Justifications

Describing Explicitly & Continuously Verifying Justification Reasonings

SIG LLODIA – 2026-06-25

jean-michel.bruel@irit.fr

Available material

https://www.jpipe.org/

https://bit.ly/jmb-talks

Get the slides (pdf)

Jean-Michel Bruel et al, “Justification Diagrams presentation at the SIG LLODIA”. Webinar, 2026.

If you have any content that I did not reference well or that should be removed, please do not hesitate to contact me so that I can correct this presentation.

anr agence nationale de la recherche
ANR-24-IAS2-0002

Outline

- Context
- Jpipe
- Ongoing research

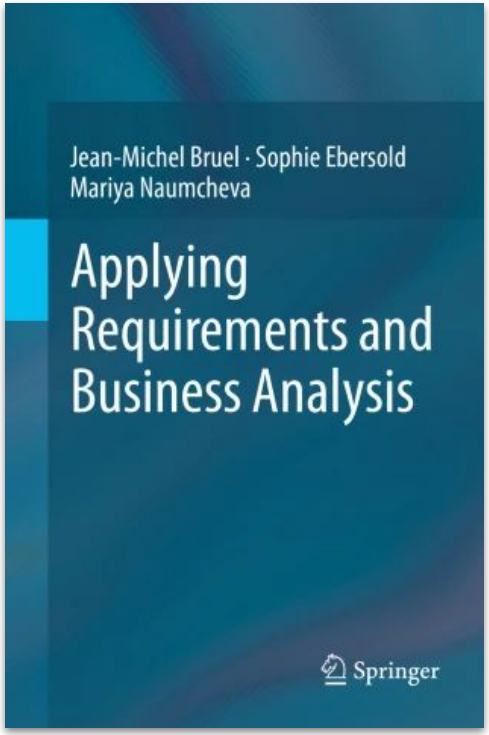
anr agence nationale de la recherche
ANR-24-IAS2-0002

Context

Why me?

- Professor at Toulouse University
  - Teaching modeling and DevOps
- Member of the CNRS-IRIT Laboratory
  - Model-Based Systems Engineering
- Airbus MBSE Chair of Toulouse
- Leader of the companion book (published in 2025)

https:/bit.ly/jmbruel



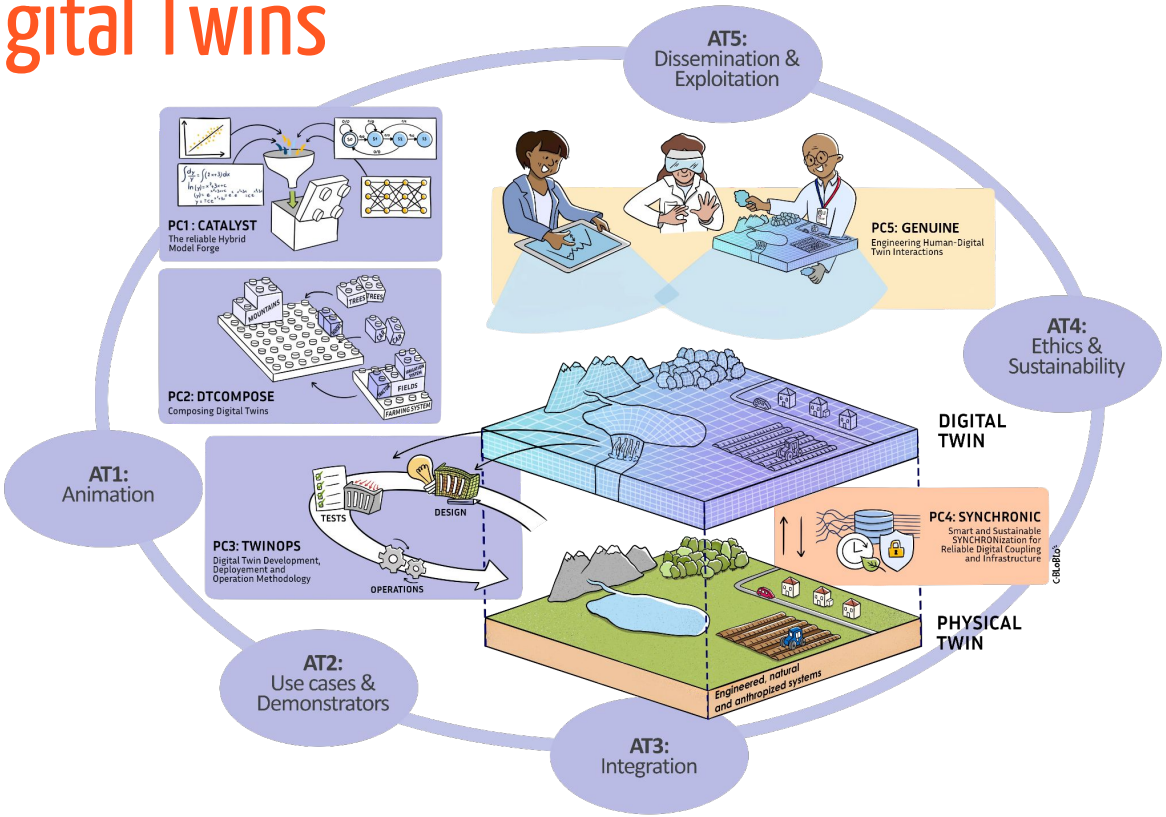
https://requirements.university

anr agence nationale de la recherche
ANR-24-IAS2-0002

Engineering Digital Twins

- French national project
  - 40 PhDs
  - 6 years
- Leading PC3 on **methodology**

https://edtlab.fr/en/



anr agence nationale de la recherche
ANR-24-IAS2-0002

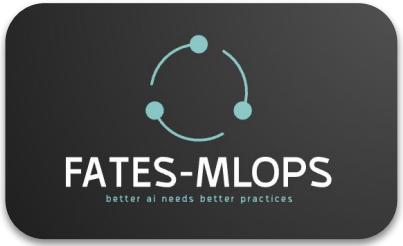
Collaboration with Steffen Zschaler

V&V of of **Digital Twins**

=> Justification Diagrams + **Ontologies**

=> Interest for SIG LLODIA?

anr agence nationale de la recherche
ANR-24-IAS2-0002



anr agence nationale de la recherche

FATES-MLOps

Incorporating FATES Principles in Continuous Development of ML-Integrated Systems: A MLOps Perspective

ANR Project Funding this research

Fairness
Accountability
Transparency
Ethics
Security (and/or **Safety** and/or **Sustainability**)

IRIT Institut de Recherche en Informatique de Toulouse
CNRS - Toulouse INP - UT - UTC - UT2

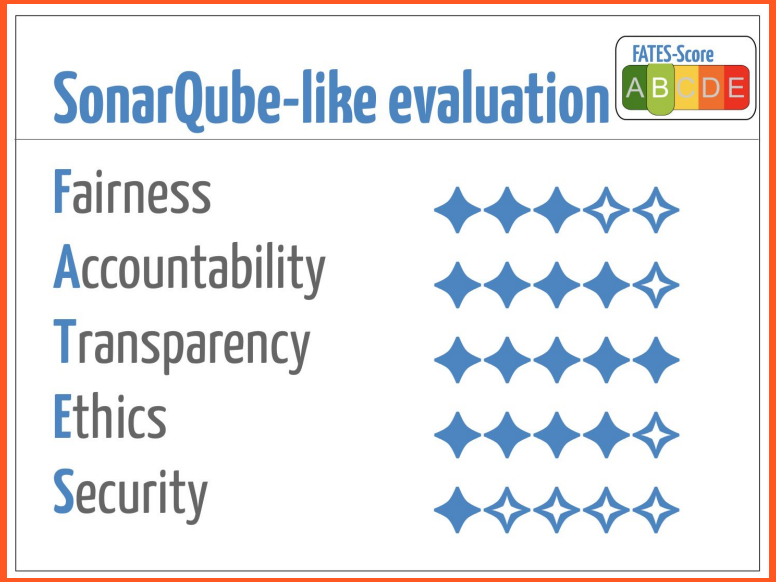
UNIVERSITÉ CÔTE D'AZUR

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

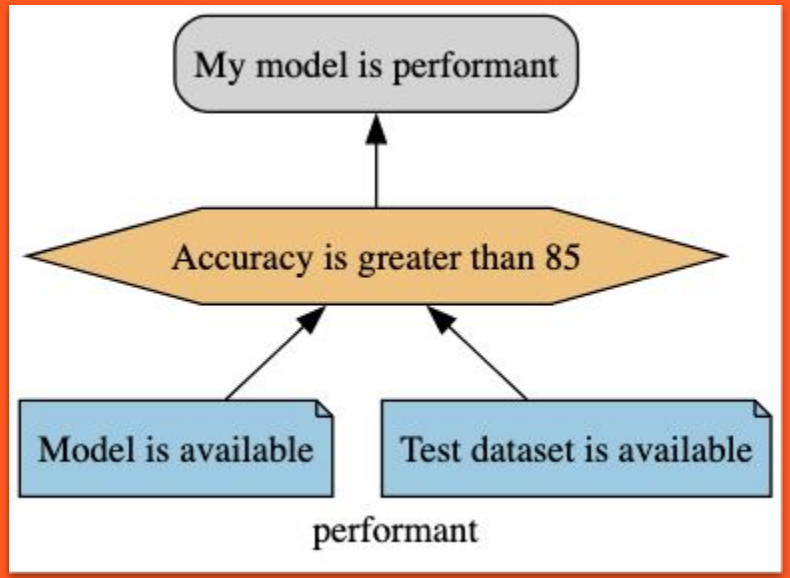
Inria

McMaster University

Claim #1: AI needs **Q&A** (Quality Assessment)

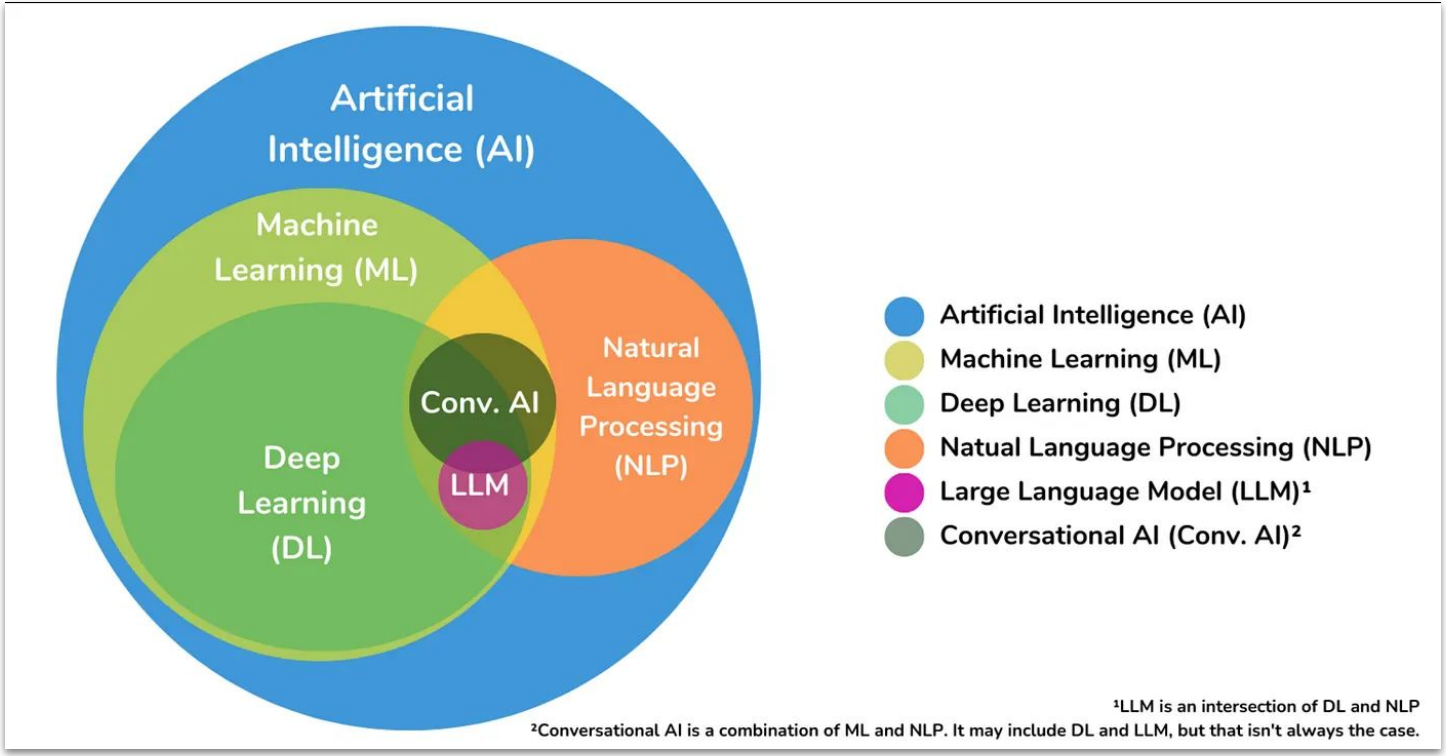


Claim #2: AI needs Requirements Engineering



https://github.com/jpipe-mcscert/bellairs-cse

AI / GenAI / LLM / ML / AIA => ML(Ops)

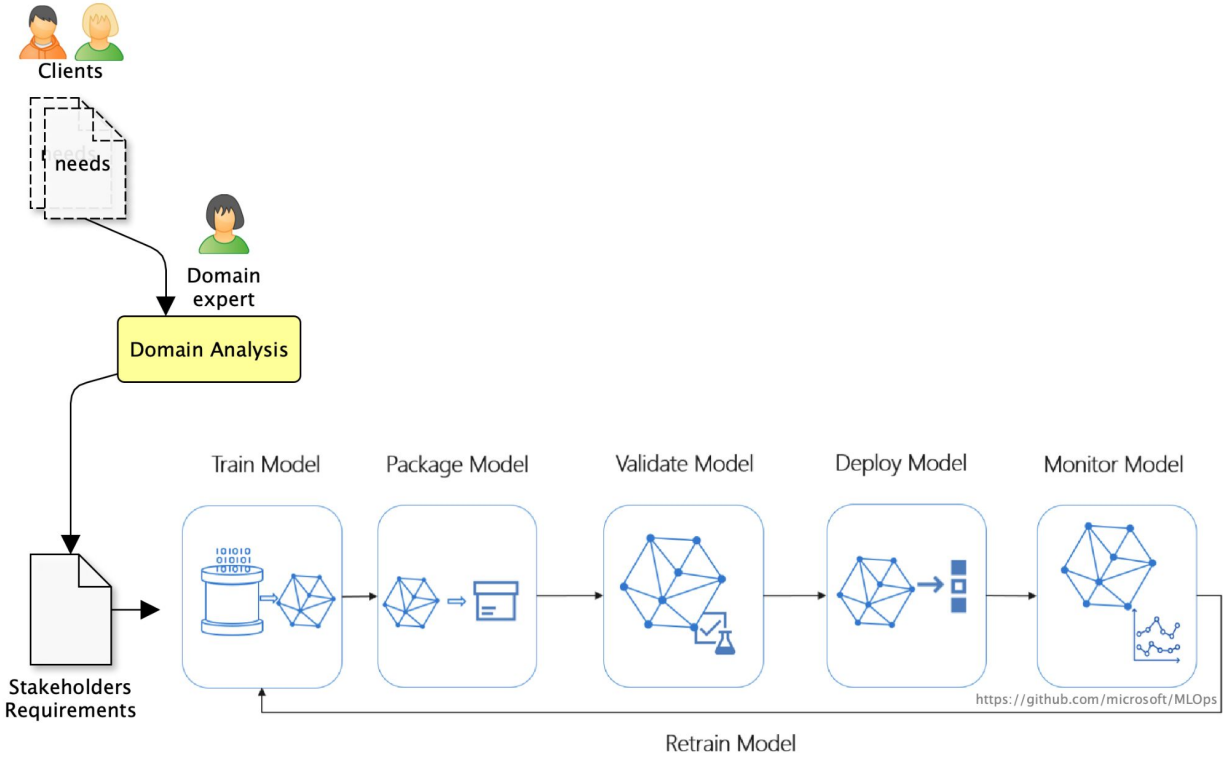


https://medium.com/@sudhanshu.bhargav/genai-101-ai-ml-llms-explained-2e324aa2a0b0

anr agence nationale de la recherche
ANR-24-IAS2-0002

Big picture

MLOps context

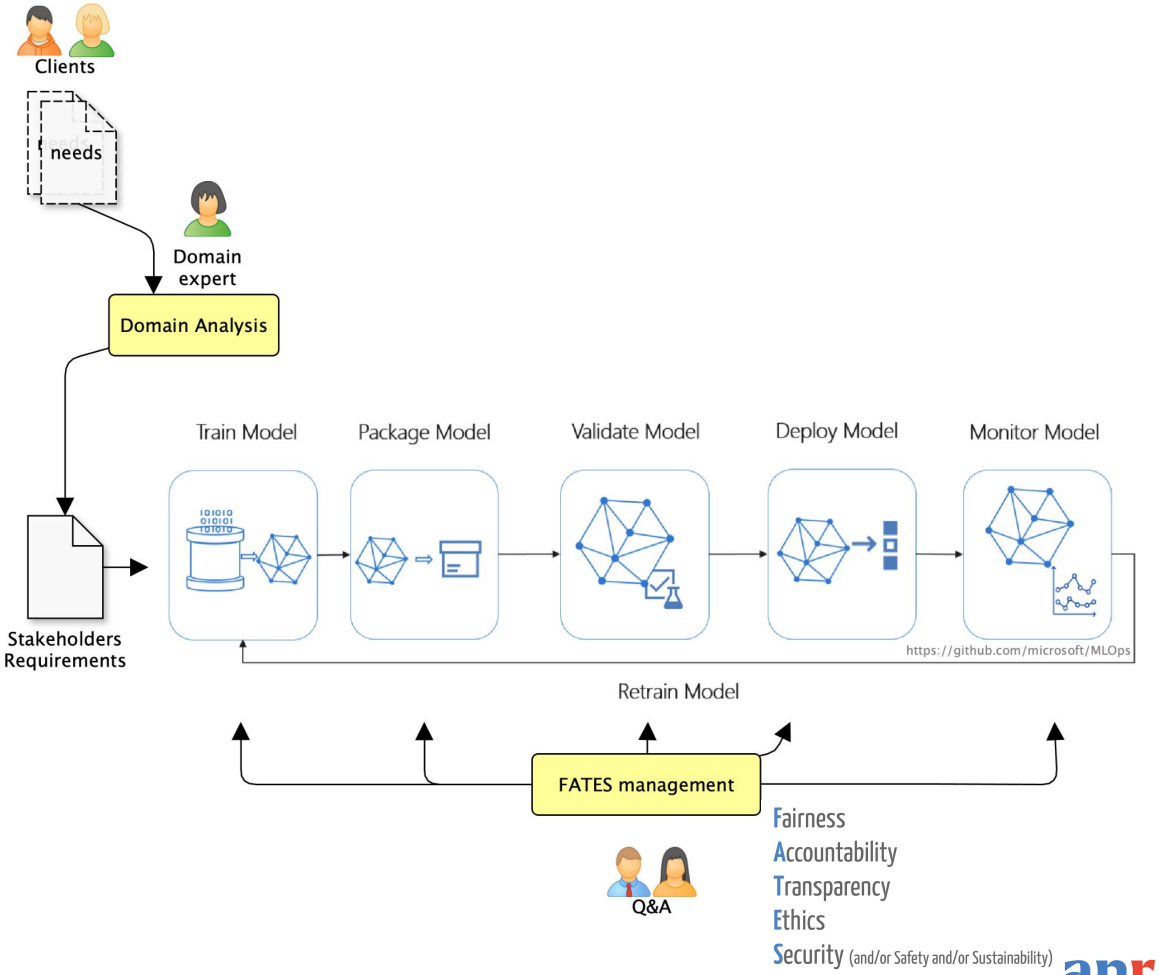


ANR-24-IAS2-0002

Big picture

FATES consideration

Continuous effort



ANR-24-IAS2-0002

FATES properties

Fairness

Accountability

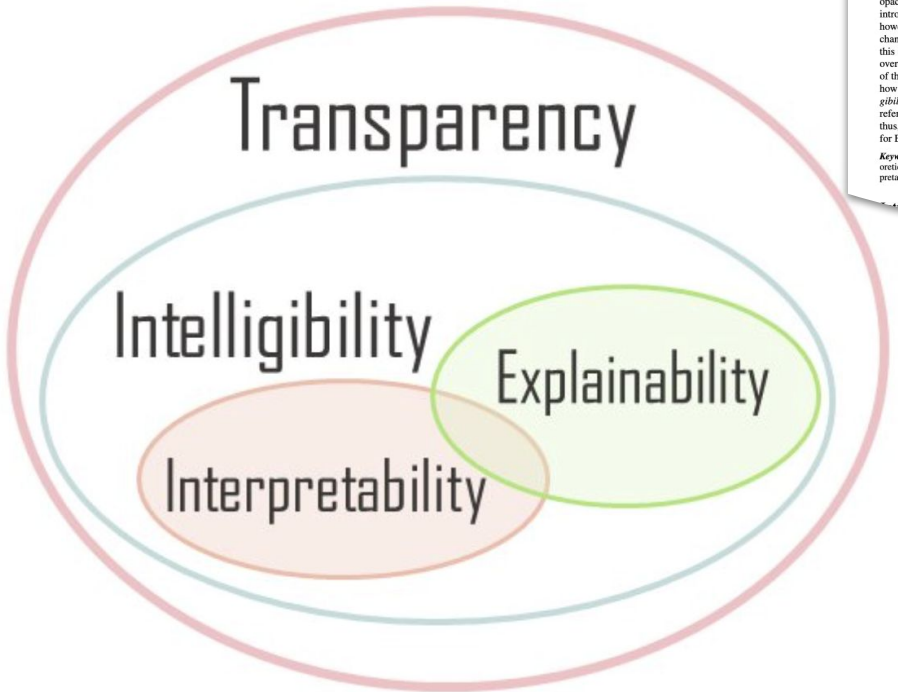
Transparency

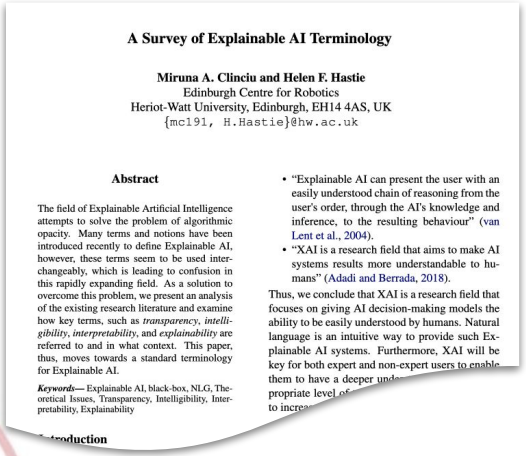
Ethics

Security (and/or **Safety** and/or **Sustainability**)

anr agence nationale de la recherche
ANR-24-IAS2-0002

Definitions issues





A Survey of Explainable AI Terminology

Miruna A. Clinciu and Helen F. Hastie
Edinburgh Centre for Robotics
Heriot-Watt University, Edinburgh, EH14 4AS, UK
{mcl91, H.Hastie}@hw.ac.uk

Abstract

The field of Explainable Artificial Intelligence attempts to solve the problem of algorithmic opacity. Many terms and notions have been introduced recently to define Explainable AI, however, these terms seem to be used interchangeably, which is leading to confusion in this rapidly expanding field. As a solution to overcome this problem, we present an analysis of the existing research literature and examine how key terms, such as *transparency*, *intelligibility*, *interpretability*, and *explainability* are referred to and in what context. This paper, thus, moves towards a standard terminology for Explainable AI.

***Keywords*—** Explainable AI, black-box, NLG, Theoretical Issues, Transparency, Intelligibility, Interpretability, Explainability

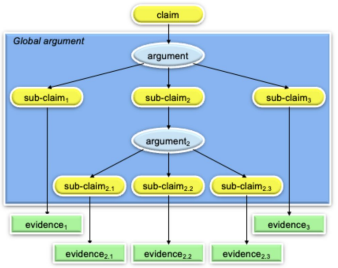
- "Explainable AI can present the user with an easily understood chain of reasoning from the user's order, through the AI's knowledge and inference, to the resulting behaviour" (van Lent et al., 2004).
- "XAI is a research field that aims to make AI systems results more understandable to humans" (Adadi and Berrada, 2018).

Thus, we conclude that XAI is a research field that focuses on giving AI decision-making models the ability to be easily understood by humans. Natural language is an intuitive way to provide such Explainable AI systems. Furthermore, XAI will be key for both expert and non-expert users to enable them to have a deeper und... propriate level of... to increa...

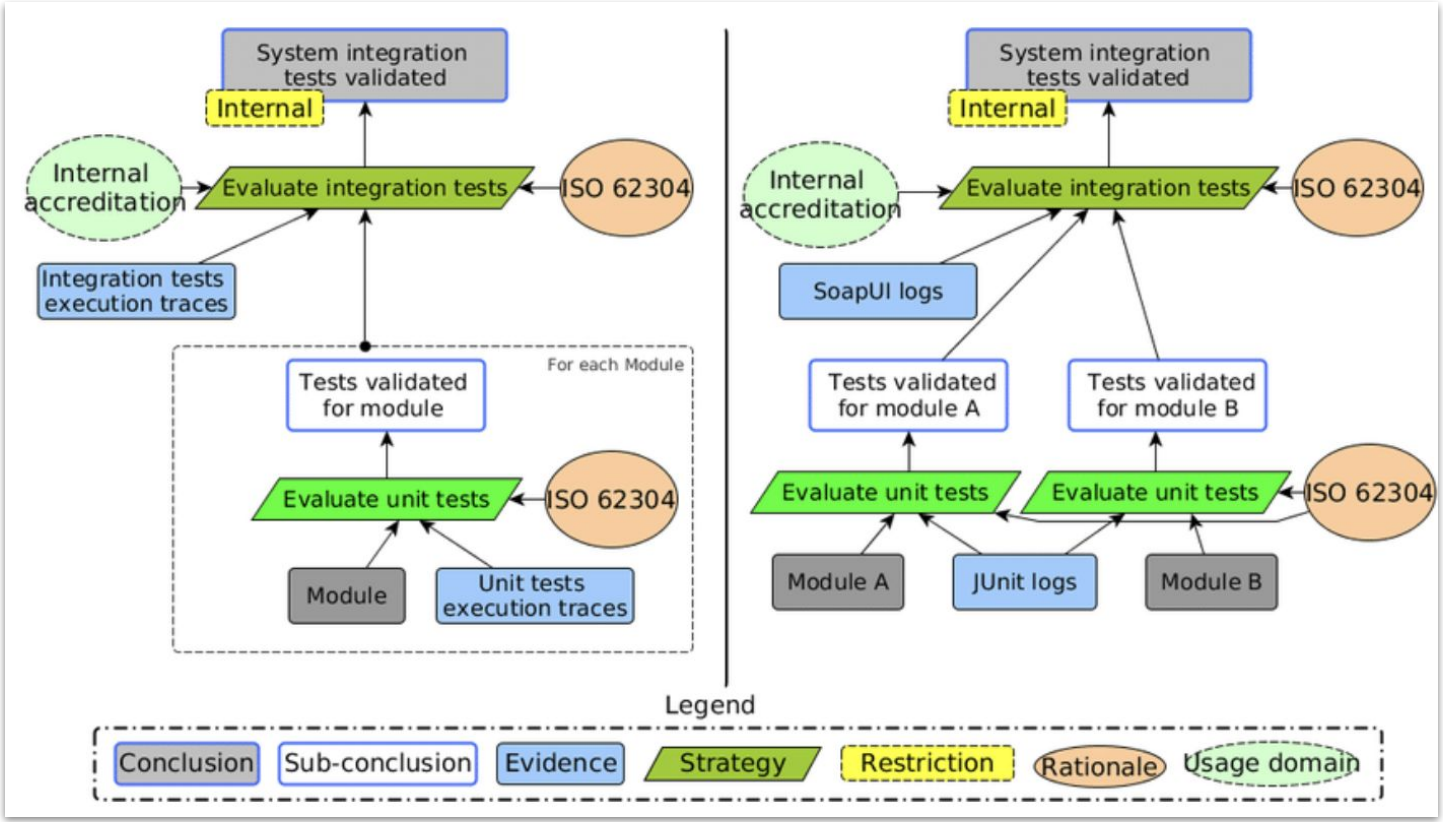
...troduction

https://www.researchgate.net/publication/338086557_A_Survey_of_Explainable_AI_Terminology

Justification diagrams (ISO-IEC-IEEE 15026-2)

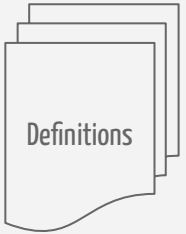


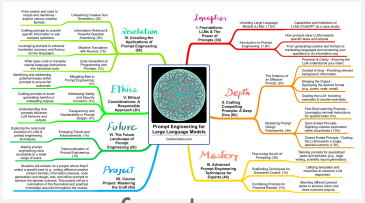
ISO 15026-2



ANR-24-IAS2-0002

Requirements and Traceability Issues

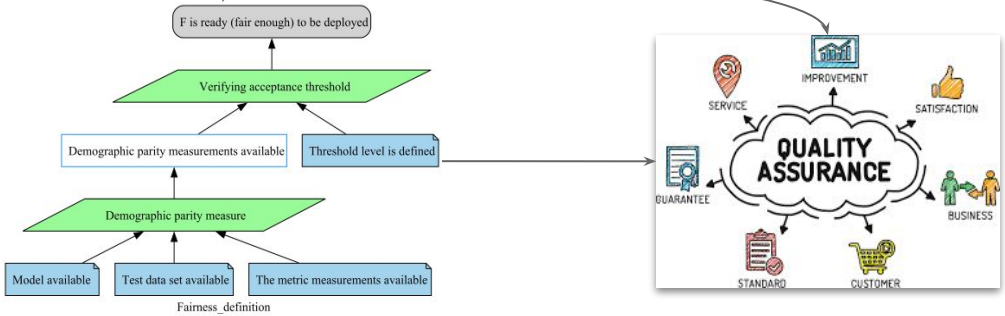




This evolves fast!

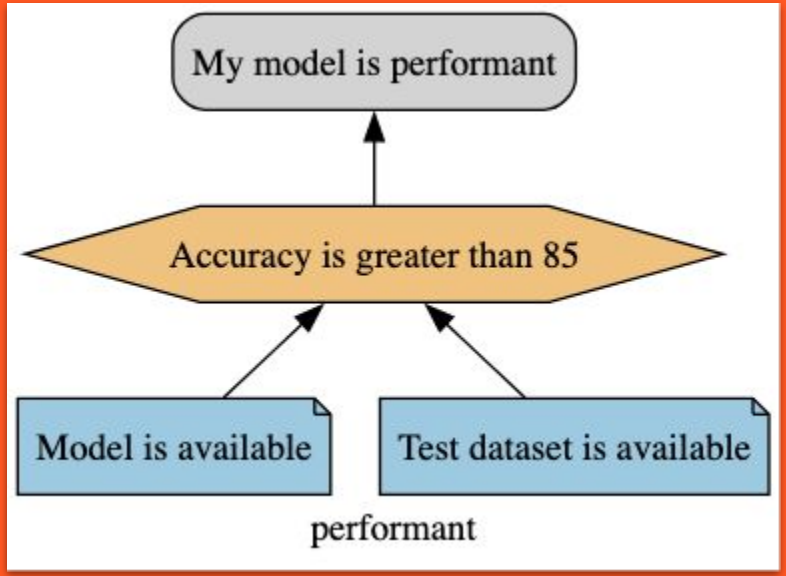
Feature Models | Goal-Oriented Models | Ontologies | Knowledge Graphs | ...

What's best?

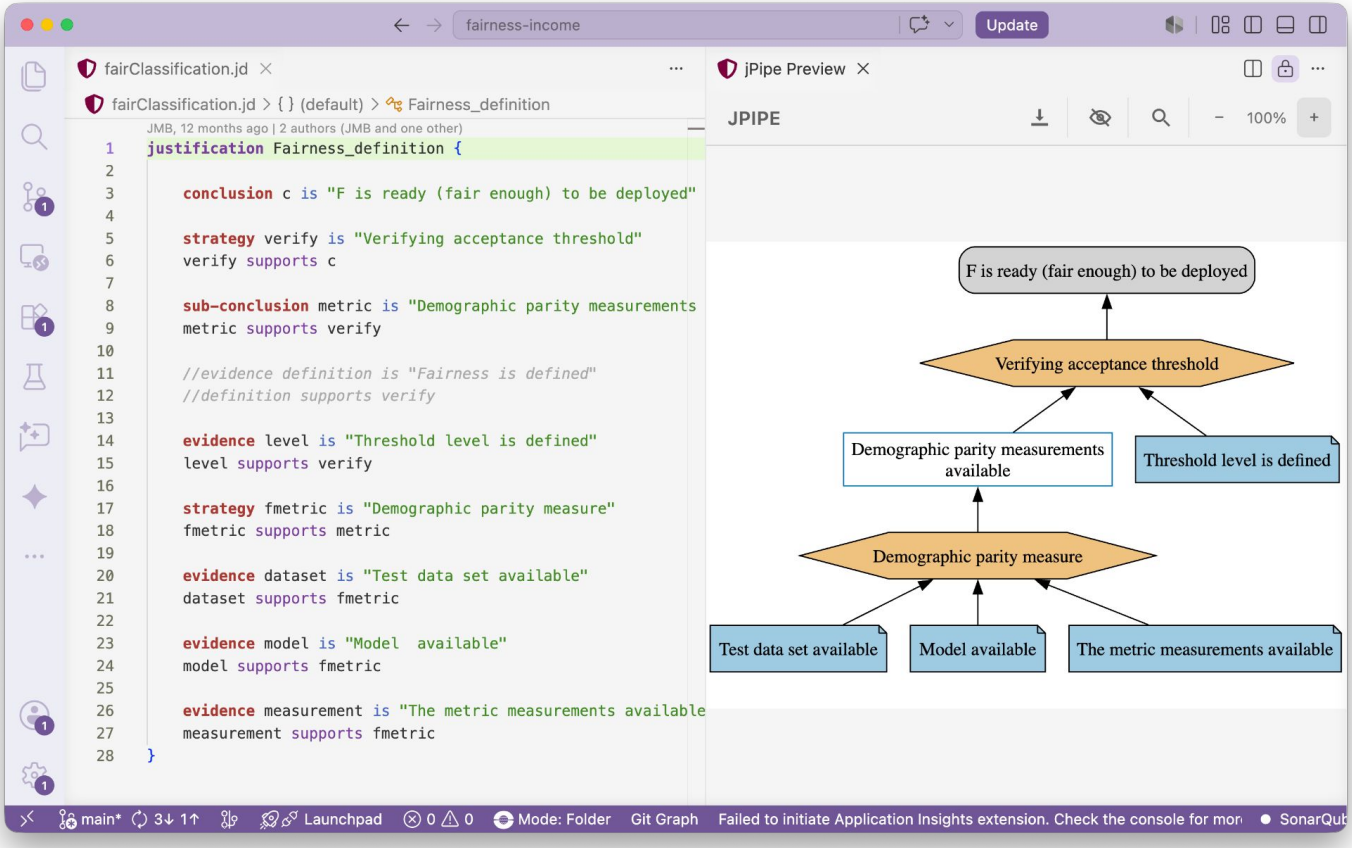


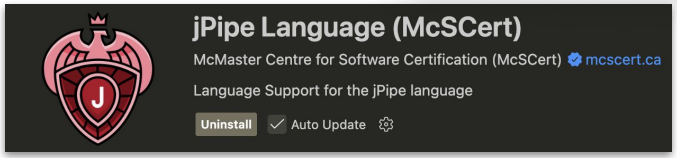
anr agence nationale de la recherche
ANR-24-IAS2-0002

Jpipe


My model is performant
Accuracy is greater than 85
Model is available
Test dataset is available
performant

Jpipe

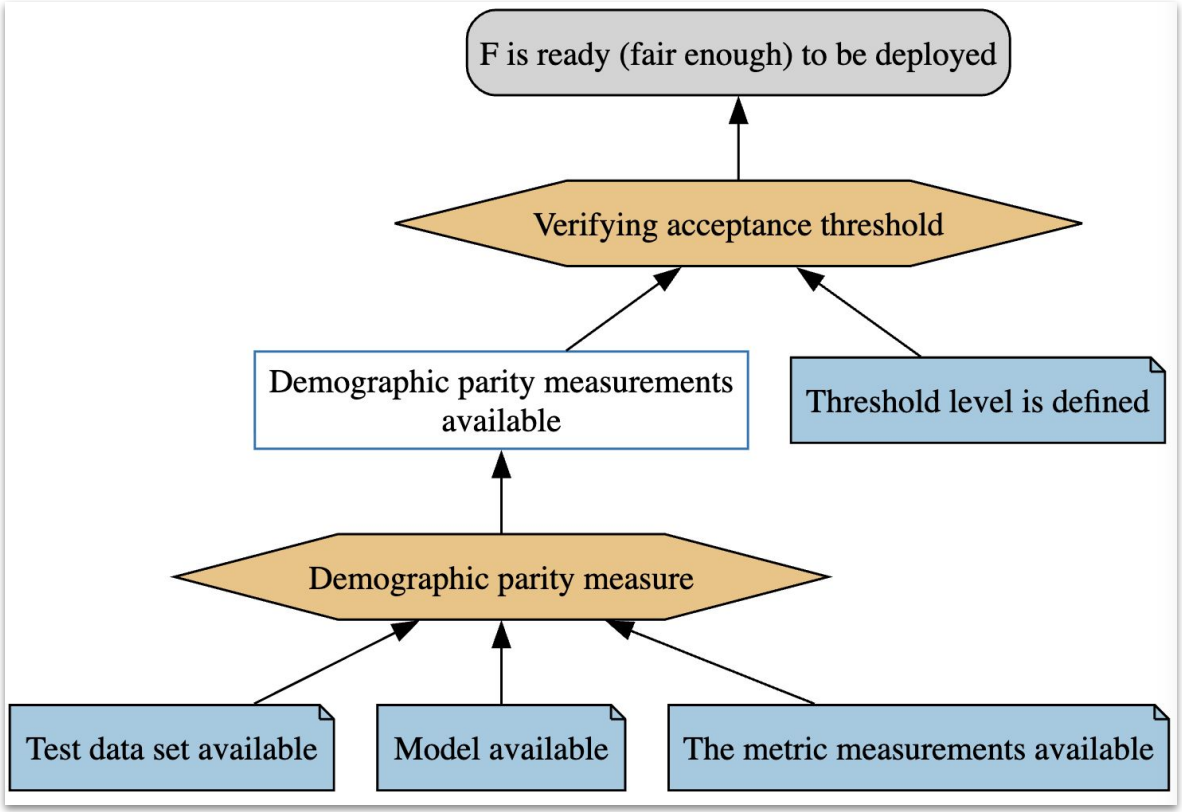




https://jpipe.org

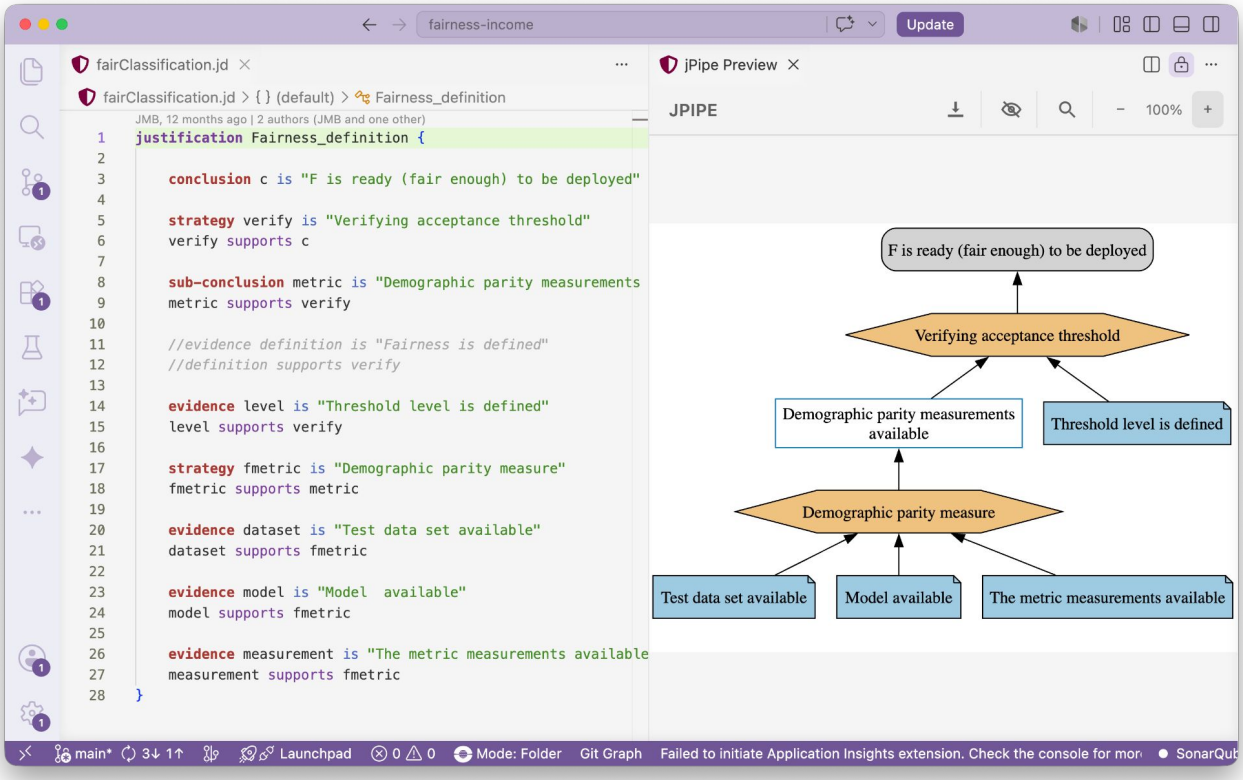
anr agence nationale de la recherche
ANR-24-IAS2-0002

To express requirements we need measurable properties



anr agence nationale de la recherche
ANR-24-IAS2-0002

Jpipe: an **editor** for justification diagrams (vscode plugin)



ANR-24-IAS2-0002

Jpipe: a **code generator** to support evaluations

```python
@jpipe_link("performant:e1")
@jpipe(produce=["model"])
def model_is_available(produce: JpipeProduce) -> bool:
    """[evidence] Model is available"""
    if (found := 'model_file' in mock):
        produce('model', mock['model_file'])
    return found


@jpipe_link("performant:e2")
@jpipe(produce=["tests"])
def test_dataset_is_available(produce: JpipeProduce) -> bool:
    """[evidence] Test dataset is available"""
    if (found := 'test_dataset' in mock):
        produce('tests', mock['test_dataset'])
    return found
```

https://github.com/jpipe-mcscert/bellairs-cse

anr agence nationale de la recherche
ANR-24-IAS2-0002

Jpipe: a runner to execute...

```
step_02 $ jpipe-runner --library steps/performant.py \
                       --diagram performant \
                       --format svg performant.json
```

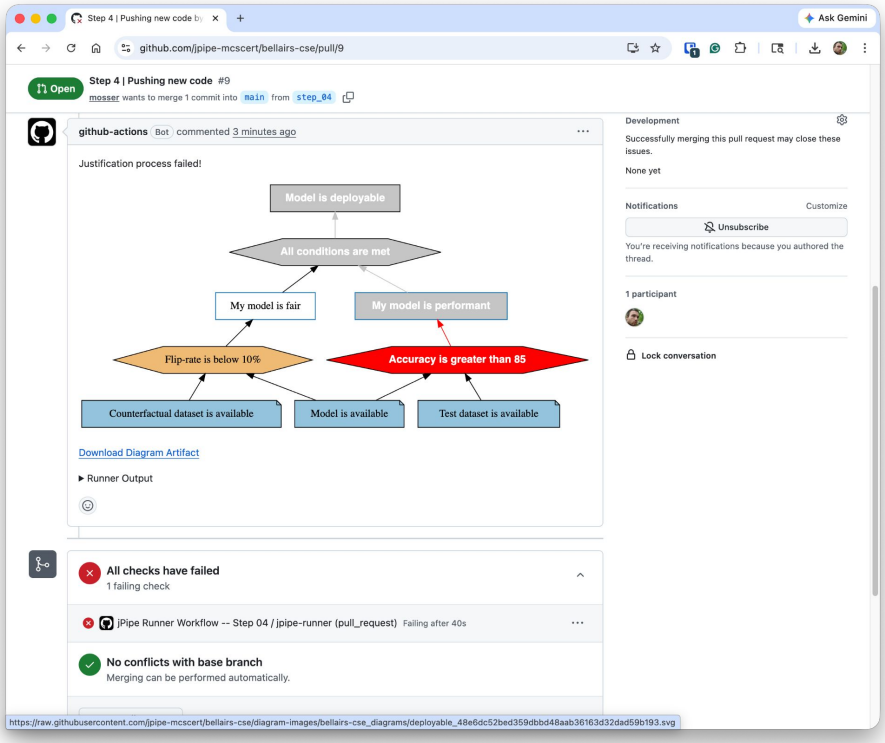
```
    _ ____  _                 ____
   (_)  _ \(_)_ __   ___    |  _ \ _   _ _ __  _ __   ___ _ __
   | | |_) | | '_ \ / _ \   | |_) | | | | '_ \| '_ \ / _ \ '__|
   | |  __/| | |_) |  __/   |  _ <| |_| | | | | | | |  __/ |
  _/ |_|   |_| .__/ \___|   |_| \_\\__,_|_| |_|_| |_|\___|_|
 |__/        |_|
```

```
================================================================================
jPipe Files
================================================================================
jPipe Files.Justification :: performant
================================================================================
evidence<performant:e1> :: Model is available                          | PASS |
--------------------------------------------------------------------------------
evidence<performant:e2> :: Test dataset is available                   | PASS |
--------------------------------------------------------------------------------
strategy<performant:s> :: Accuracy is greater than 85                  | PASS |
--------------------------------------------------------------------------------
conclusion<performant:c> :: My model is performant                     | PASS |
--------------------------------------------------------------------------------
jPipe Files
1 justification, 4 passed, 0 failed, 0 skipped
================================================================================
performant diagram saved to: performant.svg
```

https://github.com/jpipe-mcscert/bellairs-cse

anr agence nationale de la recherche
ANR-24-IAS2-0002

Jpipe: a **runner** to execute & support CI/CD

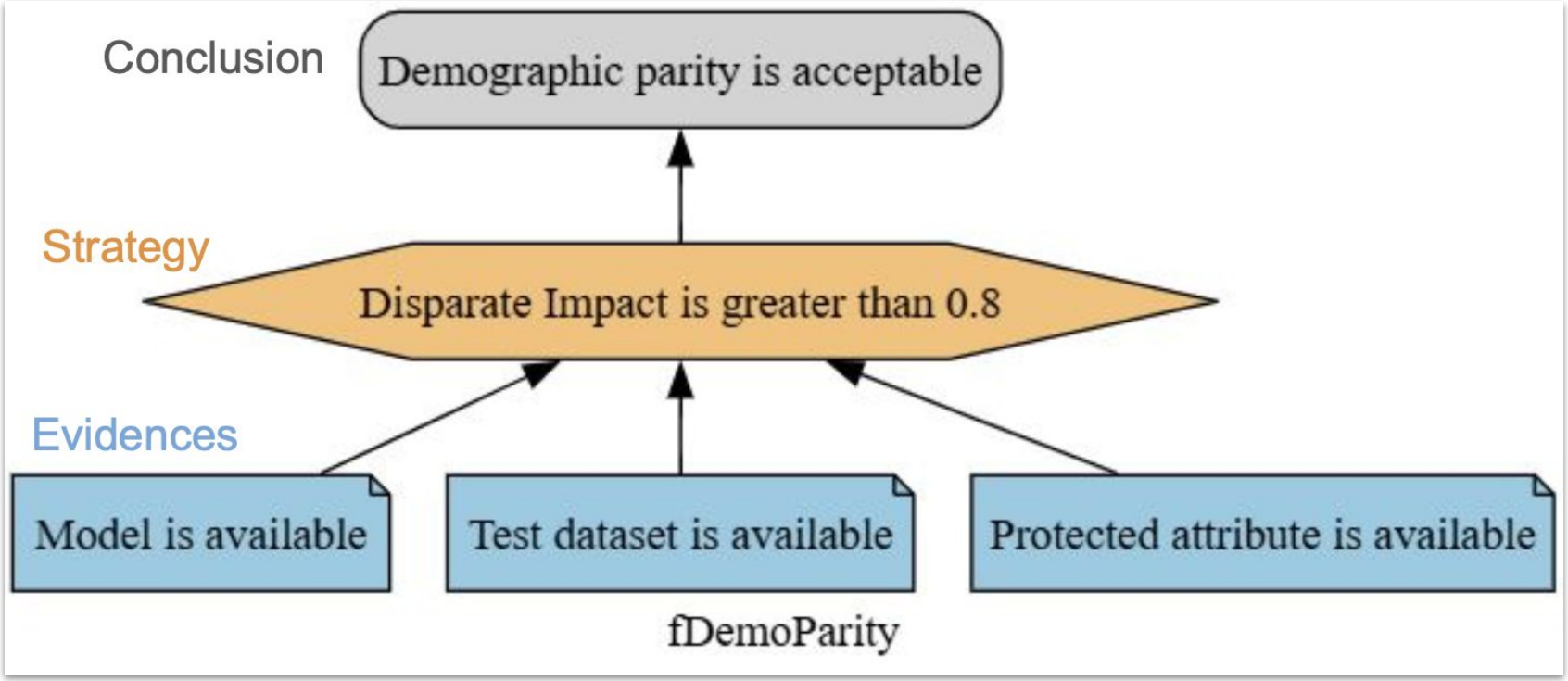


https://github.com/jpipe-mcscert/bellairs-cse

ANR-24-IAS2-0002

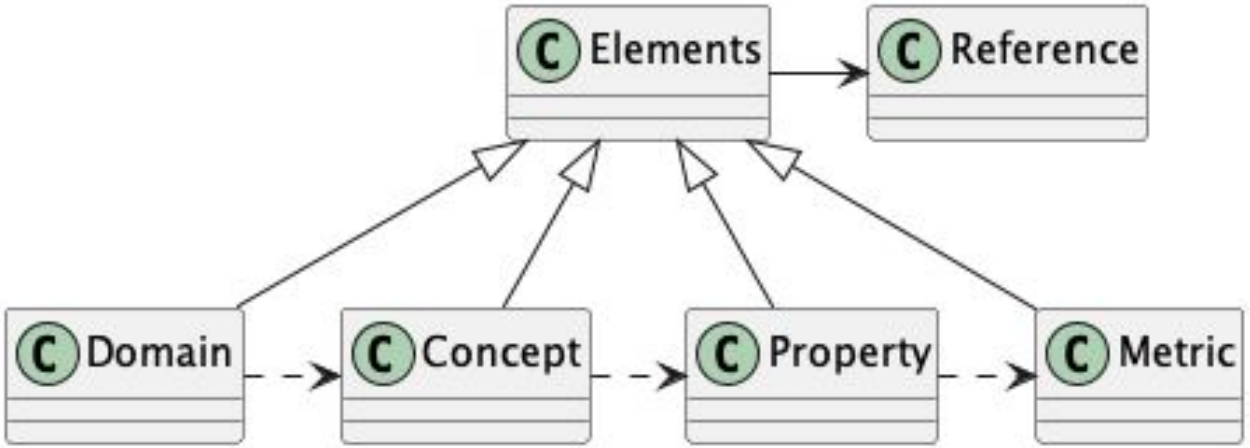
Ongoing Research

Semantically correct justifications



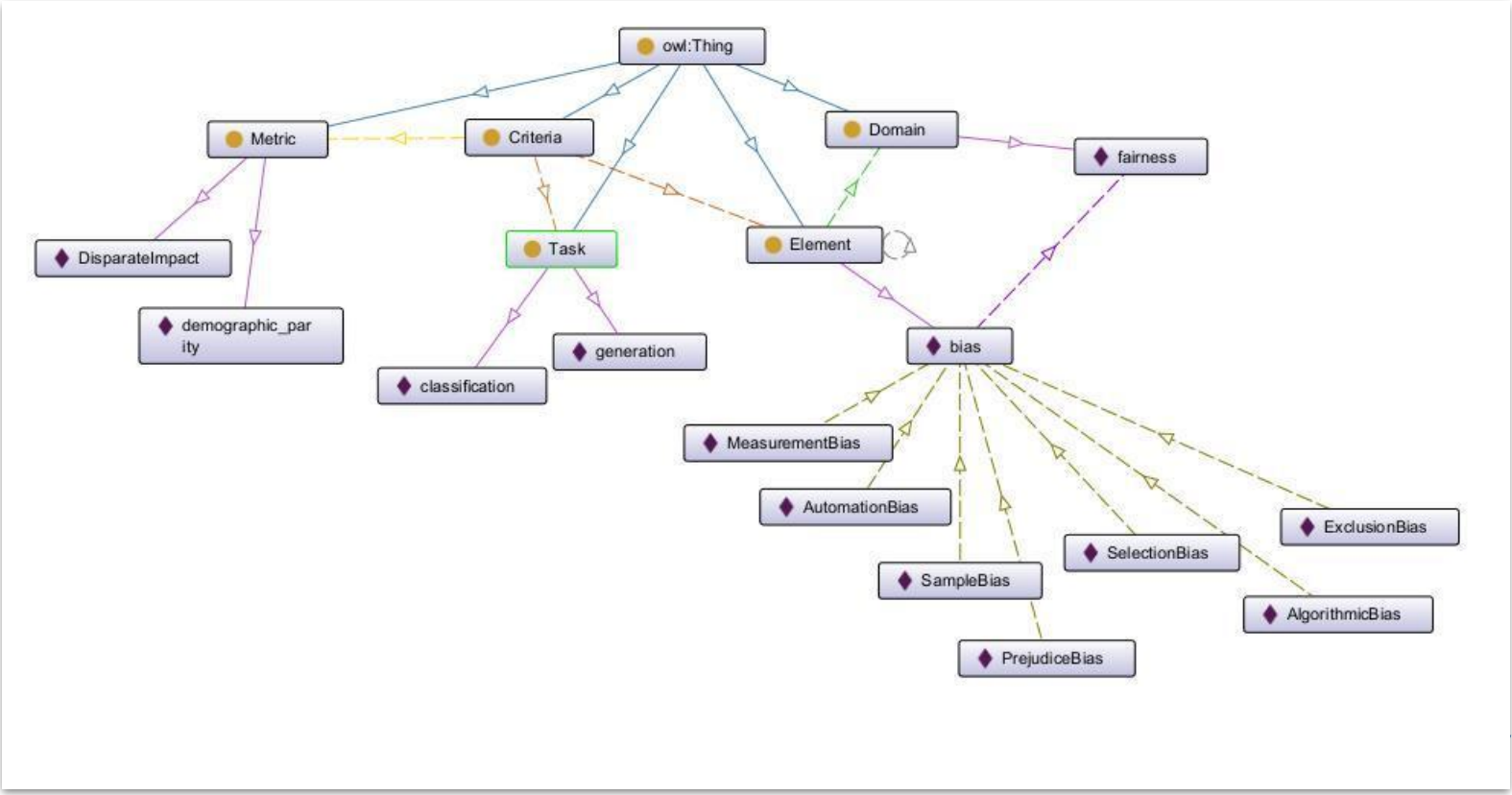
anr agence nationale de la recherche
ANR-24-IAS2-0002

Domain / Concepts / Properties / Metrics



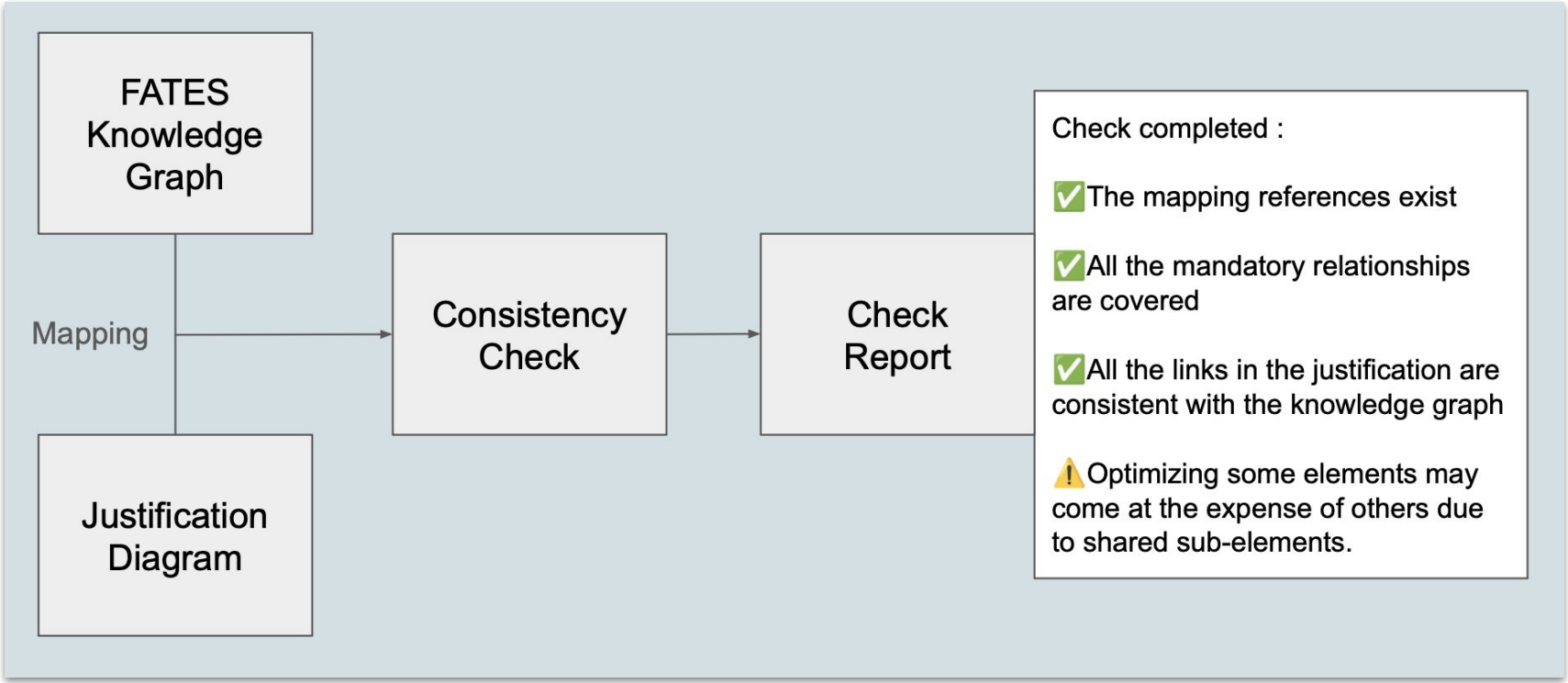
anr agence nationale de la recherche
ANR-24-IAS2-0002

Domain / Concepts / Properties / Metrics



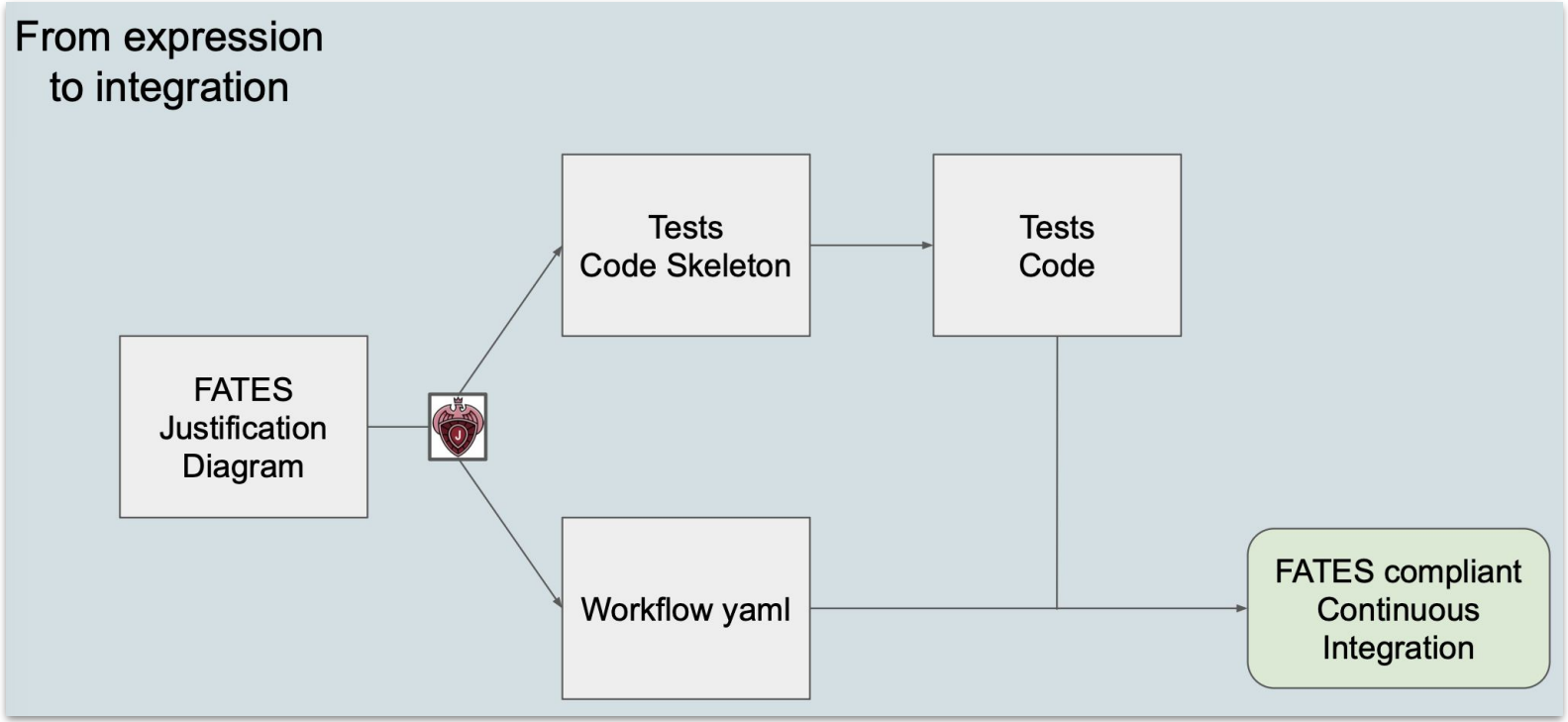
ANR-24-IAS2-0002

Semantically correct justifications

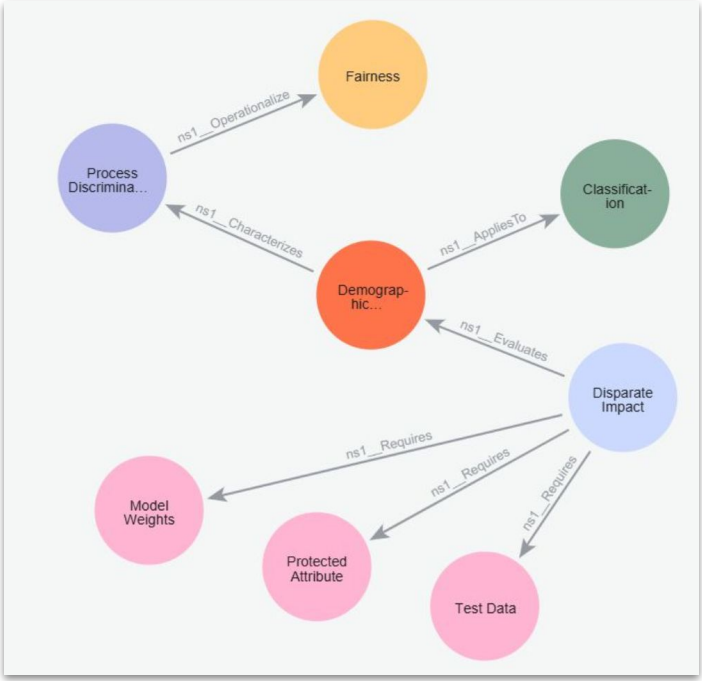


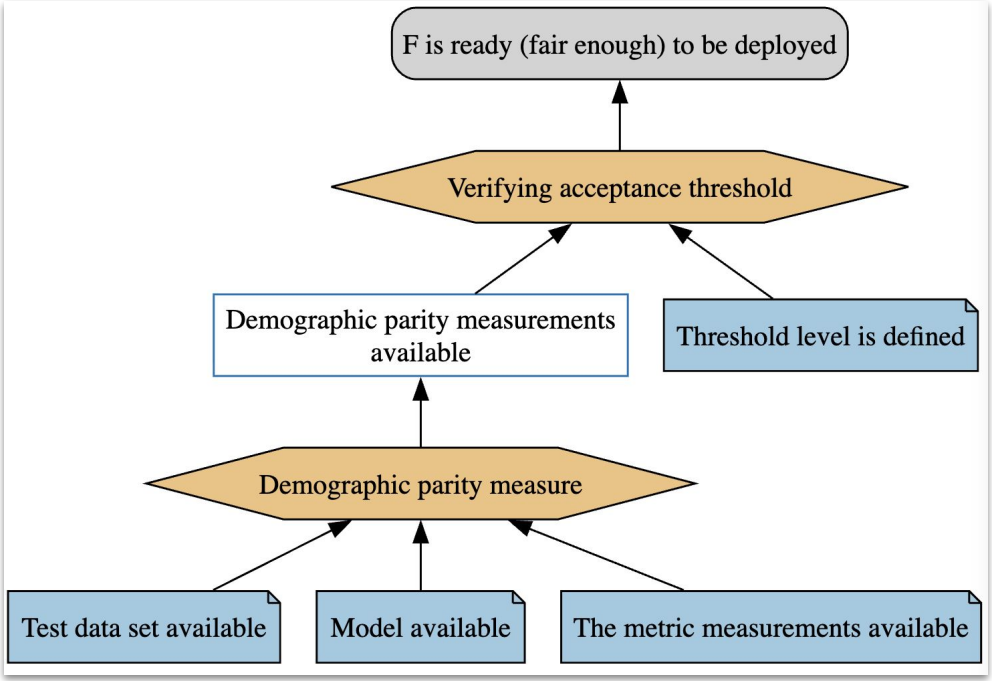
anr agence nationale de la recherche
ANR-24-IAS2-0002

Semantically correct justifications



Semantically correct justifications





anr agence nationale de la recherche
ANR-24-IAS2-0002

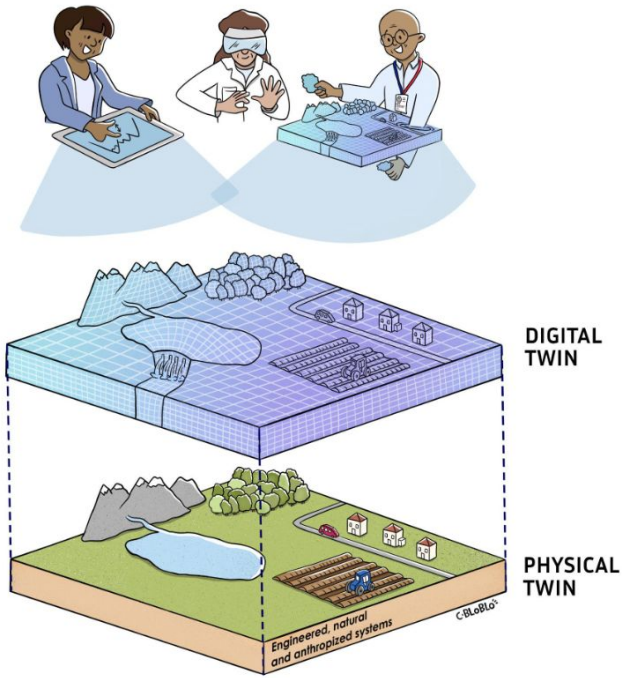
Ongoing Research

Digital Twins, Yet Another Definition…

*"A digital twin is a software system that **purposefully represents** an original, **accurately reflects** its changes, can **act upon** its original, and provides **added value to users or other systems**."*

-- Michael, Rumpe, Wortmann, Combemale, Jézéquel

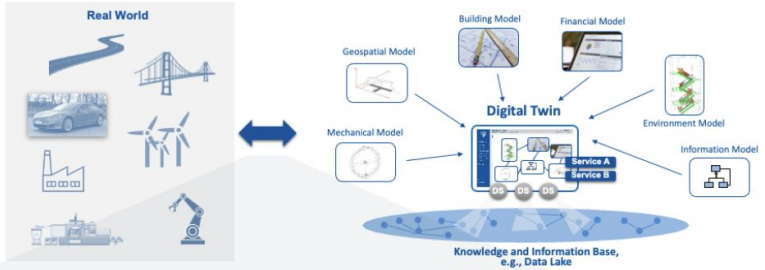
In upcoming book…

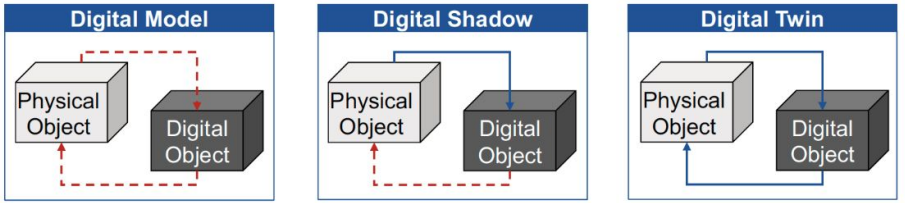


Université de Rennes

Creating Digital Twins for…

… elements in the "real" world that can be sensed, monitored, actuated and controlled





W. Kritzinger, M. Karner, G. Traar, J. Henjes, W. Sihn: *Digital Twin in manufacturing: A categorical literature review and classification.* IFAC-PapersOnLine, 2018.

Engineering Digital Twins

anr agence nationale de la recherche
ANR-24-IAS2-0002

Digital Twins: Engineering the V&V

Once DT validated:

- How to formalize the justification?
- How to ensure fidelity (continuous validation)?
- What is the diff equivalent in that situation
  - Original evolutions?
  - Twin evolutions?
  - Drift?

anr agence nationale de la recherche
ANR-24-IAS2-0002

http://fates-mlops.org/
https://www.jpipe.org
https://edtlab.fr/en/

Discussions time!

https://bit.ly/jmbruel
@jmbruel

https://bit.ly/jmb-talks
Get the slides

IRIT Institut de Recherche en Informatique de Toulouse
CNRS - Toulouse INP - UT - UTC - UT2
UNIVERSITÉ CÔTE D'AZUR
RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité
Inria
McMaster University
anr agence nationale de la recherche