JupyterFlow
Jupyter Notebooks at Scale

Iacopo Colonnelli
Sergio Rabellino
Università di Torino, Computer Science Dept.
HPC4AI: federated GARR cloud at UniTO

Supported by:
- Arm
- Cisco
- IBM
- NVidia
- E4Engineering
- Loquendo
- Consoft
- BlueReply
- CSP
- AizoOn
- O.R.S.
- Reply
- Exemplar
- NetValue
- Celi
- LabInf
- Comau
- FCA
- Leonardo
- Prima Industrie
- General Motors
- IREN
- TIM
- Intesa SanPaolo
- Reale Mutua
- Banca Sella
- TopIX
- TorinoWireless
- INRIM
- SITI

Technological Partner:
- GARR
- INFN-TO
- Collegio Carlo Alberto
- Città Salute e Scienza
- Fondazione ISI
- ISMB
- IIT Genova
- Human Technopole

Universities and Departments:
- DIPINF
- DIPMAT
- DIPGIU
- UNITO (coord)
- DIPES
- DIPFIL
- C3S
- ICxT
- MEDHIUM
- DET
- DAUIN
- POLITO
- SmartData
- HPC

Data Centers:
- C3S
- PdF
- SmartData
- HPC

Hardware:
- green cooling
- specialised islands
- GARR cloud “Piemonte zone”
- specialised islands (non federated)
- green cooling

Iacopo Colonnelli and Sergio Rabellino - Università di Torino, Computer Science Dept.
HPC4AI: federated GARR cloud at UniTO
HPC4AI: federated GARR cloud at UniTO
Exploring the Lorenz System

In this Notebook we explore the Lorenz system of differential equations:

\[
\begin{align*}
\dot{x} &= \sigma(y - x) \\
\dot{y} &= px - y - xz \\
\dot{z} &= -\beta z + xy
\end{align*}
\]

This is one of the classic systems in non-linear differential equations. It exhibits a range of complex behaviors as the parameters \((\sigma, \beta, \rho)\) are varied, including what are known as chaotic solutions. The system was originally developed as a simplified mathematical model for atmospheric convection in 1963.
Jupyter Notebooks as a Service on HPC4AI

Container images defined in kernelspec

- TensorFlow
- Caffe2
- Caffe
- Keras

Community image

Kernel

JupyterLab

JupyterHub will provision custom images containing Notebook + NB2KG extension

Jupyter Enterprise Gateway

Spark on Kubernetes

Kernel
Jupyter Notebooks as a Service on HPC4AI

Launch screen with options for different environments such as Python on Kubernetes, R on Kubernetes, Scala on Kubernetes, Spark - Python on Kubernetes, and Spark - R on Kubernetes.
Hybrid HPC+Cloud Workloads

HPC (e.g. occam@UNITO)

Cloud back-end

HPC4AI VISION
Hybrid HPC+Cloud Workloads

1000x speed to Jupyter Notebook using Techila Distributed Computing Engine

24,500 views · 11 Feb 2019
StreamFlow: Towards Cloud-HPC Continuum

Iacopo Colonnelli and Sergio Rabellino - Università di Torino, Computer Science Dept.

[Diagram showing the relationship between workflow description files, model description files, StreamFlow file, StreamFlow executor, and StreamFlow extensions with HPC, Docker/Kubernetes, and other deployment managers.]
StreamFlow: Towards Cloud-HPC Continuum

Workflow + Deployment models = StreamFlow

SPMD

cluster1

cluster2

k8s
JupyterFlow: Jupyter Notebook at Scale

Convolutional Neural Network Example

Build a convolutional neural network with TensorFlow.

This example is using TensorFlow layers API, see 'convolutional_network_raw' for its implementation with variables.

- Author: Aymeric Damien
- Project: https://github.com/aymericdamien/TensorFlow-Examples/

CNN Overview

MNIST Dataset Overview

This example is using MNIST handwritten digits. The dataset contains 60,000
Thank you

Any Questions?

HPC4AI website: https://hpc4ai.unito.it
StreamFlow website: https://streamflow.di.unito.it
StreamFlow code: https://github.com/alpha-unito/streamflow