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Commissione Calcolo e Reti

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# MATLAB as a Service on INFN Cloud

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# Introduction

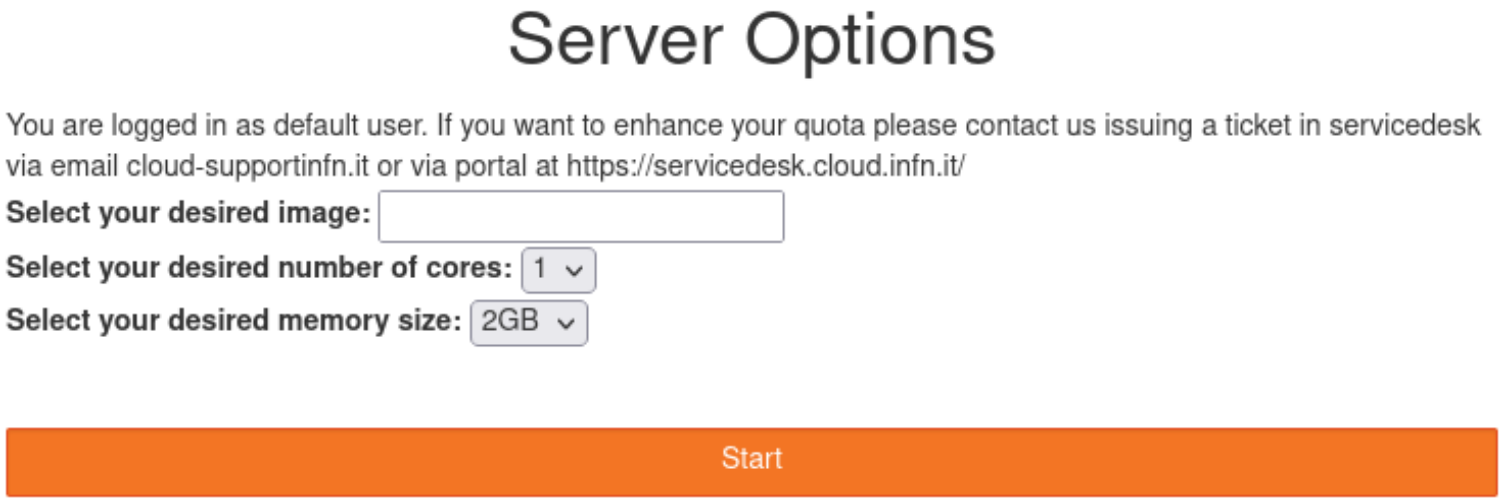
- Why MATLAB as a Service on INFN Cloud?
- Because:
  - Many scientific collaborations and projects would leverage MATLAB as a powerful framework for their computations and analyses
  - INFN has bought unlimited MATLAB licenses for the current year
  - The most straightforward way to provide INFN users with MATLAB would be adding a related INFN Cloud service to the present Portfolio
- How to provide the service?
  - The majority of INFN Cloud communities exploits Jupyter Notebooks as the main tool to perform computations on a user basis
  - MATLAB can be integrated with Jupyter Notebooks: that seems the ideal solution

# Supported Use Cases - NaaS

- At present, INFN Cloud provides Jupyter Notebooks through JupyterHub

CENTRALISED SERVICES:

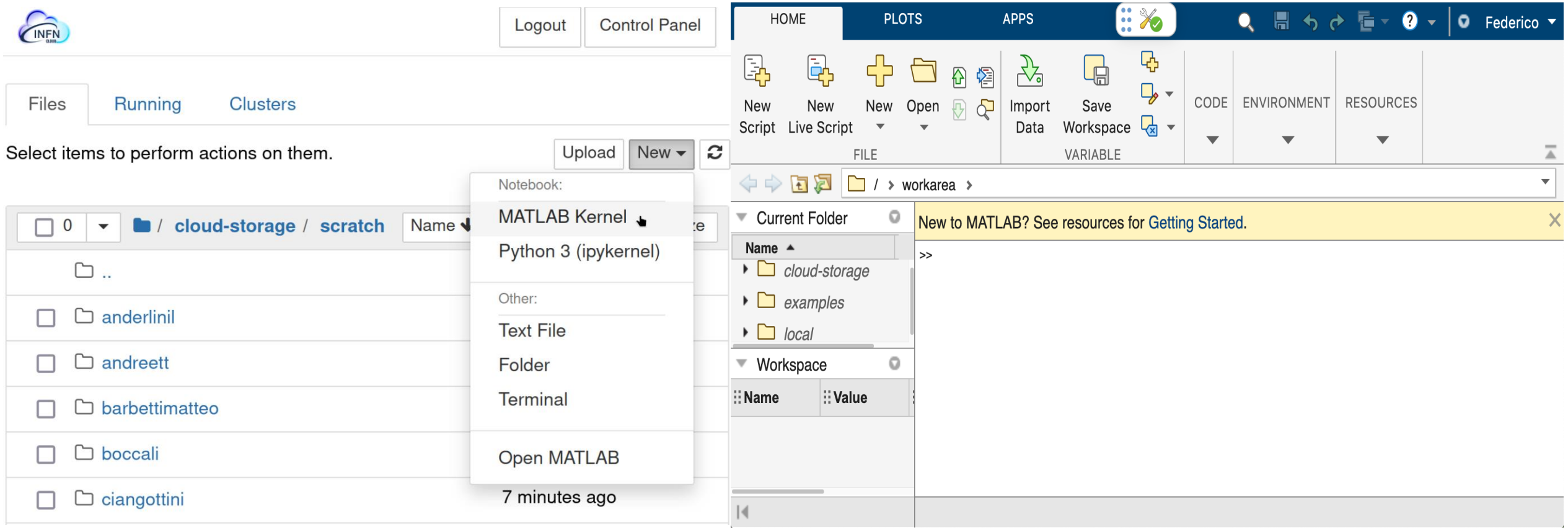
NaaS


- The INFN Cloud user connects to the Hub through INFN Cloud IAM and:
  - selects a Jupyter Docker image to be downloaded from a public registry
  - selects number of cores and RAM size for the server to be run
  - spawns a Jupyter server based on the selected Docker image

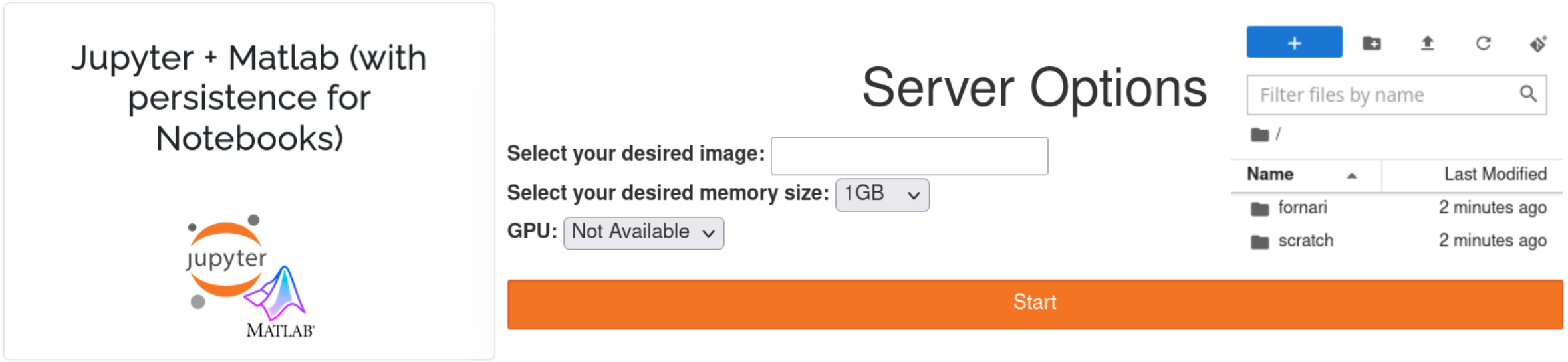
# Supported Use Cases - NaaS

- The Docker image *harbor.cloud.infn.it/jupyter-matlab/naas_matlab* provides Juptyer Notebook integration for MATLAB and INFN Cloud MinIO buckets



# Supported Use Cases - Jupyter with Persistence

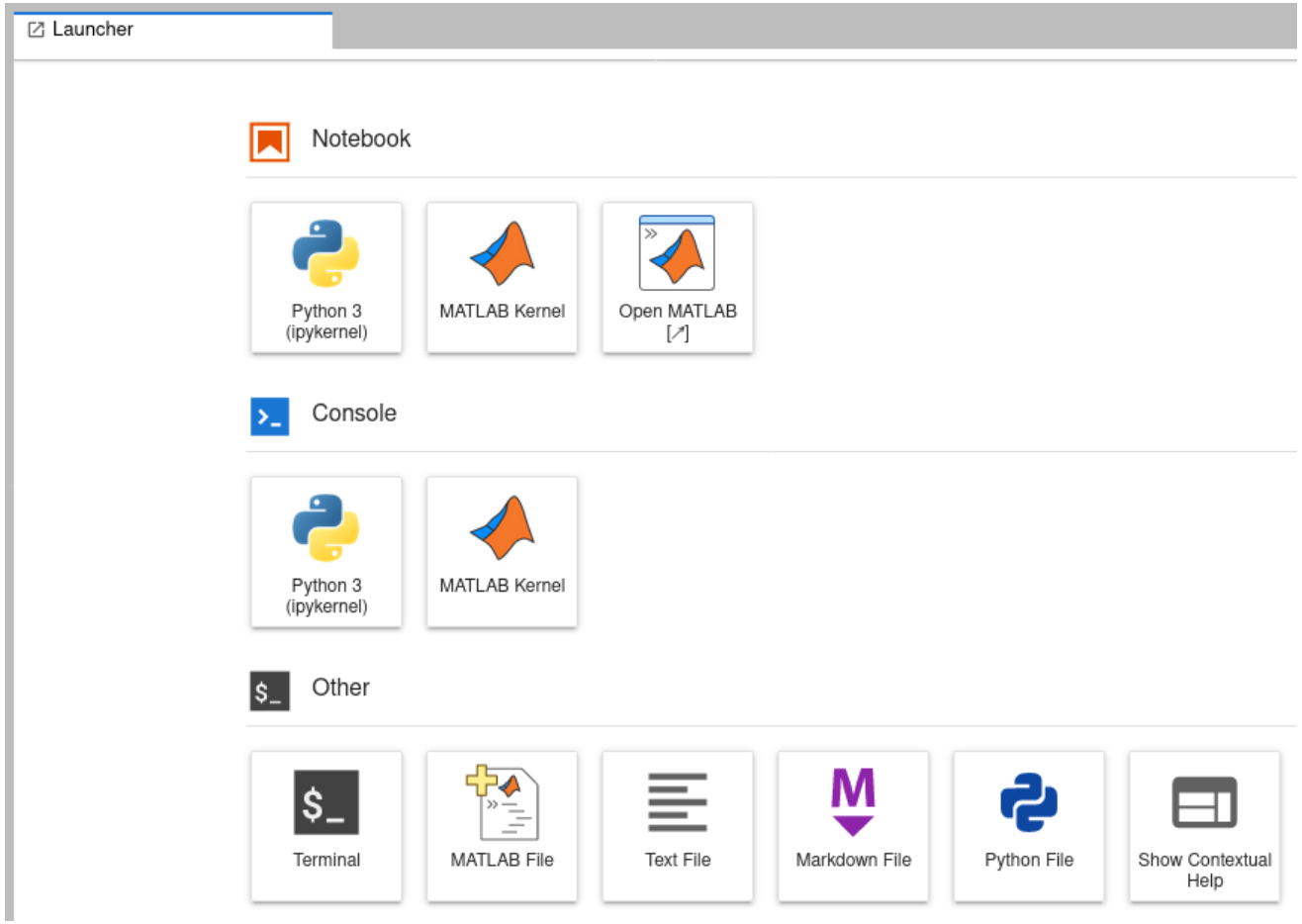
- INFN Cloud also supports Notebooks deployment via Hub on personal VM




- The INFN Cloud user connects to personal Hub via INFN Cloud IAM and:
  - selects a JupyterLab Docker image to be downloaded from a container registry
  - selects RAM size for the server to be run (and GPU if available)
  - spawns a JupyterLab server based on the selected Docker image providing POSIX access to centralized MinIO S3 buckets (personal and scratch)

# MATLAB personal interface for Jupyter

- The Docker image *harbor.cloud.infn.it/jupyter-matlab/jupyter_matlab* provides JuptyerLab with:
  - MATLAB kernel for Notebook
  - MATLAB kernel for console
  - MATLAB native web interface
  - Python 3 kernel for Notebook
  - Python 3 kernel for console
  - Terminal with shell session
  - File editor for:
    - MATLAB files
    - Markdown files
    - Python files
    - Generic text files



# MATLAB collaborative interface for Jupyter

- The Docker image *harbor.cloud.infn.it/jupyter-matlab/collaborative_matlab* provides JuptyerLab with collaborative editing feature that allows collaboration in real-time between multiple users. It is disabled by default.

jupyterlab_collaborative

true

enable the jupyter collaborative service

jupyterlab_collaborative_image

harbor.cloud.infn.it/jupyter-matlab/collaborative_matlab

Default image for jupyter collaborative service including MATLAB

iam_groups

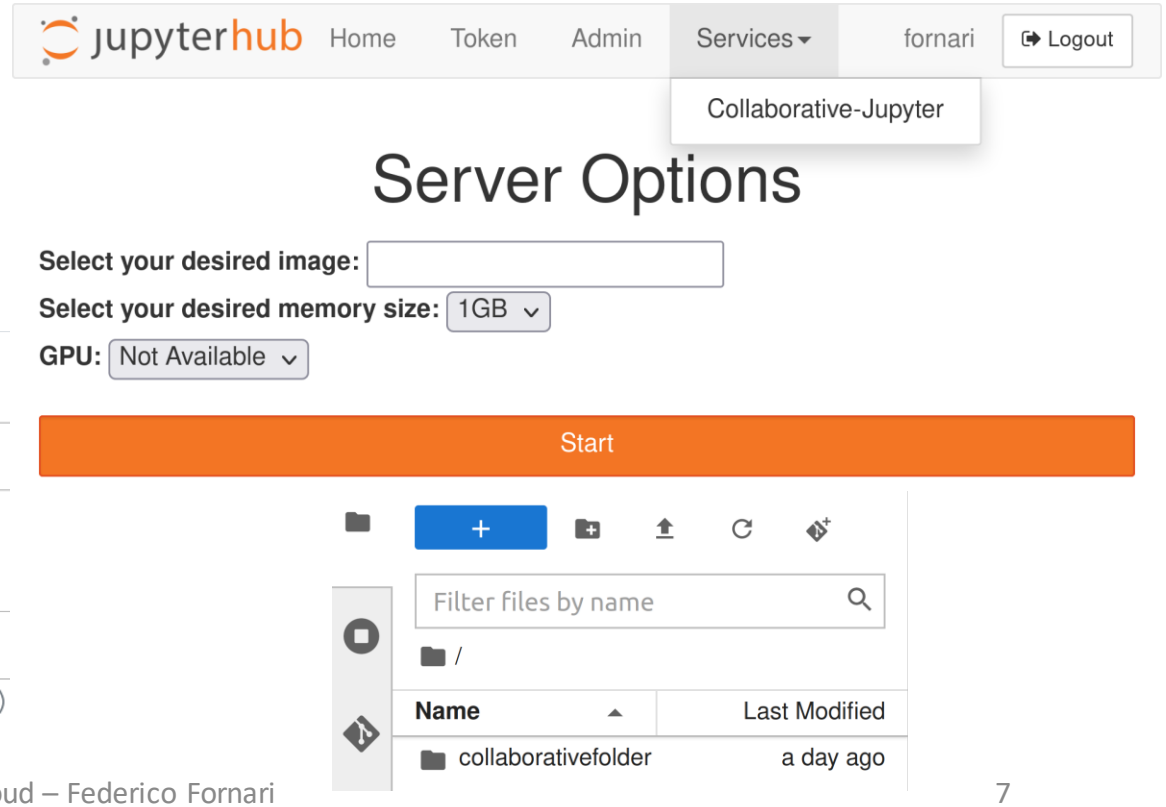
× admins/beta-testers × admins

IAM groups for authorization management (comma delimited list of strings)

iam_admin_groups

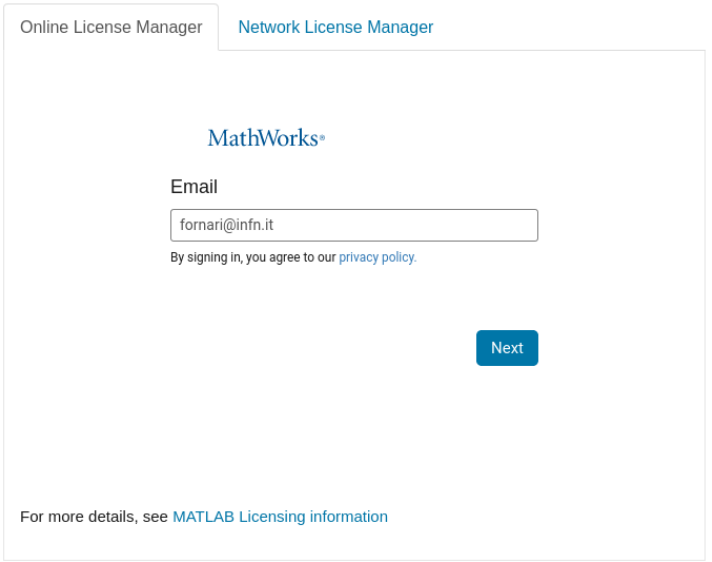
× admins/beta-testers × admins

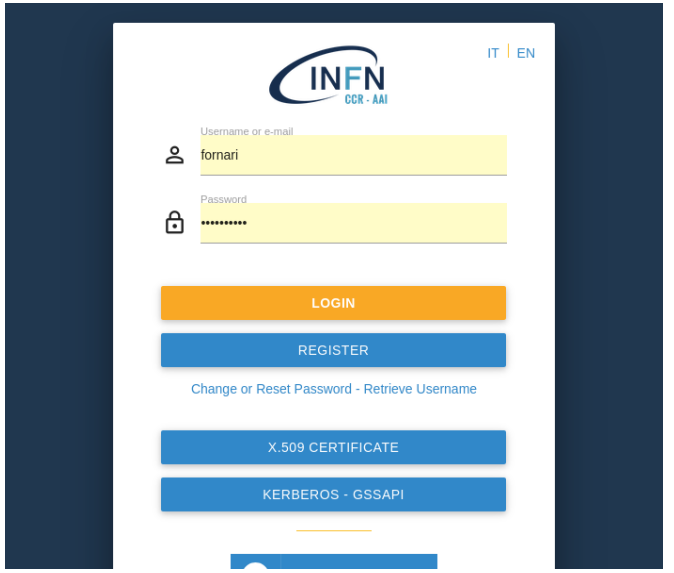
IAM groups for JupyterHub ADMIN authorization management (comma delimited list of strings)

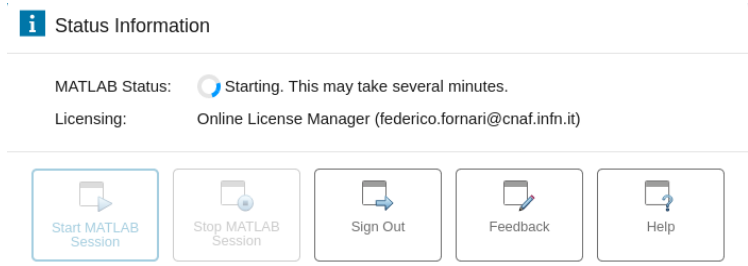


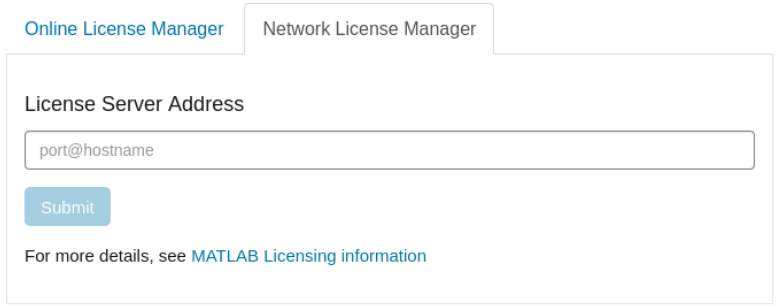
# MATLAB license management

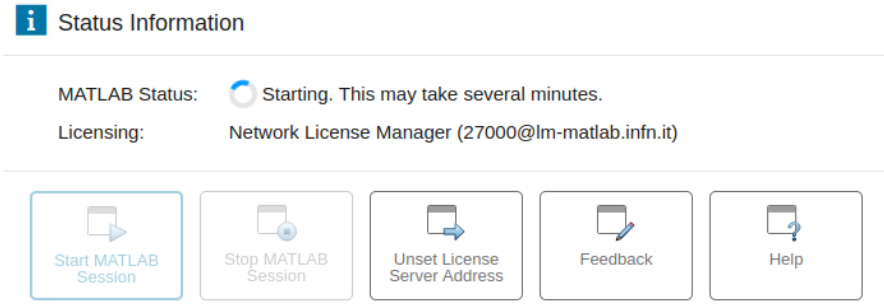
- License for MATLAB usage can be obtained by:
  - Online License Manager:
    - Login with Mathworks account
    - Authentication via INFN AAI
    - User based license released
  - Network License Manager:
    - Provide License Manager hostname and port
    - Host based license released



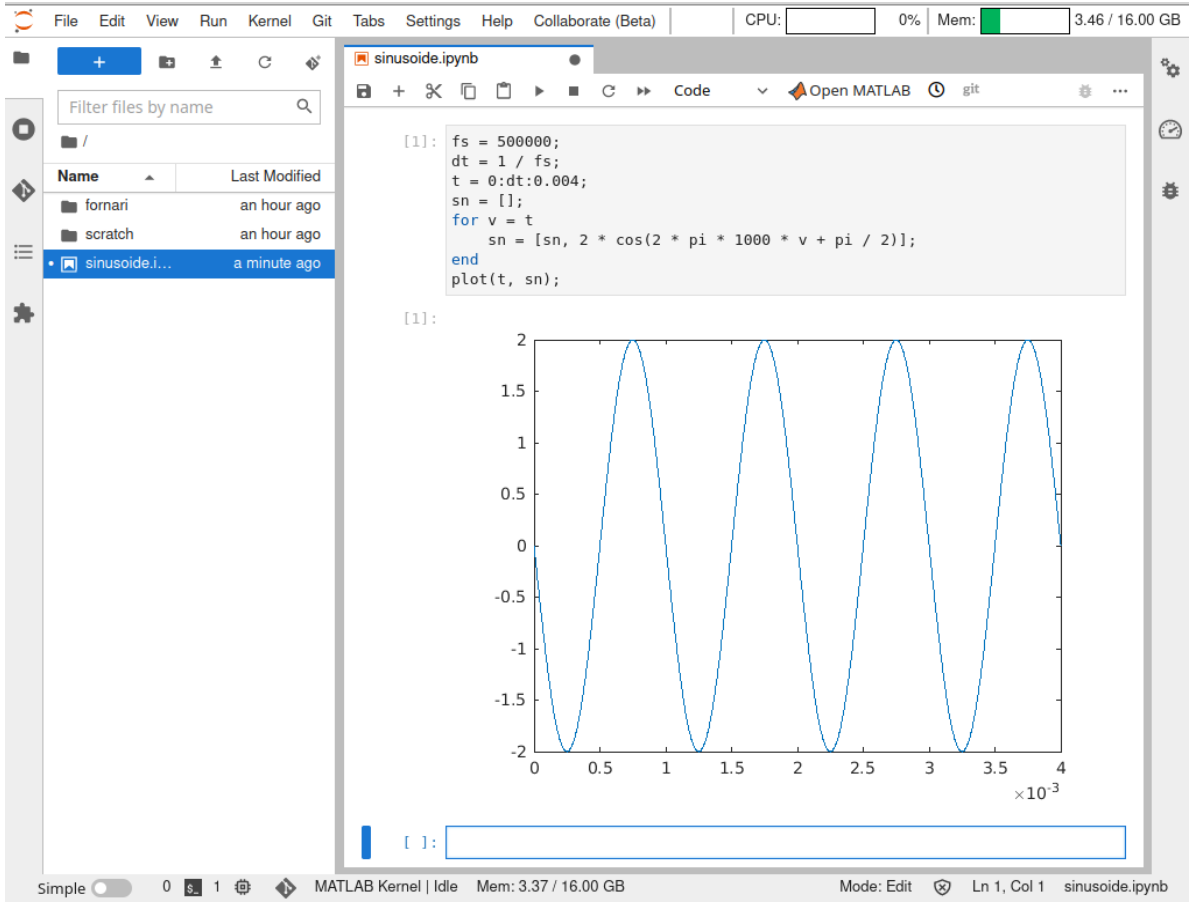



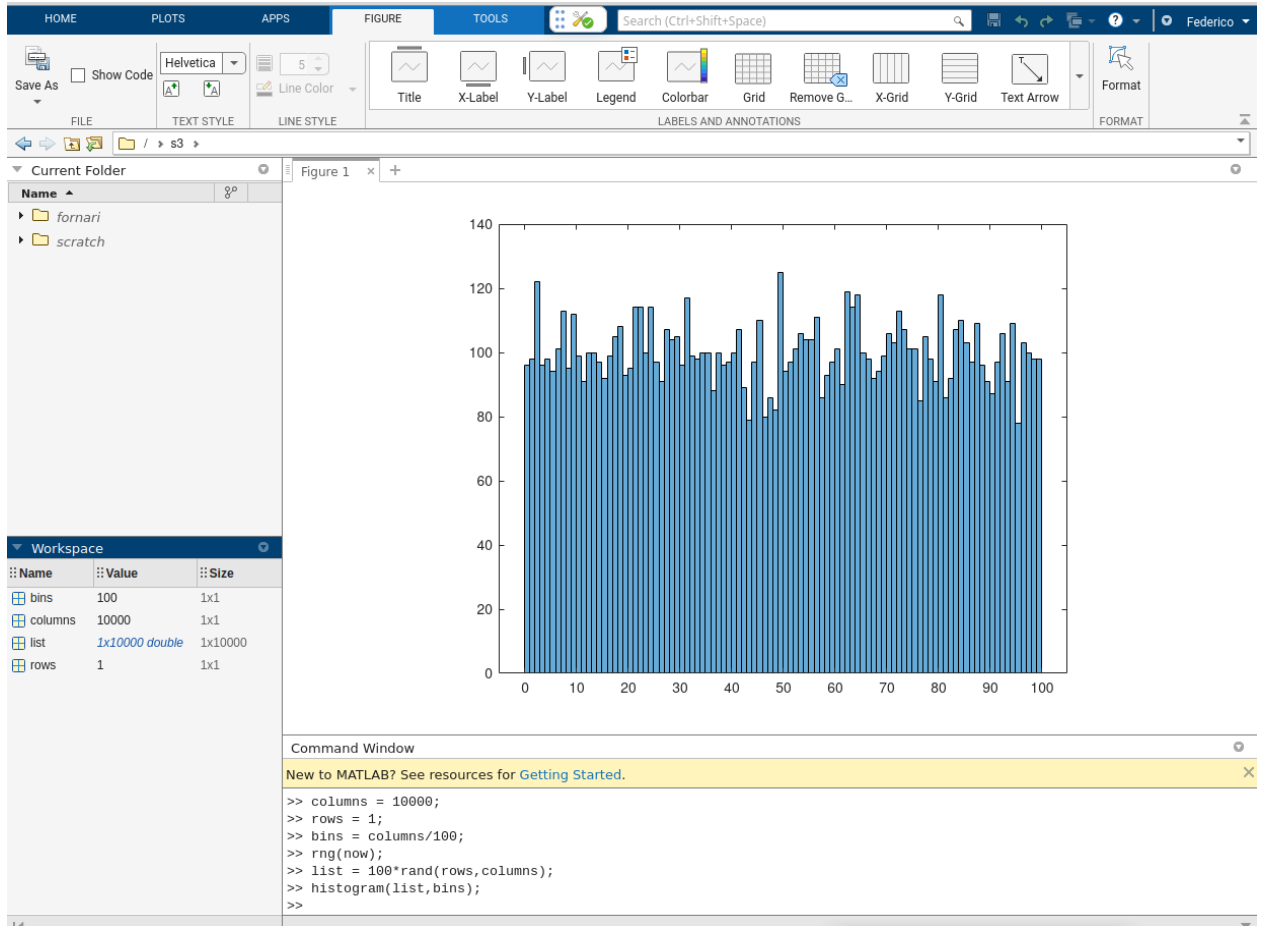



# MATLAB web interface and Jupyter kernel

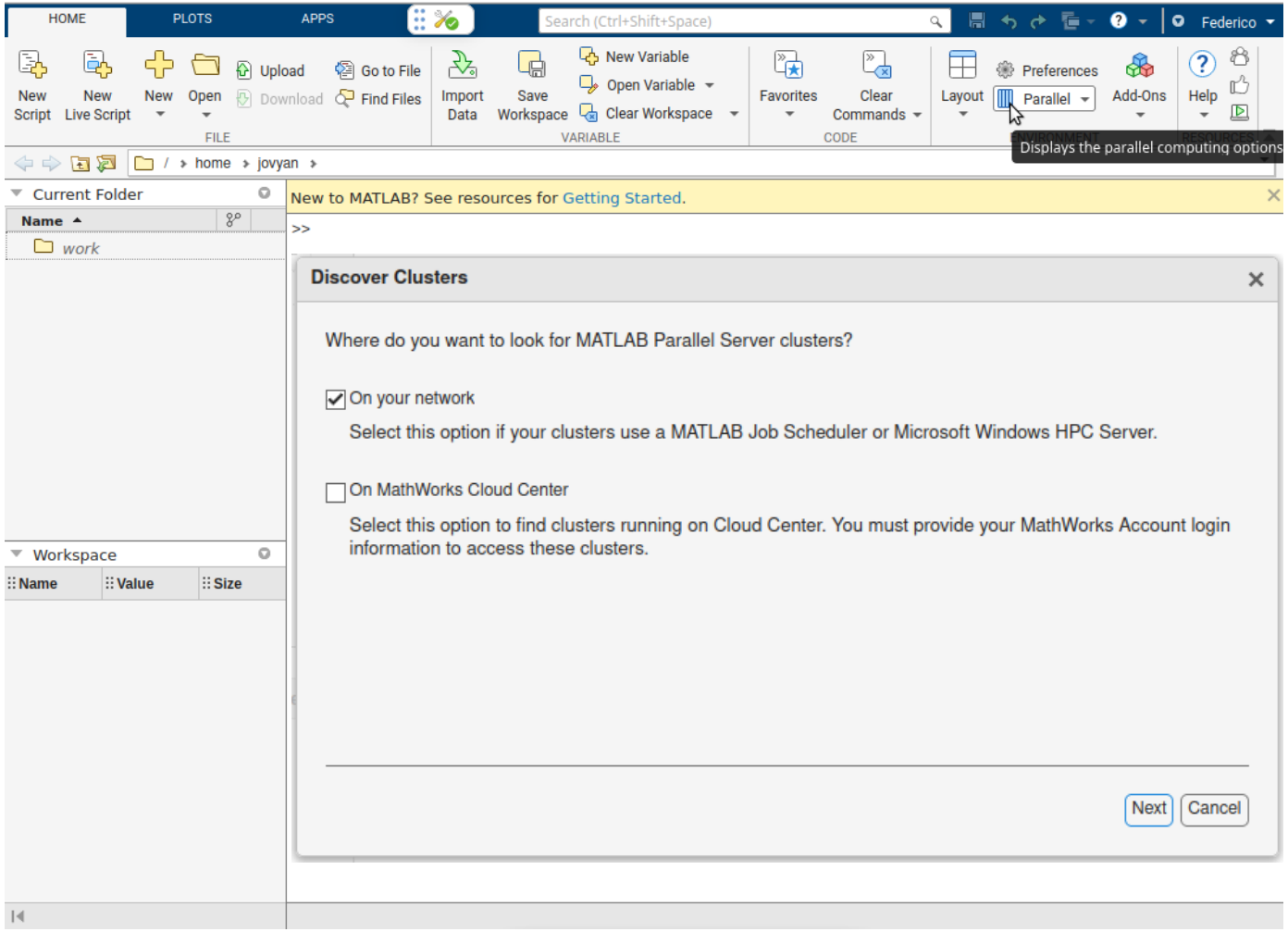
- MATLAB native web interface and Jupyter Notebook kernel can be used to perform computations and produce plots



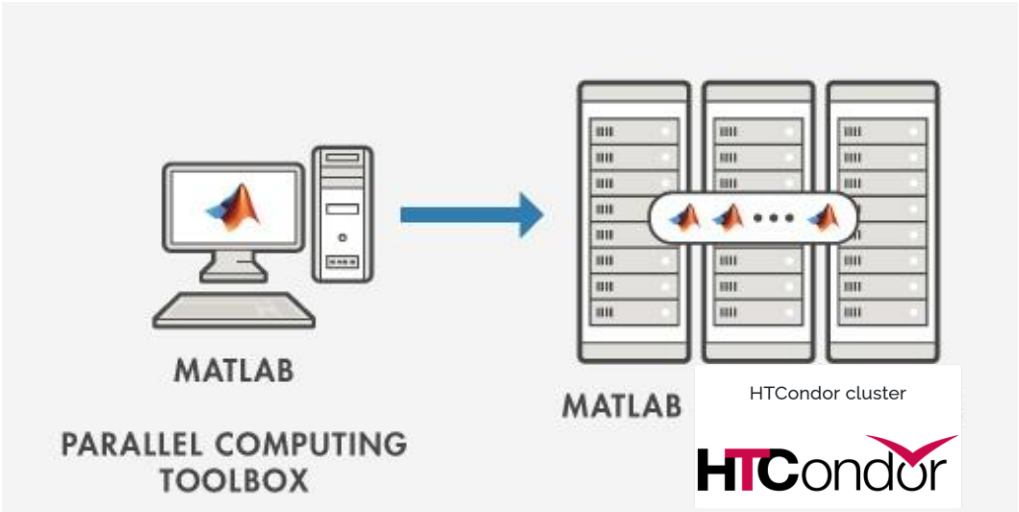
# MATLAB additional Toolboxes

- Additional MATLAB Toolboxes can be installed by building suitable Docker images
- A Dockerfile for MATLAB integration for Jupyter is available at:
  - https://github.com/mathworks-ref-arch/matlab-integration-for-jupyter.git
- For example, to install Parallel Computing Toolbox and run parallel jobs on an external batch system:
  - add Parallel_Computing_Toolbox to MATLAB_PRODUCT_LIST build arg
  - build your Docker image
  - push your image to a public registry

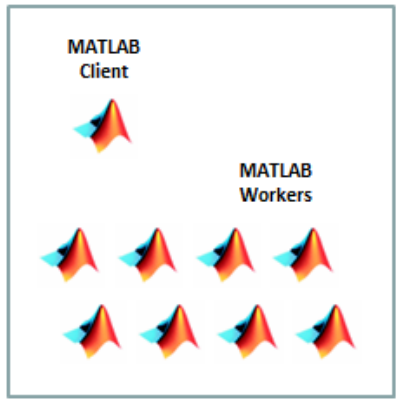


# MATLAB integration with HTCondor - WIP

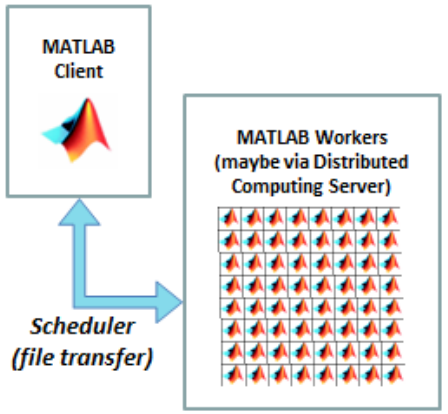
- The possibility to run MATLAB jobs on a HTCondor cluster would easily fit INFN Cloud HTCondor as a Service on Kubernetes
- An INFN Cloud user would spawn his personal HTCondor cluster integrated with MATLAB and submit MATLAB jobs to it via Parallel Computing Toolbox
- Service under development with the collaboration of MathWorks qualified experts




**Interactive** - vs. - **Batch-style**




*Start local or remote parpool, run PCT commands (scripted)*




*Submit jobs, task functions to local or remote parcluster*

# Conclusions and future plans

- MATLAB is a powerful framework for computations and simulations
- INFN invested relevant economical resources to provide this service
- INFN Cloud users may efficiently exploit MATLAB computing tools through Jupyter Notebooks
- The possibility to run MATLAB batch or interactive jobs on personal distributed computing clusters (HTCondor on K8s) would attract considerable audience among INFN communities
- The integration with heterogeneous computing environments, involving GPU resources, represents a further enhancement

# THANK YOU VERY MUCH!