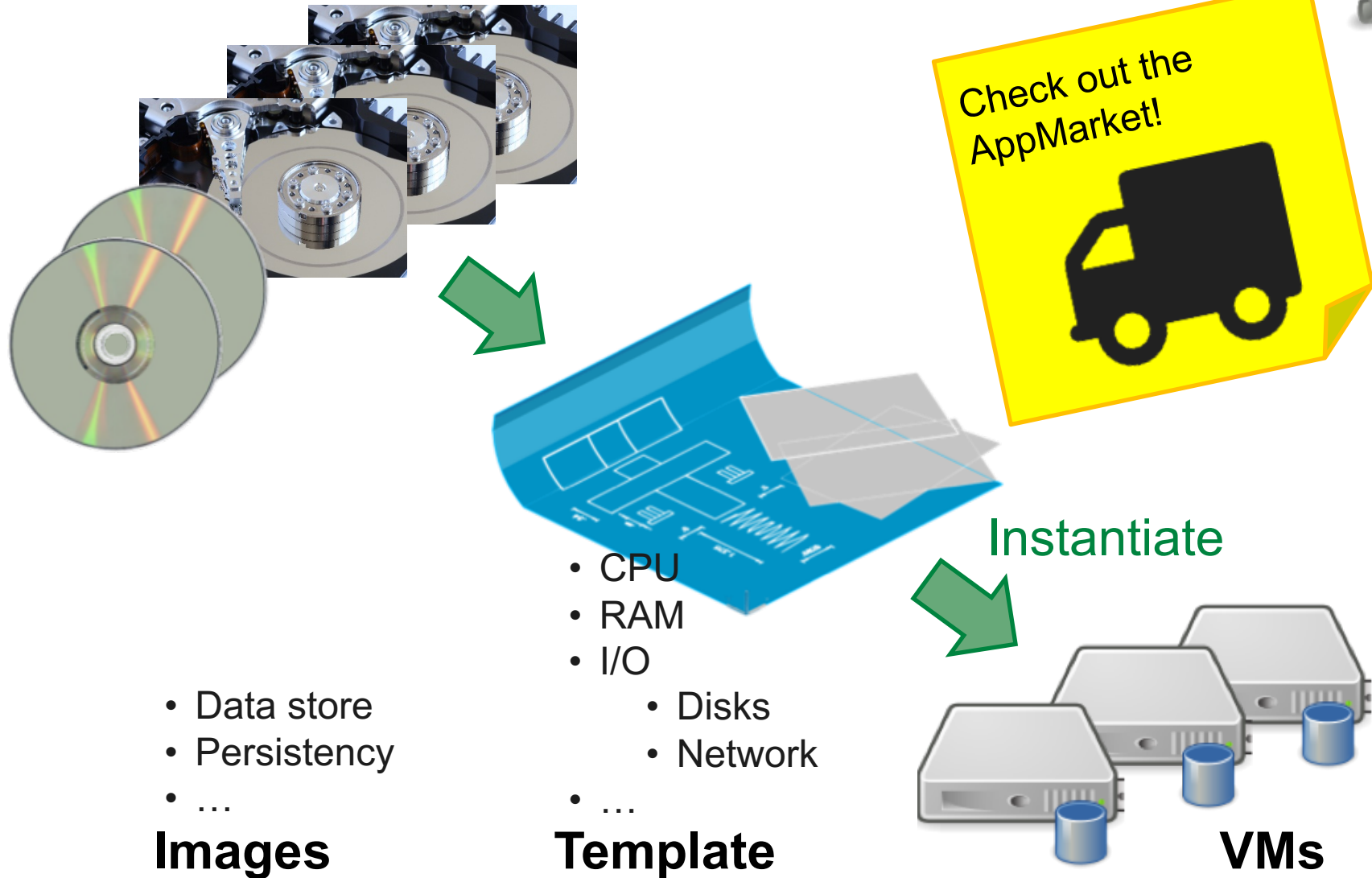
Cloud computing landscape

Screen captures: <https://clutch.co/cloud>

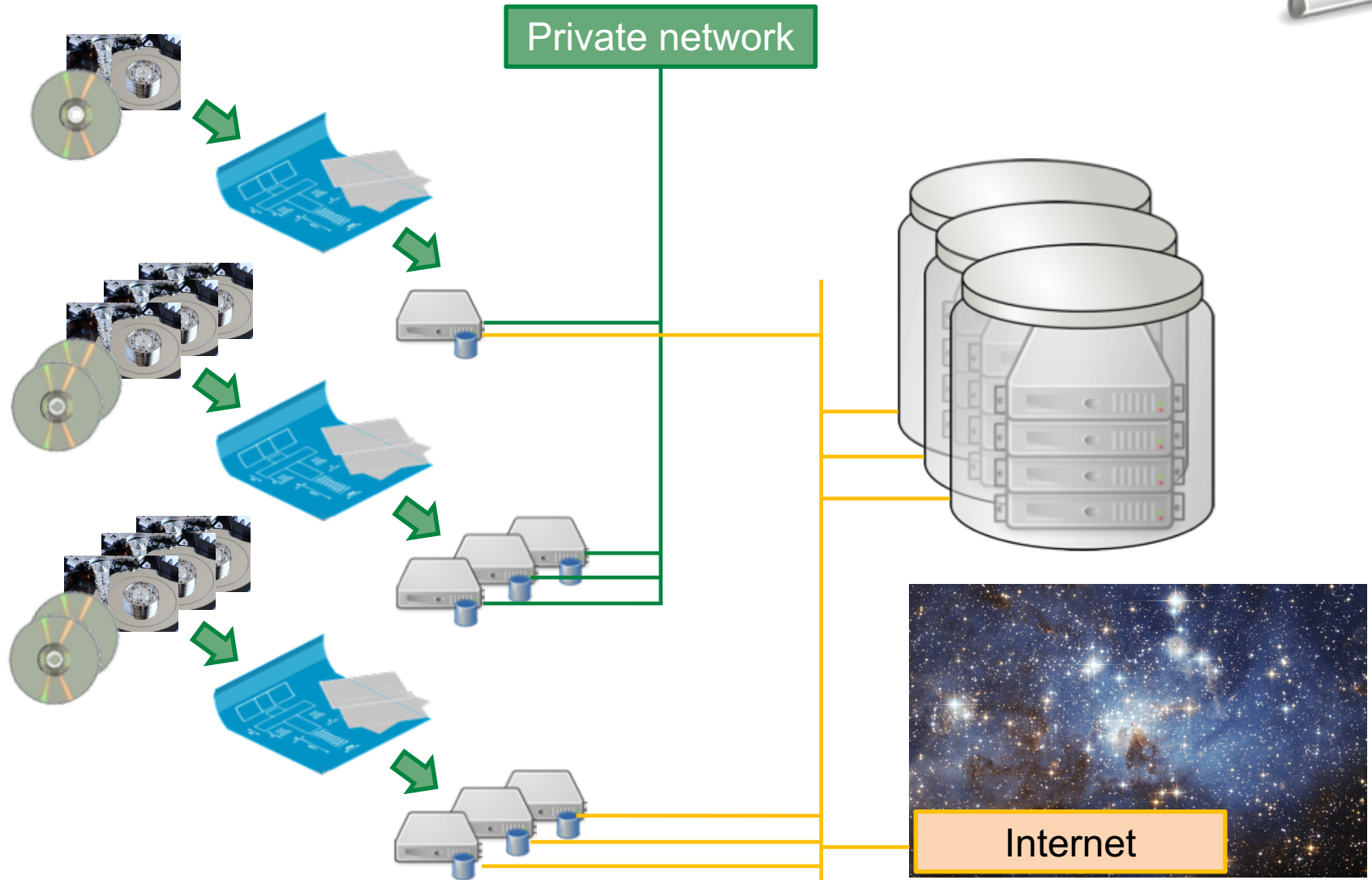
User experience



IaaS: Your place to run VMs



IaaS: your interconnected VMs



Scaling



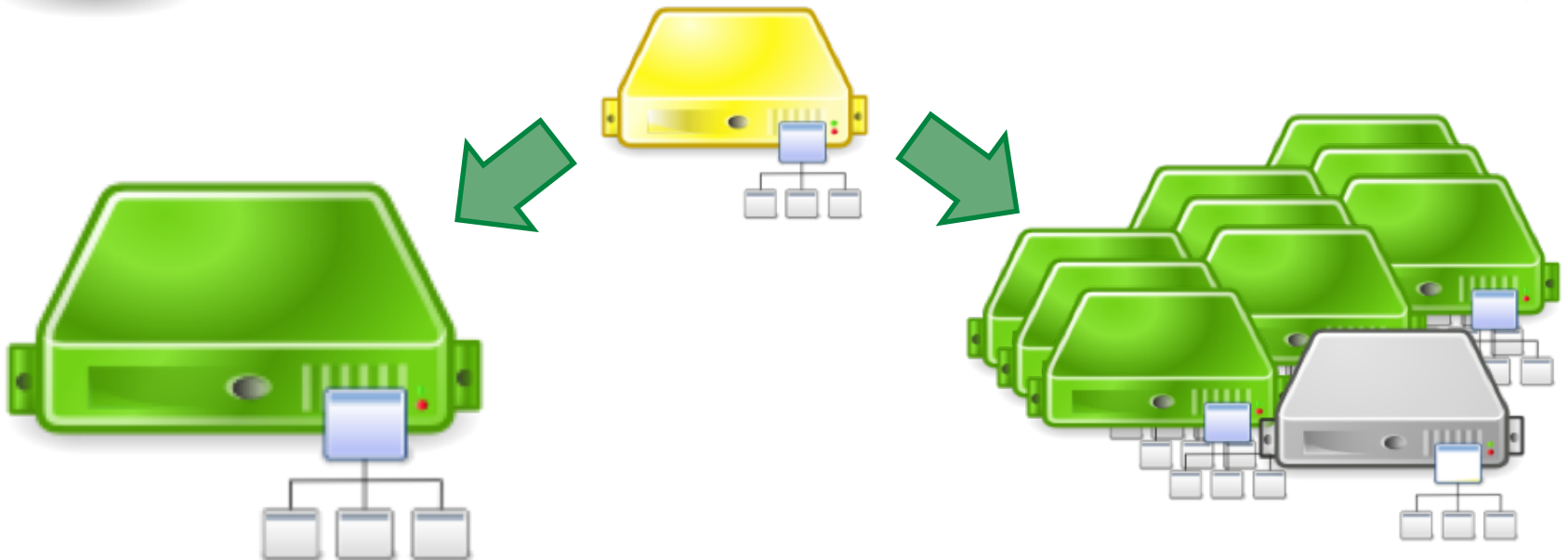
Your **application**
may need more...



Scale up

vs.

Scale out





Users **like** & **leverage**...

- Flexible software **mix**
- **Big** VMs
- **Elasticity**
- Provide their own service to **their own users**
- Software that requires **licenses**
- Set up, test and deploy **workflows**
- Deliver training; **courses**
- **Intensive** computing

...from diverse **fields**:

- Biology
- Genetics
- Informatics
- Chemistry
- Ecology
- Linguistics
- Robotics
- Business
- Social sciences
- Engineering
- Humanities
- Water management
- ...

Demo

3



Request: <https://e-infra.surfsara.nl>
UI: <https://ui.hpccloud.surfsara.nl>
Doc: <https://doc.hpccloud.surfsara.nl>

Credits

Images: Wikipedia, Science Park, RRZE icons,
NIST, nVidia, Ceph
Slides: SURFsara colleagues

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SURF SARA

<<EOF

Introduction to cloud computing for the VPH

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VPH Webinar Series 30/01/2018



Sheffield Teaching Hospitals 
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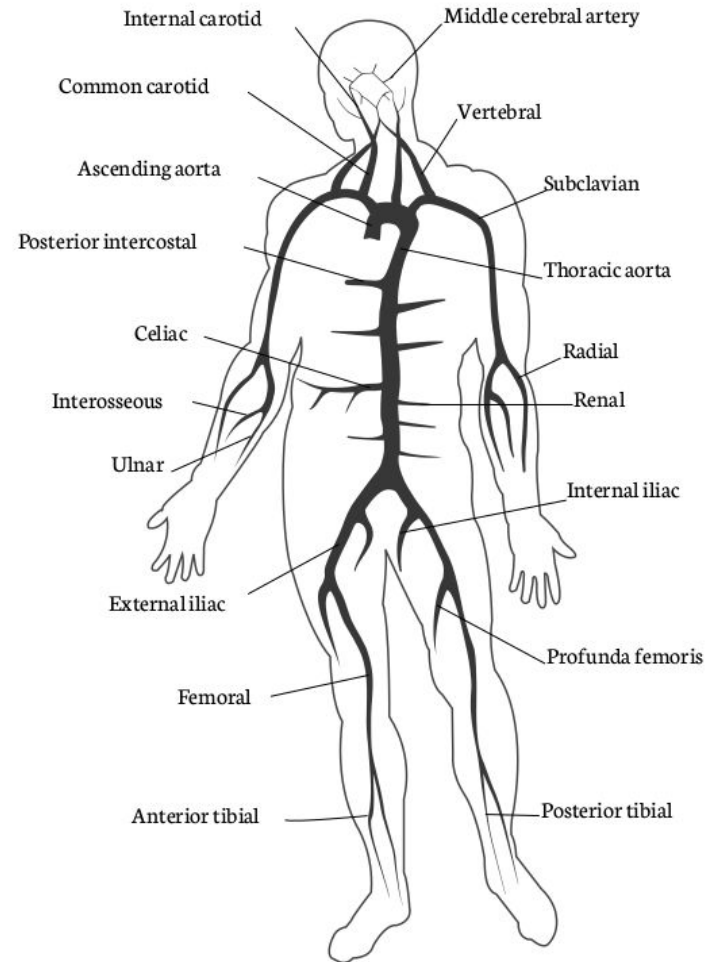
Outline

- Introduction to openBF
 - What it does
 - How it does it
 - What you get
- Typical application
 - From individual to population studies
 - Serial vs parallel (desktop vs cloud)
 - MC results
 - Convergence
 - Biomarker distributions

openBF

- Finite volume 1D solver based on Navier-Stokes equations
- Written in Julia
- Computes the solution of pulsatile flow in networks of elastic vessels
- Open-source (Apache 2.0)

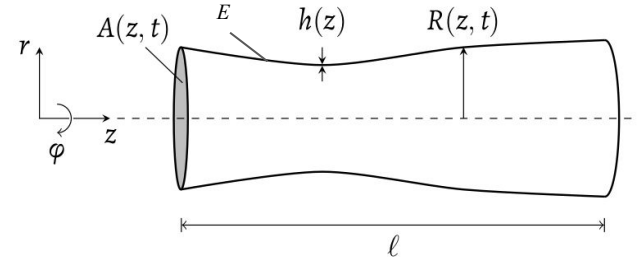
<https://github.com/INSIGNEO/openBF>



Mellis A., Gaussian process emulators for 1D vascular models, PhD Thesis, 2017
<http://theses.whiterose.ac.uk/19175/>

Single vessel

- Arteries are narrow and elastic
- Only radial displacement
- No bends
- Parameters
 - Length
 - Internal radius
 - Young's modulus (elastic properties)
 - Thickness
 - Blood properties
 - Density
 - Viscosity

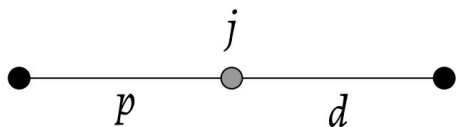


`model.csv`

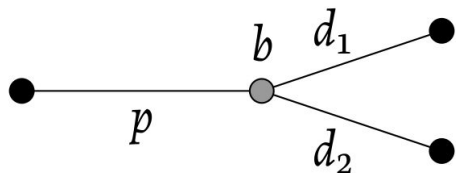
`model_constants.jl`

Network

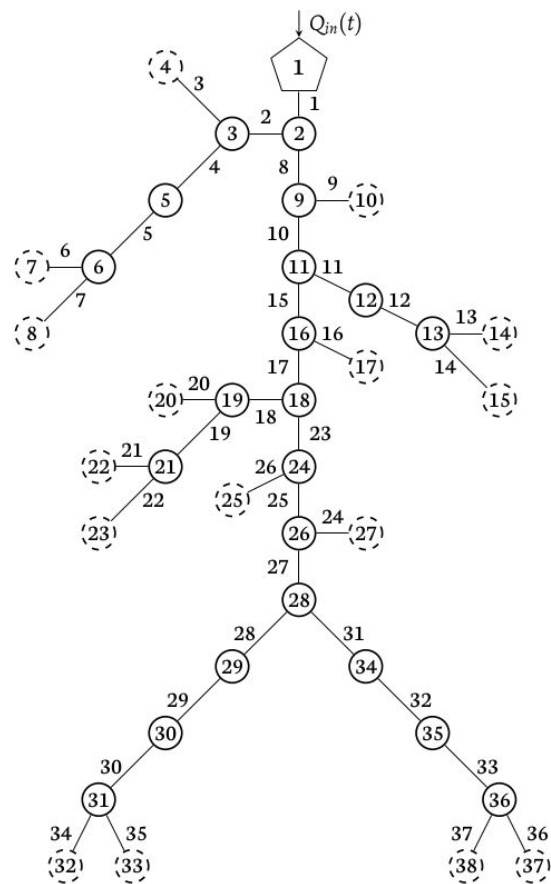
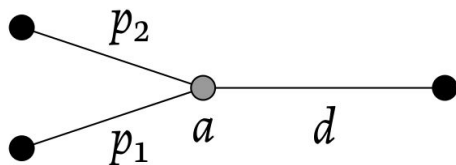
- Conjunction



- Bifurcation



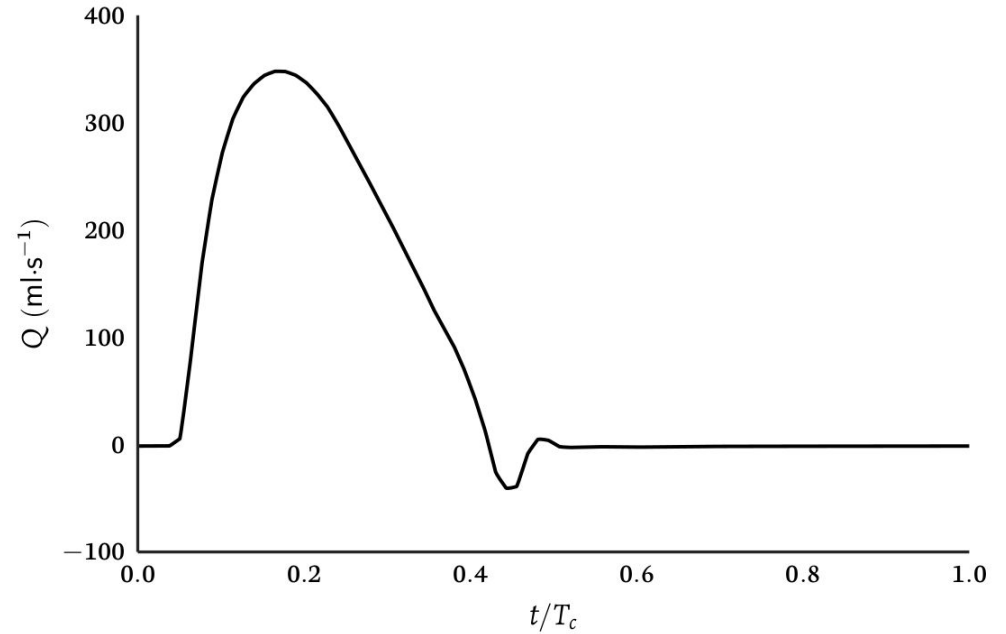
- Anastomosis



model.csv

Inlet boundary condition

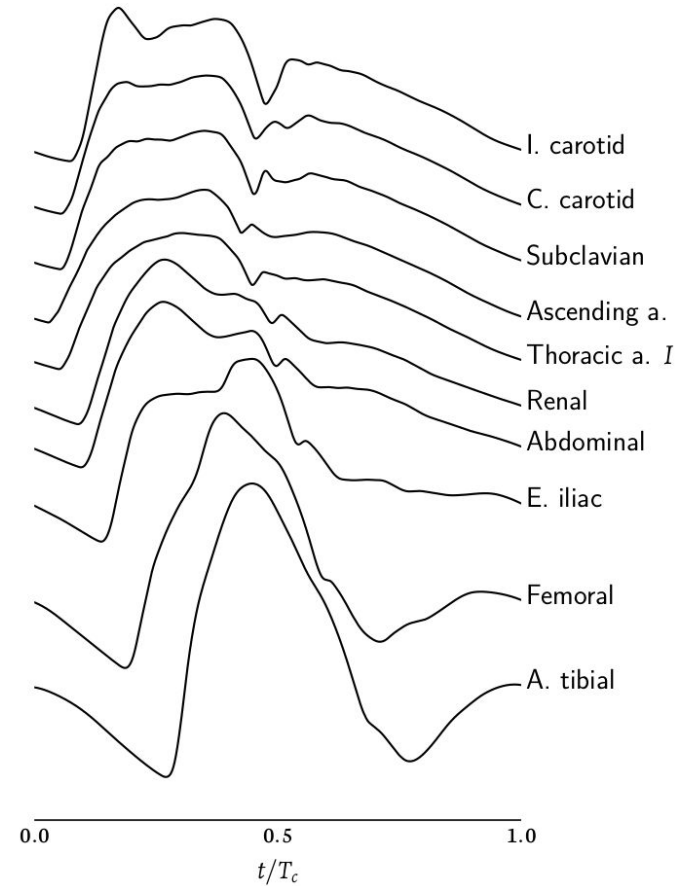
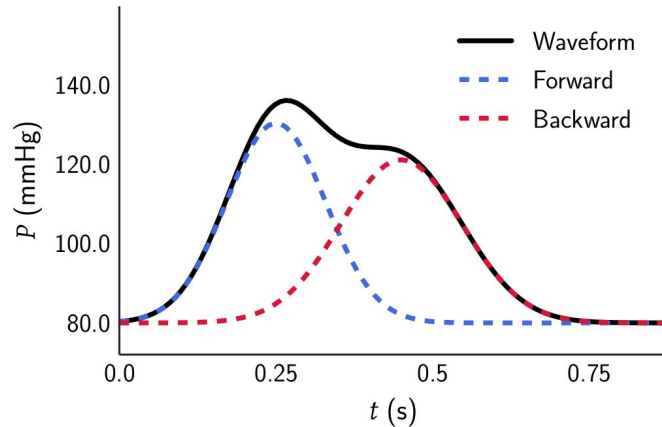
- Inlet
 - Time varying volumetric flow rate



model_inlet.dat

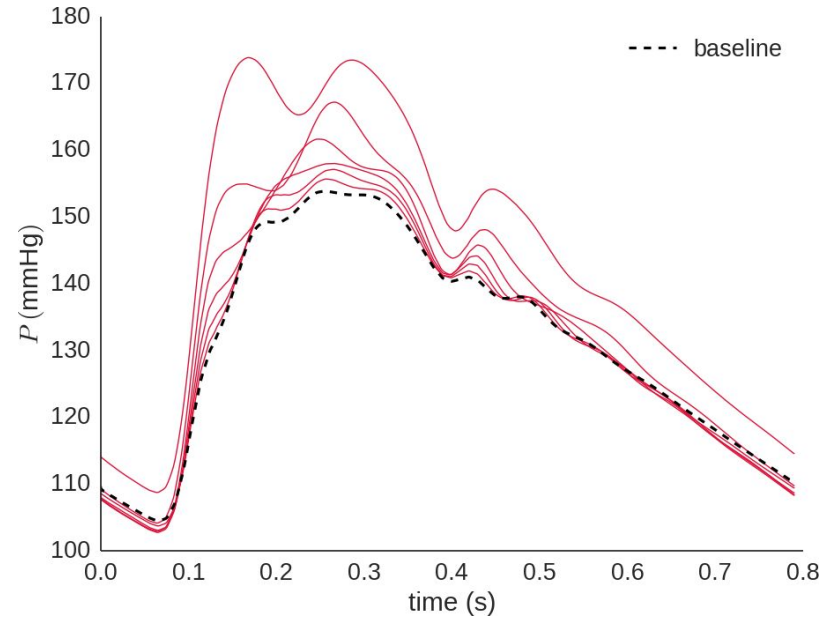
Results

- Pulse waveforms all over the network
 - Pressure
 - Volumetric flow rate
 - Cross sectional area
- Pulse wave analysis



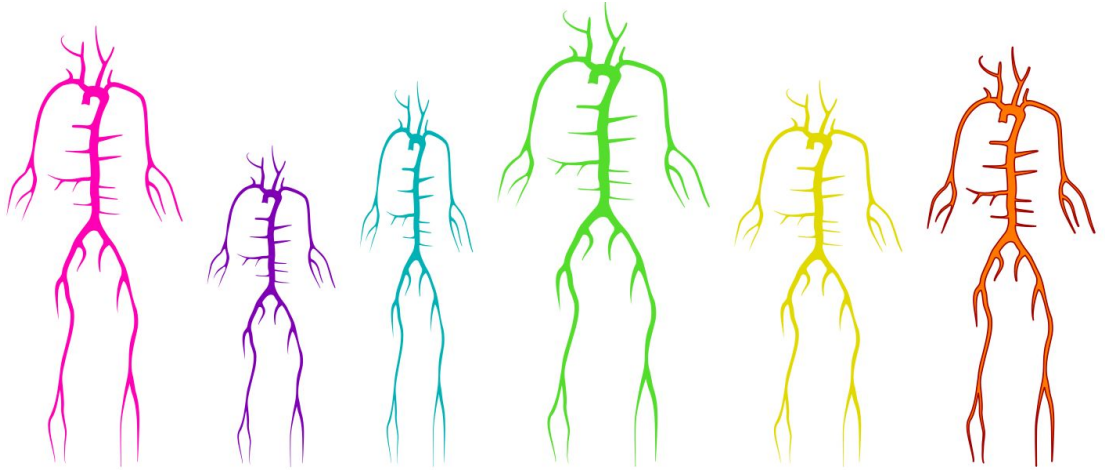
Predictions

- Change input parameters to simulate a specific cardiovascular condition
- Compare new results with baseline waveforms (healthy subject)



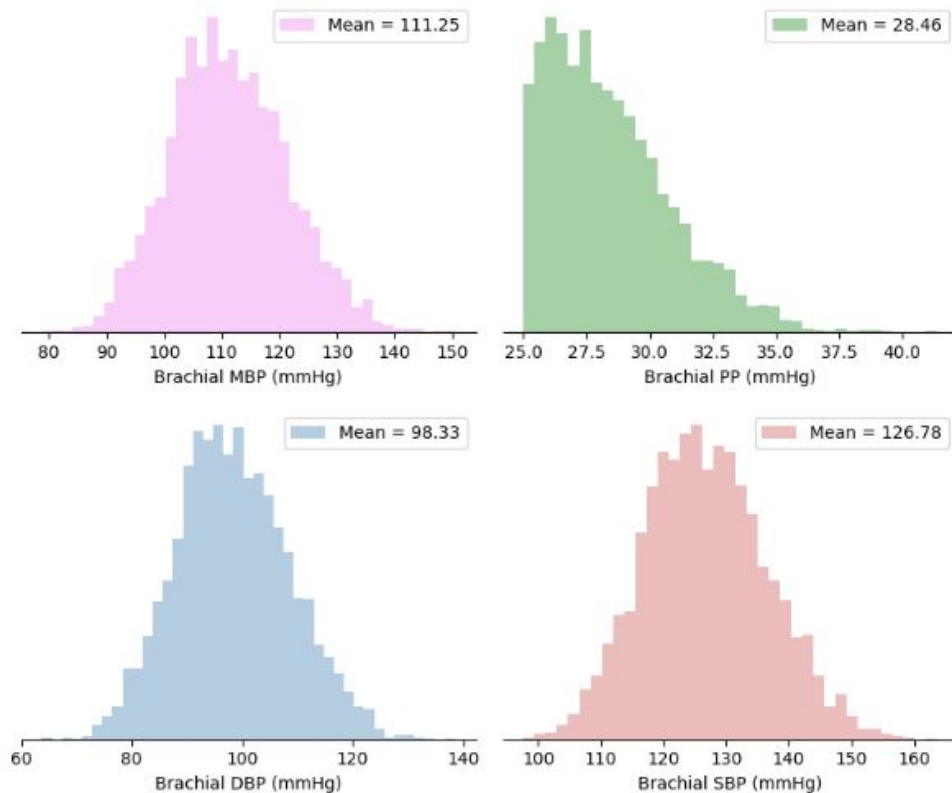
Population simulation

- Explore the entire input space
- Filter results accordingly to physiology
- Test clinical hypothesis on the population



Population results

- Common clinical cardiovascular biomarkers
- Distribution across the entire population



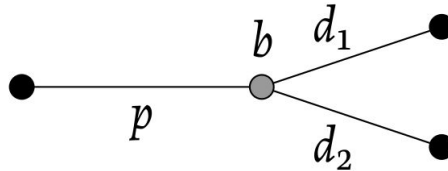
Serial vs parallel

- Single simulation runtime ~ 20'
 - MC run required 15k simulations
 - Expected total runtime if executed sequentially ~ 200 days
-
- Embarrassingly parallel strategy
 - Cloud: **scale UP** (better hardware) and **scale OUT** (more cores)
 - By running over a multi-cores VM, the total computational time decreases linearly with the number of cores available ~ 1 day

openBF installation

- Install git and wget
- Install Python, matplotlib, ... (post-processing tools)
- Clone openBF from GitHub
- Run installation script

Demo on SURFsara cloud



Thank You!

Q & A time

?



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