The DeepHealth Toolkit: a Unified Framework to Boost Biomedical Applications

Michele Cancilla, Laura Canalini, Federico Bolelli, Stefano Allegretti, Salvador Carrión, Roberto Paredes, Jon A. Gómez, Simone Leo, Marco Enrico Piras, Luca Pireddu, Asaf Badouh, Santiago Marco-Sola, Lluc Alvarez, Miquel Moreto, and Costantino Grana

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The DeepHealth Project

Aim & Goals

- Put HPC computing power at the service of biomedical applications

- Increase the productivity of medical personnel and IT professionals

- Offer a unified framework adapted to exploit underlying heterogeneous HPC and Cloud architectures

Key facts

Duration: 36 months
Starting date: Jan 2019

Budget: 14.642.366 €
EU funding: 12.774.824 €

22 partners from **9 countries**: Research centers, Health organizations, large industries and SMEs

Research Organizations

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

BSC Barcelona Supercomputing Center — Centro Nacional de Supercomputación

list b2s tech

UNIMORE — UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

Karolinska Institutet

CRS4 — IDEAS BECOME LIFE

UNIVERSITÀ DEGLI STUDI DI TORINO

OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

Health Organizations

AZIENDA OSPEDALIERO-UNIVERSITARIA Città della Salute e della Scienza di Torino

Fundación para el Fomento de la Investigación Sanitaria y Biomédica de la Comunitat Valenciana

SPITALUL CLINIC PROF. DR. THEODOR BURGHELE BUCUREȘTI

CHUV

Stockholms läns landsting

Large Industries

everis — an NTT DATA Company

PHILIPS

THALES

SIMAVI — Software Imagination & Vision

SMEs

WINGS ICT SOLUTIONS

TREE TECHNOLOGY

prodesign electronic gmbh

Stelar security tech law research

The DeepHealth Toolkit

- The *DeepHealth Toolkit* is composed of two libraries designed for computer vision and deep learning tasks:

  - **ECVL** - European Computer Vision Library

  - **EDDL** - European Distributed Deep Learning Library

- Plus, a **front-end** designed for non-expert users, which consists of:

  - A RESTful web service

  - A web-based GUI

- The entire toolkit is open-source and available at github.com/deephealthproject

Medical staff
IT professionals

Deep Health Toolkit

FRONT-END

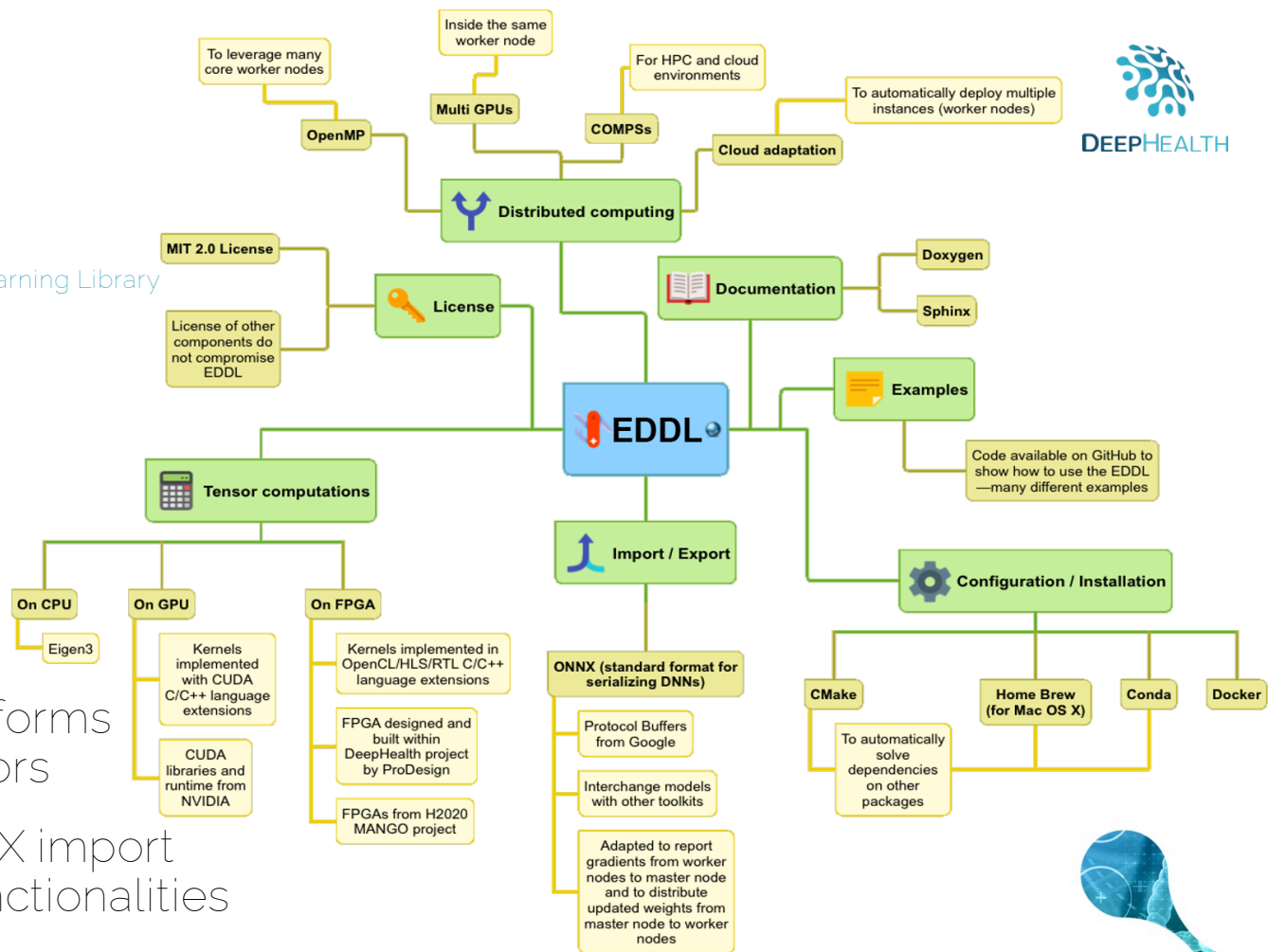FRONT-END (Graphical User Interface)

BACK-END
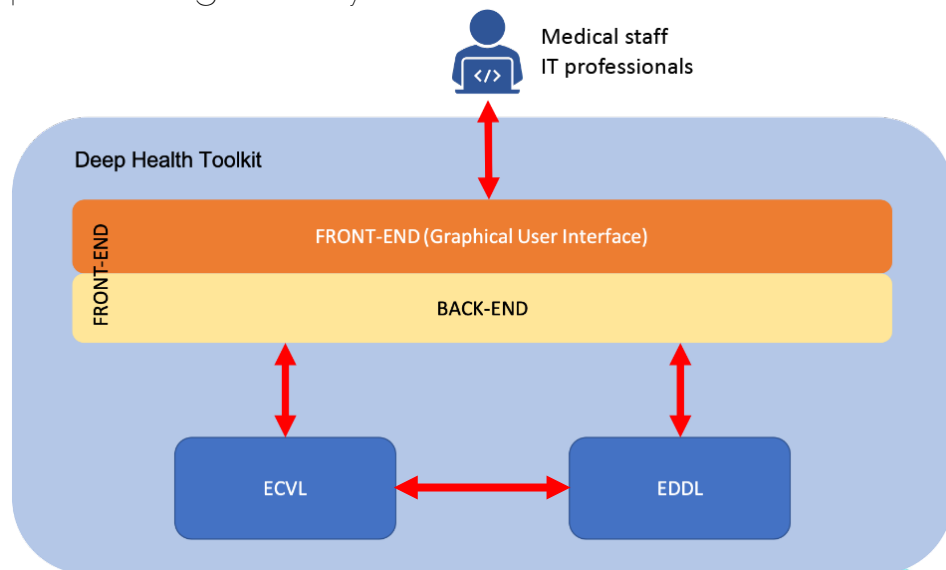
ECVL

EDDL

EDDL

European Distributed Deep Learning Library

- Written in C++
- Keras-like API
- Built-in data augmentation
- Supports different hardware platforms and accelerators
- Provides ONNX import and export functionalities

ECVL

European Computer Vision Library

- Mainly designed to integrate existing state-of-the-art Computer Vision and Image Processing libraries

- Support for multiple medical imaging formats (NIfTI, DICOM, TIFF, whole-slide)

- Core functionalities implemented for both 2D images and 3D volumes:
  - Reading and writing
  - Processing
  - Visualizing

- Domain-Specific Language for data augmentation
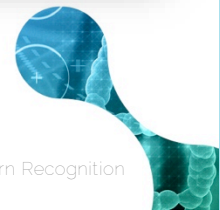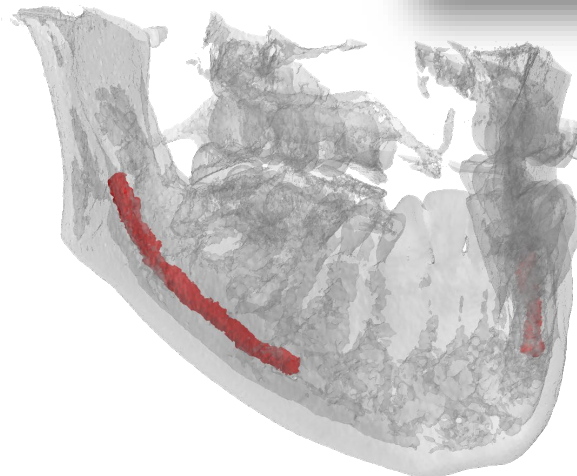
Python APIs

- PyEDDL and PyECVL have been designed for binding Python code to existing C++ code

- Python APIs avoid introducing significant inefficiencies in execution speed or memory usage by keeping any computationally intensive code in C++

- Seamless conversion between EDDL Tensor or ECVL Image objects and NumPy arrays
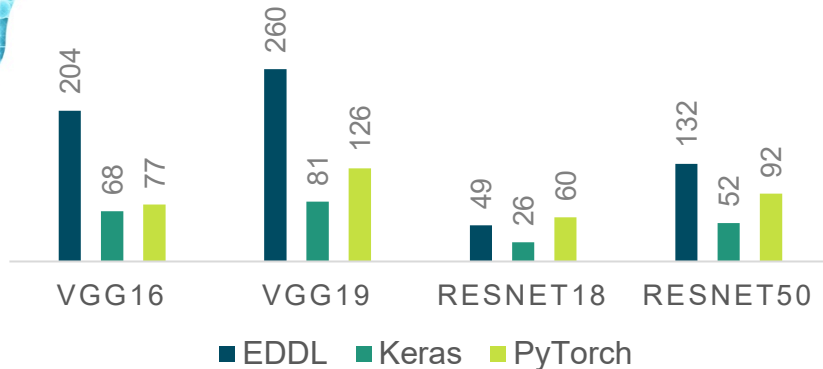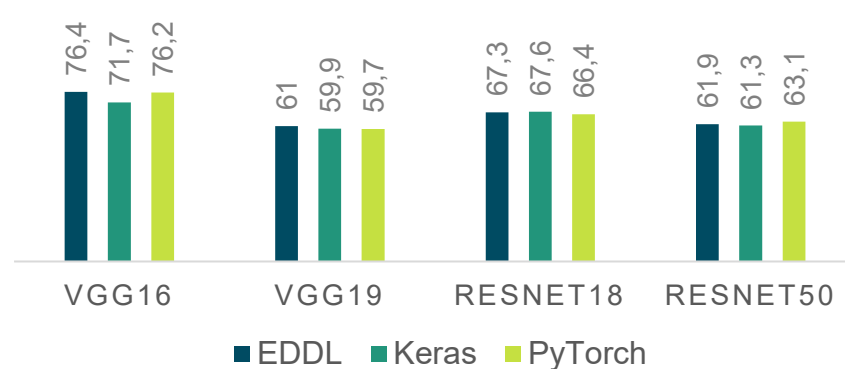
EDDL

ECVL

NumPy

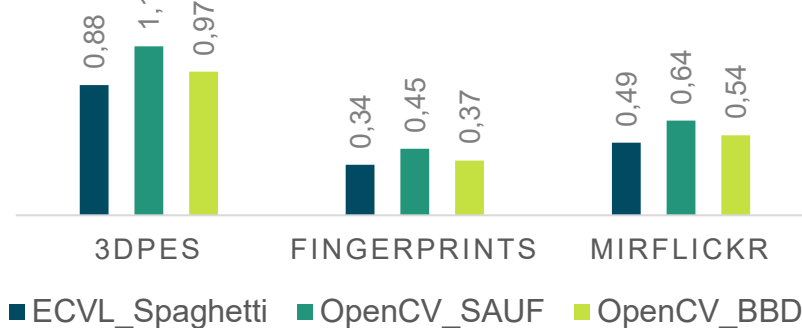PyEDDL

PyECVL

Benchmarking

GPU TIME PER EPOCH (s)

Bar chart with groups VGG16, VGG19, RESNET18, RESNET50 and legend EDDL, Keras, PyTorch.

- VGG16: 204, 68, 77
- VGG19: 260, 81, 126
- RESNET18: 49, 26, 60
- RESNET50: 132, 52, 92

TEST ACCURACY (%)

Bar chart with groups VGG16, VGG19, RESNET18, RESNET50 and legend EDDL, Keras, PyTorch.

- VGG16: 76,4 / 71,7 / 76,2
- VGG19: 61 / 59,9 / 59,7
- RESNET18: 67,3 / 67,6 / 66,4
- RESNET50: 61,9 / 61,3 / 63,1

CONNECTED COMPONENTS LABELING (ms)

Bar chart with groups 3DPES, FINGERPRINTS, MIRFLICKR and legend ECVL_Spaghetti, OpenCV_SAUF, OpenCV_BBDT.

- 3DPES: 0,88 / 1,14 / 0,97
- FINGERPRINTS: 0,34 / 0,45 / 0,37
- MIRFLICKR: 0,49 / 0,64 / 0,54

Thank you!

Federico Bolelli

federico.bolelli@unimore.it