joint research centre

European Commission

Knowledgebase of Politically Motivated Conflict Events

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Pinar Oezden Wennerberg

pinar.oezden@jrc.it

Agenda

- Introduction
  - Knowledge engineering
  - Ontologies state-of-the-art
- Motivation
  - Conflict event information in online news reports
  - Automatic knowledge acquisition via reasoning
  - Decision support
- The Knowledgebase of Conflict Events
  - The system overview
  - The ontology of conflict events and the event instances
  - Interacting with the knowledgebase
- Challenges
- Future Work

Introduction

- How do we machine-process information?
  - Statistical, data-driven approaches
    - Study the information (data) and come up with rules that describe regularities
    - Apply those rules to new information
    - No notion of representation
    - Implies learning
  - Representational, knowledge-driven approaches
    - Describe the prior information (knowledge) in a formal, logical, machine-processable form (representation)
    - Process the new information according to the representation
    - Implies knowing

Introduction

- Knowledge Engineering
  - Humans and software agents need knowledge about the world to reach good decisions
  - Such knowledge and the ways to process are typically stored in knowledgebases
  - It is possible to construct such a knowledgebase by telling it what it needs to know
  - The process of constructing a knowledgebase is called knowledge engineering
  - „A knowledge engineer is someone, who
    - investigates a particular domain,
    - determines what concepts and relations are important in that domain,
    - and creates a formal representation of objects and relations in that domain“

(Russel & Norvig, 1995)

Introduction

- What is ontology?
  - "An ontology is a formal, explicit specification of a shared conceptualization"

    (Gruber, 93)
    - it uses a fixed vocabulary to describe a particular view of some domain
  - Ontology is the common formal language to encode the knowledge so that
    - computers can process the input information
    - both heterogeneous computer systems and humans can share and reuse the knowledge

Introduction

- Why ontology?
  - Assist communication between people
    - by minimizing ambiguity that emerges as a result of different viewpoints of people with different backgrounds
  - Achieve inter-operability among heterogeneous computer systems
    - by translating between different modelling methods, paradigms, languages and software tools
  - Improve the process of engineering software systems by means of:
    - Re-usability (exploit what is already available)
    - Reliability (formal representation does not allow invalid, contradicting information)

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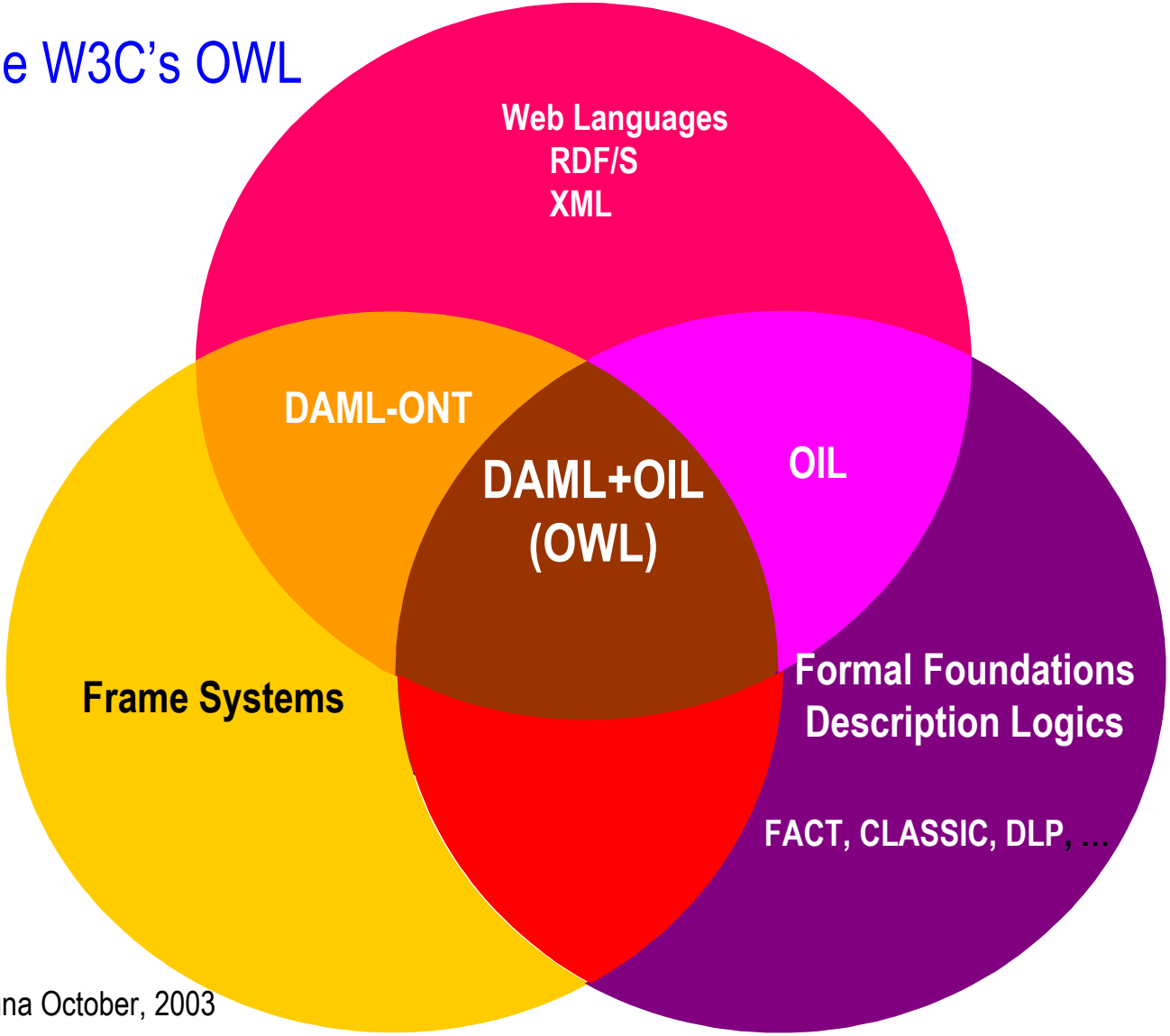
Introduction

Ontology language W3C's OWL



Adapted from:McGuiness, Cogna October, 2003

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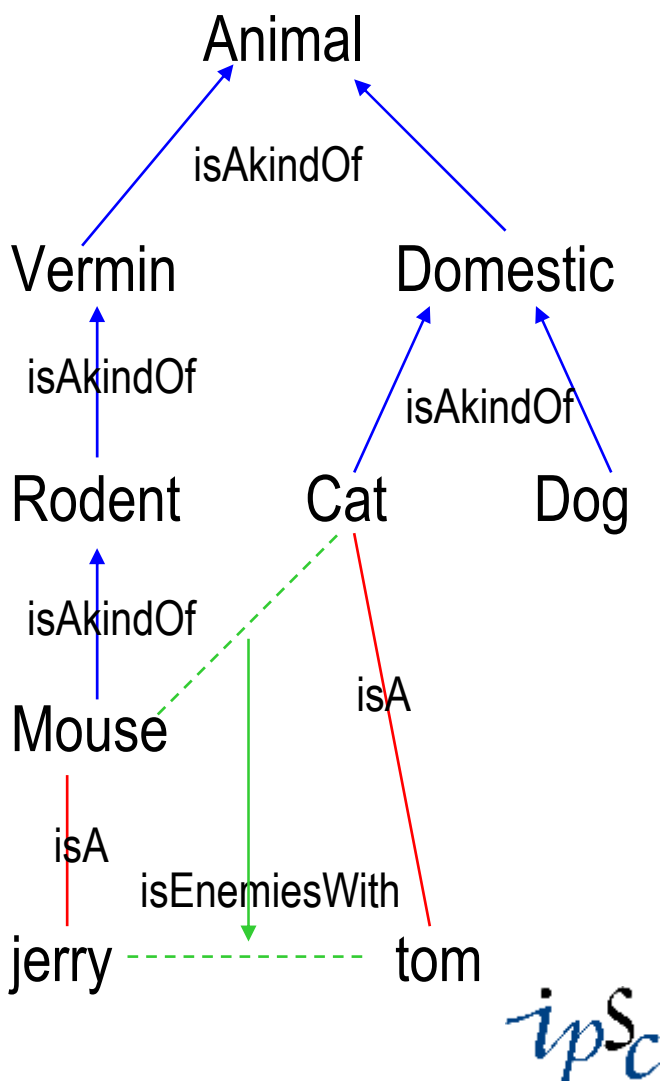
Introduction

- Components of an Ontology
  - Individuals (also called Instances)
    - tom, jerry
  - Concepts (also called Classes or Types)
    - Cat, Dog
  - Properties (also called Attributes or Slots or Roles)
    - hasColour
  - Relationships
    - isEnemiesWith
  - Axioms
    - jerry isEnemiesWith Tom
  - Restrictions
    - all Mice isEnemiesWith Cats



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Introduction

- Information vs. Knowledge-Based Systems
  - The purpose of an information system is to inform the system user about the related domain
  - The purpose of a knowledge-based system is to enrich its own knowledge about a specific domain AND that of the user
  - Therefore, a knowledge-based system consists of
    - The knowledge about a domain of interest (e.g. conflict events) = ontology
    - The information (data) about the domain of interest = instances
    - The ways to process = reasoning

Introduction

- The goal of this project is to develop a module that provides Europe Media Monitor a knowledgebase extension that shall
  - process information about conflict events extracted from the EMM using a priori domain knowledge
  - apply reasoning to discover relationships and facts between the conflict events
  - allow policy makers and security intelligence analysts to explore the possible relationships between seperate events to reach good decisons

Motivation

- Conflict event information in Europe Media Monitor's online news reports
  - There is a structure in the description of each conflict event
    - Certain entities such as, people, organizations, locations, time indicators seem to be almost always present
    - These entities may be connected to each other by certain relationships such as kinship, business, spatial etc.
  - This structure is typically revealed by the question „Who Did What to Whom, Where and When?"

    e.g. „ Indian troops kill five in Valley "

Motivation

- Conflict event information in Europe Media Monitor's online news reports
  - There are relationships between seemingly disparate conflict events

09-01-2005, RSS:

"…… Aafia Siddique, who traveled to Afghanistan …. "

09-10-2005, GUARDIAN:

"Abdullah Al Reshood and his roommate Aafia Siddique …. "

10-15-2005, HT:

"…..the Al Qaeda member Aafia Siddique…. "

06-15-2005,Reuters:

"Abdullah Al Reshood had traveled to Afghanistan …. "

Motivation

- Knowledge acquisition
  - Formal, explicit modelling of the entities and relationships enables reasoning
  - Via reasoning it is possible to acquire new knowledge about conflict event from news reports

Fact 1: Person(Aafia Siddique) roommateOf Person(Abdullah Al Reshood)
Fact 2: Person(Abdullah Al Reshood) isMemberOf TerrorOrganization(AlQueada)

Hypothesis1: Person(Aafia Siddique) isRelatedTo TerrorOrganization(AlQueada)?

Fact 3: Person(Aafia Siddique) traveledTo Place(Afghanistan)
Fact 4: Person(Abdullah Al Reshood) traveledTo Place(Afghanistan)
Fact 5: Person(Aafia Siddique) isRelatedTo TerrorOrganization(AlQueada)

Hypothesis2: TerrorOrganization(AlQueada) relatedTo Place(Afghanistan)?

Motivation

Constraints

TerrorOrganization organizerOf ConflictEvent
Person travelsTo Place
Person roommateOf Person

Relations

relatedTo
|_roommateOf
|_travelsTo
|_organizerOf

Facts

Aafia Siddique isA Person
Abdullah Al Reshood isA Person
AlQueada isA TerrorOrganization
Afghanistan isA Place

Rules

If X organizerOf Y →
Then X relatedTo Y

Motivation

- In sum
  - EMM's online news reports contain valuable information about conflict events, which is not obvious at the first sight
  - A conflict events ontology can help capture that information (e.g. relations between events)
  - Using the ontology, rules and logic can help discover new relations and facts about conflict events resulting in automatic knowledge acquisition
  - Analysts can explore these relations and facts by interacting with the knowledgebase to gain insight and to reach good decisions

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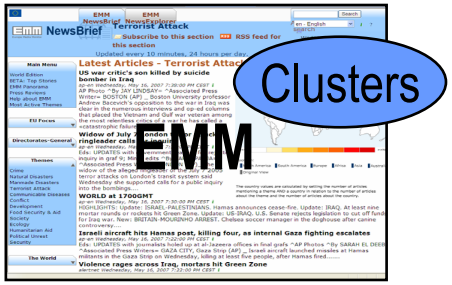
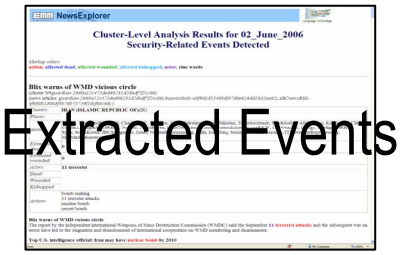
Violent Event Extraction

Extraction



Clusters

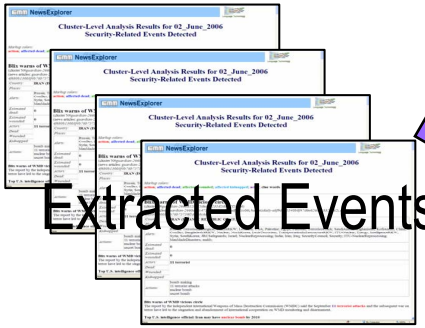
Extraction Patterns



Extracted Events

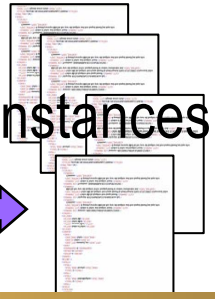
Ontology Modelling and Knowledgebase Population

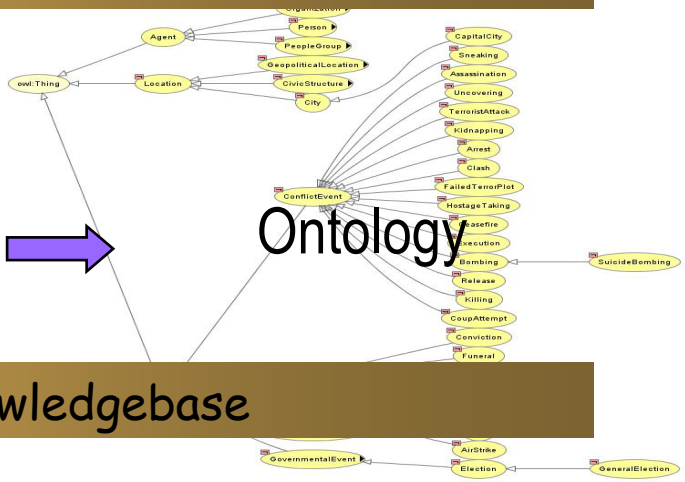
Modelling



Extracted Events

Instances

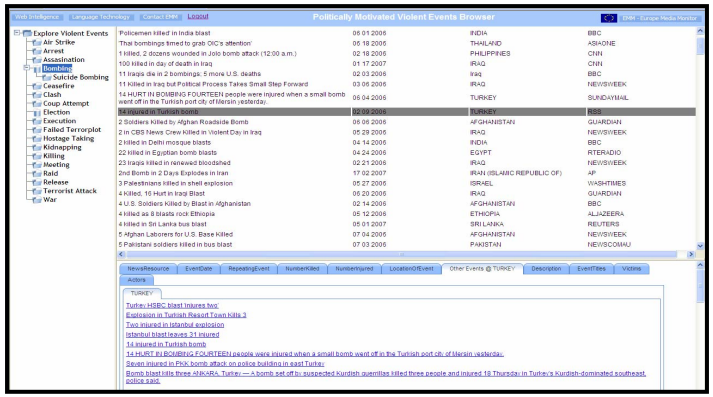


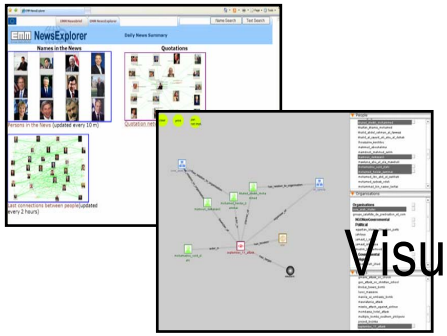


Ontology

Querying, Browsing and Visualization of the Knowledgebase

Browsing





Visualize

The Ontology of Conflict Events

PMVE Protégé 3.1 beta (file:\C:\MyOntologies\PMVE_04\PMVE.pprj, OWL Files (.owl or .rdf))

File Edit Project OWL Code Window Tools Help

protégé

OWLClasses | Properties | Forms | Individuals | Metadata

SUBCLASS RELATIONSHIP

For Project: PMVE

Asserted Hierarchy

- Agent
  - Organization
    - EducationResearchOrganizatio
    - FinancialOrganization
    - GovernmentalOrganization
    - MilitaryOrganization
    - NGO
    - PoliticalOrganization
    - ReligiousOrganization
    - UnknownOrganization
  - PeopleGroup
  - Person
    - Civilian
    - GovernmentalPerson
    - Insurgent
    - MilitaryPerson
    - UnknownPerson D
- Event
  - ConflictEvent
    - Assassination
    - Bombing
    - Clash
    - CoupAttempt
    - Escape ≡ Flee
    - EventsUnderInvestigation
    - Execution
    - FailedTerrorPlot
    - Flee ≡ Escape
    - HostageTaking
    - Kidnapping
    - Killing
    - PossibleThreat
    - Sneaking
    - TerroristAttack

CLASS EDITOR

For Class: ConflictEvent (instance of owl:Class)

Name | SameAs | DifferentFrom

ConflictEvent

rdfs:comment

Annotations

Property	Value	Lang

Asserted | Inferred

Asserted Conditions

NECESSARY & SUFFICIENT

NECESSARY

- Event ⊆
- ∀ hasPeopleArrested (PeopleGroup ⊔ Person) ⊆
- ∀ hasPeopleKilled (PeopleGroup ⊔ Person) ⊆
- ∀ hasTarget (Person ⊔ PeopleGroup ⊔ CivicStructure) ⊆
- ∀ hasWounded (PeopleGroup ⊔ Person) ⊆
- ∀ isKilledAt (PeopleGroup ⊔ Person) ⊆

INHERITED

- ∀ happensAtPlace Location [from Event] ⊆
- ∀ hasActor Agent [from Event] ⊆
- ∀ hasAttendant Agent [from Event] ⊆
- ∀ hasEventReportDate EventReportDate [from Event] ⊆
- ∃ hasEventReportDate EventReportDate [from Event] ⊆
- ∀ hasLocationOfEvent Location [from Event] ⊆
- ∀ isOrganizedBy (Organization ⊔ PeopleGroup ⊔ Person) [from Event] ⊆
- ∀ isSubEventOf Event [from Event] ⊆

All instances are sub event of event

Properties

- hasDamage
- hasNumberArrested (multiple xsd:string)
- hasNumberInjured
- hasNumberKidnapped
- hasPeopleKilled (multiple Person ⊔ PeopleGroup)
- hasTarget (multiple Person ⊔ GeopoliticalLocation)
- isArrestedAt
- happensAtPlace
- hasActor
- hasAttendant (multiple PeopleGroup ⊔ Person)
- hasEventReportDate (multiple EventReportDate)
- hasLocationOfEvent
- hasPeopleArrested (multiple ConflictEvent ⊔ Person)
- hasWounded

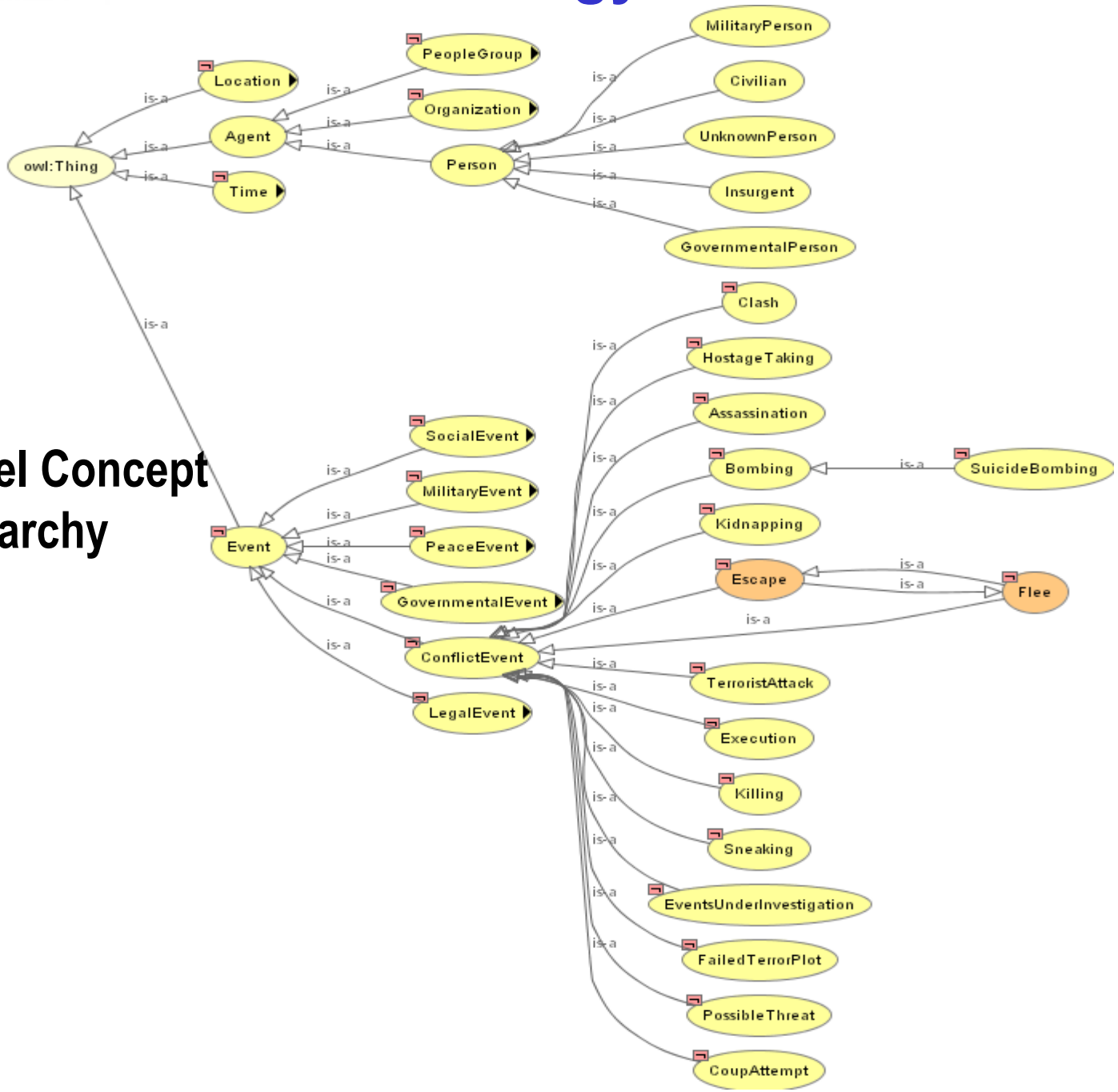
Disjoints

- ent
- SocioReligousEvent
- MilitaryEvent
- GovernmentalEvent
- SocialEvent
- PeaceEvent

Logic View | Properties View

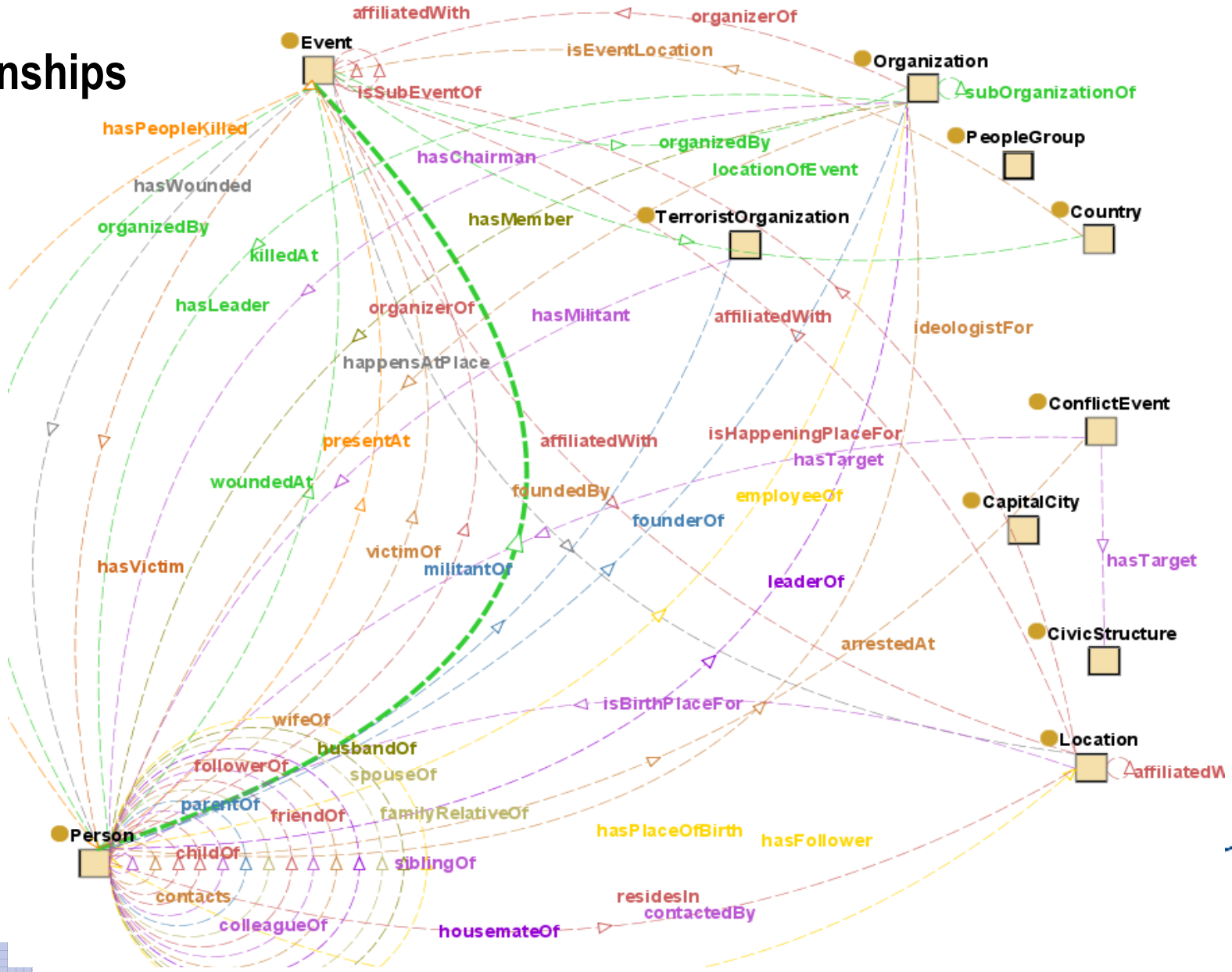
The Ontology of Violent Events

High Level Concept Hierarchy



The Ontology of Conflict Events

Relationships



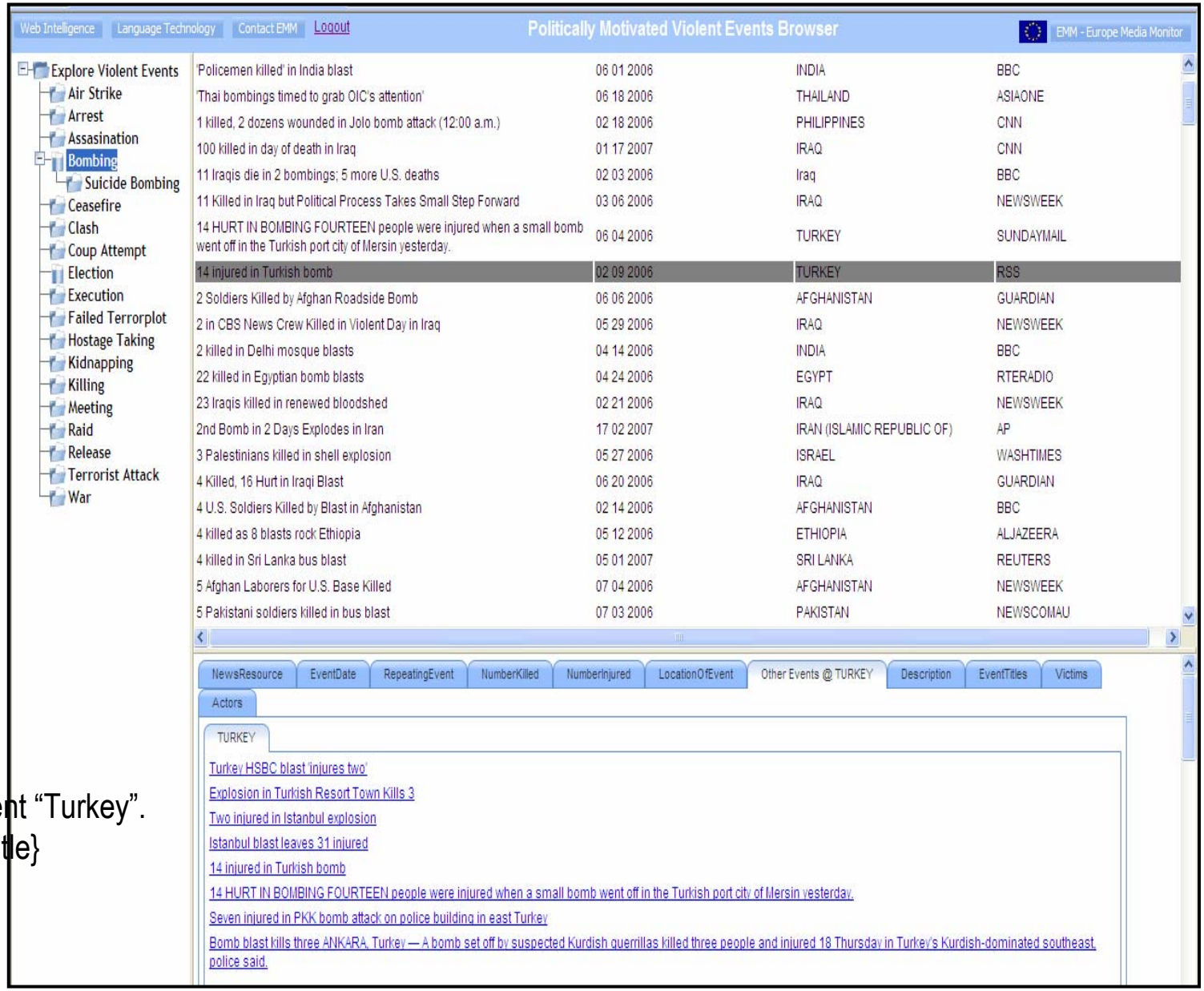
User Interaction with the Knowledgebase

Query

Other Related Events
(e.g. other events in Turkey)

<u>Example SPARQL Query</u>

```
SELECT ?event ?title
WHERE{
?event PMVE:locationOfEvent “Turkey”.
?event PMVE:eventTitles ?title}
```



Challenges

- Knowledge engineering specific
  - Knowledge acquisition bottleneck
    - domain experts are not easily available
    - expensive in terms of time and resources
  - Adressing different views
    - different levels of detail (granularity) are required to meet different expectations of the analysts
  - Ambiguity of the natural language
    - two different reports, one same event (identity problem)
    - implicit information (difficult for machine-processing, understanding)

      e.g. “Five killed in a bomb attack”
  - Keeping track of time

Challenges

- Domain specific
  - Retaining objectivity
    - Different views of news media on the same event
  - Domain restriction
    - It is not trivial to draw the line between politically and non-politically motivated conflict events as one may be the cause or the consequent of another

Future Work

- Finer grained classification of the events such as precedent and consequent events
- Implementation of the fast inference engine
- Semantic visualization interface in order to allow a graphical information exploration for the analysts
  - Instance based i.e. not only the concepts of the ontology but also the instances shall be visualized
  - Graph structure i.e. one can explore the relationships between events as nodes and edges in a graph
  - Semantic lables i.e. the edges between the nodes are labeled in a meaningful way to reveal the essence of the relationship

Thank You