

Question Answering

COMP3361 – Week 11

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Many materials from Stanford CS224n and Eunsol Choi, with special thanks!

Question Answering

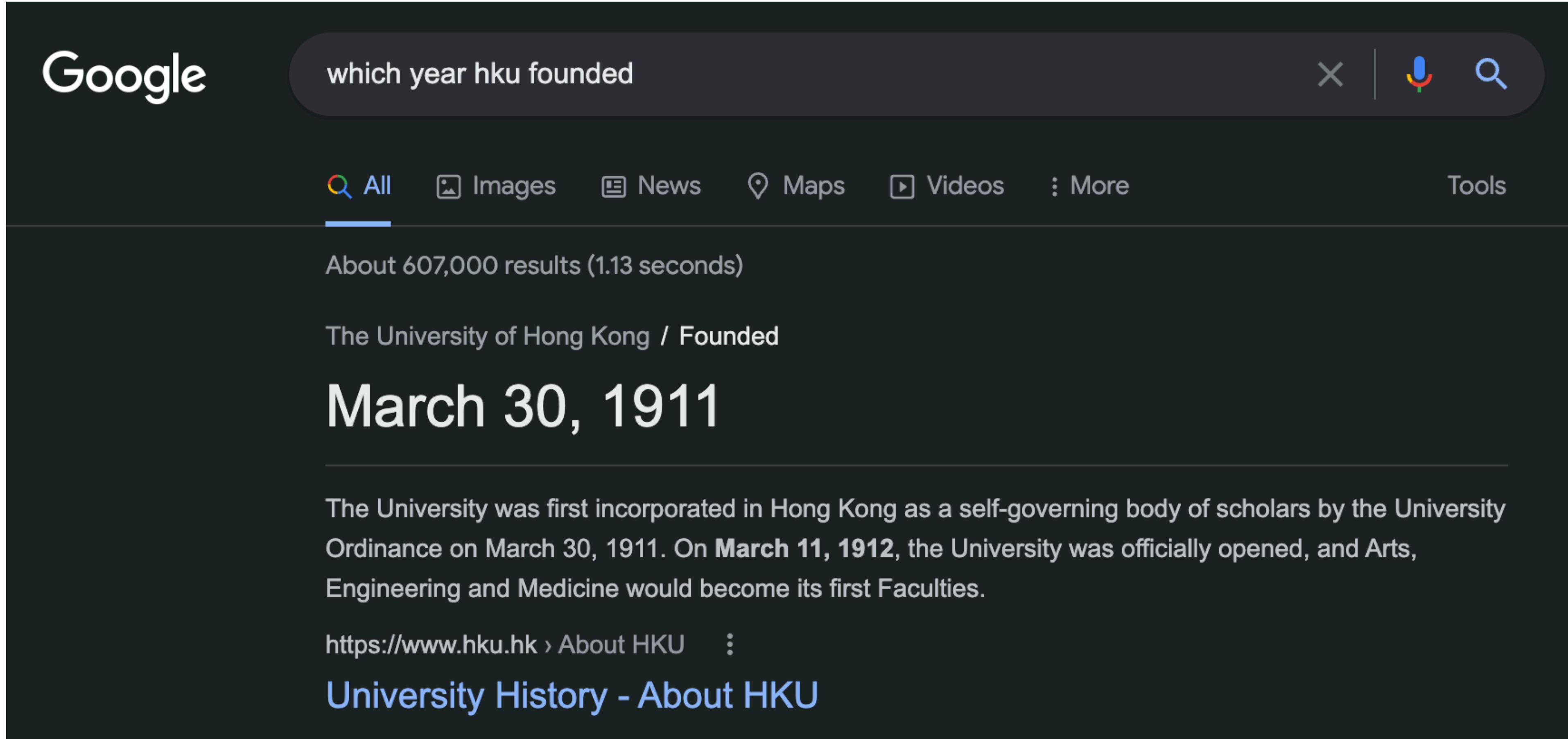


IBM Watson on Jeopardy! 2011

Question Answering is (almost) NLP Complete

- I: Jane went to the hallway.
- I: Mary walked to the bathroom.
- I: Sandra went to the garden.
- I: Daniel went back to the garden.
- I: Sandra took the milk there.
- Q: Where is the milk?
- A: garden
- I: It started boring, but then it got interesting.
- Q: What's the sentiment?
- A: positive
- Q: POS tags?
- A: PRP VBD JJ , CC RB PRP VBD JJ .

Question Answering



A screenshot of a Google search results page. The search query "which year hku founded" is entered in the search bar. Below the search bar, there are navigation links for All, Images, News, Maps, Videos, More, and Tools. A summary states "About 607,000 results (1.13 seconds)". The top result is a snippet from "The University of Hong Kong / Founded" which displays the date "March 30, 1911". A detailed description follows, mentioning the incorporation of the university by the University Ordinance on March 30, 1911, and its official opening on March 11, 1912, with Arts, Engineering, and Medicine becoming its first Faculties. Below this, a link to "University History - About HKU" is provided.

Google which year hku founded X |  

All Images News Maps Videos More Tools

About 607,000 results (1.13 seconds)

The University of Hong Kong / Founded

March 30, 1911

The University was first incorporated in Hong Kong as a self-governing body of scholars by the University Ordinance on March 30, 1911. On **March 11, 1912**, the University was officially opened, and Arts, Engineering and Medicine would become its first Faculties.

<https://www.hku.hk> › About HKU

[University History - About HKU](#)

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<https://www.hku.hk> › About HKU :: University History - About HKU

This is bold.

Snapshot from Google, Nov 15, 2021

Question Answering

The University was first incorporated in Hong Kong as a self-governing body of scholars by the University Ordinance on March 30, 1911.

On March 11, 1912, the University was officially opened, and Arts, Engineering and Medicine would become its first Faculties.

To repeal and replace the University Ordinance 1911.

[1 September 1958] *G.N.A. 54 of 1958*
(Format changes—E.R. 5 of 2021)

1. **Short title**

This Ordinance may be cited as the University of Hong Kong Ordinance.

(Amended 1 of 1968 s. 2)

2. **Interpretation**

(1) In this Ordinance, unless the context otherwise requires—

Chancellor (校監) means the Chancellor of the University and also any person acting as Chancellor of the University by virtue of section 12(3);

Court (校董會), **Council** (校務委員會), **Senate** (教務委員會) and **Convocation** (畢業生議會) respectively mean the Court, the Council, the Senate and Convocation of the University; (Replaced 1 of 1968 s. 3. Amended 80 of 1997 s. 100)

officers (主管人員) and **teachers** (教師) respectively mean the officers and teachers of the University;

Pro-Chancellor (副校監) means the Pro-Chancellor of the University; (Added 1 of 1968 s. 3)

statutes (規程) means the statutes of the University;

University (大學) means the University of Hong Kong;

Vice-Chancellor (校長), **Deputy Vice-Chancellor** (首席副校長), **Pro-Vice-Chancellors** (副校長), **Treasurer** (司庫), **Deans of Faculties** (學院院長), **Registrar** (教務長) and **Librarian** (圖書館館長) respectively mean the Vice-Chancellor, Deputy Vice-Chancellor, Pro-Vice-Chancellors, Treasurer, Deans of Faculties, Registrar and Librarian of the University. (Replaced 22 of 1992 s. 2)

(2) For the purposes of this Ordinance, **good cause** (好的因由), when used with reference to removal from office, membership or place and with reference to such of the members of the University and of the officers and teachers as shall be designated by the Ordinance and statutes, means inability to perform efficiently the duties of the office, neglect of duty, or such misconduct, whether in an official or a private capacity, as renders the holder unfit to continue in office. (Amended 66 of 1988 s. 2; E.R. 5 of 2021)

QA evaluates machines' understanding

incorporate verb

 Save Word

in·cor·po·rate | \ in-'kör-pə-rāt \

incorporated; incorporating

Definition of *incorporate* (Entry 1 of 2)

transitive verb

1 a : to unite or work into something already existent so as to form an indistinguishable whole

b : to blend or combine thoroughly

2 a : to form into a legal corporation

b : to admit to membership in a corporate body

3 : to give material form to : [EMBODY](#)

intransitive verb

1 : to unite in or as one body

2 : to form or become a corporation

ordinance noun

 Save Word

or·di·nance | \ 'örd-nən(t)s \ , 'ör-də-nən(t)s \

Definition of *ordinance*

1 a : an authoritative decree or direction : [ORDER](#)

// On that day the king signed three *ordinances*.

b : a law set forth by a governmental authority

specifically : a municipal regulation

// A city *ordinance* forbids construction work to start before 8 a.m.

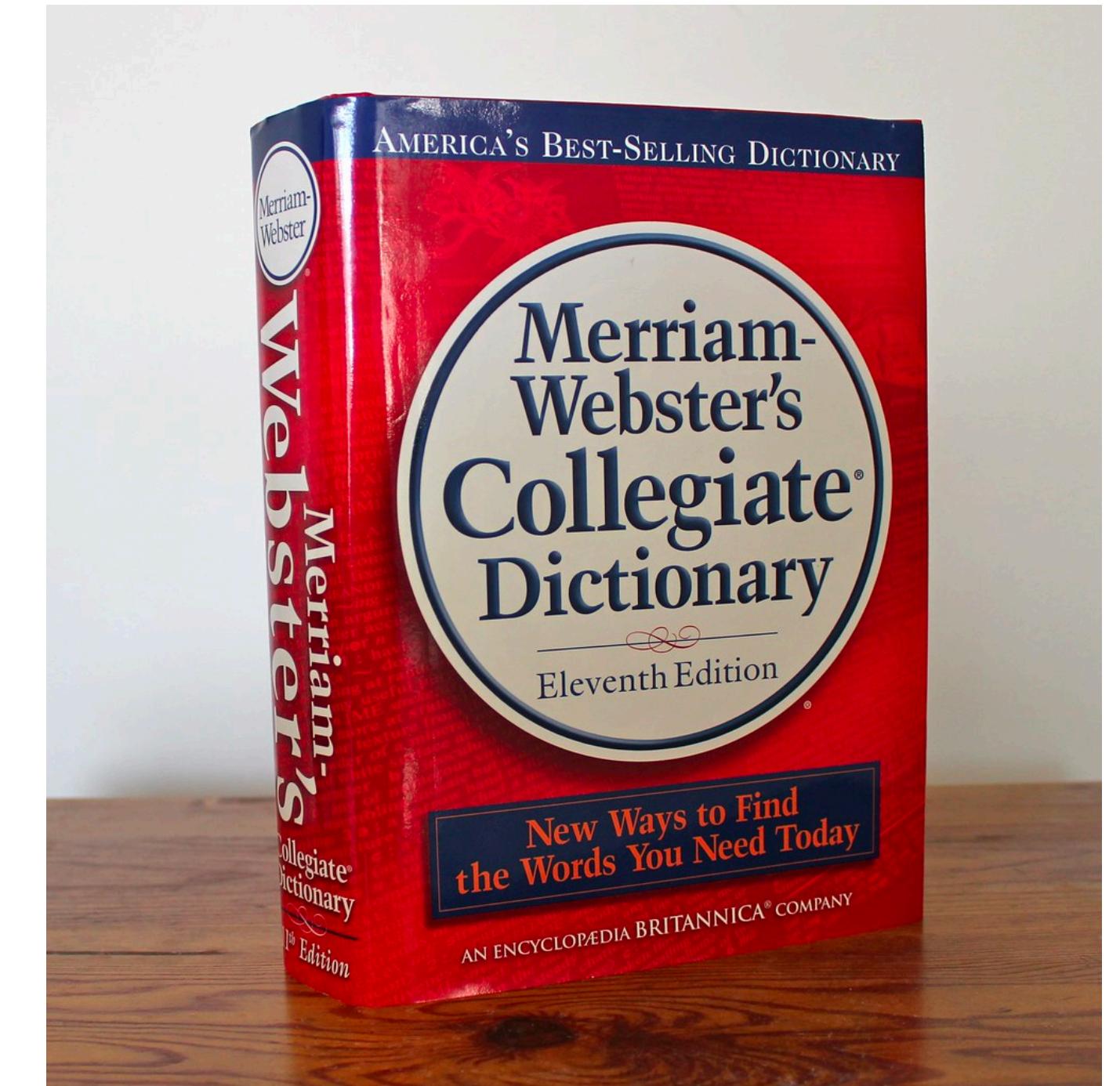
2 : something ordained or decreed by fate or a deity

// Let *ordinance* come as the gods foresay [=foretell] it.

— William Shakespeare

3 : a prescribed usage, practice, or ceremony

// observes the *ordinance* of abstinence during Lent



QA seeks information

Google

what is cadenza in music



All

Images

Videos

News

Shopping

More

Tools

About 8,040,000 results (0.39 seconds)

<https://en.wikipedia.org/wiki/Cadenza> ::

Cadenza - Wikipedia

In music, a **cadenza** is, generically, an improvised or written-out ornamental passage played or sung by a soloist or soloists, usually in a "free" rhythmic ...

[In concerti](#) · [As a vocal flourish](#) · [In jazz](#) · [Notable examples](#)

Cadenza: (Coda:)

Piano

Orch.

v1 v2

sol

More images

Cadenza



In music, a **cadenza** is, generically, an improvised or written-out ornamental passage played or sung by a soloist or soloists, usually in a "free" rhythmic style, and often allowing virtuosic display. During this time the accompaniment will rest, or sustain a note or chord. [Wikipedia](#)

Feedback

“Easy”, “Hard”, “Good”, and “Bad” Questions

To be, or not to be, that is the question.

When will COVID-19 disappear?

What were the main causes for World War II?

When did World War III start?

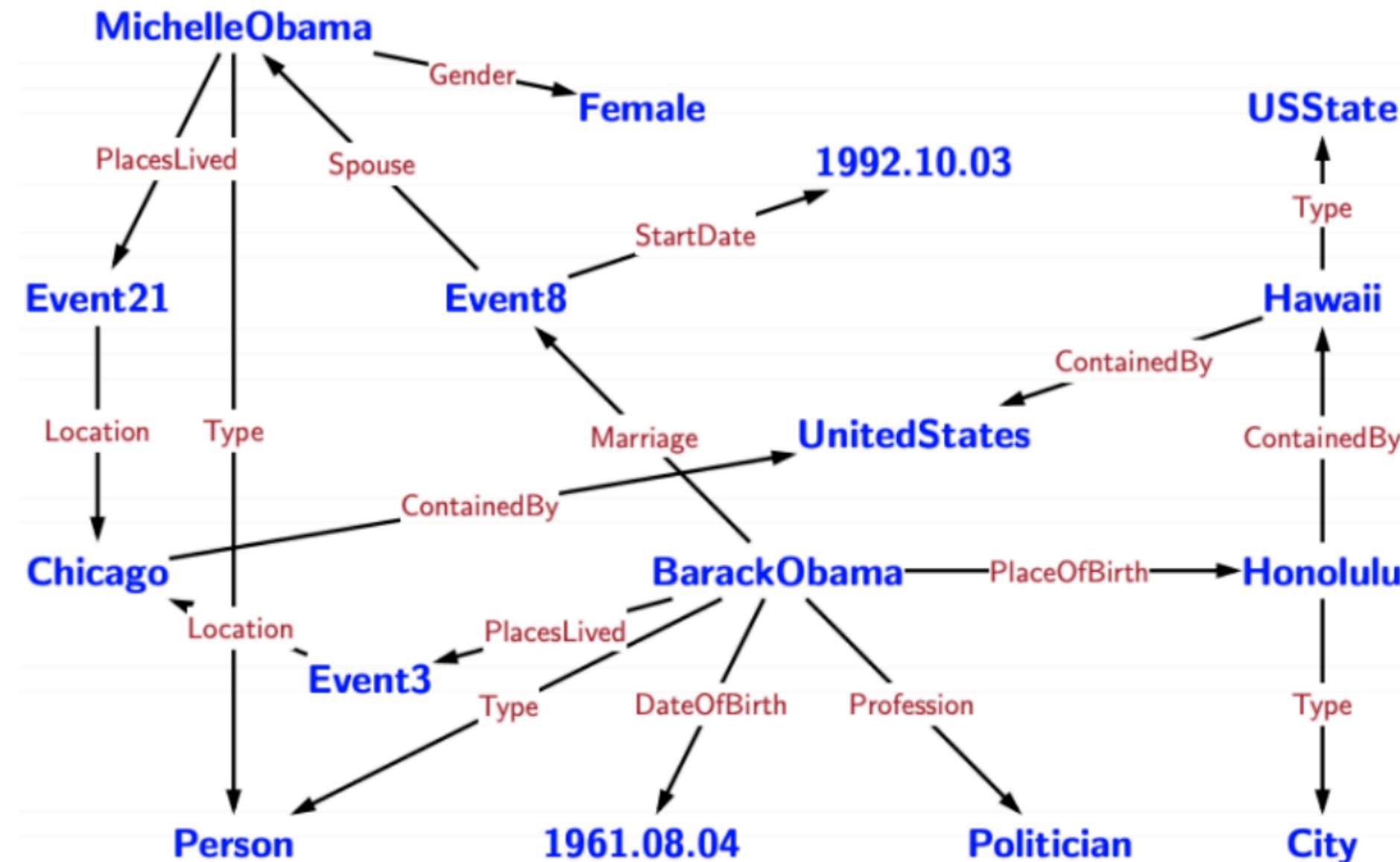
What is the best restaurant in Hong Kong?

Knowledge Based QA

 Freebase™

100M entities (nodes)

1B assertions (edges)



Query Window

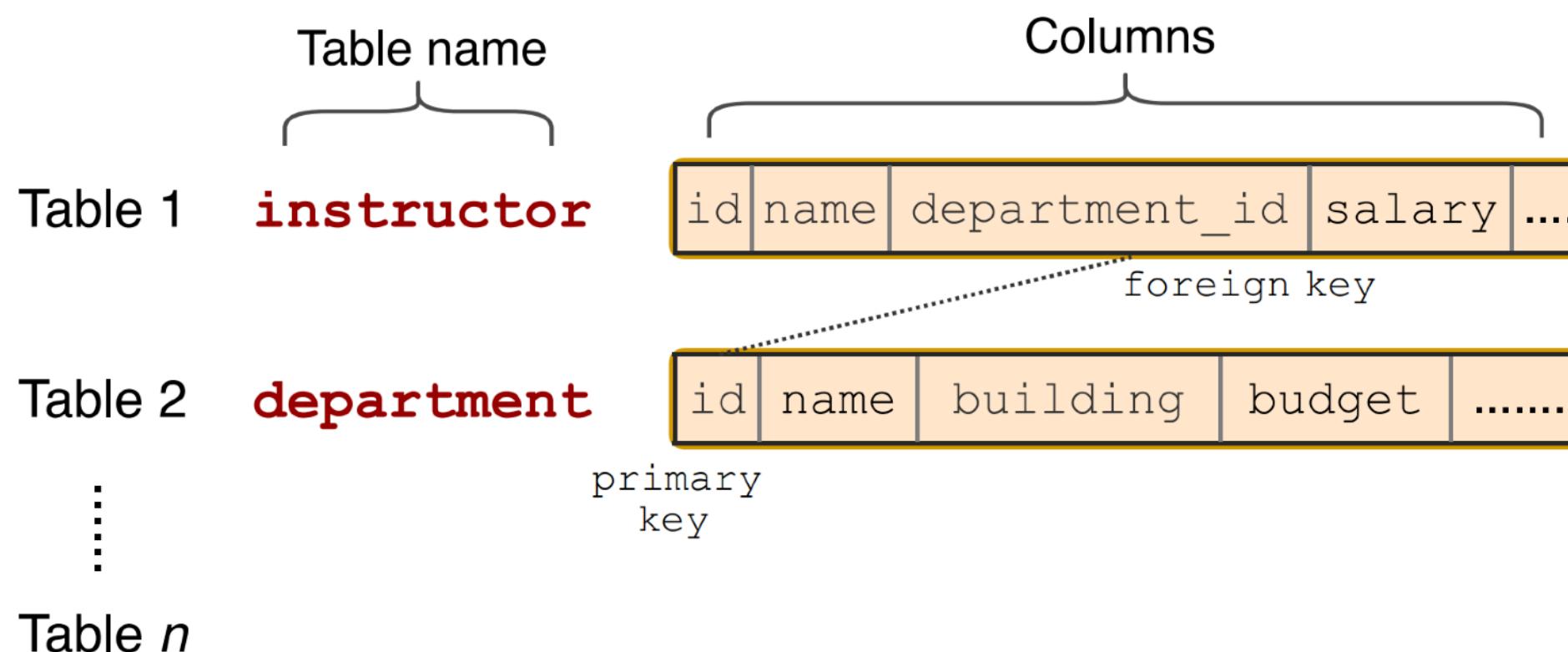
```
?- likes(john, jane). ← dot necessary  
true. ← answer from prolog interpreter  
sign on  
prolog query  
prompt  
variables  
? - friends(X, Y).  
X = john,  
Y = jane ; ← type ; to get next solution  
X = jane,  
Y = john.
```

Prolog (Programming Language), 1972

$$\lambda x. \text{type}(x, \text{LOCATION}) \wedge \text{born_in}(\text{BARACKOBAMA}, x)$$

Natural Language to Structured Query

Annotators check database schema (e.g., database: college)

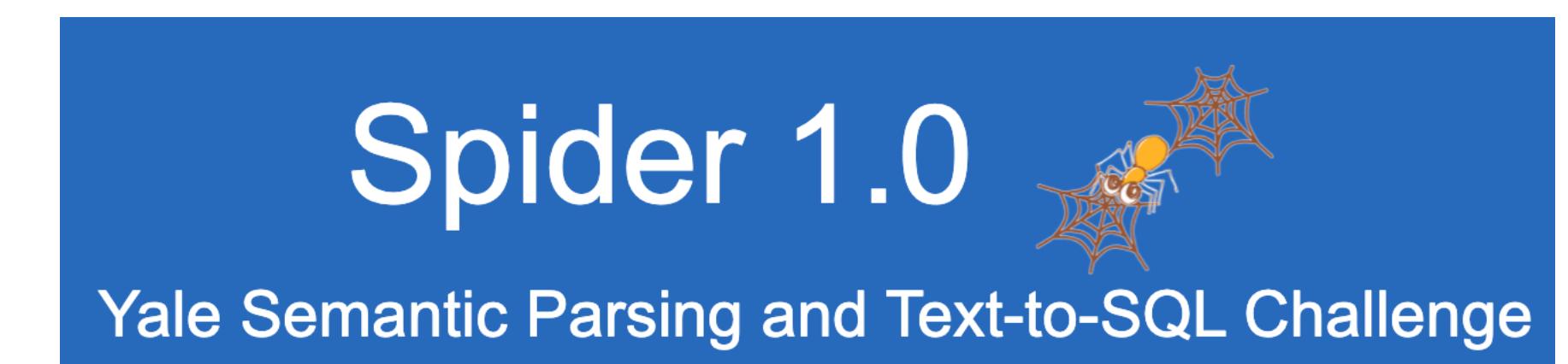


Annotators create:

Complex question What are the name and budget of the departments with average instructor salary greater than the overall average?

Complex SQL

```
SELECT T2.name, T2.budget
FROM instructor as T1 JOIN department as
T2 ON T1.department_id = T2.id
GROUP BY T1.department_id
HAVING avg(T1.salary) >
(SELECT avg(salary) FROM instructor)
```



Yu et al., 2019

SQuAD Task

In meteorology, precipitation is any product of the condensation of atmospheric water vapor that falls under **gravity**. The main forms of precipitation include drizzle, rain, sleet, snow, **graupel** and hail... Precipitation forms as smaller droplets coalesce via collision with other rain drops or ice crystals **within a cloud**. Short, intense periods of rain in scattered locations are called "showers".

What causes precipitation to fall?

gravity

What is another main form of precipitation besides drizzle, rain, snow, sleet and hail?

graupel

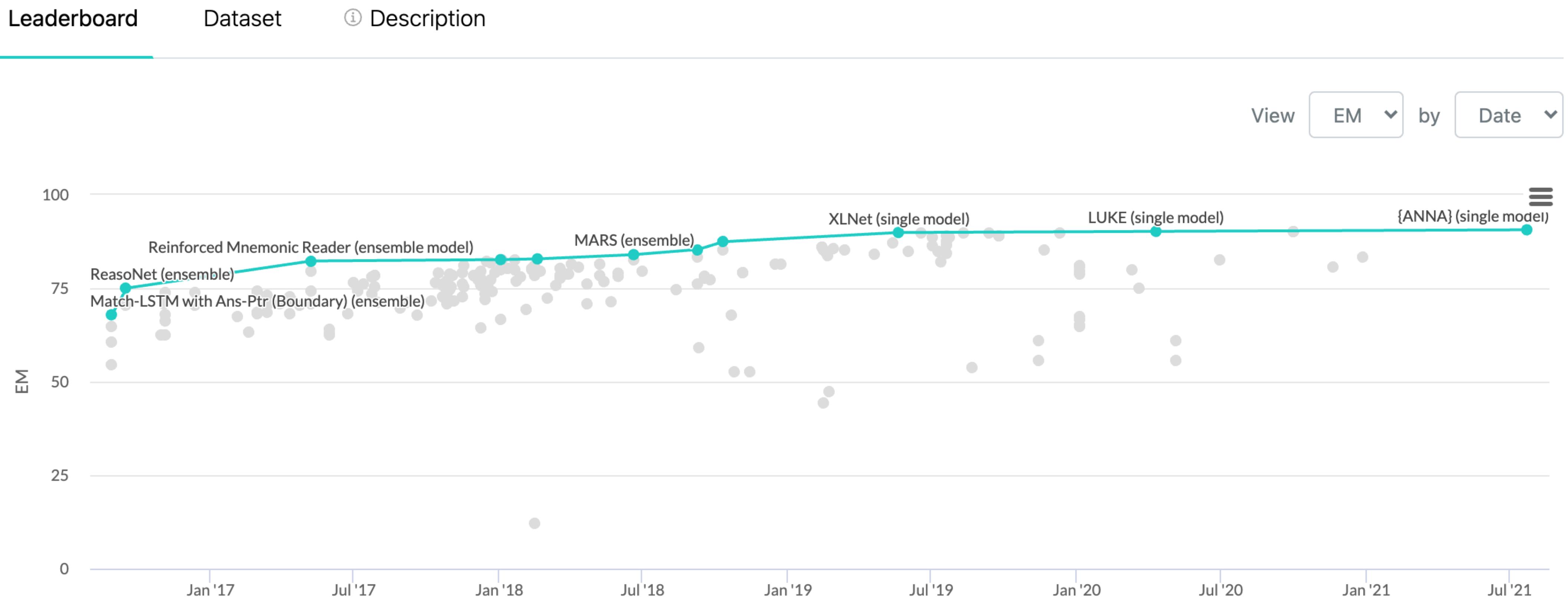
Where do water droplets collide with ice crystals to form precipitation?

within a cloud

100k annotated (passage, question, answer) triples.

Answers are spans in the passage.

SQuAD Leader Board



Rajpurkar et al., 2016

SQuAD 2.0 Task

Article: Endangered Species Act

Paragraph: “*... Other legislation followed, including the Migratory Bird Conservation Act of 1929, a 1937 treaty prohibiting the hunting of right and gray whales, and the Bald Eagle Protection Act of 1940. These later laws had a low cost to society—the species were relatively rare—and little opposition was raised.*”

Question 1: “Which laws faced significant opposition?”

Plausible Answer: *later laws*

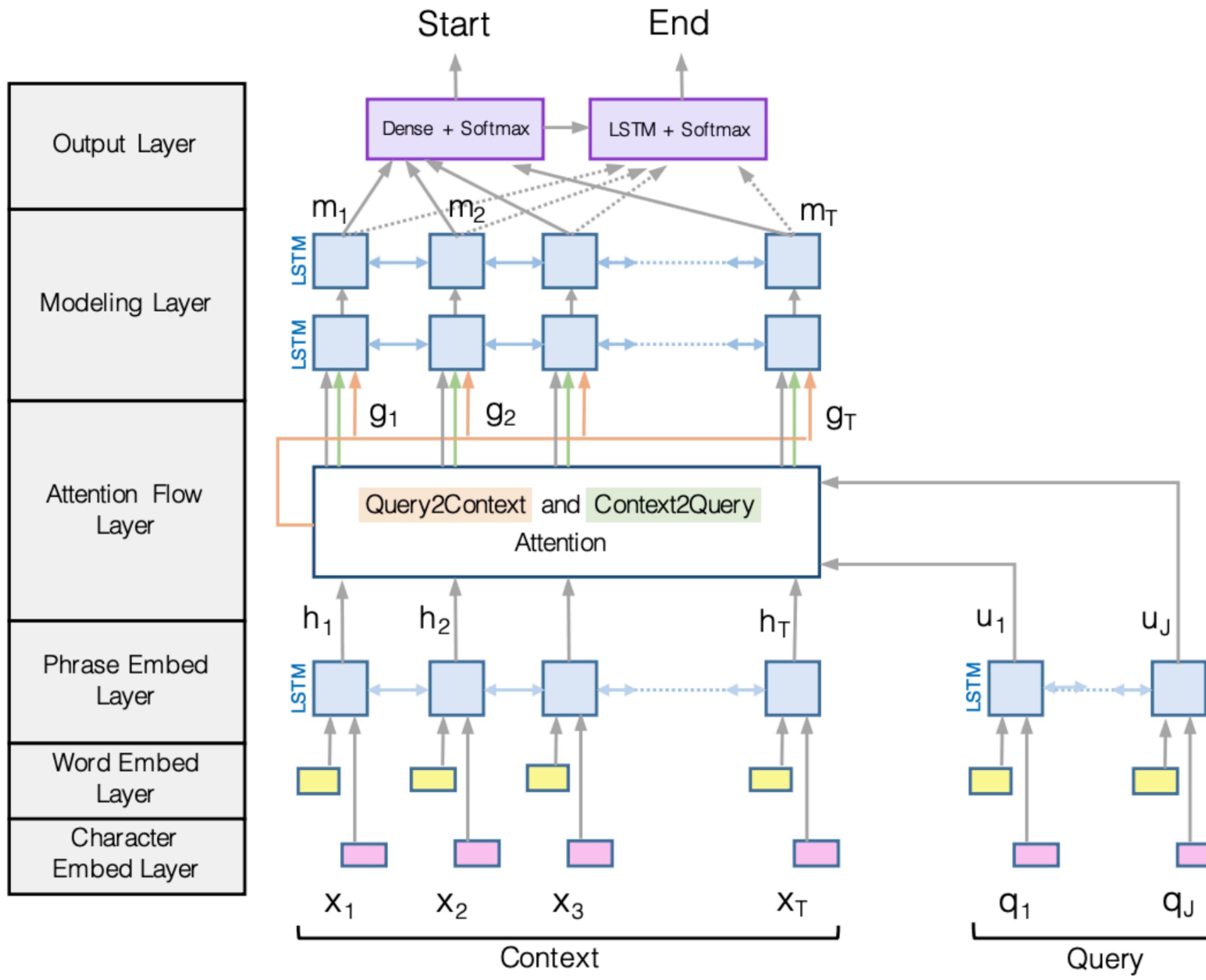
Question 2: “What was the name of the 1937 treaty?”

Plausible Answer: *Bald Eagle Protection Act*

Unanswerable Questions

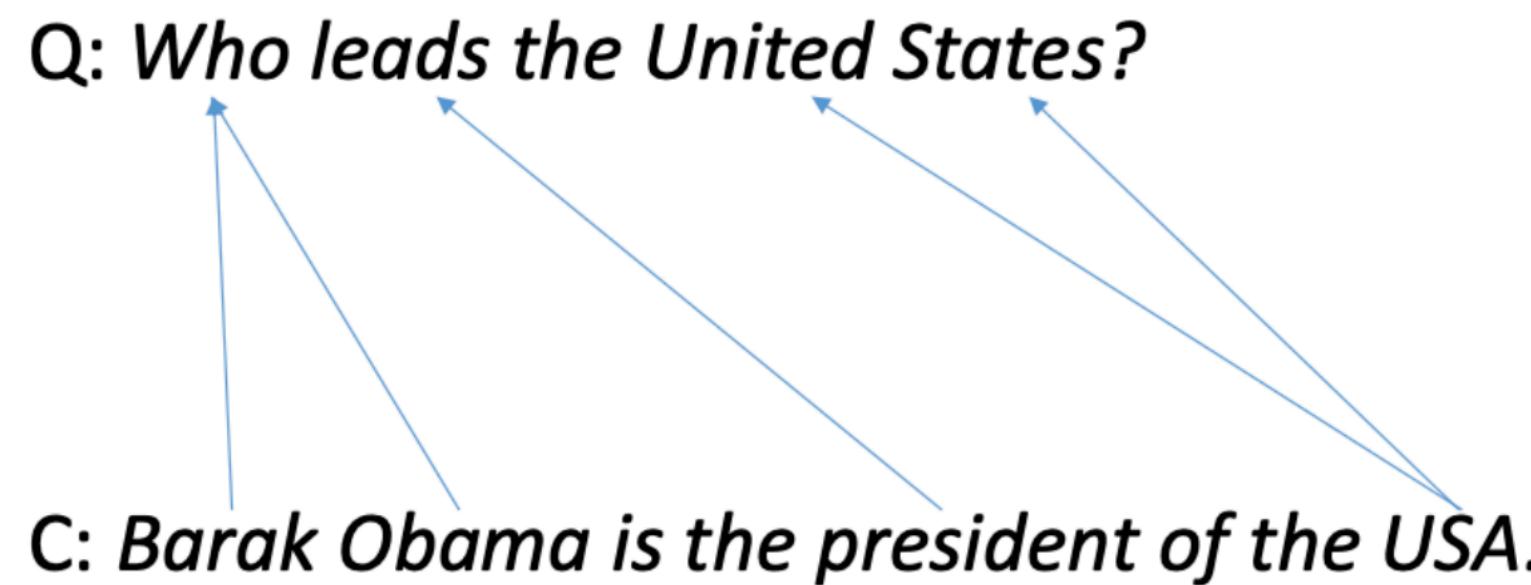
Plausible (but incorrect) answers

Bidirectional Attention Flow Model



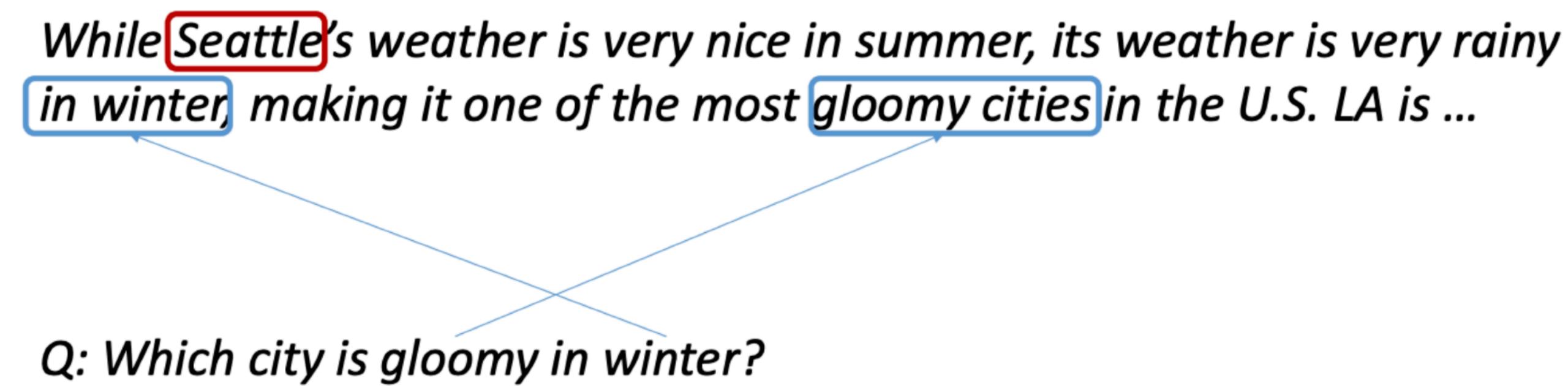
Bidirectional Attention Flow Model

Context-to-query attention

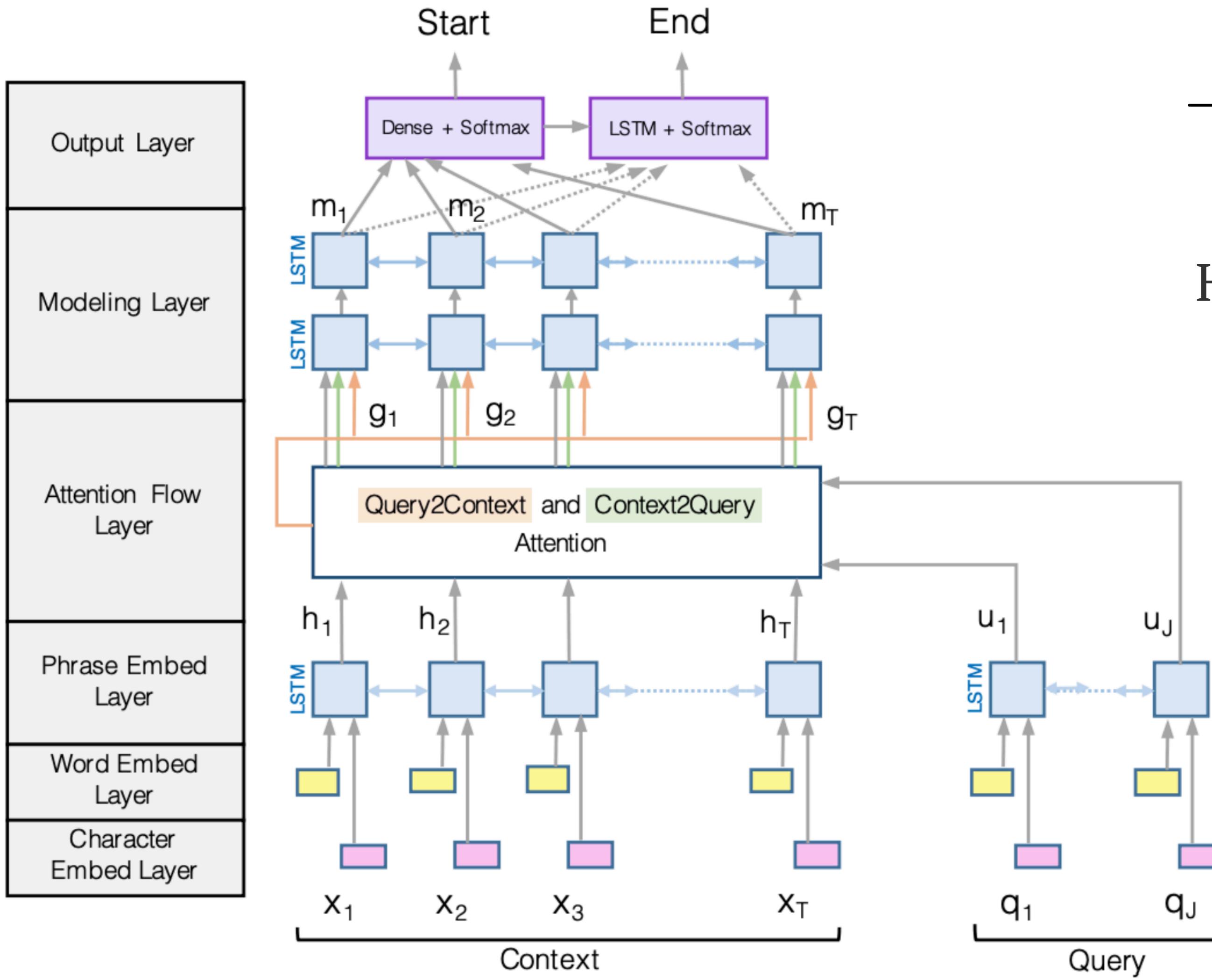


For each context word, find the most relevant query word.

Query-to-context attention



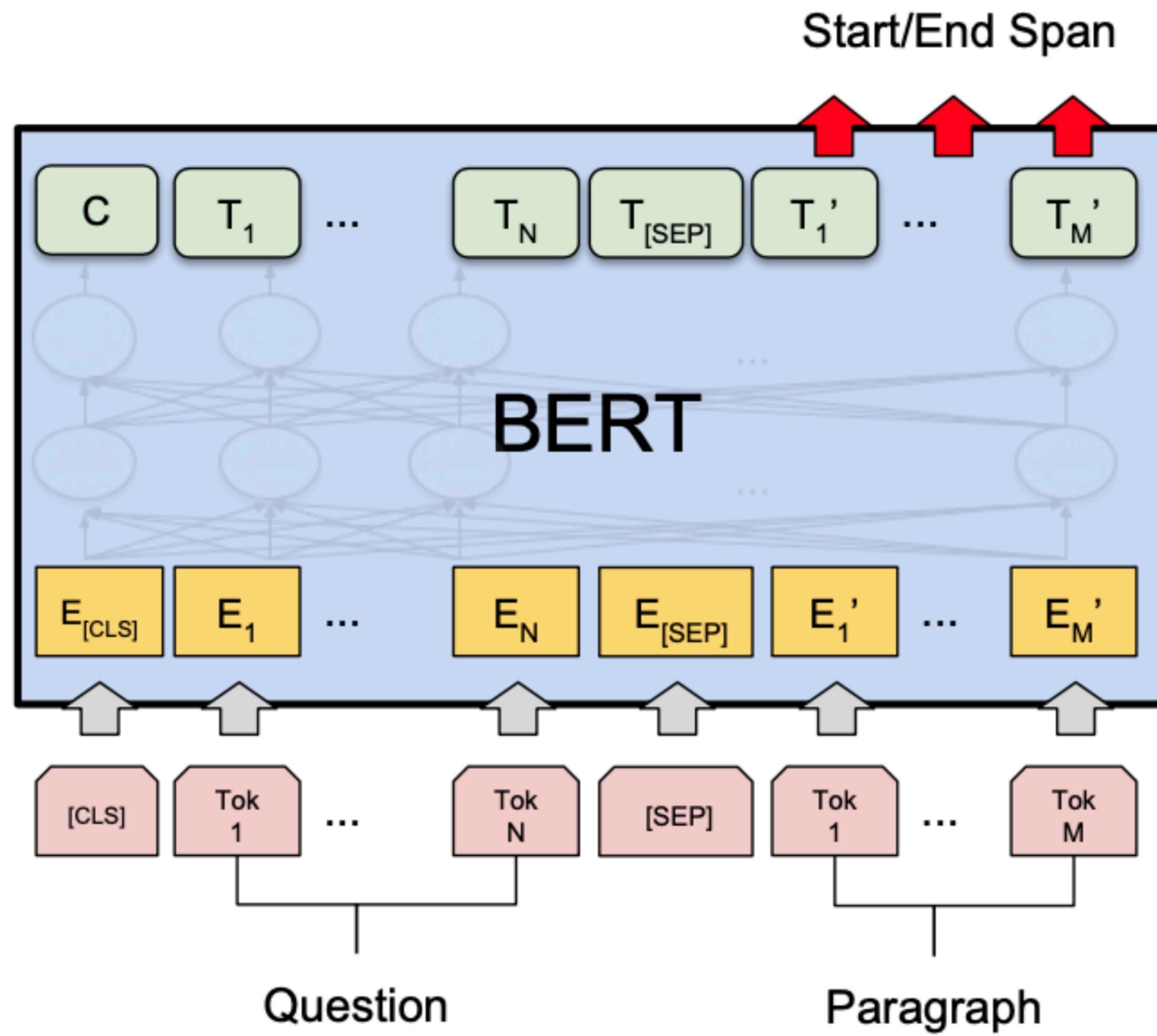
Bidirectional Attention Flow Model



$$-\log p_{\text{start}}(s^*) - \log p_{\text{end}}(e^*)$$

How to find the max scoring span?

BERT QA



Fine-tune on the SQuAD dataset.

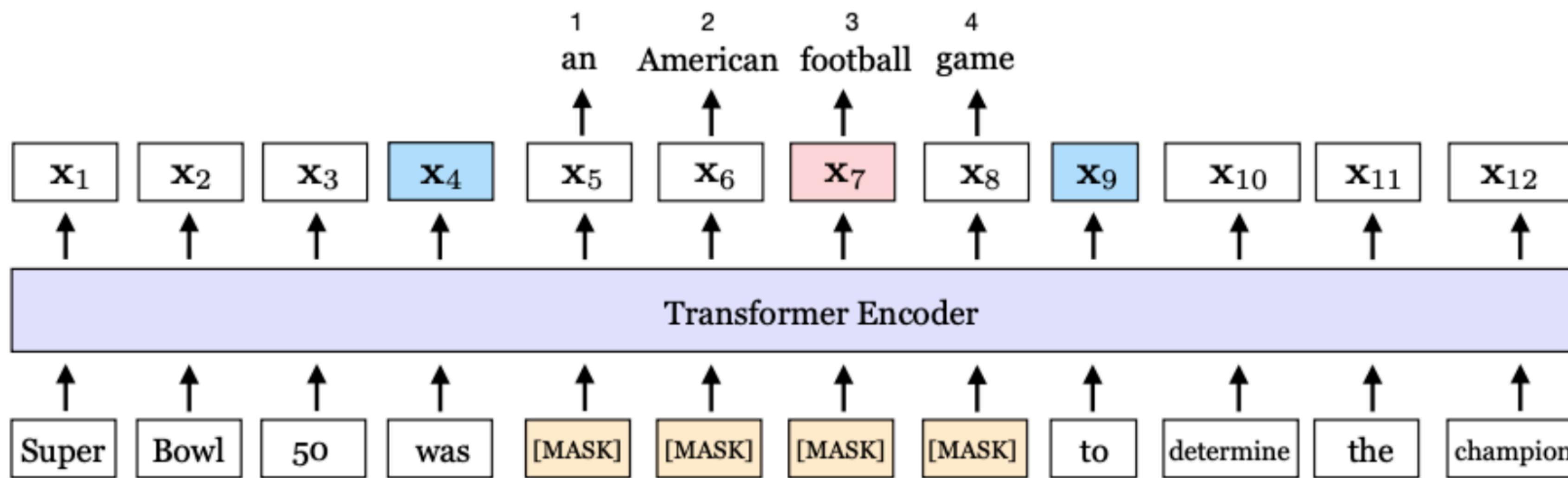
$$-\log p_{\text{start}}(s^*) - \log p_{\text{end}}(e^*)$$



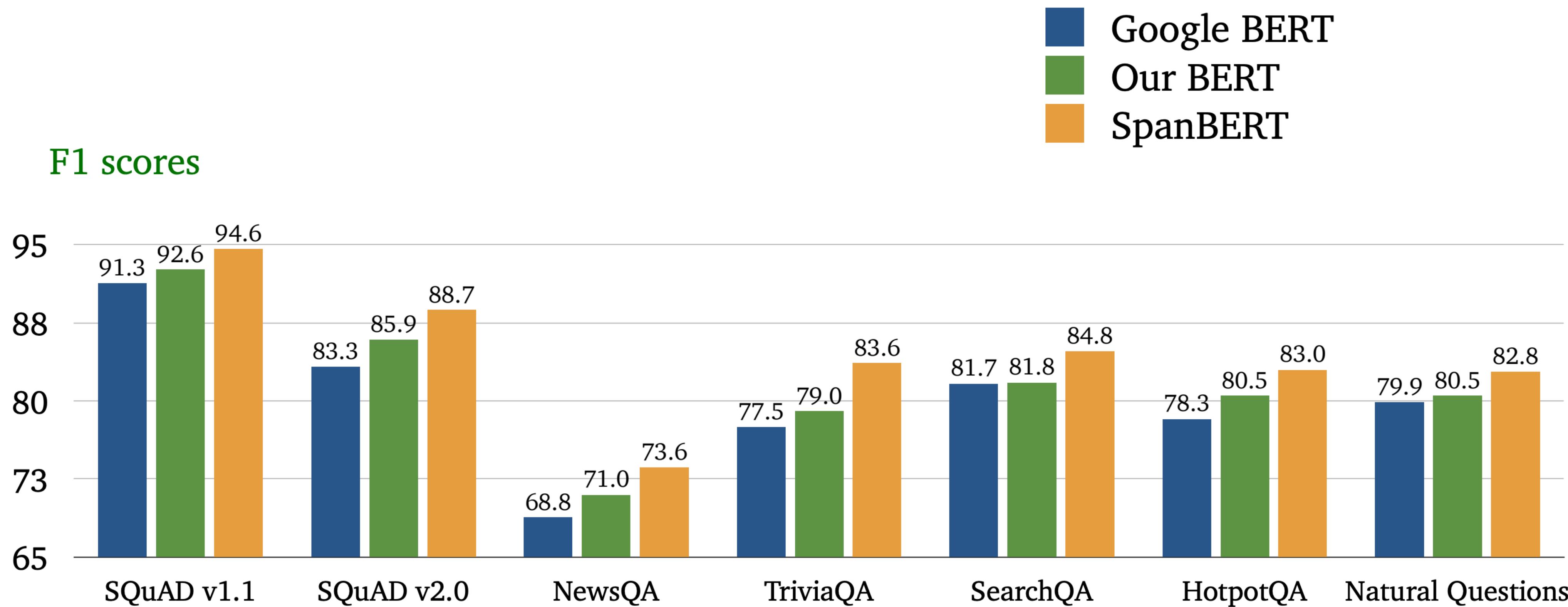
SpanBERT — Pretraining Objectives

$$\mathcal{L}(\text{football}) = \mathcal{L}_{\text{MLM}}(\text{football}) + \mathcal{L}_{\text{SBO}}(\text{football})$$

$$= -\log P(\text{football} \mid \mathbf{x}_7) - \log P(\text{football} \mid \mathbf{x}_4, \mathbf{x}_9, \mathbf{p}_3)$$



SpanBERT – Pretraining Objectives



Multi-hop Reasoning QA

Question: What government position was held by the woman who portrayed Corliss Archer in the film Kiss and Tell ?

Doc 1 Shirley Temple Black was an American actress, businesswoman, and singer ...
As an adult, she served as Chief of Protocol of the United States

Same entity

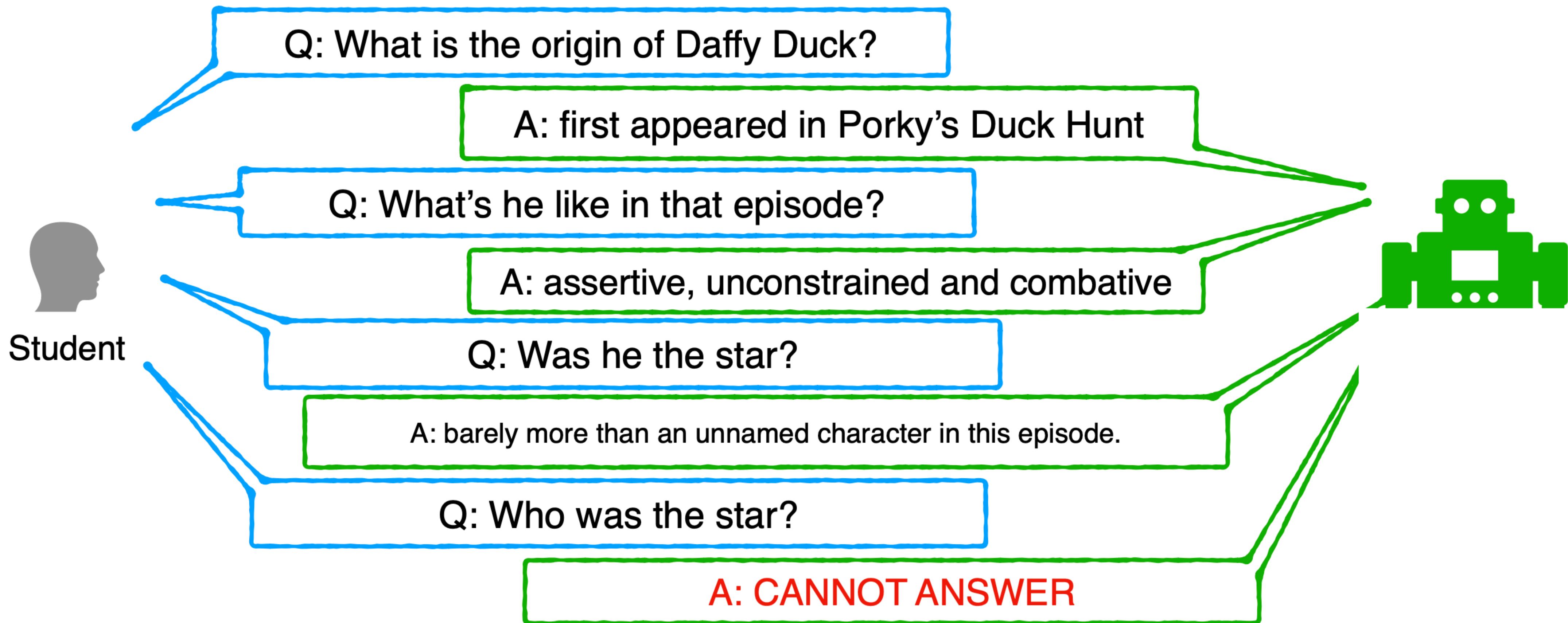
Same entity

Doc 2 Kiss and Tell is a comedy film in which 17-year-old Shirley Temple acts as Corliss Archer .

...

Doc 3 Meet Corliss Archer is an American television sitcom that aired on CBS ...

Conversational QA

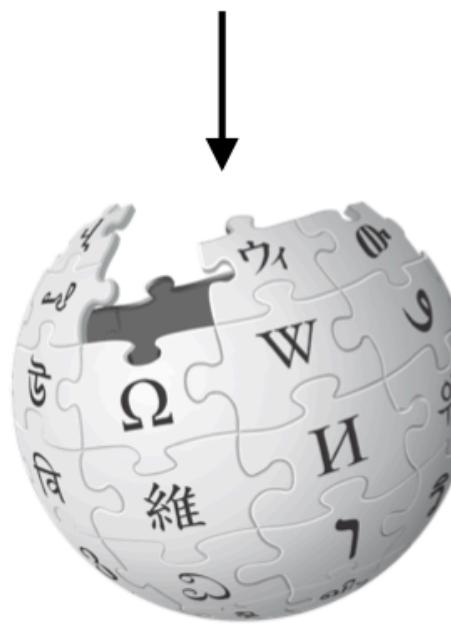


Open-domain QA

Open-domain QA

SQuAD, TREC, WebQuestions, WikiMovies

Q: How many of Warsaw's inhabitants spoke Polish in 1933?

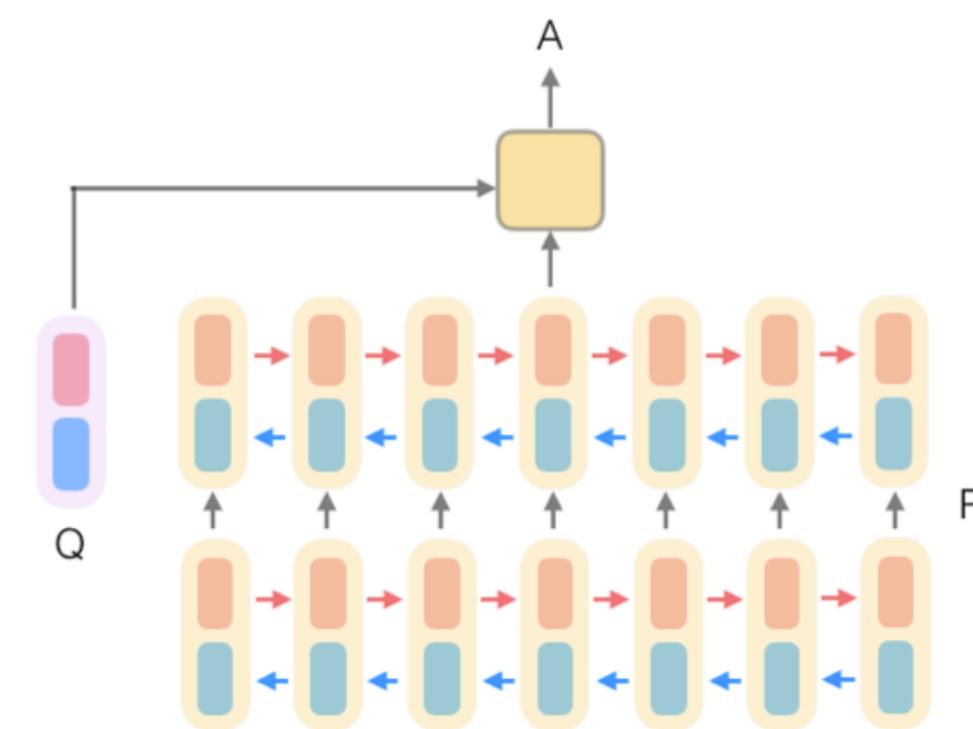


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833,500

Latent Retrieval

