Context Associations: an Application-Independent Annotation Method for RDF Knowledge Graphs

Workshop on Quality of Knowledge Graphs at ESWC 2026

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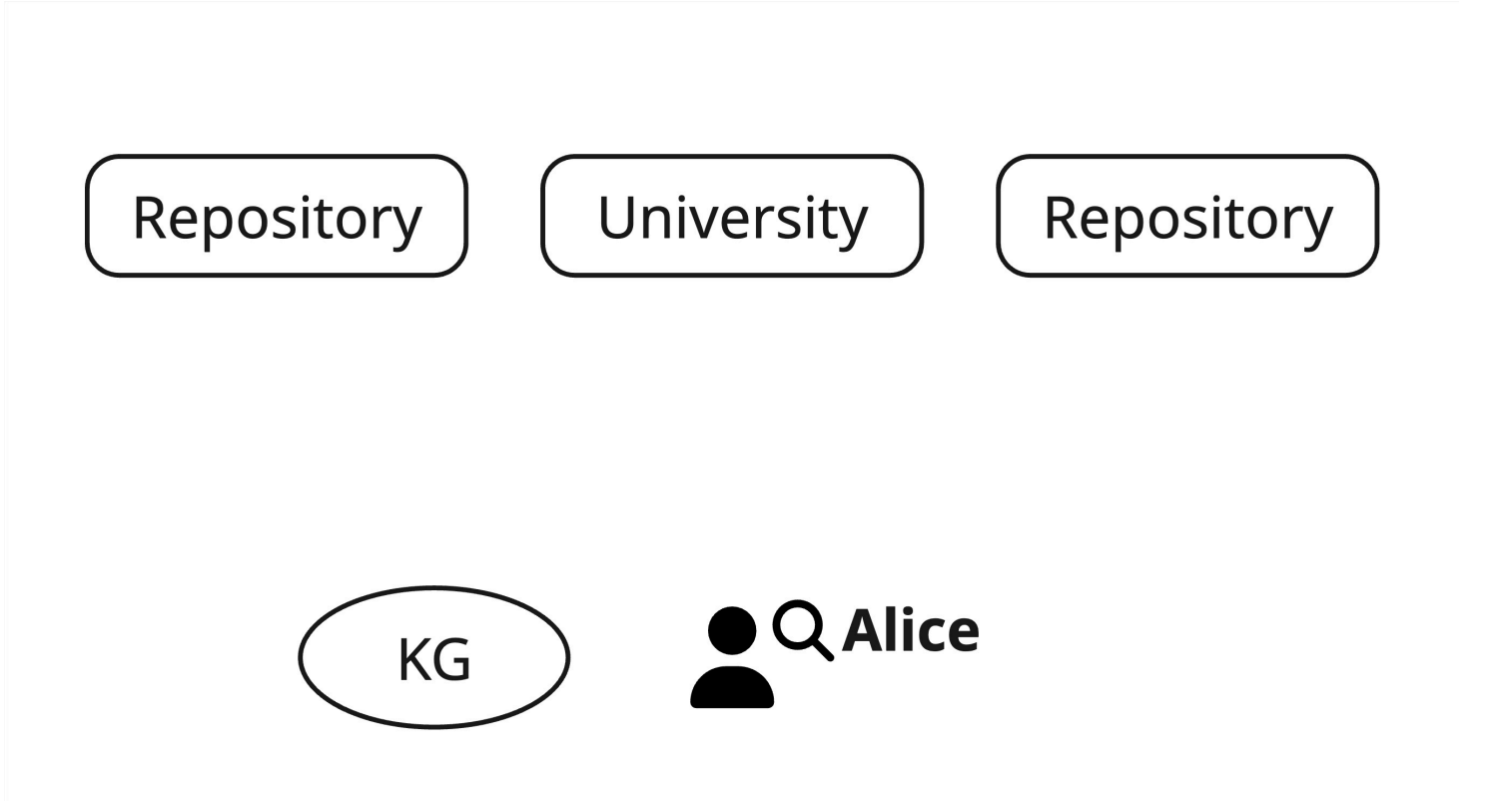
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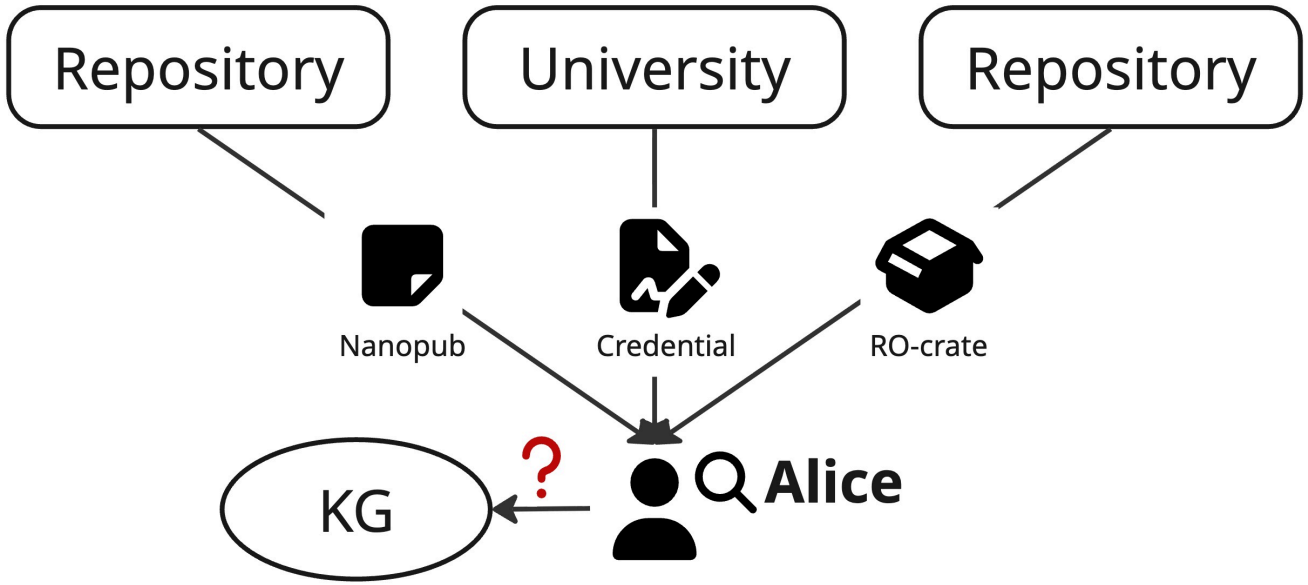
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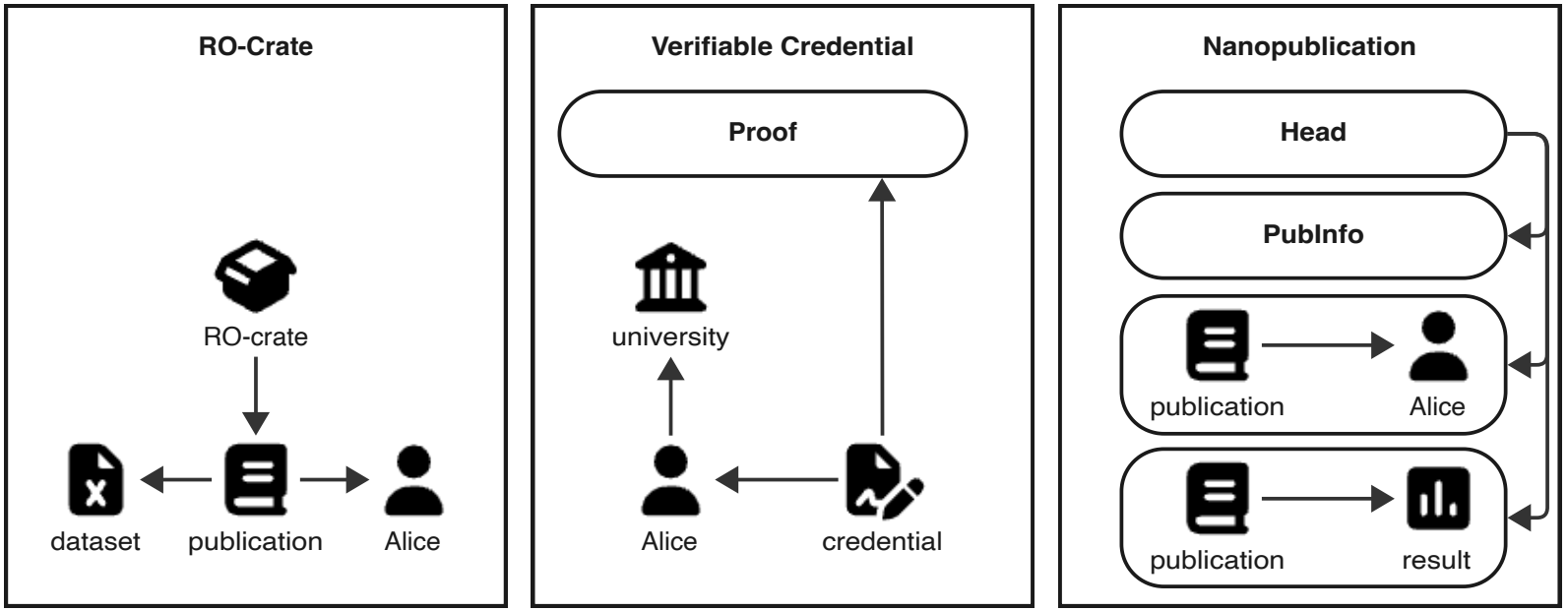
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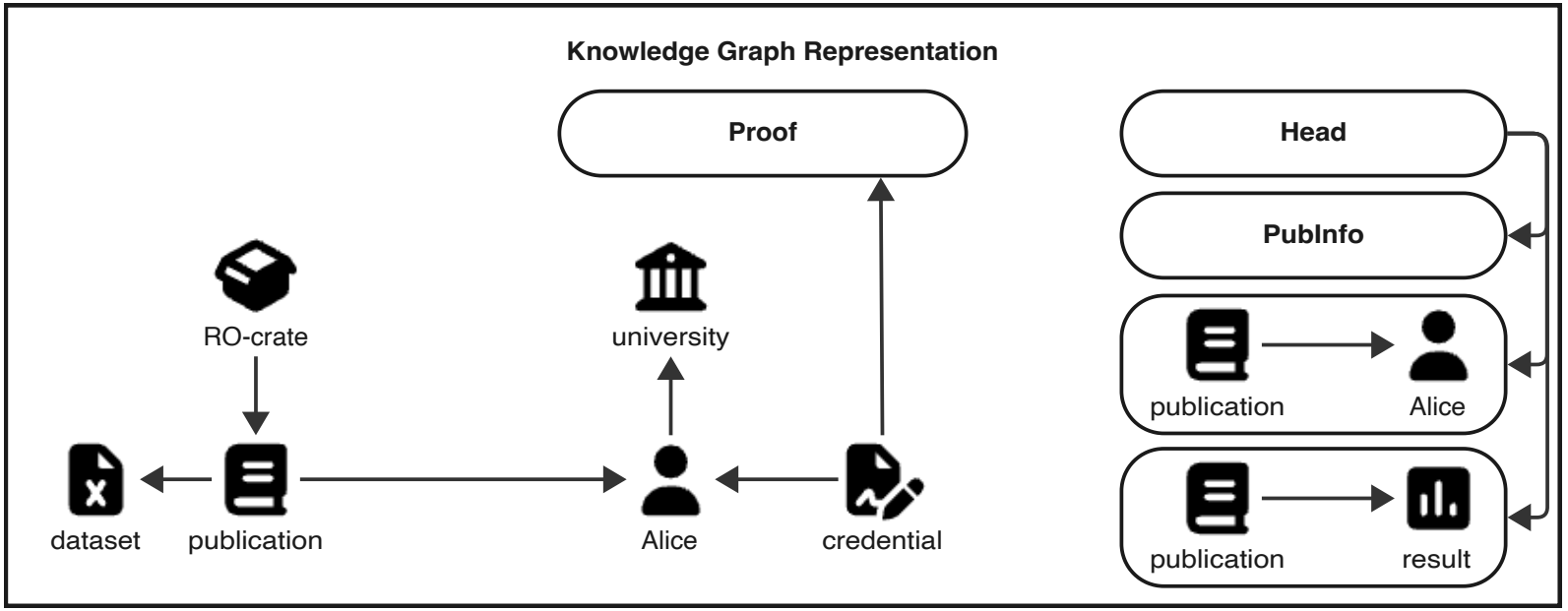
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Defining requirements

Context Associations

Querying context

Integrating annotations

Heterogeneous methods

- Hard to store uniformly
- Hard to query generically

Context and data become hard to distinguish

How do we ensure uniform extraction of associated context to target data from KGs

Defining annotation requirements

Interoperable: processed using RDF tooling

Agnostic: can target any set of RDF statements

Explicit: data and context are explicitly defined

Immutable: preserves associations under merge

Recursive: associations can be recursively defined

Defining requirements

Context Associations

Querying context

For a given associated context

```
<Credential> <primarySubject> <Alice>
<Alice> <employee> <University>
<Credential> <proof> <ProofGraph>

<ProofGraph> {
    _:proof <proofValue> "..."
}
```

Graphs for target boundary

```
_:data {
    _:data ca:graphName ca:DefaultGraph
    <Credential> <primarySubject> <Alice>
    <Alice> <employee> <University>
    <Credential> <proof> <ProofGraph>
}

<ProofGraph> {
    _:proof <proofValue> "..."
}
```

Anchor triples to define associations

```
_:data {
    _:data ca:graphName ca:DefaultGraph
    <Credential> <primarySubject> <Alice>
    <Alice> <employee> <University>
    <Credential> <proof> <ProofGraph>
}

<ProofGraph> {
    <ProofGraph> ca:aboutGraph _:data
    _:proof <proofValue> "..."
}
```

Blank nodes to prevent conflicting merges

```
_:data {
    _:data ca:graphName ca:DefaultGraph
    <Credential> <primarySubject> <Alice>
    <Alice> <employee> <University>
    <Credential> <proof> <ProofGraph>
}
_:proofGraph {
    _:proofGraph ca:aboutGraph _:data
                 ca:graphName <ProofGraph>
    _:proof <proofValue> "..."
}
```

Context Associations

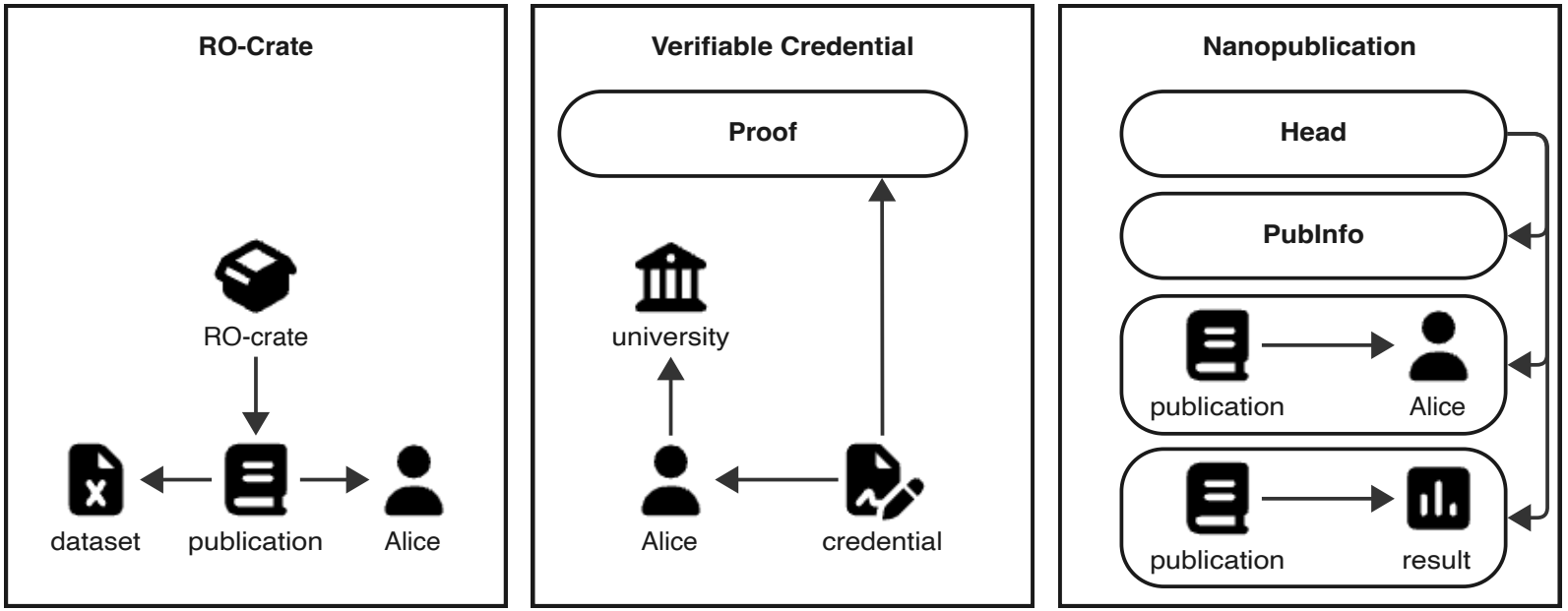
Minimal annotation method using named graphs

Defines a relation between

- a named graph of target statements
- a named graph of context statements

through an anchor triple in the context graph

```
_:contextGraph ca:aboutGraph _:targetGraph
```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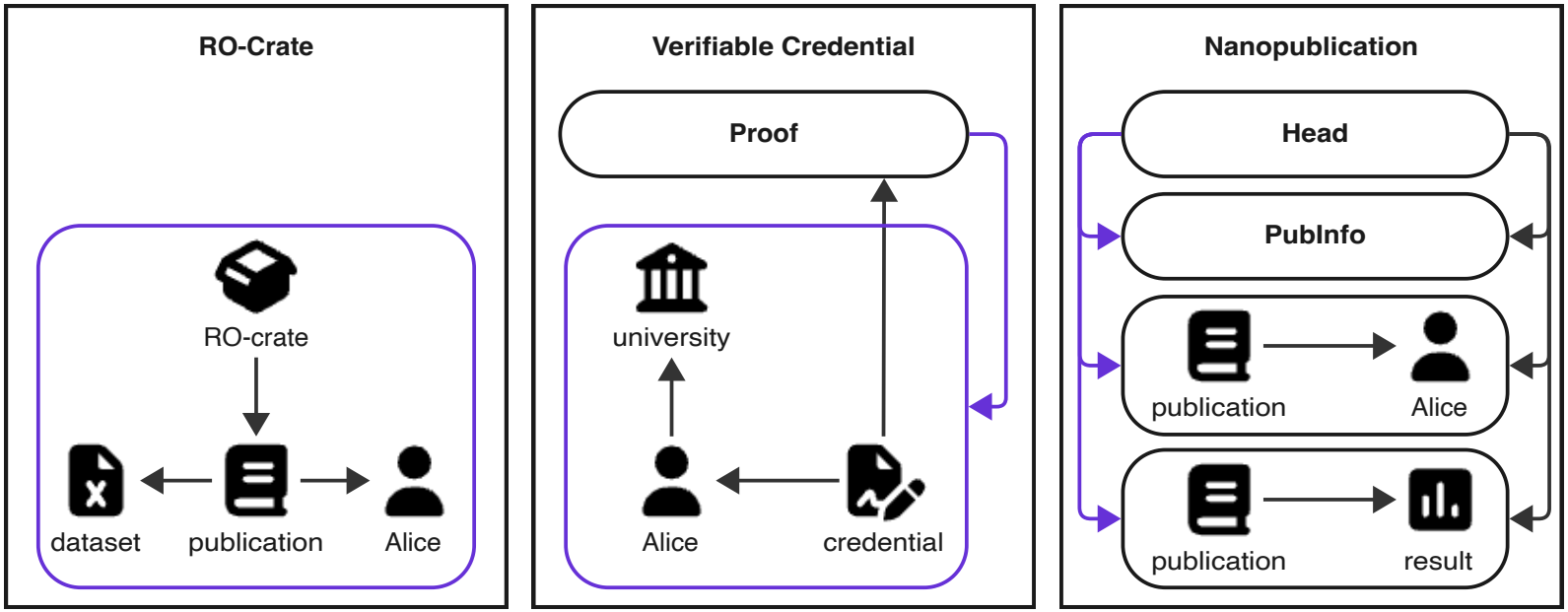
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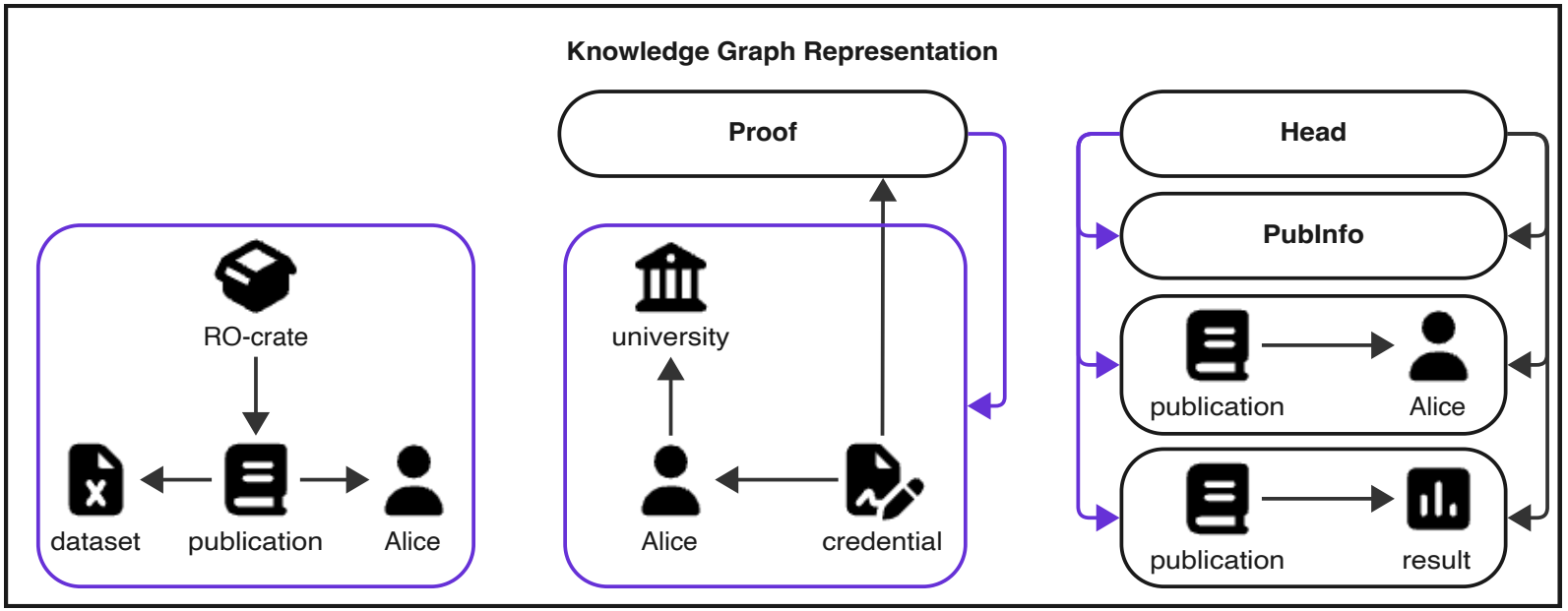
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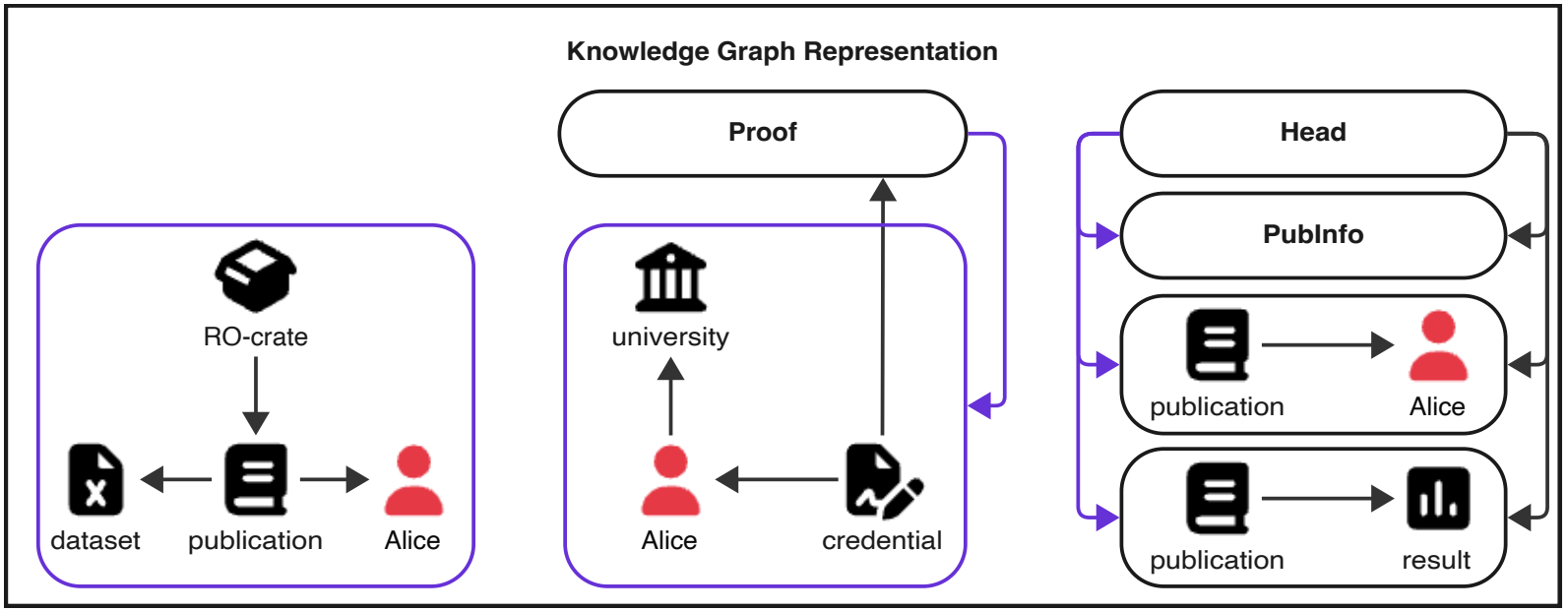
Defining requirements

Context Associations

Querying context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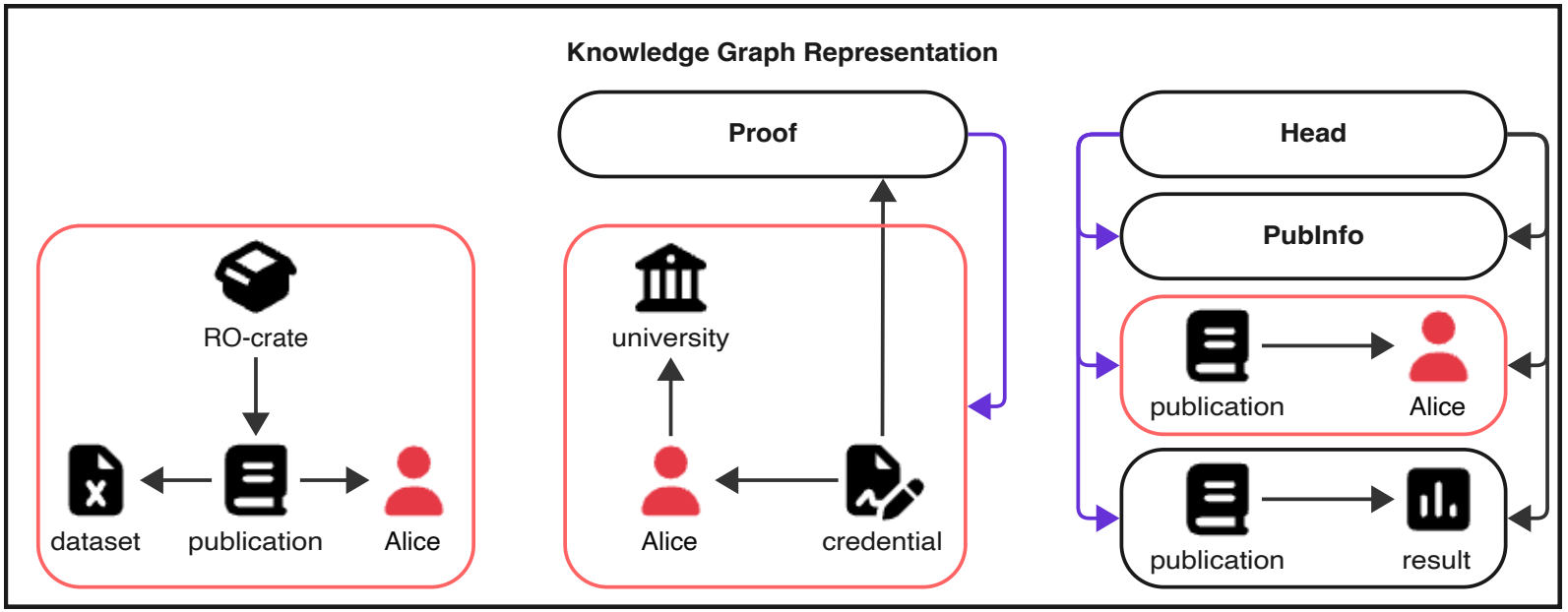
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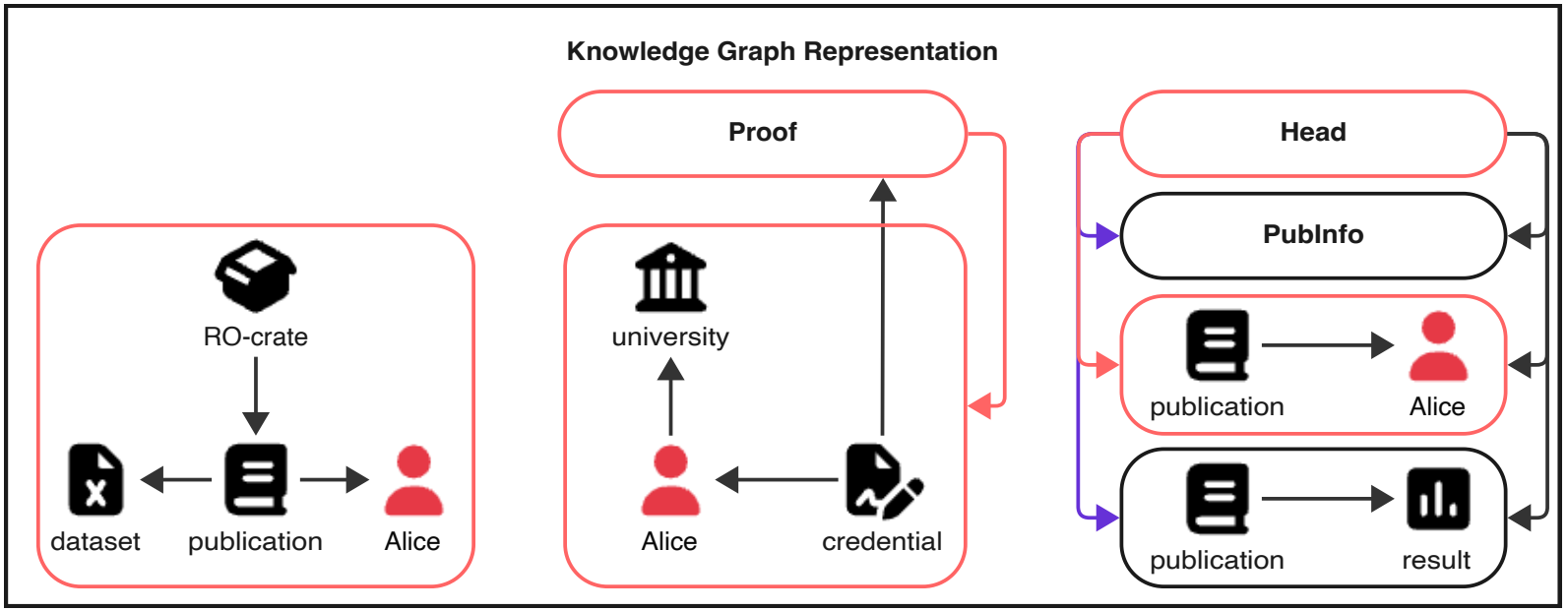
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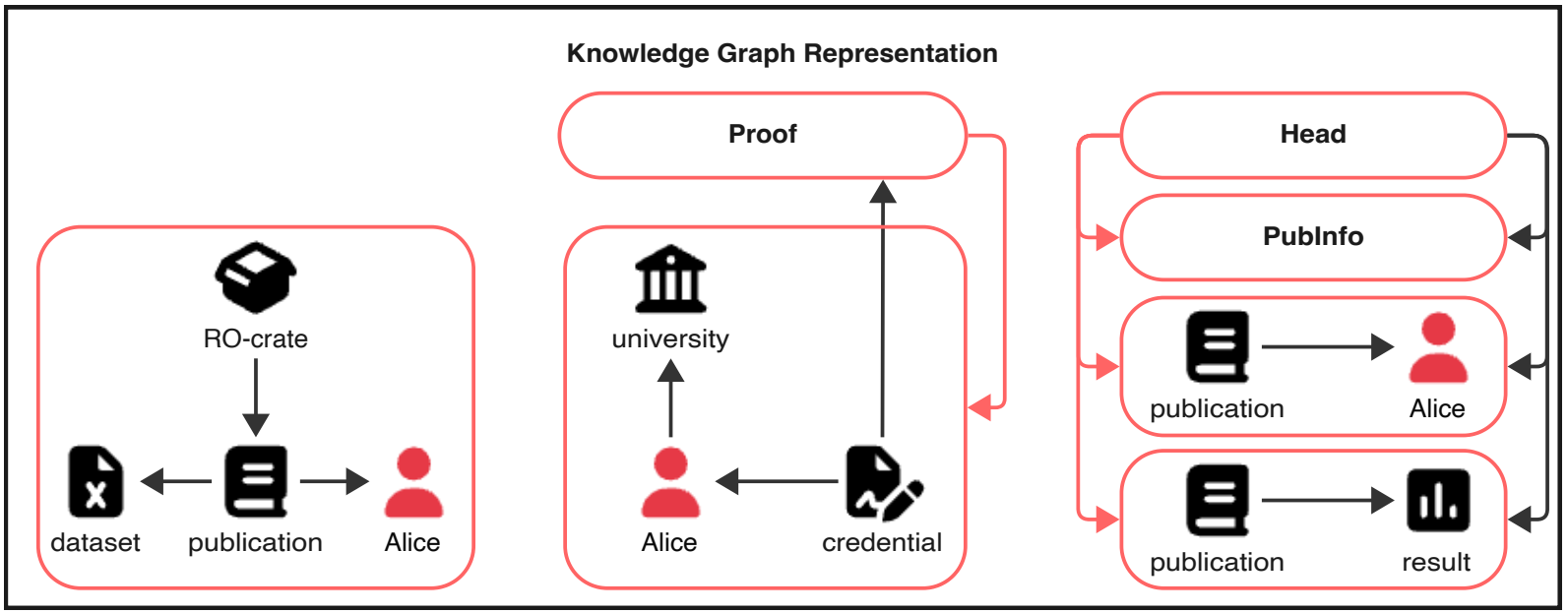
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Querying with SPARQL

Cannot evaluate variable length property paths over named graphs

Cannot create named graphs with SPARQL construct

Resolved with Apache Jena ARQ

Encoding / decoding

Define organization of graph links

Method-specific requirement (JSON-LD frames)

```
_:g0 {
  <University> <states> _:b0 .
  _:b0 a rdf:Statement .
  _:b0 rdf:subject <Alice> .
  _:b0 rdf:predicate <employee> .
  _:b0 rdf:object <University> .
}
```

```
_:g0 {
  _:g0 ca:aboutGraph _:g1 .
  <University> <states> _:graph .
}
_:g1 {
  _:g1 ca:encodedFrom ca:reification .
  <Alice> <employee> <University> .
}
```

Where does this land us

Interoperable: ~ works with SPARQL, better with ARQ

Agnostic: ✓ complexity in encoding step

Explicit: ✓ explicit data, context and encoding info

Immutable: ✓ stable under dataset merge

Recursive: ✓ requires custom encoding routines

Specification

https://w3id.org/context-associations/specification

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