RDF graph synchronization for collaborative robotics

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RGS⊕: RDF graph synchronization for collaborative robotics

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What are RDF graphs?

- A set of entities (nodes) and fact statements (edges) in the form of triples (*subject*, *relation*, *object*)

(Earth; part of; Solar System)

(Albert Einstein; name; “Albert Einstein”)

- Three types of nodes:
    - IRIs (entities, properties)
    - Literals (values)
    - Blank nodes (not used here)

(IRI; IRI; IRI or literal)

Working scenario

- Rescue operation after a disaster
- Multiple robots (agents) take part
- High frequency of input data from each agent
- Data needs to be synchronised across agents
- Quick reactions are crucial

Assumptions

- Agents operate asynchronously
- Agents may experience failures to operate or communicate
- Agents store data locally in permanent storages
- Agents are equal in behaviour
- Agents operate in good faith and are truthful
- Messages are sent without guarantees on arrival time bounds
- Messages can be lost, arrive out of order, or be duplicated
- Received messages are not corrupted (corrupted messages are ignored)

Goal of the system

Synchronise knowledge graphs between multiple agents in real-time, while each agent continuously appends new data, and while also handling issues typically present in wireless communication.

By:

- Adding knowledge graph versioning
- Implementing merging mechanism
- Designing and implementing communication protocols for graph synchronisation

Used platform

Version 3.2.3

Research questions

- Is the proposed system feasible to implement?
- Will the proposed system lead to eventual graph synchronisation?
- Can the proposed system handle high frequency input of data?
- Can the proposed system be used to synchronise graphs in near real-time manner?
- Will the proposed system function in presence of difficulties such as loss of connection, varying speed of data transfer, message loss or duplication?
- Can the proposed system be improved upon?

Measuring the results

- Conduct simulations of the working system
  - Check if all agents synchronise
  - Determine time for full graph synchronisation
- Introduce additional strain on the system
  - Add cost of data transfer to simulate limited bandwidth
  - Add random simulated errors (i.e. loss of communication, delay, agents failure)

Thank you for attention

Feel free to ask questions