AI-Enabled National Mapping Needs Structure, Not Just Models

Architecture of AI-enabled geospatial infrastructure

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Looks correct ≠ is correct

→ correctness depends on structure
→ structure is often inferred, not explicit

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The Risk We Are Accepting

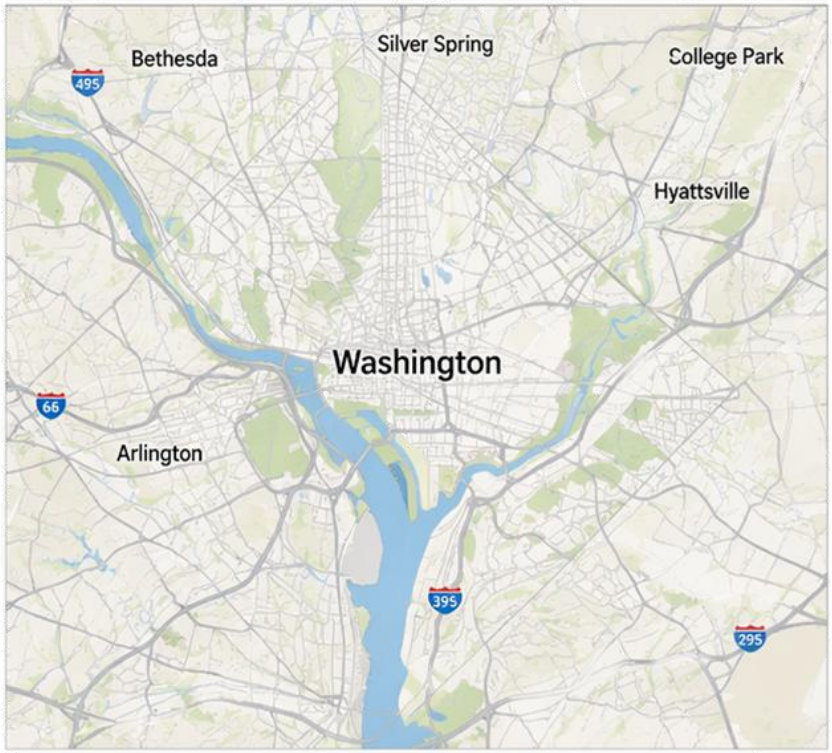
AI outputs appear correct

We increasingly accept them without structural validation

Representation Is Not Reality

Abstraction preserves some truths and distorts others

REALITY: GEOGRAPHIC MAP



Shows distance, direction, and geography
Rich in detail. Harder to navigate

REPRESENTATION: SUBWAY MAP

Preserves connectivity and relationships
Distorts distance, direction, and scale

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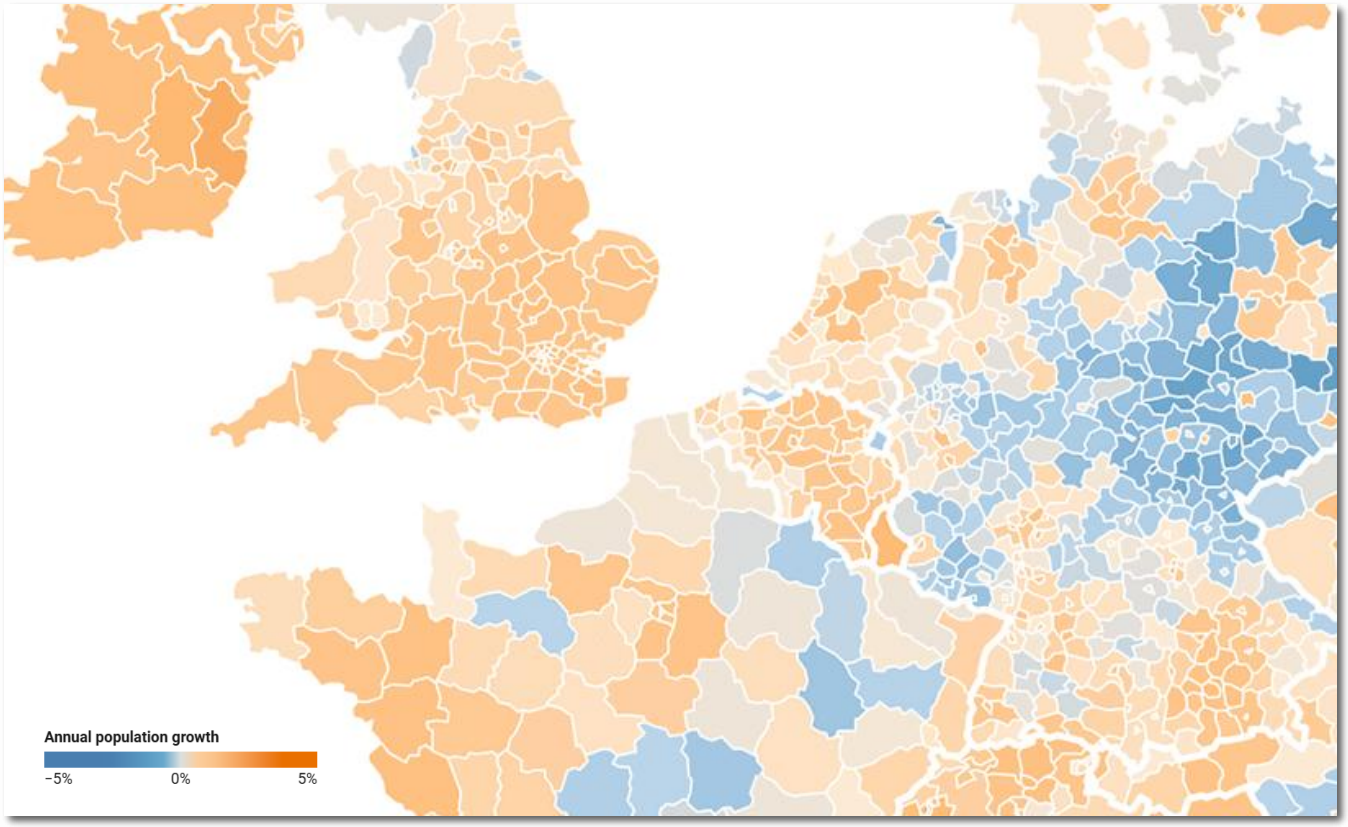
Structure Determines Outcome

Data structure constrains results before models run

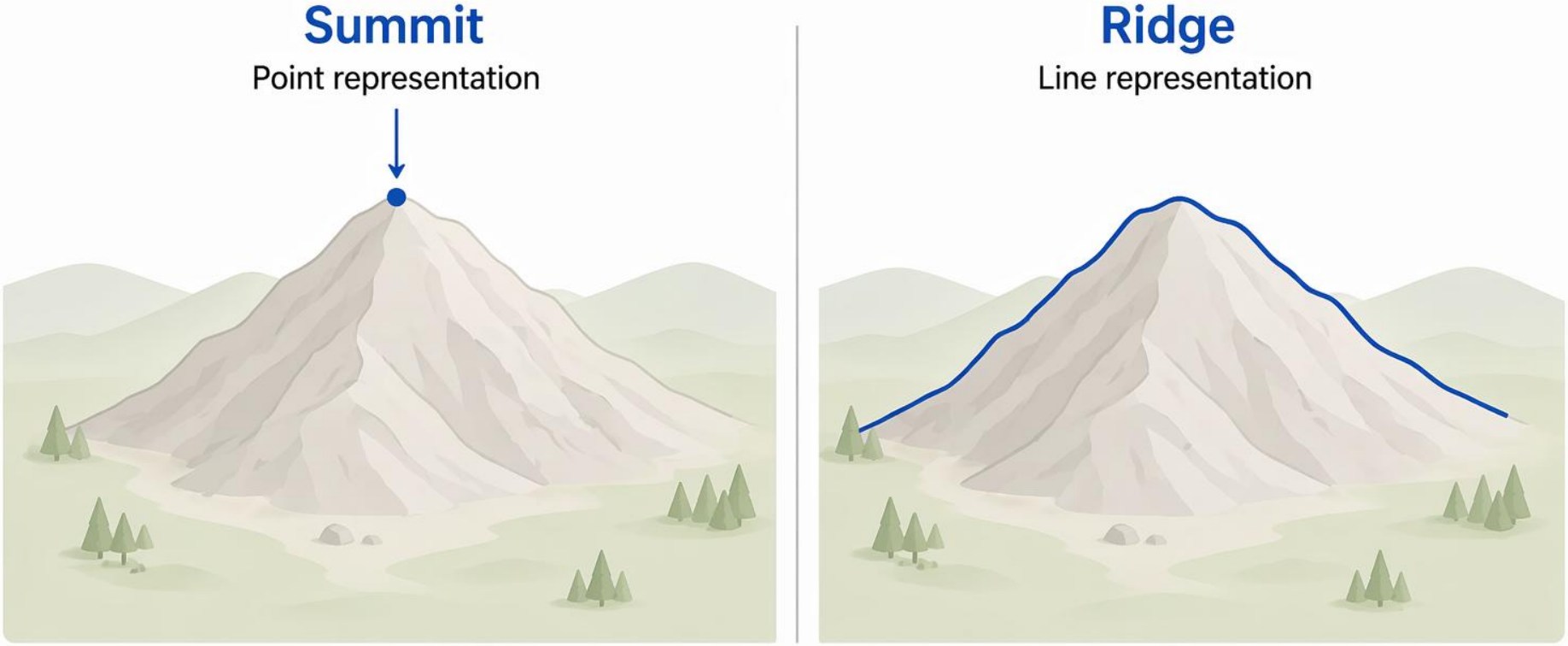


From: https://www.datawrapper.de/blog/weekly-chart-europegrowth

These are structural decisions

These are not visualization issues
They are structural decisions

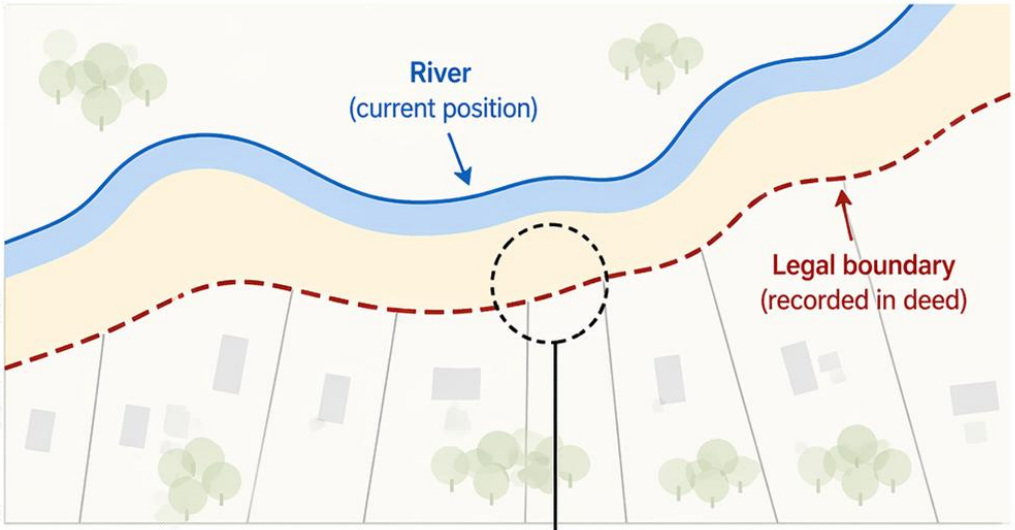
A Geospatial Example



Same feature. Different structure.

The Real Problem

Two correct answers. One system output.



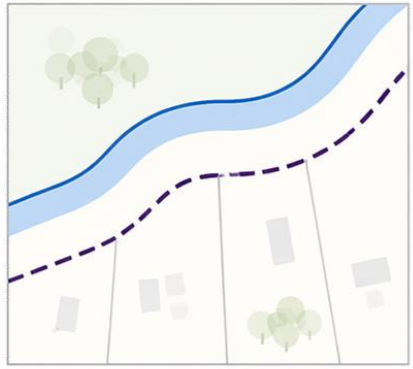
Hydrologic definition

Boundary follows the river centerline (current).

Legal definition

Boundary follows the legal description (recorded).

AI output: one boundary



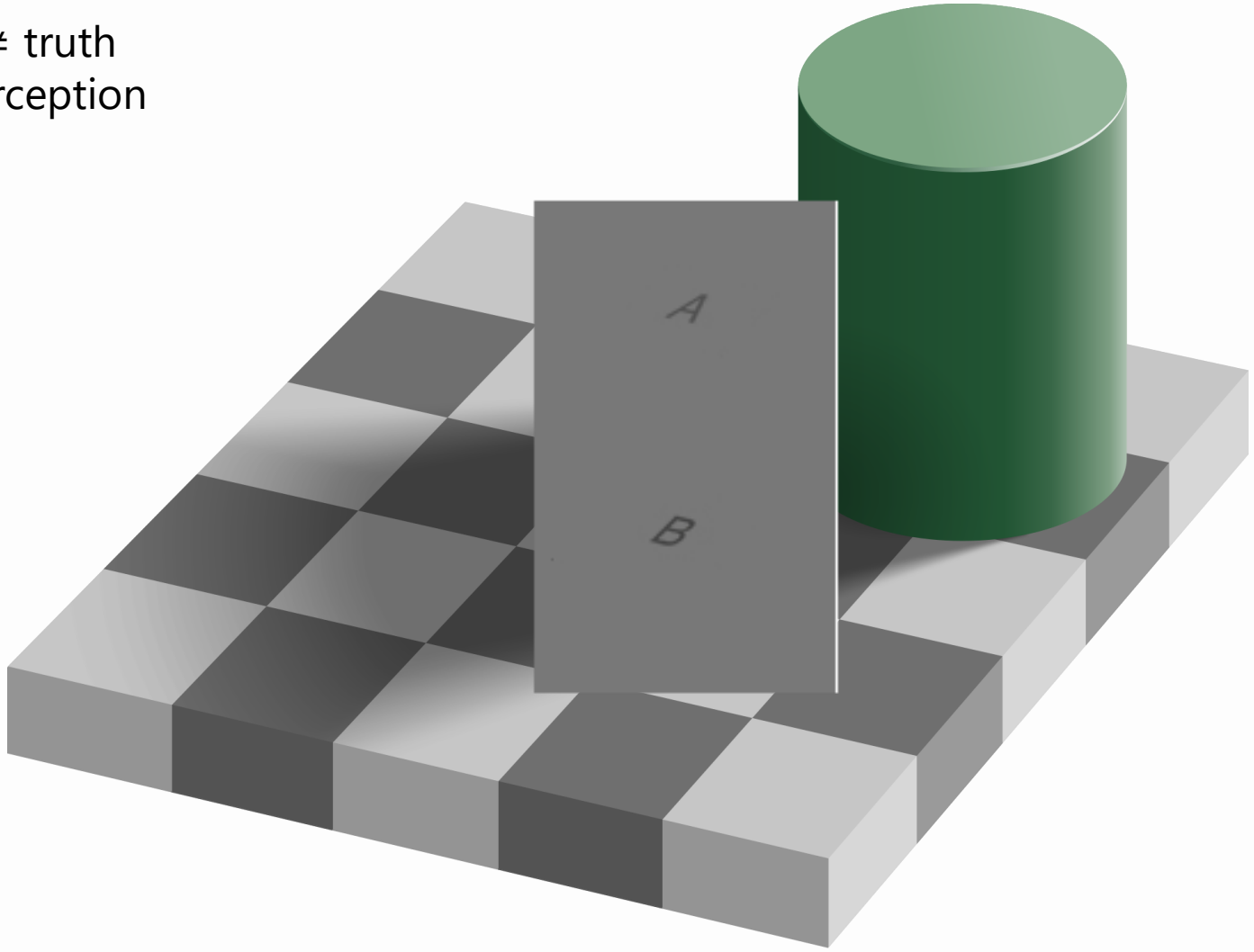
AI systems must return one answer, collapsing multiple valid interpretations.

Both interpretations are correct under different authorities.

When structure, semantics, and provenance are not explicit, authority is assigned without representing uncertainty.

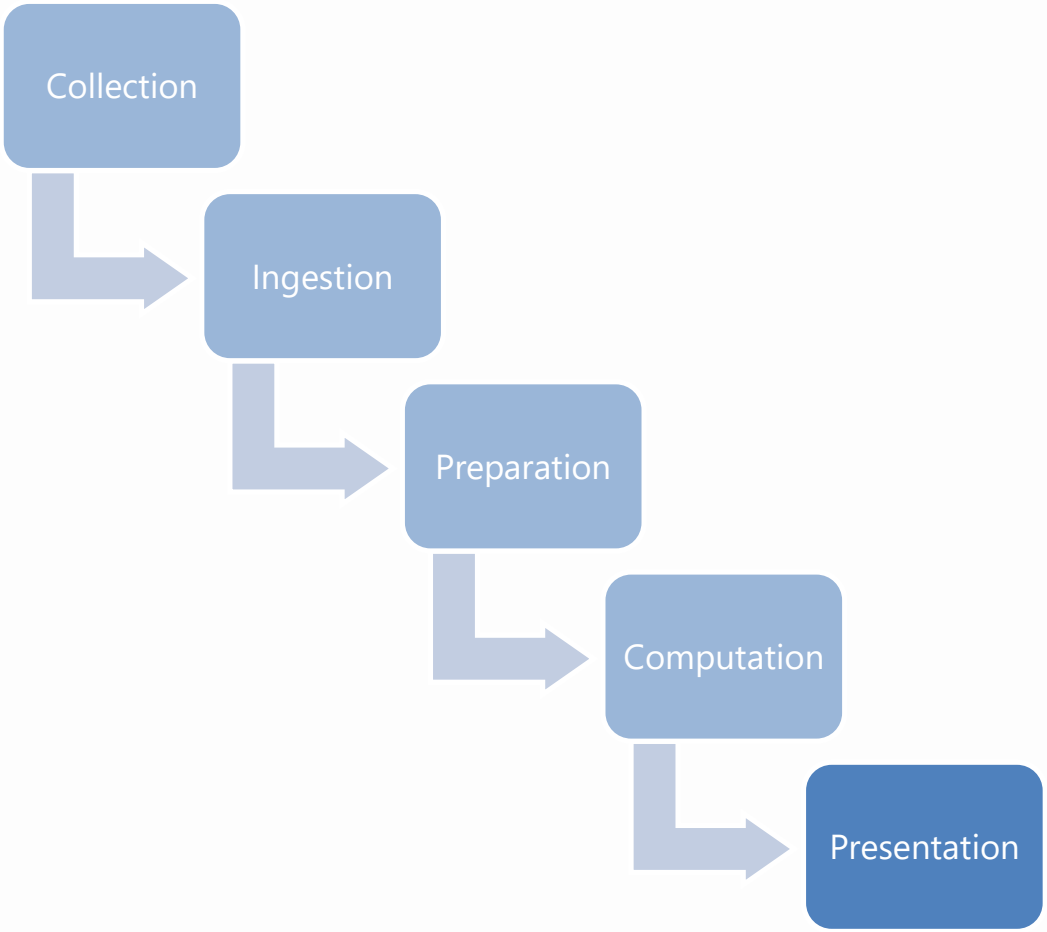
AI Does Not Solve This

Perception ≠ truth
AI scales perception

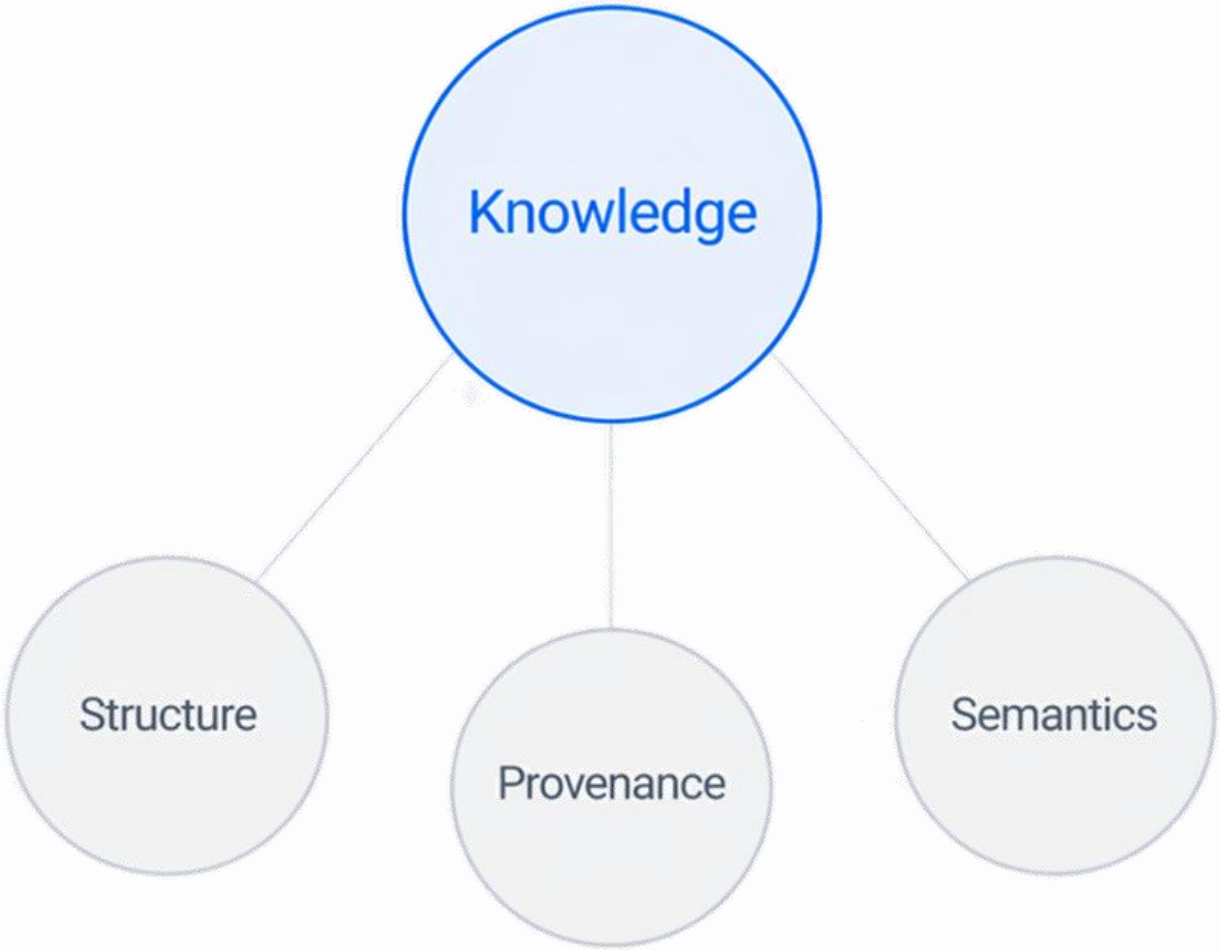


https://en.wikipedia.org/wiki/Checker_shadow_illusion

Our Current Architecture



The Shift to Knowledge



Structure → Semantics → Provenance → Knowledge

What National Mapping Must Do

Make structure explicit

Preserve multiple interpretations

Establish authoritative frameworks

If structure is known, error is obvious.

If it isn’t, we automate illusion.