DEEPHEALTH

Deep-Learning and HPC to Boost Biomedical Applications for Health

DeepHealth Needs & Requirements for Benchmarking

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DataBench BenchLearning webinar

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The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825111.

A Little bit of context

- Healthcare: key sector in the global economy
- Public health systems generate large datasets of biomedical images
  - Large unexploited knowledge database
  - Interpretation of the clinical expert manually
- R & D on applying Artificial Intelligence (AI) to analyze biomedical images but . . .
  - Need for advanced skills in AI and different technologies and tools
  - Expensive processes in time and resources
  - Needs of high-quality data and take care of ethics
- HPC and BigData technologies (Big Data, HPC) sufficiently mature and available.

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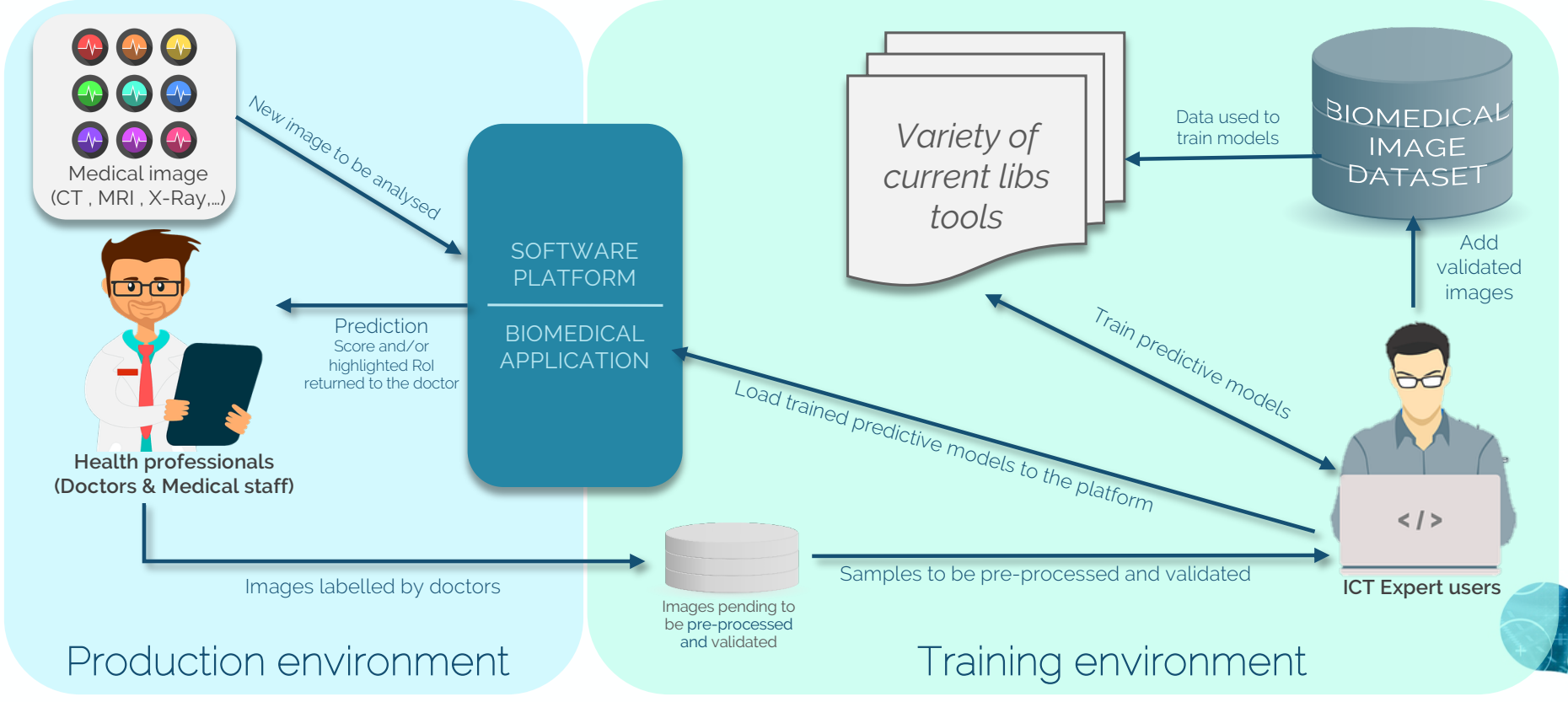
The scenario



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About DeepHealth

DEEPHEALTH

Aim & Goals

- **Put HPC computing power at the service of biomedical applications** with DL needs and apply DL techniques on large and complex image biomedical datasets to support **new and more efficient ways of diagnosis, monitoring and treatment of diseases.**
- Facilitate the daily work and **increase the productivity of medical personnel and IT professionals** in terms of image processing and the **use and training of predictive models** without the need of combining numerous tools.
- Offer a **unified framework** adapted to exploit underlying heterogeneous **HPC and Cloud architectures** supporting state-of-the-art and next-generation **Deep Learning (AI) and Computer Vision algorithms** to enhance European-based medical software platforms.

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 Organisations

Universitat Politècnica de València · Barcelona Supercomputing Center · list · UNIMORE · Karolinska Institutet · CRS4 · Università degli Studi di Torino · Otto von Guericke Universität Magdeburg

Health Organisations

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 · CHUV · Spitalul Clinic Prof. Dr. Theodor Burghele București · 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 · security Stelar research

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Developments & Expected Results

- **The DeepHealth toolkit**
  - Free and open-source software: 2 libraries + front-end.
    - ***EDDLL:*** *The European Distributed Deep Learning Library*
    - ***ECVL:*** *the European Computer Vision Library*
  - Ready to run algorithms on Hybrid HPC + Cloud architectures with heterogeneous hardware (Distributed versions of the training algorithms)
  - Ready to be integrated into end-user software platforms or applications
- **HPC infrastructure** for an efficient execution of the training algorithms which are computational intensive by making use of heterogeneous hardware in a transparent way
- Seven enhanced **biomedical and AI software platforms** provided by EVERIS, PHILIPS, THALES, UNITO, WINGS, CRS4 and CEA that integrate the DeepHealth libraries to improve their potential
- Proposal for a structure for anonymised and pseudonymised data lakes
- **Validation** in 14 use cases (*Neurological diseases, Tumor detection and early cancer prediction, Digital pathology and automated image annotation*).

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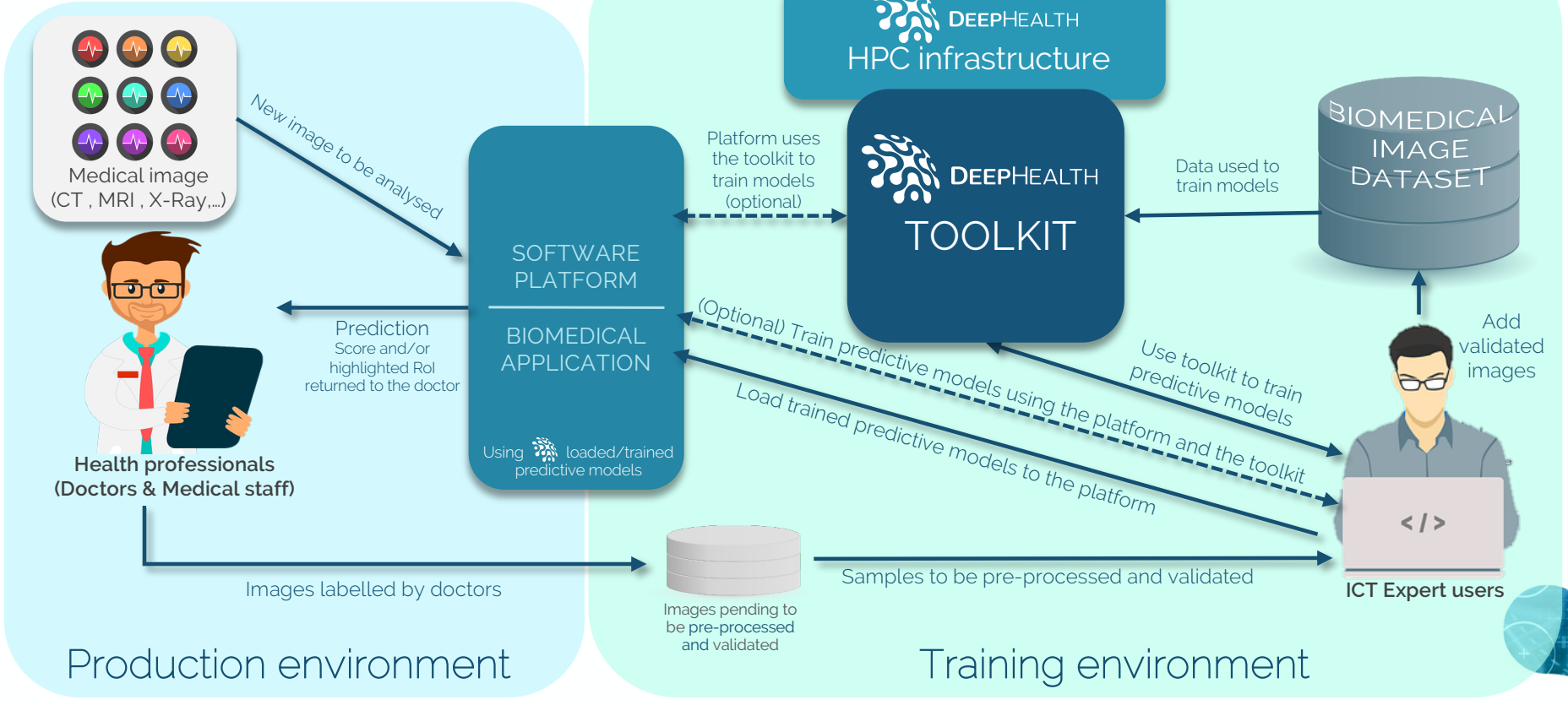
The Concept



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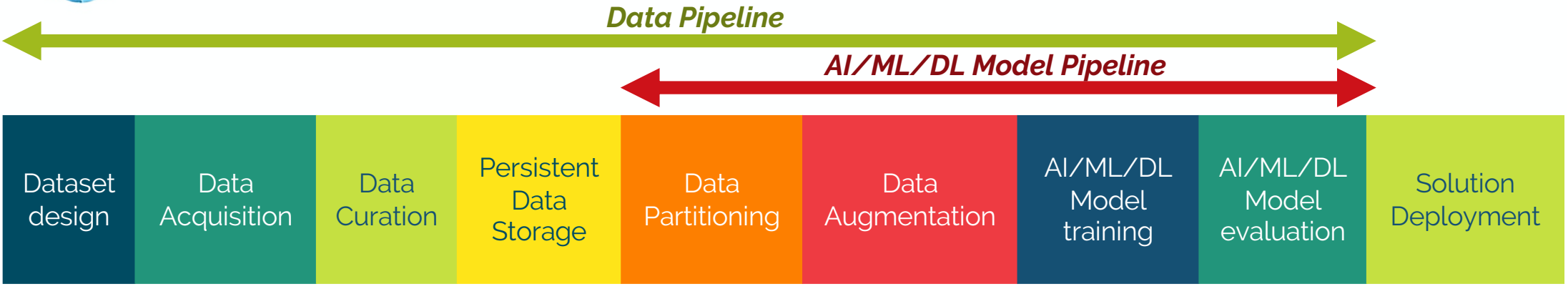
Data & Model Pipelines



Model Pipeline is considered part of the ***Data Pipeline***

Both pipelines are suitable for business and research applications

The whole ***Data Pipeline*** is applicable to any sector. Our project is focused on the Health sector

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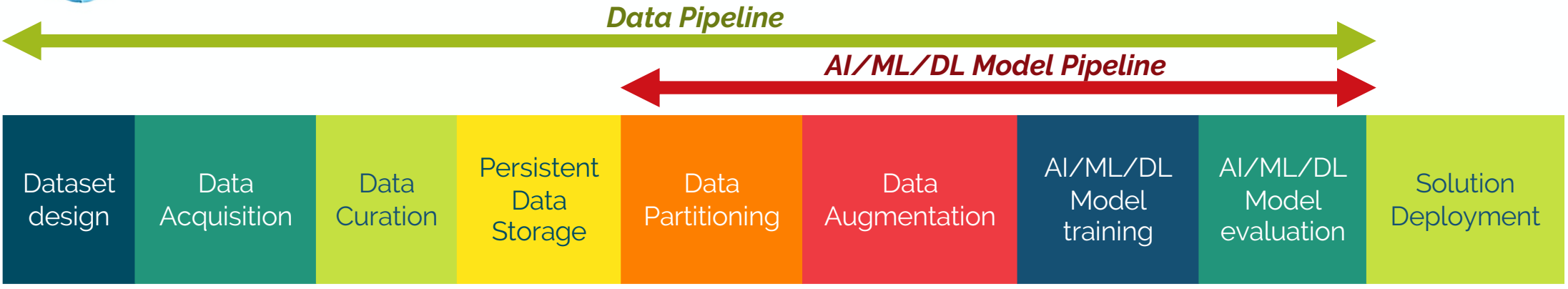
Data & Model Pipelines – Dataset Design



- Data types and formats –identification and definition
- Metadata definition
- Data Lake structure definition
- Guidelines / HOW-TOs
- Etc.

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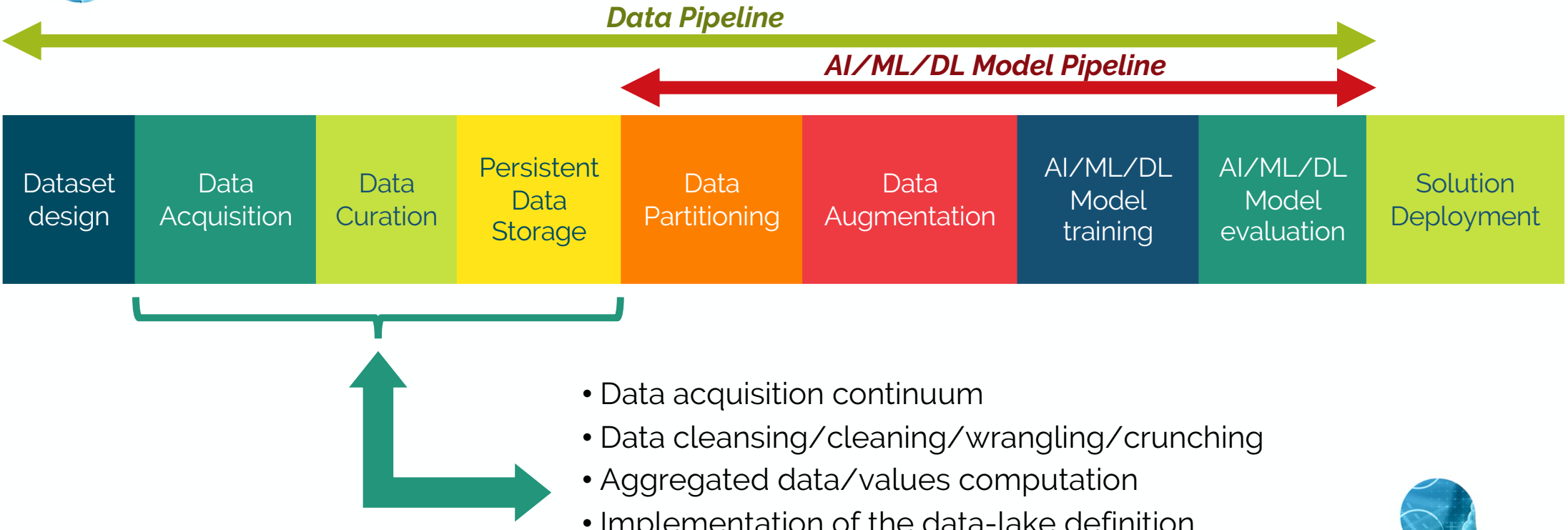
Data & Model Pipelines – Acquisition + Curation + Storage



- Data acquisition continuum
- Data cleansing/cleaning/wrangling/crunching
- Aggregated data/values computation
- Implementation of the data-lake definition
- Creation of users and permissions or make data public

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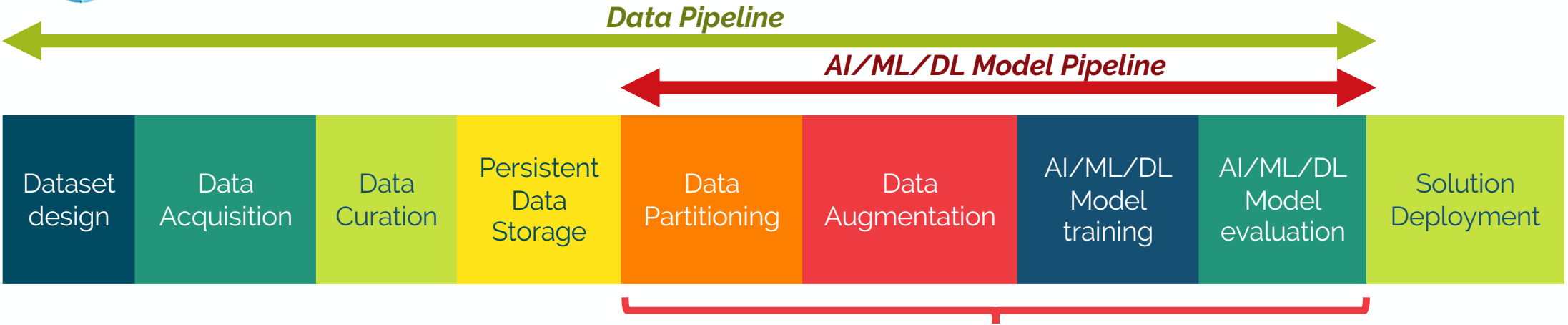
Data & Model Pipelines – Model Pipeline



Model training loop:

- Partitioning in training/validation/test subsets
- Data augmentation on-the-fly
- Training and evaluation of models
- Cloud & High Performance Computing requirements

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Needs & Requirements

Evaluate **datasets** in terms of

1. **Findability** – where should a data scientist search for the dataset?
2. **Availability** – how long does a data scientist need to start the initial exploratory data analysis?
3. **Interoperability** – how long does a data scientist need to start training AI/ML/DL models with a dataset?
4. **Reusability** – are previously obtained results with a dataset public and available to other researchers / data scientists?
5. **Privacy / Anonymisation** – can the dataset be made public without compromising the identity of individuals?
6. **Quality** – is the dataset biased or unbalanced? What procedure has been followed to validate annotations?

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Needs & Requirements

Evaluate **Deep Learning libraries** in terms of

1. **Speed-up** – is distributed learning really efficient?
2. **Convergence** – does the distributed learning reach the same model accuracy in less time?
3. **Usability** – how long does a developer need to use the libraries effectively?
4. **Integrability** – how difficult is it to integrate the libraries as part of solutions to deploy?
5. **KPI**s: time-of-training-models (**totm**), performance/power/accuracy trade-off, etc.
6. **Others** – can you help us to evaluate other aspects?

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Needs & Requirements

Evaluate **Software Platforms** in terms of

1. **Usability** – how long does a domain application expert need to manage the software tool effectively?
2. **Completeness** – does the application platform provide all the algorithms/procedures/functions to allow domain application experts to easily define the sequences of steps to implement the data and/or model pipelines?
3. **Compatibility** – how many data formats does the platform admits to import/export data and models from/to other frameworks?
4. **KPI**s: time-to-model-in-production (**ttmip**), time-of-pre-processing-images (**toppi**), etc.
5. **Others** – can you help us to evaluate other aspects?

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Questions?

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