University of Southampton

CoDeR Model

A Minimal Algebra and Data Model for Continuous Deductive Reasoning

WAIS
WEB AND INTERNET SCIENCE
Research Group

Why CoDeR?

- Motivations
  - Short Term
    - Reduce streamed data traffic
  - Long Term
    - Support research into the expression of stream reasoning

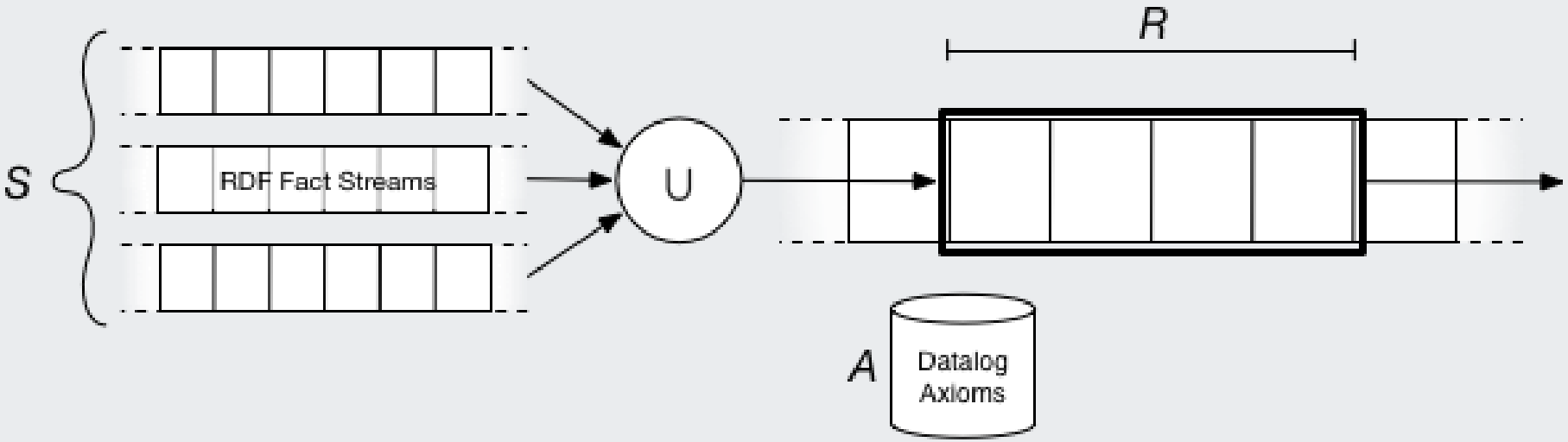
- Aim
  - Represent continuous reasoning over streamed RDF as a first class problem

Existing Solutions

- Traditional reasoners
  - Window maintenance is as complex as reasoning
  - Entailments are Instantaneous, not Continuous
- Stream queries
  - Semantics of windows do not survive iterated application

Continuous Datalog

- Semantics
  - Theorem proving
  - Sliding window
- Continuous Datalog Programs: *CDP* = {*A*,*S*,*R*}



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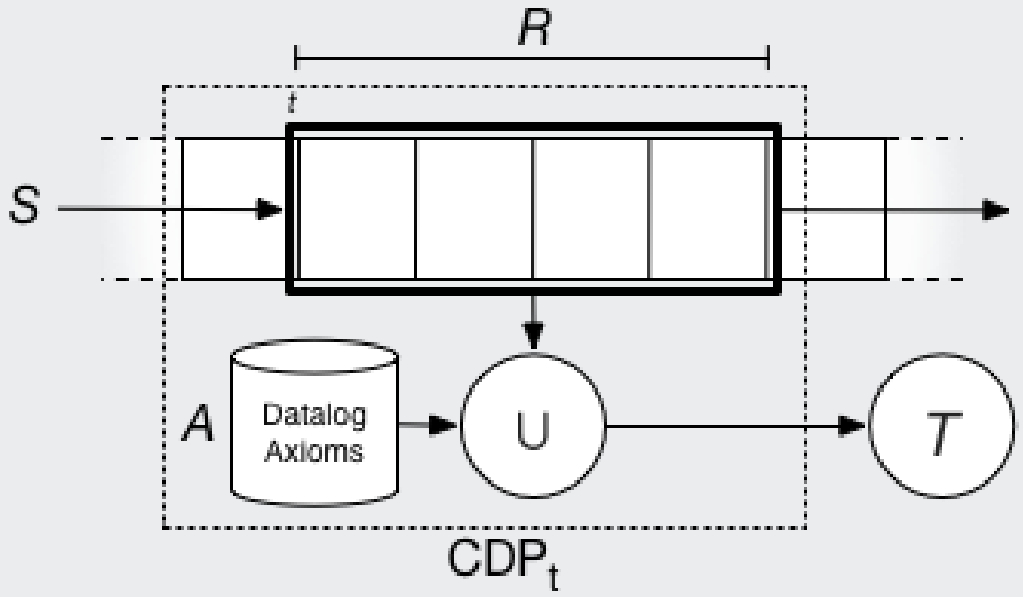
- Continuous Datalog Programs: $CDP = \{A,S,R\}$
- Instantaneous truth:
  - $CDP_t = W^{S,R}{}_t \cup A$



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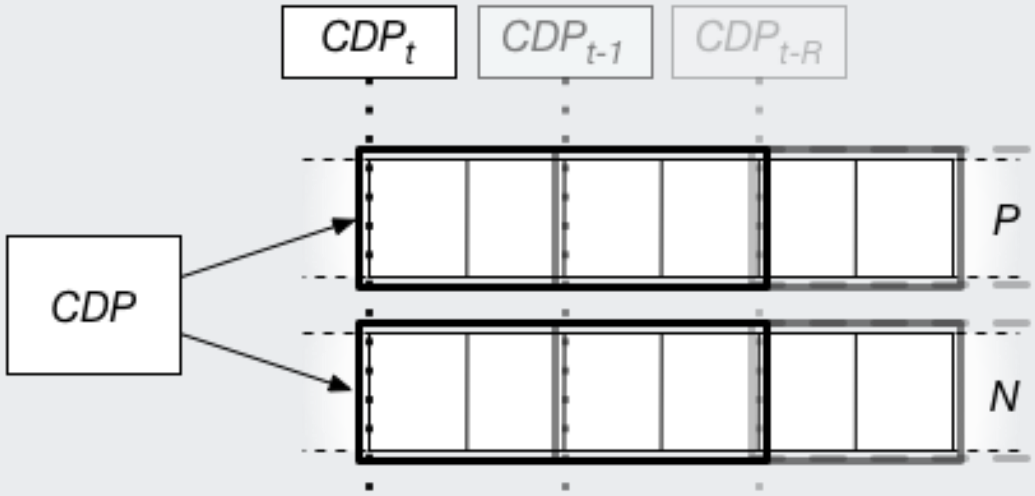
- Continuous Datalog Programs: $CDP = \{A,S,R\}$
- Instantaneous truth:
  - $CDP_t = W^{S,R}{}_t \cup A$
- Continuous entailments:
  - $CDP \models \{A,P,N\}$
  - $CDP_t \models (W^{P,R}{}_t \setminus W^{N,R}{}_t) \cup A$

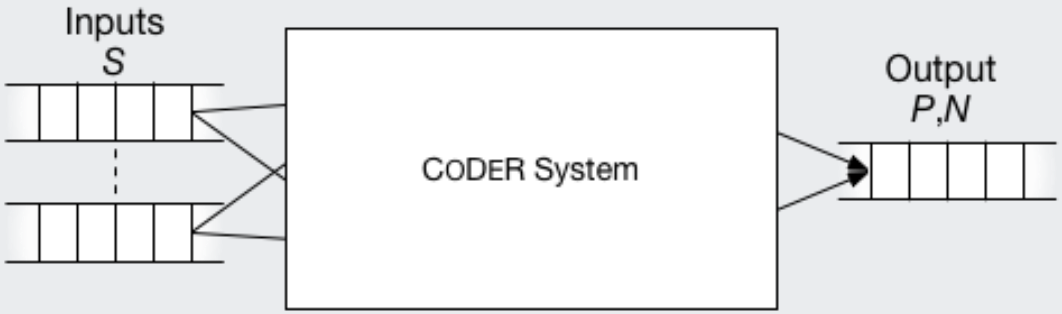


CODER Model

- Expresses the semantics of Continuous Datalog
  - Streamed Data Model
  - Minimal Functional Algebra

CODER: Streamed Data Model

- Input/Output Streams
  - Sequences of RDF triples
    - May be Annotated with Entailment and Negation times: { T, t_E, t_N }



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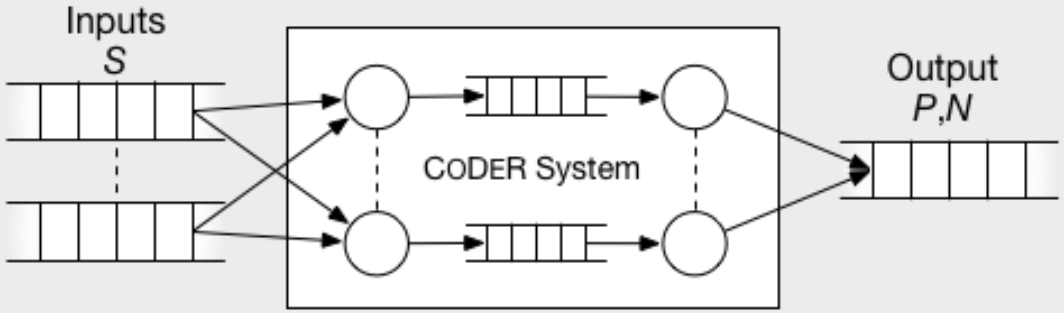

- Inter-Operator Streams
  - Each composed of matches to a single graph pattern
    - Valid-Time Annotated RDF Graphs: { G, t_E, t_N }

CODER Minimal Algebra

- Based on the minimal operators of Positive Datalog: {⊨,⊥,∧}
- Includes triple-stream filter operators: {⊨,⊥,∧,$\boldsymbol{\sigma_T}$}
  - Forward Chaining
- Conjunction expressed by Sequential Conjunction: {⊨,⊥,**seq**,σ_T}
  - Supports Event Processing/Reasoning

$$\{ A \wedge B \models C \} \equiv \{ (A \text{ seq } B) \vee (B \text{ seq } A) \models C \}$$
$$\equiv \{ A \text{ seq } B \models C,\ B \text{ seq } A \models C \}$$

- RIF-Core built-in functions: {⊨,⊥,seq,σ_T,$\boldsymbol{\sigma_B}$}

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Thank You for Listening

Key Points

- Continuous Datalog: Streamed Entailment Semantics
- CODER Data Model: Duality of Stream Semantics
- CODER Algebra: Minimal Operators for Event Reasoning