

Tecnologie ibride per la trasparenza

Conoscenza Strutturata e Modelli Generativi

124° Nexa Lunch Seminar - Mercoledì 24 Settembre 2025

Giuseppe Futia, PhD



Making data available does not
automatically
produce transparency



Transparency requires information
that is easy to access, process, and
interpret



**CHICAGO
DATA PORTAL**

Chicago Data Portal



Search to find a specific dataset...



**Public
Procurement
Risk Data Manager**

Regulatory Compliance
Detect invalid contracts
due to licensing issues.



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Procurement
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**Public
Procurement
Risk Data Manager**

Conflict of Interest
Uncover links between
people, contracts, licenses,
and departments.

Regulatory Compliance

Detect invalid contracts
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Public Procurement Risk Data Manager

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360-Degree View
Track all activities tied
to a business owner.



Our journey

Building

From business understanding to knowledge graph generation

Analysis

Rules generation, validation reporting, contextual explainability

Application

Regulatory compliance, conflict of interest, 360-degree view

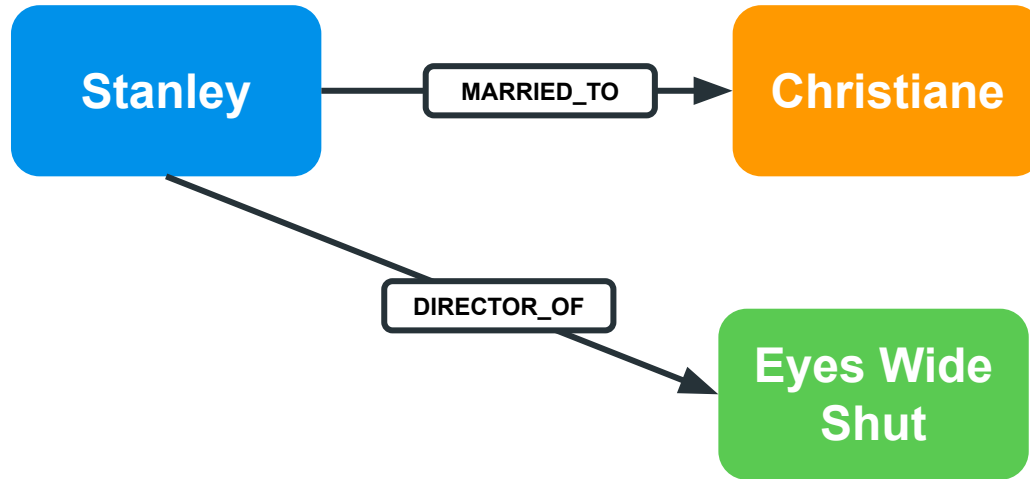


1. Building Phase

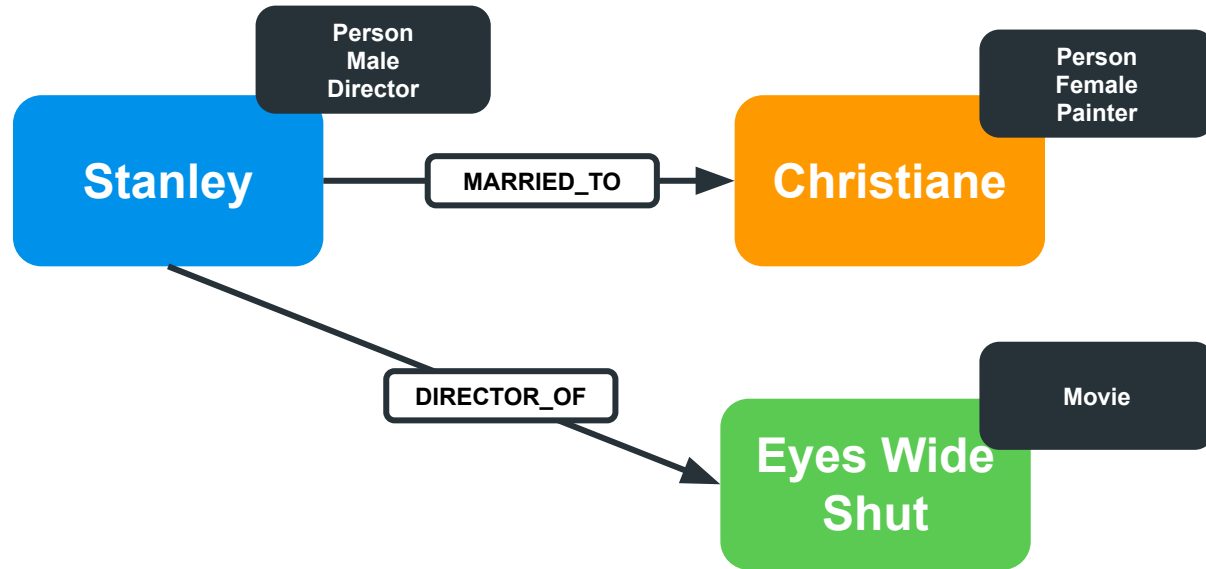
From Business Understanding to
Knowledge Graph Generation
(Labeled Property Graph - LPG)



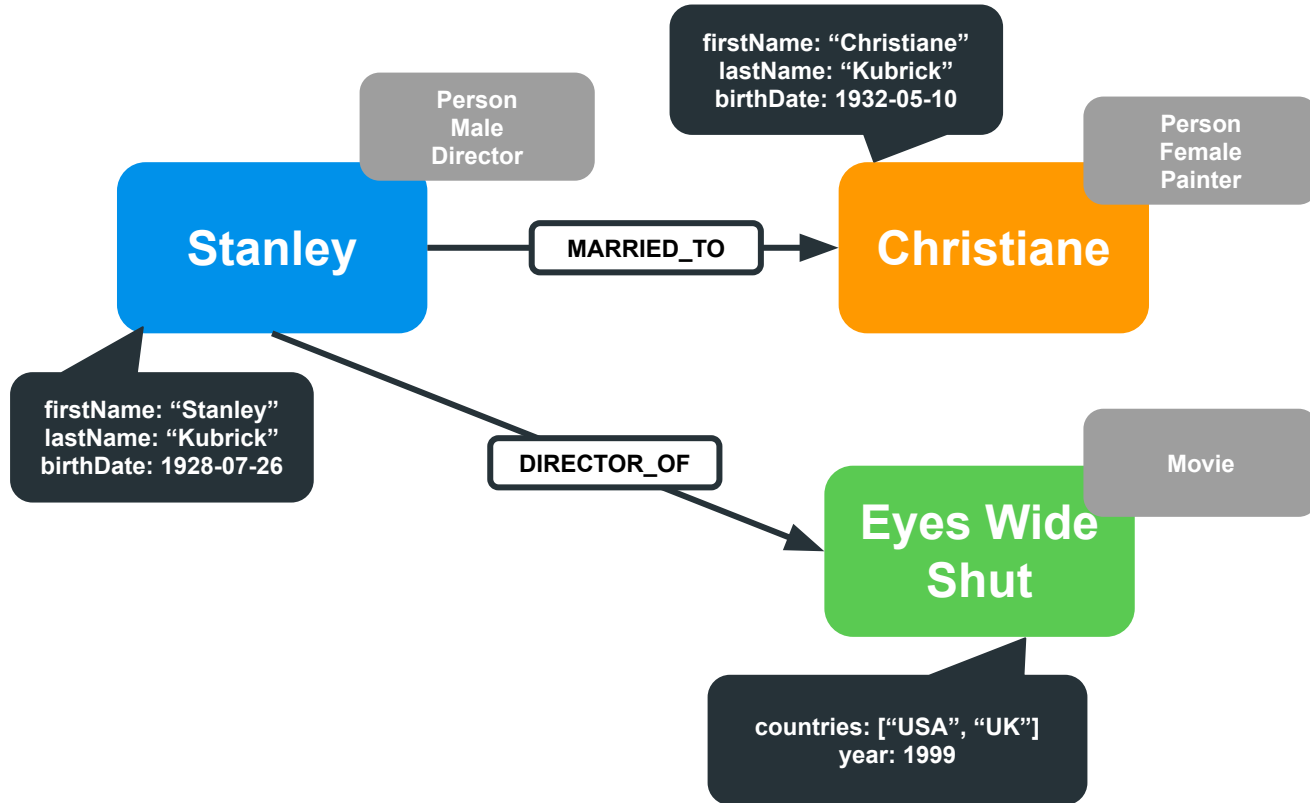
LPG Example



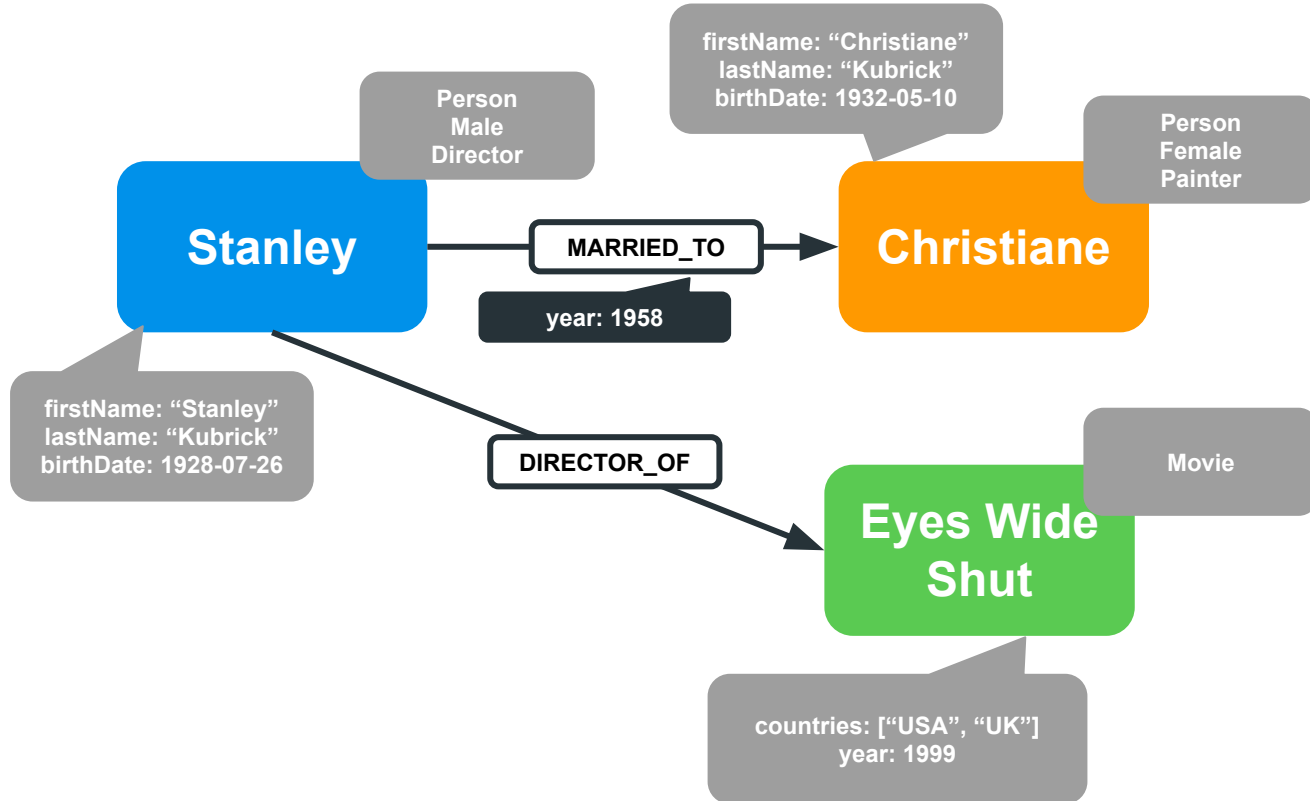
Zero, one, or more labels...



Node Properties



Relationship Properties



Building Phase

CSV files released by the City of Chicago

Integrating information from different sources into the KG unified representation

The resulting KG can support for starting specific investigations

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Public
Procurement
Risk Manager



Owners



Employees

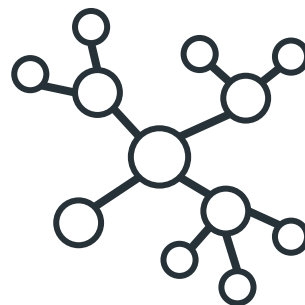


Licenses



Contracts

Mapping Data to
Nodes,
Relationships
and Properties



Business
Understanding

Data
Understanding

Graph Model
Definition

Knowledge
Graph
Generation

Building Understanding

Regulatory Compliance

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**Business
Understanding**

Data Understanding

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Procurement
Risk Manager



Owners



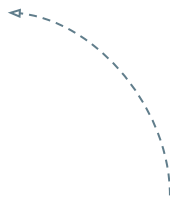
Employees



Licenses



Contracts



Business
Understanding



Data
Understanding

Connections Between the Datasets

CSV files released by the City of Chicago

No shared ids
between owners
and employees

Regulatory Compliance

Detect invalid contracts due to licensing issues.

Conflict of Interest

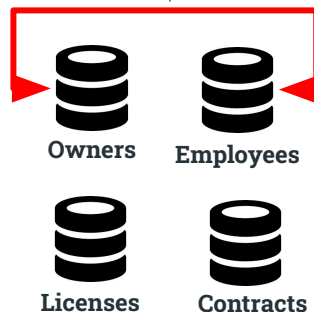
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Public
Procurement
Risk Manager



Business
Understanding

Data
Understanding

Connections Between the Datasets

CSV files released by the City of Chicago

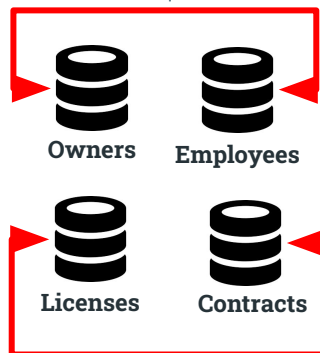
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Regulatory Compliance

Detect invalid contracts due to licensing issues.



Public
Procurement
Risk Manager



No shared ids
between ORGs in
licenses and
contracts

360-Degree View

Track all activities tied to a business owner.

Business
Understanding

Data
Understanding

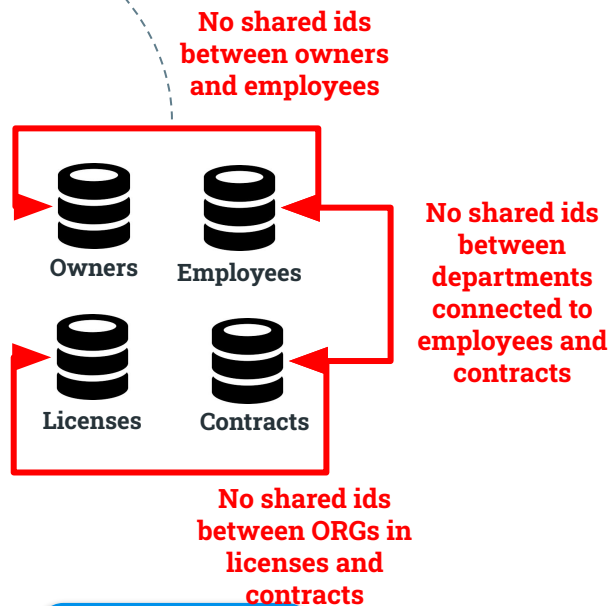
Connections Between the Datasets

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Business Understanding

Data Understanding

Connections Between the Datasets

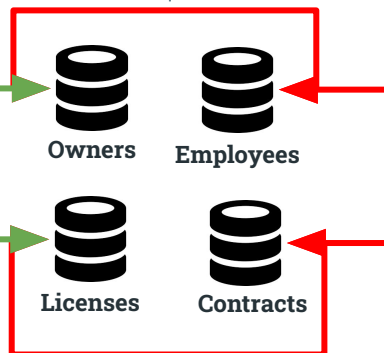
CSV files released by the City of Chicago

Shared ORG ids
in owners and
licenses

No shared ids
between owners
and employees

No shared ids
between
departments
connected to
employees and
contracts

No shared ids
between ORGs in
licenses and
contracts



Business
Understanding

Data
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Graph Model Definition

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Integrating information from different sources into the KG unified representation

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Procurement
Risk Manager



Owners



Employees



Licenses



Contracts

Mapping Data to
Nodes,
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Business
Understanding

Data
Understanding

Graph Model
Definition

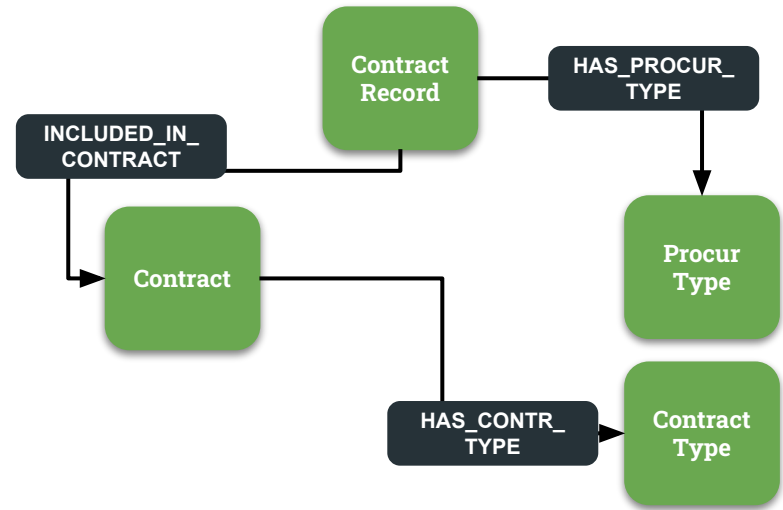
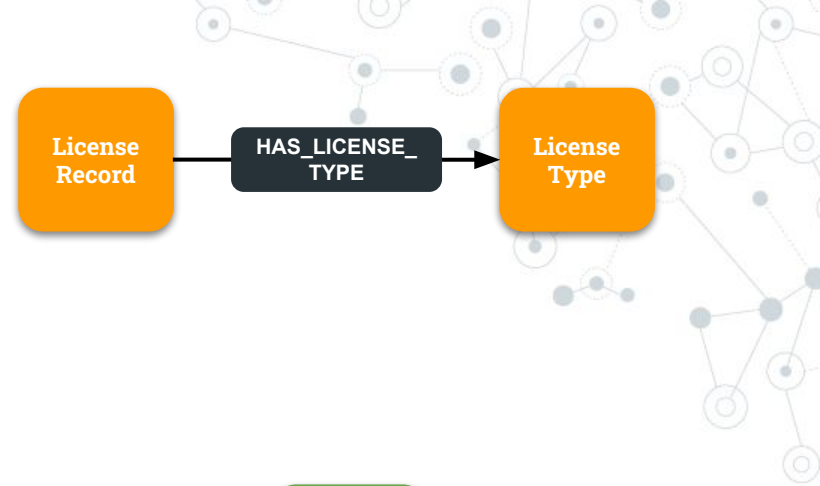
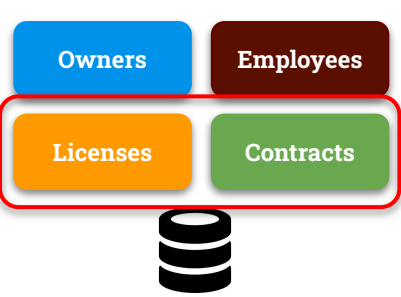
Owners

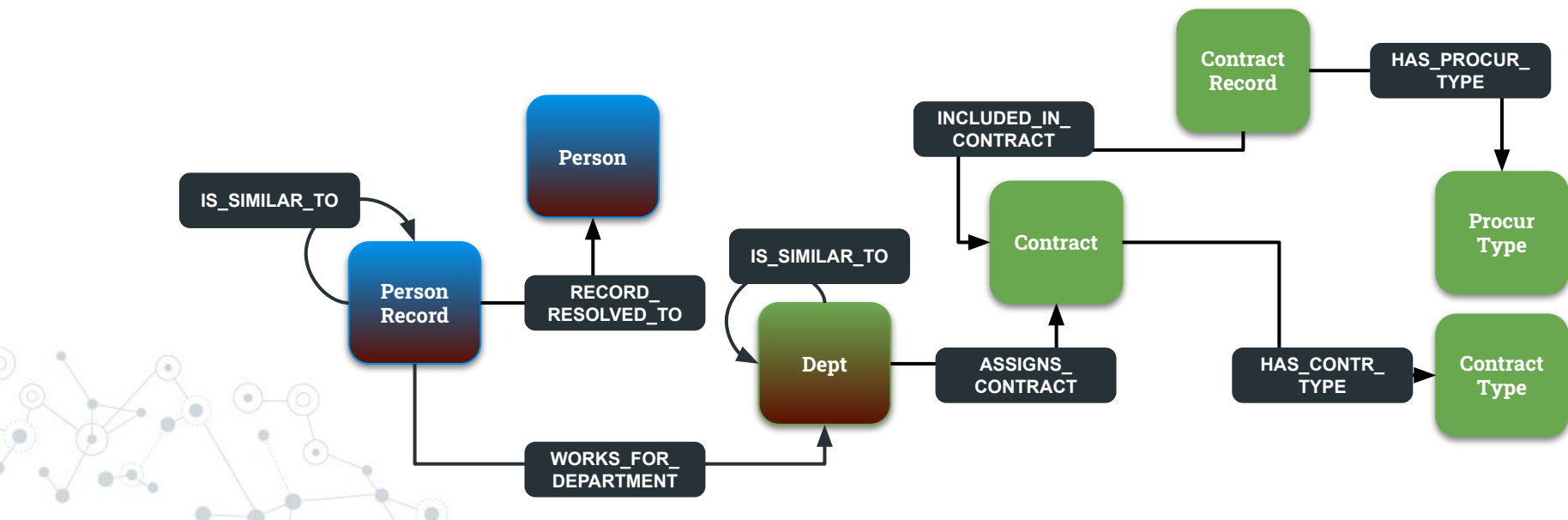
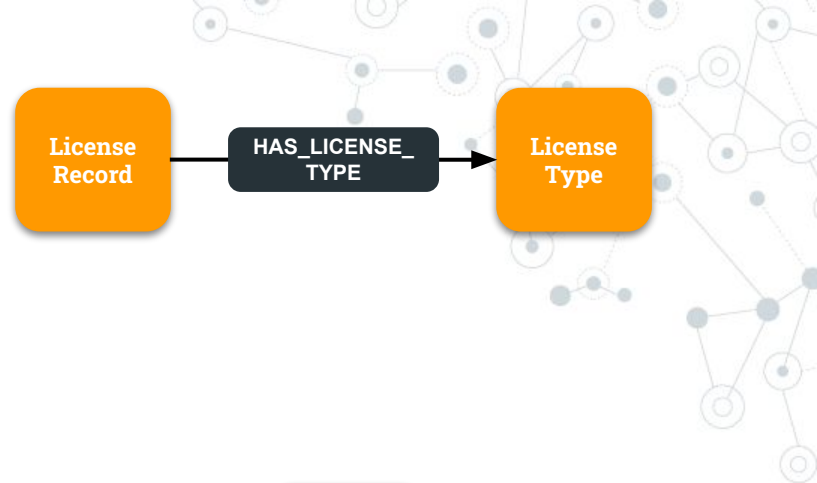
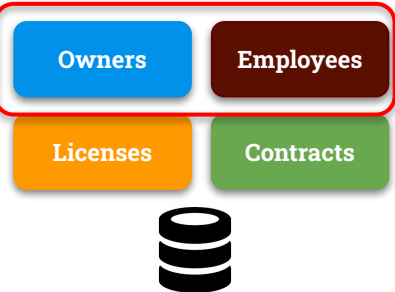
Employees

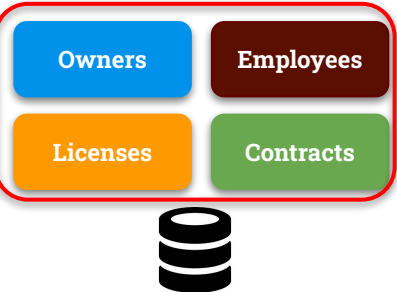
Licenses

Contracts

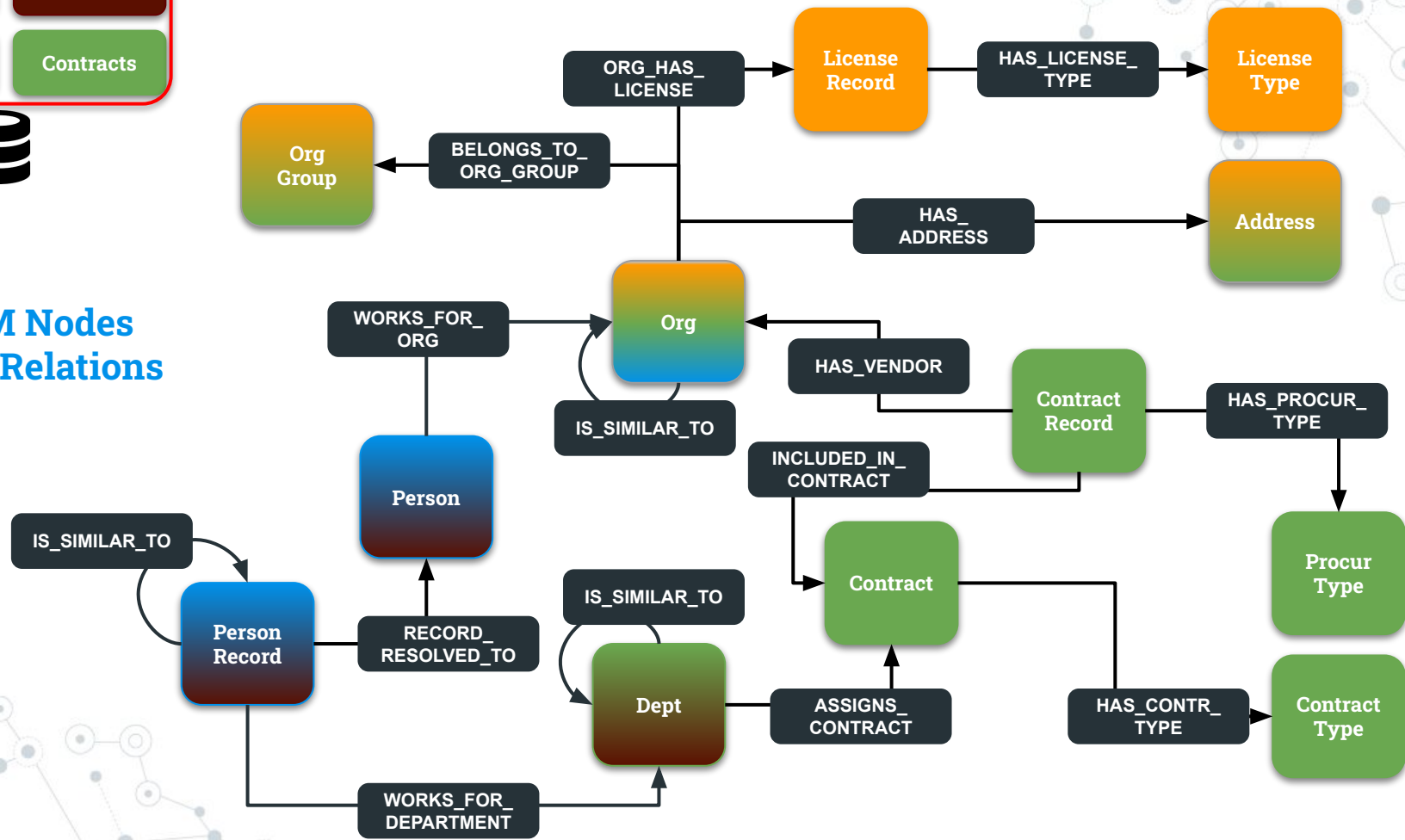








1M Nodes
2M Relations



Knowledge Graph Generation

CSV files released by the City of Chicago

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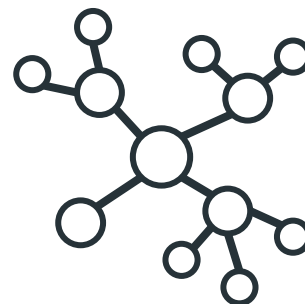


Licenses



Contracts

Mapping Data to Nodes, Relationships and Properties

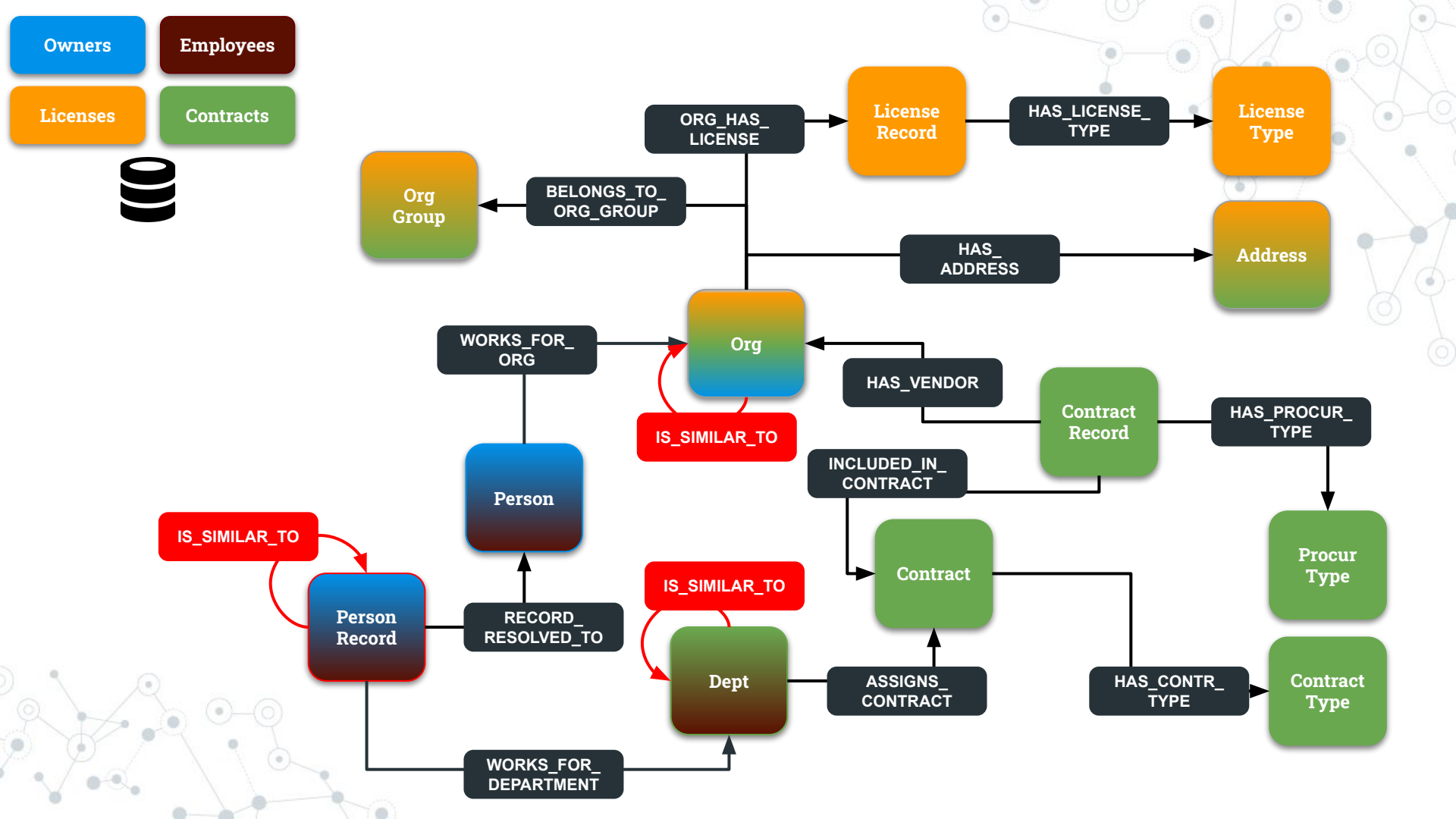


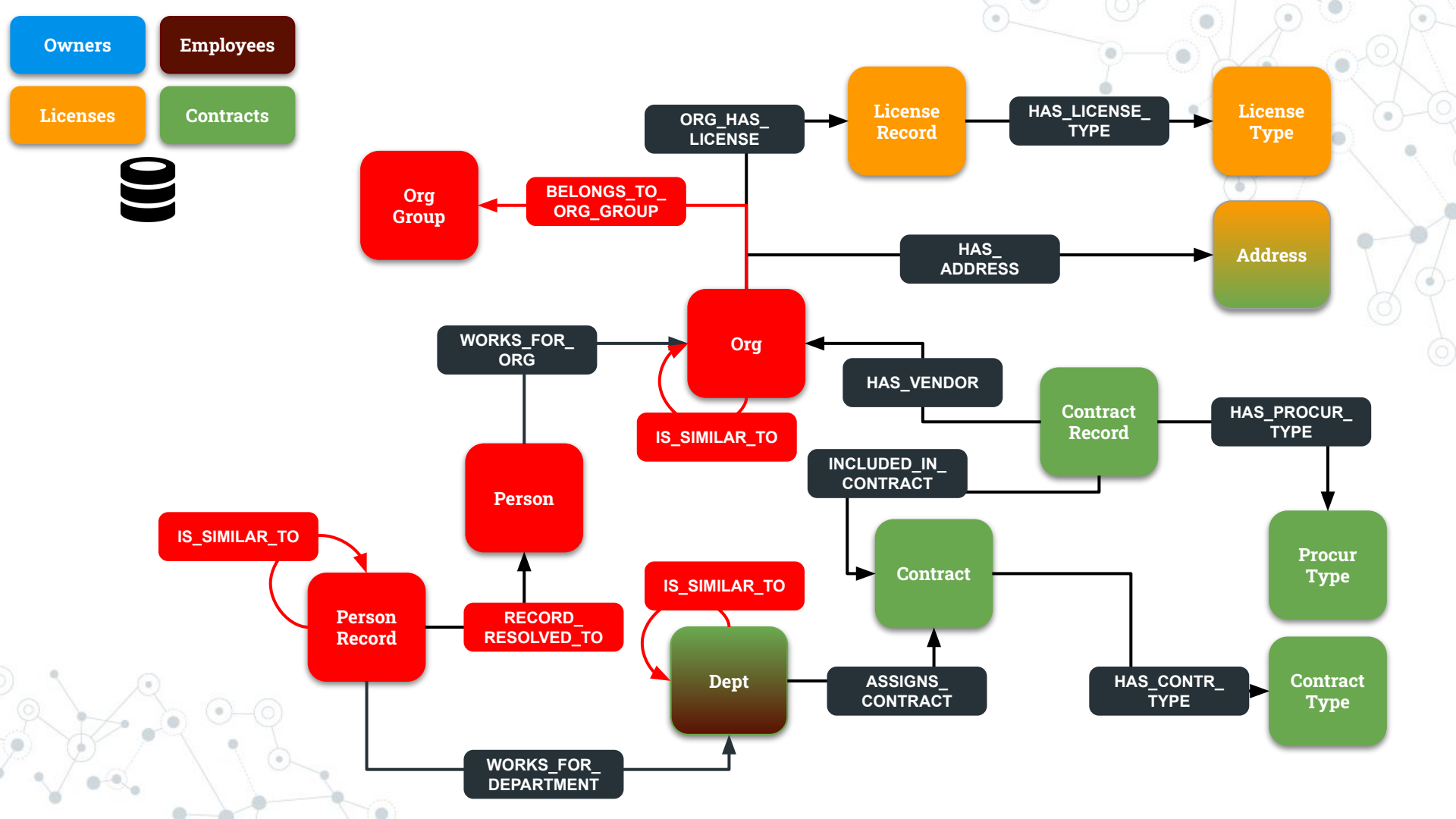
Business Understanding

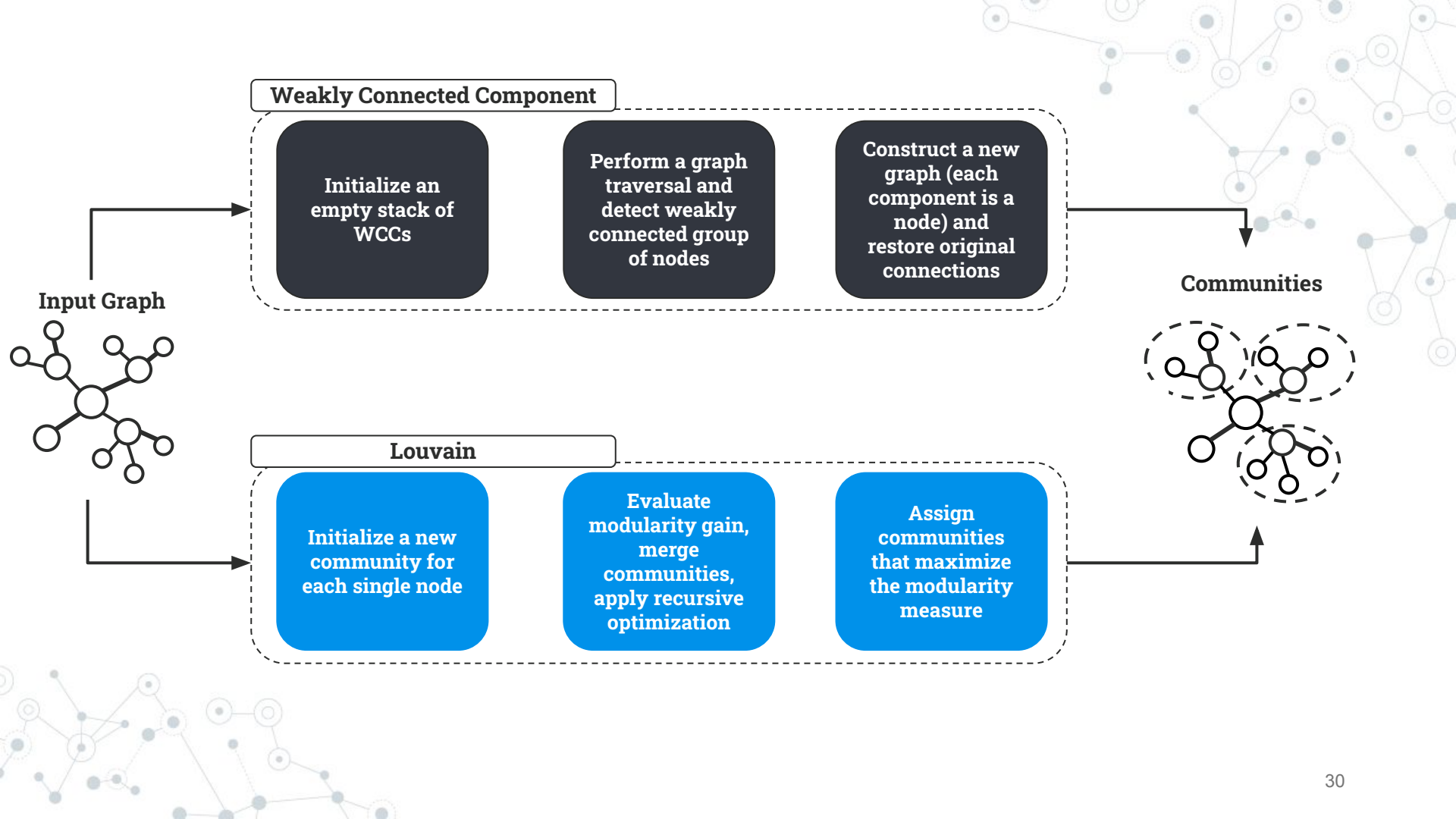
Data Understanding

Graph Model Definition

Knowledge Graph Generation









2. Analysis Phase

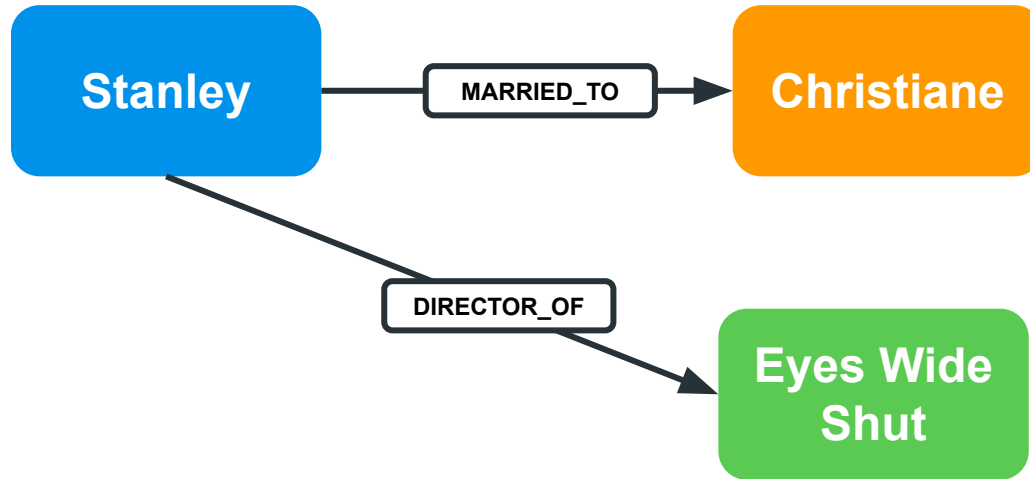
From Business Understanding to
Insights Extraction
Resource Description Framework (RDF)



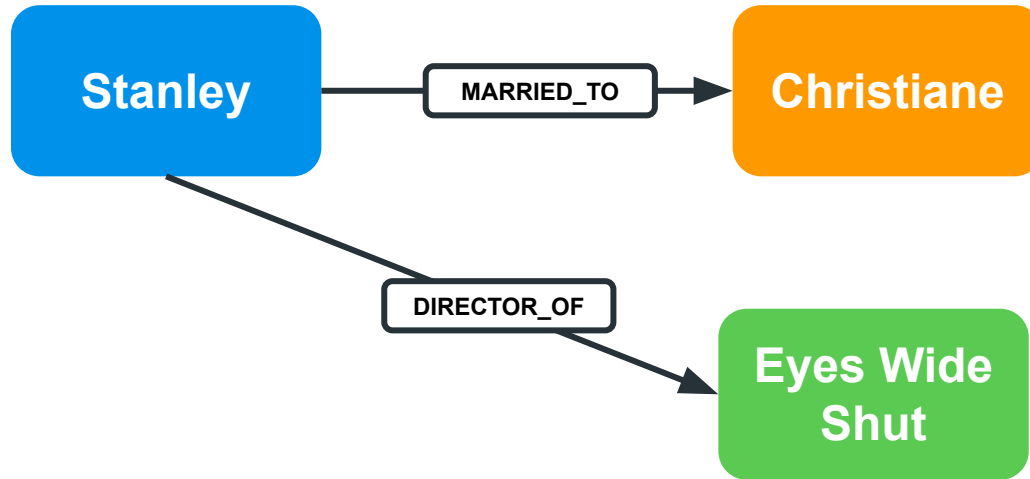


Exploratory Phase!

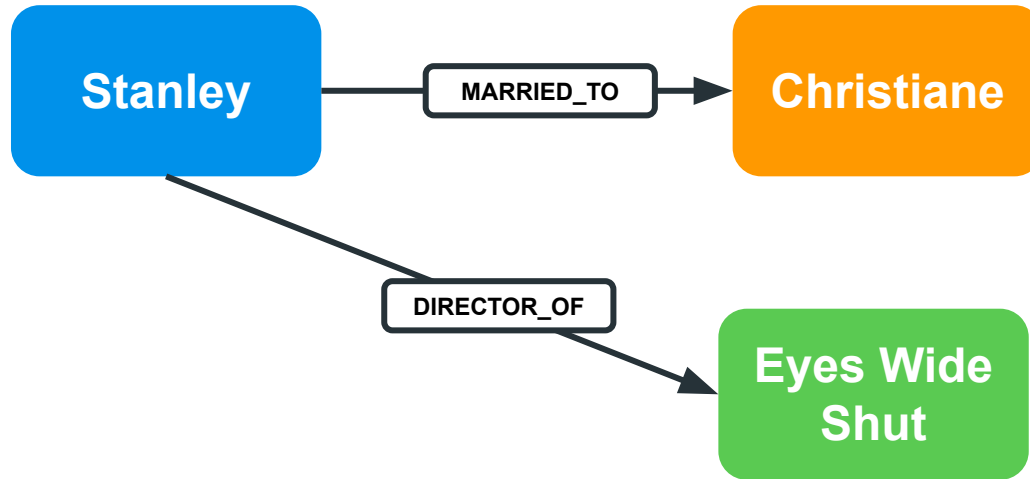
RDF Example



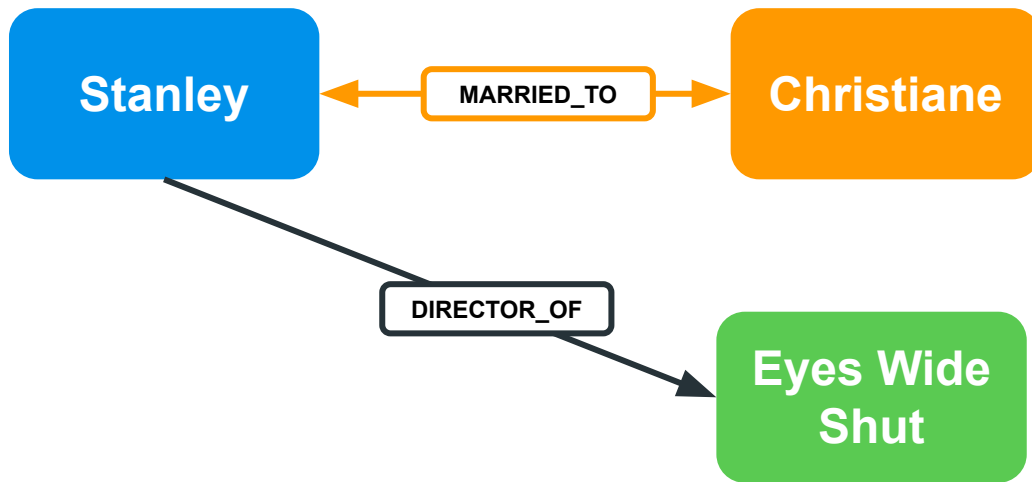
dbr:Stanley_Kubrick myo:married_to dbr:Christiane_Kubrick .



```
dbr:Stanley_Kubrick myo:married_to dbr:Christiane_Kubrick .  
myo:married_to rdf:type owl:SymmetricProperty .
```



```
dbr:Stanley_Kubrick myo:married_to dbr:Christiane_Kubrick .  
myo:married_to rdf:type owl:SymmetricProperty .  
dbr:Christiane_Kubrick myo:married_to dbr:Stanley_Kubrick .
```



OWL Reasoning

```
dbr:Stanley_Kubrick myo:influenced dbr:Katsuhiro_Otomo .  
dbr:Katsuhiro_Otomo myo:influenced dbr:Satoshi_Kon .  
  
myo:influenced rdf:type owl:TransitiveProperty .
```

OWL (Web Ontology Language) Reasoning

```
dbr:Stanley_Kubrick myo:influenced dbr:Katsuhiro_Otomo .  
dbr:Katsuhiro_Otomo myo:influenced dbr:Satoshi_Kon .
```

```
myo:influenced rdf:type owl:TransitiveProperty .
```

```
dbr:Stanley_Kubrick myo:influenced dbr:Satoshi_Kon .
```

SHACL (Shapes Constraint Language) Validation

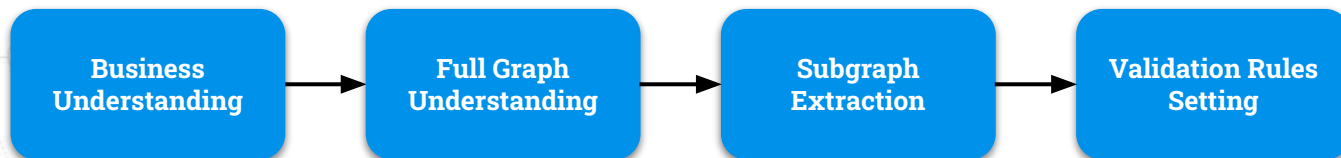
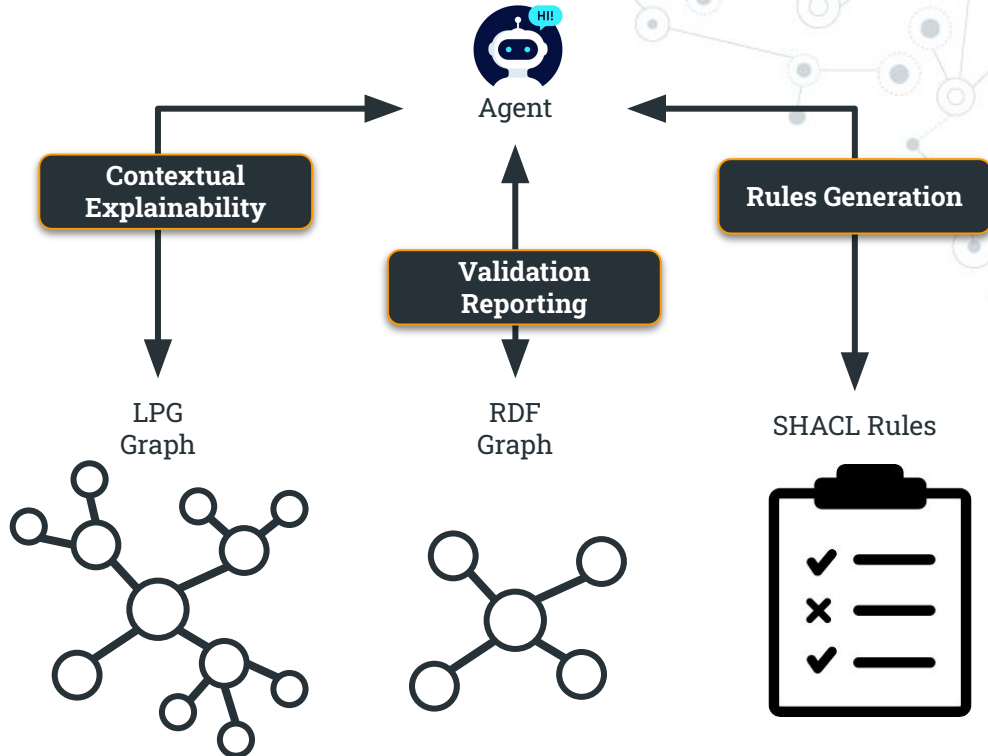
```
ex:InfluencedConstraintShape
  a sh:NodeShape ;
  sh:targetSubjectsOf ex:influenced ; # Apply to subjects of 'influenced' property
  sh:class ex:Person ; # Subject must be a Person
  sh:property [
    sh:path ex:influenced ;
    sh:class ex:Person ; # Object must also be a Person
    sh:message "Only a Person may be influenced, and only a Person may influence
others." ;
  ] .
```

Analysis Phase

Regulatory Compliance
Detect invalid contracts due to licensing issues.

Conflict of Interest
Uncover links between people, contracts, licenses, and departments.

360-Degree View
Track all activities tied to a business owner.



Full Graph Understanding

Regulatory Compliance

Detect invalid contracts due to licensing issues.

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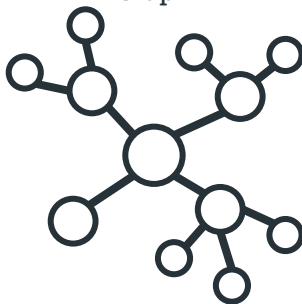
360-Degree View

Track all activities tied to a business owner.



Procurement
Officer/Manager

LPG
Graph



Business
Understanding



Full Graph
Understanding

Full Graph Understanding

```
MATCH (c:Contract)<-[:INCLUDED_IN_CONTRACT]-(:ContractRecord)-[:HAS_VENDOR]->(:Organization)
-[:BELONGS_TO_ORG_GROUP]->(o:OrganizationGroup)
RETURN DISTINCT elementId(c) as src_id, elementId(o) as dst_id
```

Regulatory

Detect invalid
to licensing

Conflict

Uncover li
people, cont
and dep

```
MATCH (l:LicenseRecord)<-[:ORG_HAS_LICENSE]-(:Organization)
-[:BELONGS_TO_ORG_GROUP]->(o:OrganizationGroup)
RETURN DISTINCT elementId(o) as src_id, elementId(l) as dst_id
```

360-Degree

Track all act
business

Business
Understanding

Full Graph
Understanding

Full Graph Understanding

Regulatory Compliance

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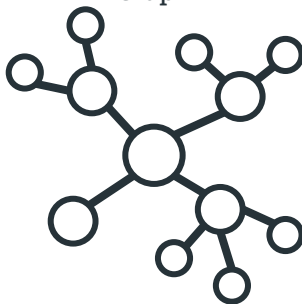
360-Degree View

Track all activities tied to a business owner.



Procurement
Officer/Manager

LPG
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Business
Understanding



Full Graph
Understanding

Subgraph Extraction

Regulatory Compliance

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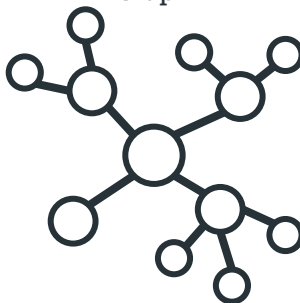
360-Degree View

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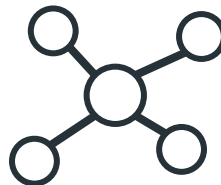


Procurement
Officer/Manager

LPG
Graph



RDF
Graph



Business
Understanding

Full Graph
Understanding

Subgraph
Extraction

Sub

```
object_property_mappings = {  
  "HAS_VENDOR": {  
    "src_uri": "http://purl.org/procurement/public-contracts#Contract",  
    "rel_uri": "http://purl.org/procurement/public-contracts#bidder",  
    "dst_uri": "http://purl.org/goodrelations/v1#BusinessEntity",  
    "query": ""  
      MATCH (c:Contract)<-[:INCLUDED_IN_CONTRACT]-(:ContractRecord)  
              -[:HAS_VENDOR]->(o:Organization)  
              -[:BELONGS_TO_ORG_GROUP]->(o:OrganizationGroup)  
      RETURN DISTINCT elementId(c) as src_id, elementId(o) as dst_id  
    ""  
  }  
}
```

Regulatory

Detect inva
to licen

Conflict

Uncover lin
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Procurement
Officer/Manager

360-Degree View

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Business
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Subgraph Extraction

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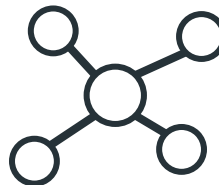


Procurement
Officer/Manager

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Business
Understanding

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Validation Rule Setting

Regulatory Compliance

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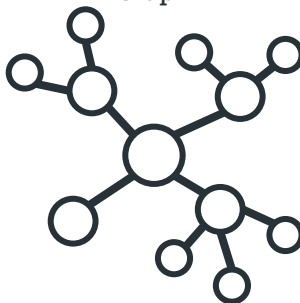
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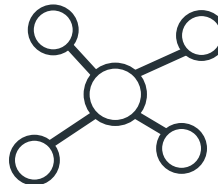


Procurement Officer/Manager

LPG Graph



RDF Graph



SHACL Rules



Business Understanding

Full Graph Understanding

Subgraph Extraction

Validation Rules Setting

V

```
<#BusinessLicenseContractShape> a sh:NodeShape ;
  sh:targetClass gr:BusinessEntity ;
  sh:sparql [
    a sh:SPARQLConstraint ;
    sh:message "The newest license end date must not be before the oldest contract start
date." ;
    sh:select "" SELECT ?this WHERE {
      {
        SELECT ?this (MAX(?licenseEndDate) AS ?maxLicenseEndDate) WHERE {
          ?this a gr:BusinessEntity .
          ?this gr:hasLicense ?license .
          ?license pco:actualEndDate ?licenseEndDate .
        } GROUP BY ?this
      }
      {
        SELECT ?this (MIN(?contractStartDate) AS ?minContractStartDate) WHERE {
          ?contract pco:bidder ?this .
          ?contract pco:startDate ?contractStartDate .
        } GROUP BY ?this
      }
      FILTER(?maxLicenseEndDate < ?minContractStartDate)
    }"" ;
  ] .
```

RegulatDetect inv
to lice**Conflict**Uncover
people, con
and de**360-Degre**Track all ac
busin

Validation Rule Setting

Regulatory Compliance

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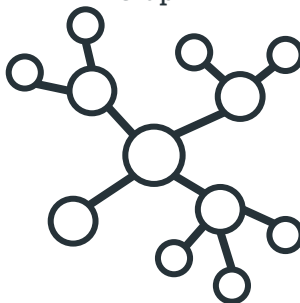
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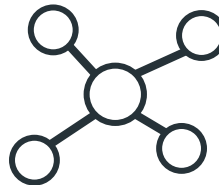


Procurement Officer/Manager

LPG Graph



RDF Graph



SHACL Rules



Business Understanding

Full Graph Understanding

Subgraph Extraction

Validation Rules Setting

Rules



Agent

Rules Generation

SHACL Rules



Regulatory Compliance

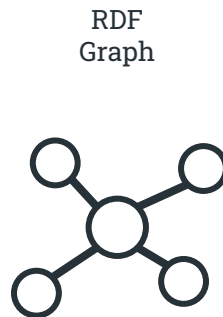
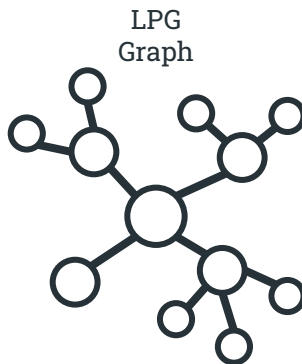
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Procurement Officer/Manager



360-Degree View

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Business Understanding

Full Graph Understanding

Subgraph Extraction

Validation Rules Setting

Reporting

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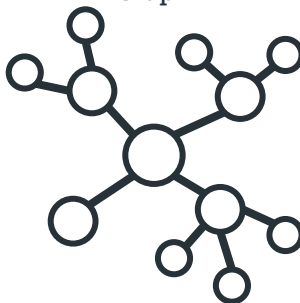
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Procurement Officer/Manager

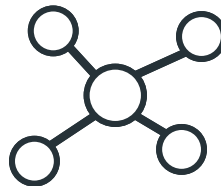
LPG Graph



Agent

Validation Reporting

RDF Graph



Rules Generation

SHACL Rules



Business Understanding

Full Graph Understanding

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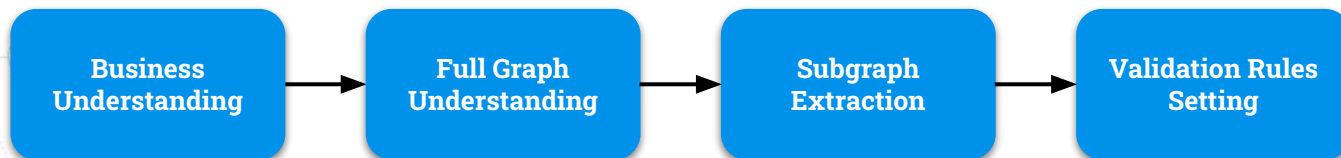
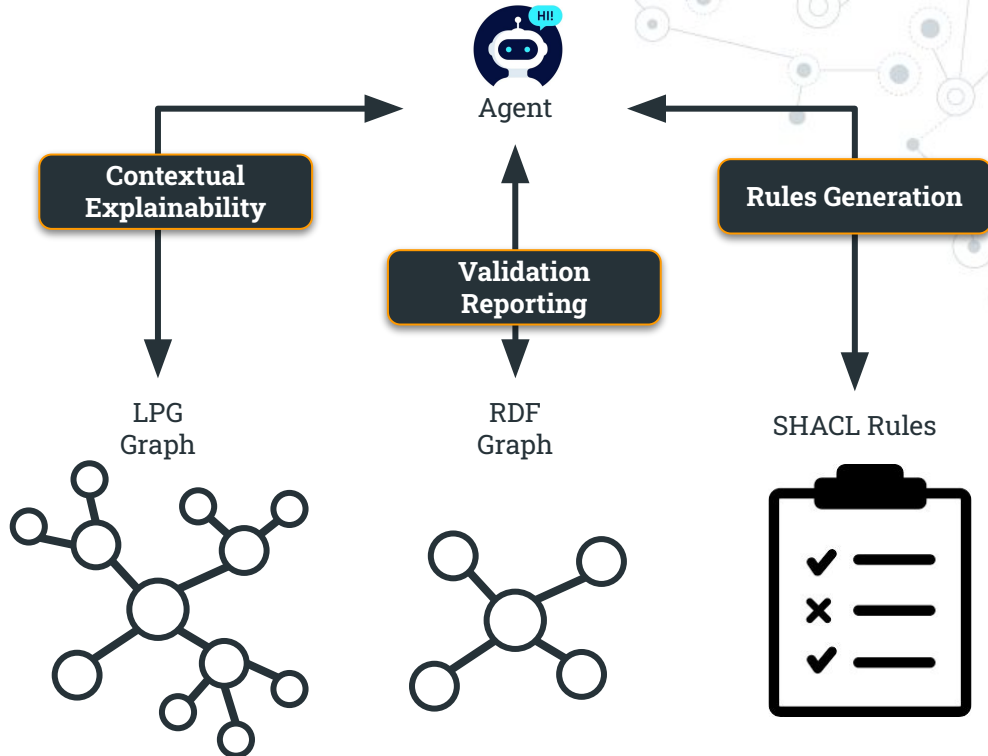
Validation Rules Setting

Explainability

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360-Degree View
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3. Use Cases

Regulatory Compliance, Conflicts of Interest,
360-Degree View





Regulatory Compliance

Detect invalid contracts due to licensing issues





Conflict of Interest

Uncover links between people, contracts, licenses,
and departments.





360-Degree View

Track all activities tied to a business owner.





Operational transparency arises when
answers are consistent, contextual,
and easy to validate



A hybrid system couples the KG's
explicit semantics and constraints
with the LLM's natural-language
access and synthesis



MANNING

Knowledge Graphs and LLMs IN ACTION

Alessandro Negro
Giuseppe Fotia
Vlastimil Kös
Fabio Montagna

MEAP

