

The Romano Lab @ Penn: Knowledge-driven environmental health

presented by Joseph D. Romano, PhD

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DEPARTMENT of
BIOSTATISTICS
EPIDEMIOLOGY &
INFORMATICS

Center of Excellence in
Environmental Toxicology

Penn Institute for
Biomedical Informatics



The Romano Lab @ Penn



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Chloé Paris
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Estefania Morales
Summer Undergraduate Internship Program (SUIP) Fellow

Not Pictured:

Kevin Shen
Undergraduate Researcher

Tom Pan
Undergraduate Researcher

We study...

- Computational toxicology
 - Designing interpretable AI models to predict toxicity
 - Discovering *mechanisms* linking specific chemicals to human diseases
- Autoimmunity
 - Biomarker discovery for immune-related adverse events (irAEs)
- Clinical informatics
 - How to computationally model and extract knowledge from electronic health record data
- Artificial Intelligence and Machine Learning
 - Multimodal graph machine learning
 - Automated machine learning
 - Large language models (LLMs) and their applications in biomedicine

Computational Toxicology and Artificial Intelligence

Drugs (incl. withdrawn, investigational...)

DRUGBANK Online

Browse ▾

Search ▾

Interaction Checker

 Small Molecule Drugs

 Biotech Drugs

FILTER BY GROUP

Approved Nutraceutical Illicit

Investigational Withdrawn Experimental

FILTER BY MARKET AVAILABILITY

U.S. Canada E.U.

Displaying drugs 1 - 25 of 12220 in total

1 2 3 4 5 ... > »

Environmental chemicals of toxicological concern

CompTox Chemicals Dashboard

Search 1,200,059 Chemicals

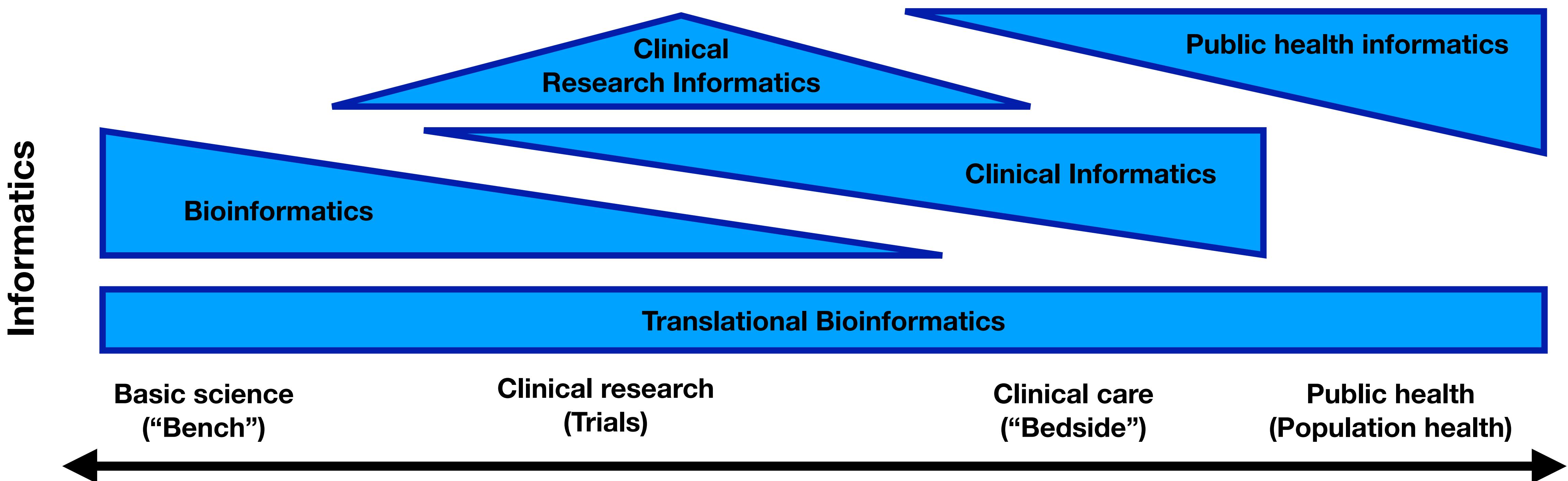
Chemicals Products/Use Categories Assay/Gene

Search for chemical by systematic name, synonym, CAS number, DTXSID or InChIKey

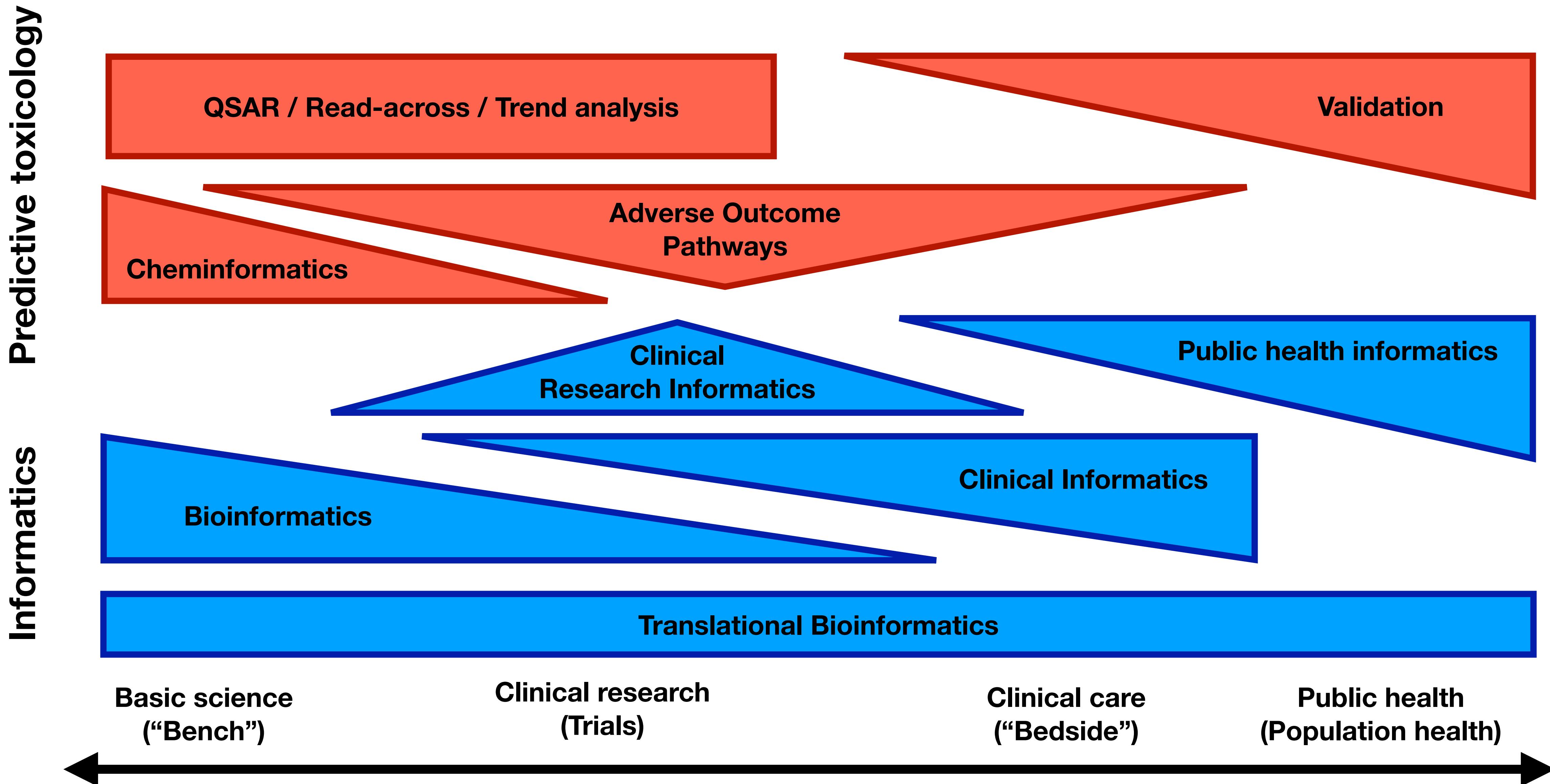
Start typing to search.

Identifier substring search

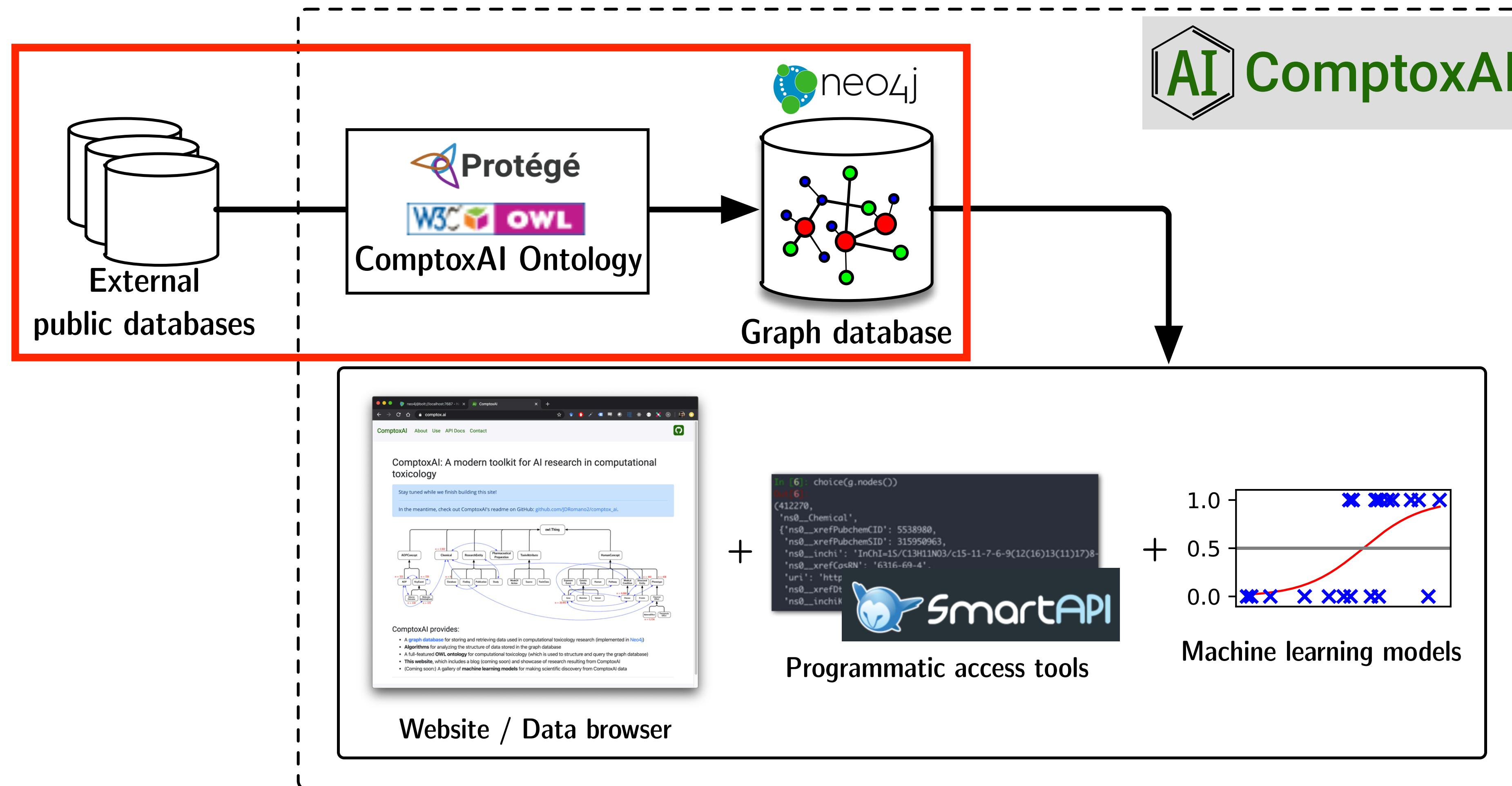
Informatics and the translational spectrum



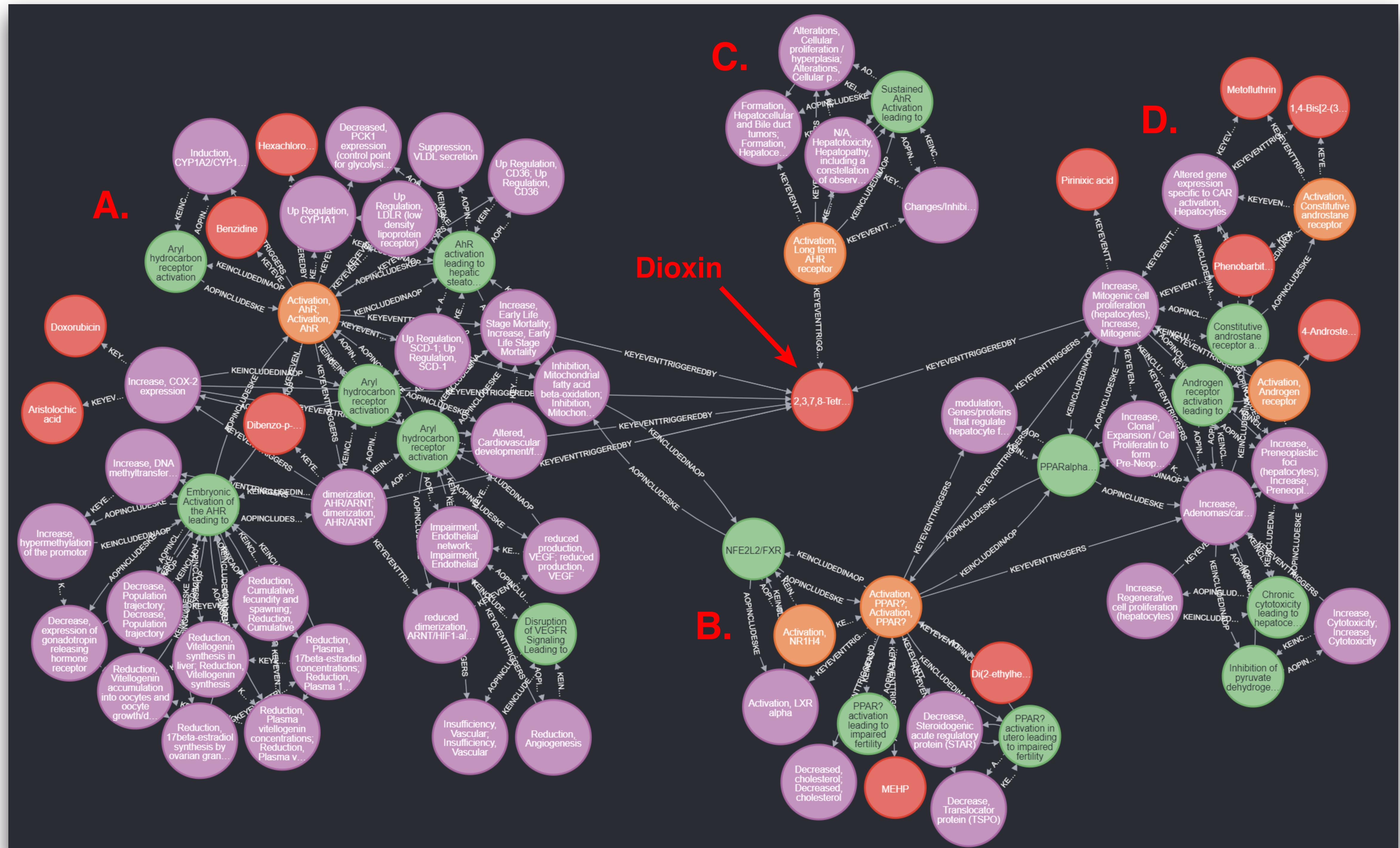
Where does predictive toxicology fit in?



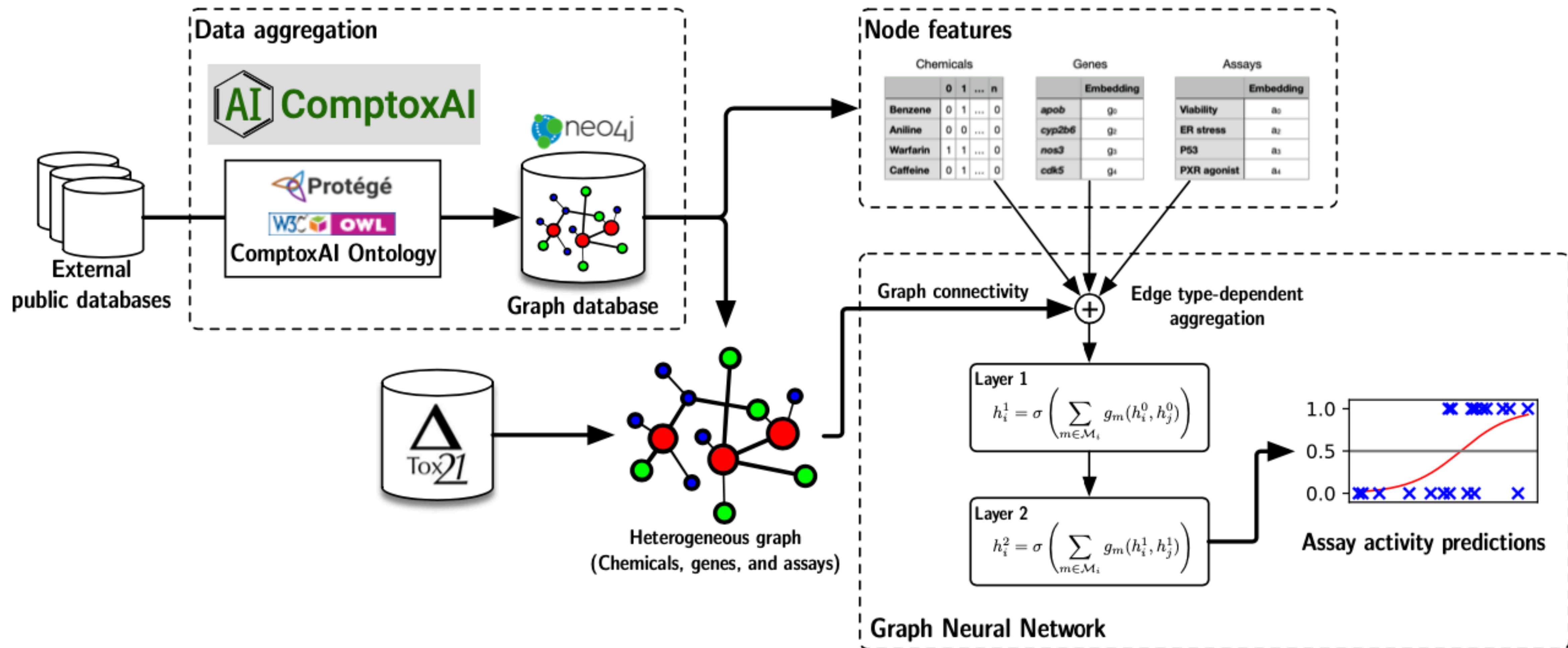
ComptoxAI



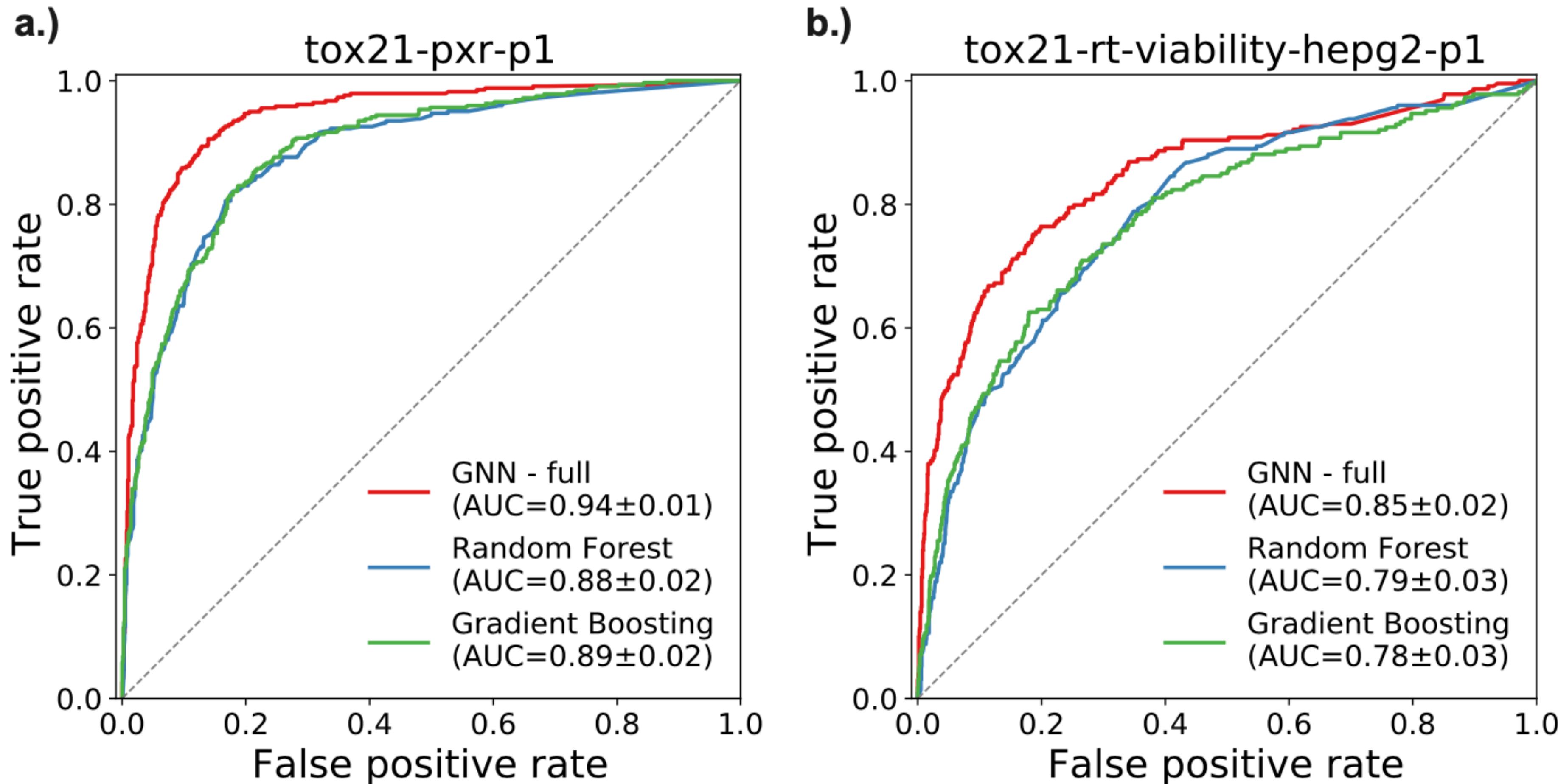
<https://comptox.ai>



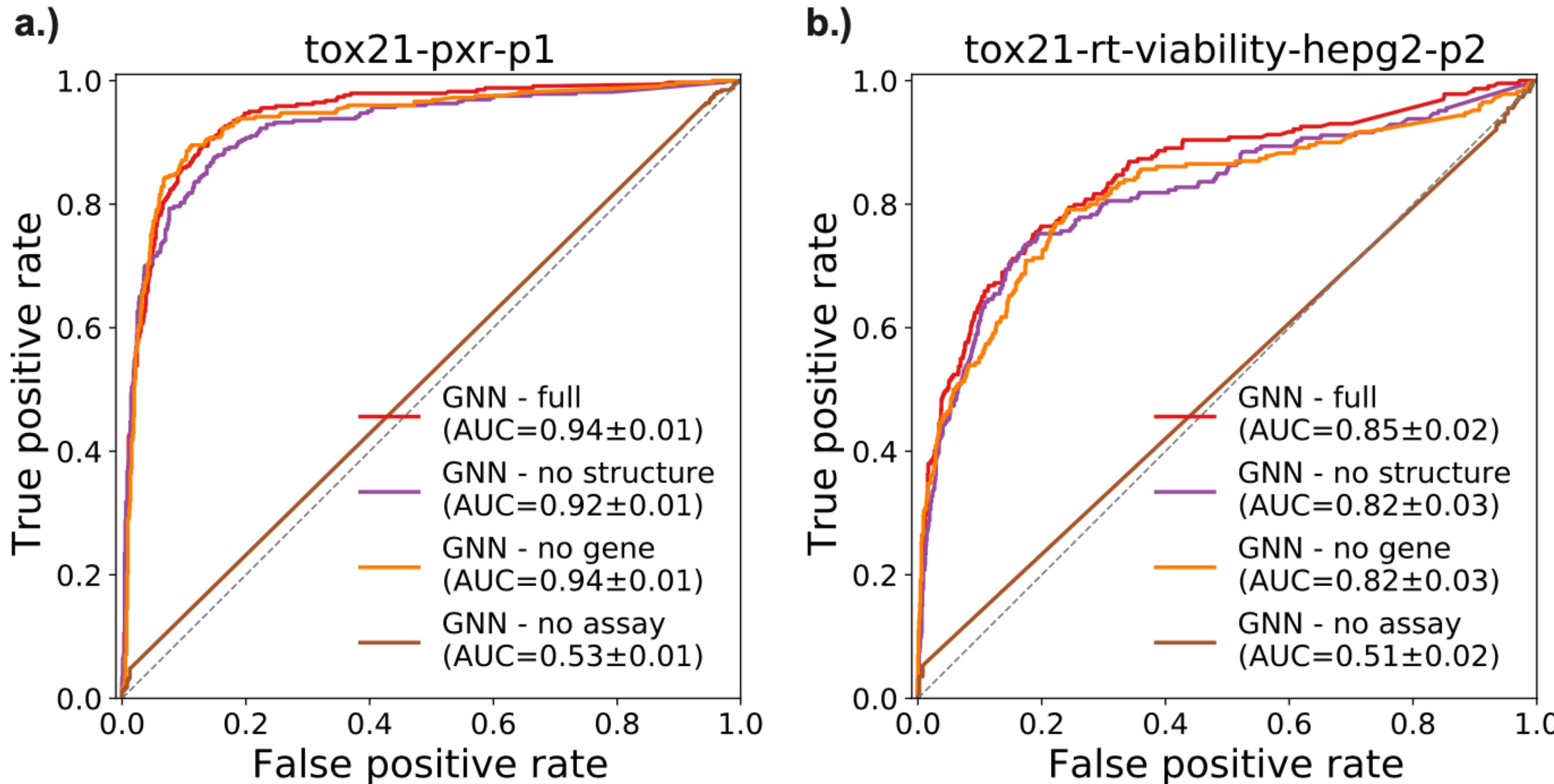
Predicting chemical toxicity with graph neural networks



Graph neural network performance

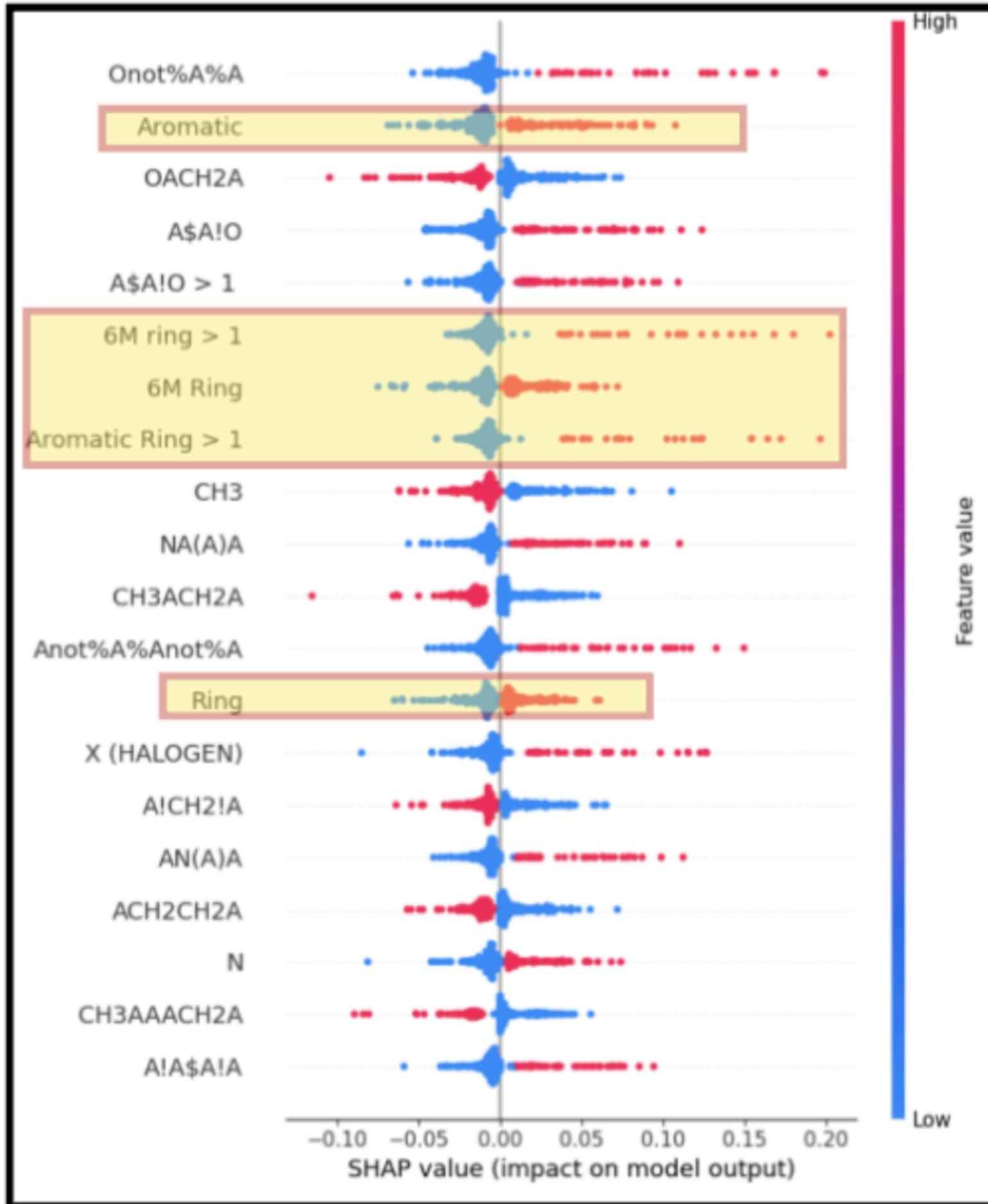


Why do the GNNs perform so much better?

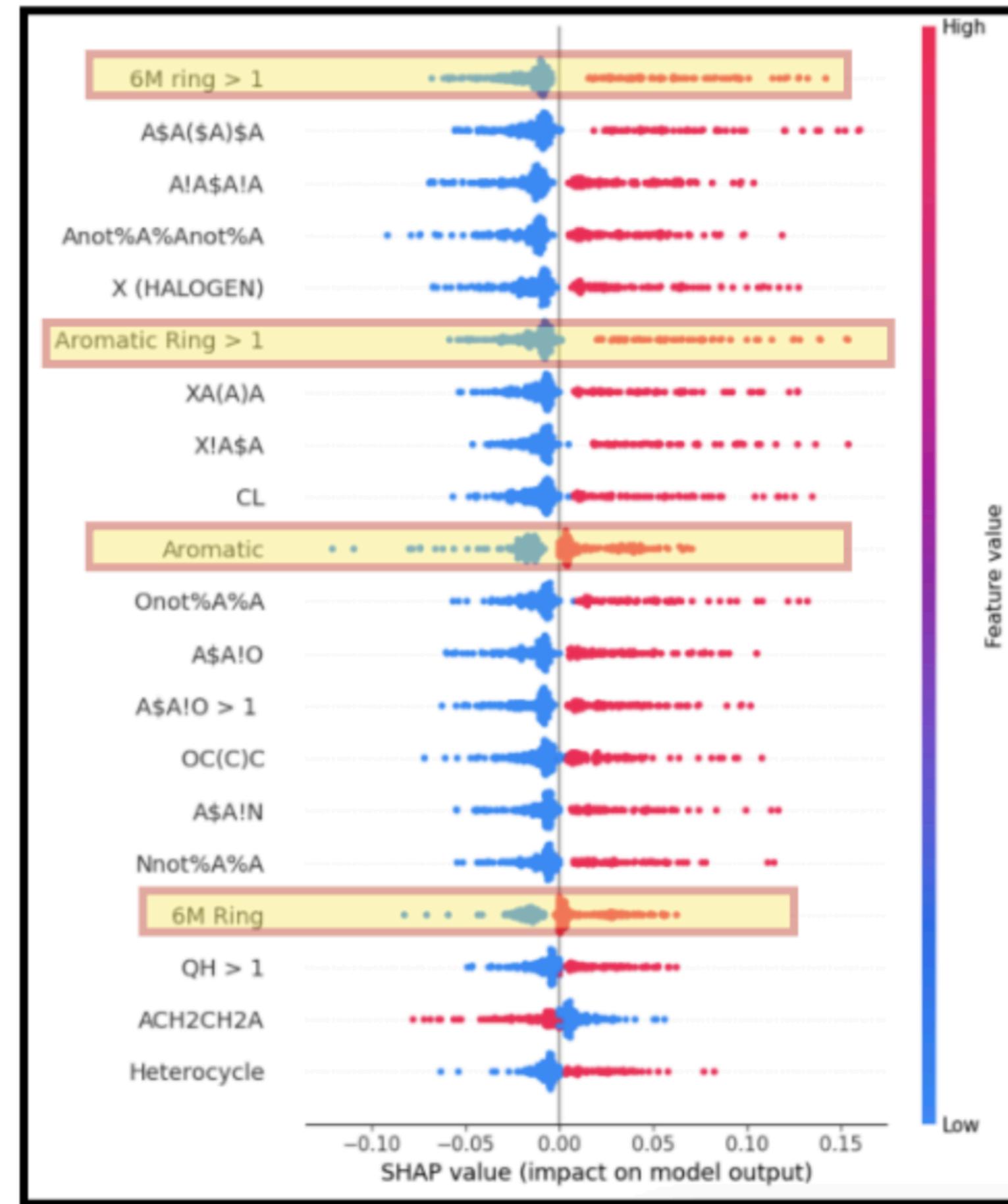


Interpretable Predictive Toxicology

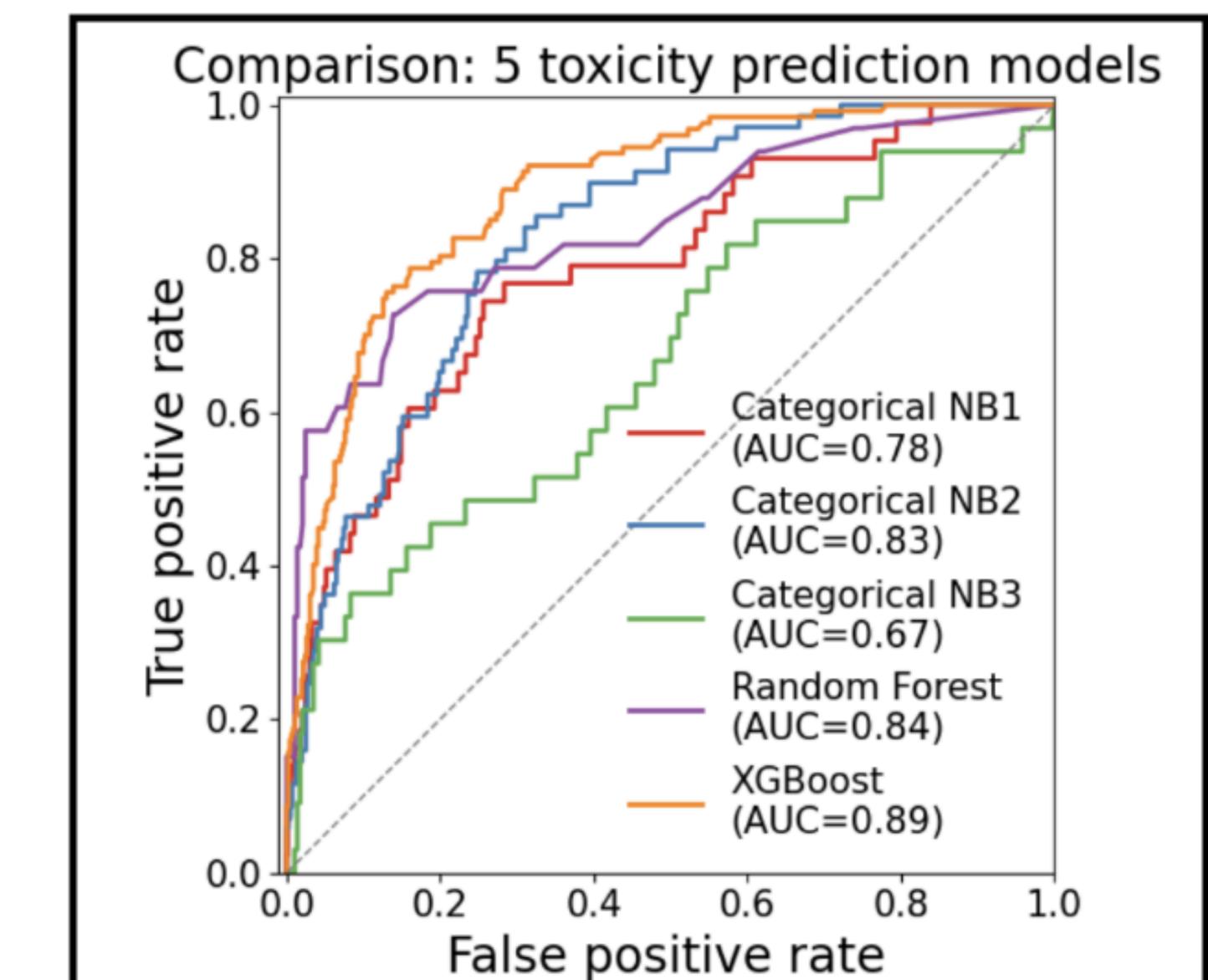
Food Contact Chemicals Database with Liver Assay



Hazardous Substances with Colon Cancer Assay



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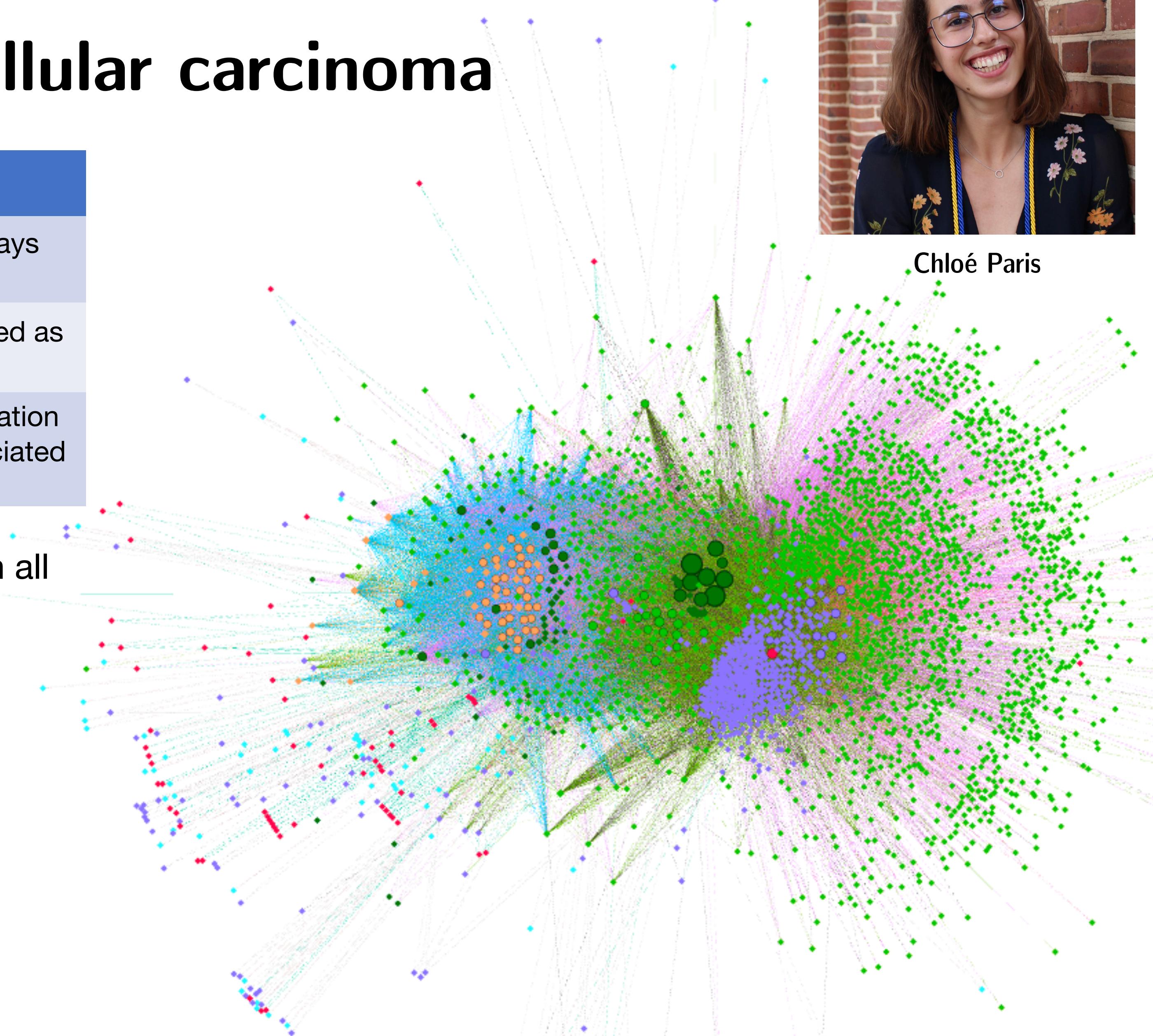
Current and future work

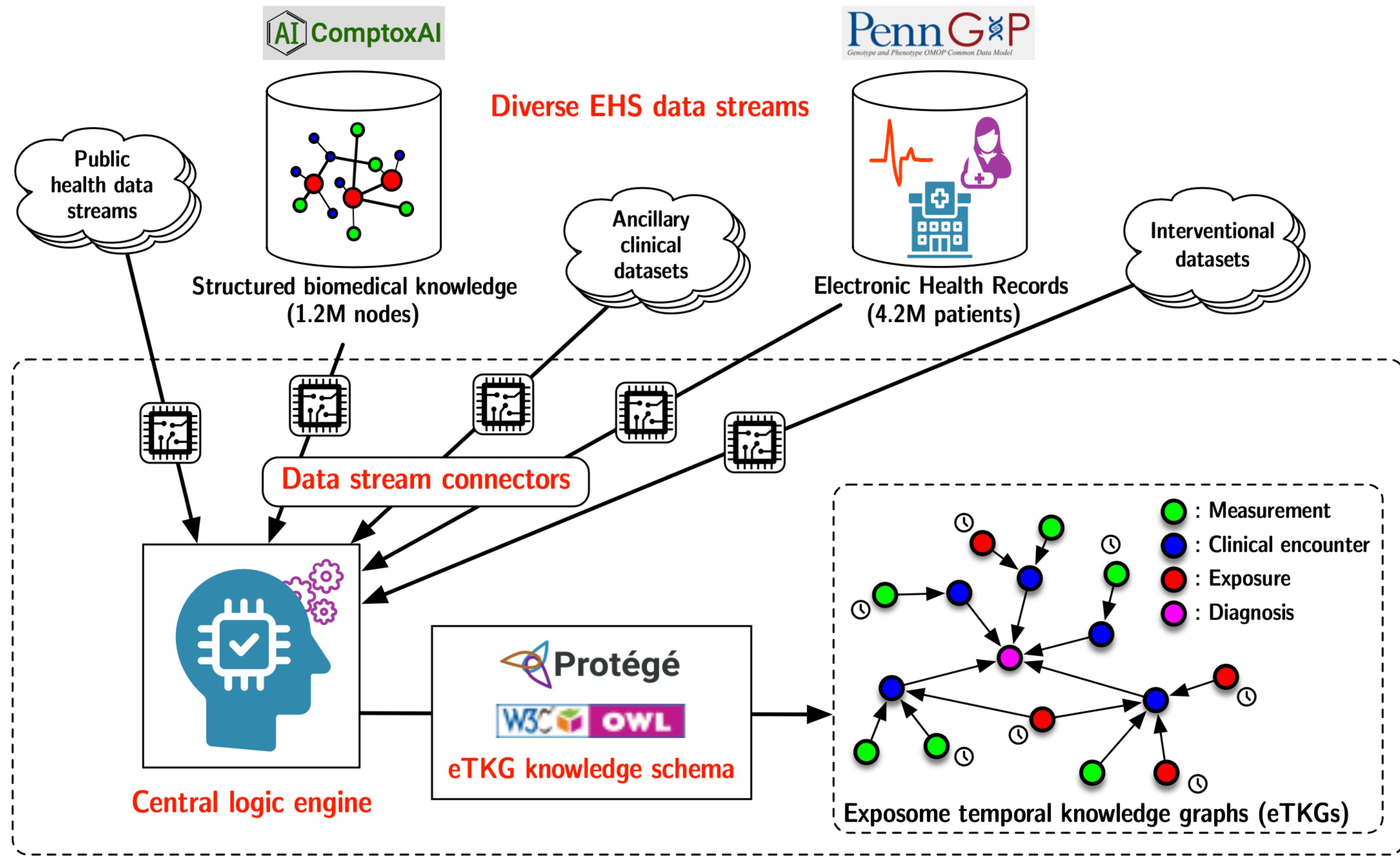
GxE interactions in PFAS-induced hepatocellular carcinoma



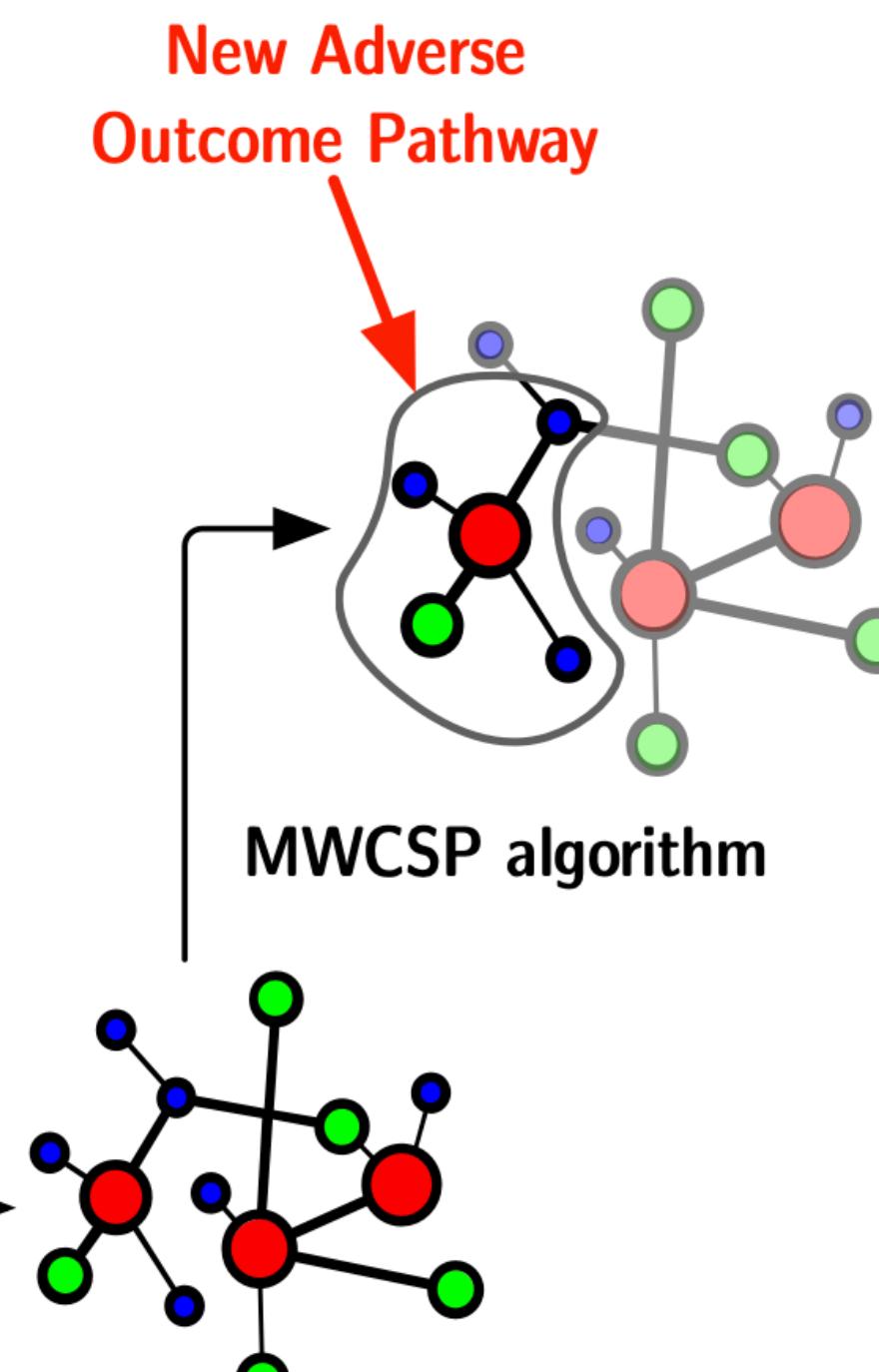
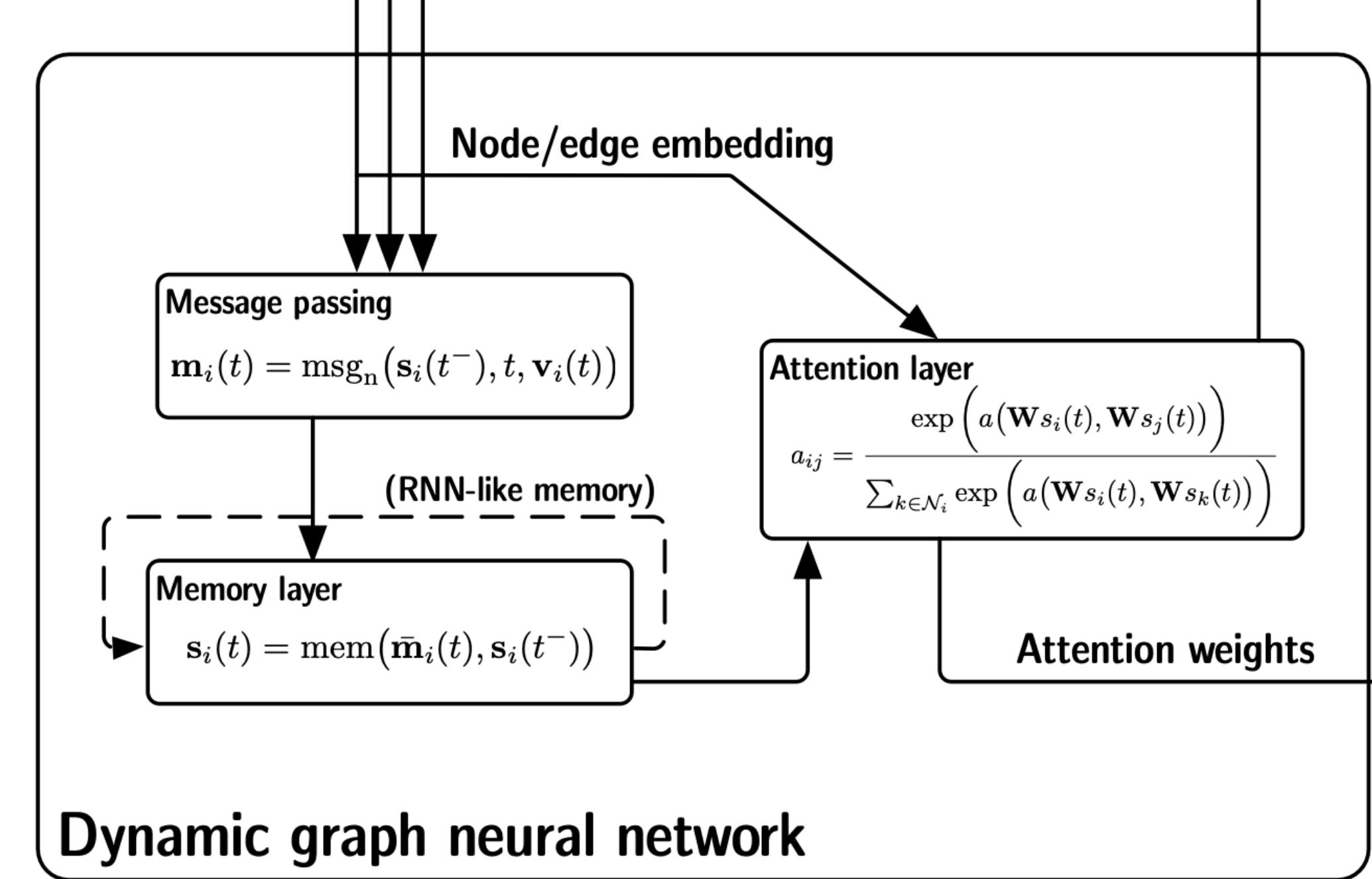
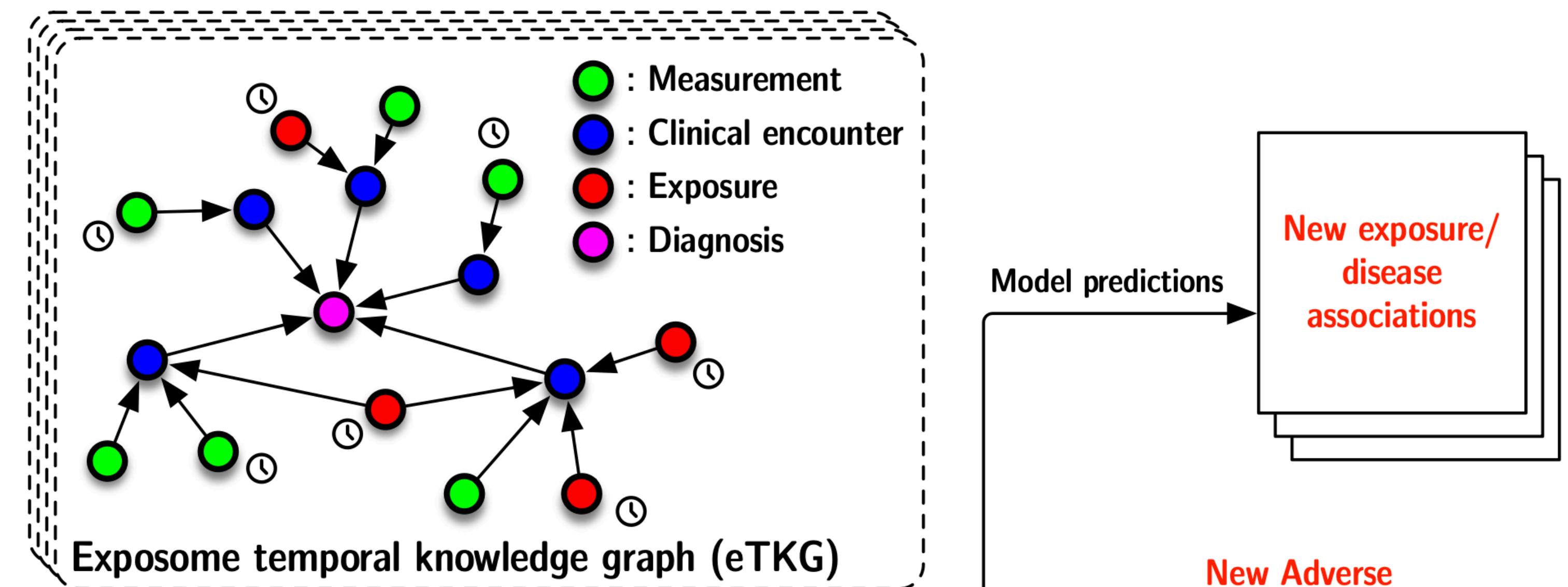
Gene Symbol	Function
TP53	Most common mutation found in HCC (plays important role in genomic stability)
DNAJB1	Fusion of DNAJB1 and PRKACA suggested as a possible marker for FLC
HMOX1	Suggested to play a role in HCC cell migration + its metabolite bilirubin has been associated with HCC

- Calculate the base **communicability score** between all PFAS-HCC node pairs in subgraph
- Defined as a weighted sum of all possible “walks” linking a pair of nodes
- For each gene in the network:
 - Remove the gene from the network
 - Recalculate communicability scores for all PFAS-HCC pairs
 - Determine the change in communicability score
- Identify genes yielding the greatest mean change in communicability





Patient-level eTKGs



We're recruiting...

- ...PhD students
 - GCB and PGG
- ...Postdocs
 - Info on [romanolab.org](#)
- ...Masters students
- ...Collaborators!

Acknowledgements

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<https://jdr.bio/assets/pdf/romano-retreat-talk.pdf>

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See more at: romanolab.org