DEEP Hybrid-DataCloud

Intensive computing techniques for applications needing specialised hardware

Workshop on Solutions supporting Scientific Analysis in the EOSC ecosystem from H2020 EINFRA21 initiatives
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On behalf of all the partners of DEEP

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DEEP architecture - Pilot Preview testbed

- DEEP as a Service
  - https://github.com/deephdc/
  - https://cloud.docker.com/u/deephdc/
- WP2 Docker images
- WP3
- WP4
- WP5
- WP6
- Federation
  - AAI DEEP IAM
- Data management services (XDC-dCache, onedata)
- Datasets
- CMDB
- SLAM
- Zabbix
- INDIGO PaaS
- Virtual router
- TOSCA
- Orchestrator
- CPR
- DEEP Catalog
- https://a4c.ncq.ingrid.pt
- https://paas.cloud.cnaf.infn.it/orchestrator/
- https://im.deep-hybrid-datacloud.eu:8800
- https://iam.deep-hybrid-datacloud.eu/
- https://paas.cloud.cnaf.infn.it/
- https://mesos.ui.sav.sk/mesos-web/
- https://cereus.man.poznan.pl/mesos
- https://cereus.man.poznan.pl
- https://portal.cloud.ifca.es
- https://dcache-xdc.desy.de:3880/
DEEP Pilot Preview testbed - details

DEEP testbed

Federated AAI
DEEP-JAM

XDC testbed

Onezone (OneData service XDC)
## DEEP core components

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**IaaS components**

**udocker:** improve support of GPUs, improve support of low latency interconnects (Infiniband)

**Mesos/Marathon/Chronos:** authn/authz with oidc/oauth, documentation/configuration support for GPUs and Infiniband, recipes for on-demand deployments.

**Kubernetes:** same as mesos

**HPC Integration Tools:** Provides the way to access HPC resources from the PaaS Orchestrator - containers in HPC through udocker
PaaS components

- Develop/Improve support of deployments requiring GPUs and Infiniband
- Better support for the hybrid multi-site deployments
- Provide Tosca recipes for all required deployments
DEEPaaS components

Alien4Cloud: TOSCA template composition & deployment

DEEP Open Catalog/Marketplace:
provides the universal point of entry to all services offered by DEEP.
DEEPaaS components

Deep Learning Applications

REST API that is focused on providing unskilled users with access to machine learning models.

Image Recognition

Plants

Author: Ignacio Horedia

Description
This application classifies a plant image among 6K plant species mainly from Western Europe.

More Info
- Paper
- Github
User communities and applications

Citizen Science: Plant classification  Image Classification

For training and testing image classifiers (CNNs; TensorFlow). From this model the following services are derived:

- Plants (dataset: up to 1 TB)
- Conus marine snails
- Seeds
- Phytoplankton

Earth Observation: Satellite Imagery

Explore application of Machine Learning for satellite imagery (e.g. remote object detection, terrain segmentation, meteorological prediction).

Currently being developed is super-resolution service to upscale low resolution bands to high resolution with deep learning (e.g. DSen2; TensorFlow. Dataset: ca. 1 TB)
User communities and applications

**Biological and Medical Science: Retinopathy**

Diabetic retinopathy is a fast-growing cause of blindness worldwide. The use-case focuses on a deep learning approach (CNNs; TensorFlow) to automated classification of retinopathy based on color fundus retinal photography images (DR=0 (=healthy) .. 4 (blind)). Dataset: ca. 100 GB

**Computing Security:**
**Massive Online Data Streams: Online analysis of data streams**

Intrusion detection systems: provide an architecture able to analyze massive on-line data streams, also with historical records, in order to generate alerts in real-time. Based on proactive time-series prediction adopting artificial neural networks (e.g. LSTM, GRU; TensorFlow). Dataset: 100 GB currently, then up to 2 TB /day

**Physics: Post-processing**

Of HPC simulations (Lattice QCD): analysis of a large number of configurations for Lattice QCD simulation. Move the configurations to long-term storage, perform checks and metadata operations. Requirements: Infiniband, data of 1 TB
DEEP serves different users’ profiles

Unskilled* Users: want to use a trained deep neural network for prediction/classification of their own data
→ no expert knowledge of ML
→ no access to high-level computing resources

Intermediate* Users: want to use a trained deep neural network and adapt it for solving their problem (transfer learning)
→ some knowledge of ML
→ access to limited computing resources

Advanced* Users: want to develop their own deep neural network (with special requirements as e.g. data privacy)
→ expert knowledge of ML
→ need access to high-level computing resources

(*) - knowledge level
DEEP CI/CD for user applications

Development and integration in cloud resources.

Jenkins pipeline for user applications:
- CI/SQA: Code style, security scan.
- CD:
  - Immediate availability of application.
  - Automatic building (Docker images).
  - Automatic publishing (Docker Hub).
  - Notification (email to developers).
DEEP user applications

WP3
- Code version control
- Jenkins (github.com/deep HDC)
  - flake8 / PEP8
  - Bandit security scanner
- Unit tests
- Coverage report
- OWASP Dependency-check

WP2
- Code testing & Quality Control
- Docker build & push to test registry
- Deploy to test environment
- Post-deployment testing
- Deployment for long training

Engagement

Possible extension to be included in Jenkins pipeline

Under discussion: Blue-Green deployment on production

DEEP Open Catalog
DEEP vision & work on Software Quality Assurance

● Vision:
  ○ We support the HLEG vision on delivering quality software for the EOSC
  ○ We produced “A set of common software quality assurance baseline criteria for research projects”
    ■ http://hdl.handle.net/10261/160086
    ■ Done together with the eXtreme DataCloud and INDIGO projects
  ○ Objective: align baseline criteria within different projects

● Work:
  ○ Current EOSC synergies (eXtreme-DataCloud)
    ■ SQA baseline
    ■ **Automation**: continuous integration and delivery for core products
      ● Common library for CI/CD pipeline functionalities
    ■ **Agile** software development: jump-started from WP2 requirements
  ○ **DEEP goes beyond**: automation techniques supporting user communities
    ■ **Continuous integration** and **delivery** pipelines in place: Docker Hub images re-creation triggered by changes in i) DEEPaaS and ii) application itself
    ■ Initial **continuous deployment prototype**: readiness/provision of training and inference as a service
    ■ Rendering and generation of the **marketplace portal**: leveraging (JSON) schema- validated metadata descriptions
Collaboration with ongoing initiatives

- Collaboration with **EINFRA-21** projects:
  - **eXtreme-DataCloud**: Integration of data management solutions (XDC) and computing solutions (DEEP), exploiting event driven executions. Work on software quality.
  - **DARE**: Provide ML/DL services to integrate into workflows
- Collaboration with **other** initiatives:
  - **EOSC-Hub**: Integration of developments into production tools (cloud-info-provider, TOSCA-Parser).
  - **EGI.eu**: Improved support for accelerators in Cloud resources
  - Developments merged upstream
- Collaborations with **external** user communities:
  - Royal Botanical Garden of Madrid, LifeWatch ERIC, Mouse Motor Lab (Rowland Institute Harvard), Centre for Automatic and Robotics (CSIC)
Thank You