

PREJUST4WOMEN (PREdictive JUSTice for WOMEN)

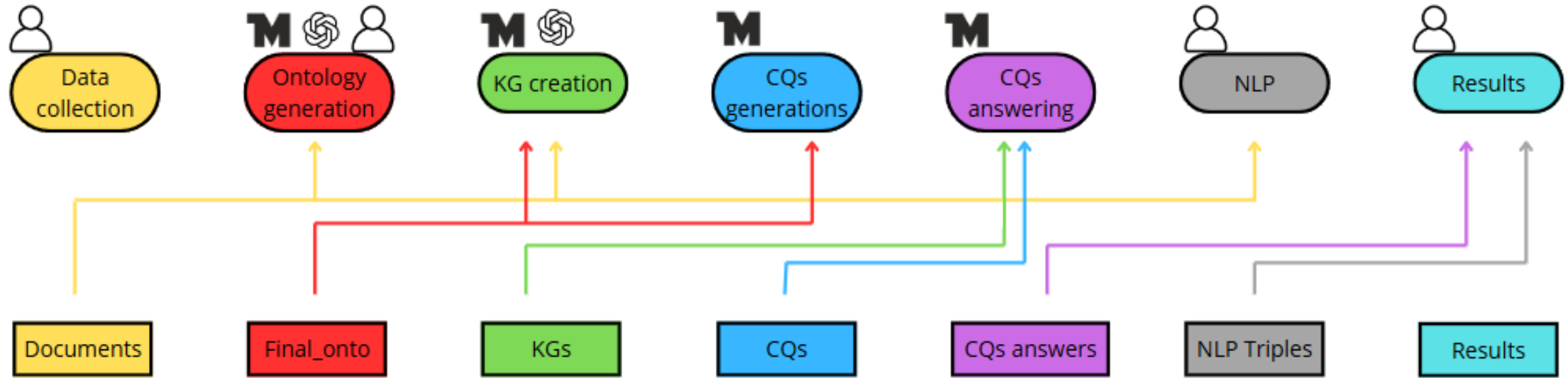
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- **EXAM:** Semantic Technologies and Knowledge graphs
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 - **YEAR:** 2023/2024



Introduction

- The project is developed in the field of predictive justice on women's violence.
- A growing problem, according to OMS data about 35% of women globally have experienced violence.
- Difficulties in creating common laws for violence against women due to different social/cultural contexts.
- Project goal is to create a KG automatically using LLM by extracting information from legal documents.

ELABORATION PIPELINE



Documents

- ECHR Database
- 5 documents randomly selected from the database.
- 2 types of approaches, use of the entire document and use of a sub-part selected by domain experts.
 - **Full-text approach:**
 - Wider context
 - About 10000+ tokens
 - **Sub-part approach:**
 - Less broad but more specific context
 - About 1500+ token

LLM

The LLMs that were tested via TogheterAI are:

- StripedHyena, Llama, Mixtral 8x7b, Mixtral 8x22b, GPT 4.o.

The choice of LLMs used took into account the number of input and output tokens.

Crucial is the engineering part:

- Zero-shot prompts for the most comprehensible tasks
- Few-shot prompts for tasks requiring more imagination

RAG

- That can improve the quality of generative artificial intelligence
- Parametric and non parametric data to inspect

NO-RAG

```
:Abuse1 a :Abuse ;
:hasPerpetrator :Perpetrator1 ;
:hasVictim :Victim1 ;
:hasContext :Context1 ;
:hasConsequence :Consequence1 ;
:hasDate "2022-01-01"^^xsd:date ;
:hasLocation "New York" ;
:hasDuration "PT1H"^^xsd:duration ;
:hasFrequency 1 ;
:hasSeverity 5 .

:Perpetrator1 a :Perpetrator ;
:hasName "John Doe" ;
:hasAge 30 ;
:hasGender :Male ;
:hasOccupation :PoliceOfficer .

:Victim1 a :Victim ;
:hasName "Jane Doe" ;
:hasAge 25 ;
:hasGender :Female ;
:hasOccupation :Model .
```

RAG

```
:Abuse_1 a :PhysicalAbuse, :EmotionalAbuse ;
:hasPerpetrator :D ;
:hasVictim :C ;
:hasContext :Context_1 ;
:hasConsequence :Consequence_1 ;
:hasLocation "Georgia" ;
:hasDuration "P2Y6M"^^xsd:duration ; # December 2011 - June 2012
:hasFrequency 20 ; # assuming approximately 20 incidents based on escalation over the period
:hasSeverity 5 . # assuming a severity scale of 1-10

:D a :Perpetrator ;
rdfs:label "D" ;
rdfs:comment "The primary perpetrator, a police officer." .

:C a :Victim ;
rdfs:label "C" ;
rdfs:comment "The primary victim, who endured physical and psychological harassment." .
```

Ontology

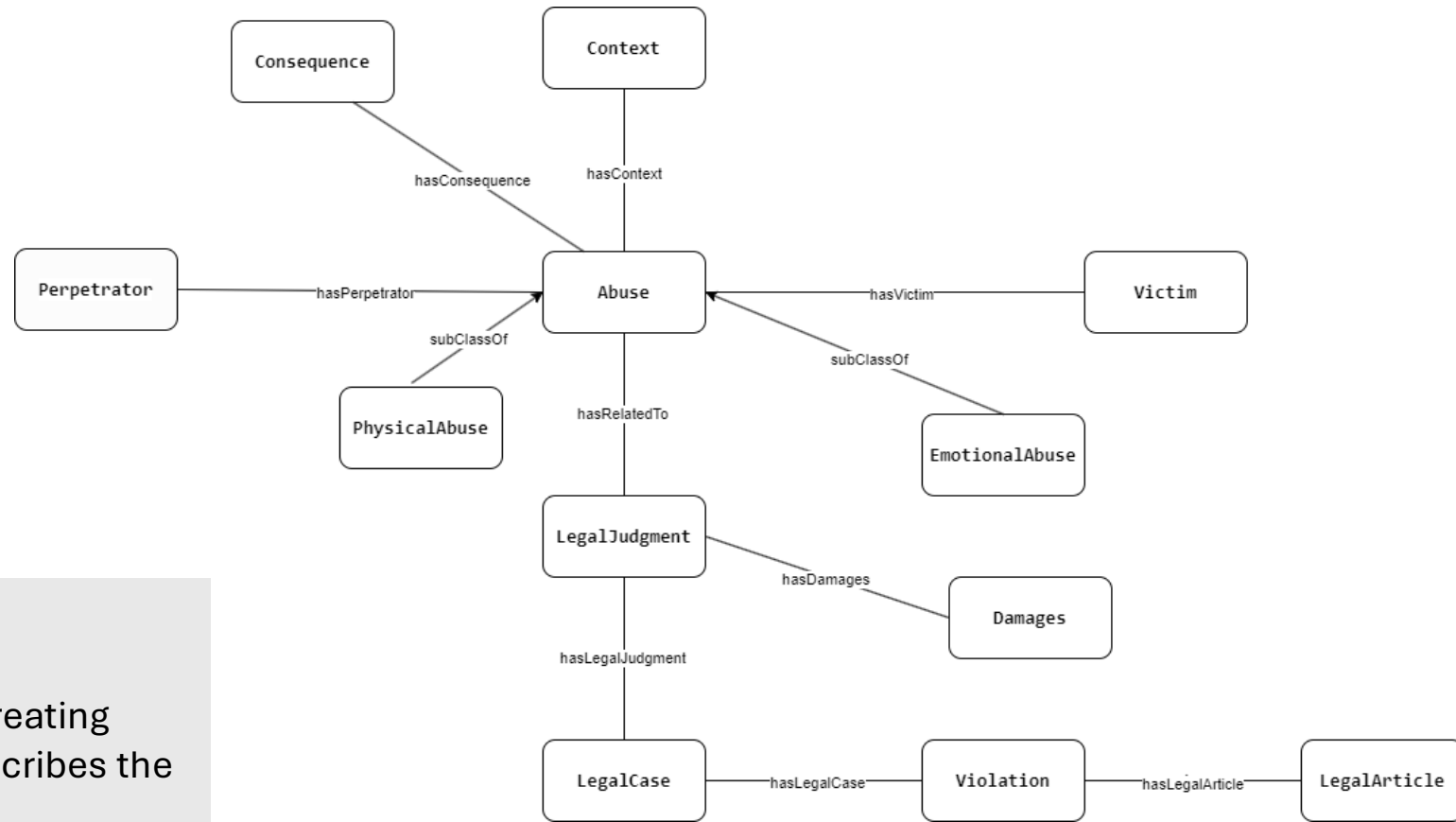
- Generating a Generic Ontology with ChatGPT
- Specialization by a **zero-shot prompt**
- Elements between document specializations

PROMPT:

You are an ontology expert.

Following the given ontology extends it, creating data property and object property, for describes the context.

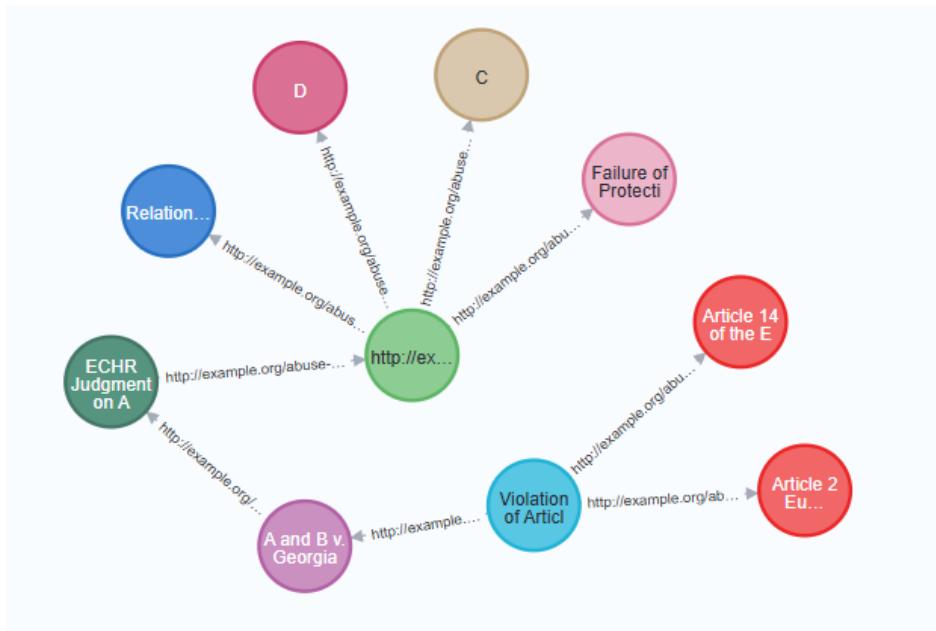
Do not generate Class or Individuals.



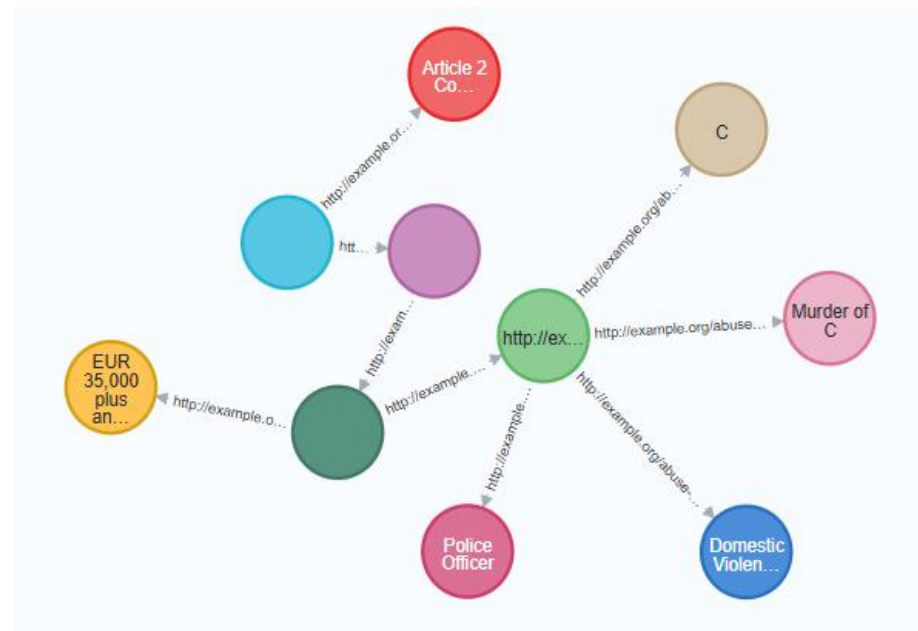
Knowledge graph

- Generating KG for each document by a few shot prompts providing the structure of the KG as an example.
- Same ontology without further specialisation.
- Union of all KG while maintaining their meaning and avoiding inconsistency .

Full-text



Sub-part



PROMPT KG

You are a knowledge graph engineer.

Using the ontology provided, generate the graph instances based on the information in the document.

Do not generate new DatatypeProperty, use the provided ones in the ontology schema.

Give the output in RDF turtle format following the example.

If you cannot represent the concept with the provided ontology, do not try to generate additional part of the schema, just simplify using the provided ontology or not represent it.

#Example

:Abuse1 a :Abuse ;

 :hasPerpetrator :Perpetrator1 ;

 :hasVictim :Victim1 ;

 :hasContext :Context1 ;

 :hasConsequence :Consequence1 ;

 :hasDate "1997-09-25"^^xsd:date ;

 :hasLocation "Strasbourg" ;

 :hasDuration "P1D"^^xsd:duration ;

 :hasFrequency 1 ;

 :hasSeverity 8 .

CQs

- Create on the ontology using a **zero-shot prompt**
- Used for quantitative evaluation of the responses from each Knowledge graph.
- In order of importance suggested by LLM.

PROMPT:

Based on the following ontology, create a list of competency questions.

Competency Questions

What is the legal outcome of Case?

Which legal case is associated with Violation?

What is the legal status?

How much in legal damages and costs were awarded?

Which court judged the Case?

What is the reason stated for the judgment?

What is the context of Abuse?

What are the consequences of Abuse?

What is the duration and frequency of Abuse?

What is the severity level of Abuse?

Which legal article are violated?

What abuse is related to Judgment?

What are the damages related to Judgment?

CQs Answering

- Use of a zero-shot prompt to answer the questions.
- Every answer was provided by each KG.
- Each answer was checked if present in the document.

Question	Answer
What is the legal outcome of Case?	violation of Article 8 of the Convention
Which legal case is associated with Violation?	Case A
What is the legal status?	admissible
How much in legal damages and costs were awarded?	Legal damages: 9470.0; Legal costs: 4470.0
Which court judged the Case?	European Court of Human Rights
What is the reason stated for the judgment?	The respondent State is to pay the applicant
What is the context of Abuse?	Incidents of verbal and physical violence, death threats by B
What are the consequences of Abuse?	Sentenced to imprisonment and ordered to undergo psychiatric treatment
What is the duration and frequency of Abuse?	Duration: 2 years; Frequency: 3 (not specified if this is daily, weekly, etc.)
What is the severity level of Abuse?	5
Which legal article are violated?	Article 8 of the Convention
What abuse is related to Judgment?	Abuse A
What are the damages related to Judgment?	EUR 9470

PROMPT:

Given this KG, answer to this questions extracting the answers from KG.

Do not try to generate answers that are not in KG.

Do not try to generate other questions.

If the answer is not provided in the KG just answer "the information is not provided".

If there are multiple object (for example abuse1, abuse2 or consequence 1 and consequence 2) create a different answer for each of them.

Generate the output in csv format.

NLP

- Comparison of the old and the new state of the art.
- **Preprocessing** of documents:
 - Lower text
 - Removing punctuation
 - Removing stopwords
 - Tokenizzazione
 - Lemmatization
- Spacy for POS and the creation of 'subject-predicate-object' triples

Results

- The questions are in order of importance
- Quantitative evaluation on the number of total responses for each approach
- Manual check of the existence of reposts in documents.

Question	Answer
What is the legal outcome of Case?	
Which legal case is associated with Violation?	
What is the legal status?	
How much in legal damages and costs were awarded?	
Which court judged the Case?	
What is the reason stated for the judgment?	
What is the context of Abuse?	:Context1
What are the consequences of Abuse?	:Consequence1
What is the duration and frequency of Abuse?	
What is the severity level of Abuse?	
Which legal article are violated?	
What abuse is related to Judgment?	
What are the damages related to Judgment?	

Results	Full-text	Sub-part
Which legal case is associated with Violation?	3	4
What is the legal outcome of Case?	4	4
What is the reason stated for the judgment?	4	2
What abuse is related to Judgment?	5	4
What is the severity level of Abuse?	2	2
What is the duration and frequency of Abuse?	3	2
Which legal articles are violated?	4	4
What is the context of Abuse?	5	4
Which court judged the Case?	2	1
What are the damages related to Judgment?	1	3
What are the consequences of Abuse?	5	4
How much in legal damages and costs were awarded?	0	4
What is the legal status?	5	3
Total	40/65	37/65

Discussions

Full-text

Pros:

- More information extracted.

Cons:

- More computing time.
- Difficulties in managing tokens.
- Dispersive information.

Sub-part

Pros:

- Computational speed.
- Fewer tokens to manage.
- More detailed information on the affected part.

Cons:

- Less information extracted.
- Need to subdivide the initial document.

NLP

Pros:

- Very huge number of triples compared to LLMs approach.
- Absence of bias in generation.

Cons:

- Loss of semantics if no rules are applied.
- Slower generation process.

Final consideration:

- Full-text for more extracted information.
- Sub-part for more targeted information and ease of computation.
- NLP can be used to support LLM operations.

Another approach

- Generation of CQs via LLM
- Answer to CQs from documents
- Extraction of key concepts from CQs and answers
- Creation of ontology with CQs concepts
- Creating KGs with response concepts

CQs

- 1- What are the governmental entities in the document?
- 2- What are the nongovernmental entities in the document?
- 3- What are the types of abuse mentioned in the document?
- 4- What was the consequence of any abuse suffered by the victim?
- 5- What are the laws and articles mentioned in the document?
- 6- What are the international regulations that protect women's rights in cases of violence?
- 7- What are the legal consequences for victims who do not report the violence they experienced?
- 8- What are the rights of women in cases of stalking or sexual harassment?
- 9- What are the legal rights of victims of sexual violence?
- 10- What governmental or nonprofit organizations offer support services to victims of violence against women?
- 11- How do you interpret the legal principle of due diligence in cases of violence against women?
- 12- What was the judgment?
- 13- Was the ruling made unanimously?

Answer CQ1:::

Concepts CQ1: governmental entities, Ministry of the Interior, Chief Public Prosecutors Office, General Inspectorate, police officers
Relationships CQ1: mentioned

Answer CQ3:::

Concepts CQ3: types of abuse, physical harassment, psychological harassment, stalking, killing
Relationships CQ3: mentioned

Answer CQ5:::

Concepts CQ5: laws, articles, Article 1005 of the Civil Code, Articles 3 and 8 of the Convention, legal principle of due diligence
Relationships CQ5: mentioned

Answer CQ11:::

Concepts CQ11: legal principle, due diligence, violence against women, public authorities, allegations, discrimination
Relationships CQ11: requires

Answer CQ12:::

Concepts CQ12: judgment, respondent authorities, liable, individual officials, measures, protect, victim, violent incidents, Articles 3 and 8 of the Convention
Relationships CQ12: failed to take, in breach of

Answer CQ13:::

Concepts CQ13: ruling, European Court of Human Rights
Relationships CQ13: made by

Limitations

- Hardware limitations for the use of more powerful systems.
- Difficulties for LLMs given the very specific context
- Limitations in abstraction due to the not too familiar domain
- The prompt had to be handled in small instructions otherwise it could not generate the required one.
- Difficult to evaluate qualitatively due to the lack of domain experts

Conclusions and future works



Have domain experts evaluate the results obtained, to have a qualitative review on the outcome, and the CQs.



Increase the number and process documents to enlarge the Knowledge graph, including using a combination with results obtained from NLP techniques.



Use other LLMs than those used (Mixtral 8x22b and GPT 4.o), using weights through a provider such as Hugging Face.



Improve prompting or use other techniques such as Graph Prompting