DEIM 2019 G7- 5

A Scheme for Factoid Question Answering Over Knowledge Base

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Outline

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- Related work
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- Approach
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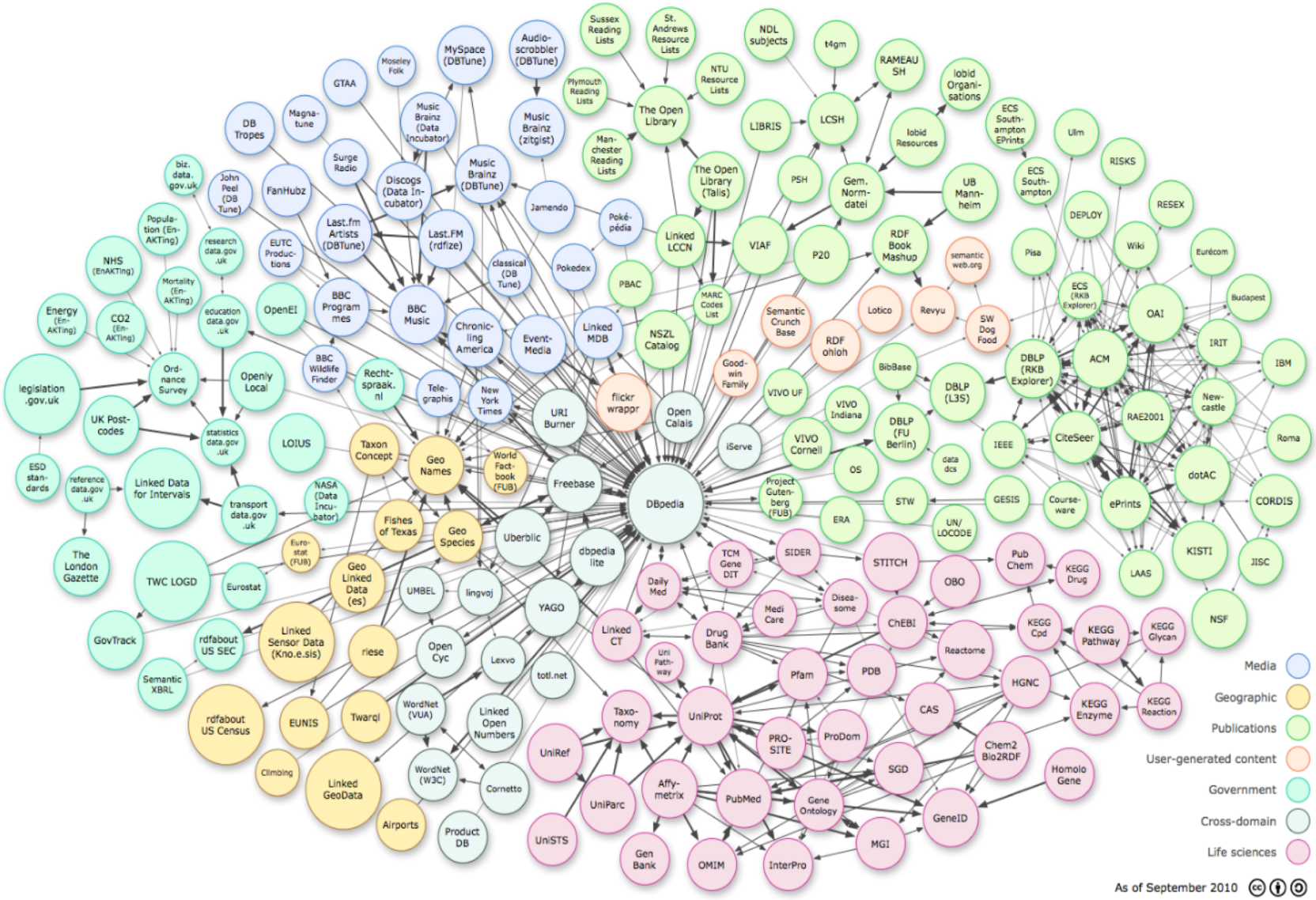
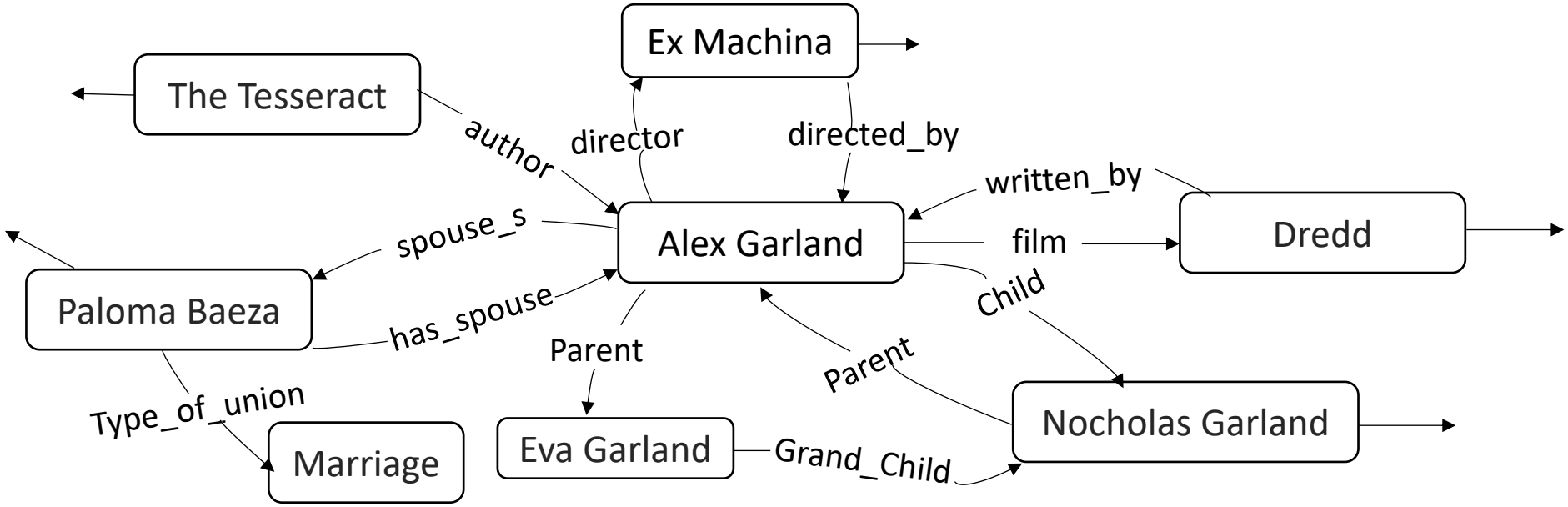
- Conclusion & Future work

Knowledge Bases



RDF_graph

(Subject, Relation, Object)



SPARQL query

```
PREFIX:  <http://bedrock/>
SELECT ?subject ?predicate ?object
WHERE {?subject ?predicate ?object}
```

Out put

Subject	Predicate	Object
Alex Garland	director	Ex Machina
Ex Machina	directed_by	Alex Garland
The Tesseract	author	Alex Garland
Paloma Baeza	has_spouse	Alex Garland

Knowledge base question answering

Ex Machina

British theatrical release poster

Directed by	Alex Garland
Produced by	Andrew Macdonald Allon Reich
Written by	Alex Garland
Starring	Domhnall Gleeson Alicia Vikander Oscar Isaac
Music by	Ben Salisbury Geoff Barrow

What else did the director of the movie Ex Machina direct?

Semantic Parsing

```
select ?y
(  fb:m.0fkf28   fb:object.type      fb:film.film
   fb:m.0fkf28   fb:film.film.directed_by   ?y
   ?x            fb:film.director.film      ?y
   ?y            fb:object.type     fb:film.film )
```

Freebase

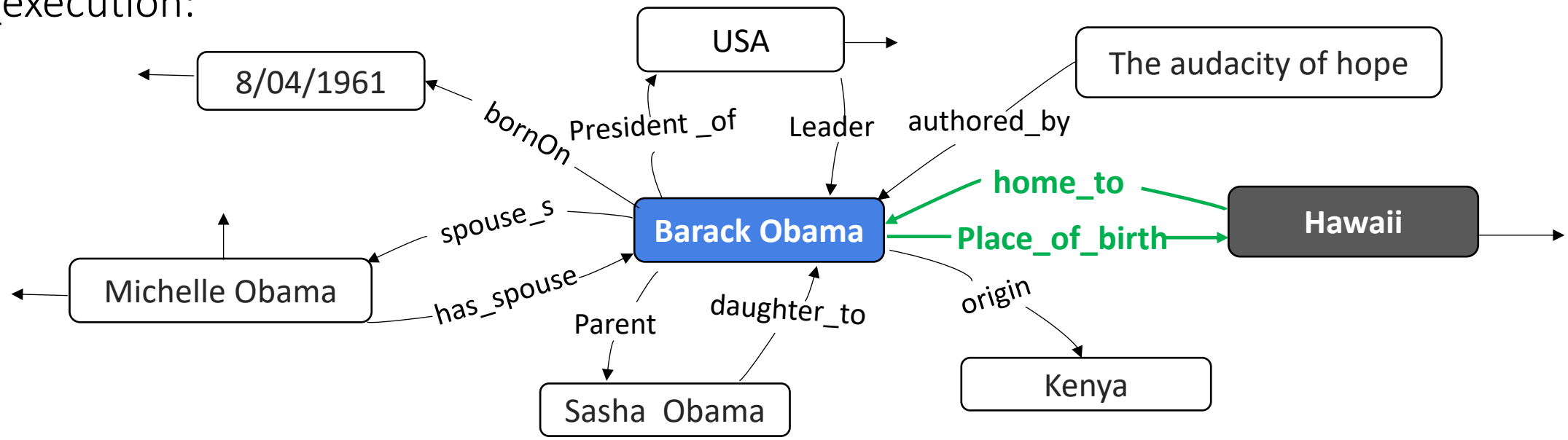
Annihilation 28 Days Later Sunshine
Never let Me Go Dredd

Task definition

Question: Where was Barack Obama born?

Formal definition: 1 – Subject: Barack Obama 1 – Relation: place_of_birth

KB_execution:



Candidate triple: (‘Barack Obama’; ‘place_of_birth’; ‘Hawaii’)

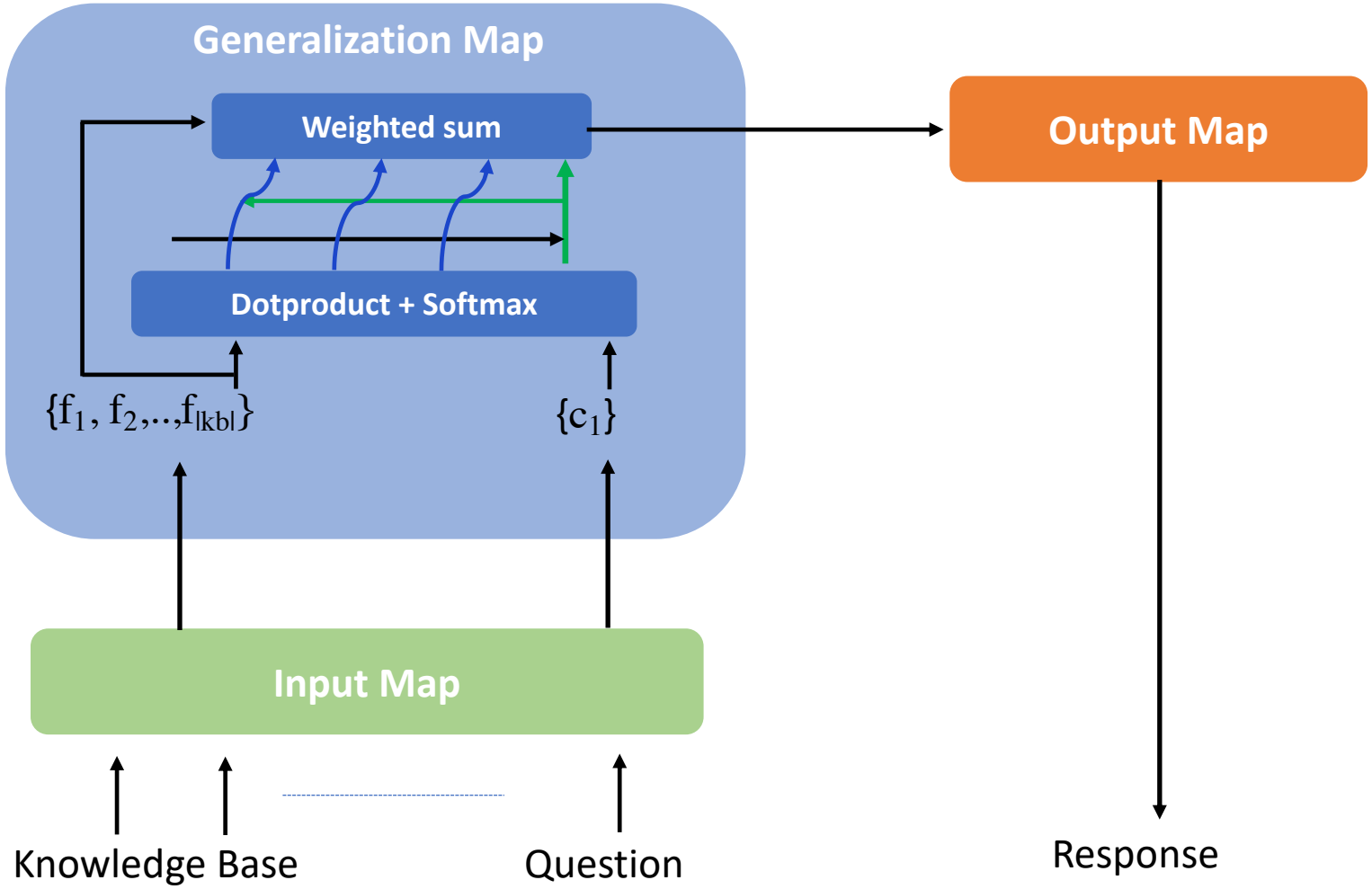
Motivation

Motivation

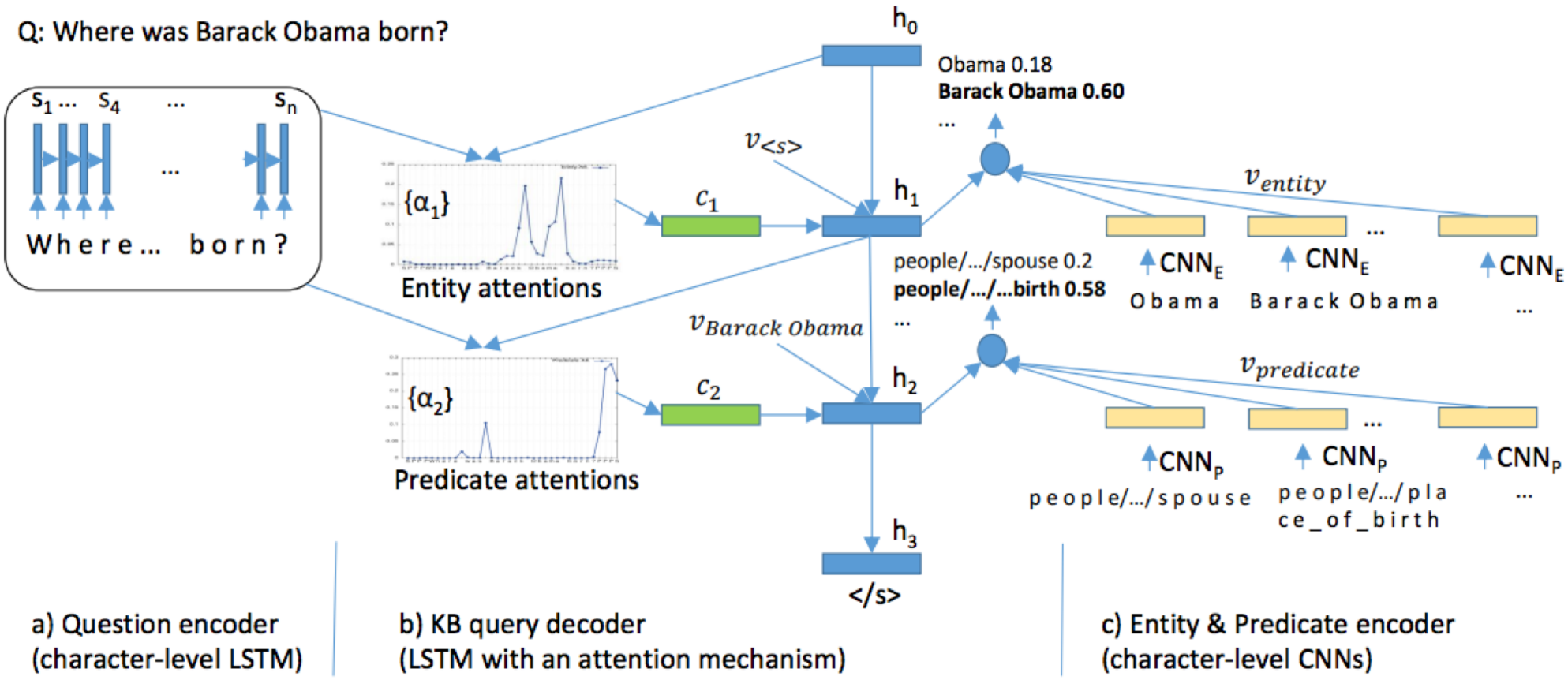
- Simple questions are commonly used in web search, voice assistants, chatbots etc.
- Availability of a large simple questions benchmark of 108, 442 questions.
- The simple questions benchmark is far from being solved with (76.4% state-of-the-art)

Related work

Memory networks (Bodes et al., 2015)

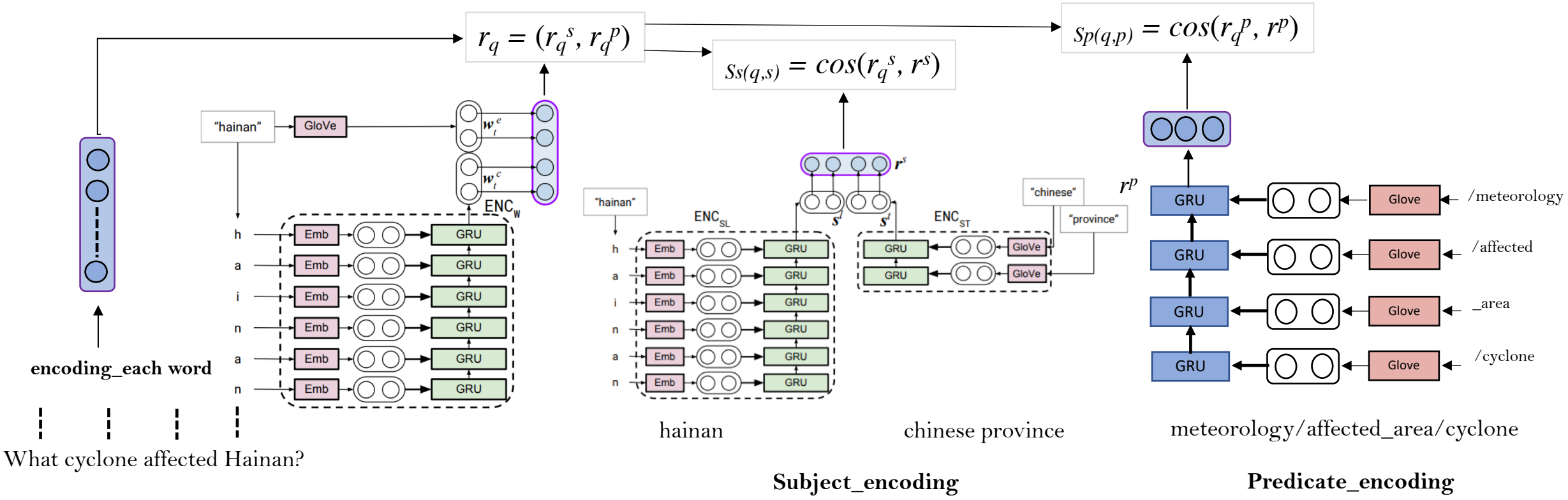


Character-level attention-based Encoder-Decoder (Golub & He, 2016)



Related work

Hierarchical word/char-level Encoder (Lukovinikov et al., 2017)

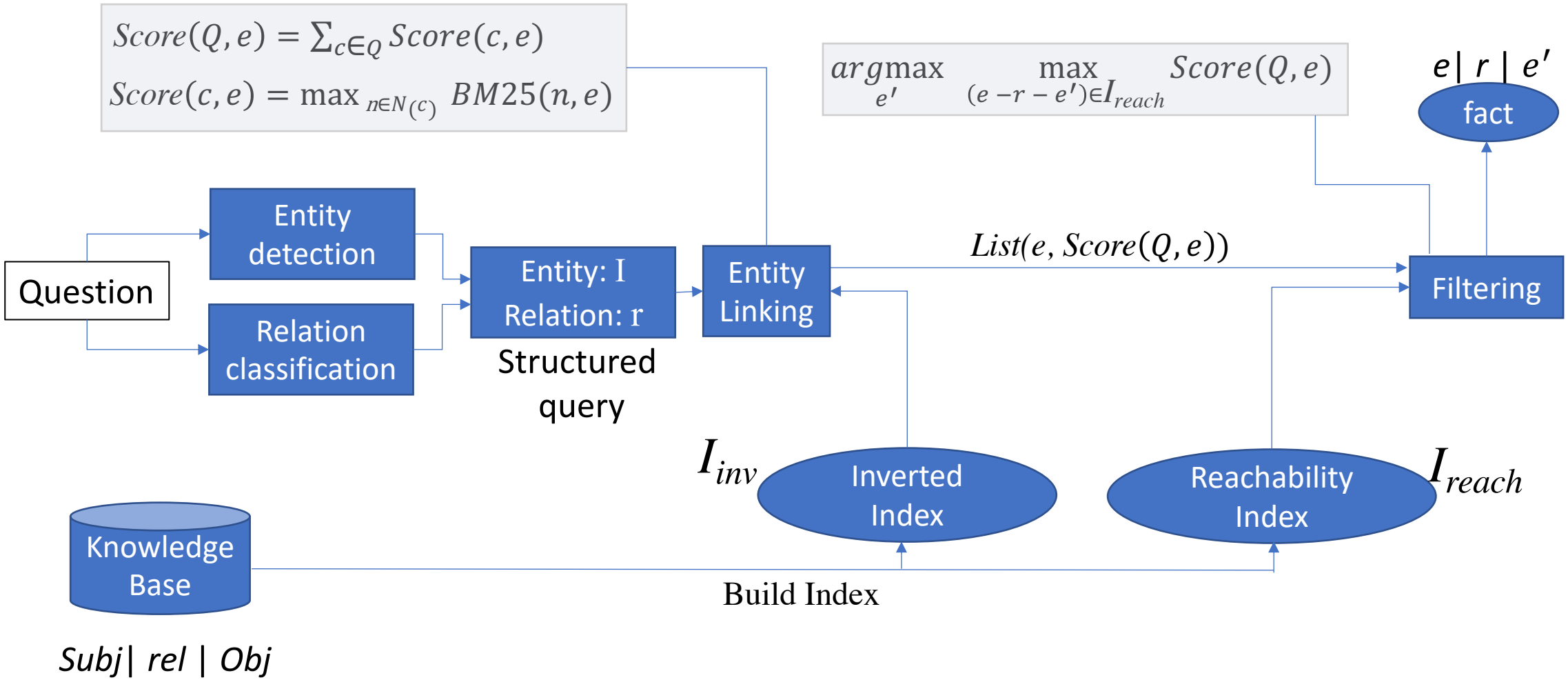


Objective

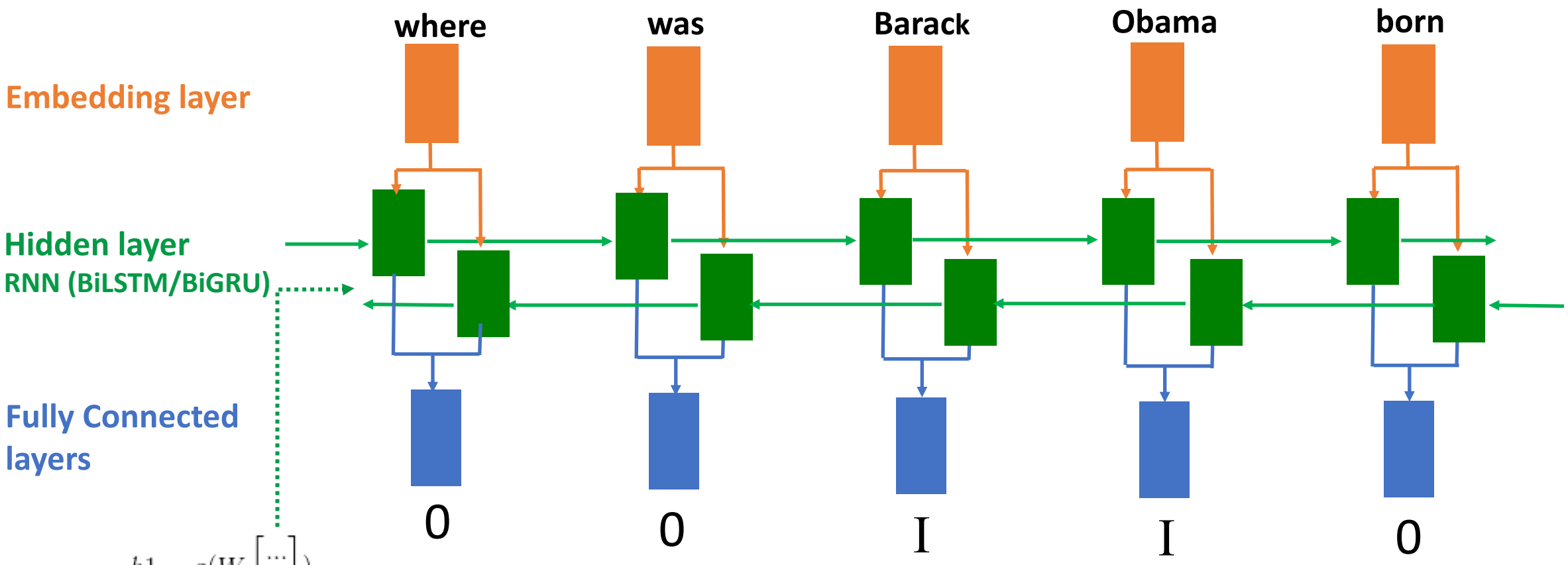
- Examine the necessity of complex models for simple QA
- Explore simple and strong baseline methods that achieve reasonable performance on the simple QA task.

Approach

Proposed Approach



Approach: Entity detection - RNN



Approach: Entity detection - CRF

Conditional Random Field: A conditional sequence model that represents the probability of a hidden state sequence given some observation

Stanford Named Entity Recognizer (NER):

Sequence labels: 4 classes

Person, Organization, Location, not-entity

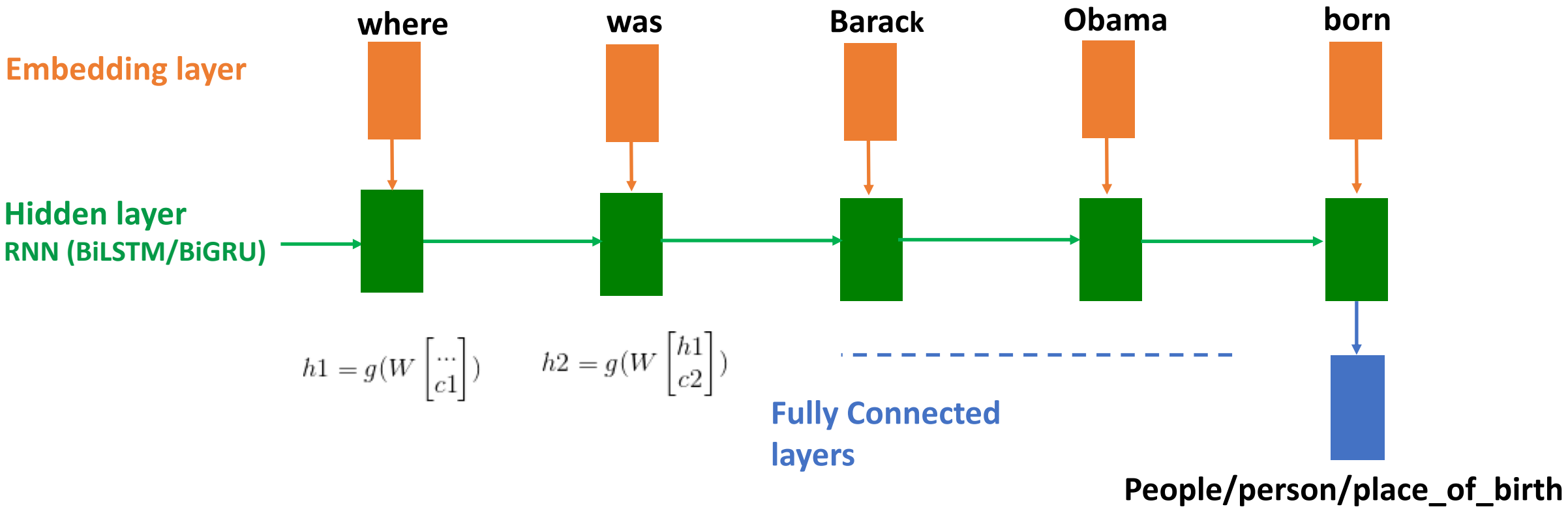
We considered:

Entity : (Person, Organization, Location)

Two Classes : Entity

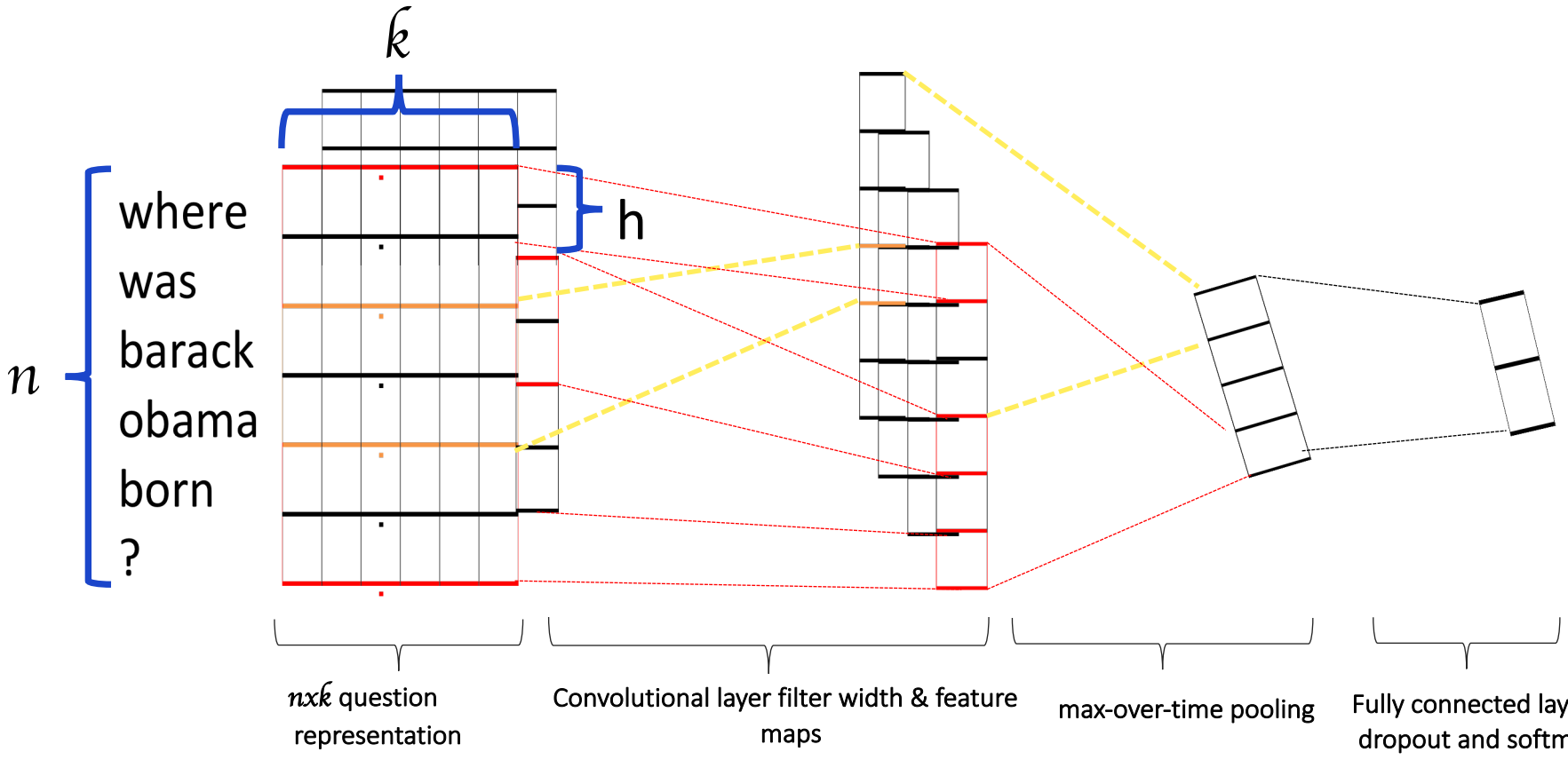
: Non-entity

Approach: Relation Classification - RNN



Approach: Relation Classification - CNN

CNN for sentence classification (Kim et al 2014)



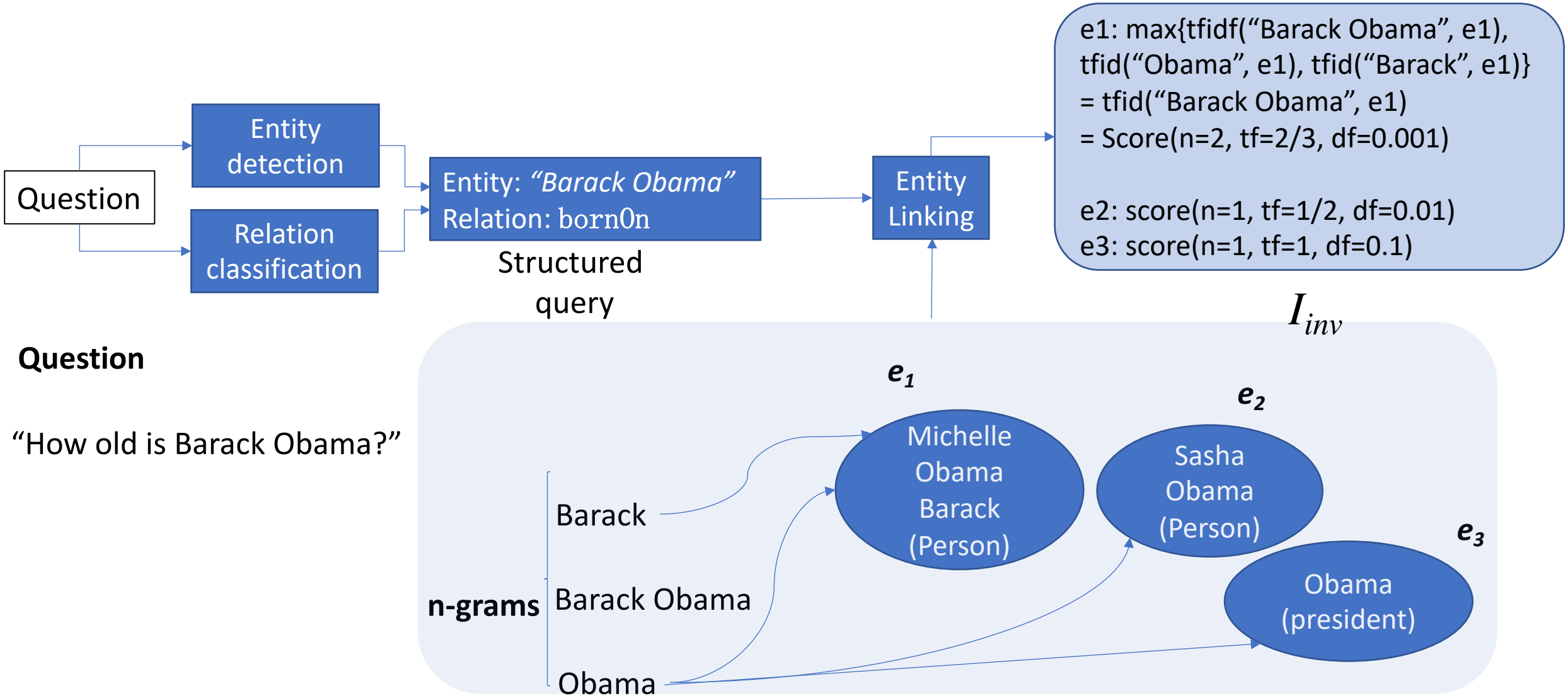
$$x_{1:n} = x_1 \oplus x_2 \oplus \ldots \oplus x_n, \quad (1)$$

$$c_i = f(W.\, x_{i:i+h-1} + b). \quad (2)$$

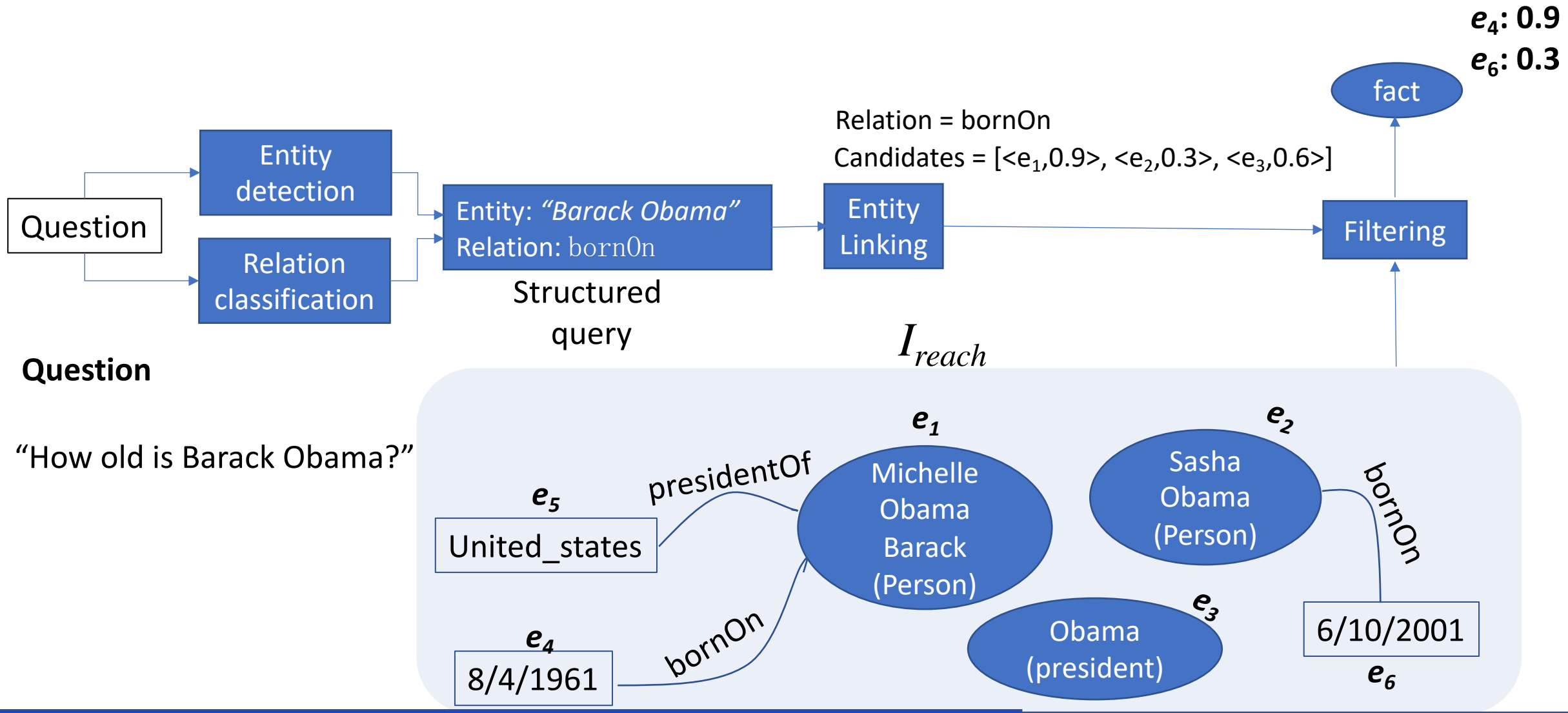
$$\mathbf{c} = [c_1, c_2, \ldots, c_{n-h+1}]. \quad (3)$$

n: question length k: word vector dimension h: word window size

Approach: Entity linking – Creating the Inverted Index



Approach: Entity linking – Creating the Reachability Index



Results

Experimental set up

Table 1: Simple question dataset Statistics

Dataset	Datasplit	Size	Vocabulary_size
Simple question	Total Sample	108,442	6,333
	Training	75,910	
	Validation	10,845	
	Test	21,687	

Table 2: Knowledge base Statistics

Knowledge Base	Item	Total
2M Freebase subset	Entities	2.1M
	Relation	1837
	Tripples	14.1M

Results: Entity detection and linking

Table 3: Entity detection

	GRU		LSTM		CRF	
	Val	Test	Val	Test	Val	Test
Precision(%)	92.56	92.09	91.89	91.08	90.71	90.72
Recall (%)	93	92.92	92.87	91.21	89.92	89.8
F1 (%)	92.78	92.5	92.26	91.53	90.36	90.2

Table 4: Entity linking

R@N	LSTM		CRF	
	Val	Test	Val	Test
1	0.679	0.662	0.663	0.649
5	0.827	0.811	0.809	0.796
20	0.889	0.876	0.871	0.861
50	0.912	0.903	0.895	0.889

Results: Relation Prediction

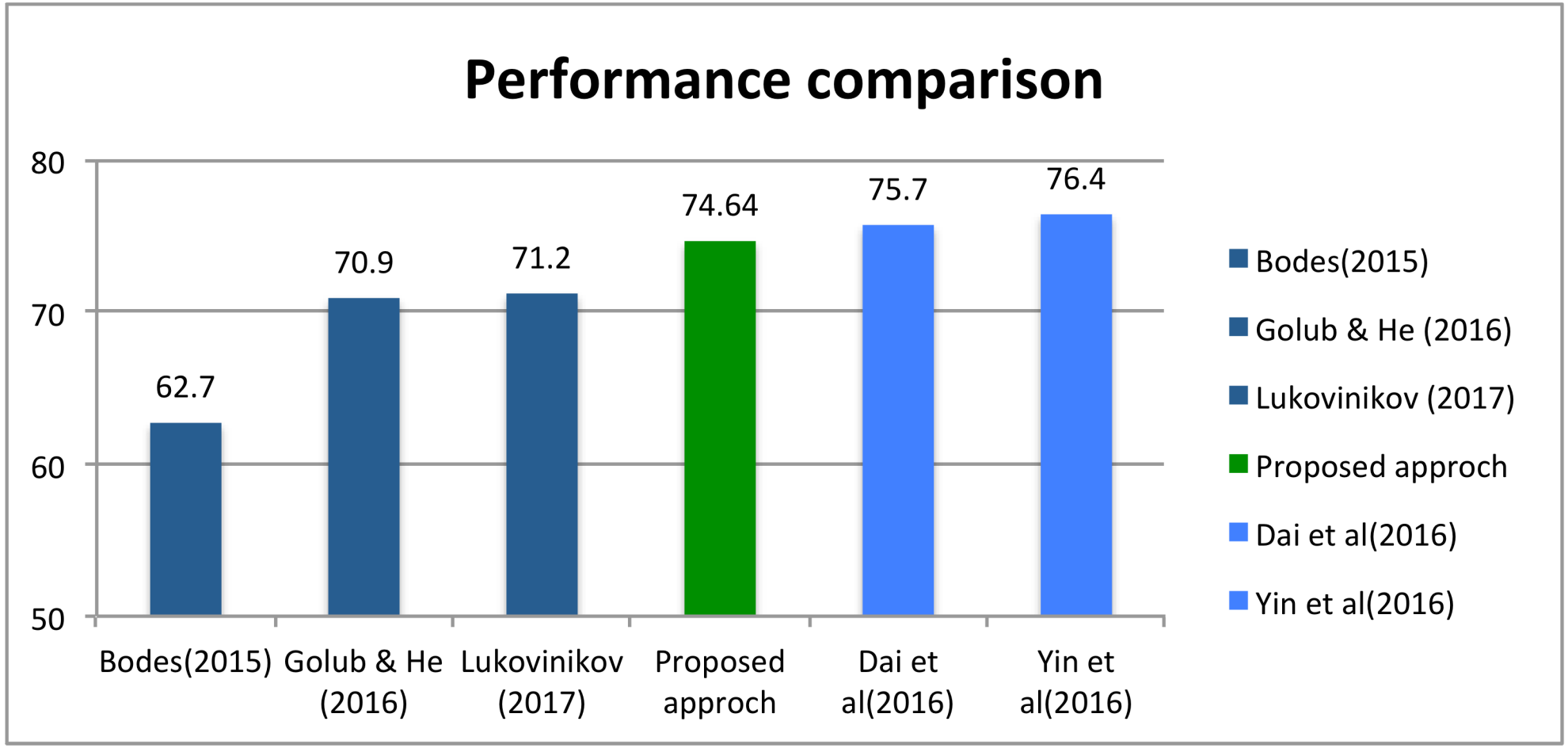
Table 5: Relation Prediction

Precision@N	GRU		CNN	
	Val	Test	Val	Test
1	82.22	81.59	82.88	81.92
3	93.75	93.68	93.75	93.68
5	95.93	95.76	95.86	95.64

Results: End-to-end combination

Entity detection	Relation prediction	Accuracy
BiLSTM	BiGRU	74.64
BiLSTM	CNN	74.63
BiLSTM	BiLSTM	74.59
CRF	CNN	73.42
CRF	BiGRU	73.39
CRF	BiLSTM	73.34

Results: Comparison



Conclusion and Future work.

Conclusion

- We explore simple yet effective approach for Simple question answering
- There is still need to adequately examine simple baselines rigorously before rushing to sophisticated deep learning techniques at least for Simple QA.
- There is need to consider other non-neural network baselines in future
- Consider more complex questions with joint knowledge sources.

Thank you

Time for **human** Question Answering! 😉