Gen AI vs. NLP for Legal Entity Extraction

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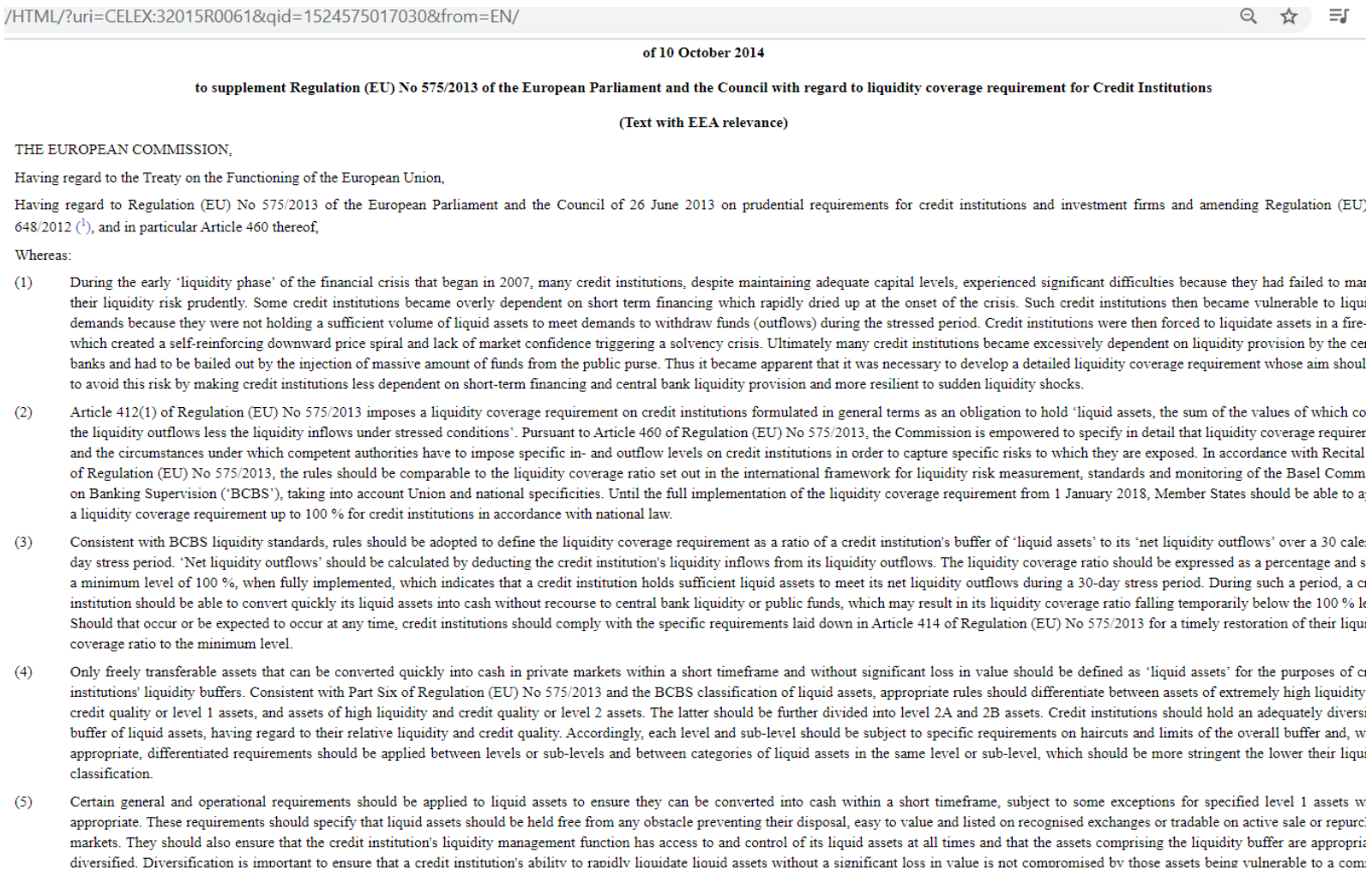
Agenda

- Introduction
- Entities Extraction
- Literature Review
- Approach 1
- Approach 2
- Evaluation
- Result
- Discussion
- Conclusion

Introduction



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of 10 October 2014

to supplement Regulation (EU) No 575/2013 of the European Parliament and the Council with regard to liquidity coverage requirement for Credit Institutions

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) No 575/2013 of the European Parliament and the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) 648/2012 ([1]), and in particular Article 460 thereof,

Whereas:

(1) During the early 'liquidity phase' of the financial crisis that began in 2007, many credit institutions, despite maintaining adequate capital levels, experienced significant difficulties because they had failed to mar their liquidity risk prudently. Some credit institutions became overly dependent on short term financing which rapidly dried up at the onset of the crisis. Such credit institutions then became vulnerable to liqui demands because they were not holding a sufficient volume of liquid assets to meet demands to withdraw funds (outflows) during the stressed period. Credit institutions were then forced to liquidate assets in a fire- which created a self-reinforcing downward price spiral and lack of market confidence triggering a solvency crisis. Ultimately many credit institutions became excessively dependent on liquidity provision by the cer banks and had to be bailed out by the injection of massive amount of funds from the public purse. Thus it became apparent that it was necessary to develop a detailed liquidity coverage requirement whose aim shoul to avoid this risk by making credit institutions less dependent on short-term financing and central bank liquidity provision and more resilient to sudden liquidity shocks.

(2) Article 412(1) of Regulation (EU) No 575/2013 imposes a liquidity coverage requirement on credit institutions formulated in general terms as an obligation to hold 'liquid assets, the sum of the values of which co the liquidity outflows less the liquidity inflows under stressed conditions'. Pursuant to Article 460 of Regulation (EU) No 575/2013, the Commission is empowered to specify in detail that liquidity coverage requirer and the circumstances under which competent authorities have to impose specific in- and outflow levels on credit institutions in order to capture specific risks to which they are exposed. In accordance with Recital of Regulation (EU) No 575/2013, the rules should be comparable to the liquidity coverage ratio set out in the international framework for liquidity risk measurement, standards and monitoring of the Basel Comm on Banking Supervision ('BCBS'), taking into account Union and national specificities. Until the full implementation of the liquidity coverage requirement from 1 January 2018, Member States should be able to a a liquidity coverage requirement up to 100 % for credit institutions in accordance with national law.

(3) Consistent with BCBS liquidity standards, rules should be adopted to define the liquidity coverage requirement as a ratio of a credit institution's buffer of 'liquid assets' to its 'net liquidity outflows' over a 30 cale day stress period. 'Net liquidity outflows' should be calculated by deducting the credit institution's liquidity inflows from its liquidity outflows. The liquidity coverage ratio should be expressed as a percentage and s a minimum level of 100 %, when fully implemented, which indicates that a credit institution holds sufficient liquid assets to meet its net liquidity outflows during a 30-day stress period. During such a period, a cr institution should be able to convert quickly its liquid assets into cash without recourse to central bank liquidity or public funds, which may result in its liquidity coverage ratio falling temporarily below the 100 % le Should that occur or be expected to occur at any time, credit institutions should comply with the specific requirements laid down in Article 414 of Regulation (EU) No 575/2013 for a timely restoration of their liqui coverage ratio to the minimum level.

(4) Only freely transferable assets that can be converted quickly into cash in private markets within a short timeframe and without significant loss in value should be defined as 'liquid assets' for the purposes of cr institutions' liquidity buffers. Consistent with Part Six of Regulation (EU) No 575/2013 and the BCBS classification of liquid assets, appropriate rules should differentiate between assets of extremely high liquidity credit quality or level 1 assets, and assets of high liquidity and credit quality or level 2 assets. The latter should be further divided into level 2A and 2B assets. Credit institutions should hold an adequately diversi buffer of liquid assets, having regard to their relative liquidity and credit quality. Accordingly, each level and sub-level should be subject to specific requirements on haircuts and limits of the overall buffer and, w appropriate, differentiated requirements should be applied between levels or sub-levels and between categories of liquid assets in the same level or sub-level, which should be more stringent the lower their liqui classification.

(5) Certain general and operational requirements should be applied to liquid assets to ensure they can be converted into cash within a short timeframe, subject to some exceptions for specified level 1 assets w appropriate. These requirements should specify that liquid assets should be held free from any obstacle preventing their disposal, easy to value and listed on recognised exchanges or tradable on active sale or repurc markets. They should also ensure that the credit institution's liquidity management function has access to and control of its liquid assets at all times and that the assets comprising the liquidity buffer are appropria diversified. Diversification is important to ensure that a credit institution's ability to rapidly liquidate liquid assets without a significant loss in value is not compromised by those assets being vulnerable to a com

Introduction

- Structure unstructured texts is by converting them to graphical models

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Introduction

- Detecting reporting obligations in text
  - *Who reports what to whom which date*
  - *Addresser reports an actionResult to Addressee by Deadline*

No later than 5 September 2010, the Commission shall submit a report to the European Parliament and to the Council on the issue of the reprocessing of medical devices in the Community.

Introduction

Identify from reporting obligations

- Adresser: Who performs the action.
- Action: What action is performed.
- ActionResult: What is done.
- Addressee: To whom the action is directed.
- Date: When the action occurs/deadline.

Literature Review

- Rule-based vs LLM:
  - [1-3] found rule-based syntactic parsing outperformed LLMs in tasks, such as clinical information extraction, communication and financial chatbot.
- Information Extraction in Legal domain:
  - [4] present an annotated Chinese legal dataset focusing on named entity recognition and relation extraction. They evaluated the performance of fine-tuning using the RoBERTa model.
  - [5] presents LexNLP, a toolkit based on natural language processing, designed to extract entities from legal text.

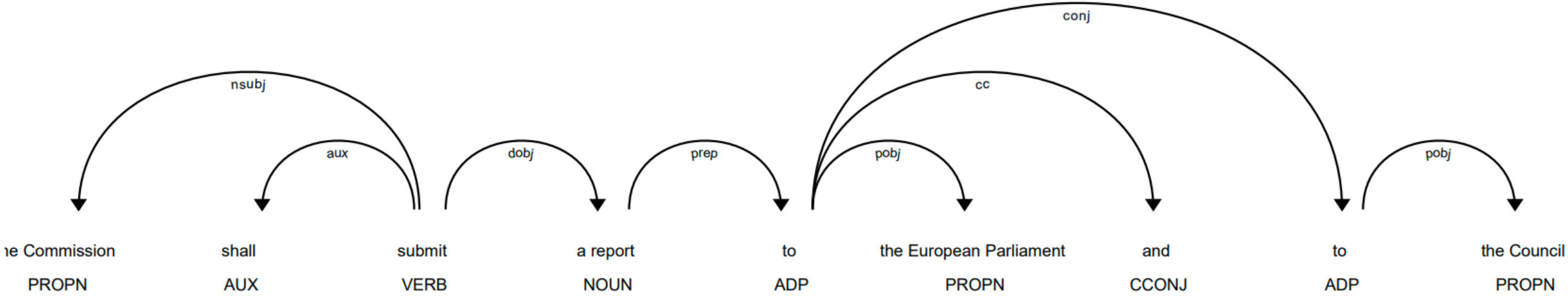
Approach 1: Rule-based NLP Syntactic Parsing

- Standard Name Entity Recognition (NER)
  - Limited to specific entities (country, person, organization)
  - Assume entities to be manifested as single-word terms
    - "Bank" vs. "European Central Bank"
- Approach 1
  - Exploit Rule-based NLP Syntactic Parsing: Dependency Tree (DT), Name Entity Recognition (NER), Part-of-speech (POS).
  - Python, Spacy library, Timexy (NER customization for time detection)

Spacy: https://spacy.io
Timexy: https://pypi.org/project/timexy/

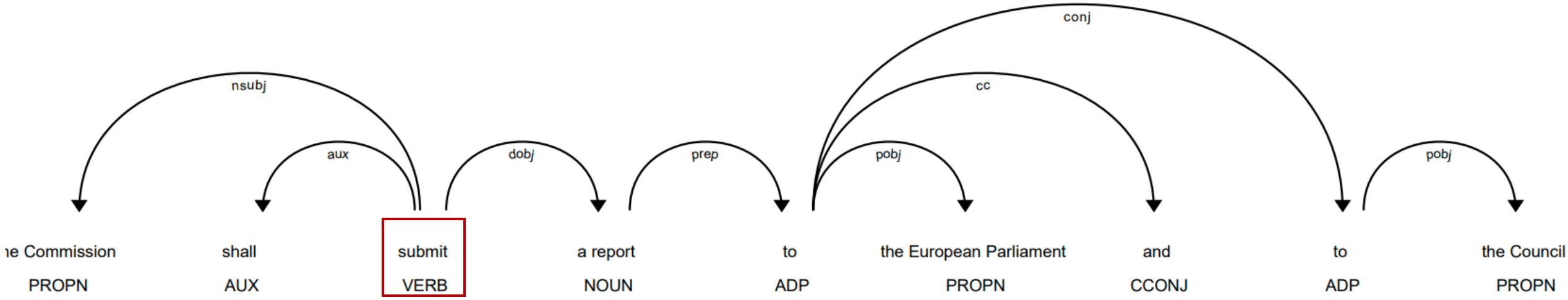
Approach 1: Rule-based NLP Syntactic Parsing

- Use the spacy library to tag the input sentence.
- No later than 5 September 2010, the Commission shall submit a report to the European Parliament and to the Council on the issue of the reprocessing of medical devices in the Community.



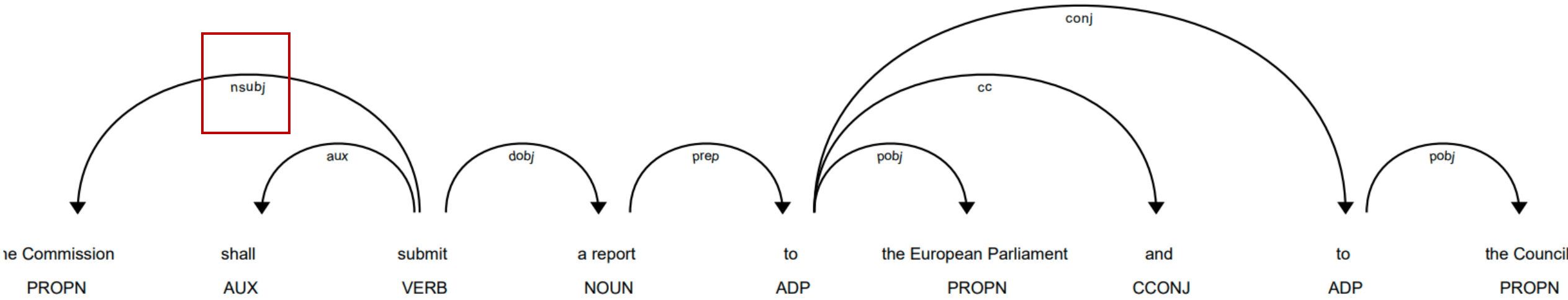
Approach 1: Rule-based NLP Syntactic Parsing

- Parse tree starting from root
- Consider reporting verb (detected earlier) as root



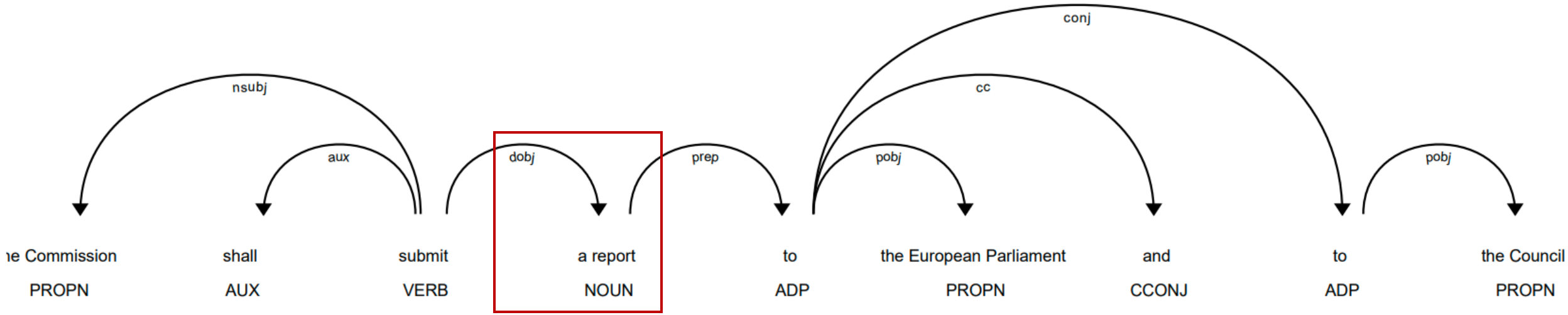
Approach 1: Rule-based NLP Syntactic Parsing

- Addresser *(who)* corresponds to nominative subject (nsubj)



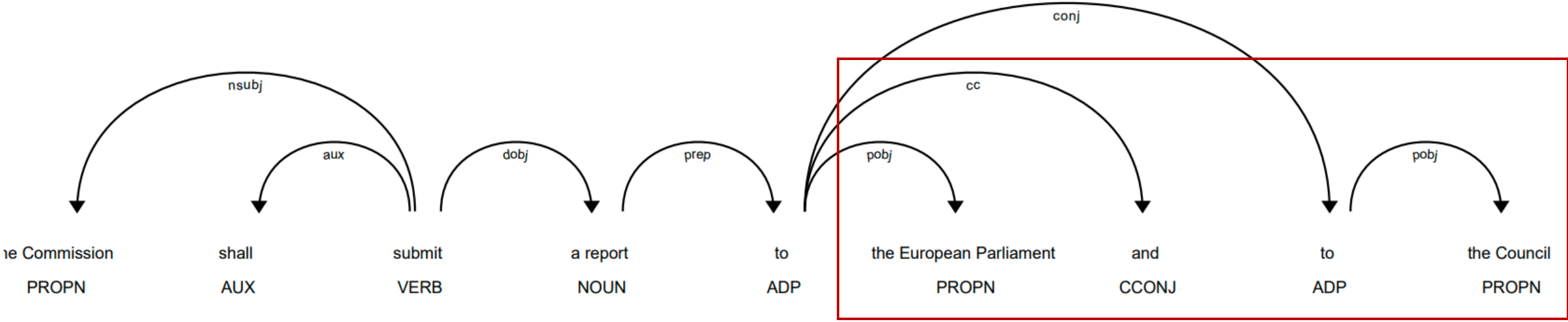
Approach 1: Rule-based NLP Syntactic Parsing

- ActionResult *(what)*
  - Get the token which is dobj (direct object) and is a child of root the syntax tree.



Approach 1: Rule-based NLP Syntactic Parsing

- Addressee (*to whom*)
  - Get the pobj(object of a preposition) which is a child of root the syntax

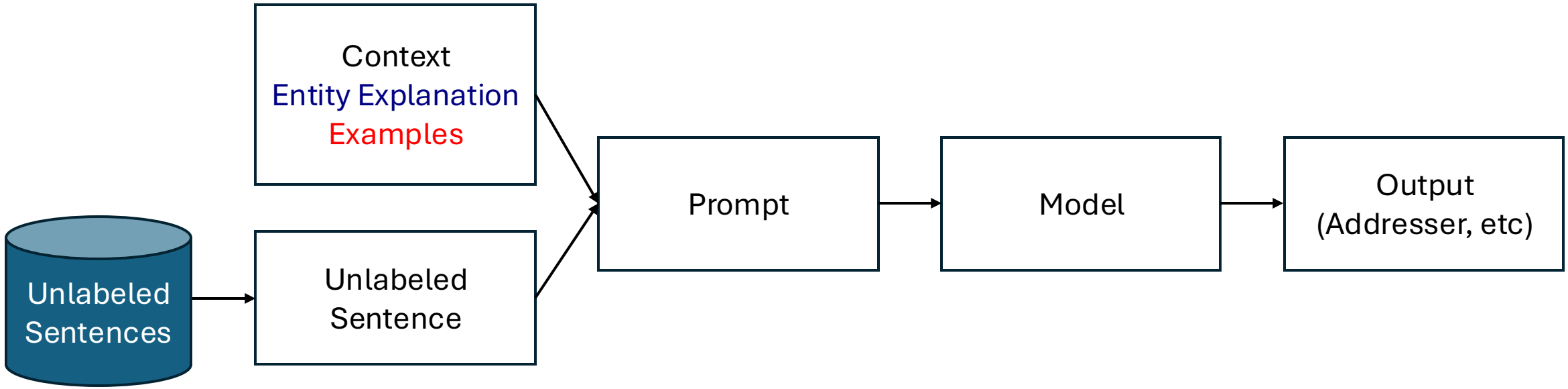


Approach 1: Rule-based NLP Syntactic Parsing

- Date
  - To detect the Date entity, we use the Timexy library to tag all tokens and check each token is a Date or not. If it is a Date we will use it as Date entity.

No	O
Later	O
than	O
5	Date
September	Date
2010,	Date
The	O
Commission	O
shall	O
submit	O

Approach 2: Few-shot prompting



Approach 2: Few-shot prompting

- Model:
  - Llama3-8B-Instruct (Meta)
  - Chatgpt 4o
- Parameter: temperature 0

Approach 2: Few-shot prompting

You are a virtual annotator.
For each sentence, you annotate the addresser, addressee, actionResult, date.
The output should be in Json format. Here are some samples:

Adresser: Who performs the action.
Action: What action is performed.
ActionResult: What is done.
Addressee: To whom the action is directed.
Date: When the action occurs/deadline.

Approach 2: Few-shot prompting

Sentence: By 31 December 2010 and, thereafter, at least every three years, the Commission shall review the provisions concerning its implementing powers and present a report to the European Parliament and to the Council on the functioning of those powers.

{
"addresser": ["the commission"],
"Action": ["present“],
"ActionResult": ["a report on the functioning of those powers“],
"addressee": ["the european parliament", "the council"],
"Date": ["By 31 December 2010“]
}

Approach 2: Few-shot prompting

Example Result

- *Sentence: By 5 September 2010, the Commission shall report on the operation of this Directive to the European Parliament and the Council.*

Output:

```
{
"addresser": ["the commission"],
"Action": [" report “],
"ActionResult": [" the operation of this Directive “],
"addressee": ["the european parliament", "the council"],
"Date": ["By 5 September 2010 “]
}
```

Evaluation

- Eur-lex Dataset
- Use this method to annotate 257 sentences and manually verify them.
- Use F1-score metric.

Eur-lex Dataset: https://eur-lex.europa.eu/homepage.html

Results

Entity	RBSDP	Llama3 8B	ChatGPT-4o
Addresser	0.34	0.63	**0.70**
Action	0.62	**0.98**	0.84
Addressee	0.12	**0.76**	0.67
ActionResult	0.13	**0.48**	0.27
Date	0.07	0.67	**0.68**

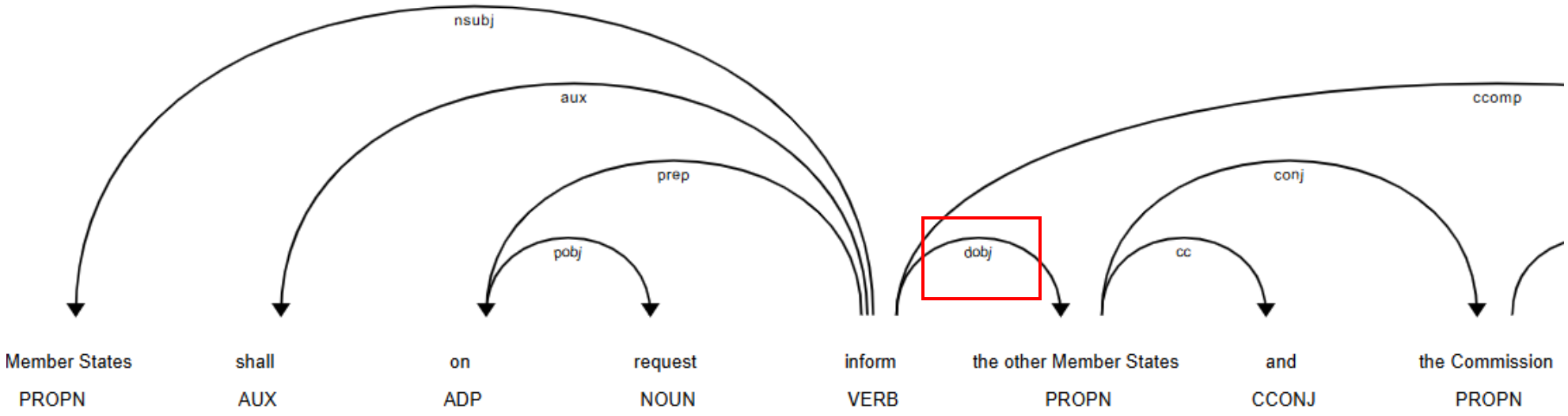
Discussion: Approach 1 Challenges

- Syntactic information unable to extract Date entity
  - No later than 5 September 2010

- Syntactic parsing complex
  - Tree traversal is not generalizable

Discussion: Approach 1 Challenges

- The Member States shall on request inform the other Member States and the Commission of the details referred to in the first subparagraph of paragraph 1 given by the manufacturer or authorised representative."



Discussion: Approach 2 Challenges

- Addresser, Addressee: difficulty distinguishing these entities when it included the conjunction “or”; they consistently treated it as a single entity.
- ActionResult: They were inconsistency due to its lengthy content.
- Date: when the Date includes the conjunction “and”, they consistently treat it as a single entity.
- Action: multiple verbs

Discussion: Approach 2 Challenges

- Hallucination:
  - Chatgpt 4o mistakenly identified an adverb as the Action entity.
  - Trend to create a new

Conclusion

- No complex syntactic parsing
- Flexible, customizable

Conclusion

- But…
  - Blackbox
  - Lack of interpretability & explainability
  - No ability to reason

Conclusion

- Found:
  - Small Language model can outperform Large Language model in this task.
  - Few shot prompting approach could outperform rule-base approach.

Future Work

- Expand Dataset size
- Experiment with other models like Bart, Solar

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Thank you