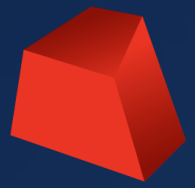


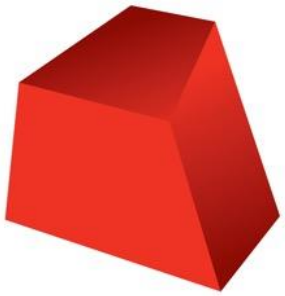
GUROBI
OPTIMIZATION

Gurobi in Cloud and Container Applications

Jennifer Locke
Technical Account Manager

GUROBI DAYS
PARIS

Gurobi incorporates seamlessly
into your application.



Gurobi Optimizer

Lightweight APIs

Your Application

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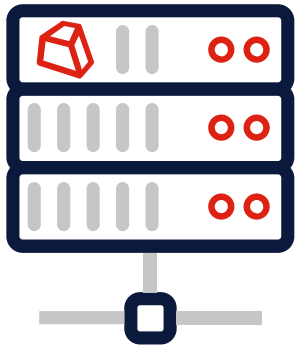
Solve your model

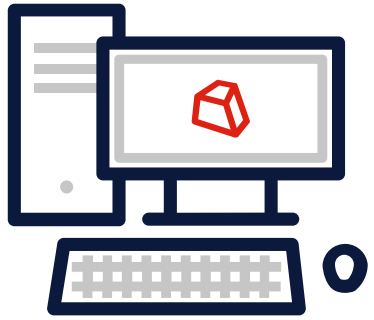
In the way that's most convenient,
based on your existing IT environment

Cloud

Server



Local



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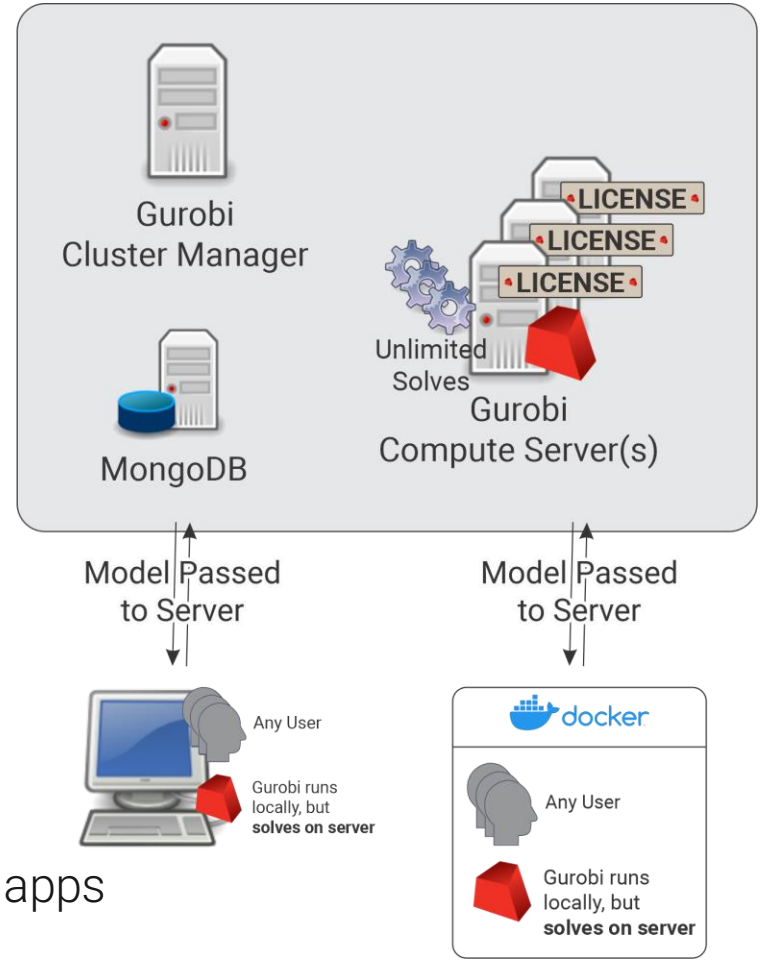
Gurobi Compute Server

Optimization as a service

- Software hosted by you:
  - on-prem or cloud
- 3 Components
  - Compute Server
    - Node license required
  - Cluster Manager
  - MongoDB
- Typical use cases
  - Team of developers
  - Deployed applications
  - One server solves for multiple apps



- Central, powerful solver
- Queuing of solves
- Batch mode
- Seamless integration

Legend:

= User

= solver runs here (Gurobi Use)

= Gurobi software installed here

LICENSE = Gurobi license installed here

Compute Server – Key Factors

- Gurobi Compute Server is a high-performance optimization service implementation based on state-of-the-art web standards.
  - **No interface change**: The client application uses the **exact same API** to interact with the Gurobi solver compared to solving on a local machine. No need to rewrite an existing application.
  - **Flexible deployment**: Client/server separation is optional. The decision on where a model should be solved (locally or remote) can be changed at any time.
  - **Scalability**: Gurobi Compute Server can be deployed on a single server machine or within a cluster of multiple powerful machines that can be accessed remotely. Features for job management and high-availability (e.g., load balancing, queuing and failover) are already implemented.
  - **Performance**: Compute Server is a completely integrated into the Gurobi Optimizer. No need for any intermediate software layer that consumes additional memory or CPU resources.

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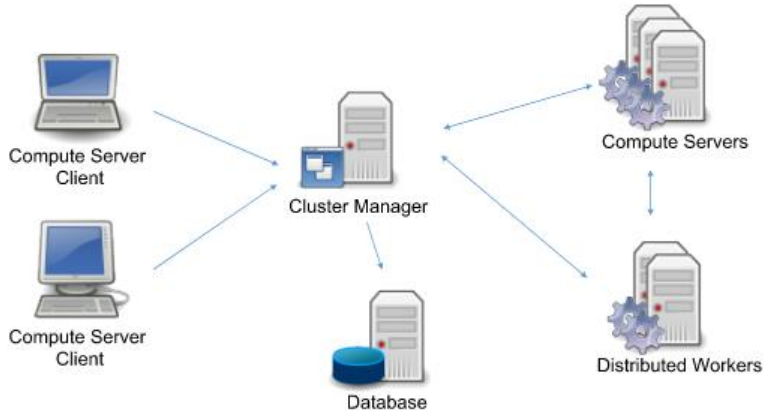
Cluster Manager

- **Cluster Manager** is an optional component to manage a set of **Compute Server nodes**.
  - Enables a graphical monitoring interface (web application for management)
  - Enables additional security (authentication methods)
  - Enables record of optimization jobs
  - Enables batch processing (offline mode)
  - Can be controlled through a REST API
- Although Cluster Manager is optional, it enables several **enterprise-grade features** for Compute Server deployments.



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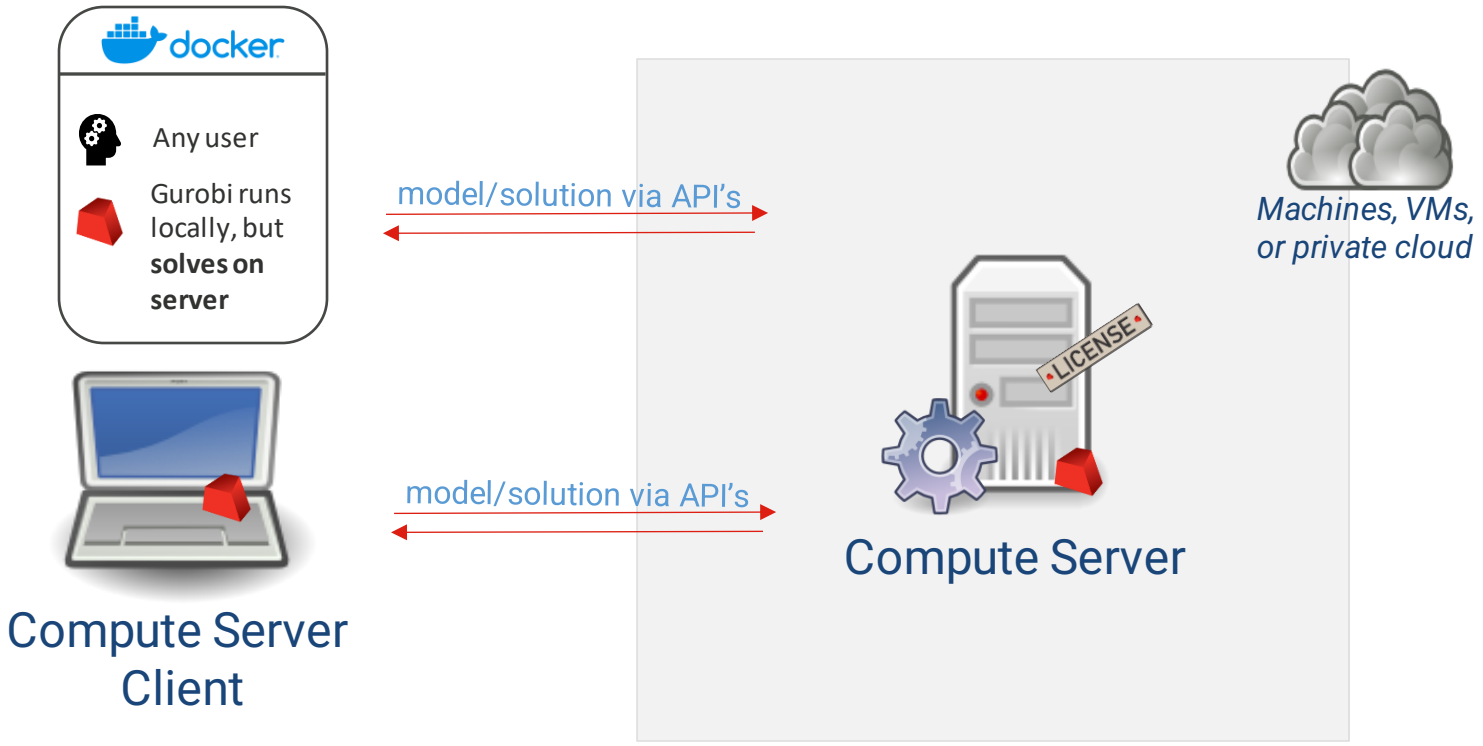
Compute Server – Minimal Setup



Legend:

- = Any User
- = solver runs here (Gurobi Use)
- = Gurobi software installed here
- = Gurobi license installed here
- = synchronous communication
- = asynchronous communication

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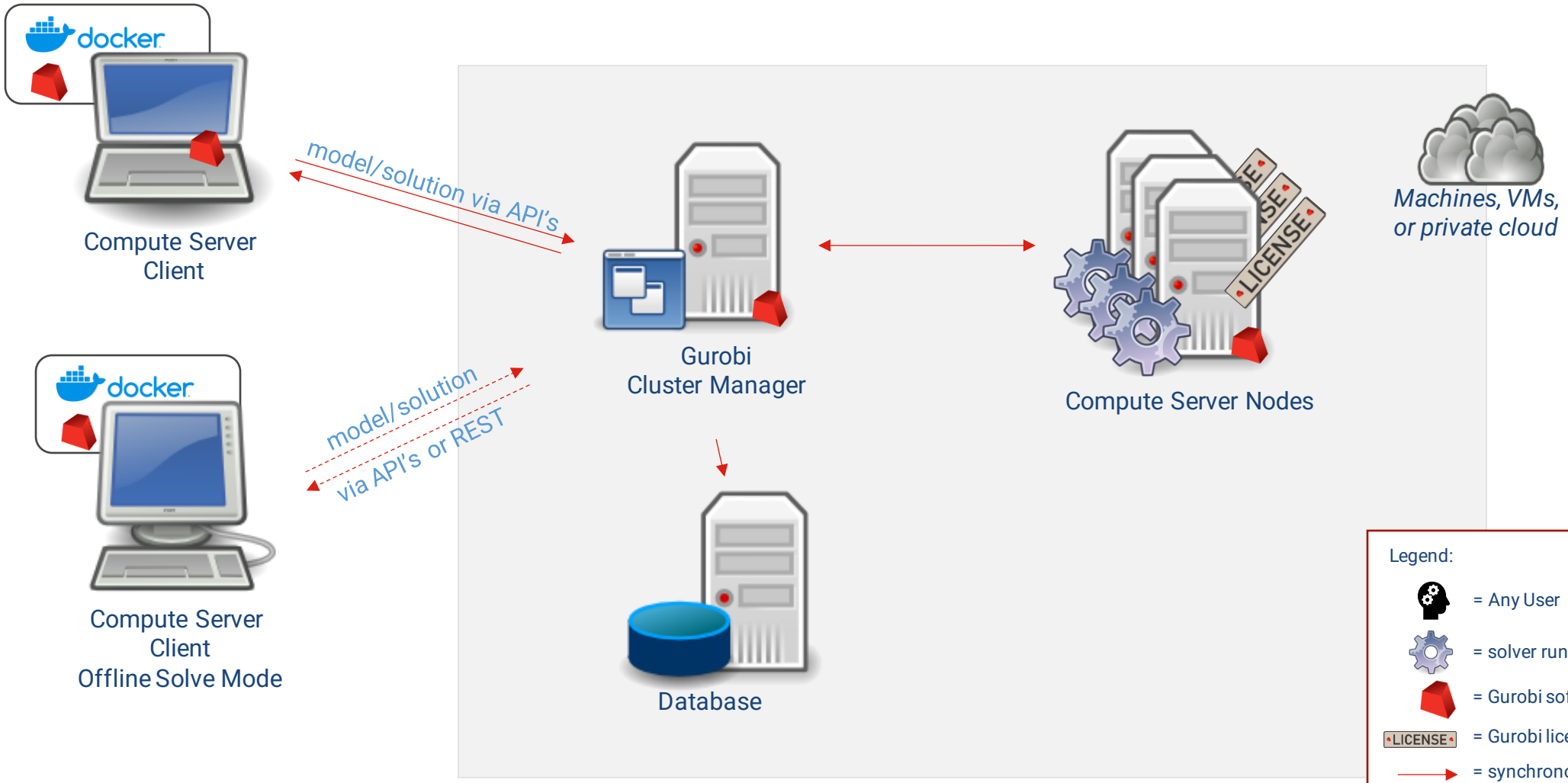
Compute Server with Cluster Manager



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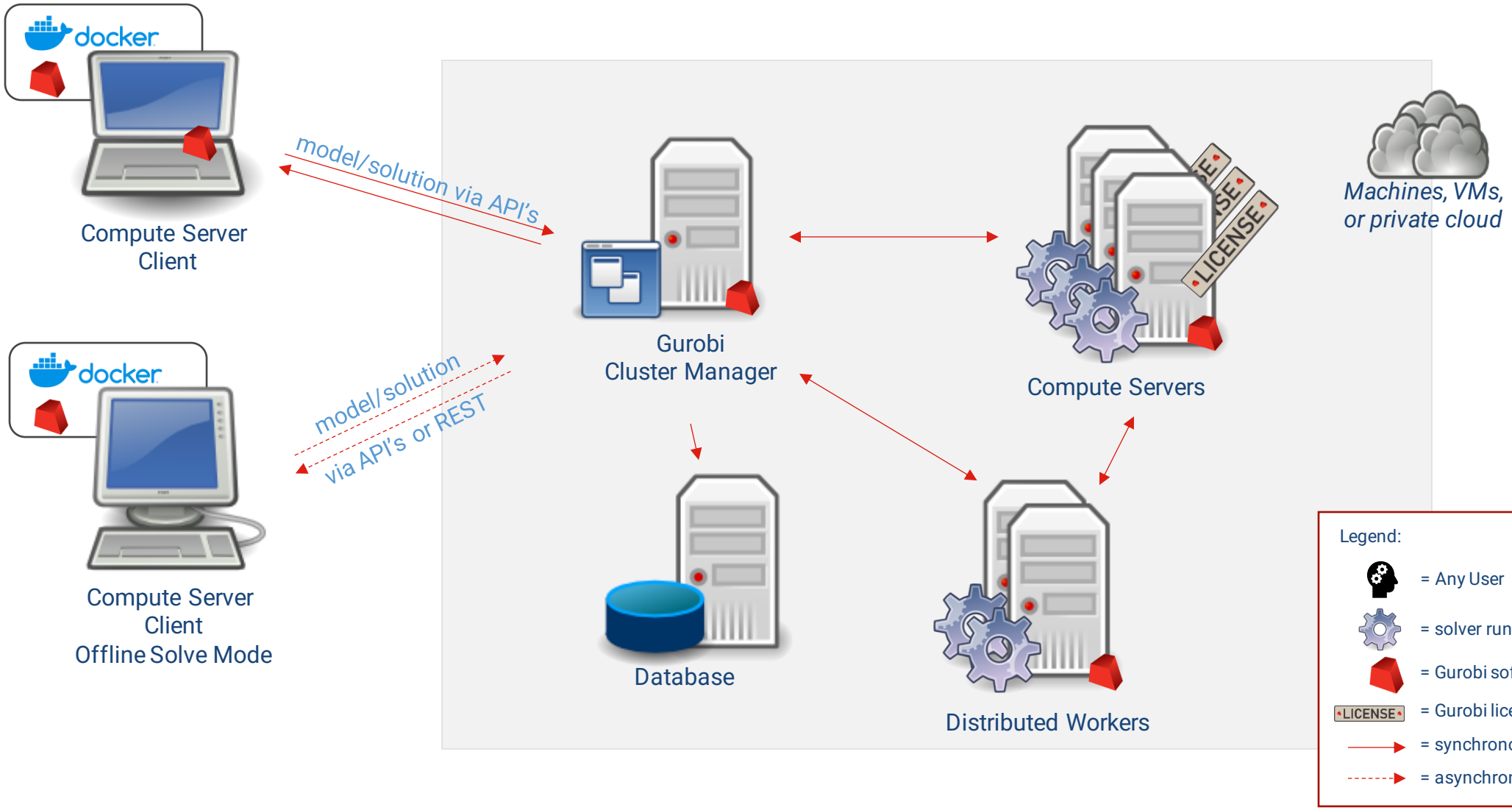
Gurobi Compute Server – With Worker Nodes



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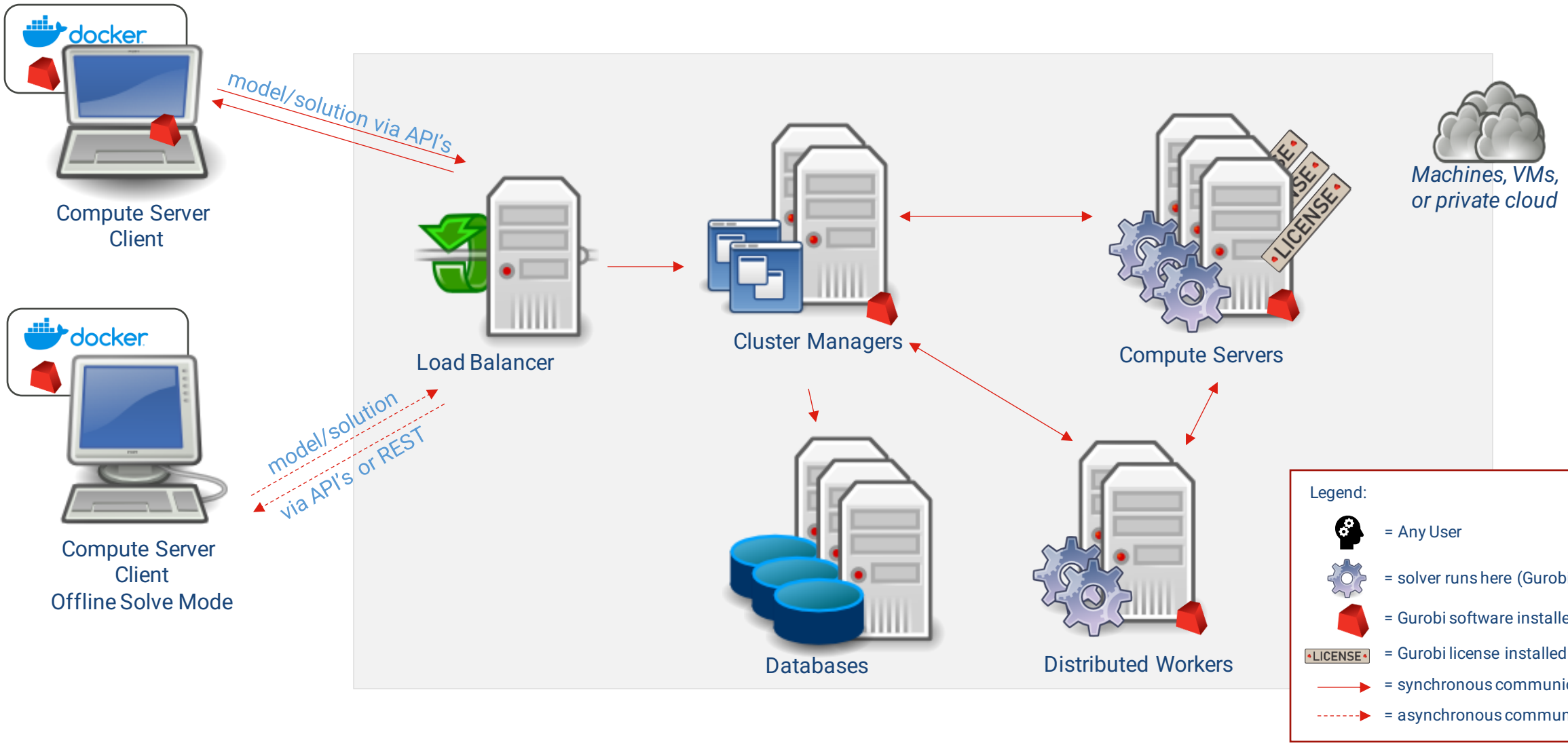
Compute Server – Scalable Cluster Manager



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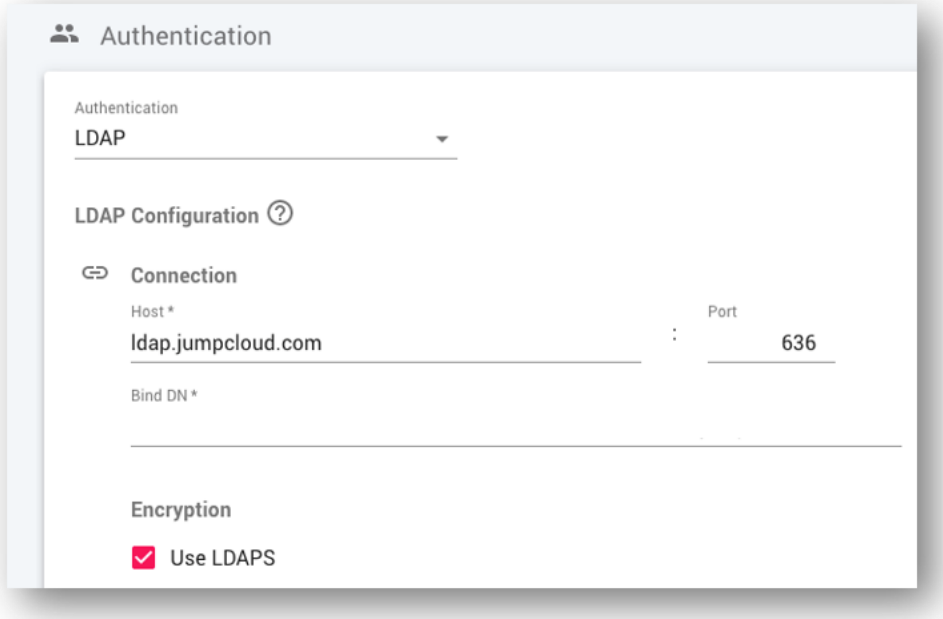
Enterprise LDAP Integration

LDAP support allows **enterprise-grade Compute Server deployments** using an **industry-standard directory service** for user authentication and authorization.

- Define who can access the Cluster Manager centrally in the LDAP server
- Account will be created automatically during user login
- Accounts are synchronized, users will be disabled if not a member any longer.



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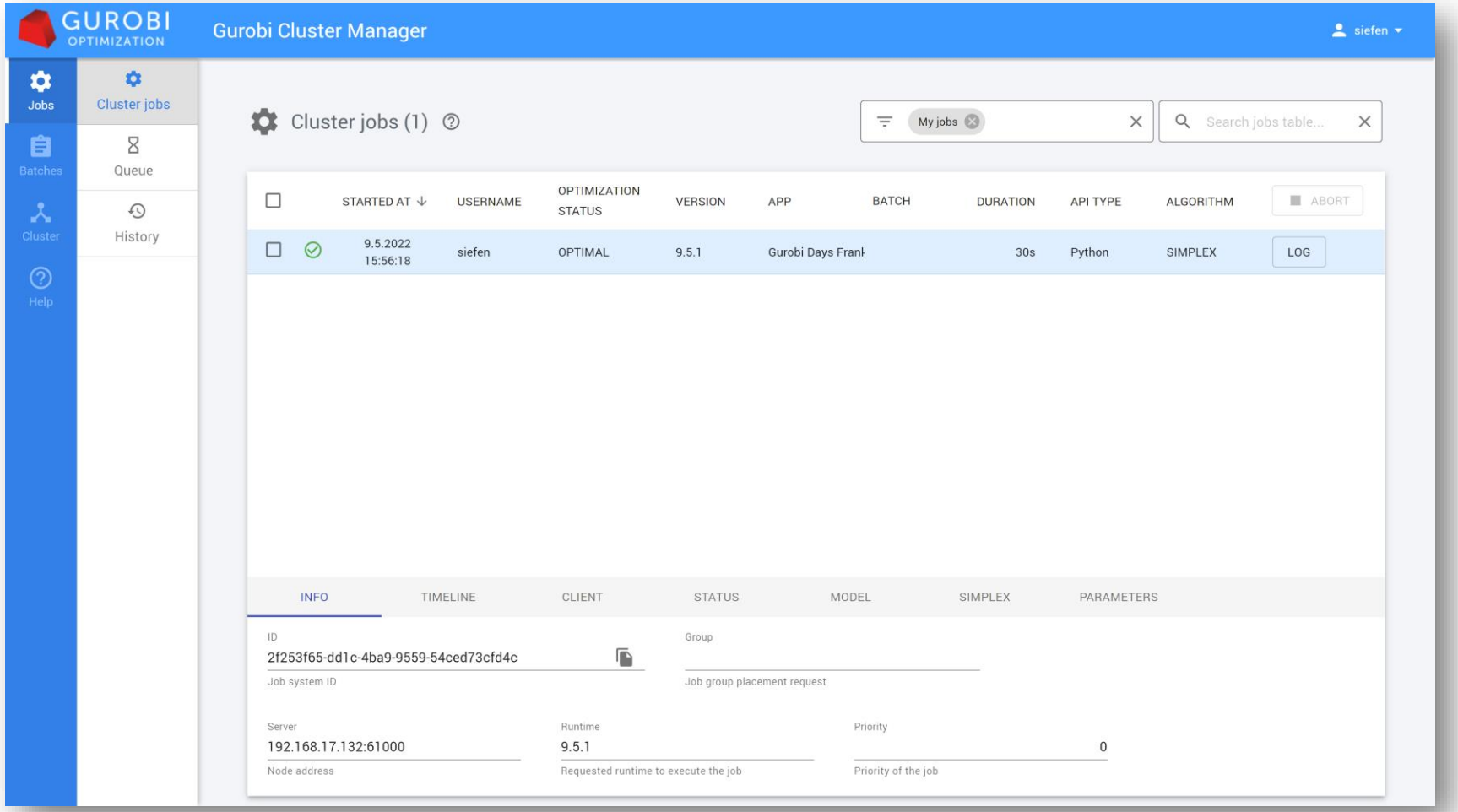
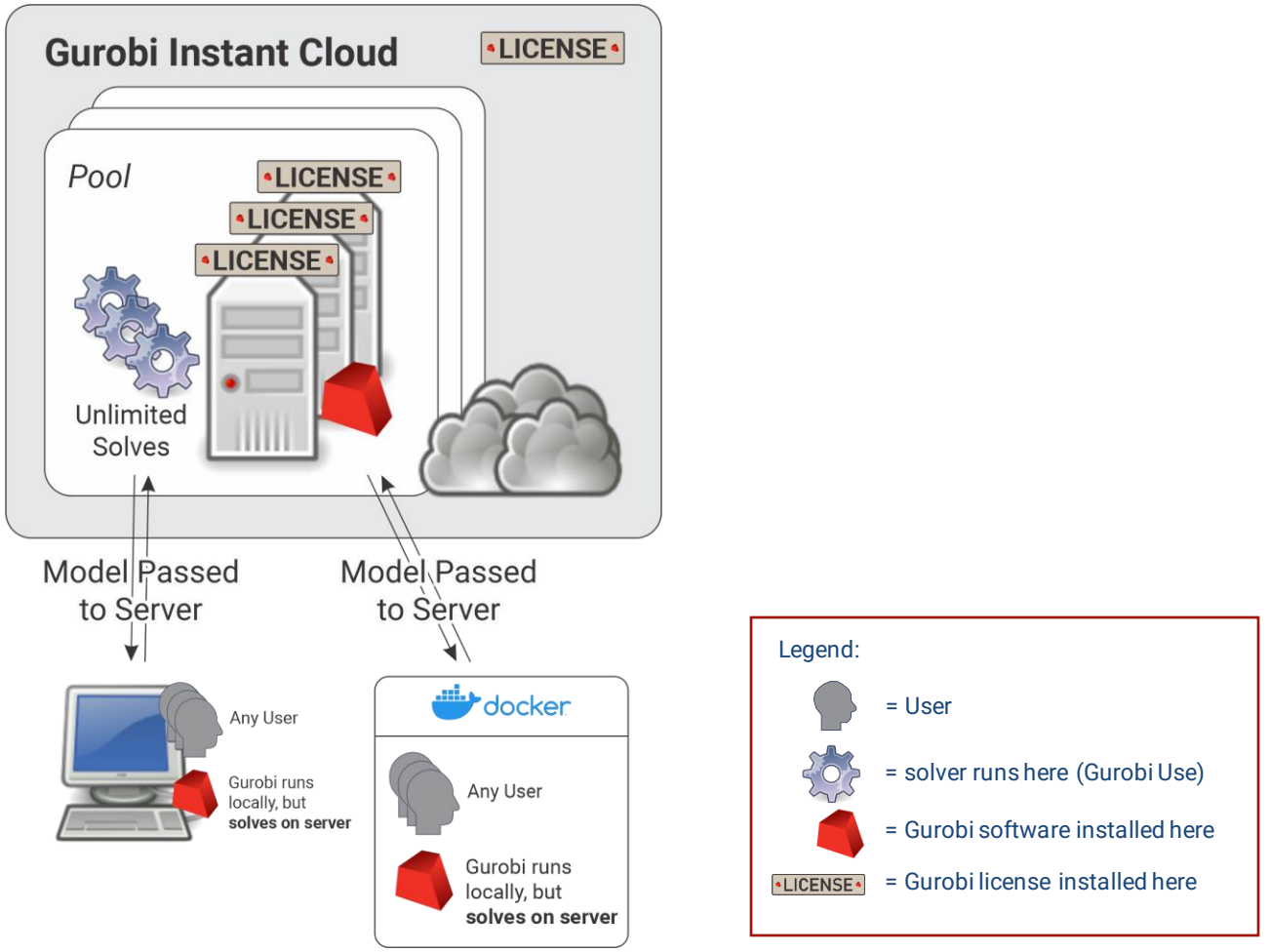
Demo


GUROBI OPTIMIZATION
Gurobi Cluster Manager
siefen
Jobs
Batches
Cluster
Help
Cluster jobs
Queue
History
Cluster jobs (1)
My jobs
Search jobs table...
STARTED AT
USERNAME
OPTIMIZATION STATUS
VERSION
APP
BATCH
DURATION
API TYPE
ALGORITHM
ABORT
9.5.2022 15:56:18
siefen
OPTIMAL
9.5.1
Gurobi Days Franl
30s
Python
SIMPLEX
LOG
INFO
TIMELINE
CLIENT
STATUS
MODEL
SIMPLEX
PARAMETERS
ID
2f253f65-dd1c-4ba9-9559-54ced73cfd4c
Job system ID
Group
Job group placement request
Server
192.168.17.132:61000
Node address
Runtime
9.5.1
Requested runtime to execute the job
Priority
0
Priority of the job

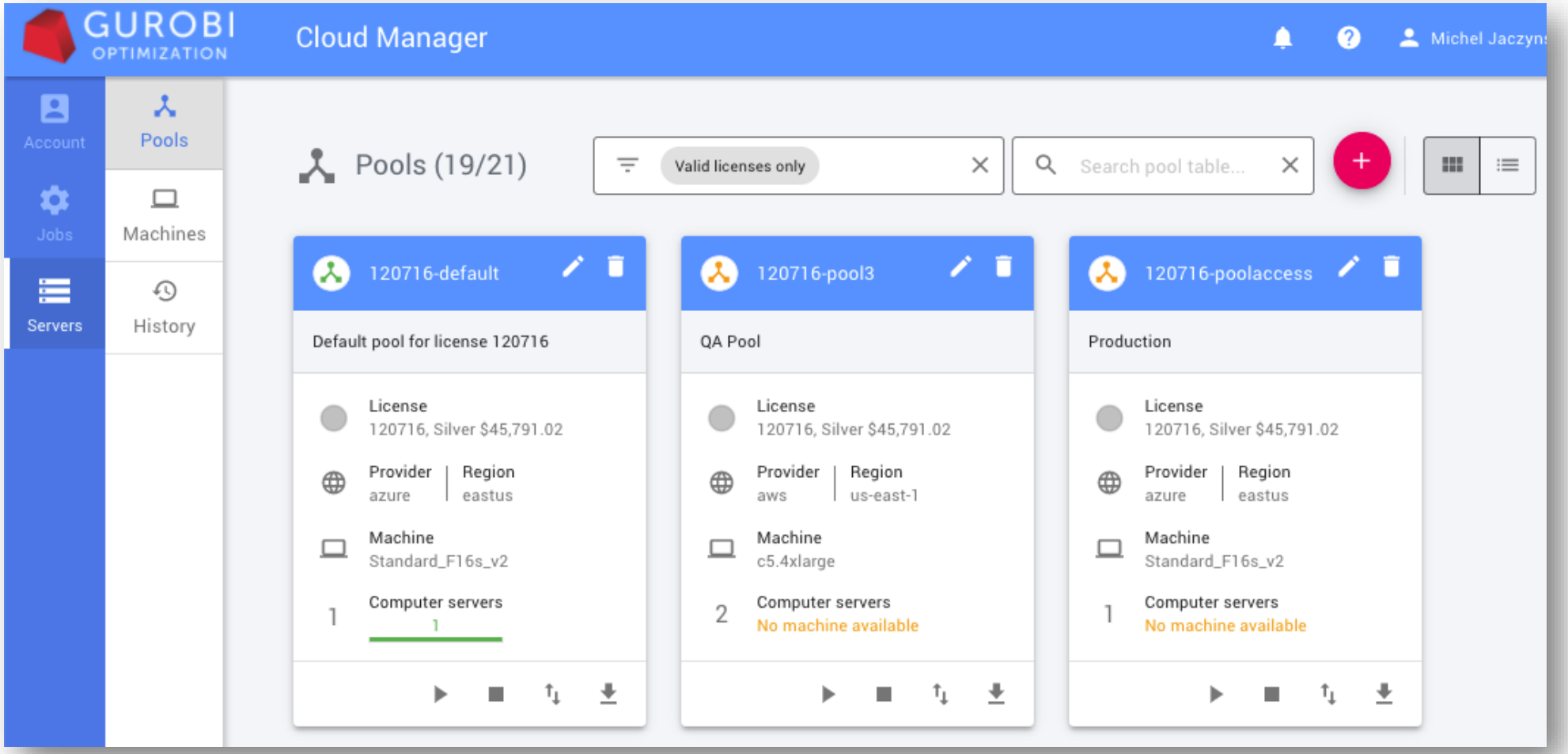
Gurobi Instant Cloud

Optimization as a service

- Hosted in Gurobi's Cloud
  - Amazon or Azure
- Pools
  - One or more Compute Servers
  - You choose CPU and memory
  - You choose host region
- Typical use cases
  - Low usage
  - Unpredictable spikes in usage
  - Don't want to manage servers

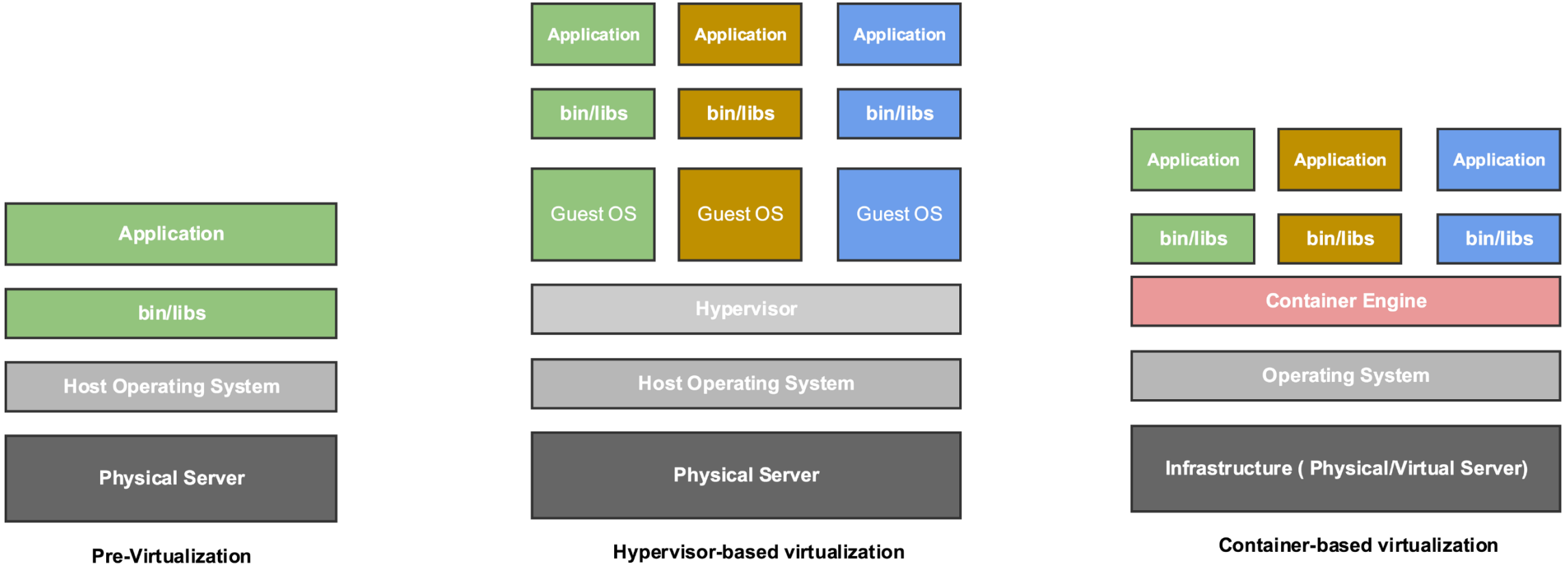


Demo


GUROBI OPTIMIZATION
Cloud Manager
Michel Jaczyn
Account
Jobs
Servers
Pools
Machines
History
Pools (19/21)
Valid licenses only
Search pool table...
120716-default
Default pool for license 120716
License
120716, Silver $45,791.02
Provider
azure
Region
eastus
Machine
Standard_F16s_v2
1
Computer servers
1
120716-pool3
QA Pool
License
120716, Silver $45,791.02
Provider
aws
Region
us-east-1
Machine
c5.4xlarge
2
Computer servers
No machine available
120716-poolaccess
Production
License
120716, Silver $45,791.02
Provider
azure
Region
eastus
Machine
Standard_F16s_v2
1
Computer servers
No machine available

Containers

Containerization



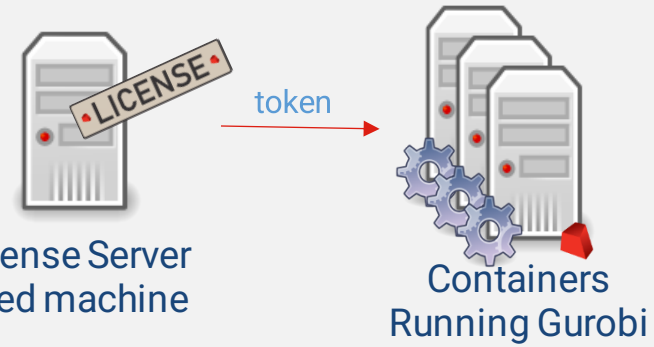
Source: https://medium.com/@anilktalla/why-container-virtualization-abb8bfc04048

Evolution of Virtualization

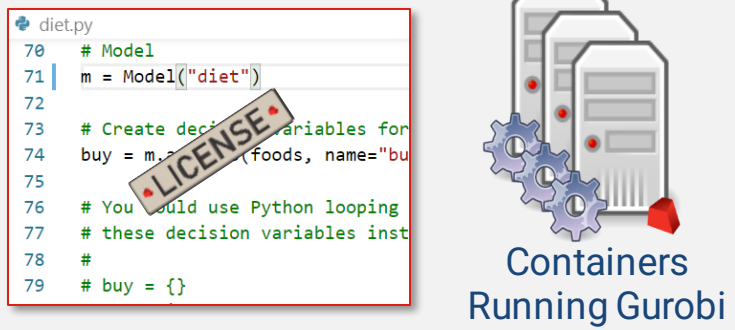
Container Scenarios

GUROBI OPTIMIZATION

Floating Use



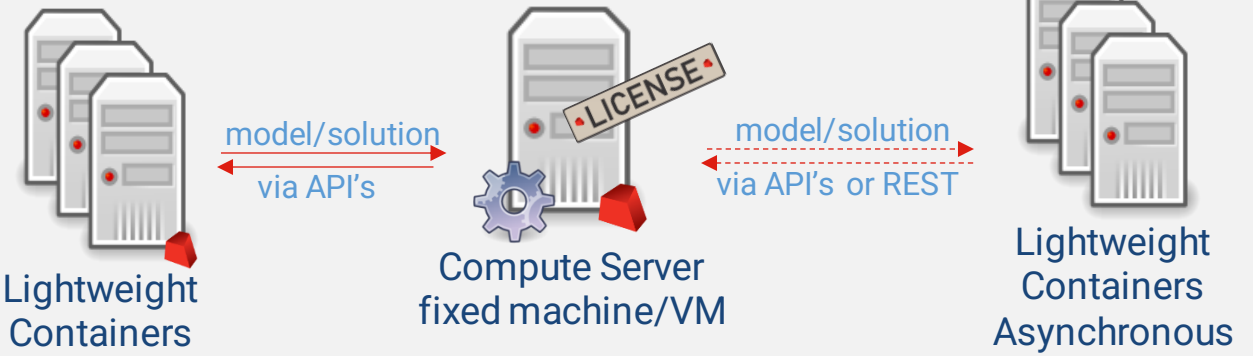
Web License Service



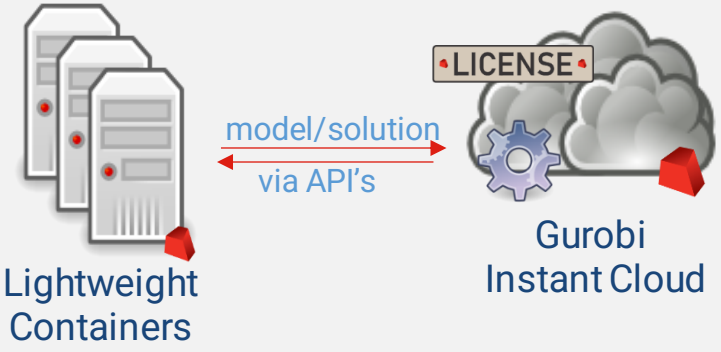
Legend:

- = Any User
- = solver runs here (Gurobi Use)
- = Gurobi software installed here
- LICENSE = Gurobi license installed here
- = synchronous communication
- = asynchronous communication

Compute Server



Instant Cloud



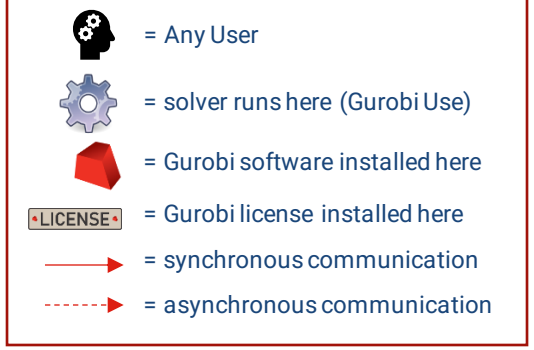
Web License Service

Container on Desktop

Web License Server
- hosted by Gurobi
- high availability
- worldwide failover

Container on Production Server batch runs, etc.

Token
- One for each container
- Json web token (JWT)



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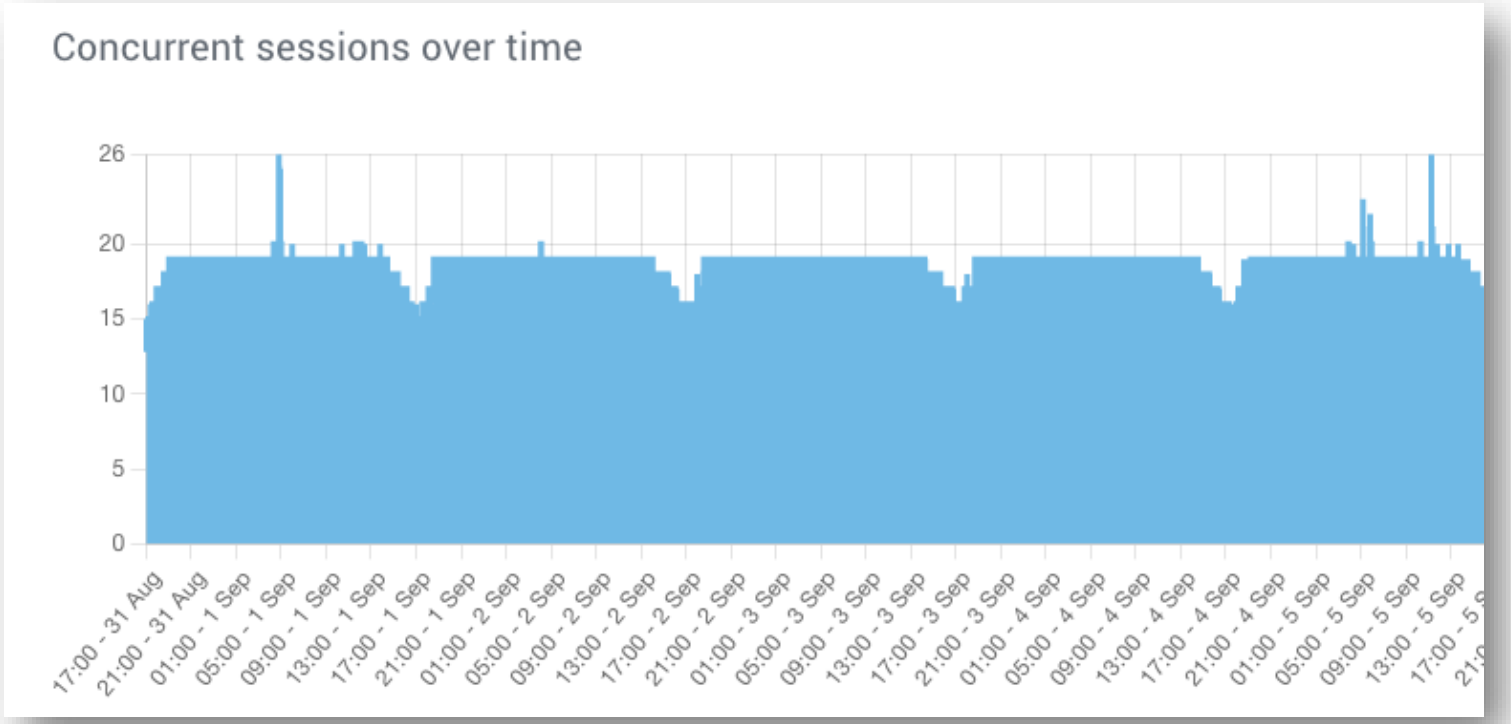
Usage Monitoring

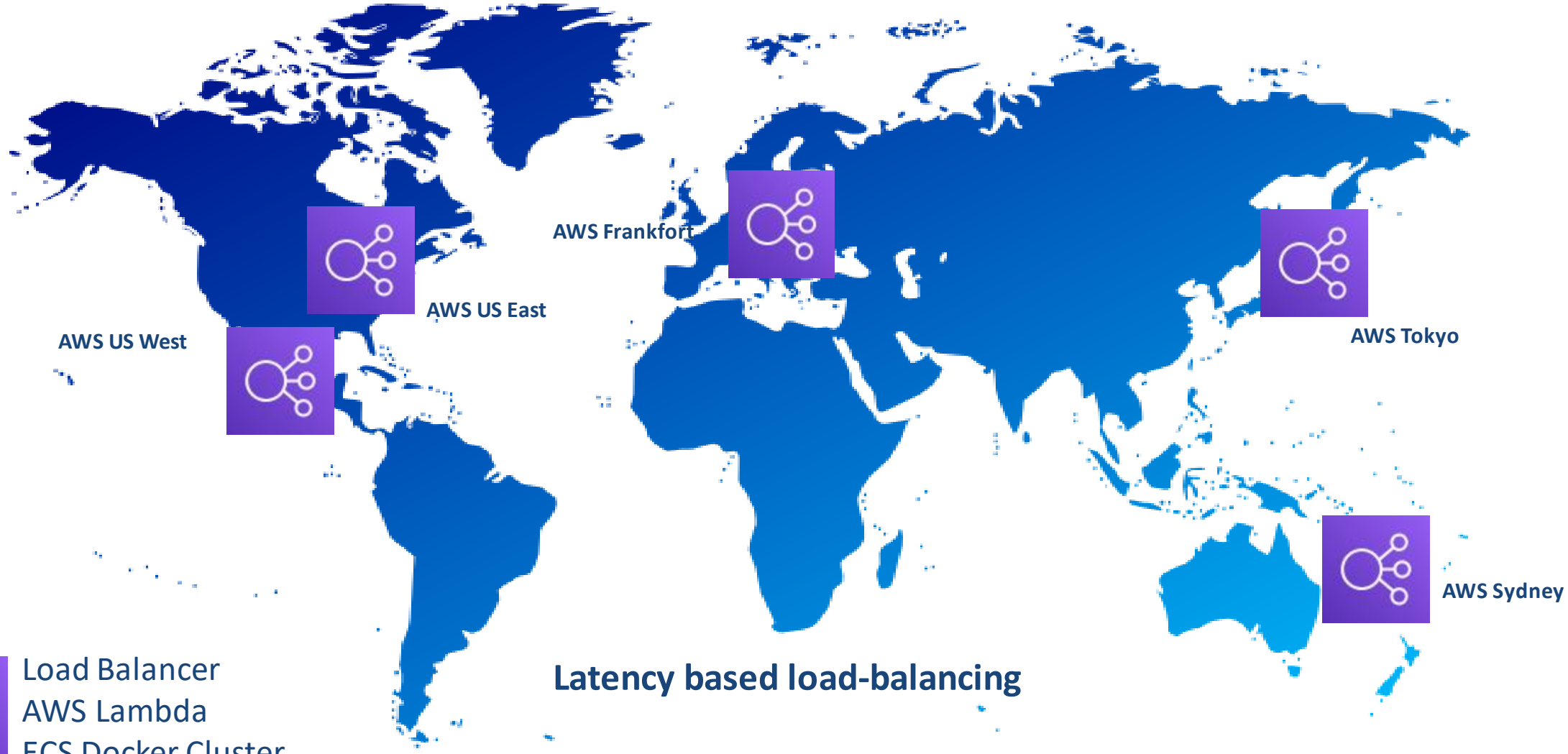
https://license.gurobi.com



WLS - Key Capabilities & Opportunities

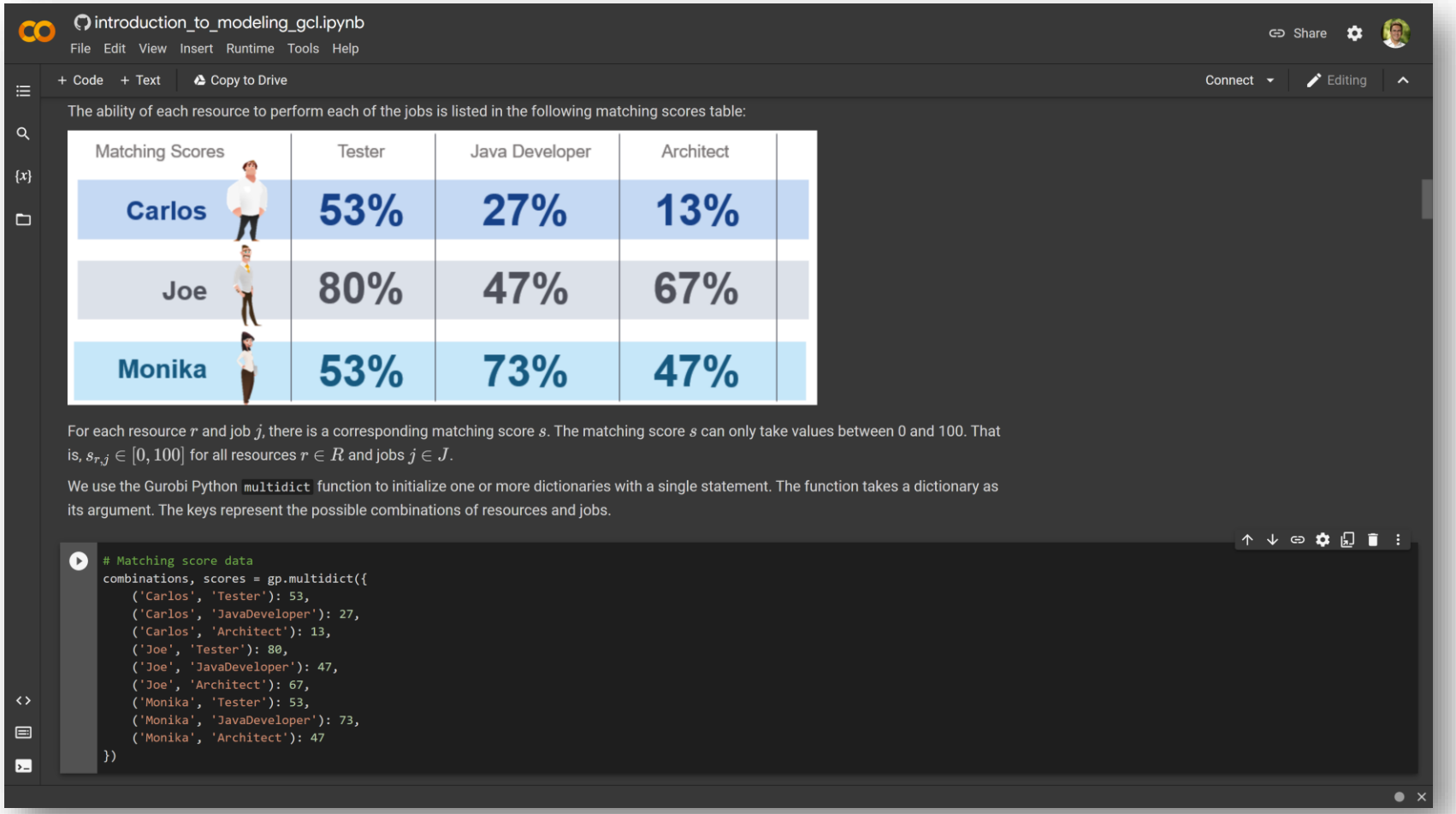
- Usage reporting
  - WLS logs allows to track product use and monitor usage intensity
  - Visible both for Gurobi and the customer
- Built-in scalability and flexibility
  - Dynamic container limits for scenarios where scalability is important
- New deployment and licensing options
  - Containerized Compute Server without Token Server
  - Unlimited-Use licensing within containers
  - Flexible limits (ex: “m*N+a concurrent containers” or overtime)
- Simplified IT integration & control
  - Only deploy client license key once, the rest is handled on the server side

WLS Infrastructure

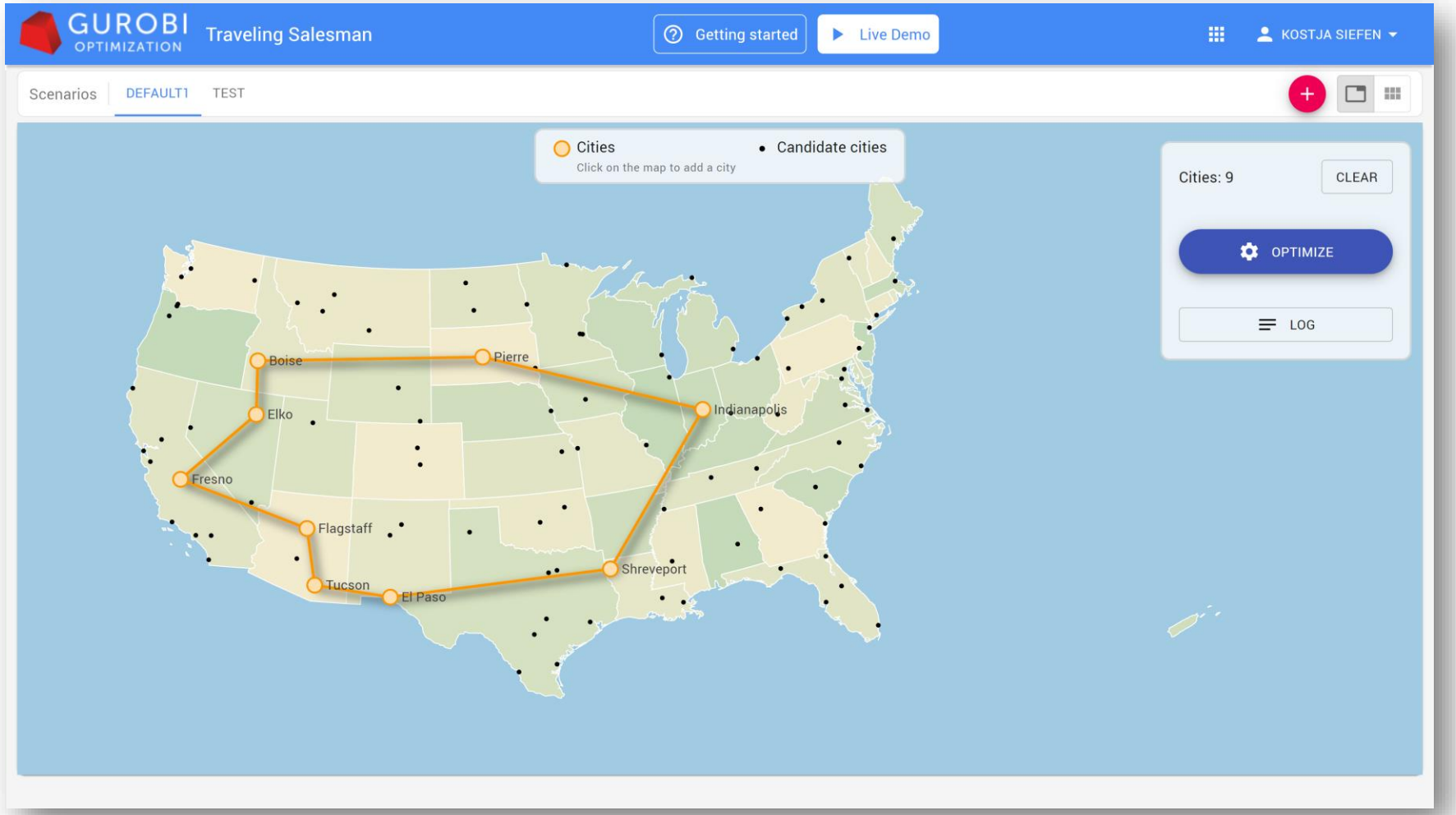


How To Try

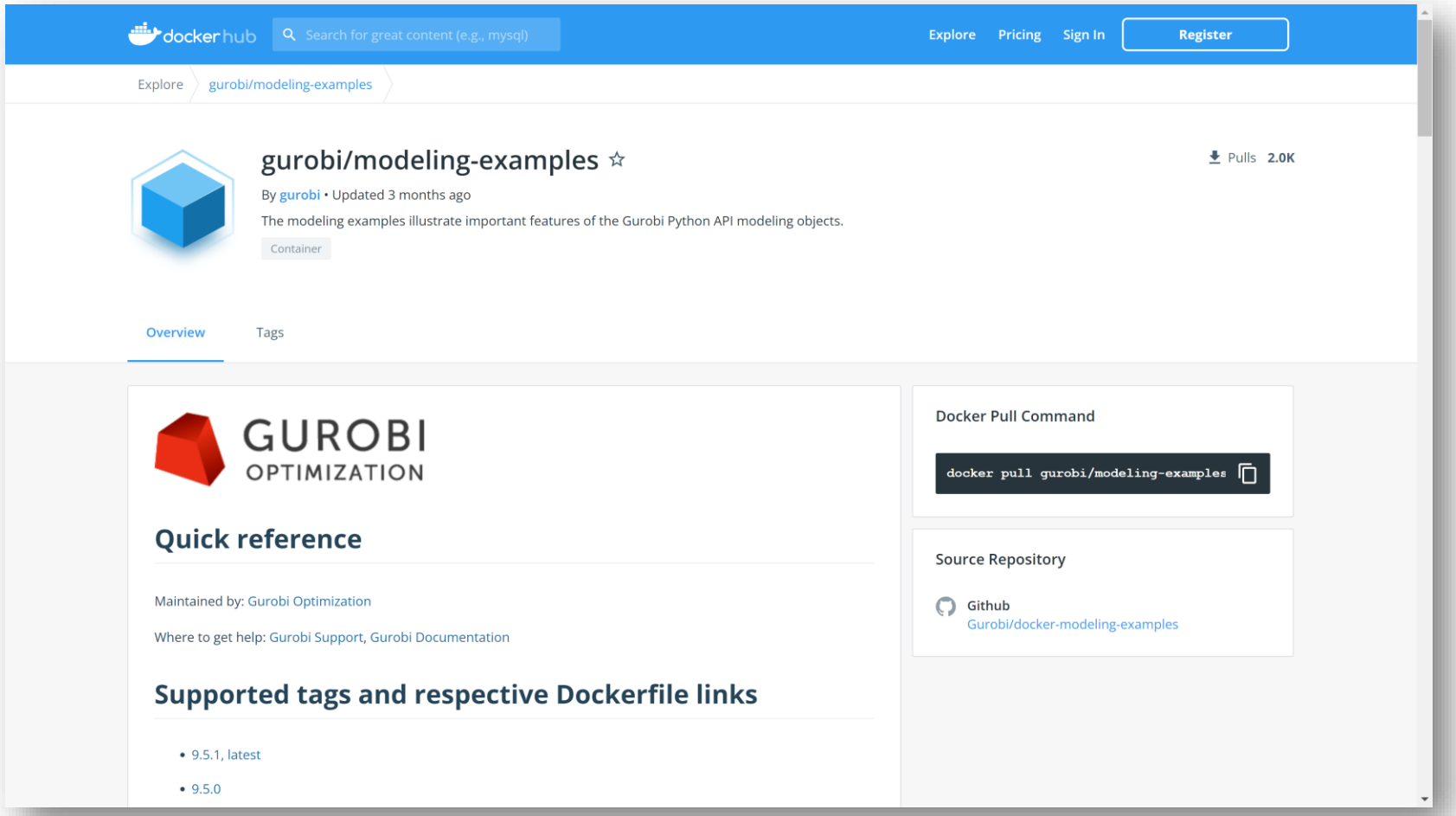
Google Colab

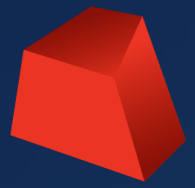


demos.gurobi.com



DockerHub


dockerhub
Search for great content (e.g., mysql)
Explore
Pricing
Sign In
Register
Explore
gurobi/modeling-examples
gurobi/modeling-examples ☆
Pulls 2.0K
By gurobi • Updated 3 months ago
The modeling examples illustrate important features of the Gurobi Python API modeling objects.
Container
Overview
Tags
GUROBI
OPTIMIZATION
Quick reference
Maintained by: Gurobi Optimization
Where to get help: Gurobi Support, Gurobi Documentation
Supported tags and respective Dockerfile links
9.5.1, latest
9.5.0
Docker Pull Command
docker pull gurobi/modeling-examples
Source Repository
Github
Gurobi/docker-modeling-examples



GUROBI
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Thank You

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