



School of Computing



Web Information Retrieval
Natural Language Processing Group



Unsupervised Multi-hop Question Answering by Question Generation

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Paper: <https://arxiv.org/pdf/2010.12623.pdf>

Codes: <https://github.com/teacherpeterpan/Unsupervised-Multi-hop-QA>

Multi-hop QA

- ❑ Multi-hop QA requires the integration and reasoning over different information sources to find the answer.

Homogeneous data sources

Paragraph A: All Join Hands

"All Join Hands" is a song by the British rock band Slade, released in 1984 as the lead single from the band's twelfth studio album "Rogues Gallery".

Paragraph B: Slade

Slade are an English glam rock band from Wolverhampton. They rose to prominence during the early 1970s with 17 consecutive top 20 hits and six number ones on the UK Singles Chart.

Question #1:

When did the rock band that sang "All Join Hands" rise to prominence?

Heterogeneous data sources

2004 United States Grand Prix

Pos	No	Driver	Constructor	Time	Gap
1	2	Rubens Barrichello	Ferrari	1:10.223	—
2	1	Michael Schumacher	Ferrari	1:10.400	+0.177
3	10	Takuma Sato	BAR - Honda	1:10.601	+0.378
4	9	Jenson Button	BAR - Honda	1:10.820	+0.597
5	3	Juan Pablo Montoya	Williams - BMW	1:11.062	+0.839

Jenson Alexander Lyons Button MBE (born 19 January 1980) is a British racing driver and former Formula One driver. He won the 2009 Formula One World Championship, driving for Brawn GP.

Question #2:

What nationality was the driver who finished in position 4 in the 2004 United States Grand Prix?

Training a Multi-hop QA System

- Training a QA system **requires large-scale data**.
- It is **time-consuming** for human to write a high-quality multi-hop question.



Could we use QG to generate **synthetic QA-pairs** to train the QA model?

**Human-labeled
QA Pairs**



Evaluate

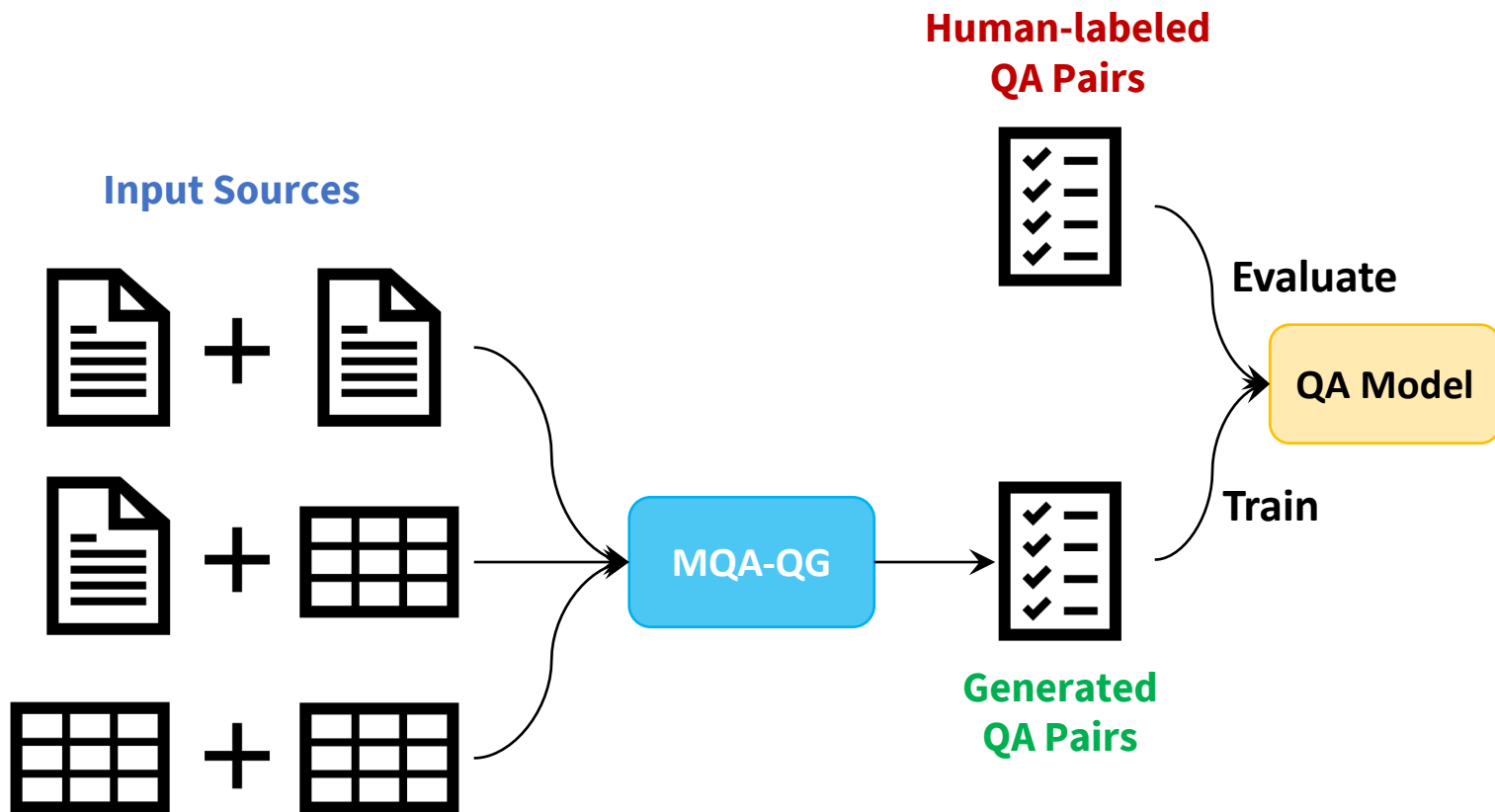
QA Model



Train

**Human-labeled
QA Pairs**

Zero-shot Multi-hop QA



Zero-shot Multi-hop QA



But how can we generate multi-hop questions
without seeing any human-written examples?

Answer Multi-hop Questions

When did the rock band that sang "All Join Hands" rise to prominence?

Multi-hop Question

Which rock band sang "All Join Hands"?

Paragraph A: All Join Hands

"All Join Hands" is a song by the British rock band Slade, released in 1984 as the lead single from the band's twelfth studio album "Rogues Gallery".

*Ans = **Slade***

When did **Slade** rise to prominence?

Paragraph B: Slade

Slade are an English glam rock band from Wolverhampton. They rose to prominence during the early 1970s with 17 consecutive top 20 hits and six number ones on the UK Singles Chart.

*Ans = **Early 1970s***

Generate Multi-hop Questions

When did the rock band that sang "All Join Hands" rise to prominence?

Multi-hop Question

Which rock band sang "All Join Hands"?

Ans = **Slade**

When did **Slade** rise to prominence?

Paragraph A: All Join Hands

"All Join Hands" is a song by the British rock band Slade, released in 1984 as the lead single from the band's twelfth studio album "Rogues Gallery".

Paragraph B: Slade

Slade are an English glam rock band from Wolverhampton. They rose to prominence during the early 1970s with 17 consecutive top 20 hits and six number ones on the UK Singles Chart.

Paragraph A: All Join Hands
"All Join Hands" is a song by the British rock band Slade, released in 1984

Paragraph B: Slade
Slade are an English glam rock band from Wolverhampton. They rose to prominence during the early 1970s with

What rock band sang "All Join Hands"?

Answer: Slade

#1

FindBridge

Slade

#3

QGwithAns

QGwithEnt

#2

Slade sang "All Join Hands"?

#4

QuesToSent

When did the rock band Slade rise to prominence?

Answer: Early 1970s

#5

BridgeBlend

When did the rock band that sang "All Join Hands" rise to prominence?

Answer: Early 1970s

Medal	Championship	Name	Event
Silver	2010 Pruszkow	Tim Veldt	Men's omnium
Bronze	2011 Apeldoorn	Kristen Wild	Women's omnium
Gold	2013 Apeldoorn	Elis Ligtlee	Women's keirin

Kirsten Carlijn Wild (born 15 October 1982) is a Dutch professional racing cyclist, Wild competed in two track cycling events at the 2012 Summer Olympics.

Kirsten Wild #1

FindBridge

Kirsten Wild of Netherlands won the bronze medal in the 2011 Apeldoorn.

#2

DescribeEnt

#3

QGwithEnt

What is the birthdate of Kirsten Wild?

Answer: 15 October 1982

#4

BridgeBlend

What is the birthdate of the athlete that of Netherlands won the bronze medal in the 2011 Apeldoorn?

Answer: 15 October 1982

The Blending Function

e: Kirsten Wild

q: What is the birthdate of Kirsten Wild? **Answer:** 15 October 1982

s: Kirsten Wild of Netherlands won the bronze medal in the 2011 Apeldoorn.



What is the birthdate of the _____ that of Netherlands won the bronze medal in the 2011 Apeldoorn?



What is the birthdate of the athlete that of Netherlands won the bronze medal in the 2011 Apeldoorn? **Answer:** 15 October 1982



BERT

Evaluation Datasets

HotpotQA

Text + Text

Paragraph A: Walchelin de Ferriers

Walchelin de Ferrieres (or Walkelin de Ferrers) (died 1201) was a Norman baron and principal captain of King Richard I of England.

Paragraph B: Richard I of England

Richard I (8 September 1157 – 6 April 1199) was King of England from 6 July 1189 until his death. He also ruled as Duke of Normandy, Aquitaine and Gascony, Lord of Cyprus, Count of Poitiers, Anjou, Maine, and Nantes, and was overlord of Brittany at various times during the same period. He was the third of five sons of King Henry II of England and Duchess Eleanor of Aquitaine. He was known as Richard Cœur de Lion or Richard the Lionheart because of his reputation as a great military leader and warrior. He was also known in Occitan as Oc e No ("Yes and No"), because of his reputation for terseness.

Q: Who is the mother of the king that Walchelin de Ferriers was principal captain to?

A: Duchess Eleanor of Aquitaine

(Yang et al., EMNLP 2018)

HybridQA

Table + Text

The 2016 Summer Olympics officially known as the Games of the XXXI Olympiad (Portuguese : Jogos da XXXI Olimpíada) and commonly known as Rio 2016 , was an international multi-sport event

Name	Year	Season	Flag bearer
XXXI	2016	Summer	Yan Naing Soe
XXX	2012	Summer	Zaw Win Thet
XXIX	2008	Summer	Phone Myint Tayzar
XXVIII	2004	Summer	Hla Win U
XXVII	2000	Summer	Maung Maung Nge
XX	1972	Summer	Win Maung

Yan Naing Soe (born 31 January 1979) is a Burmese judoka . He competed at the 2016 Summer Olympics in the men 's 100 kg event , He was the flag bearer for Myanmar at the Parade of Nations .

Zaw Win Thet (born 1 March 1991 in Kyonpyaw , Patheingyi District , Ayeyarwady Division , Myanmar) is a Burmese runner who

Myint Tayzar Phone (Burmese : မိုင်တေဇာဖုန်း) born July 2 , 1978) is a sprint canoer from Myanmar who competed in the late 2000s .

Win Maung (born 12 May 1949) is a Burmese footballer . He competed in the men 's tournament at the 1972 Summer Olympics ...

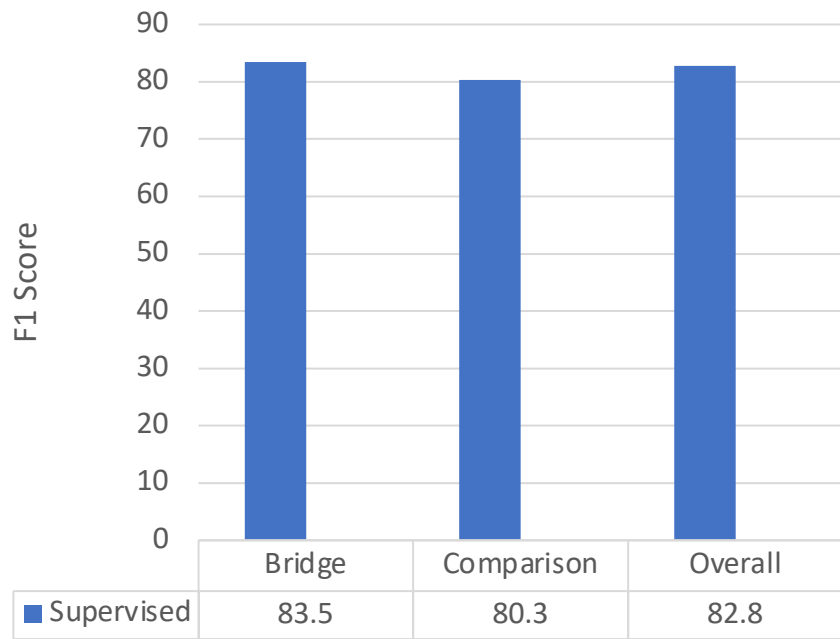
Q: In which year did the judoka bearer participate in the Olympic opening ceremony?	A: 2016
Q: Which event does the does the XXXI Olympic flag bearer participate in?	A: men's 100 kg event
Q: Where does the Burmese judoka participate in the Olympic opening ceremony as a flag bearer?	A: Rio
Q: For the Olympic event happening after 2014, what session does the Flag bearer participate?	A: Parade of Nations
Q: For the XXXI and XXX Olympic event, which has an older flag bearer?	A: XXXI
Q: When does the oldest flag Burmese bearer participate in the Olympic ceremony?	A: 1972

Hardness
↓

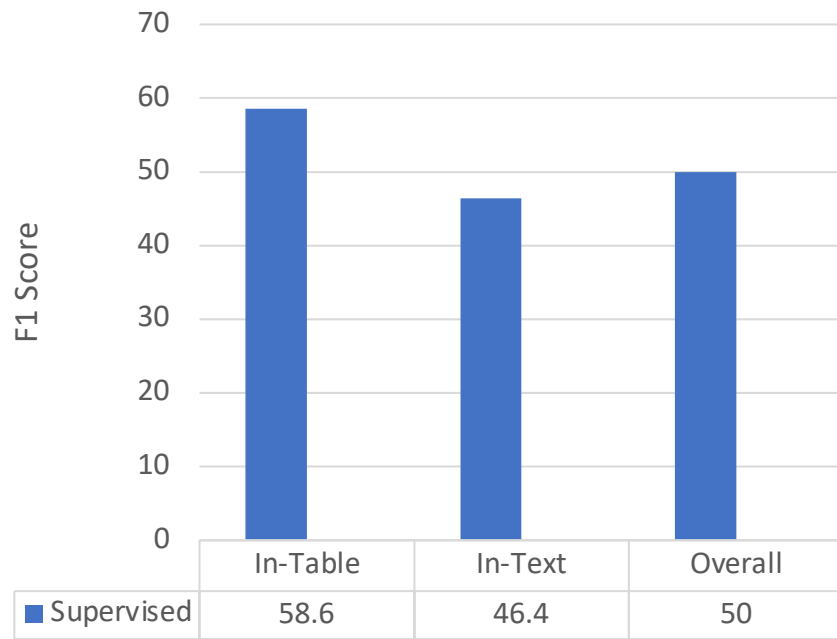
(Chen et al., EMNLP 2020)

Supervised QA Performance

HotpotQA

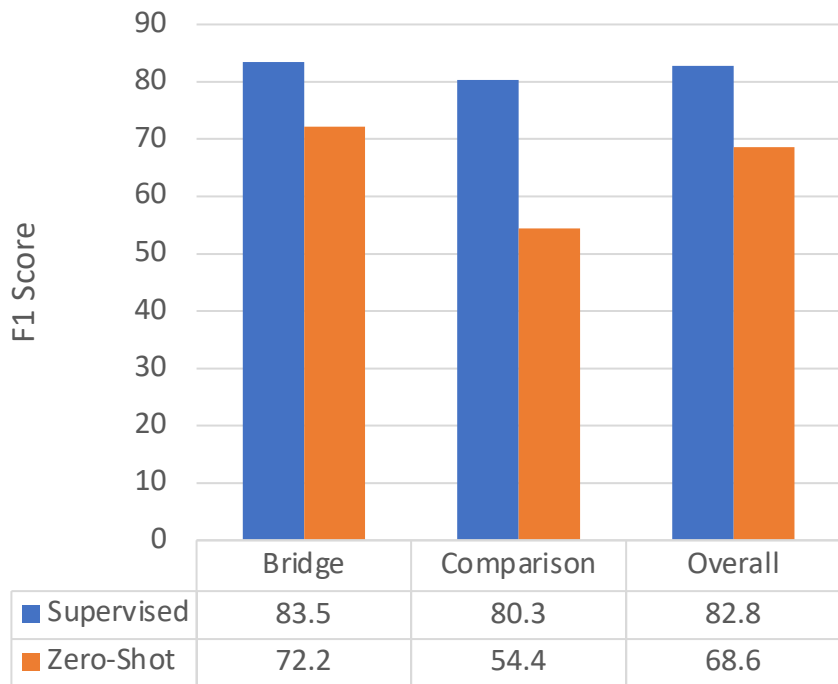


HybridQA

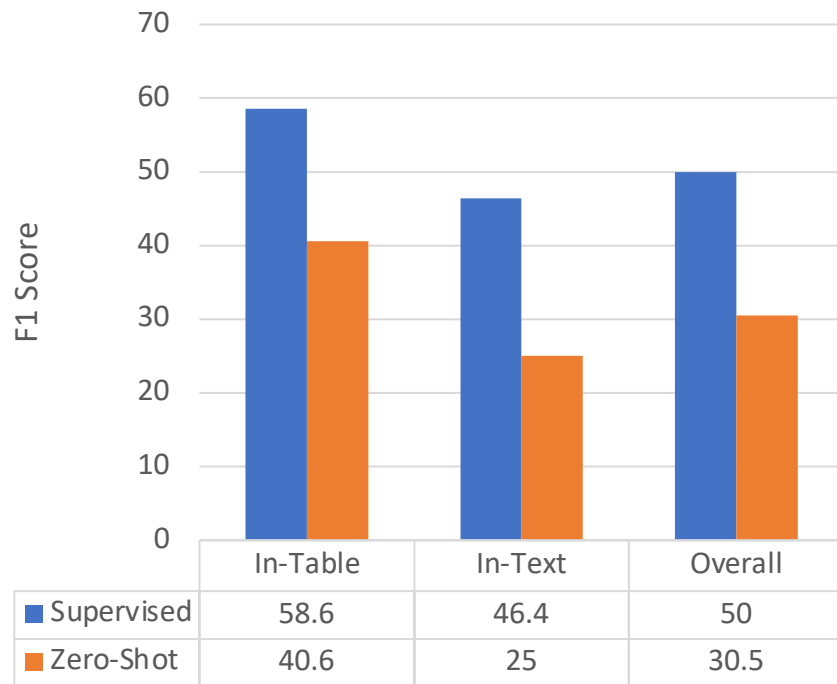


Zero-shot QA Performance

HotpotQA



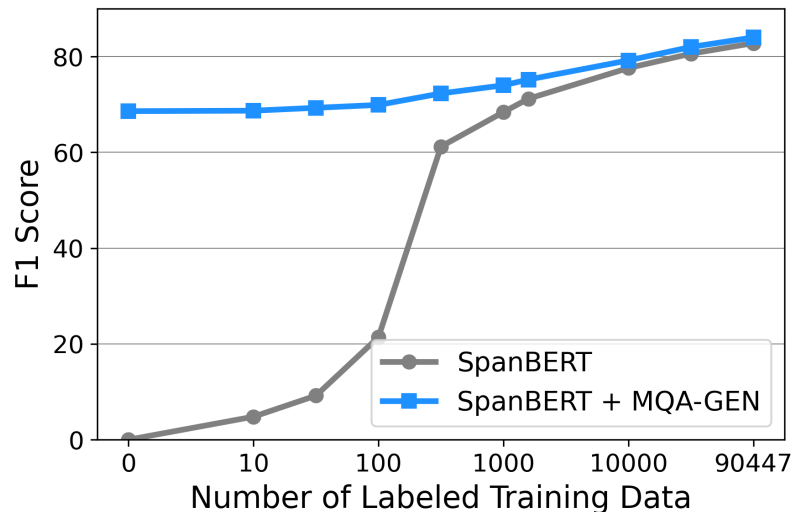
HybridQA



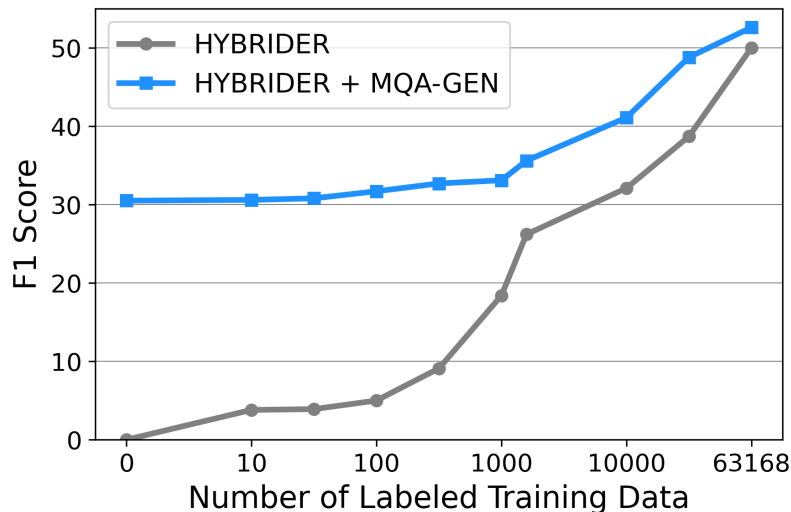
Few-shot QA Performance

HotpotQA

The F1 score for progressively larger training dataset sizes for finetuning.



HybridQA



Examples of Generated Questions

Type	Question	Answer
Table-Text	When did the one that won the Eurovision Song Contest in 1966 join Gals and Pals?	1963
	How many students attend the teams that played in the Dryden Township Conference?	1900
Text-Table	What album did the Oak Ridge Boys release in 1989?	American Dreams
	When was the name that is the name of the bridge that crosses Youngs Bay completed?	Summer
Text-Text	Which Canadian cinematographer is best known for his work on Fargo?	Craig Wroblewski
	What is illegal in the country that is Bashar Hafez al - Assad 's father?	Cannabis
Comparison	Who was born first, Terry Southern or Neal Town Stephenson?	Terry Southern
	Are Beth Ditto and Mary Beth Patterson of the same nationality?	Yes

Thanks!

Any questions?

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