

Machine Learning for Geographical Indications

Capturing the Territorial Signatura (Data Acquisition)



Terroir



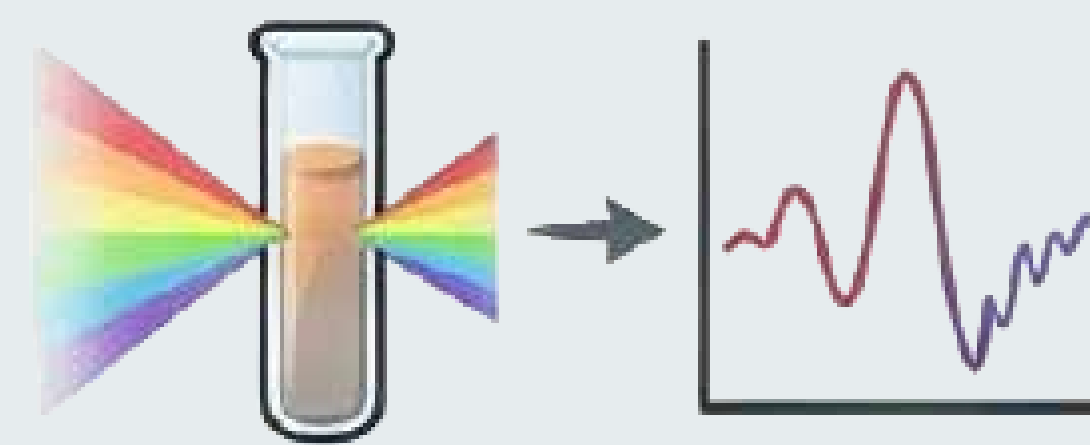
WINE



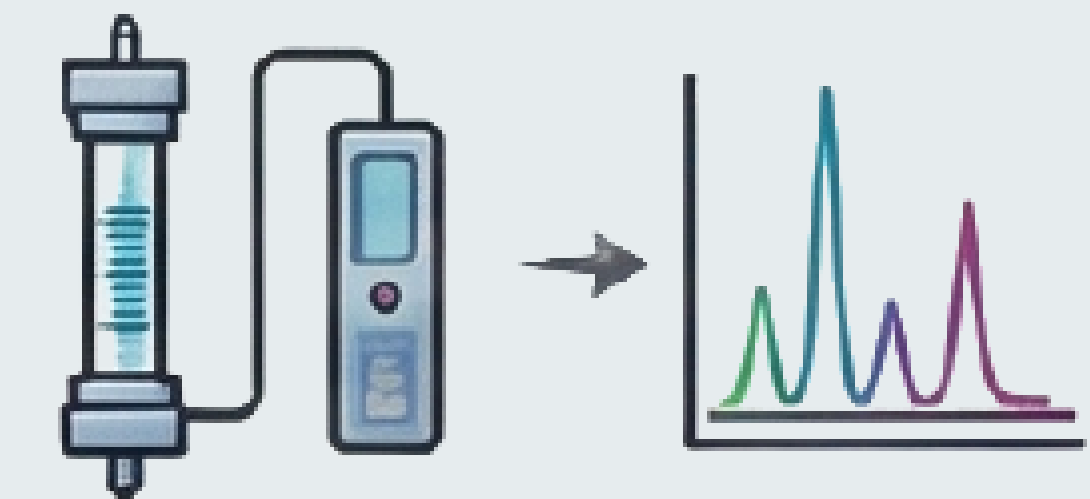
TEA



MEAT



Spectroscopy (NIR/FTIR)

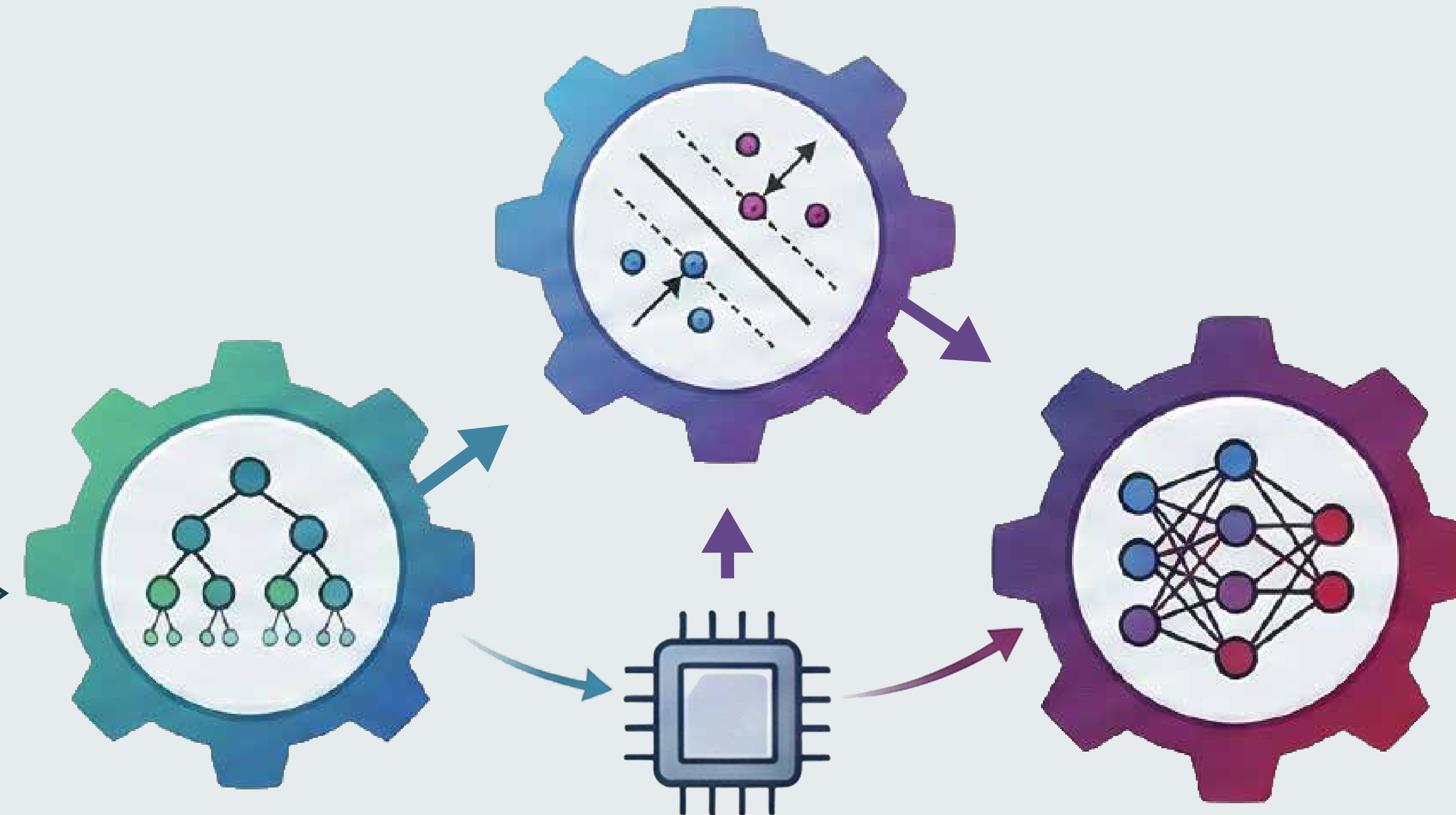


Chromatography (GC/LC-MS)



**Sensors/Imaging
(e-nose/Hyperspectral)**

Machine Learning Evolution & Technological Modules (Processing)



Module 1:
Spectroscopy + Tree-
based Models
(Random Forest)
Focus: Wines, Honey

Module 2:
Algorithmic
Processing & Pattern
Recognition

Module 3:
Sensor/Images +
Deep Learning (CNN)
Focus: Teas, Oils

2010

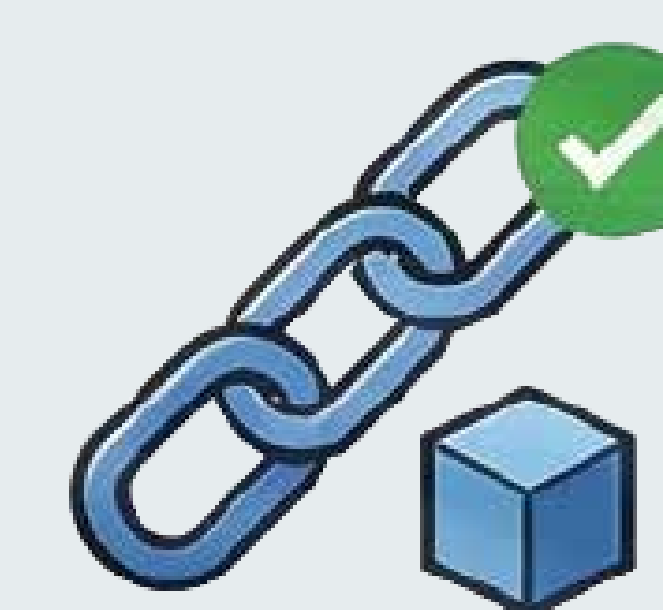
400% Growth in Publications

2025

Outcomes & Certification Challenges



**Authentication &
Fraud Detection**
(79% of studies)



**Traceability &
Blockchain
Integration**



**Quality
Prediction**



CRITICAL GAPS IDENTIFIED



Limited External Validation:
Only 23% tested on Independent geographical
samples



Interpretability Challenge:
Need for explainable AI over "black-boxes"
for regulatory trust.