Towards Understanding Structures in KG Embedding Spaces for Experimental Design

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Speculation and Discussion

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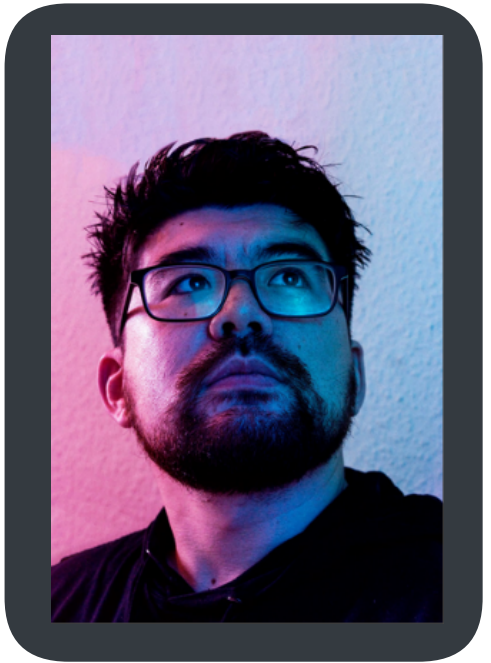
1. Introduction & Background
2. The Problem Space
3. What
4. Accelerating KE

Cogan Shimizu

Assistant Professor*

Department of Computer Science & Engineering

Wright State University



KASTLE Landscape

HelioKnow
NASA/JPL Prospective

Geoweave
NSF Prospective

Wicked Problems
NSF Prospective

AI Validity
DHS Current

EduGate
NSF Current

TIKA
NSF Current

KGWRAPS
DAGSI Current

TASK-MATS
DAGSI Current

Proto-KAI
NSF Forthcoming

Phenomenology

Geospatial KGs

Causality

KG Embeddings

Reasoning

KGs + LLMs

AI Literacy

Knowledge Modeling

Education

Space Weather

Polymer Science

Manufacturing

Autonomous Experimentation

Cybersecurity

Rose
Bacc. Thesis

Emily
Bacc. Thesis

David
SP I

Jon W.
SP I

Ashish
SP II

Abishek
Capstone

Alexis
Dissertation

Antrea
Dissertation

Ben
Dissertation

Spencer
Dissertation

Stacie
Dissertation

Anmol
Thesis

Chris
Thesis

Ellie
Thesis

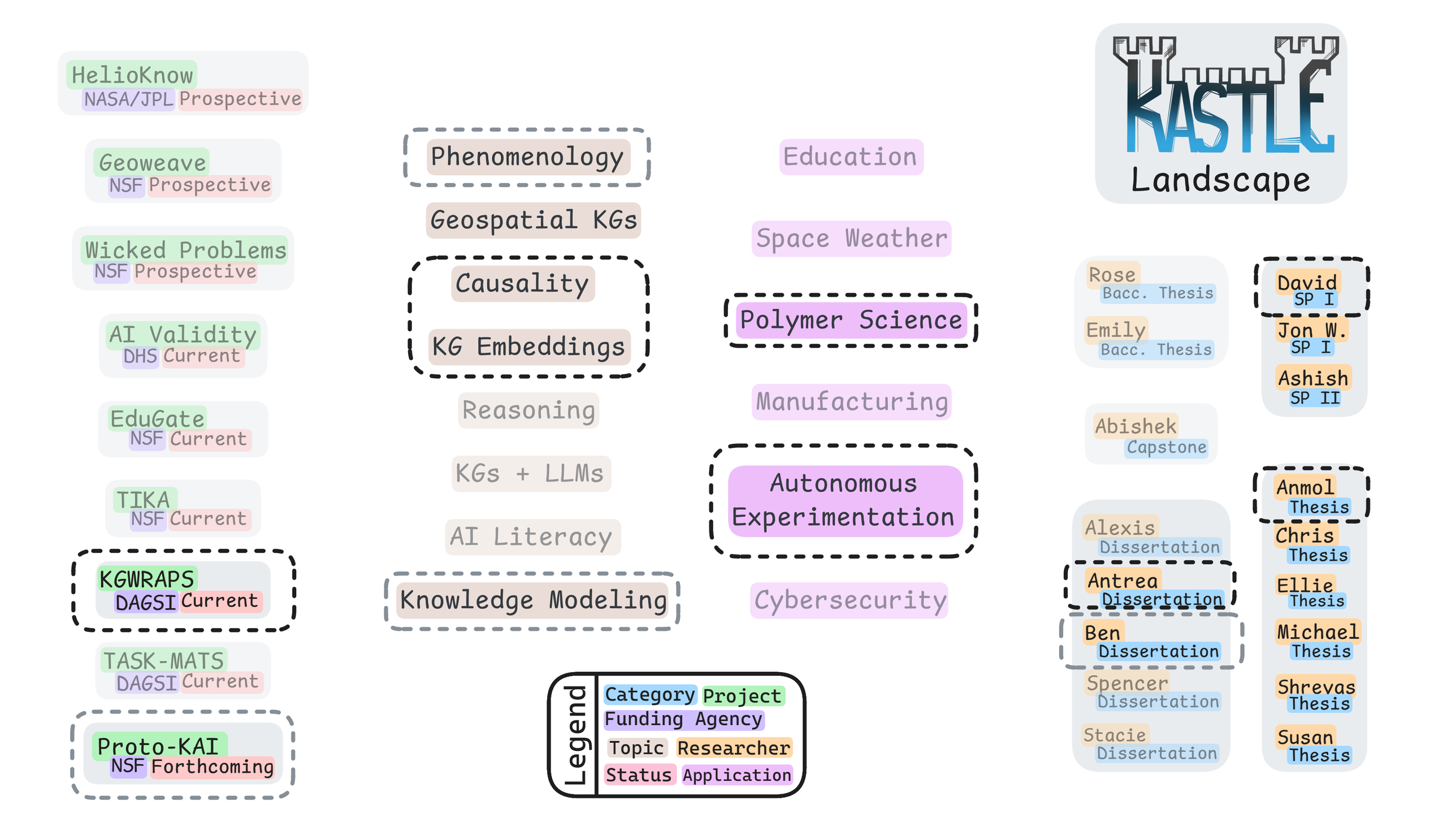
Michael
Thesis

Shrevas
Thesis

Susan
Thesis

Legend

Category Project
Funding Agency
Topic Researcher
Status Application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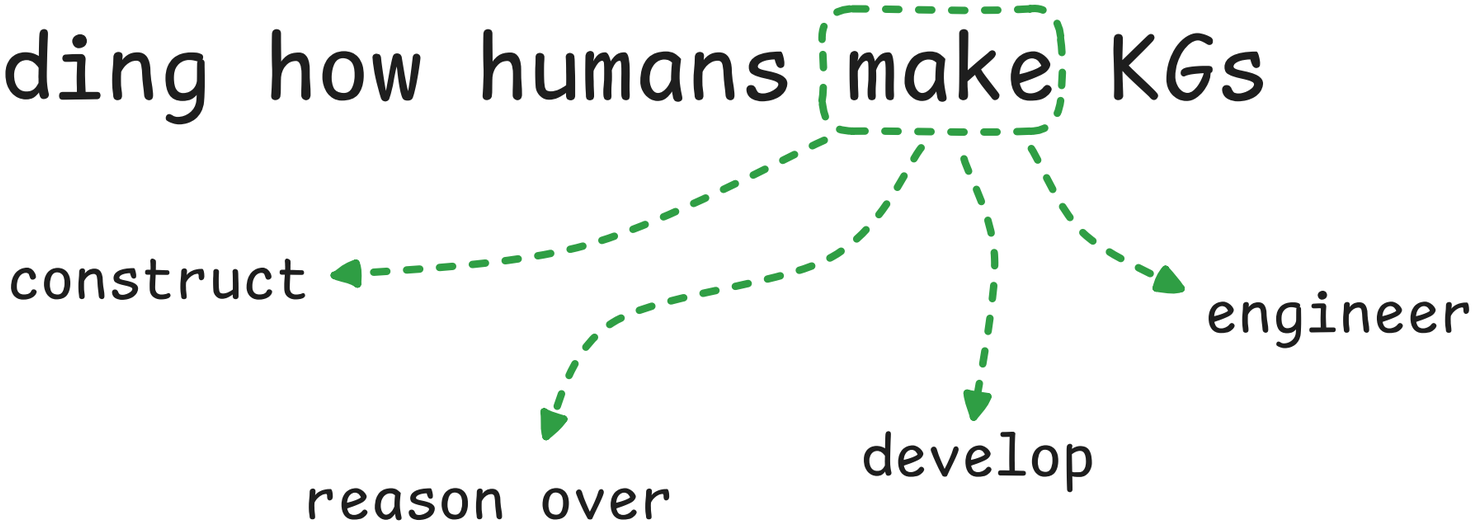
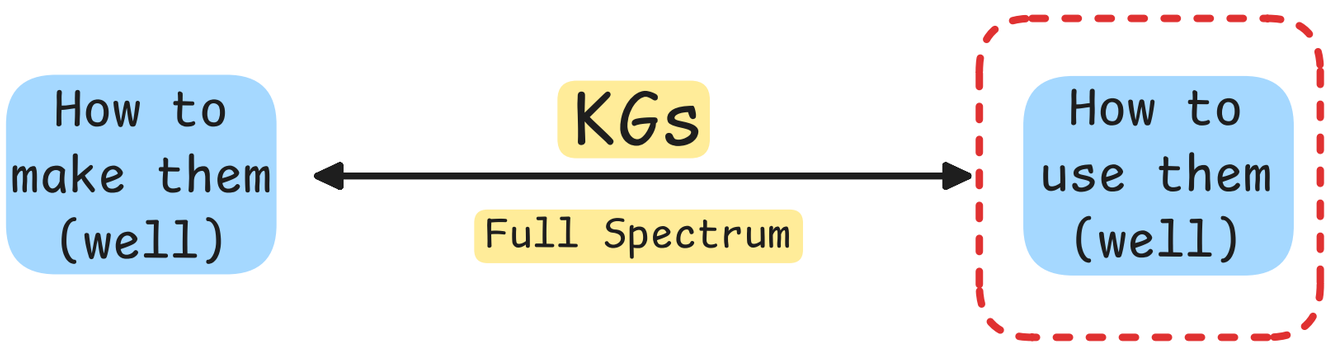
My Background

Understanding how humans make KGs



Break it into pieces
Visualize those pieces
Adapt those pieces



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Knowledge Graph Powered Research Assistant for Polymer Science

Collect & Manage Data

conversation

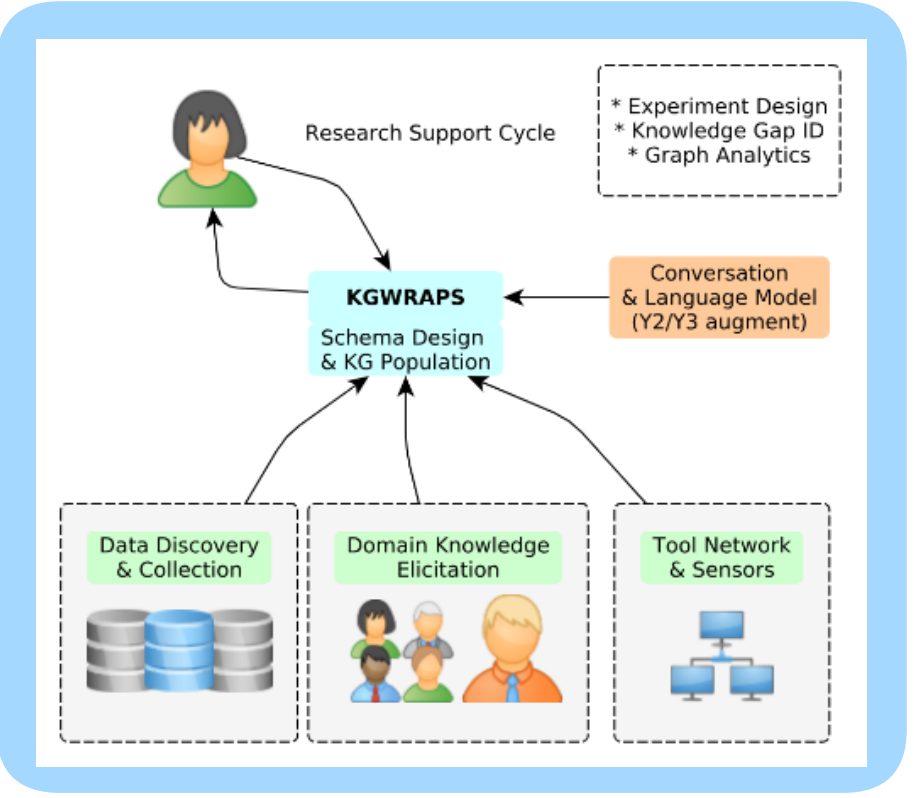
Find and extract data from literature

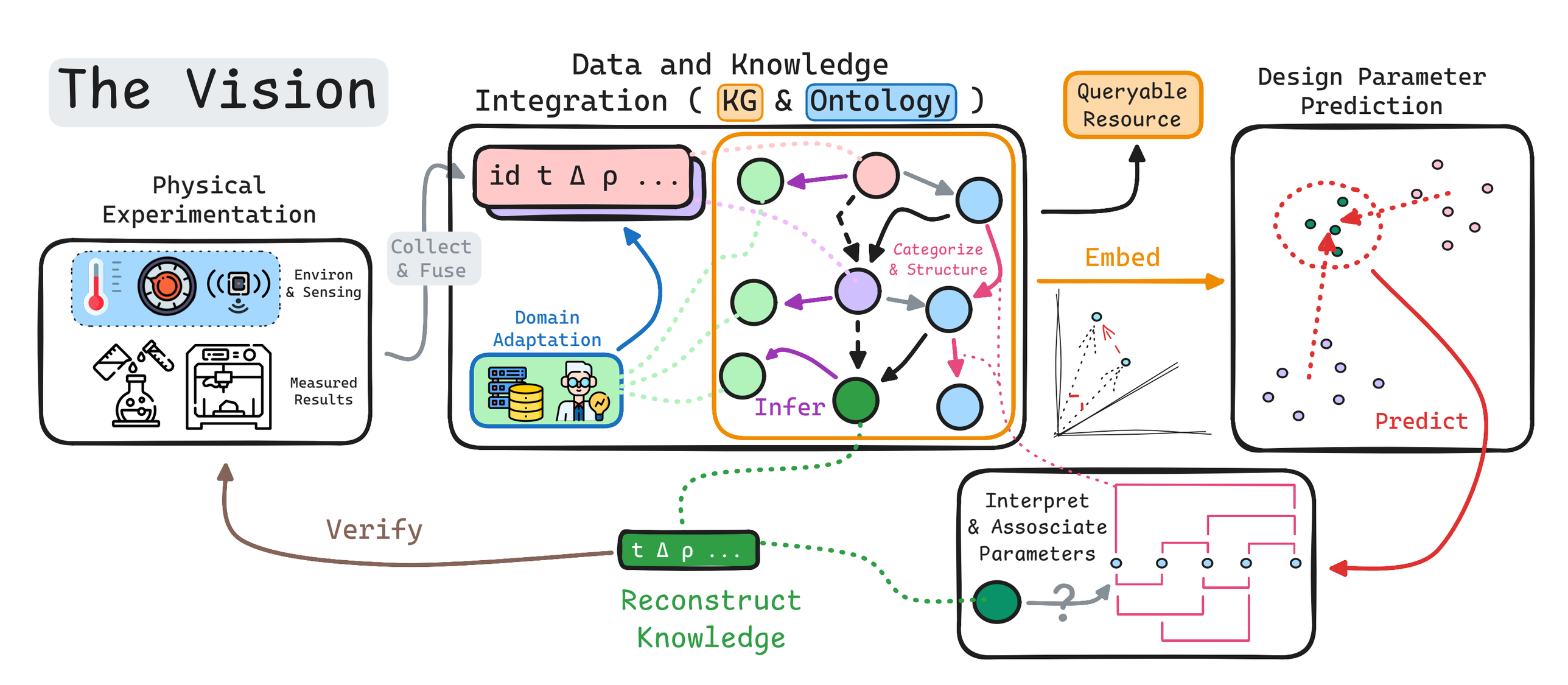
experiments

Curate, Maintain & Evolve Knowledge

encode physical understanding

Design & Predict New Experiments




The Vision
Data and Knowledge Integration (KG & Ontology)
Queryable Resource
Design Parameter Prediction
Physical Experimentation
Environ & Sensing
Measured Results
Collect & Fuse
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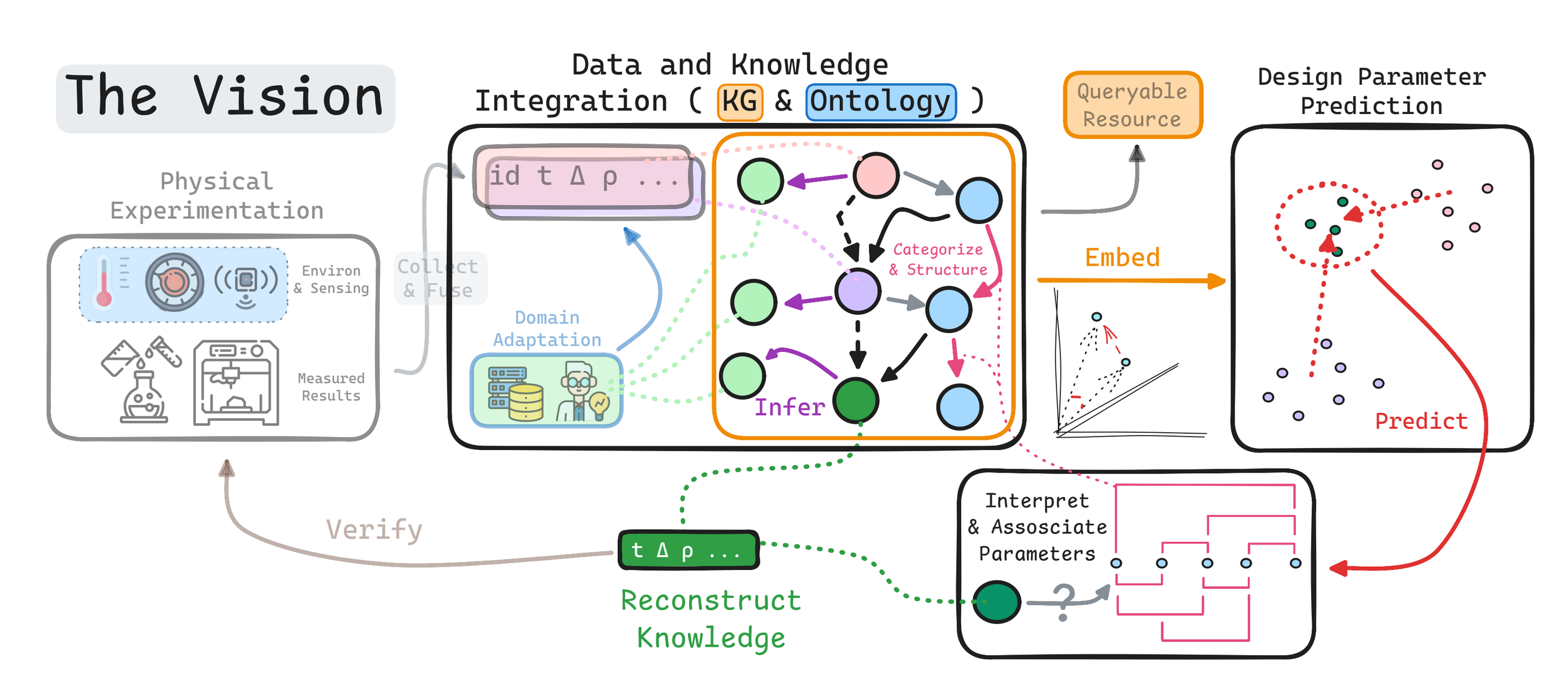
Domain Adaptation
Categorize & Structure
Infer
Embed
Predict
Verify
t Δ ρ ...
Reconstruct Knowledge
Interpret & Associate Parameters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A Good Graph for Good Learning

We have phenomenological knowledge.

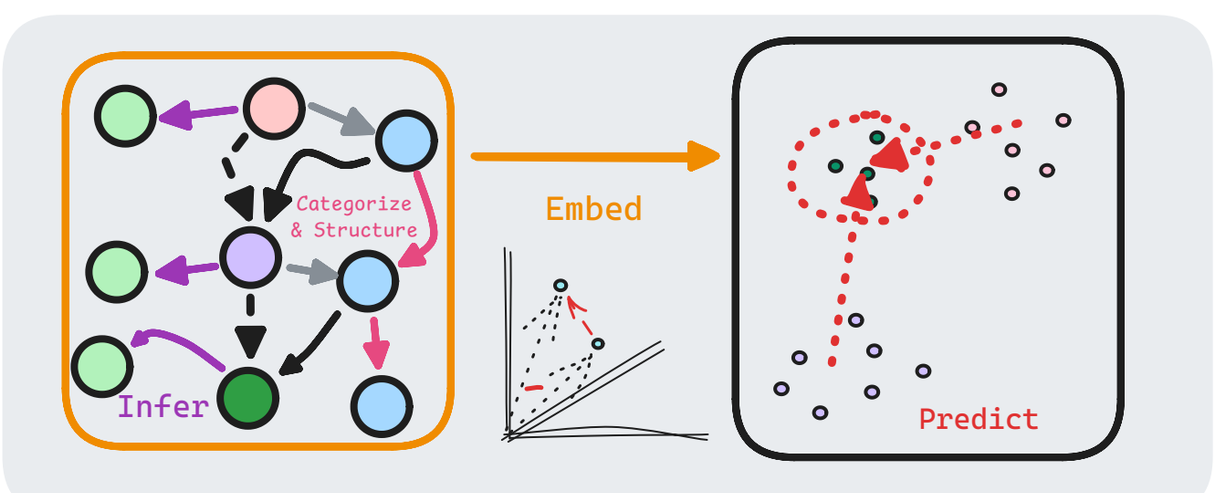
We have environmental context.

And knowledge about those phenomena...

We have experimental results.

We have procedural data & knowledge.

What do we include (or how much)?

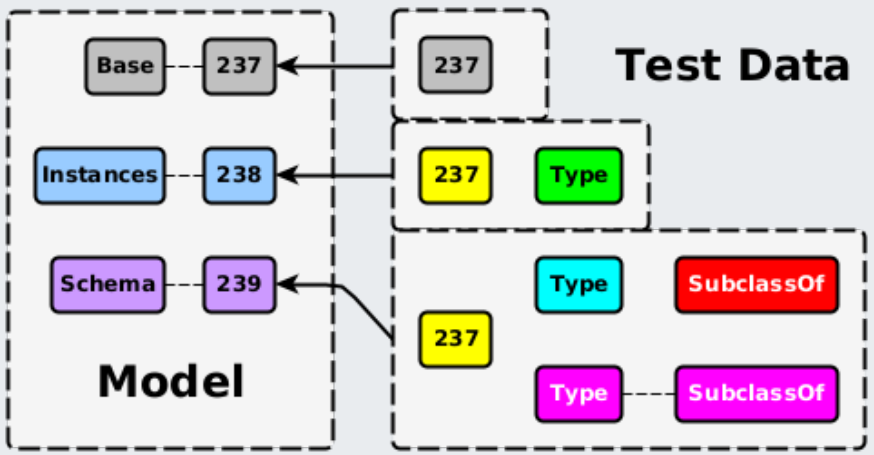


What are we looking at?

Antrea

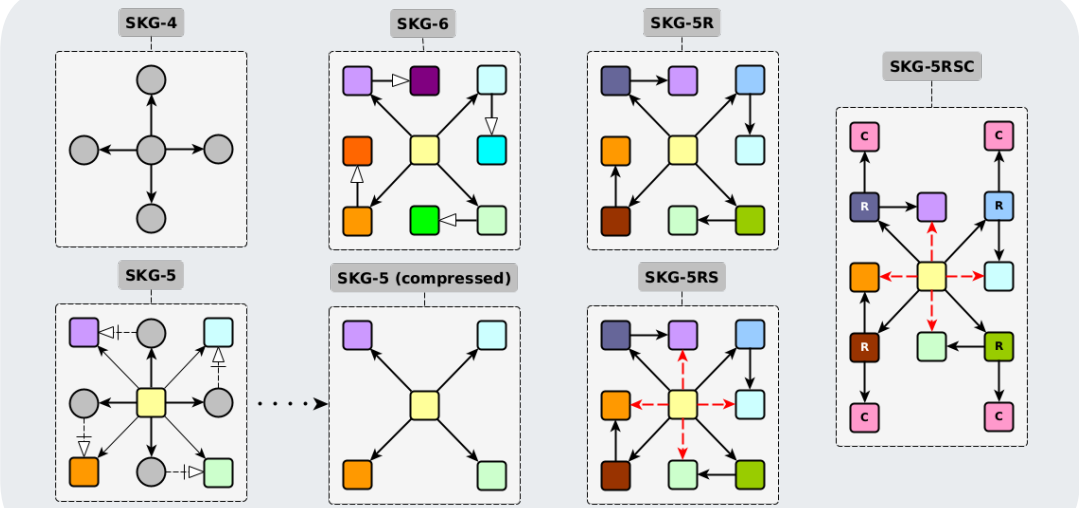
Training with the knowledge helps!
Evaluating it, not so much.

How does including additional semantic information impact the embedding space?



Brandon Dave, Antrea Christou, Cogan Shimizu: Towards Understanding the Impact of Graph Structure on Knowledge Graph Embeddings. NeSy (2) 2024: 41-50

How does the actual graph structure impact the latent space?



Antrea Christou, Brandon Dave, Cogan Shimizu: Experiments in Graph Structure and Knowledge Graph Embeddings. Neurosymbolic AI. Under Review.

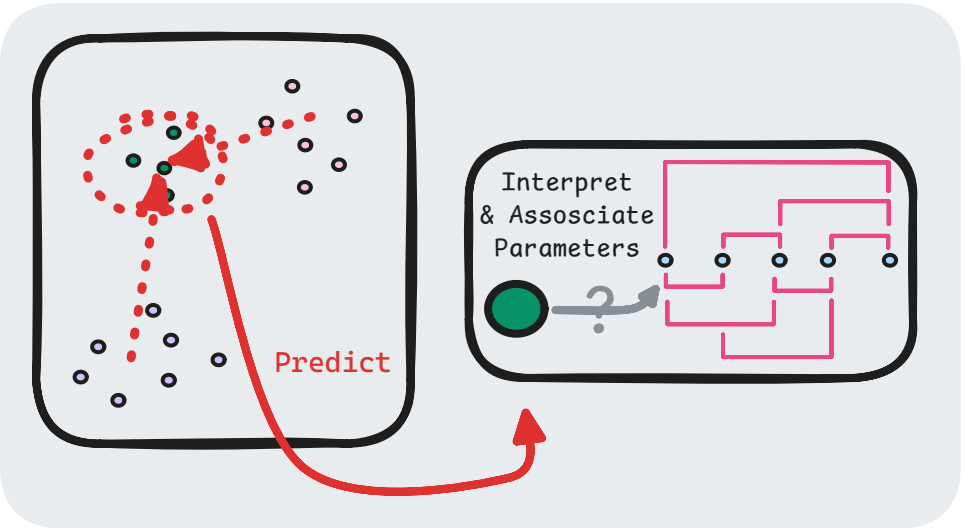
And what next?

Interpreting latent space.

- Learn manifold, predict optimality?
- How does density effect learned structure?

Our current experiment...

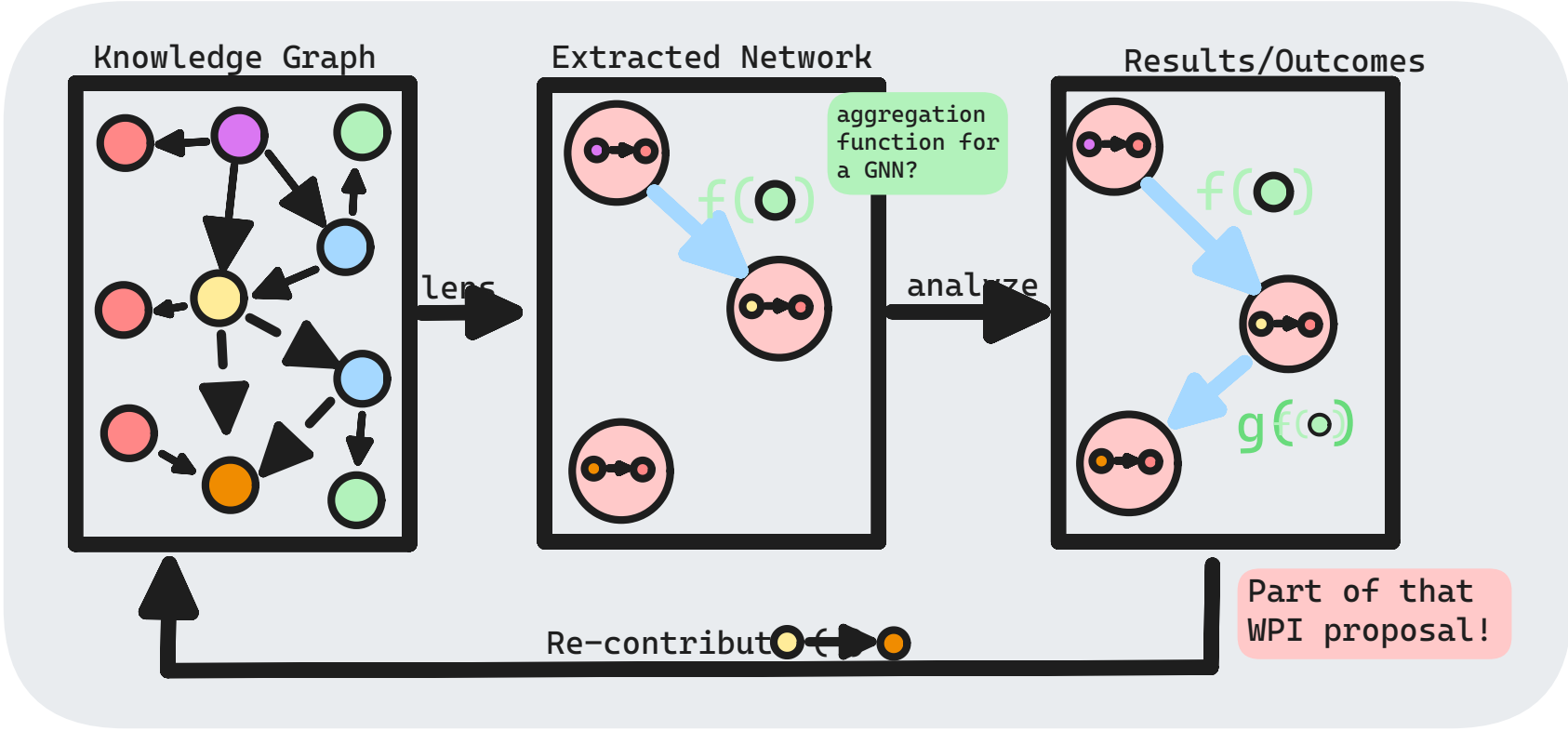
- normalize the numeric space
- define windowed classes & interrelations
- interpret based on granularity of the window



Yet another knowledge graph embedding?

KGEs are strange.

- They don't seem to learn what we expect.
- KGs also don't make great networks.
- Can we collapse them appropriately?



THANKS!

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