

技術勉強会 2022/11/15 オンライン

ナレッジグラフにおける推論

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RDFデータをトリプルストアに格納



- GraphDB by Ontotextのフリー版で説明
 - 下記ボタンの遷移先フォームから必要情報を入力して送信するとダウンロードリンクが送られてきます

The screenshot shows the Ontotext website's product page for GraphDB. It features three main sections: GraphDB Enterprise, GraphDB Standard, and GraphDB Free. Each section includes a small icon, a title, a brief description, and a red "Click Here to Give It a Try" button. Below each button is a "Compare GraphDB Editions" link. A red box highlights the GraphDB Free section.

Download GraphDB

GraphDB Enterprise

You will receive a 60-day trial license key for your recent GraphDB EE

Click Here to Give It a Try

Compare GraphDB Editions

GraphDB Standard

You will receive a 60-day trial license key for your recent GraphDB SE

Click Here to Give It a Try

Compare GraphDB Editions

GraphDB Free

You will receive our free version with limited processing capabilities

Click Here to Give It a Try

Compare GraphDB Editions

<https://www.ontotext.com/products/graphdb/>

リポジトリの作成

ここから実演します

- Setup > Repositories > Create Repositories

The screenshot shows the GraphDB interface with the 'Create Repository' form. The left sidebar has a 'Repositories' tab selected. The main form contains the following fields:

Repository properties	
Repository ID*	LOD-WS-2020
Repository title	LOD-WS-2020
Type	GRAPHDB-FREE
Storage folder	storage
Ruleset	RDFS-Plus (Optimized)
<input checked="" type="checkbox"/> Disable owl:sameAs	
<input type="checkbox"/> Supports SHACL validation	
Base URL	http://example.org/owlim#
Entity index size	10000000
<input checked="" type="checkbox"/> Use predicate indices <input checked="" type="checkbox"/> Cache literal language tags	
<input type="checkbox"/> Use context index <input checked="" type="checkbox"/> Enable literal index	
<input type="checkbox"/> Check for inconsistencies <input type="checkbox"/> Throw exception on query time-out	
<input type="checkbox"/> Read-only	
Entity ID bit-size	32

There is also a red button labeled "Upload custom ruleset" with an upward arrow icon.

インポート



- Import > RDF > Upload RDF Files > ファイル選択 > Import

The screenshot shows the GraphDB interface with the 'Import' menu selected. The main area is titled 'Import' with tabs for 'User data' and 'Server files'. It features three main input methods: 'Upload RDF files' (using an upload icon), 'Get RDF data from a URL' (using a link icon), and 'Import RDF text snippet' (using a text editor icon). Below these is a control bar with an 'Import' button, a 'Reset status' button, and a 'Remove' button. A 'Type to filter' search bar is also present. At the bottom, a list shows a file named 'test.ttl' with a checkmark, indicating it has been imported successfully. The message says 'Imported successfully in less than a second.'

データの確認：トリプル



- Explore > Graph overview > The default graph

The screenshot shows the GraphDB interface with the following details:

- Left Sidebar:** Includes 'Import', 'Explore' (selected), 'Graphs overview', 'Class hierarchy', 'Class relationships', 'Visual graph' (selected), 'Similarity', 'SPARQL', 'Monitor', 'Setup', and 'Help'.
- Header:** Shows 'LOD-WS-2020' and a dropdown menu.
- Title:** 'nil' with an edit icon.
- Source:** 'Source: http://www.openrdf.org/schema/sesame#nil'
- Filter Bar:** Buttons for 'subject', 'predicate', 'object', 'context', 'all' (selected), 'Explicit only' dropdown, 'Show Blank Nodes' (disabled), 'Download as' dropdown, and 'Visual graph' (selected).
- Data Table:** A table showing four triples:

	subject	predicate	object	context
1	ex:Aさん	rdf:type	wd:Q215627	http://www.ontotext.com/explicit
2	ex:Aさん	wdt:P19	wd:Q1490	http://www.ontotext.com/explicit
3	wd:Q1490	wdt:P17	wd:Q17	http://www.ontotext.com/explicit
4	wd:Q1490	wdt:P429		
- Visual graph:** A small graph visualization showing nodes 'Aさん' (red circle), 'Q1490' (blue circle), and 'Q17' (blue circle) connected by edges labeled 'P19' and 'P17'. Below it is the text '可視化も'.

データの確認：グラフ



- Visual graph

The screenshot shows the GraphDB interface for the 'nil' dataset. On the left, there's a sidebar with various navigation options like Import, Explore, SPARQL, Monitor, Setup, and Help. The main area displays a table of triples with columns for subject, predicate, object, and context. At the top right of the table, there are buttons for 'Explicit only', 'Show Blank Nodes', 'Download as', and a prominent red button labeled 'Visual graph'. A large blue arrow points from this interface to the next one.

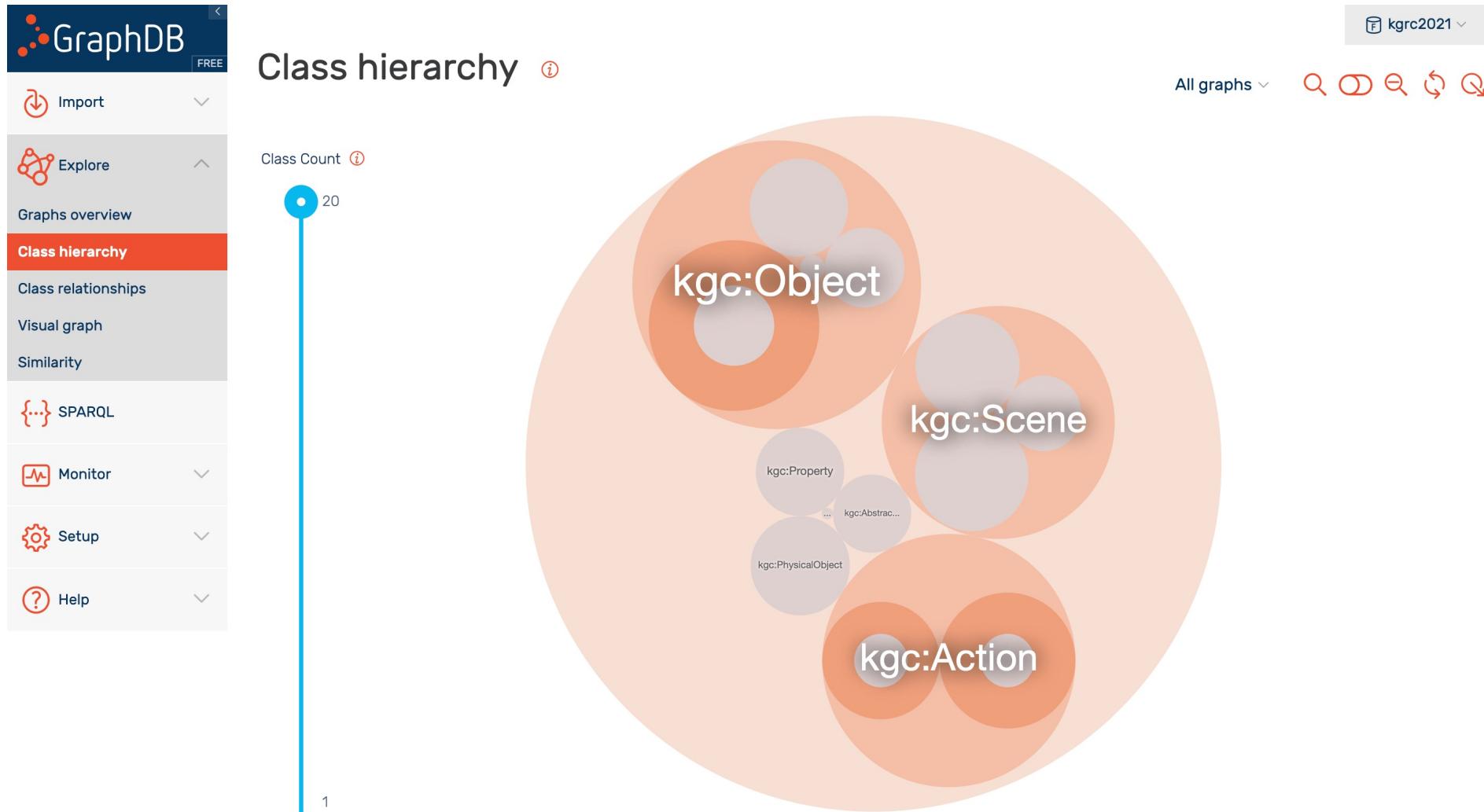
This screenshot shows the GraphDB interface with the 'Visual graph' section selected in the sidebar. The main area displays a visual representation of the data as a graph. It consists of three nodes: a red circle labeled 'Aさん', a light blue circle labeled 'Q1490', and another light blue circle labeled 'Q17'. Arrows connect the nodes: one arrow goes from 'Aさん' to 'Q1490' labeled 'P19', and another arrow goes from 'Q1490' to 'Q17' labeled 'P17'.

Visual graph

データの確認：クラス階層



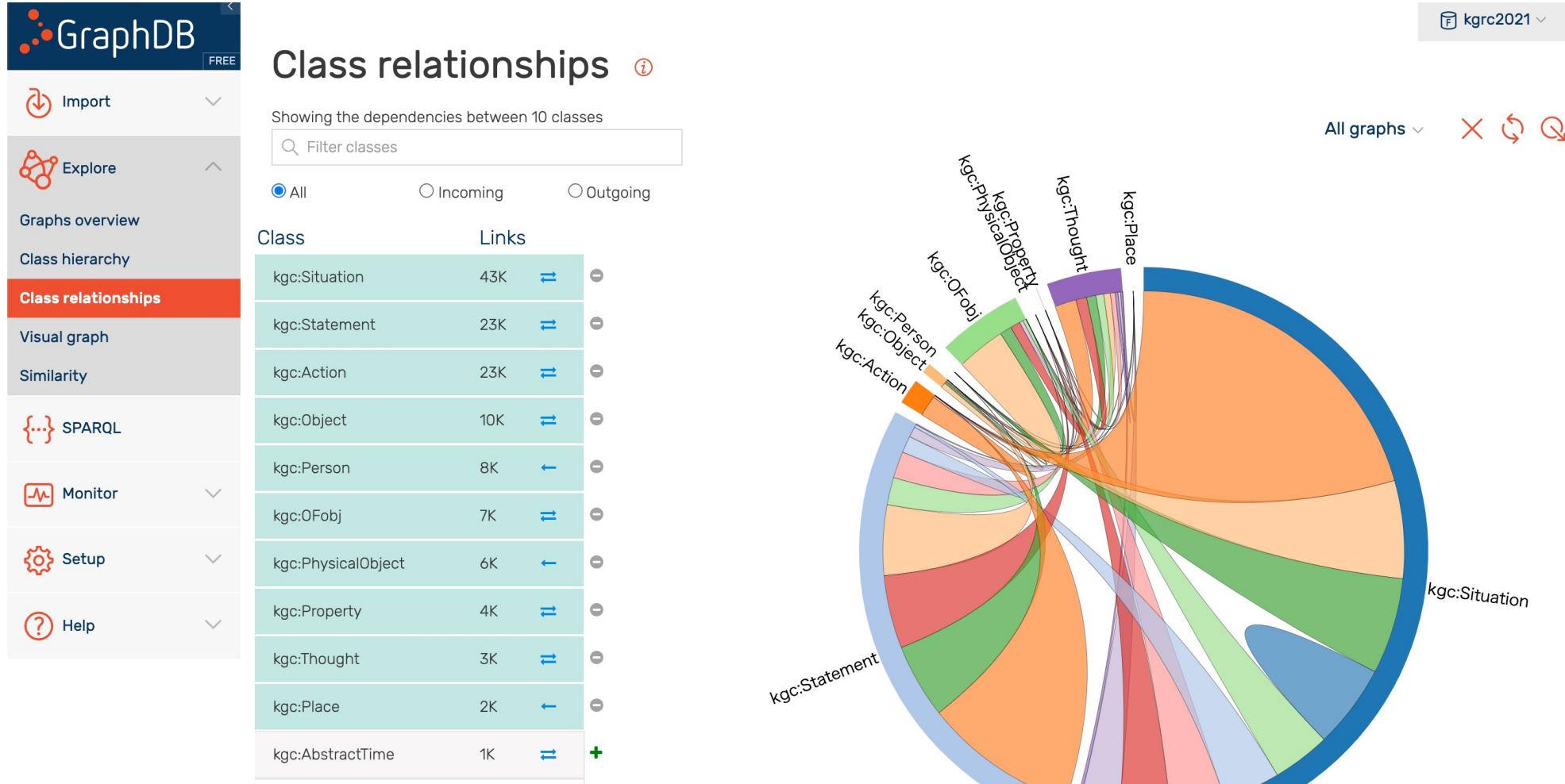
- Explore > Class hierarchy



データの確認：クラス関係



- Explore > Class relationships



SPARQL検索



- 検索が可能

The screenshot shows the GraphDB interface. On the left is a sidebar with options: Import, Explore (selected), Graphs overview, Class hierarchy, Class relationships, Visual graph, Similarity, SPARQL (highlighted in orange), Monitor, Setup, and Help. The main area is titled "SPARQL Query & Update". A query is entered in the editor:

```
1 select * where {  
2   ?s ?p ?o .  
3 } limit 100
```

Below the editor are tabs: Table, Raw Response, Pivot Table, Google Chart, and a "Run" button. The results section shows a table with one row:| | s | p | |
| --- | --- | --- | --- |
| 1 | rdf:type | rdf:type | rdf:Property |

SPARQL検索：可視化



- 検索結果のチャート表示も可能

Unnamed X Unnamed X 述語数カウント X +

```
PREFIX kgc: <http://kgc.knowledge-graph.jp/ontology/kgc.owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
select ?label (count(?label) AS ?cnt) where {
  ?s kgc:hasPredicate ?o .
  ?o rdfs:label ?label .
} group by ?label order by desc(count(?label)) limit 20
```

Run Save

Table Raw Response Pivot Table Google Chart

Chart Editor

Start Charts Customize

Recommended charts - More »

Use 1st column as labels

label	cnt
say	180
exist	100
go	80
see	70
hear	60
enter	50
meet	40
put	30
open	20
sit	10

SPARQL検索：推論



- OWLやルールに基づく推論が可能

The screenshot shows the GraphDB SPARQL Query & Update interface. On the left is a sidebar with options: Import, Explore (Graphs overview, Class hierarchy, Class relationships, Visual graph, Similarity), SPARQL (selected), Monitor, Setup, and Help. The main area is titled "SPARQL Query & Update". A query is entered in the editor:

```
1 select * where {  
2   ?s ?p ?o .  
3 } limit 100  
4
```

The interface includes tabs for Editor only, Editor and results (which is selected), and Results only. To the right of the query editor are four icons: a save icon, a folder icon, a link icon, and a circular icon with three dots. Arrows point from the text "推論機能ON" and "owl:sameAsリンクの展開機能ON" to the link and circular icons respectively. Below the query editor is a toolbar with Table, Raw Response, Pivot Table, Google Chart, and Download as. At the bottom, there is a filter bar and a message: "Showing results from 1 to 80 of 80. Query took 0.2s, moments ago." A table is displayed with columns s, p, and rdf:type.

SPARQL検索：推論（2）



SPARQL Query & Update ⓘ

Editor only Editor and results Results only

```
v 1 PREFIX ex: <http://example.com/terms>
v 2 select * where {
3   ?s a ex:哺乳類 .
4 }
```

Run

Press Alt+Enter to autocomplete

Table Raw Response Pivot Table Google Chart

Download as

No results. Query took 0.1s, moments ago.

Filter query results

s
No data available in table

推論OFF

SPARQL Query & Update ⓘ

Editor only Editor and results Results only

```
v 1 PREFIX ex: <http://example.com/terms>
v 2 select * where {
3   ?s a ex:哺乳類 .
4 }
```

Run

Press Alt+Enter to autocomplete

Table Raw Response Pivot Table Google Chart

Download as

Showing results from 1 to 1 of 1. Query took 0.1s, moments ago.

s
1 ex:Aさん

推論ON

エクスポート

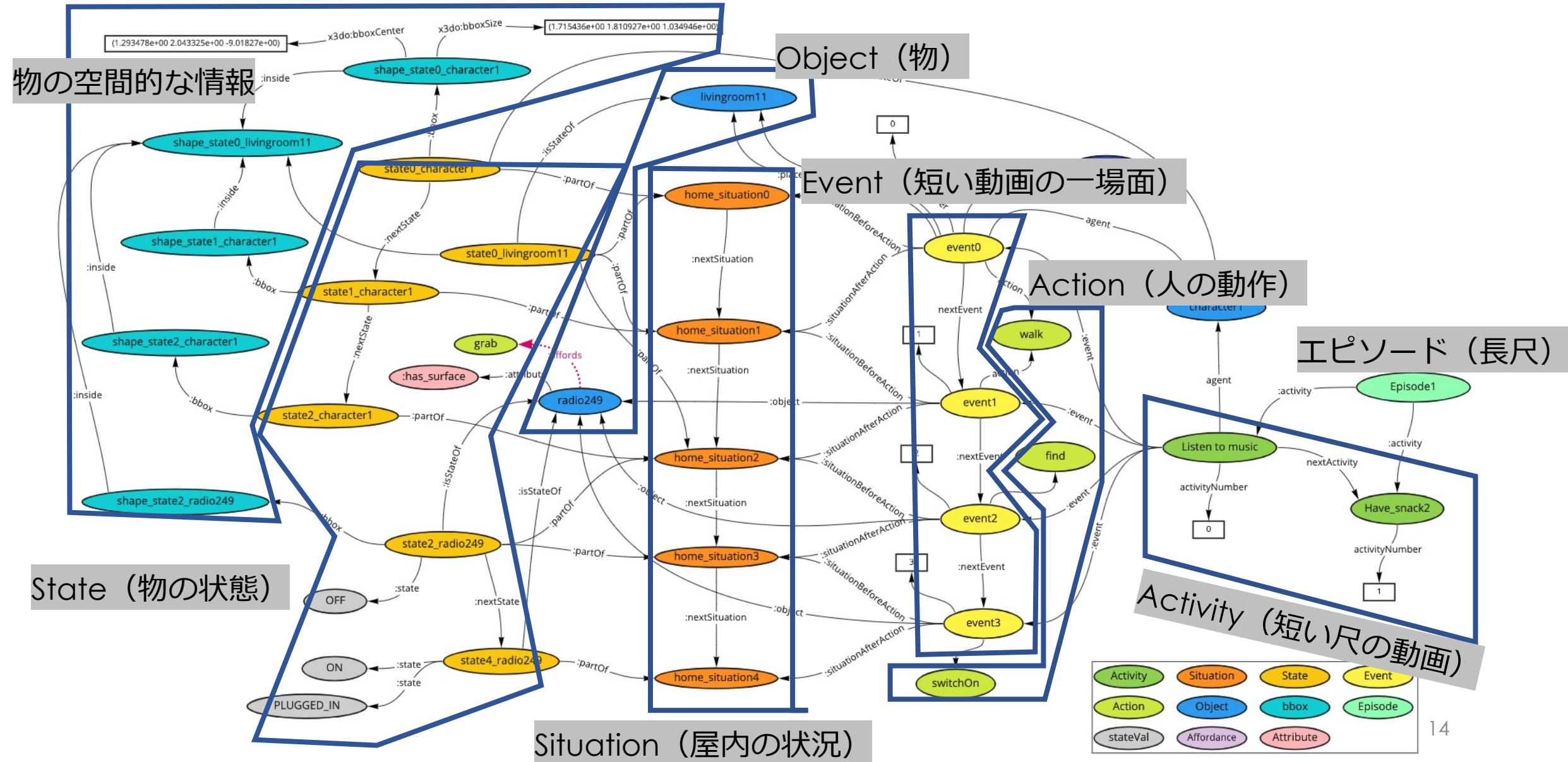


- リポジトリを好みの形式でエクスポート可能

The screenshot shows the GraphDB interface with the following details:

- Header:** GraphDB FREE, User: kgrc2021
- Sidebar:** Import, Explore, Graphs overview (highlighted in red), Class hierarchy, Class relationships, Visual graph, Similarity, SPARQL, Monitor, Setup, Help.
- Main Content:** Graphs overview with a search bar and filters for results (1-9 of 9) and graphs per page (All).
- Export Options:** A dropdown menu titled "Export repository" lists various formats: JSON, JSON-LD, RDF-XML, N3, N-Triples, N-Quads, Turtle, Turtle*, TriX, TriG, TriG*, and Binary RDF. Each item has a "Q" icon for search and a trash bin icon for deletion.
- Bottom:** A footer bar with a checkbox and a URL: http://kgc.knowledge-graph.jp/data/DancingMen.

提供するナレッジグラフの説明



Activity	Situation	State	Event
Action	Object	bbox	Episode
stateVal	Affordance	Attribute	

転倒・転落リスクの分類



- 事故データバンク (<https://www.jikojoho.caa.go.jp/ai-national/>)、高齢者行動ライブラリ (<https://www.behavior-library-meti.com/behaviorLib/>) を参考に、転倒・転落の事故リスクを手動抽出
- 抽出したリスクを行動や状況の観点で整理

② 動作と人や物のメタデータの組み合わせ次第で危険

- 重いものを運ぶ
- 高い場所にあるものに手を伸ばす
- 不安定なものにもたれる
- 椅子に座ったまま床から物を拾う
- 低い棚からものを取り出す

① 危険な動作

- 段差を上り下りする
- ものをまたぐ
- 後ろ向きに歩く
- 片足で立つ
- 足を使ってなにかする
- 支え無しで立ち上がる

③ 危険な位置関係

- 歩く導線上に物が置かれている
- ベッドと壁の間に隙間がある
- 椅子の上に座布団が敷かれている
- ベッドに柵が無い
- 椅子に肘掛けが無い

リスクの一例

- リスク「高い場所にあるものに手を伸ばす」

- 必要な情報を検討

高い場所にあるものに手を伸ばす

簡略化のため、身長より高い=高い場所とする

- 身長
- ものの位置座標
- ものの高さ

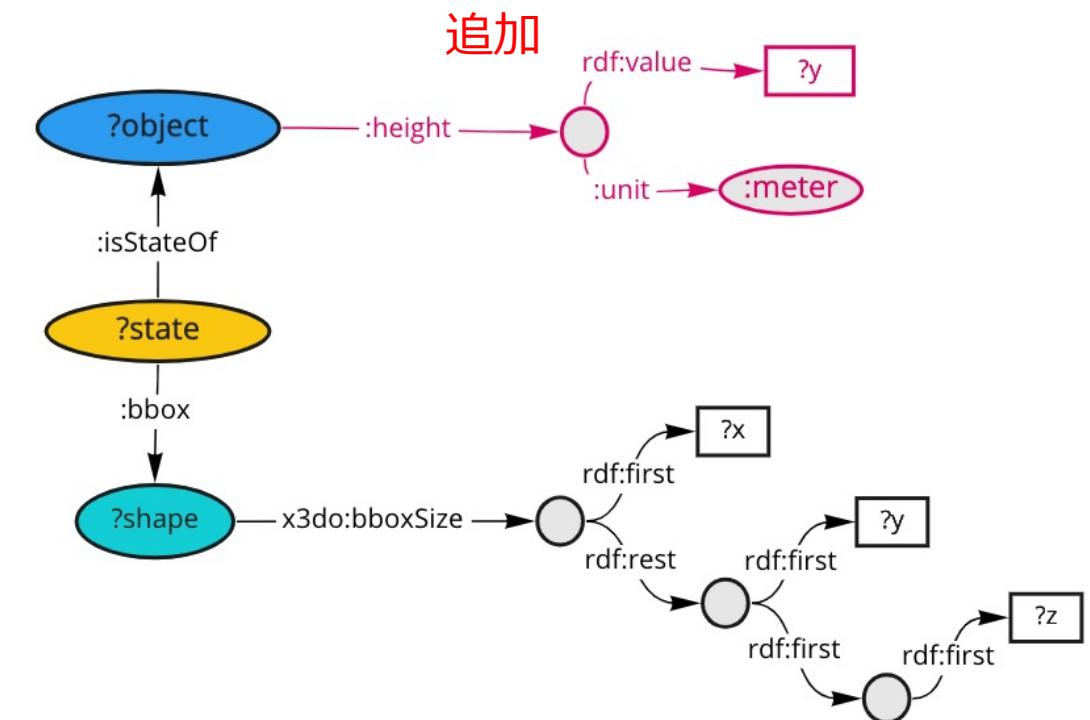
簡略化のため、手を使う系の動作全般とし、「歩く」「見る」「向く」以外の動作とする

推論による知識の補完



- ・オブジェクト（キャラクター含む）の高さ情報の補完
 - ・オブジェクトの3D Bounding Boxのサイズの値を使用し、CONSTRUCTクエリで補完

```
1 PREFIX x3do: <https://www.web3d.org/specifications/X3dOntology4.0#>
2 PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
3 PREFIX : <http://example.org/virtualhome2kg/ontology/>
4 PREFIX ex: <http://example.org/virtualhome2kg/instance/>
5 CONSTRUCT {
6   ?object :height ?height_node .
7   ?height_node rdf:value ?size_y1 ;
8     :unit :meter .
9 } WHERE {
10  ?state1 :isStateOf ?object ; :bbox ?shape1 .
11  ?shape1 x3do:bboxSize ?size1 .
12  ?size1 rdf:rest/rdf:first ?size_y1 .
13  BIND(REPLACE(STR(?object), STR(ex:), "") AS ?object_name)
14  BIND(URI(CONCAT(STR(ex:),"height_", ?object_name)) AS ?height_node)
15 }
```



推論によるリスク情報の補完



- 「高い場所にあるものに手をのばす」 イベントを判定するルール
- 前件（以下の条件を検索する）
 - あるアクティビティは構成イベントを持つ
 - そのイベントで対象としているオブジェクトがある
 - そのオブジェクトにはそのイベント直後の状態の情報がある
 - その状態の時に以下の空間的な条件を満たす
 - (オブジェクトの高さ/2 + オブジェクトのY座標値) > (キャラクターの高さ + キャラクターのY座標値)
 - イベントの動作は「歩く」「見る」「向く」ではない
 - オブジェクトは床、壁、部屋全体などではない

- 後件（以下のトリプルが追加される）
 - 該当するアクティビティのリスク要因(risksFactor)は該当するイベントである
 - 該当イベントは「高い場所にあるものに手をのばす」クラスのインスタンスである

```
CONSTRUCT {
  ?a hra:riskFactor ?e .
  ?e a hra:DoSomethingToHighPositionObject .
} WHERE {
  ?a :hasEvent ?e .
  ?e :agent ?person ; :situationAfterEvent ?situation ; :ho:object ?o ; :action ?action .
  ?o :height/rdf:value ?oh .
  ?person :height/rdf:value ?ph .
  ?state1 :isStateOf ?person ; :partOf ?situation ; :bbox ?shape1 .
  ?state2 :isStateOf ?o ; :partOf ?situation ; :bbox ?shape2 .
  ?shape1 x3do:bboxCenter ?center1 ; x3do:bboxSize ?size1 .
  ?center1 rdf:rest/rdf:first ?center_y1 .
  ?shape2 x3do:bboxCenter ?center2 ; x3do:bboxSize ?size2 .
  ?center2 rdf:rest/rdf:first ?center_y2 .
  FILTER ((?center_y2 + (?oh * 0.5)) > (?center_y1 + (?ph * 0.5)))
  FILTER (?action != ac:walk && ?action != ac:watch && ?action != ac:turnTo && ?action != ac:lookAt)
  MINUS {?o rdf:type/rdfs:subClassOf* ob:Room }
}
```

推論結果



	subject	predicate	object
1	ex:find_some_food_scene1	vh2kg:homeriskactivity/riskFactor	ex:event1_find_some_food_scene1
2	ex:event1_find_some_food_scene1	rdf:type	vh2kg:homeriskactivity/DoSomethingToHighPositionObj
3	ex:find_some_food_scene1	vh2kg:homeriskactivity/riskFactor	ex:event2_find_some_food_scene1
4	ex:event2_find_some_food_scene1	rdf:type	vh2kg:homeriskactivity/DoSomethingToHighPositionObj
5	ex:find_some_food_scene1	vh2kg:homeriskactivity/riskFactor	ex:event4_find_some_food_scene1
6	ex:event4_find_some_food_scene1	rdf:type	vh2kg:homeriskactivity/DoSomethingToHighPositionObj
7	ex:find_some_food_scene1	vh2kg:homeriskactivity/riskFactor	ex:event5_find_some_food_scene1
8	ex:event5_find_some_food_scene1	rdf:type	vh2kg:homeriskactivity/DoSomethingToHighPositionObj
9	ex:take_off_clock_scene1	vh2kg:homeriskactivity/riskFactor	ex:event1_take_off_clock_scene1
10	ex:event1_take_off_clock_scene1	rdf:type	vh2kg:homeriskactivity/DoSomethingToHighPositionObj

この結果のトリプルをトリプルストアに追加することで、リスクイベントを検索可能

可視化ツールで確認

- #### ・近日中に公開予定