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GENERATIVE-AI BASED AGENTS TO REVOLUTIONIZE MEDICAL DIAGNOSIS AND TREATMENT OF CANCER

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#PathfinderChallenges

Agentic AI

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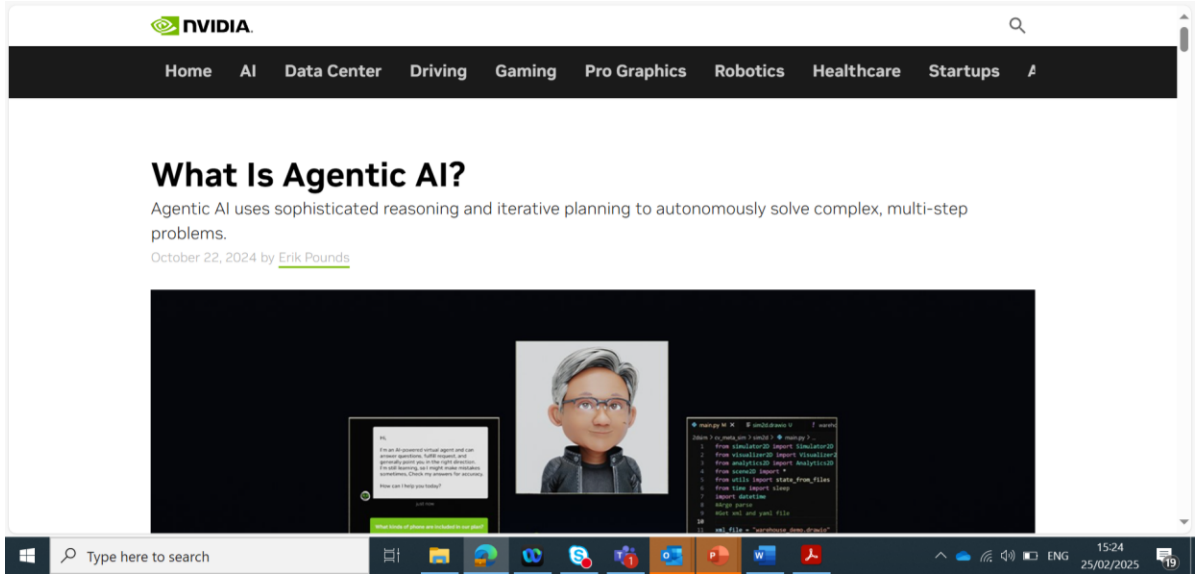
- Agentic AI refers to artificial intelligence systems that possess autonomous decision-making capabilities, enabling them to independently analyze challenges, develop strategies, and execute tasks without human intervention. These systems are designed to handle complex, multi-step problems by employing sophisticated reasoning and iterative planning.



Background: barriers in cancer diagnosis and treatment

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High amount of data to be processed by the radiologist/clinician:

- lack of **holistic** perspective on patient care, disease or treatment progression
- lack of **pattern** identification
- variability in interpretation leading to inconsistencies and **errors** in diagnoses and/or treatment

The current state-of-the-art in AI for oncology

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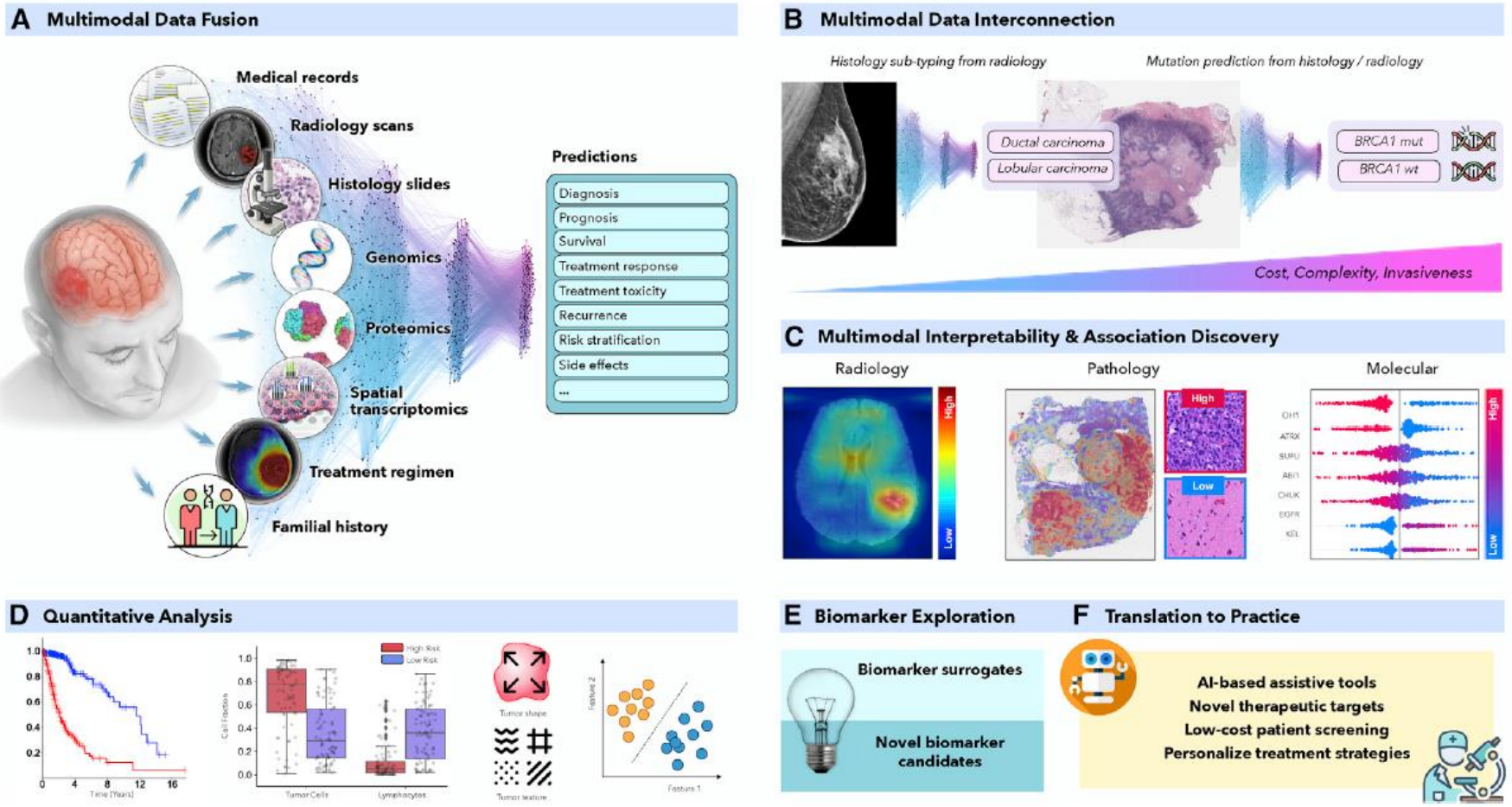

Figure 1. AI-driven multimodal data integration

(A and C–F) (A) AI models can integrate complementary information and clinical context from diverse data sources to provide more accurate outcome predictions. The clinical insights identified by such models can be further elucidated through (C) interpretability methods and (D) quantitative analysis to guide and accelerate the discovery of new biomarkers or therapeutic targets (E and F).

(B) AI can reveal novel multimodal interconnections, such as relations between certain mutations and changes in cellular morphology or associations between radiology findings and histology tumor subtypes or molecular features. Such associations can serve as non-invasive or cost-efficient alternatives to existing biomarkers to support large-scale patient screening (E and F).

Cancer Cell

CellPress
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Review

Artificial intelligence for multimodal data integration in oncology

Jana Lipkova,[1,2,3,4] Richard J. Chen,[1,2,3,4,5] Bowen Chen,[1,2,6] Ming Y. Lu,[1,2,3,4,7] Matteo Barbieri,[1] Daniel Shao,[1,2,6] Anurag J. Vaidya,[1,2,6] Chengkuan Chen,[1,2,3,4] Luoting Zhuang,[1,8] Drew F.K. Williamson,[1,2,3,4] Muhammad Shaban,[1,2,3,4] Tiffany Y. Chen,[1,2,3,4] and Faisal Mahmood[1,2,3,4,9,*]

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Unsolved Challenges & Technology Gaps

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- Lack of structured, unified multimodal representations. No spatiotemporal modeling.
- Synthetic data lacks biological constraints. No standard validation benchmarks.
- Static knowledge graphs. AI lacks reasoning & insight generation.
- AI models don’t adapt to evolving patient data. Limited exploration of Digital Twins & Reinforced Learning.
- AI models lack explainability, interpretability and trustworthiness
- No advanced models for patient shared decision making

Scope of the Challenge

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- Support **population-level real-world data multimodal multidimension learning**

- Enable streamlining tasks like determination:
  - of **clinical pathway,**
  - **patient risk** assessment**,**
  - prediction of **disease progression,**
  - assessment of **personalized treatment**

- Address **data** scarcity, biases, and privacy concerns for AI applications

Specific objectives of the Challenge

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AREA 1: Technological

i. AI-based tools and architecture for Integrating Multimodal Multidimensional Data

ii. AI-based tools for Medical Data Augmentation

iii. AI-based tools and architecture for Medical Knowledge Representation and Integration

AND*

AREA 2 Clinical (exploiting info from area 1)

i. Autonomous agents for Predictive Diagnosis

ii. Autonomous agents for personalized Treatment Selection

*At least on sub-objective from each area

Technological area

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1. GenAI for Multidimensional Multimodal Health Data Integration

- Develop GenAI algorithms that **combine multidimensional and multimodal medical data**, integrating imaging, EHRs, pathology, genetics, and knowledge databases into a **unified and structured dataset**.
- AI models should **learn relationships between different medical data types** and make them actionable for downstream clinical applications.

2. Generative AI for Medical Data Augmentation

- Investigate **novel GenAI models** for creating **highly realistic synthetic medical data**, such as **synthetic pathology slides, MRI-to-CT image synthesis, or synthetic genomic profiles**.
- These models should **enhance AI model training and generalizability** by producing **high-fidelity, diverse datasets**.

3. Generative AI for Medical Knowledge Representation & Integration

- Develop **prototype GenAI models** that build a **dynamic, structured medical knowledge base**.
- **extract knowledge from imaging features, demographics, systemic conditions, and textual clinical notes** to support AI interpretability and assist in novel medical discoveries.

Clinical Area

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4. Predictive Diagnosis: AI Agents for Cancer Risk Assessment

- Develop **autonomous AI agents** that analyse **medical history, imaging, and genetics** to **assess a patient's cancer risk**.
- The AI should provide **personalized health risk predictions** for **early detection and prevention**.

5. Personalized Treatment Selection & Disease Progression Modelling

- Build AI models that **predict optimal treatment pathways** based on **multimodal and synthetic data**.
- Develop AI-driven models to **forecast disease progression and treatment efficacy**, helping oncologists make **data-driven personalized treatment decisions**.

Horizontal to both areas

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- ✓Ethics, AI Trustworthiness & Model Transparency
- ✓Bias Detection & Mitigation
- ✓Regulatory Compliance & Clinical Validation
- ✓Cost-effectiveness and Economic Impact

The AI models developed under this Challenge are expected to comply with the EU concept for Trustworthy AI, relevant ethical principles, and the AI Act.

- https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai
- https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/640163/EPRS_BRI(2019)640163_EN.pdf
- https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

Portfolio Considerations in EIC Pathfinder

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- **EIC does not fund standalone projects—it builds collaborative portfolios.**
- Funded projects are part of a **Challenge Portfolio**, working toward a **common vision**.
- Projects interact, share knowledge, and contribute to **collective goals**.

Portfolio Management

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1. Selection of a portfolio of projects

that share common research and innovation objectives

2. Development of a Strategic Plan

highlighting joint activities of a portfolio of projects

3. Implementation

of the strategic plan to accelerate the research to market transition.

Step 1: Ranking *

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Award criteria Pathfinder Challenge 2024		
	Threshold	Weight
Excellence	4/5	60%
Impact	3.5/5	20%
Quality of implementation	3/5	20%

** EIC Work Programme 2025 for detailed reference*

Step 2: Portfolio creation

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Category 1: Type of Cancer considered by a proposal.

As defined by WP, each proposal should focus on one (and only one) of the following diseases: breast cancer, cervical cancer, ovarian cancer, prostate cancer, lung cancer, brain cancer, stomach cancer or colorectal cancer.

Category 2: Type of clinical area covered with possible values:

i. Predictive Diagnosis.
ii. Personalized Treatment Selection.

Category 3: Technology area

Which technological approach is used in the proposal. The three possible values are:

i. GenAI-based tools (or other advanced AI technologies) for Integrating Multidimensional Multimodal Health Data
ii. Medical Data Augmentation
iii. Medical Knowledge Representation and Integration.

Category 4: Access to Infrastructure, data and ecosystem integration

What are the research infrastructures and clinical facilities that the proposal aims to use, which large datasets do they have access to, and what are their partnerships with hospitals or research institutions for clinical validation.

!!!!

Projects covering all subcategories of Categories 2 and 3 will be preferred, as they best align with the holistic approach sought by the challenge.

Important!!!

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Access to infrastructure and data:

- Connection to Existing European Research and Clinical Infrastructures, e.g. Testing and Experimentation Facilities (TEFs), Euro-BioImaging, Cancer Image Europe platform*, the future UNCAN.eu platform, etc.
- National Cancer/Screening Registries and Open Databases.

Ecosystem Integration

- Collaboration with Leading Clinical Institutions focused on oncology is **KEY**. The projects should be clinically driven
- seek complementarity and synergies with other activities already funded or in the funding pipeline in the framework of the Health cluster of Horizon Europe or Innovative Health Initiative Joint Undertaking

***EUCAIM webinar on 12/05**

In support of the European AI Strategy[1] , the Cancer Plan for Europe[2] and the Cancer Image Europe platform[3]_

[1] European approach to artificial intelligence | Shaping Europe's digital future (europa.eu)
[2] A cancer plan for Europe - European Commission (europa.eu)
[3] https://cancerimage.eu/ , https://digital-strategy.ec.europa.eu/en/policies/cancer-imaging

Examples for Health Cluster HE

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- Projects funded on AI technologies to enable care, treatment and disease risk prediction/ progression, in the context of oncology supported under the Health cluster[1,2]
- EU Health Policy Platform, Thematic Network on 'Advancing Precision Medicine for Europe's Cancer Patients with AI-powered Imaging'[3]
- Relevant topics in the Health Cluster 1, Work Programme 2025 on Generative AI solutions (forthcoming).

[1]HORIZON-HLTH-2021-DISEASE-04-04: Clinical validation of artificial intelligence (AI) solutions for treatment and care
[2]HORIZON-HLTH-2022-STAYHLTH-01-04-two-stage: Trustworthy artificial intelligence (AI) tools to predict the risk of chronic non-communicable diseases and/or their progression
[3]https://health.ec.europa.eu/document/download/6e4f5ecb-ea9c-445a-a661-7147809aa255_en?filename=policy_20241126_js02_en.pdf

Examples for IHI

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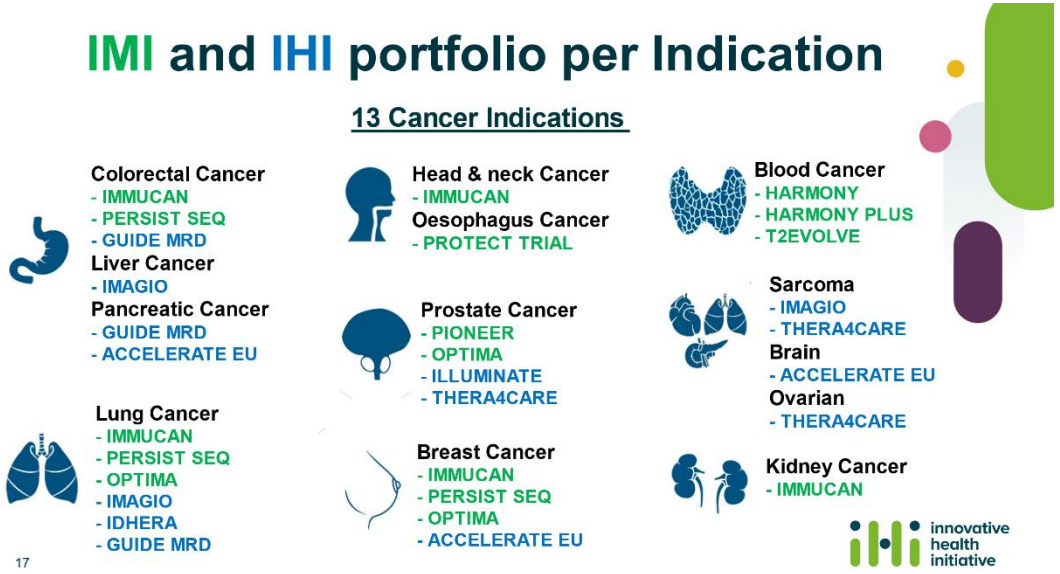
- IMAGIO “Imaging and advanced guidance for workflow optimization in interventional oncology” (Call 1, Topic 2)
- GUIDE.MRD “Guiding multi-modal therapies against MRD by liquid biopsies” (Call 1, Topic 3)
- SEARCH “Synthetic healthcare data governance hub” (Call 5, Topic 4)
- SYNTHIA “Synthetic data generation framework for integrated validation of use cases and AI healthcare applications” (Call 5, Topic 4)



Expected projects collaborations

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The portfolio of selected projects will be designed to deliver a set of agents/models for improved diagnosis and personalized treatment of the above-mentioned cancers. Specifically, the projects will collaborate to:

- Create a shared database of synthetically generated images to be used across all projects for the development of their algorithms;
- Compare the use of a combination of the agents in the case of multiple cancers;
- Benchmark agents for enhanced diagnosis and personalized treatment selection;
- Define innovative clinical pathways in oncology;
- Externally validate the developed agents within a project at clinical premises of another project in the portfolio;
- Develop standardized methods and frameworks for evaluating AI- Act and Medical Device Regulation (MDR)- compliant generative AI models.

2. Development of a strategic

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- Kickoff-meeting
- Common Vision and Mission
- Strategic Goals
- Implementation Plan
- Operating mechanisms
- Key Performance Indicators

Continuum Health Portfolio Kick-off Meeting, june 2024

3. Implementation examples: Joint efforts on…

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- Technology Integration
- Data Sharing and Analysis
- Scaling and Commercialization
- Stakeholder Engagement
- Regulatory Alignment
- Sustainability and Societal Impact

Expected outcomes and impacts:

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Impact on Healthcare

- Enhances **diagnosis and personalized treatment**.
- **Reduces clinician workload** while improving medical service quality.
- Ensures compliance with **EU Trustworthy AI principles**.

Economic & Societal Benefits

- **Cost reduction & cost avoidance** in healthcare.
- Long-term improvements in **efficiency & sustainability**.
- Positions **Europe as a leader** in AI-driven cancer care.
- Provides **significant benefits to patients, healthcare providers, and society**.

EIC Pathfinder goals

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- The EIC ultimate goals are:
  - to create societal and market impact
  - to ensure European strategic independence for key technologies

- The EIC aims to reach these goals by **identifying, developing and scaling up breakthrough technologies and game changing innovations.**

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Thank you!

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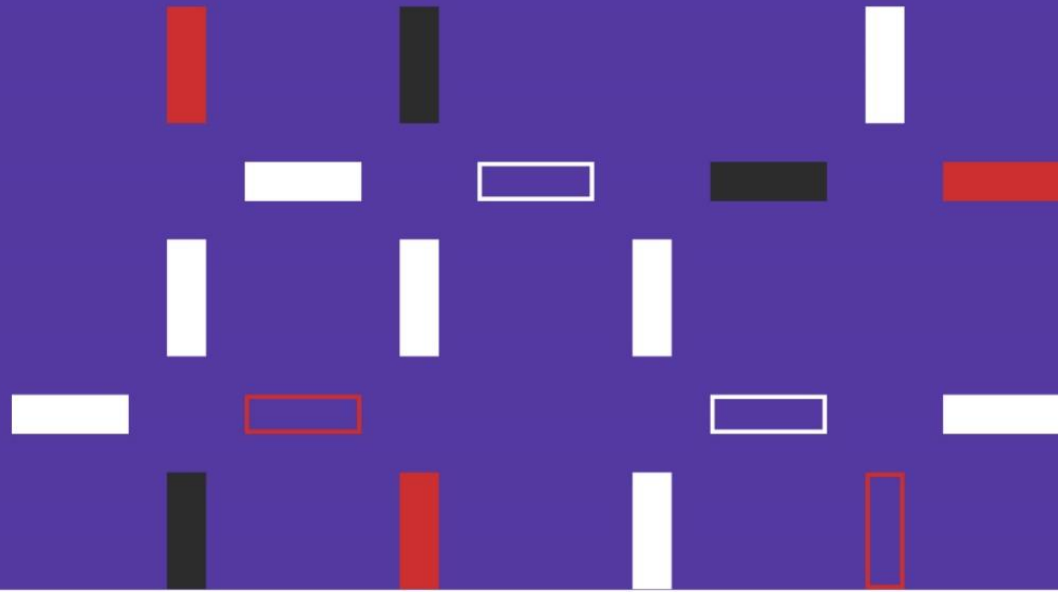

The first European AI Factories

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