W3C LBD Community Group
Minutes - Call 15/01/2024

Attendees

- Mathias Bonduel (Neanex Technologies, Belgium)
- Dimitris Mavrokapnidis (UCL London)
- Janakiram Karlapudi (TU Dresden)
- Eva Heinlein (RWTH Aachen)
- Philipp Hagedorn (Ruhr-University Bochum, Germany)
- Philipp Dohmen (Amberg Group. Schweiz)
- Al-Hakam Hamdan (A+S Consult GmbH)
- Alex Donkers (Eindhoven University of Technology)
- Georgios Triantafyllidis (Norwegian University of Science and Technology)
- Sebastian Blechmann (RWTH Aachen University)
- Fathya Zemmouri (AI Institute of the University of Stuttgart)
- Jan-Iwo Jäkel (RWTH Aachen)
- Shervin Rahnama (RWTH Aachen)
- Conor Shaw (UC Dublin)
- Klaus Linhard (HM München)
- Tim Rossi
- Pierre Bourreau (Nobatec)
- Melina Rohne (RWTH Aachen)

Please join the W3C LBD CG and subscribe to the internal mailing list:
[Linked Building Data Community Group (w3.org)](w3.org)

Presentation slides

- Slides: GitHub link

Date and time

- Monday 15th of January 2024, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

Moderators

1. Mathias Bonduel

Agenda

1. Introduction of new members
2. Dimitris Mavrokapnidis "Semi-automated extraction of HVAC topology from imperfect Building Information Models"
3. Discussion
4. Further topics

Minutes

1. **Introduction of new members**
   - Janakiram Karlapudi: knowledge engineer at Gropius, TU Dresden PhD
   - Fathya Zemmouri: University of Stuttgart, AI research with Prof Staab, modeling and topics in co-design phase of buildings
   - Melina Rohne: RWTH Aachen, highway engineering
   - Shervin Rahnama: Institute for Construction Management, Digital Engineering and Robotics in Construction - RWTH Aachen University doing research in ontologies for recycling and sustainable development

2. **Dimitris Mavrokapnidis "Semi-automated extraction of HVAC topology from imperfect Building Information Models"**
   - 4th year PhD (located at UCL London) > close to submitting, working in CBIM network of researchers in BIM and semantics
   - quality issues in BIM datasets
   - HVAC topology
     - interconnected components
     - inputs for energy simulation, fault detection, facility management
     - BIM/IFC as source?
   - BIM/IFC
     - focused on geometry > clash detection
     - modelling imperfections
       - operational requirements not modelled
       - limits in IFC: equipment and spaces relation (e.g. "feeds")
   - ongoing project New Museum of London (MoL)
     - very large BIM dataset > 24 siloed IFCs by different contractors
     - now under construction
     - IFCs unused after project delivery, despite many handover processes (CoBIE)
   - IFC vs Linked Data
     - geometry and semantic relationships in a single file <> semantics separated from geometry
     - cross domain linking
   - LBD (Linked Building Data)
     - overcoming IFC and ifcOWL > modular ontologies
     - 1-1 mapping from BIM > focus?
     - BOT and FSO for HAC system topology
     - BRICK Schema for HVAC operation logic
       - different modelling approaches (more abstract)
       - overlap with IFC: equipment and location <> Measurable and Point
   - ontology-based HVAC representation
   - transform - check - enrich
     - extract from IFC all useful HVAC data
       - ETL tool in Python ([open source](#)): ifcOpenShell + RDFLib
         - works with mapping in [custom JSON format](#)
       - gaps (missing relations) in graph due to modelling imperfections in IFCs
     - data validation using SHACL (pySHACL) > check semantic completeness (missing relations?)
       - examples of SHACL constraints
         - topological
           - every bot:Element in exactly 1 bot:Zone

- logical
  - output: XML with errors
- geometric relation checking (GRC)
  - reused GRC tool > takes geometry from IFC which have semantic errors => create relations in the graph
    - clash
    - adjacent
    - containment
    - proximity (not yet)
  - GRC: currently not available online, but plan to make it open source. Not the main developer. C++ code
  - limitations:
    - false positives can occur
    - failed to resolve all issues > GUI to support manual improvement ("semi-automatic"). Examples:
      - terminals not following the logic of the validation constraints (element not part of a system) > louvres
        - geometry detected 2 louvres connected > not really a feeds relation
      - missing elements due to lack of detail in the model => requires the improvement of the model
        - GUI under development to manually add semantic relation
      - terminals not linked to arch space limited by ceiling > requires proximity analysis
- logical inferencing
  - SPARQL IF-THEN rules for inference
    - e.g. which equipment serves which spaces
- results on MoL demo
  - GRC solved 70% errors (14140) <> 30% left for manual inspection
  - no relations between arch IFC and MEP IFC > no relations between spaces and MEP equipment
- conclusions and next steps
  - cleaning the model?
  - flexible data access with SPARQL
    - 5-6 min to load IFCs individually <> with LD graph easier to query directly
  - further development of GRC (spatial proximity)
- demo (live)
  - integrate FSO/BOT/BRICKS mappings in current-next IFC version?
  - BIM Vision IFC viewer: 2 large IFC files loaded to show the large scale of the project
    - slow response due large amount of elements and geometry
  - GraphDB Ontotext > results of IFC conversion/extraction

3. **Discussion**
- [Fathya] complex SHACL constraints > how do you create them? Considered SWRL?
  - SHACL more expressive, linking/extending constraints
  - more difficult to write
- [Fathya] manually written SHACL?
  - yes, not that many constraints needed for the case
  - starting from text constraints and manually create the SHACL

- - ○ other projects needed more complex SHACL > automated/faster through a Python script
    - ○ [Mathias] SHACL can also contain SPARQL for more complex cases. Separation between validation rules and inference rules.
  - [Janakiram] feed errors from SHACL validation to GRC > IFC logo and XML file in graph
    - ○ some pieces left open in the diagram. IFCXML file containing IFC elements (with geometry) with errors, current output of GRC
  - [Janakiram] JSON mapping between IFC and BOT/FSO/BRICKS
    - ○ forming a buildingSMART working group for IFC extension towards operational phase. No public documentation available
  - [Alex] RDF-based mapping considered? Alignments?
    - ○ not yet
  - [Mathias] IFCtoLBD converter not used?
    - ○ more familiar with Python (Java code)
    - ○ BRICKS relations not supported
  - [Alex] Lacking BIM modeling quality in general (misclassification)? Improve modeling process?
    - ○ IFC can be used by BIM modeler as they want. Had to update to IFC4 (ongoing state-of-the-art)
    - ○ already close mapping (generic) > easier to select by BIM modeler in next versions of IFC
    - ○ could create relations inside IFC
    - ○ [Mathias] what about using a BIM property for your classification instead of using the "drafting" classification from BIM authoring tools?
      - ■ UniClass code used in the project, but not considered in the mapping
  - [Mathias] In addition to BOT, you could consider using a more generic EU standardized ontology named SML (Semantic Modelling and Linking) and create your "own classification system" based on it. It's available in EN 17632-2:2022. It also contains, besides agreements on graph modeling patterns, top-level terminology and relations for connections, ports, etc.

4. **Further topics**
   - Upcoming LBD CG presentation in 19th of February 2024 by Hervé Pruvost

Next Call

- 19/02/2024, Monday, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

  Agenda: Hervé Pruvost (Fraunhofer IIS, Dresden):
  "Ontologies to automate the configuration and deployment of monitoring services for building energy systems"

  We are interested in getting suggestions from the community about potential agenda items and **Elevator Pitches** for the following calls. Please send your suggestions to the chairs or to internal-lbd@w3.org, whether you have a short presentation to bootstrap the discussion, and an approximate duration you think the discussion will last.

Previous minutes

https://github.com/w3c-lbd-cg/lbd/tree/gh-pages/minutes