EVENTSKG:

概述

- 论文名称：A Knowledge Graph Representation forTop-Prestigious Computer Science Events Metadata
- 论文地址
- 数据查询语言

1. 六个主题：
    1. information systems (IS)
    2. security and privacy (SEC)
    3. artificial intelligence (AI)
    4. computer systems organization (CSO)
    5. software and its engineering (SE)
    6. web (WWW)

- URL
- github
- 数据展示

时序知识图谱的定义和结构

关于时序时间图谱的定义

Definition 1. *A* temporal knowledge graph $TKG : \langle E_t, R_t \rangle$ *is a directed multigraph. The nodes in* $E_t = E \cup \mathcal{V}$ *are temporal entities, where* E *is a set of real-world entities and* $\mathcal{V}$ *is a set of real-world events. The directed edges in* R_t *represent temporal relations of the temporal entities in* E_t.

可以看到时序知识图谱由节点（entities）和时序关系构成（temporal relations)组成，其中节点由现实世界节点(realworld entities)和事件(events）组成。

Definition 2. *A* temporal entity $e \in E_t$ *represents a real-world entity or event. e is annotated with a tuple* $\langle e_{uri}, e_{time} \rangle$, *where* e_{uri} *is the unique entity identifier and* $e_{time} = [e_{start}, e_{end}]$ *denotes the existence time of the entity (for* $e \in E$*) or the happening time of the event (for* $e \in \mathcal{V}$*).*

时序知识图谱中的节点由两个信息来描述：第一个是e_eur表示该节点的独特的指示，第二个是e_time表示这个现实节点的存在时间或者是时间的发生时间

Definition 3. *A* temporal relation $r \in R_t$ *represents a binary relation between two temporal entities. r is annotated with a tuple* $\langle r_{uri}, r_{time}, e_i, e_j \rangle$, *where* r_{uri} *is a unique relation identifier,* e_i *and* e_j *are the temporal entities participating in the relation r and* $r_{time} = [r_{start}, r_{end}]$ *denotes the validity time interval of the temporal relation.*

第三个定义是关于边的关系

时序知识图谱的逻辑结构

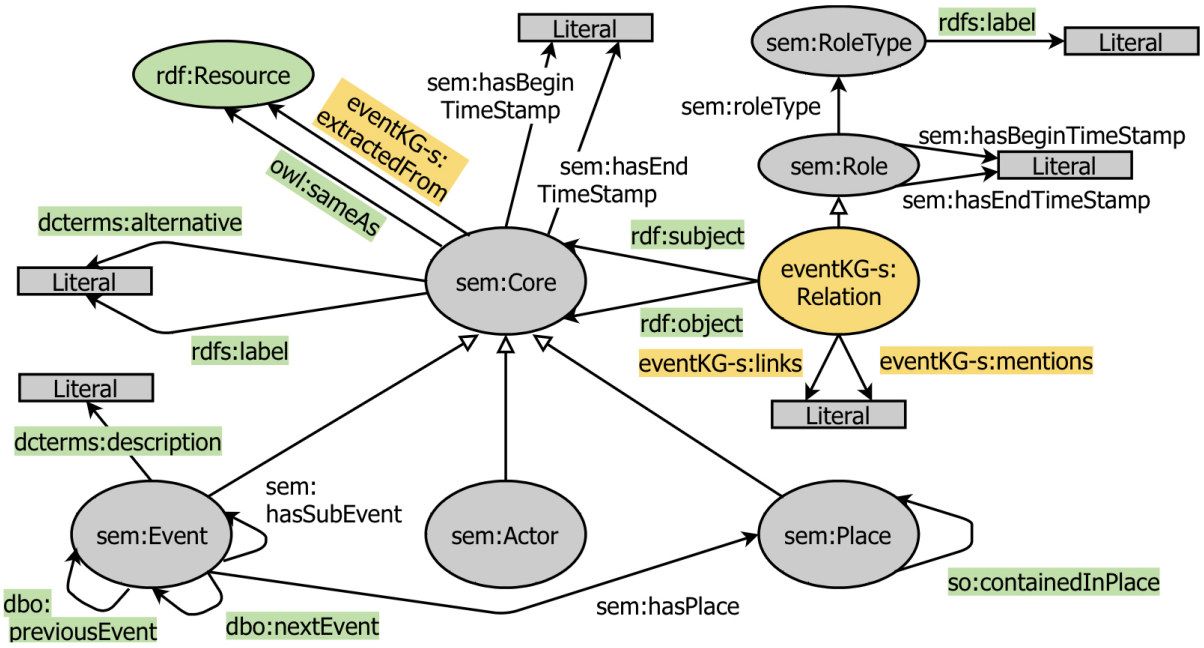

Figure 2. The EventKG schema based on SEM. Arrows with an open head denote `rdfs:subClassOf` properties. Regular arrows visualize the `rdfs:domain` and `rdfs:range` restrictions on properties. Terms from other reused vocabularies are colored green. Classes and properties introduced in EventKG are colored orange.

1. EVENTkg是在SEM的基础上进行建构的，SEM的结构和缺点参考SEM文档，在上图中绿色的是从SEM中继承的，黄色部分是在EVENTkg中附加的
2. sem:event sem:actor sem:place 都为sem:core的三个子类，用来表征一个节点的事件，参与者和地点信息
3. 在上图中，sem:core和enentKg-s:Relation中间的rdf:subject 和ref:object用来表示两个节点的关系，在图中链接到一个sem:core当中，其实是不同的
4. enentKg-s:Relation 中的links和mentions属性分别表示一个实体的连接数和提及数，可以用来计算关系强度(relation strength)和流行程度（event popularity metrics）

Namespace prefix	IRI
so:	http://schema.org/
dbo:	http://dbpedia.org/ontology/
rdf:	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs:	http://www.w3.org/2000/01/rdf-schema#
dcterms:	http://purl.org/dc/terms/rdfs:
sem:	http://semanticweb.cs.vu.nl/2009/11/sem/
eventKG-s:	http://eventKG.l3s.uni-hannover.de/schema/
eventKG-r:	http://eventKG.l3s.uni-hannover.de/resource/
eventKG-g:	http://eventKG.l3s.uni-hannover.de/graph/

> 上图为在逻辑结构图中具体资源的网站

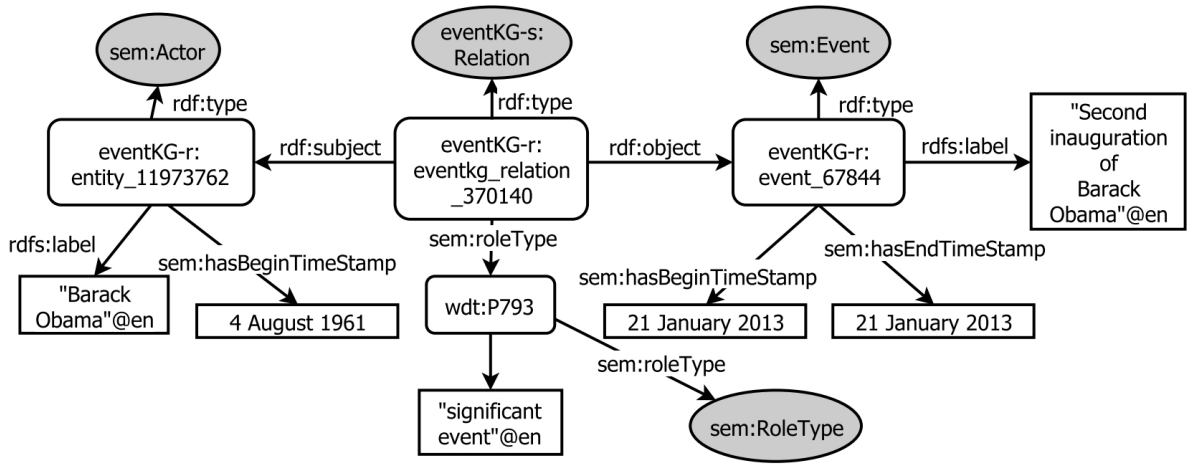

Figure 3. Example of the event representing the participation of Barack Obama in his second inauguration as a US president in 2013 as modelled in EventKG. `wdt:P793` is the Wikidata identifier for the "significant event" property.

> 上图就是EVTNTkg的一个实例，表示的含义是奥巴马的第二次当选，这个含义当中就包括了两个节点，一个是现实世界的实体节点，一个是事件节点，中间是关系，用上文所说的rdf:subject和rds:object进行连接，根据定义，在圆角长方体的中的indentifier，连接的长方体是节点的属性，包括名称和起始时间等。

EVENTkg的生成

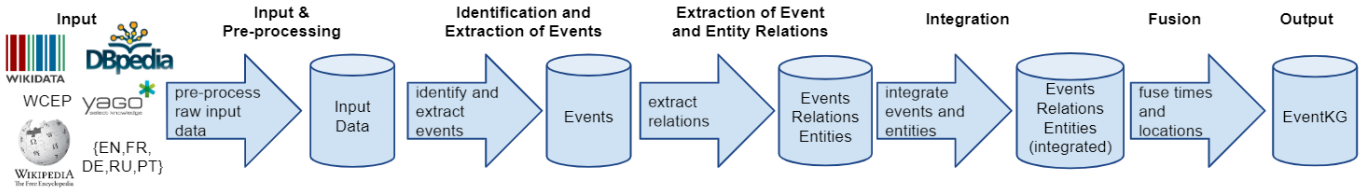

Figure 4. The EventKG generation pipeline.

> 数据的加工代码见之前的链接

1. input and pre-processing（数据输入和预处理）
    1. 数据来源
        - Wikidata
        - YAGO
        - DBpedia
        - Wikipedia Current Events Portal
    2. 使用语言 EN, FR, DE, RU and PT
    3. 预处理的过程：
        1. 确定术语（Terms）：（确定关键词maybe）
        2. 抽取数据表达式（Date expressions）：比如日期等
        3. 定义表示事件关系的谓词映射（Mapping of predicates representing event relations）也就是把找到的术语和数据和eventkg中的对应起来。注意：这里只是定义这张表格，并没有具体抽取。

Example property mapping between EventKG and its reference sources.

EventKG	Wikidata	DBpedia	YAGO
sem:hasPlace	wd:P276 (location) wd:P30 (continent) ...	dbo:place	yago:isLocatedIn yago:happenedIn
sem:hasBeginTimeStamp	wd:P580 (start time) wd:P585 (point in time) wd:P1619 (date of official opening) ...	—	yago:startedOnDate yago:happenedOnDate
sem:hasEndTimeStamp	wd:P582 (end time) wd:P585 (point in time) ...	—	yago:endedOnDate yago:happenedOnDate
so:hasSubEvent	wd:P361 (part of)	dbo:isPartOf dbo:isPartOfMilitaryConflict ...	—
so:previousEvent	wd:P155 (follows)	dbo:previousEvent dbo:previousWork	—
so:nextEvent	wd:P156 (followed by)	dbo:followingEvent dbo:subsequentWork	—
so:containedInPlace	wd:P36 (capital) wd:P706 (located on terrain feature) ...	—	—

> 上图即为对应关系

2. indentification an extraction of events（事件的识别和提取）
3. extraction of event and entities of relations
    1. 提取数据的有效时间
    2. 提取间接关系
    3. 根据上面的关系对应的表格提取实体事件关系
    4. 关系强度和流行性分析
4. integration（整合）
    1. 创建了一个命名图eventKG-g:event_kg来储存integration 和fusion的结果
    2. 从不同的信息源 获取 owl:sameAs 联系，不同语言，不同来源的联系是不同的
    3. 合并整合联系相同的节点
5. fusing
    1. 时间融合
    2. 地点融合
    3. 类型融合
6. output
    1. 最后结果以RDF 形成呈现

生成示例

Example data items about Barack Obama extracted from different reference sources.

#	Reference Source	Data Item	Related Data Items
1	$\text{Wikipedia}_{\text{EN}}$	*8 May 2018*: President Trump announces his intention to withdraw the United States from the Iranian nuclear agreement. In a statement, former U.S. President Barack Obama calls the move "a serious mistake".	—
2	Wikidata	*Barack Obama, significant event, first inauguration of Barack Obama*	Wikidata: *first inauguration of Barack Obama, point in time, 20 January 2009* YAGO: *first inauguration of Barack Obama, was created on, 17 July 1981* Wikidata: *first inauguration of Barack Obama, instance of, United States presidential inauguration* Wikidata: *United States presidential inauguration, subclass of*, occurrence*
3	Wikidata	*Barack Obama, spouse, Michelle Obama* *start time: 3 October 1992*	—
4	$\text{DBpedia}_{\text{FR}}$	*Barack Obama, prop-fr:candidat, Élection présidentielle américaine de 2012*	$\text{DBpedia}_{\text{FR}}$: *Élection présidentielle américaine de 2012 owl:sameAs United States presidential election, 2012* Wikidata: *United States presidential election, 2012, point in time, 6 November 2012*
5	$\text{Wikipedia}_{\text{PT}}$	*[The Portuguese Wikipedia page of Barack Obama links to the page "Death of Osama bin Laden" once.]*	Wikidata: *Death of Osama bin Laden*, point in time, *2 May 2011*

> 上图是抽取出来的原始数据

```
  ?rel rdfs:type
       eventKG-s:Relation .
  ?rel rdf:subject
       eventKG-r:entity_11973762 .
  ?rel rdf:object
       eventKG-r:event_527087 .

  eventKG-g:wikipedia_pt {
    ?rel eventKG-s:links 1 .
  } .
```

> 经过extraction

```
Barack Obama,
significant event:
first inauguration of Barack Obama
[2009-01-20,2009-01-20]
```

> 经过integration and fusion