



Demo of the VLab Services from RWTH Aachen

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RWTH Vlab

- Web-based Simulation Platform

- "Simulation-as-a-Service"
- Bring your own model & data
- Take-away your results

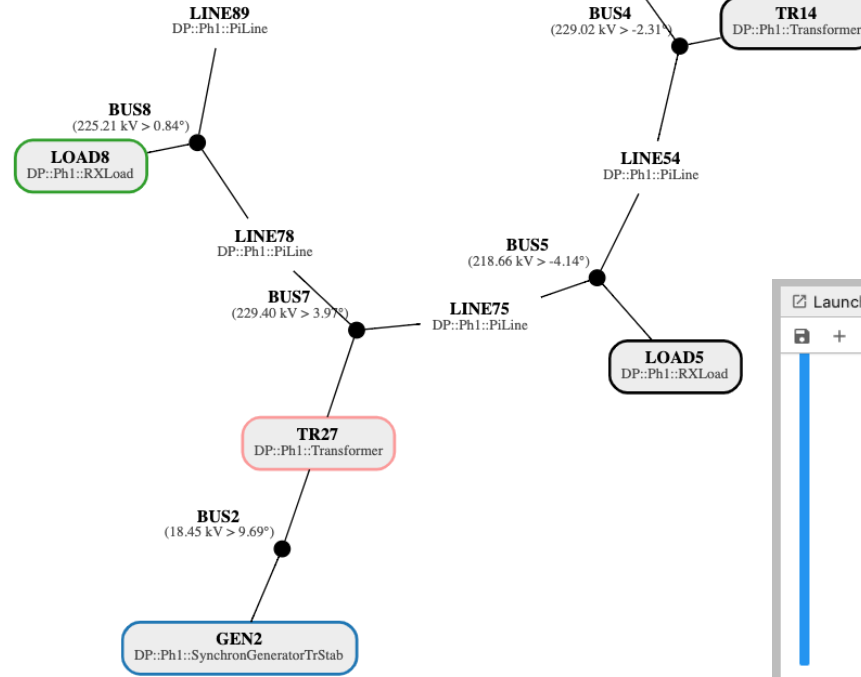
- Components

- **JupyterLab + Hub**: Interactive web-based computing environment
- **DPsim**: C++/Python Simulation Kernel for PF, EMT & DP

- Running on-premises at RWTH in our own Kubernetes cloud

- 100% Open-Source "from the ground up"

- MPL, GPL licensed



Plot node phases

```
[21]: for i in range(1,9):
      pt.plot_timeseries(20, phasors['BUS%d.v' % i]['phase'])
```

Plot node voltages

```
[22]: for i in range(4,9):
      pt.plot_timeseries(10, phasors['BUS%d.v' % i]['abs'])
      for i in range(1,4):
          pt.plot_timeseries(11, phasors['BUS%d.v' % i]['abs'])
      plt.xlim(0.0, 0.06)
```

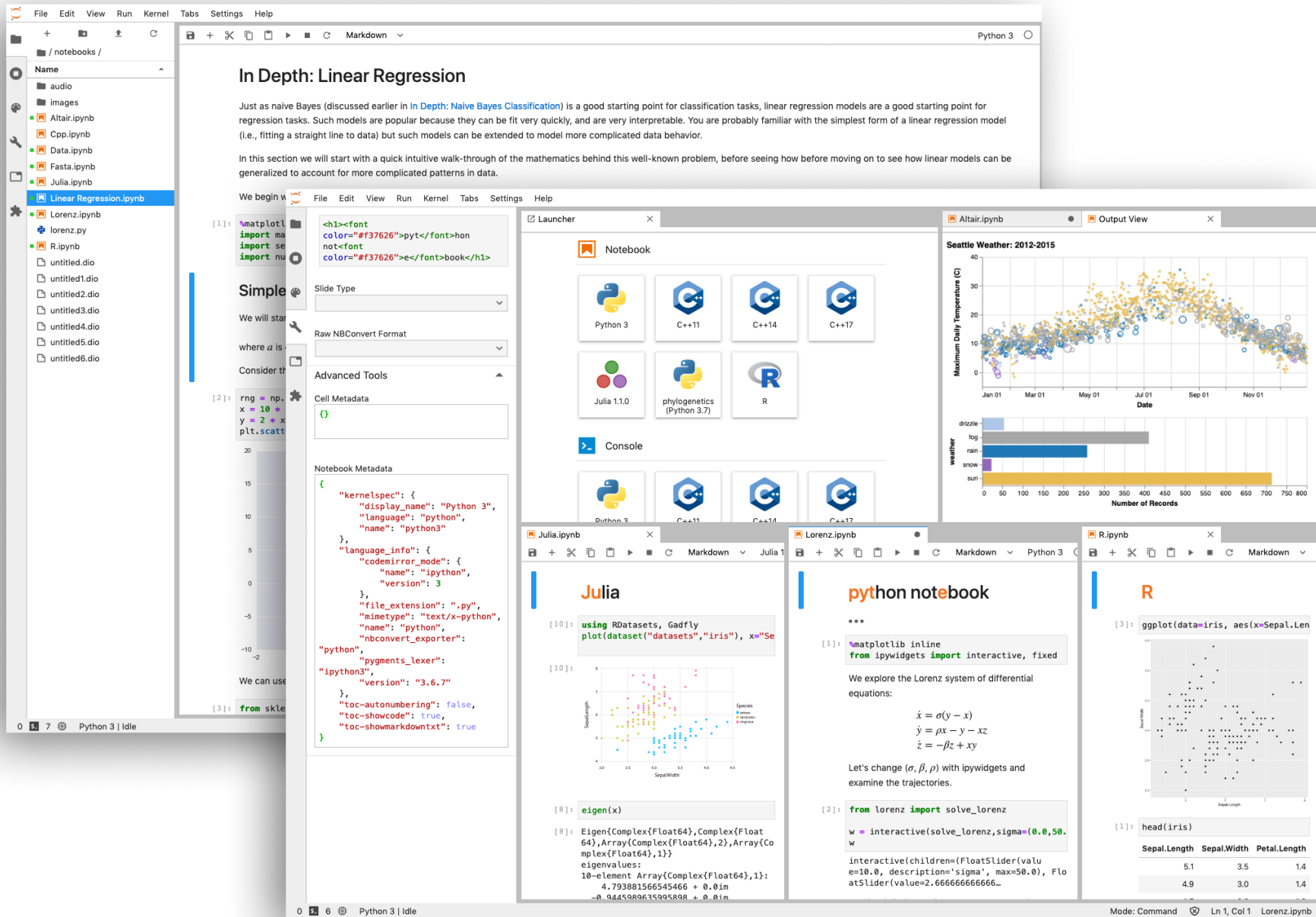
[22]: (0.0, 0.06)



Project Jupyter

- JupyterLab
 - Web-based interactive development environment for Jupyter notebooks, code, and data
 - Highly Extensible: User Interface, Programming Languages, ...
- JupyterHub
 - Multi-user management of JupyterLab instances
 - Persistent home directories
 - Scalable cloud deployments in Kubernetes
 - Integration into ERIGrid 2.0 Single-Sign-On





The screenshot displays a JupyterLab environment. The main notebook, 'In Depth: Linear Regression', contains the following text:

In Depth: Linear Regression

Just as naive Bayes (discussed earlier in [In Depth: Naive Bayes Classification](#)) is a good starting point for classification tasks, linear regression models are a good starting point for regression tasks. Such models are popular because they can be fit very quickly, and are very interpretable. You are probably familiar with the simplest form of a linear regression model (i.e., fitting a straight line to data) but such models can be extended to model more complicated data behavior.

In this section we will start with a quick intuitive walk-through of the mathematics behind this well-known problem, before seeing how before moving on to see how linear models can be generalized to account for more complicated patterns in data.

We begin with

The interface also shows a 'Launcher' window with icons for Python 3, C++11, C++14, C++17, Julia 1.1.0, phylogenetics (Python 3.7), and R. Below the launcher are three smaller notebook thumbnails:

- Julia**: Shows code using R datasets and a scatter plot of Sepal.Width vs Sepal.Length.
- python notebook**: Shows code for solving the Lorenz system of differential equations:

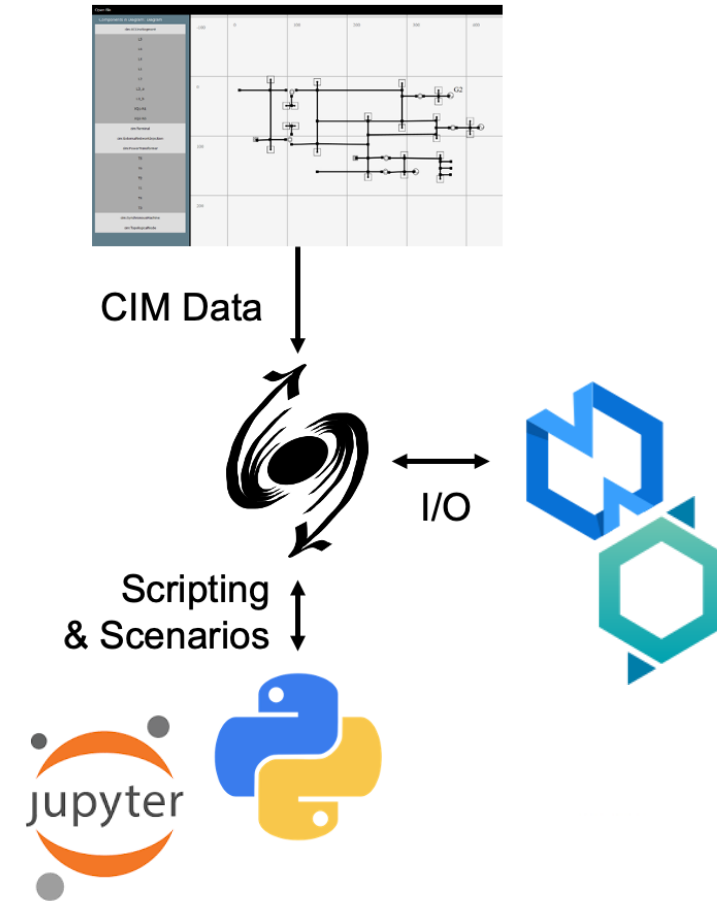
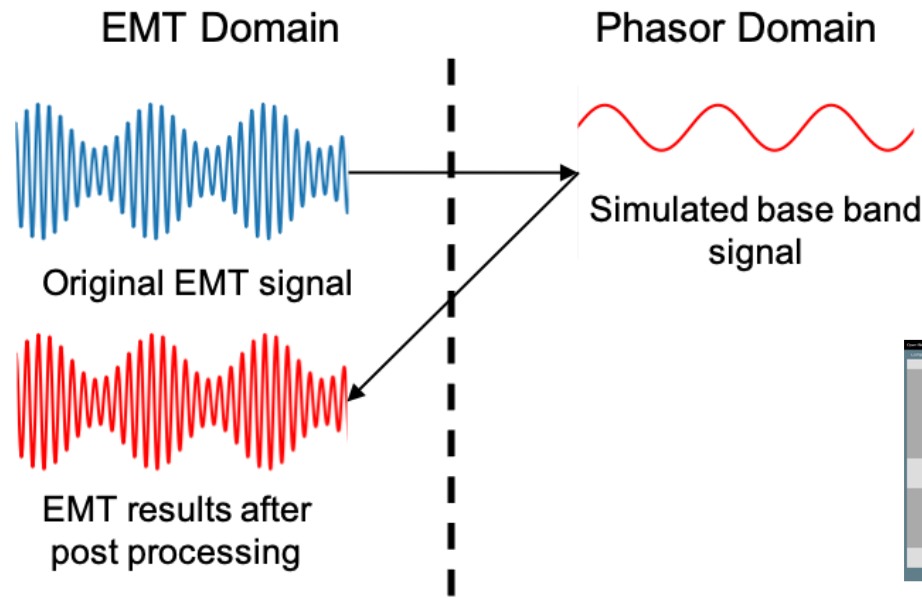
$$\begin{aligned} \dot{x} &= \sigma(y - x) \\ \dot{y} &= \rho x - y - xz \\ \dot{z} &= -\beta z + xy \end{aligned}$$
 and includes a code cell for `from lorenz import solve_lorenz`.
- R**: Shows code for plotting the iris dataset: `ggplot(data=iris, aes(x=Sepal.Length, y=Petal.Length))`.

The background shows a file explorer with various notebooks like 'Lorenz.ipynb', 'Altair.ipynb', and 'Data.ipynb'.



DPsim

- Modified Nodal Analysis Solver
- Supports multiple domains:
 - Electromagnet Transient (EMT)
 - Static Phasors (SP)
 - Dynamic Phasors (DP)
- Modelling via
 - Python, C++
 - Common Information Models (CIM)
- VILLASnode for external interfaces (MQTT, UDP, ZeroMQ, ...)
- Real-time and *offline* execution
- Licensed under MPL 2.0
- Details: <https://dpsim.fein-aachen.org/docs/concepts/>



Live Demo

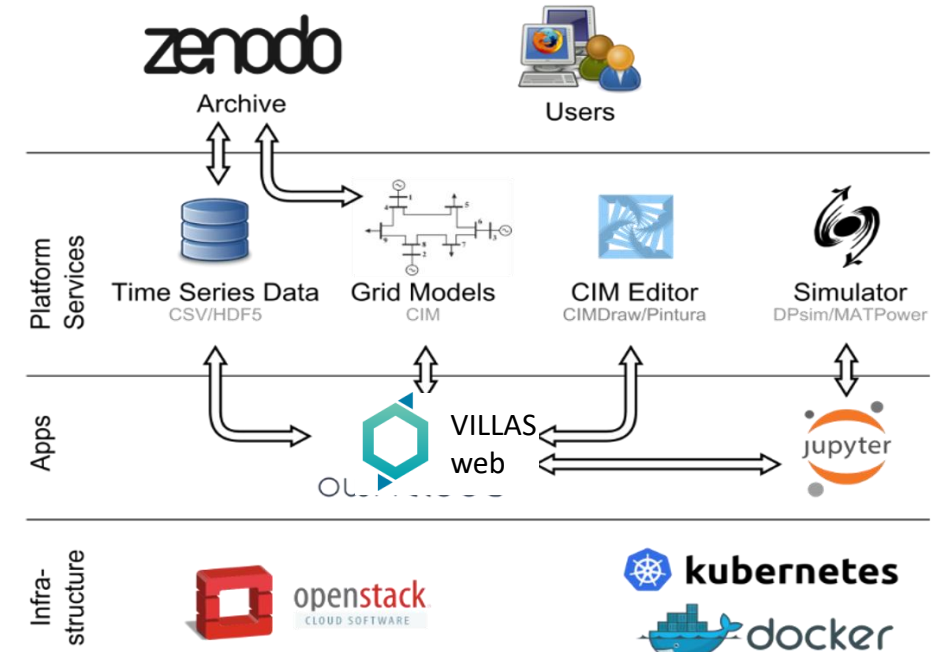
DEMO

<https://vlab.k8s.eonerc.rwth-aachen.de>



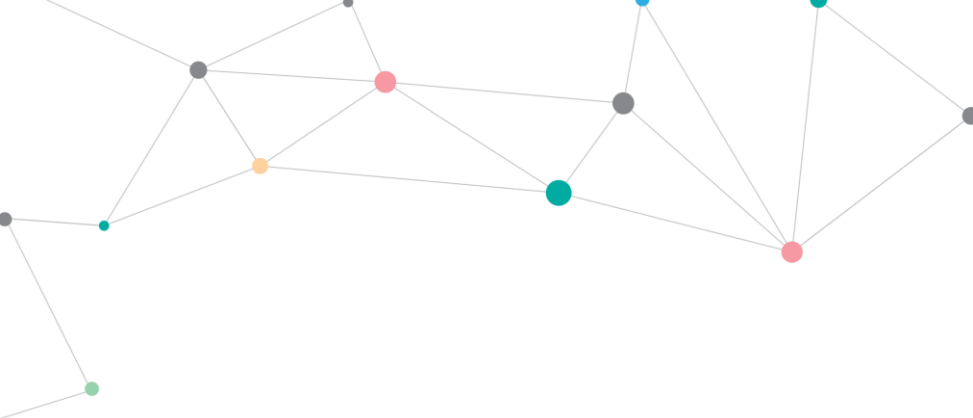
Outlook

- **SLEW**: "Second Life for Energiewende"
 - RWTH-internal project to bring virtual experiences into teaching
- Extends the Jupyter environment with **VILLASweb**
 - Manages Infrastructure Components: Simulators, Lab Equipment, Gateways, Controllers
 - Preparation and execution of experiments
 - Dashboards for supervision and control
 - Real-time plots, sliders, and other widgets more)
 - Results management
 - Import to JupyterLab
- We aim to bring SLEW to a broader audience outside of RWTH
 - ERIGrid 2 – JRA 3 work-package:
Task 3.5 "Offline Simulation-as-a-Service Prototype"



Links

- RWTH Vlab: <https://erigrd2.eu/vlab/>
- DPsim: <https://fein-aachen.org/projects/dpsim/>
- VILLASweb: <https://www.fein-aachen.org/projects/villas-web/>
- Project Jupyter: <https://jupyter.org>
- Second-Life for Energiewende "SLEW"
 - [https://www.acs.eonerc.rwth-aachen.de/\[...\]/SLEW-SECOND-LIFE-FOR-ENERGIEWENDE/?lidx=1](https://www.acs.eonerc.rwth-aachen.de/[...]/SLEW-SECOND-LIFE-FOR-ENERGIEWENDE/?lidx=1)
 - <https://slew.rwth-aachen.de/>
- Source code: <https://git.rwth-aachen.de/acs/public>



www.erigrd2.eu



@ERIGrid 2.0 Project

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