3 Trainings: Agentic Workflows for Graph RAG

- July 17: Designing for Production
  - Need for Agentic Workflows
  - Agentic for Graph Schemas
  - Intro to BAML

- **Today:** Building Production-Ready Knowledge Graphs
  - Hands-on implementation
  - Full Graph RAG loop
  - Intro to G.V(), Kuzu, LanceDB

- July 30: Evaluating & Benchmarking Results
  - How to measure success
  - Monitoring and improvement
  - Intro to Opik and ADK

Production-Ready Graph RAG

Design   Build   Evaluate

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Tools Used

- BAML: Structured Output
- Kuzu: Graph database
- LanceDB: Vector Database
- G.V(): Graph Visualization

kùzu

G.V()

LanceDB

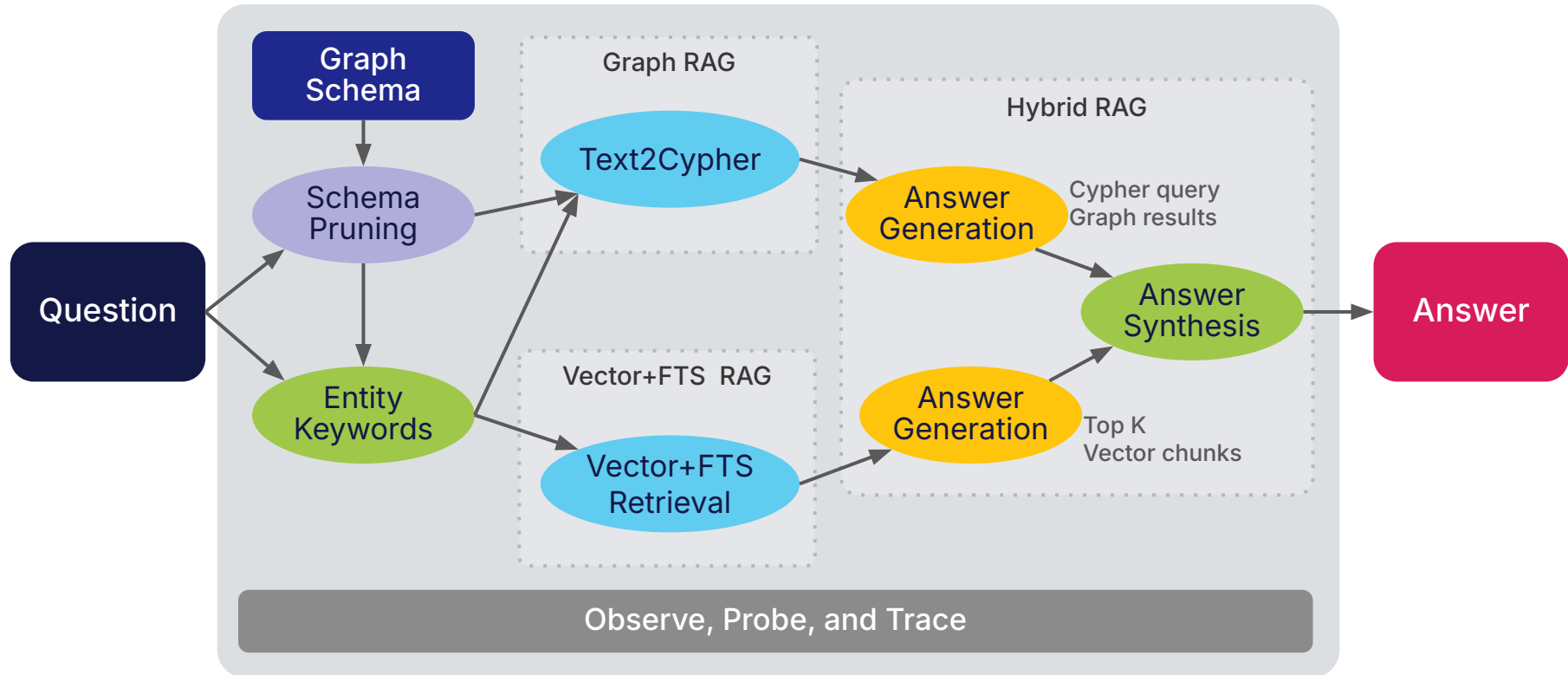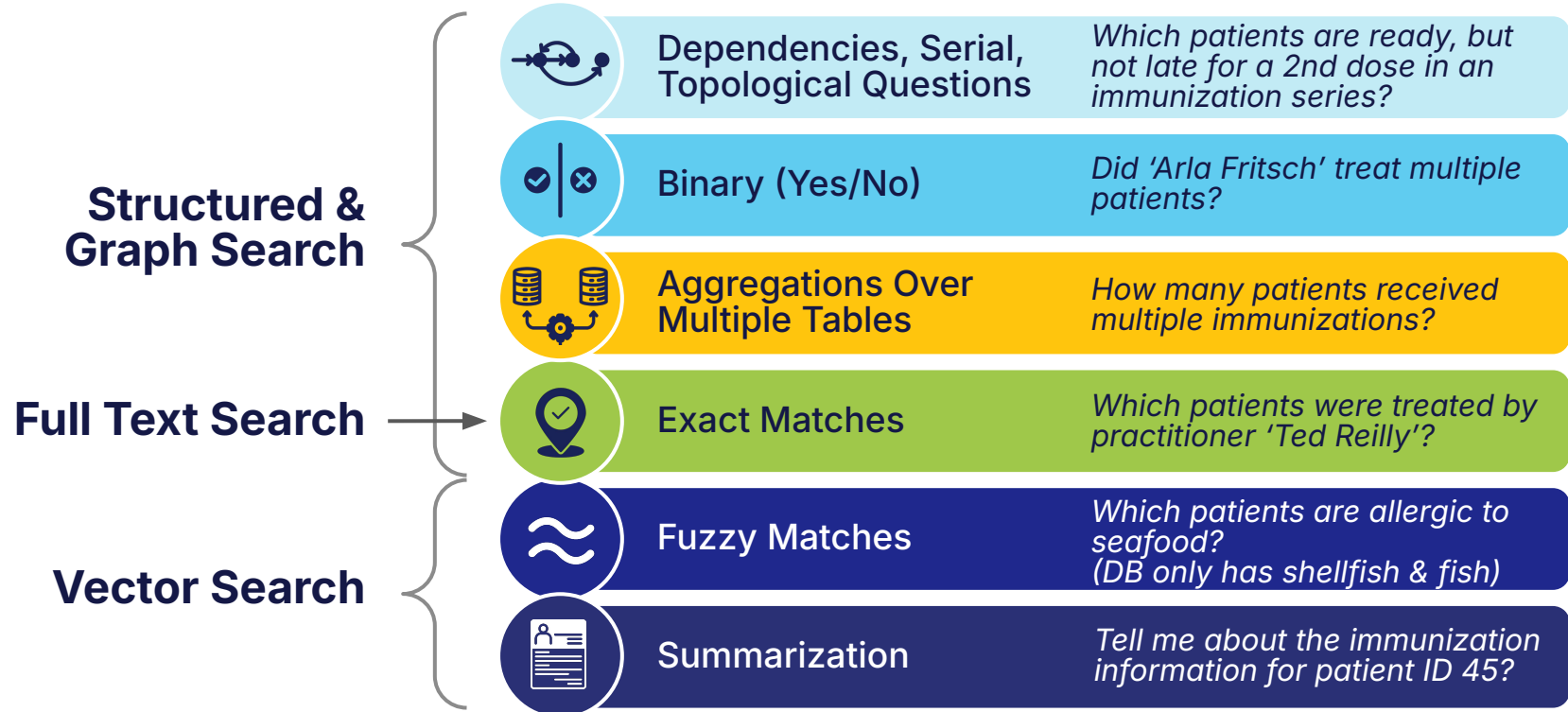# Our Graph & Hybrid RAG Workflow

Good RAG Has Multiple Components

Best tools for the job also happen to be better together

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Structured & Graph Search

Dependencies, Serial, Topological Questions — *Which patients are ready, but not late for a 2nd dose in an immunization series?*

Binary (Yes/No) — *Did 'Arla Fritsch' treat multiple patients?*

Aggregations Over Multiple Tables — *How many patients received multiple immunizations?*

Full Text Search

Exact Matches — *Which patients were treated by practitioner 'Ted Reilly'?*

Vector Search

Fuzzy Matches — *Which patients are allergic to seafood? (DB only has shellfish & fish)*

Summarization — *Tell me about the immunization information for patient ID 45?*

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Why Graph for Specialized Knowledge

Context is clear
Paths & Relationship,
not paragraphs

Domain Specificity
Schema Enforces
Domain semantics

Explainability
Cypher and Graph is
auditable

Reasoning Control
Agent choose paths
fallback on structure
and schema transversal

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What is FHIR

Unstructured Data → Graphs → RAG

Fast Healthcare Interoperability Resources (FHIR)
Standard defines how healthcare information can
be exchanged between system

https://hl7.org/fhir

Challenges FHIR Solves?

- Reduces healthcare data complexity
- Remove barriers to healthcare data exchange.

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Fast Healthcare Interoperability Resources (FHIR)

Fast Healthcare Interoperability Resources (FHIR)

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HL7 FHIR Release 5

Home | Getting Started | Documentation | Data Types | Re

Home

This page is part of the FHIR Specification (v5.0.0: R5 - STU)
Page versions: **R5** R4B R4 R3 R2

0 Welcome to FHIR®

FHIR is a standard for health care data exchange, published by

First time here?
See the executive summary, the developer's introduction, cli
and then the FHIR overview & how FHIR versions work. See
Contents and the Community Credits or you can search this s

Level 1 Basic framework on which the specification is built

Foundation | Base Documentation, XML, JSON, RDF, Datatypes, Extensions

Level 2 Supporting implementation and binding to external specifications

Implementer Support	**Security & Privacy**	**Conformance**	**Terminology**	**Exchange**
Downloads, Version Mgmt, Use Cases, Testing	Security, Consent, Provenance, AuditEvent	StructureDefinition, CapabilityStatement, ImplementationGuide, Profiling	CodeSystem, ValueSet, ConceptMap, Terminology Svc	REST API + Search Documents Messaging Services Databases Subscriptions

Level 3 Linking to real-world concepts in the healthcare system

Administration | Patient, Practitioner, CareTeam, Device, Organization, Location, Healthcare Service

Level 4 Record-keeping and Data Exchange for the healthcare process

Clinical	**Diagnostics**	**Medications**	**Workflow**	**Financial**
Allergy, Problem, Procedure, CarePlan/Goal, Family History, RiskAssessment, etc.	Observation, Report, Specimen, ImagingStudy, Genomics, etc.	Medication, Request, Dispense, Administration, Statement, Immunization, etc.	Introduction + Task, Appointment, Schedule, Referral, PlanDefinition, etc.	Claim, Account, Invoice, ChargeItem, Coverage + Eligibility Request & Response, ExplanationOfBenefit, etc.

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FHIR Schema

FHIR Schema (as JSON)

Generate NGSI-LD smart-data-models from HL7-FHIR json schema

NGSI-LD smart data models

HL7-FHIR json schema

definitions
- **Extension**
- Meta
- Element
- ResourceList
- ...

Resource Patient

Resource Practitioner

Resource X

python script to generate NGSI-LD/NGSI-V2 json schemas from HL7-FHIR global json schema, to integrate in CI (github flow)

prepare HL7/FHIR/NGSI-LD smart health json schemas

read

generate

Alternative:
nodejs app to generate NGSI-LD/NGSI-V2 json schemas from HL7-FHIR global json schema, to integrate in CI (github flow)
=> easier, thanks to the many javascript json libraries

NGSI-LD smart health HL7-FHIR models

HL7-FHIR-NGSI-definitions json schemas

reference: $ref

Patient entity NGSI json schema

Practitioner entity NGSI json schema

relationship: $ref

X entity NGSI json schema

keep definitions in global json schema files
hl7-fhir-definition-<name>.json, for simple definitions
those definition files are referenced in each resource type schema

means to explode definitions to have each definition in a separate json schema, to be able to use it as plain entities

generate one schema file per resource type of HL7,

reference definition file ("$ref": "#/definitions/Element"), for basic definitions.

use direct native types instead of HL7 definition (ex: **type: string**, not "$ref":"#/definitions/string")

reference other resources through a relationship/reference (ex: "$ref": "#/patient/Patient")

treat **Extension** as linked entity, through relationship: $ref ?, to avoid infinite recursion

Procedure
id
basedOn.reference
subject.reference
instantiatesCanonical
category
code
occurrence
bodySite

Encounter
id
basedOn.reference
subject.reference
period.start
period.end

Observation
id
partOf.reference
basedOn.reference
subject.reference
instantiatesCanonical
effectiveDateTime
category
code
value
referenceRange
bodySite
method
interpretation

ObservationDefinition
id
category
code
permittedDataType
quantitativeDetails

MedicationStatement
id
basedOn.reference
subject.reference
medicationCodableConcept
effectiveDateTime
dateAsserted
dosage

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Sample Template

SOAP Note Sample

NUR 4050: Critical Care
Clinical Experience Form
Date:

Student's Name:
Patient's Initials: S.M.

Patient Demographics	Reason for this Visit	Assessment and Interventions Done Today
Include age, gender, ethnicity, occupation and other demographics, PMH/PSH, medications, allergies pertinent to the health status.	Identify why the patient is at the site today. When possible use the patient's words/chief complaint.	Use SOAP format for the assessment data. Identify interventions done today, and anticipated before or @ next visit (e.g., procedures employed, medications prescribed, pt ed., referrals or support systems enacted). Interventions should relate to the reason for the visit as well as the health risk, health alteration and demographics of the patient. Include medical and nursing dx.
S.M. an 88 yo male Caucasian, is retired and lives with his wife in their one-story home. PMHx: hx of falls; unruptured cerebral aneurysm; legally blind; cellulitis; peripheral vascular disease PSHx: none noted in medical record Meds: aspirin 325 mg PO; Avelox 400 mg PO; Lasix 20 mg PO; Theragran PO Allergies: penicillin, erythromycin, clindamycin	To check status of three stasis ulcers and perform dry dressing change	S: Pt reported intense itching at wound site rated 10/10, with pain rated at 3/10 in the past week but 0/10 at time of assessment. Itching is more intense at night, and pt rubs area on top of wound dressing to relieve it. Pt and pt's wife requested info about protecting dressing during showers. Itching is more intense at night. O: BP 160/80 L arm sitting; T 96.4 O; RR 20, even, unlabored; HR: 84 regular, 2+, L radial --4" L x 3" W wound on left medial LE 4" above ankle; 2" L x 1" W wound on left lateral LE 1" above ankle; 2" L x 2" W wound on left medial heel 1" below ankle; all wounds red, beefy, moist with epithelialization across all sites; minimal drainage --2+ pitting on left LE from knee to proximal wound site --Shuffling gait; uses cane; pt is familiar with environment and receives assistance from wife for ambulation --lungs clear b/l; apical S1 and S2 heard, regular A: med dx: peripheral vascular disease; stasis ulcers Nursing dx: risk for falls r/t legal blindness; impaired skin integrity r/t stasis ulcers a/e/b red, beefy, moist, draining skin on left LE; edema r/t venous stasis a/e/b pitting edema 2+ on left LE from knee to proximal wound site P: Today—dry dressing change with PolyMem, 4x4 gauze pad, Stofoam gauze, ACE bandage; verbal and written education on dressing changes and dressing protection during showering; verbal education on relieving edema; checked medication compliance for elevated BP Next visit—assess wounds; assess edema change dressing; check VS and med compliance for BP

Sample Unstructured Note

SOAP Note Sample

NUR 4050: Critical Care
Clinical Experience Form
Date:

Student's Name:
Patient's Initials: S.M.

Patie...
Include age,
occupation a
PMH/PSH, r
pertinent to

S.M. an 88 y
retired and li
their one-sto

PMHx: hx o
cerebral ane
cellulitis, pe
disease

PSHx: none

Meds: aspiri
400 mg PO;
Theragran P

Allergies: pe
clindamycin

This is about Mr. Fernando Amos Breitenberg. He's married. Now let's talk about his medical encounters.\n\nThe main one is a well child visit. This happened at the clinic. The visit started on December 23, 1992, at 01:08:42 and ended on the same day at 01:23:42, with timezone being +01:00. Mr. Breitenberg was looked after by Dr. Trent Krajcik. He was the one who did the whole procedure.\n\nMoving on, Mr. Breitenberg has an allergy. It's active and confirmed. He's allergic to shellfish. We've known this since April 2, 1994, at 12:08:42, with timezone as +02:00.\n\nFinally, all this happened at our healthcare provider in Quincy. It's located at 300 CONGRESS ST STE 203, Quincy, MA, 021690907, US.

Extracting Entities

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```
class PersonNameAndTitle {
    family string? @alias("surname") @description("Surname of the patient")
    given string[]? @alias("givenName") @description("Given name(s) of the patient")
    prefix string? @alias("title") @description("Title of the patient")
}
```

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Extracting Entities

```json
{
  "name": {
    "family": "Breitenberg",
    "given": [
      "Fernando",
      "Amos"
    ],
    "prefix": "Mr."
  },
  "age": null,
  "gender": null,
  "birthDate": null,
  "address": null,
  "phone": null,
  "email": null,
  "maritalStatus": "Married",
```

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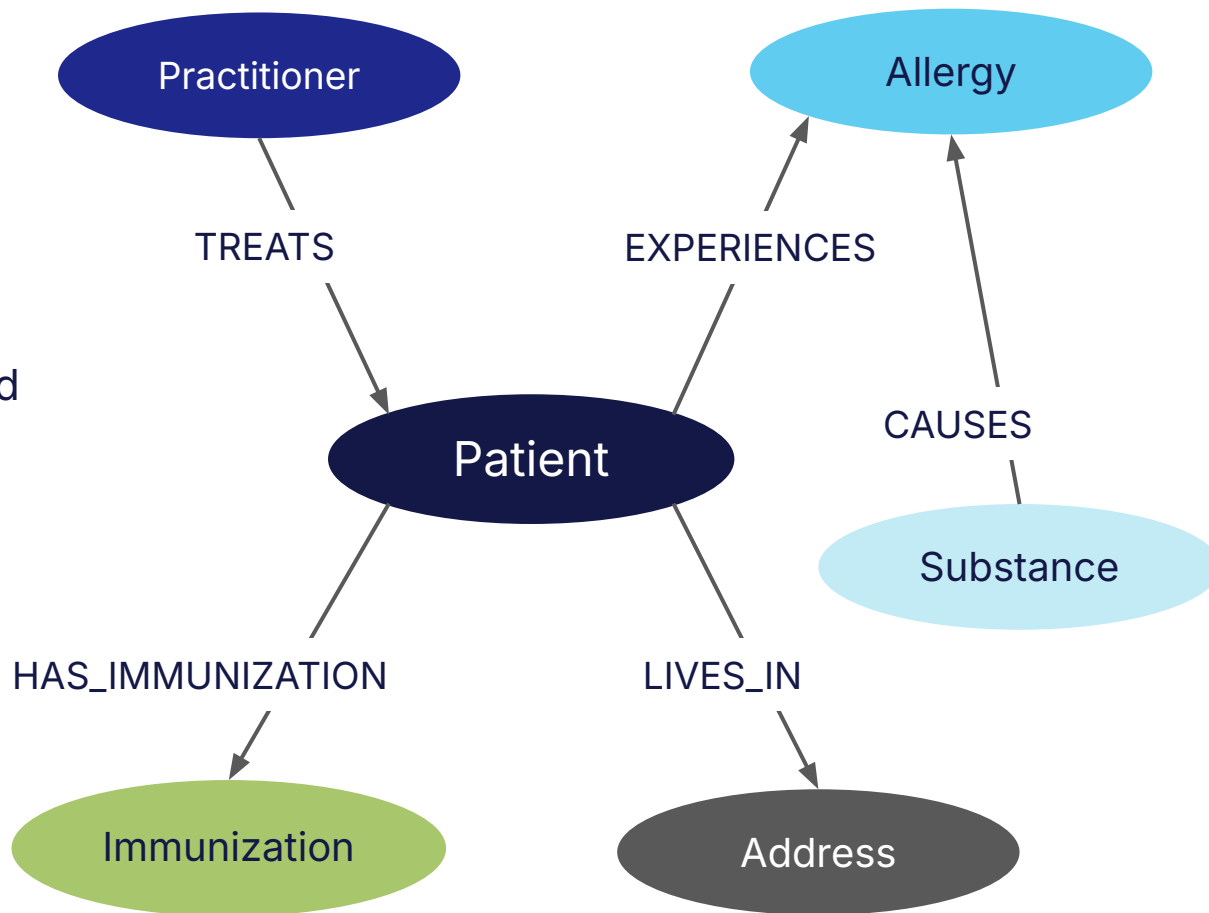
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```

The Graph Schema

Domain Specificity
Enforcing schema and domain semantics.

Recap: Why Graph for Specialized Knowledge

Context is clear
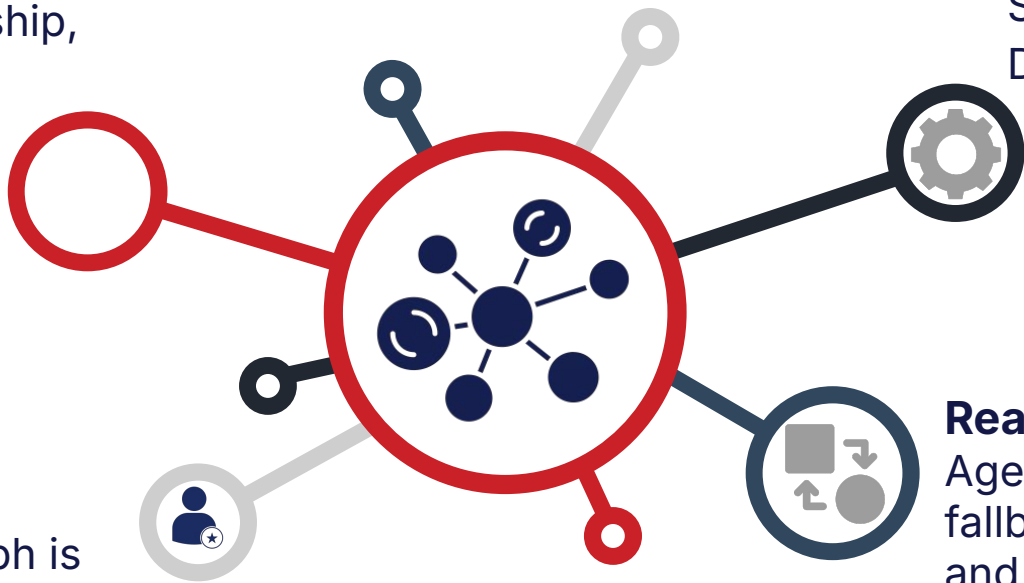Paths & Relationship, not paragraphs

Domain Specificity
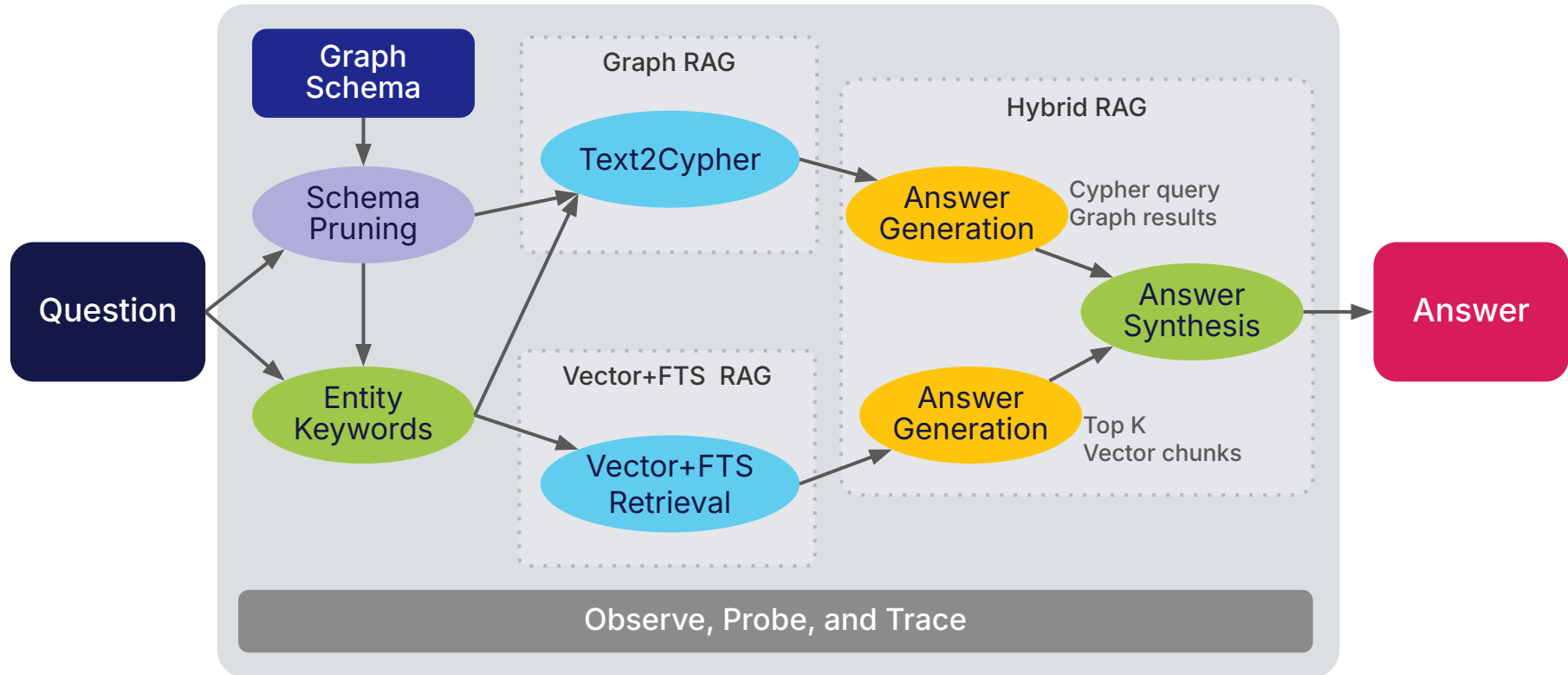Schema Enforces Domain semantics

Explainability
Cypher and Graph is auditable

Reasoning Control
Agent choose paths fallback on structure and schema transversal

Agentic Workflows for Graph RAG
Design-Build-Evaluate-Expand

Design	Build	Evaluate	Expand
Robust graph schemas are the bedrock	Enforce structure	Deterministic evaluations (factual answers)	Gradually increase autonomy by component
Agent workflows provide higher quality results	Build composable workflows	LLM evaluation (qualitative)	Evaluate with respect to baseline
Use a sliding scale for agentic systems and tailor for needs	Test full pipeline and iterate	Probe and test intermediate stages	Add new tools, workflows & agents
	Plug into observability tools	Monitor for failure mechanisms	Expand generalizability

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Vision: Increasing Agentic Control
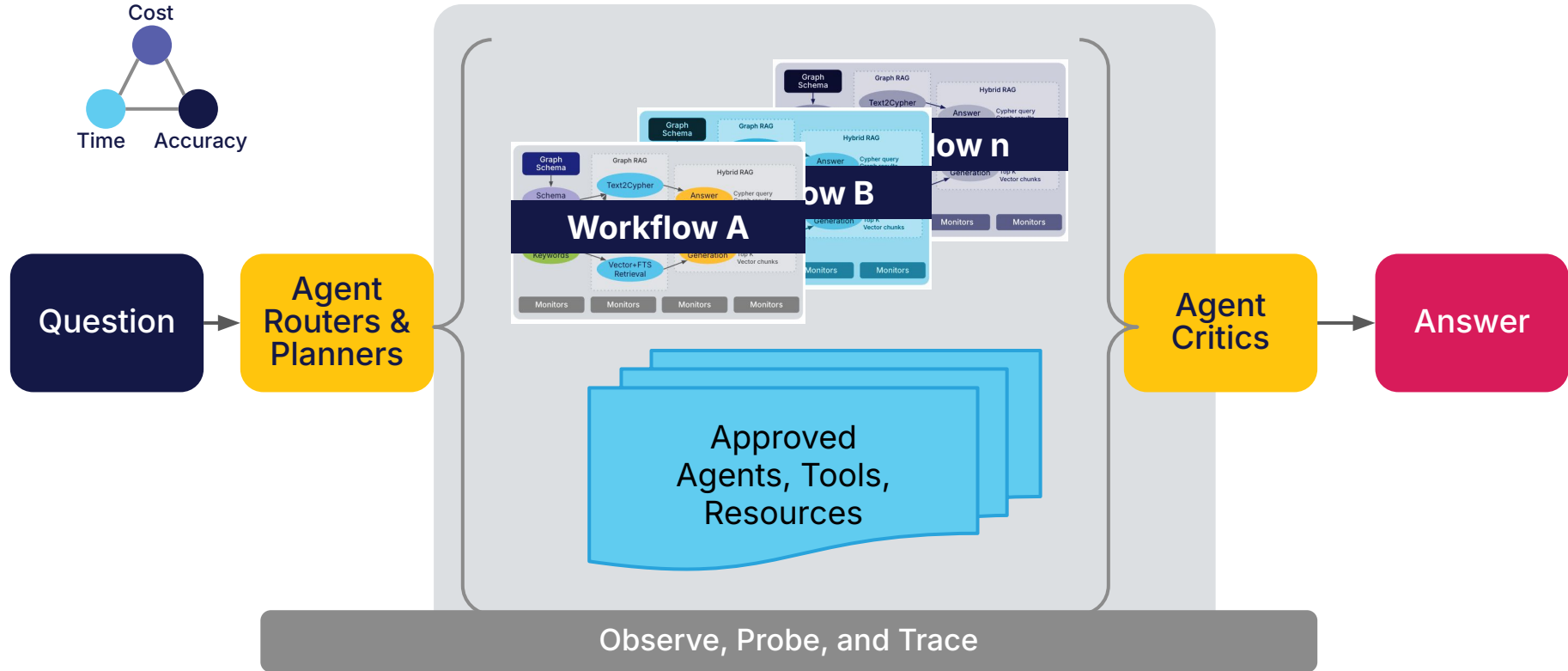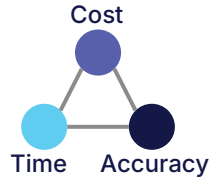
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Agentic Workflows for Graph RAG
tiny.graphgeeks.org/Agentic-Summit
Jul 30 - Evaluating & Benchmarking

ODSC

October: San Francisco
2026: East Coast, Europe ++

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graph practitioners & enthusiasts