THE GEORGE WASHINGTON UNIVERSITY
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Data Mining for Entity Relationship Associations

School of Engineering and Applied Science
Department of Computer Science CSCI 6443– Data Mining

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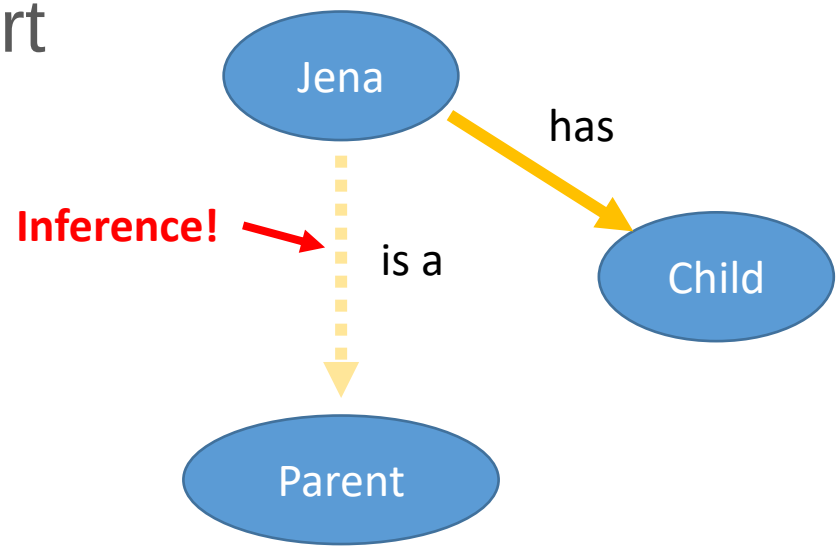
Problem Definition

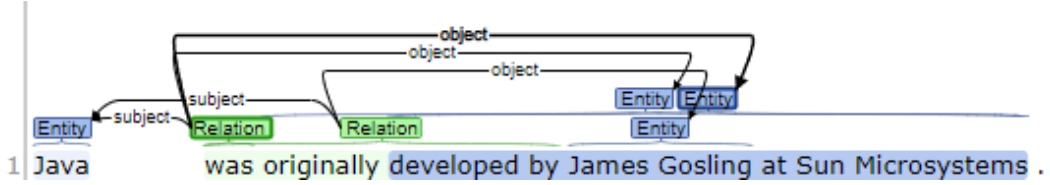
- Many chatbots are a combination of expert systems and machine learning.
- A knowledge base is often used as the “brain” of the chatbot due to its ability to perform inference.
- Traditionally knowledge bases perform inference based on inference rules, which are brittle and don’t scale well.



IF <subject> has Child
THEN <subject> is a Parent

Problem Definition Continued

- Unsupervised learning of entity relationships is difficult and supervised learning datasets are costly to create.
- Performance is subjective and language dependent.
- State-of-the-art NLP algorithms struggle to perform Relationship Extraction (RE) with the precision and recall of a person.



https://corenlp.run/

Related Work

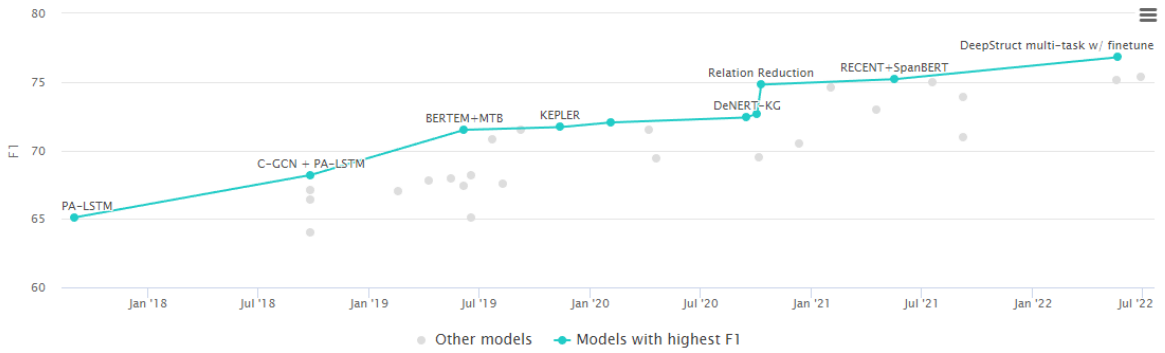
- Datasets (not all are free):
  - https://paperswithcode.com/datasets?task=relation-extraction
- Papers:
  - https://paperswithcode.com/task/relation-extraction#papers-list
- Notable Algorithms Types:
  - Long Short-term Memory (LSTM)
  - Graph Convolutional Neural Network (GCN)
  - Transformers

Trend	Dataset	Best Model	Paper	Code	Compare
	DocRED	KD-Rb-l			See all
	TACRED	DeepStruct multi-task w/ finetune			See all
	ACE 2005	PL-Marker			See all
	NYT	DeepStruct multi-task			See all

Relation Extraction on TACRED

Leaderboard Dataset

View F1 by Date for All models

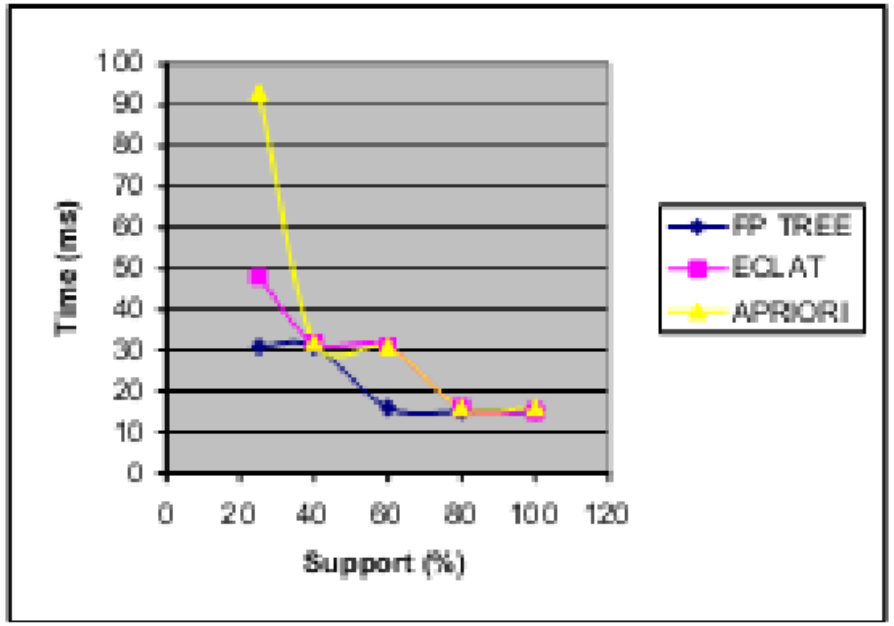


https://paperswithcode.com/task/relation-extraction

Related Work Continued

- After RE, associations between relations occurs.
- Leading association algorithms are:
  - Apriori
  - FP Growth
  - Eclat

Figure 1. Comparison of Apriori, Eclat and FP Growth algorithm on artificial dataset.



https://research.ijcaonline.org/volume69/number25/pxc3888502.pdf

Proposed Approach

- Text already mined and transforming to JSON files

kaggle

Text Dataset

- Zipped text moved to AWS cloud environment
- This allows servers to access as needed with higher download speeds

Amazon Simple Storage Service (Amazon S3)

- Download data
- Unzip
- Split into manageable data message sizes
- Publish text to queue

Amazon Elastic Compute Cloud (Amazon EC2)

- High performance queue
- Allows consuming service to be parallel by ensuring only one consumer gets each message

Amazon Simple Queue Service (Amazon SQS)

- Perform Relation Extraction (RE) to convert unstructured data to structured data
- Write to DB

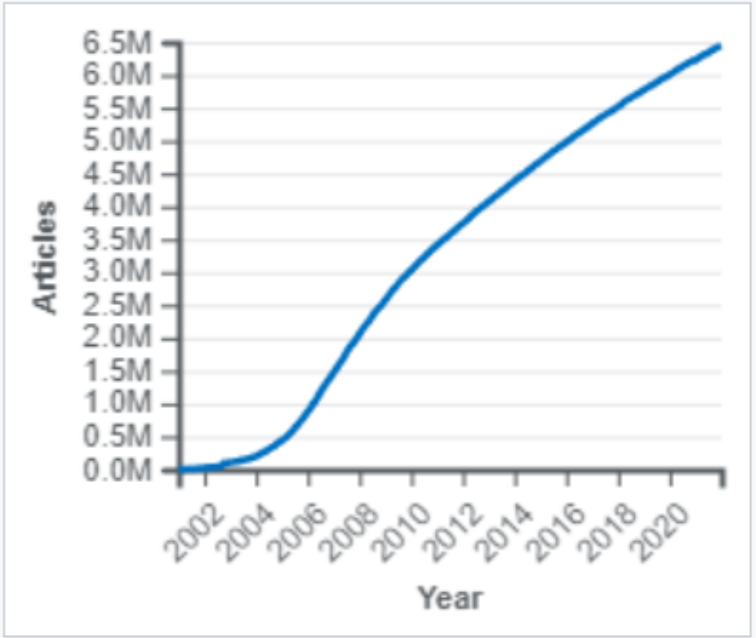
Amazon Elastic Compute Cloud (Amazon EC2)

- Clean, Transform, and Filter Structured Data
- DB Scans and Queries
- Apply FP Growth

Amazon Neptune

Selected Dataset

- Wikipedia
- 6.5M+ English articles as of 2022
- 10TB of data as of 2015
  - https://dumps.wikimedia.org/enwiki/latest/
  - https://www.kaggle.com/datasets/ltcmdrdata/plain-text-wikipedia-202011
  - https://github.com/daveshap/PlainTextWikipedia



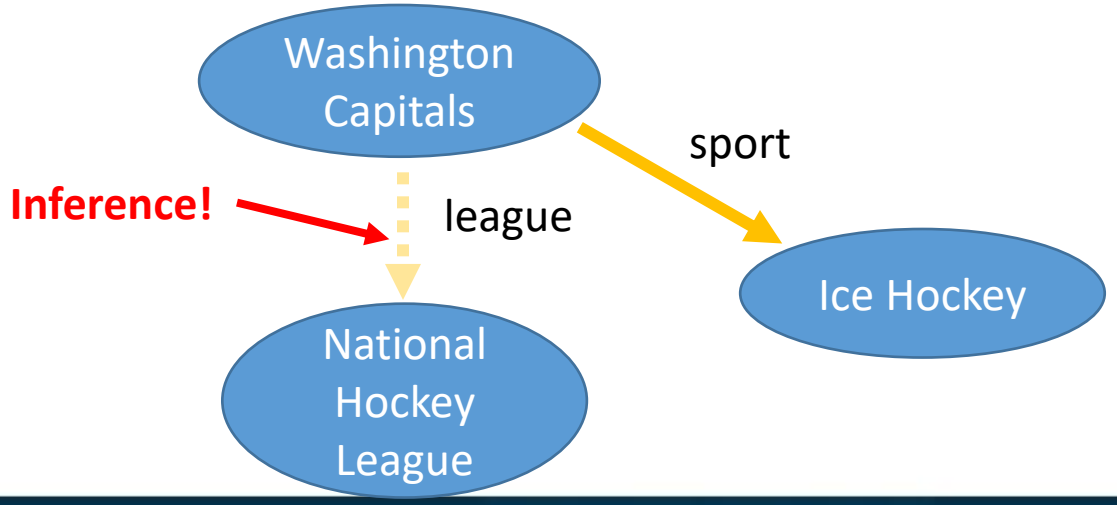
Number of English Wikipedia articles[5]

https://en.wikipedia.org/wiki/Wikipedia:Size_of_Wikipedia

Current Progress

Some early associations

support	itemsets
0.002395	(league Southern Conference, member of SEC)
0.002395	(sport ice hockey, league National Hockey League)



Date: October 2022

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Estimated Total $13.50

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Name	Instance ID	Instance state	Instance type
Article Queue Worker	i-091ebaa6da955fdaa	Terminated	t2.large
Relation Extraction Worker	i-0ab1850889ef24422	Running	c5.xlarge
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Relation Extraction Worker	i-0d9e48489f40dcf72	Running	c5.xlarge
Relation Extraction Worker	i-0bf6d65705a462b48	Running	c5.xlarge
Relation Extraction Worker	i-0915356135ede0d01	Running	c5.xlarge
Relation Extraction Worker	i-0ca912cea7d0f9f5b	Running	c5.xlarge
Relation Extraction Worker	i-0f543502e49154966	Running	c5.xlarge
Relation Extraction Worker	i-06771b02375ff6f29	Running	c5.xlarge
Relation Extraction Worker	i-0ca674c2d2d2d77f6	Running	c5.xlarge
Relation Extraction Worker	i-09daf15fce53d4b36	Running	c5.xlarge

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