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ReproVIP: Enhancing Reproducibility of Scientific Results in Medical Imaging

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REPROVIP – ENHANCING REPRODUCIBILITY OF SCIENTIFIC RESULTS IN MEDICAL IMAGING

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VIP : THE VIRTUAL IMAGING PLATFORM

- **Free & open** platform for simulation / processing of medical images.
 - ✓ 1400+ registered users;
 - ✓ 20+ applications available as a service;
 - ✓ Web portal: <https://vip.creatis.insa-lyon.fr/>
- Uses **EGI** resources to provide users with transparent access to high-throughput computing, through the **DIRAC** framework [1].



PROJECT OUTLINE

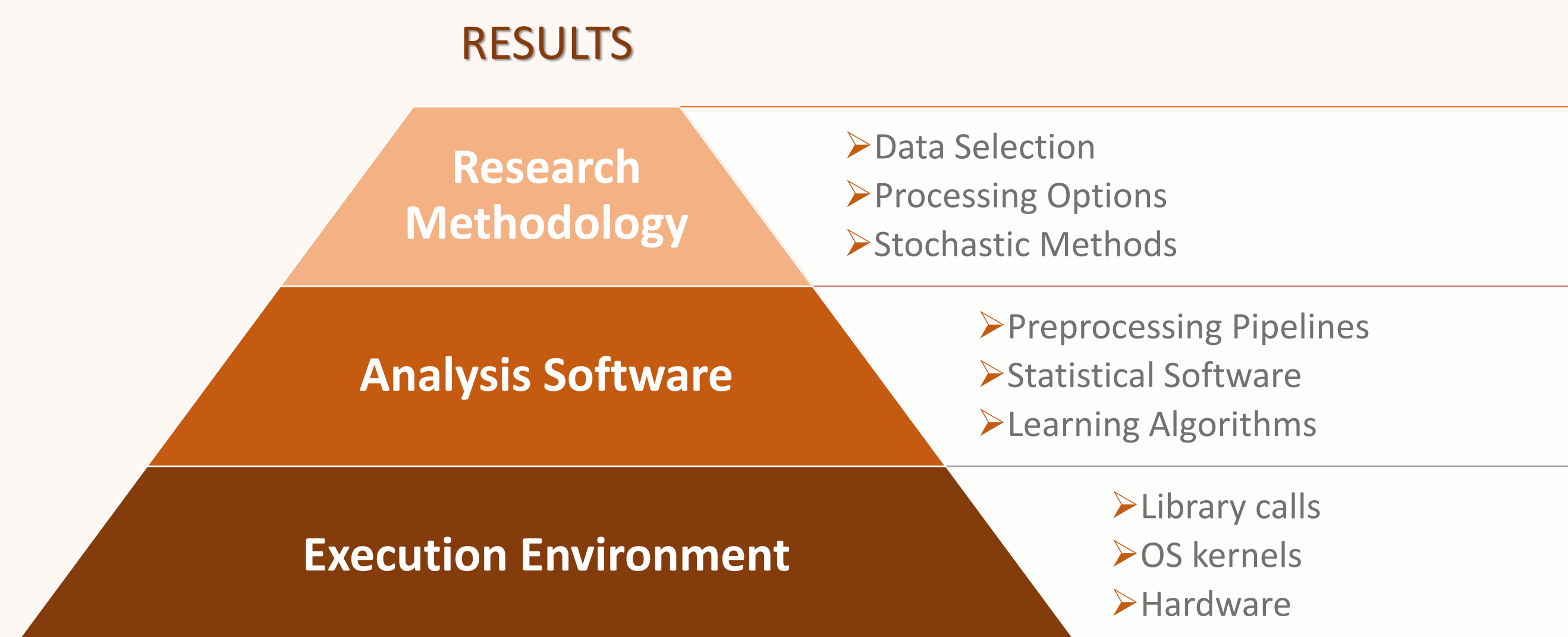
The project is structured around three complementary goals :

- Evaluate** the uncertainty of an application’s digital outcomes.
 - Define metrics & criteria to validate a “reproducible” scientific result;
 - Design a reproducibility test protocol to be run after each app execution.
- Enhance** the numerical reproducibility of VIP outcomes using software solutions for open science.
 - For the Research Methodology layer (i), provide EGI-based Jupyter Notebooks on the Web portal (able to use the DIRAC framework);
 - For the Execution Environment layer (iii), run MIR applications on *Guix* : a GNU-based Linux distribution for advanced package management.
- Apply** reproducibility metrics & know-how on two MIR issues.
 - Metabolite quantification in magnetic resonance spectroscopy;
 - Automatic tumor segmentation in the lower brain regions.

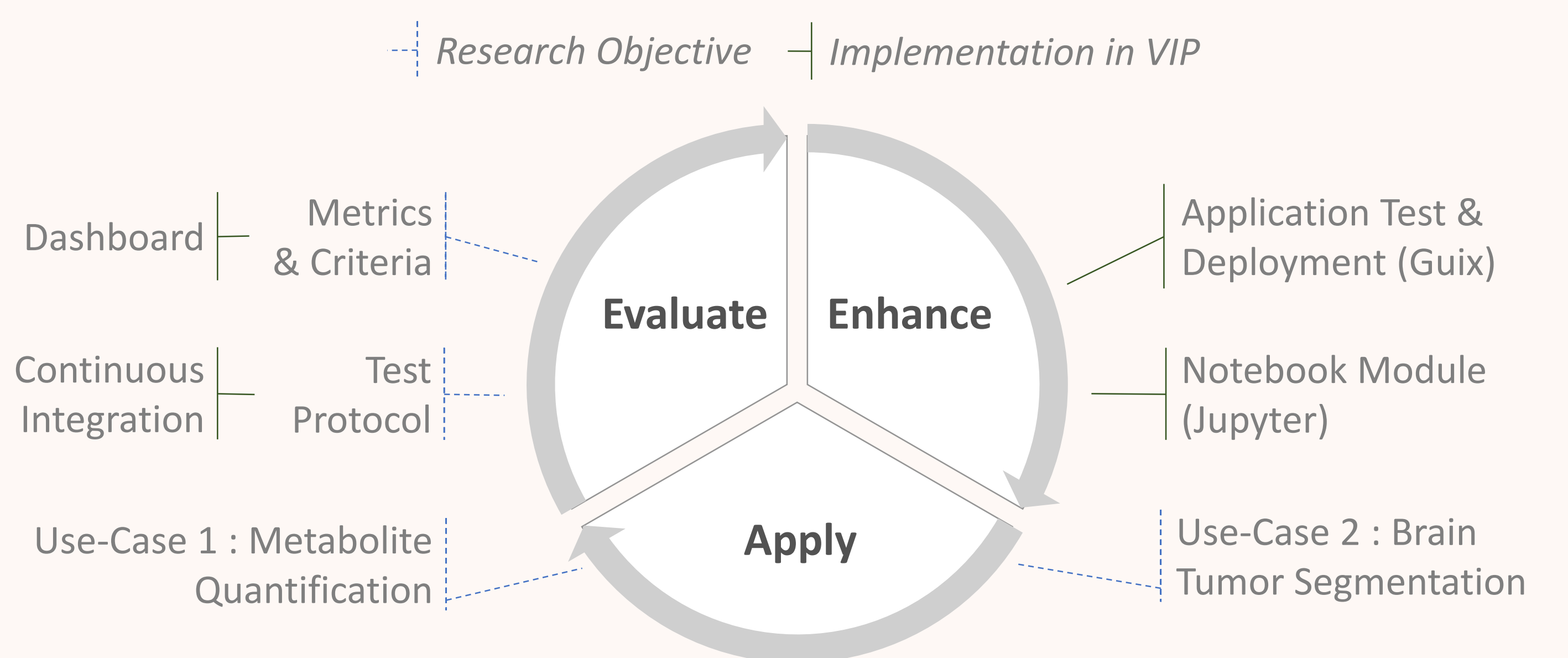
RESEARCH ISSUE

Medical Imaging Research (MIR) is facing a **reproducibility crisis**.

- Most MIR applications are unable to produce the same results twice, when applied the same sets of inputs.
- Sources of variability can be identified in distinct layers of data processing : (i) the research **methodology** [2], (ii) the analysis **software** [3] and (iii) the execution **environment** [4].

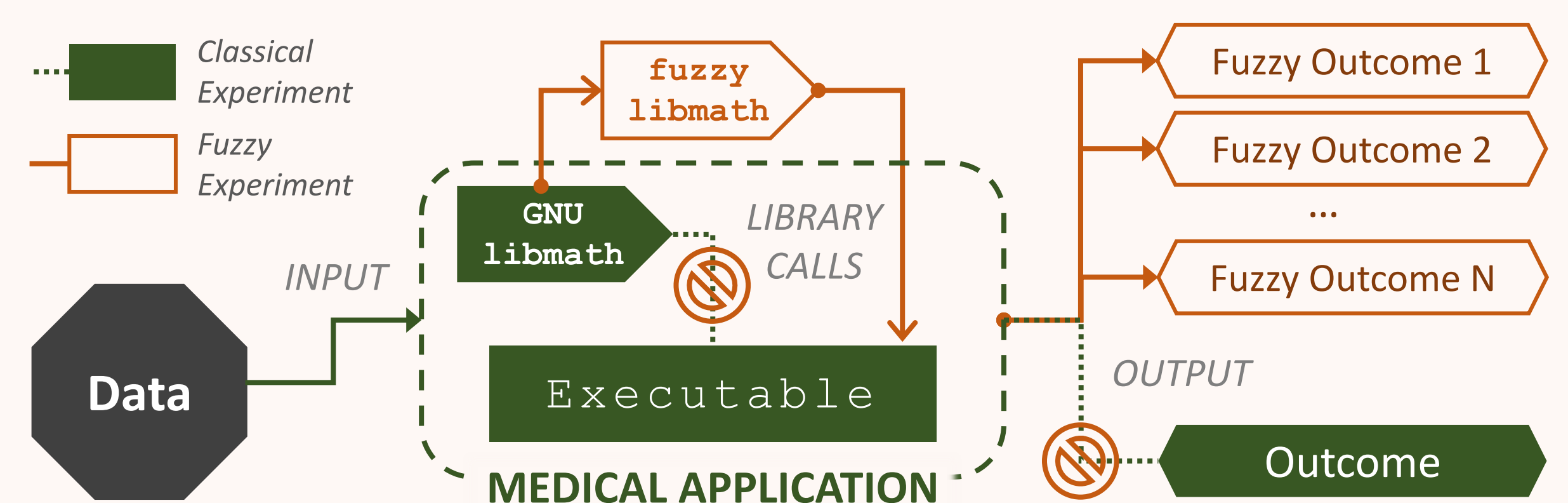


- Environment-related variability (iii) is poorly acknowledged by the MIR community and may cause variabilities in scientific results based on **distributed computing**.
- The ReproVIP project is funded by the French National Research Agency (grant N°ANR-21-CE45-0024-01), to address reproducibility issues at each layer of processing.



EARLY PROSPECTS

- By leveraging cross-environment computing resources from the EGI e-infrastructure, VIP will provide a virtual playground to **experiment** variability in a pipeline’s results at the environment level (iii).
- In the meantime, inter-OS variability can be efficiently **simulated** by introducing random perturbations in a pipeline’s mathematical operations [5]. This can be done by using a fuzzy version of the GNU mathematical library: Fuzzy-LibMath (compiled with Verificarlo API).



- Variability can be assessed across empirical or simulated outcomes.

Literature

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