



Evaluating Entity Disambiguation and the Role of Popularity in Retrieval-Based NLP

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Anthony Chen

University of California, Irvine



Pallavi Gudipati

Apple



Shayne Longpre

Apple



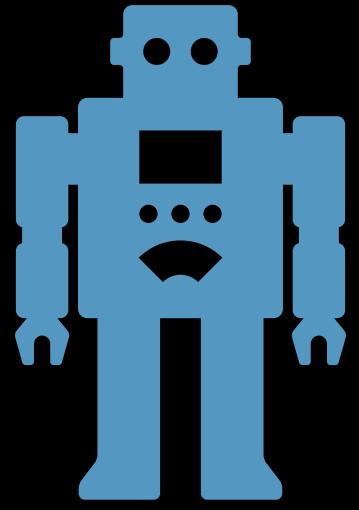
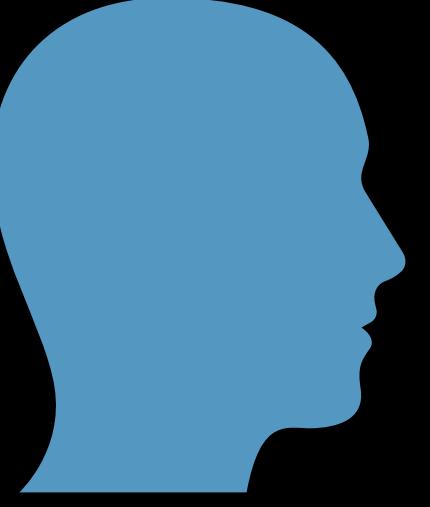
Xiao Ling

Apple

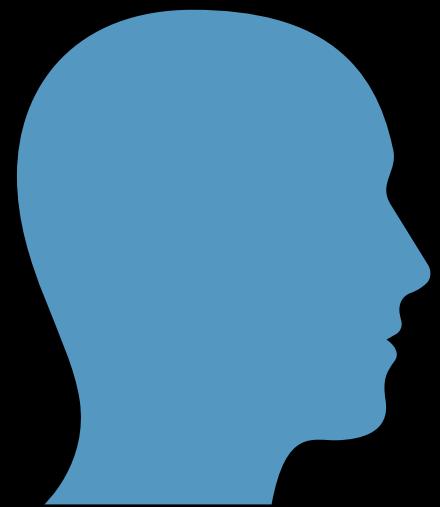


Sameer Singh

University of California, Irvine

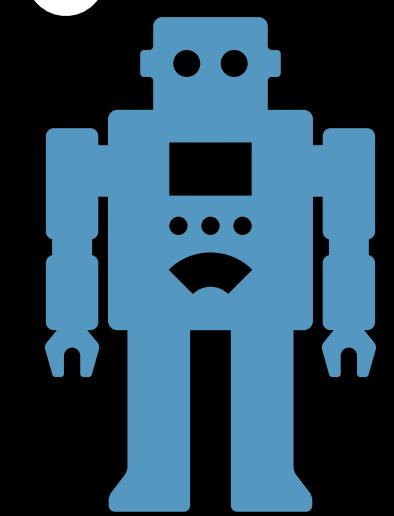


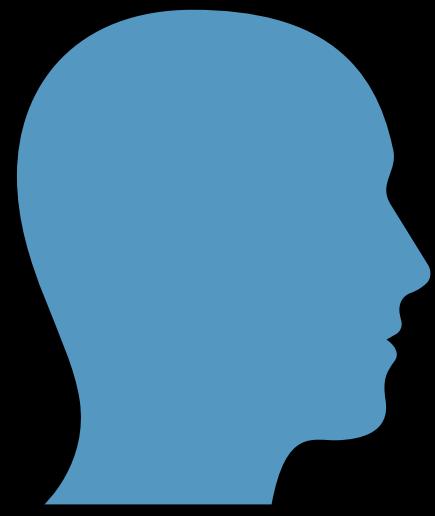
What battle did Abe Lincoln fight in?



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Which Abe Lincoln are we talking about?





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Abraham Lincoln

16th President of the United States (1861–65)

Abraham Lincoln (*/lɪŋkən/*; February 12, 1809 – April 15, 1865) was an American lawyer and statesman who served as the 16th president of the United States from 1861 until his assassination in 1865. Lincoln led the nation through the American Civil War, the country's greatest moral, cultural, constitutional, and political crisis. He succeeded in preserving the Union, abolishing slavery, bolstering the federal government, and modernizing the U.S. economy.

This article is about the 16th president of the United States. For other uses, see [Abraham Lincoln](#).

Abe Lincoln (musician)

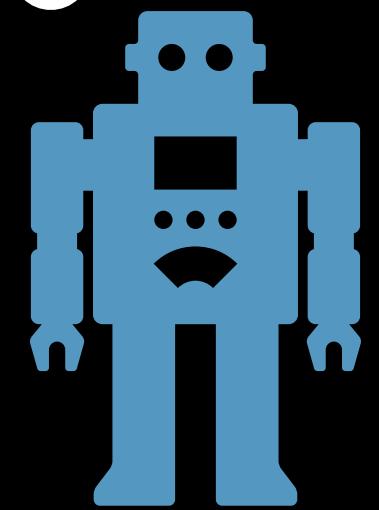
American musician

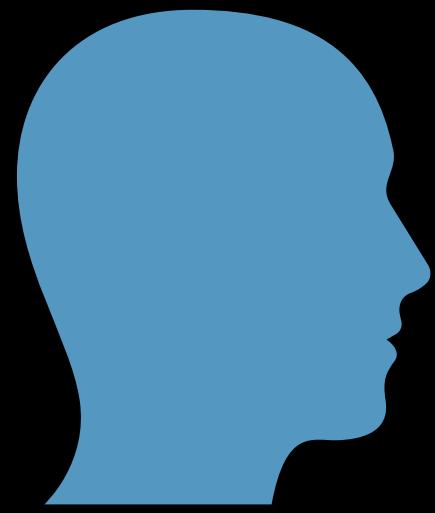
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Early life

Lincoln was born in [Lancaster](#), Pennsylvania, [1] one of six brothers. [2] He began playing





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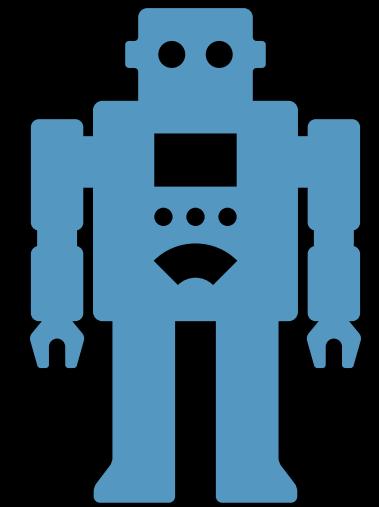
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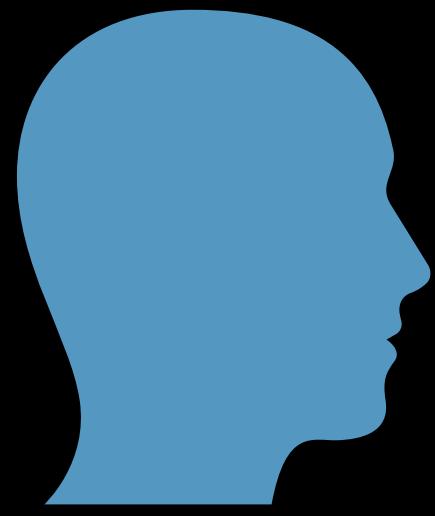
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What battle did Abe Lincoln fight in?

Should we be confident in this retriever?

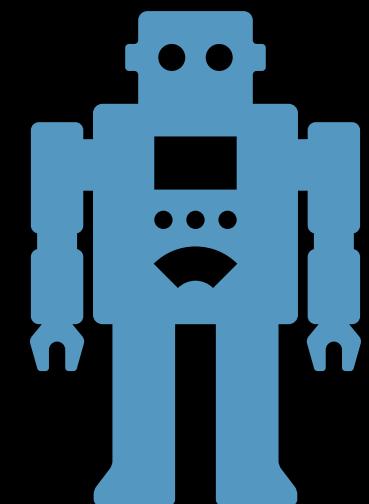


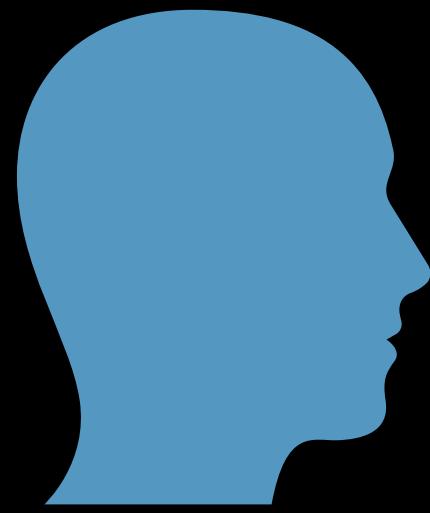
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What battle did Abe Lincoln fight in?

No! Retriever could be relying on popularity as heuristic.

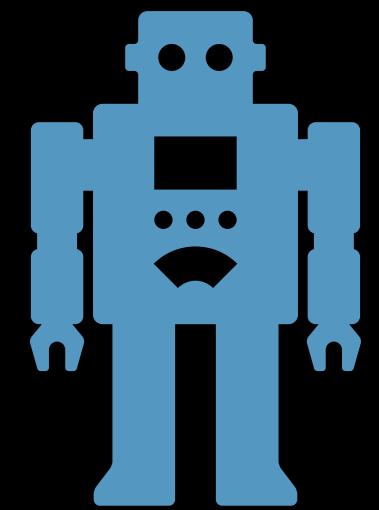


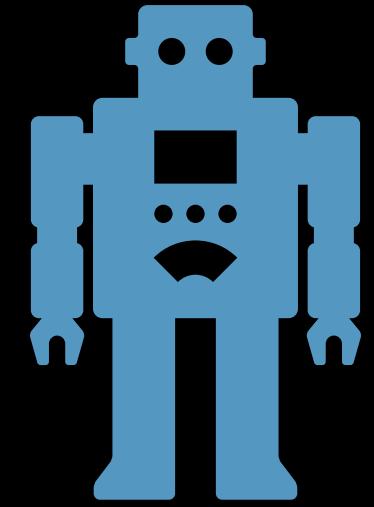
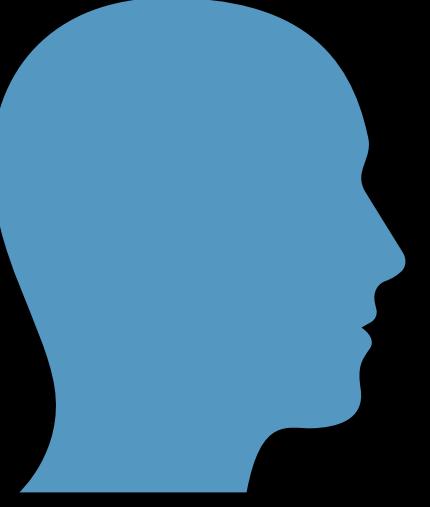
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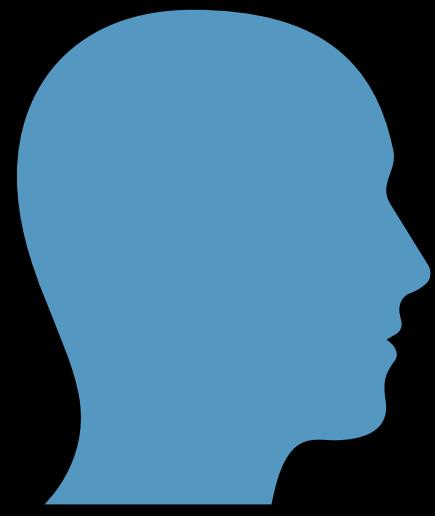
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Abe Lincoln (musician)

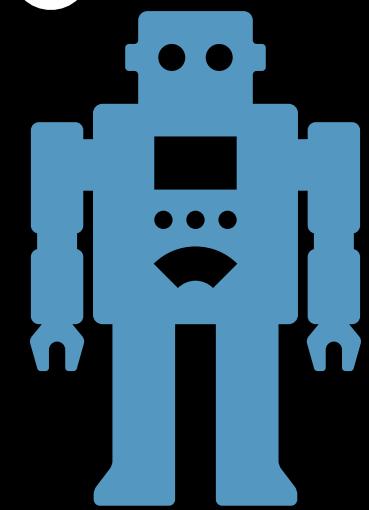
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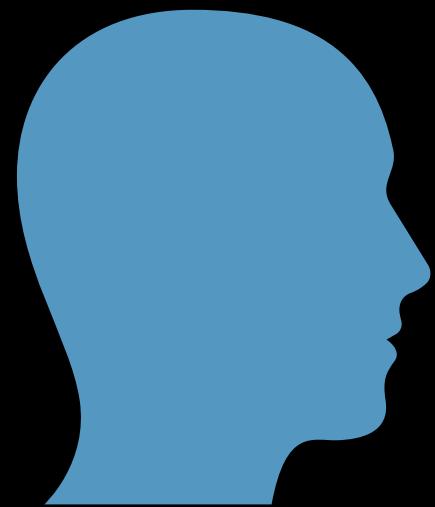
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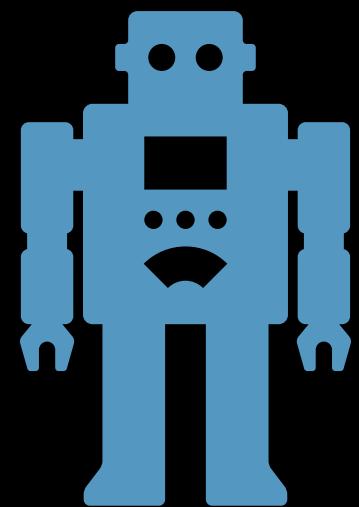
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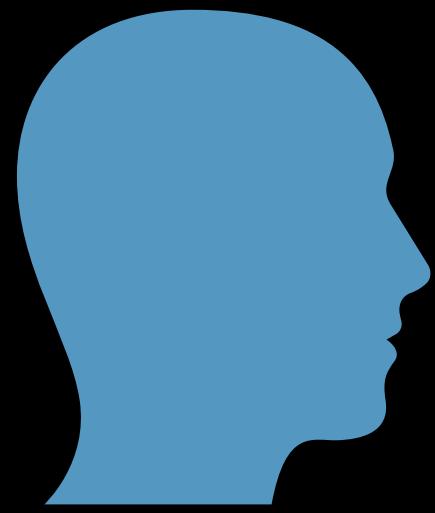
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Can be more confident!



Abe Lincoln (musician)

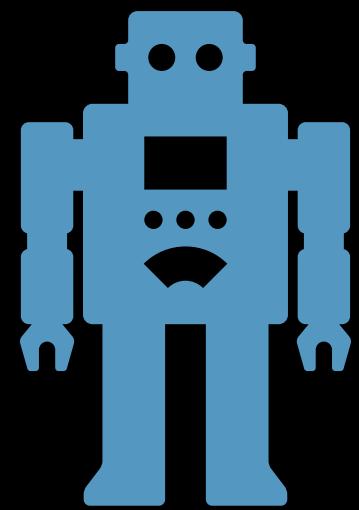
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Why Care About Retrieval?

- Growing interest in open-domain NLP tasks (e.g., question answering, fact checking, etc.).
- SOTA systems incorporate retrievers as an important first step.
- End-to-end performance is bounded by retriever performance.
- Properly evaluating retrievers is vital to open-domain progress.

Entity Ambiguity

Entity Ambiguity

An implicit (yet understudied) challenge for retrievers

- Many popular names (mentions) are shared by multiple entities.

Name	# Wikidata Entities w/ Name
Michael Jordan	> 15
George Washington	> 20
Harry Potter	> 5
Rolling Stone	> 10

Entity Ambiguity

An implicit (yet understudied) challenge for retrievers

- Many popular names (mentions) are shared by multiple entities.
- Retrievers should disambiguate popular & unpopular entity mentions equally.

How do retrievers perform on queries where there are multiple entities which match a mention?

Does the popularity of an entity affect retrieval performance (*i.e.*, do retrievers exhibit popularity bias)?

Existing resources obfuscate challenges in entity disambiguation.

AmbER Sets

AmbER Sets

- An evaluation benchmark for evaluating the entity disambiguation capabilities of retrievers we call *Ambiguous Entity Retrieval* (AmbER) sets.
- Each AmbER set is a collection of queries.

AmbER Sets

Each set covers entities which share a name and associated queries

"Abe Lincoln" AmbER Set		
Query	Answer	Gold Document
What battle did Abe Lincoln fight in?	Civil War	Abraham_Lincoln
What instrument did Abe Lincoln play?	Trombone	Abe_Lincoln_(musician)

AmbER Sets

Queries for **head entity** (most popular) AND **tail entities** (less popular)

"Abe Lincoln" AmbER Set		
Query	Answer	Gold Document
What battle did Abe Lincoln fight in?	Civil War	Abraham_Lincoln
What instrument did Abe Lincoln play?	Trombone	Abe_Lincoln_(musician)

AmbER Sets

Queries have resolvable ambiguity

"Abe Lincoln" AmbER Set		
Query	Answer	Gold Document
What battle did Abe Lincoln fight in?	Civil War	Abraham_Lincoln
What instrument did Abe Lincoln play?	Trombone	Abe_Lincoln_(musician)

AmbER Sets

Coverage over human and non-human entities

"Apple" AmbER Set		
Query	Answer	Gold Document
What industry is Apple in?	Electronics	Apple_Inc.
What is the record label of Apple ?	Page One	Apple_(band)
Who acted in Apple ?	Ray Shell	The_Apple_(1980_film)

AmbER Sets

Multi-task coverage: fact checking, slot filling, and question answering

"Apple" AmbER Set		
Query	Answer	Gold Document
Apple [SEP] industry	Electronics	Apple_Inc.
Apple [SEP] record label	Page One	Apple_(band)
Apple [SEP] cast member	Ray Shell	The_Apple_(1980_film)

AmbER Sets

Multi-task coverage: fact checking, slot filling, and question answering

"Apple" AmbER Set		
Query	Answer	Gold Document
Apple is an electronics company.	TRUE	Apple_Inc.
The label of Apple is Capitol Records.	FALSE	Apple_(band)
Ray Shell acted in Apple.	TRUE	The_Apple_(1980_film)

AmbER Sets

Automated creation pipeline!

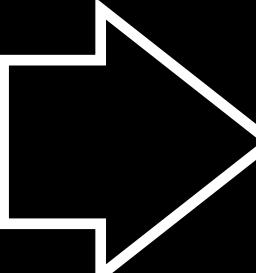
Name

"Davy Jones"

Name

Wikidata Entities
w/ Aligned Wikipedia Pages

"Davy Jones"



David Bowie*

Popularity: 4.09

*born Davy Jones

**Davy Jones
(racing driver)**

Popularity: 2.49

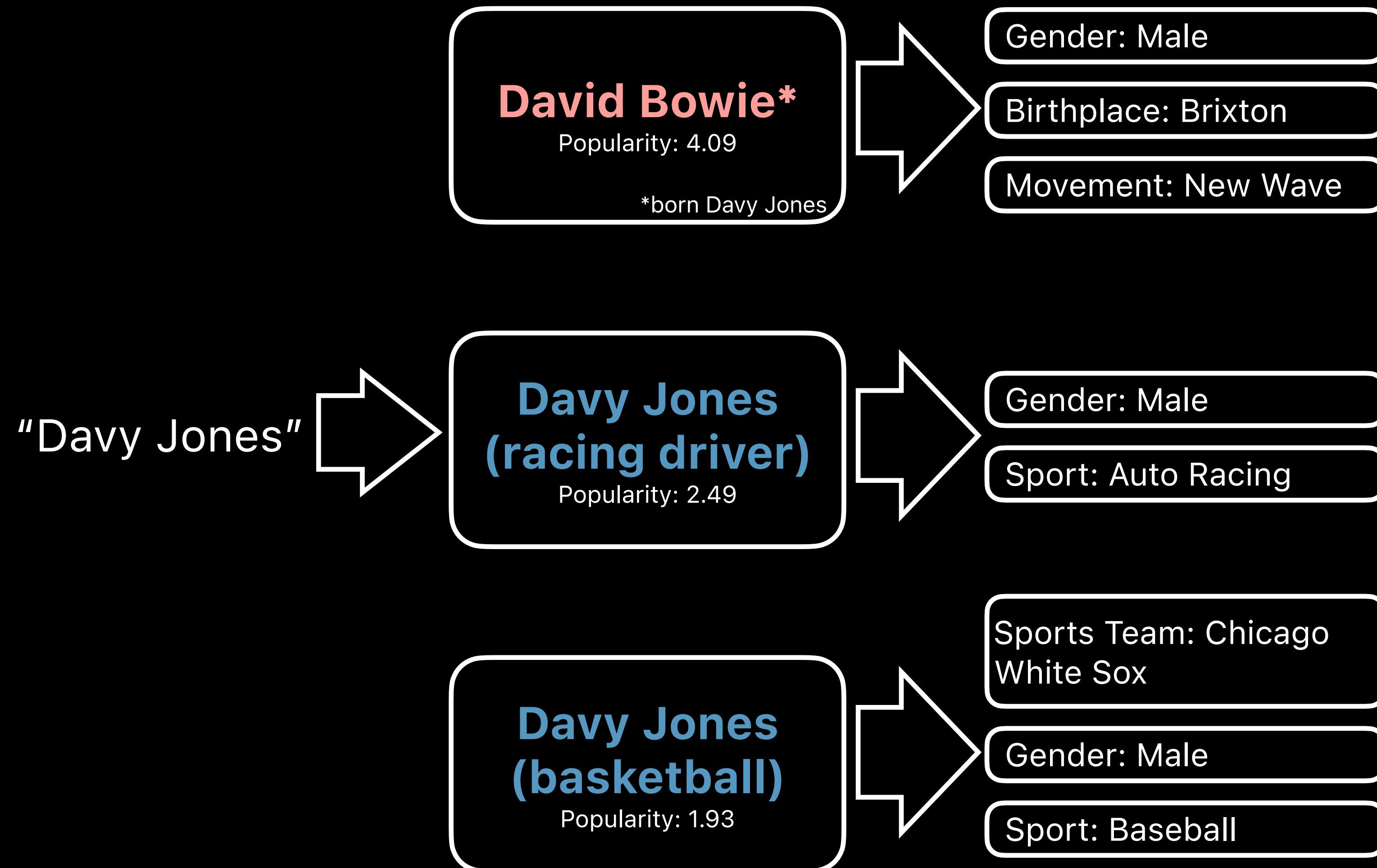
**Davy Jones
(basketball)**

Popularity: 1.93

Name

Wikidata Entities w/ Aligned Wikipedia Pages

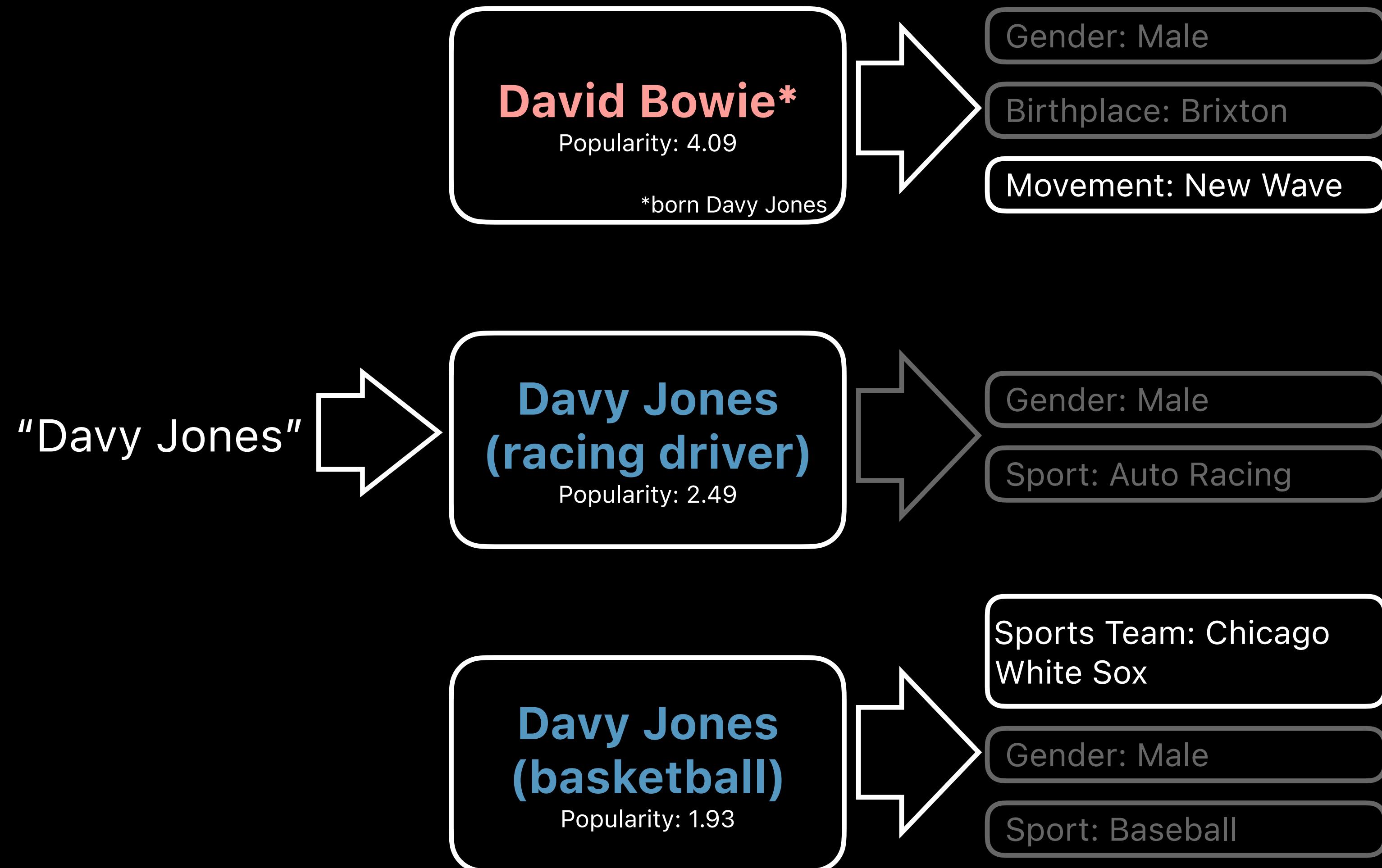
Wikidata Properties



Name

Wikidata Entities w/ Aligned Wikipedia Pages

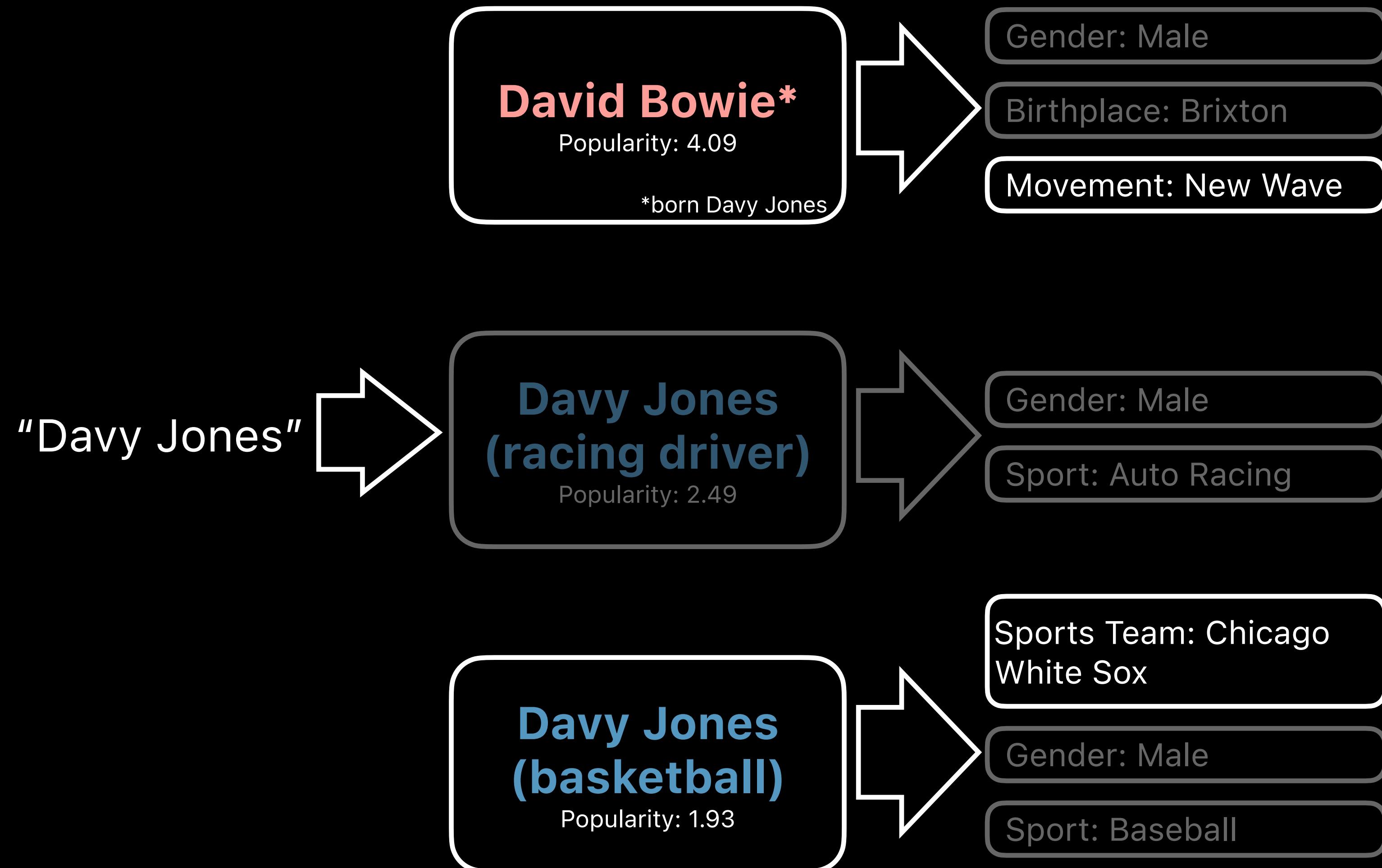
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Wikidata Properties



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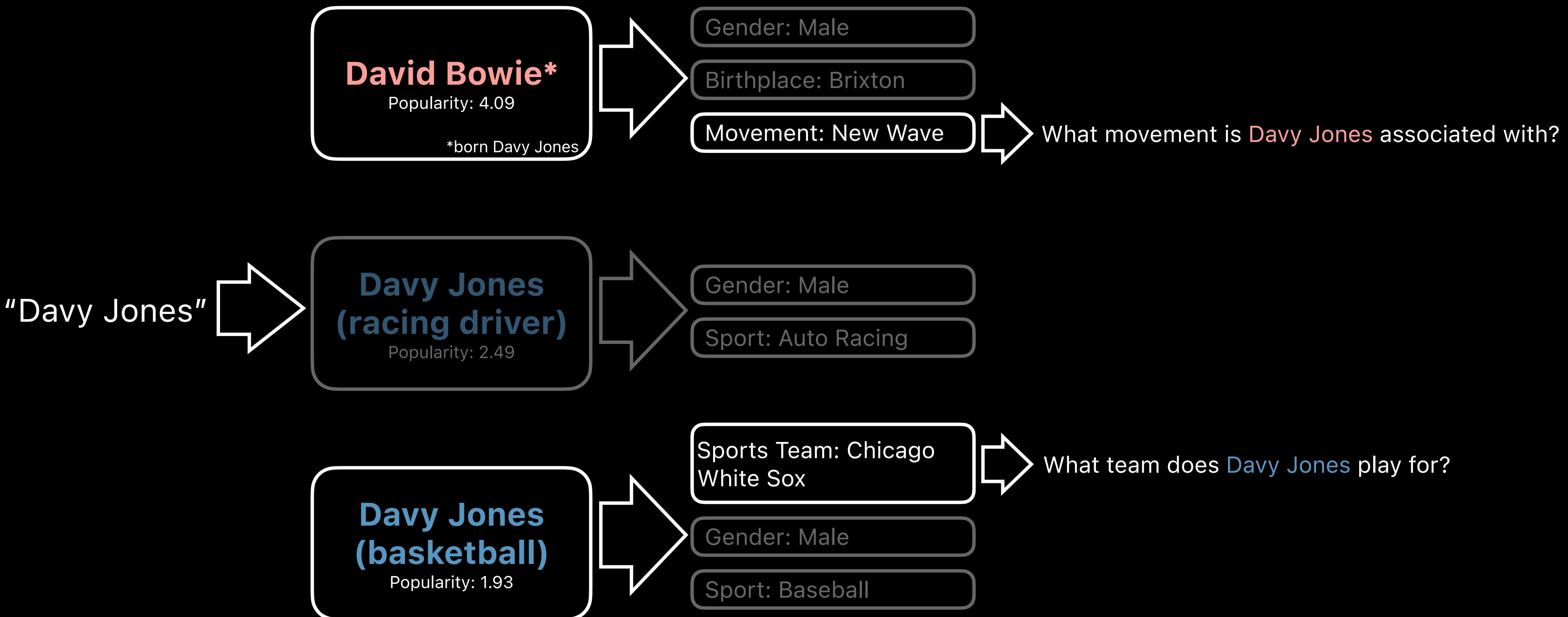
Wikidata Entities

w/ Aligned Wikipedia Pages

Wikidata Properties

Question Answering Instances

Instantiated via Templates



Name

Wikidata Entities

w/ Aligned Wikipedia Pages

Wikidata Properties

Slot Filling Instances



Gender: Male

Birthplace: Brixton

Movement: New Wave

Davy Jones [SEP] movement

"Davy Jones"



Gender: Male

Sport: Auto Racing



Sports Team: Chicago White Sox

Gender: Male

Sport: Baseball

Davy Jones [SEP] sports team

Name

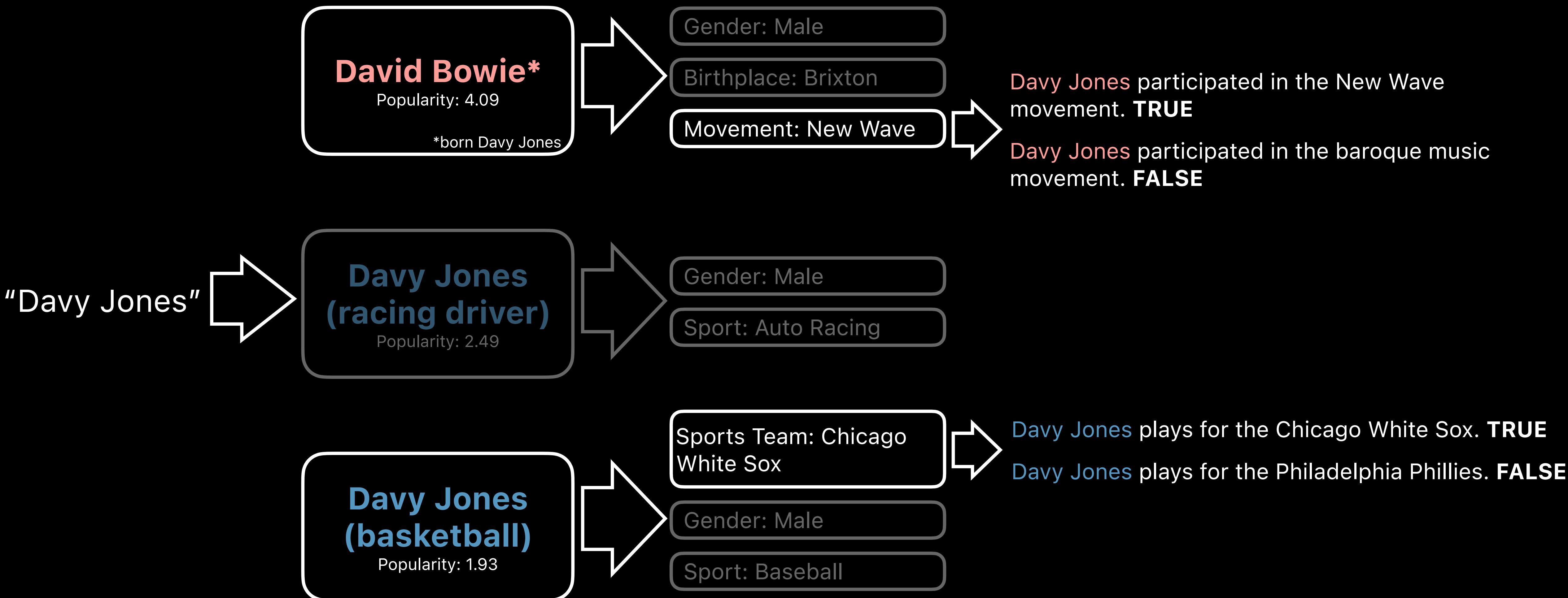
Wikidata Entities

w/ Aligned Wikipedia Pages

Wikidata Properties

Fact Checking Instances

Instantiated via Templates



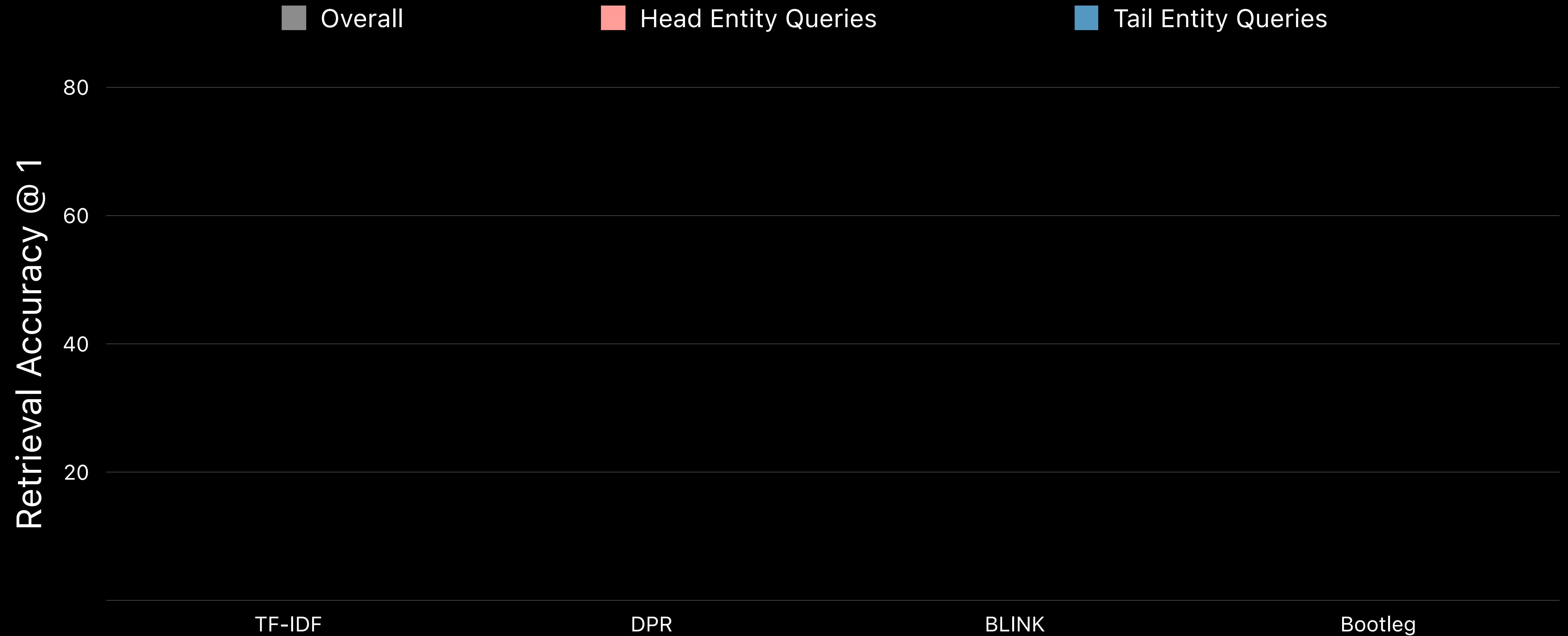
AmbER Sets

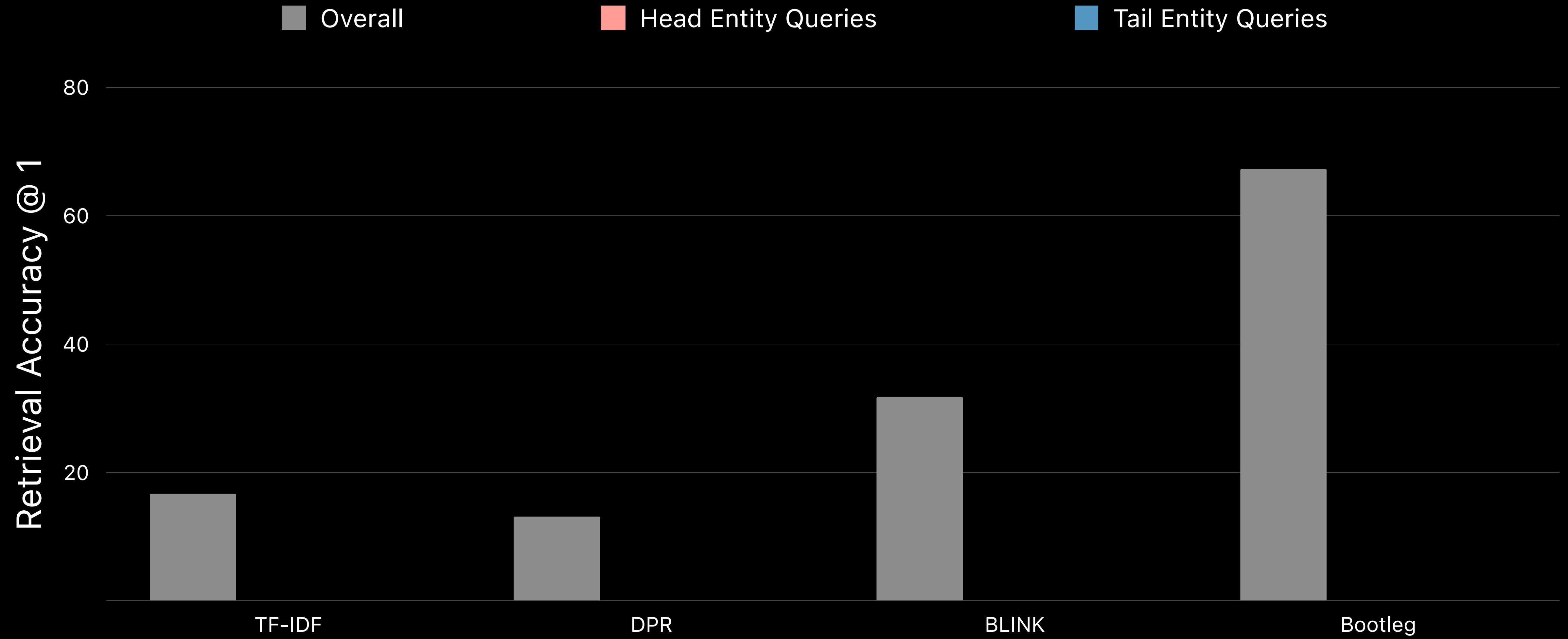
Statistics

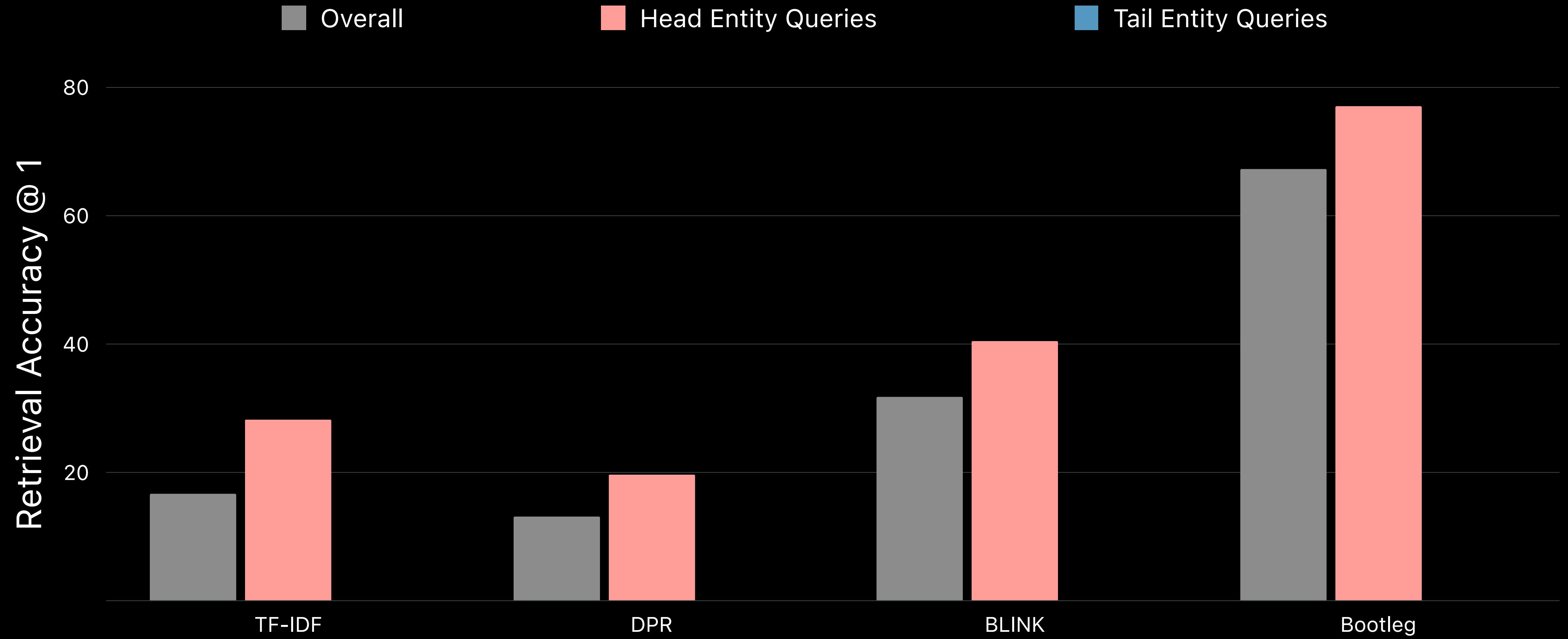
	AmbER-H	AmbER-N
# AmbER Sets	2,093	5,237
Avg. # Entities Per Set	2.98	2.42
# Input Queries	23,768	55,216
..... Question Answering	5,942	13,804
..... Slot Filling	5,942	13,804
..... Fact Checking	11,884	27,608

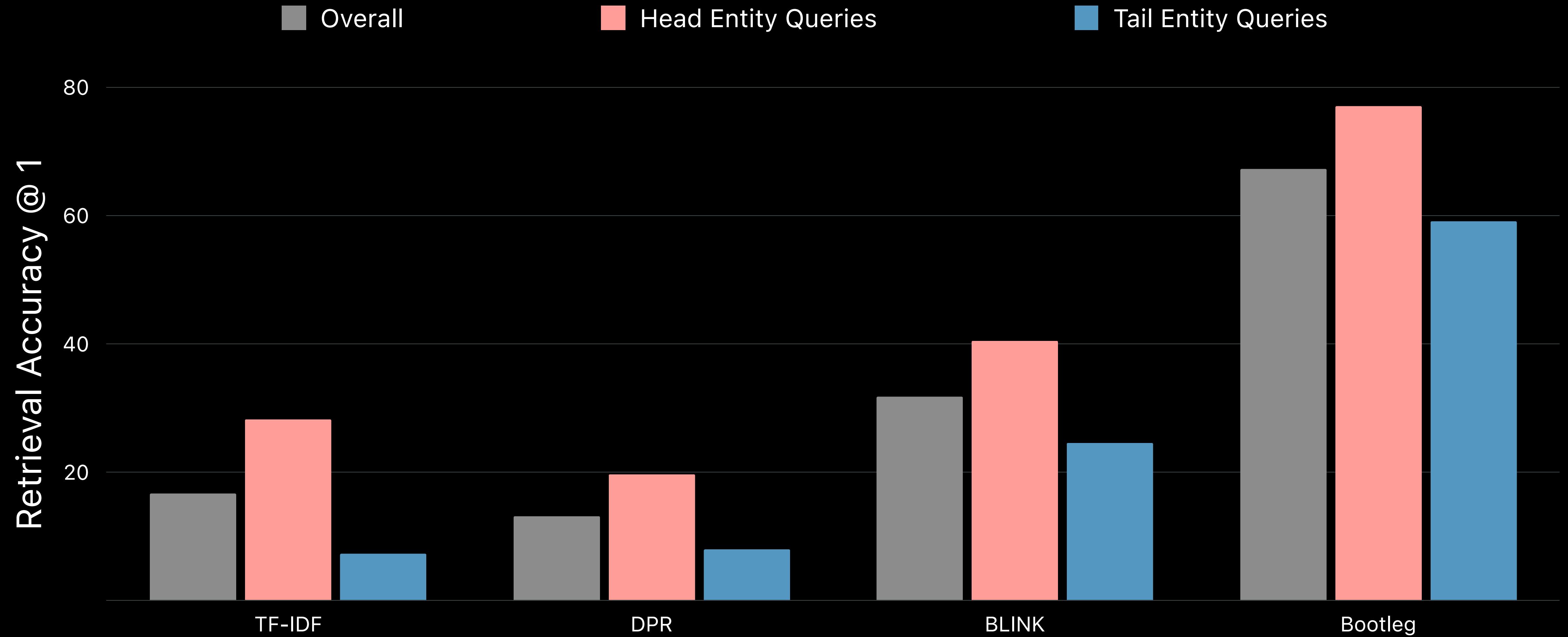
Experiments

How do retrievers perform on AmbER sets?









Do retrievers collapse a name to single entity?

All Correct (\forall) @ 1

40

30

20

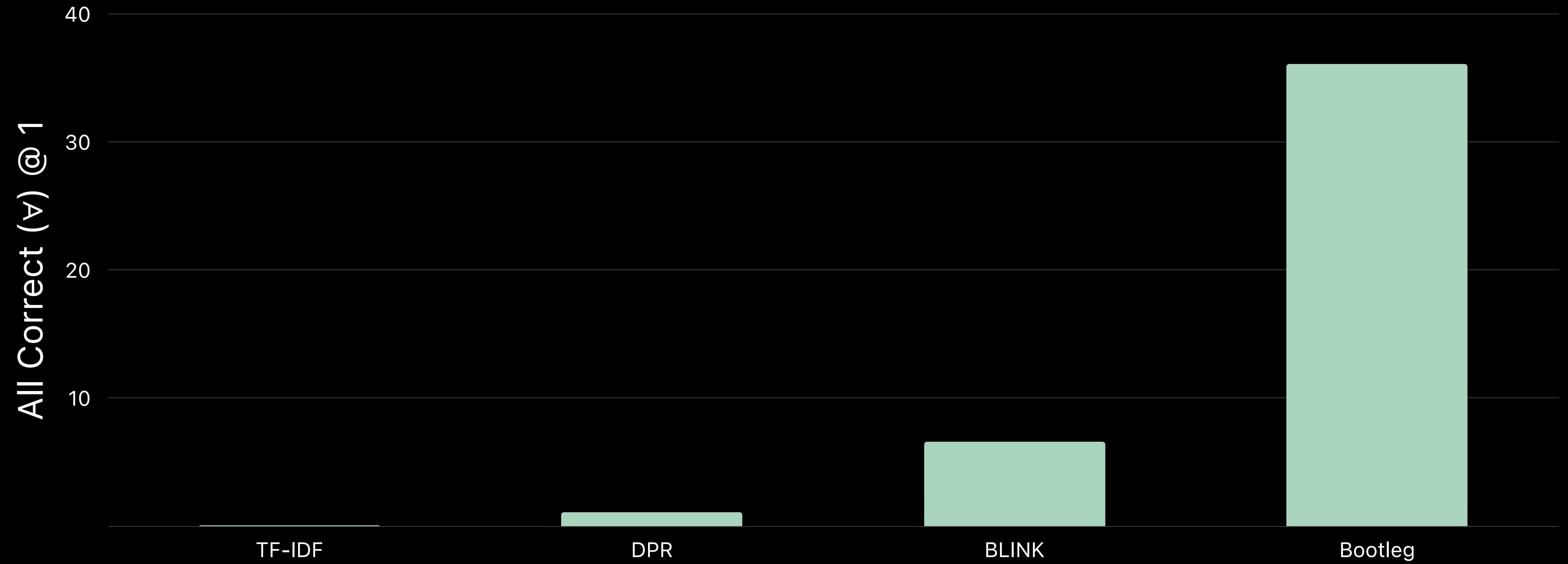
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TF-IDF

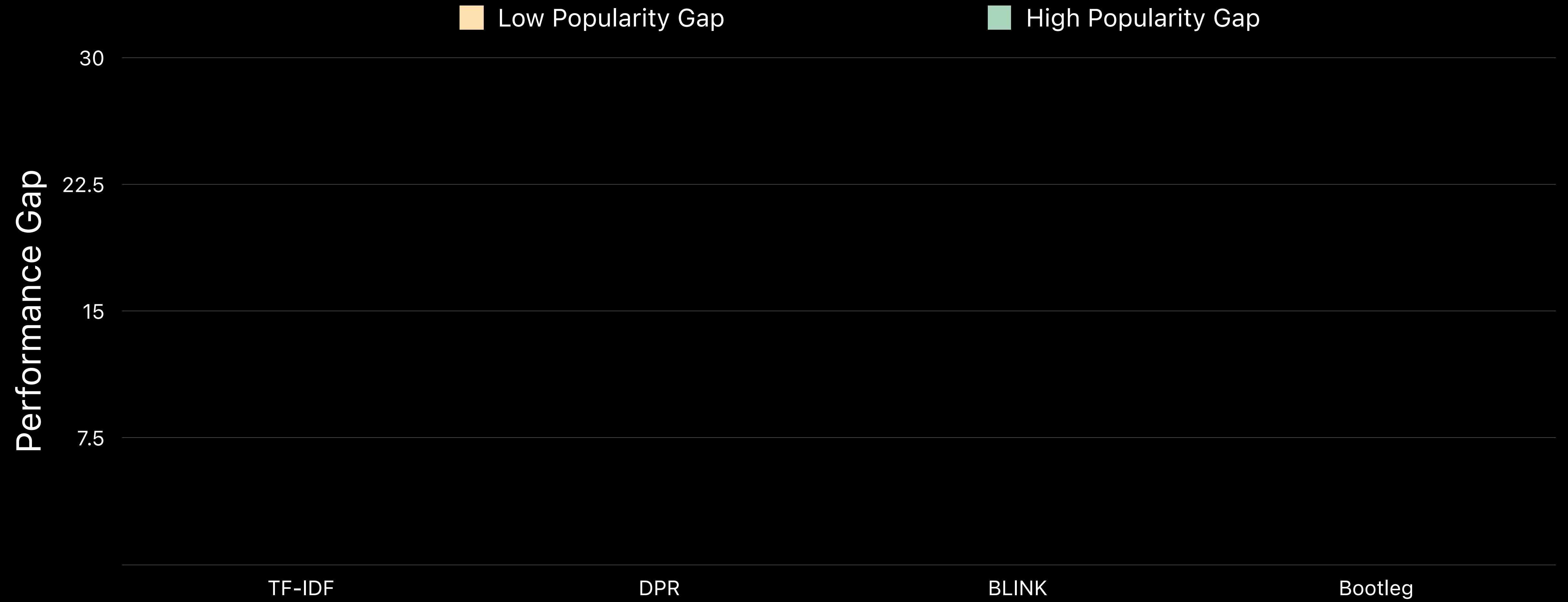
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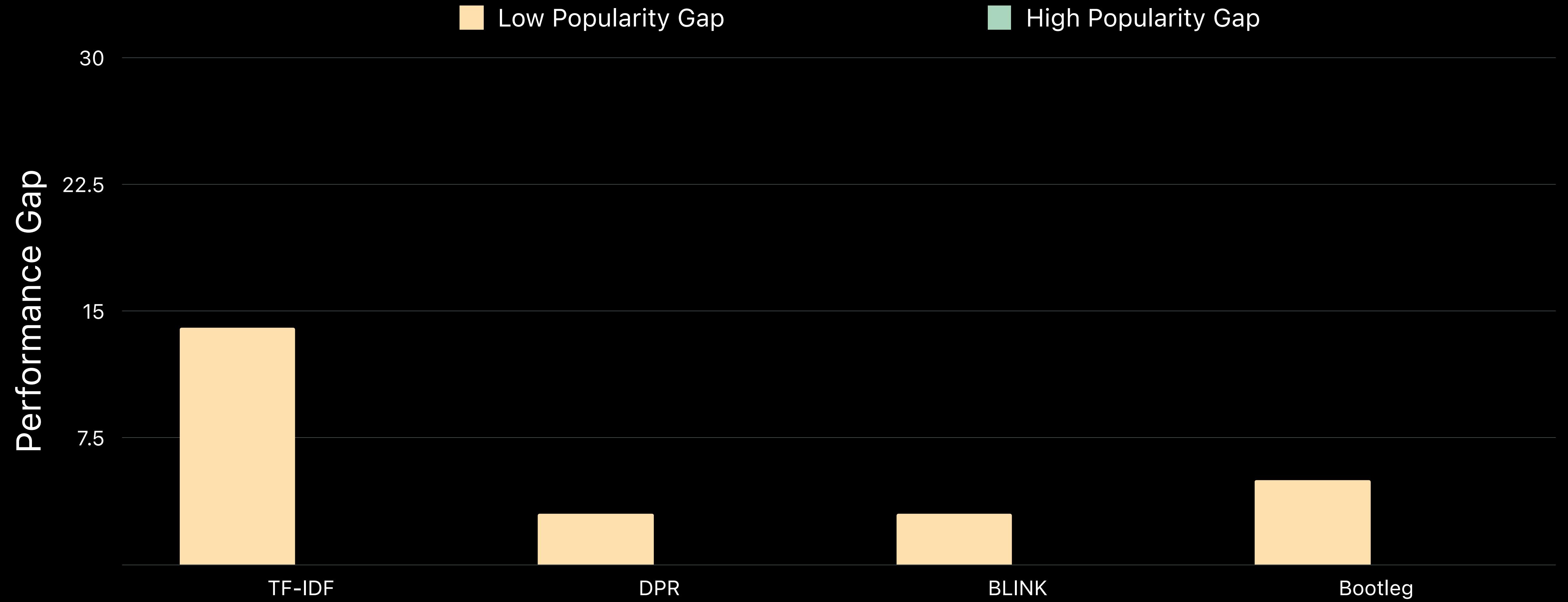
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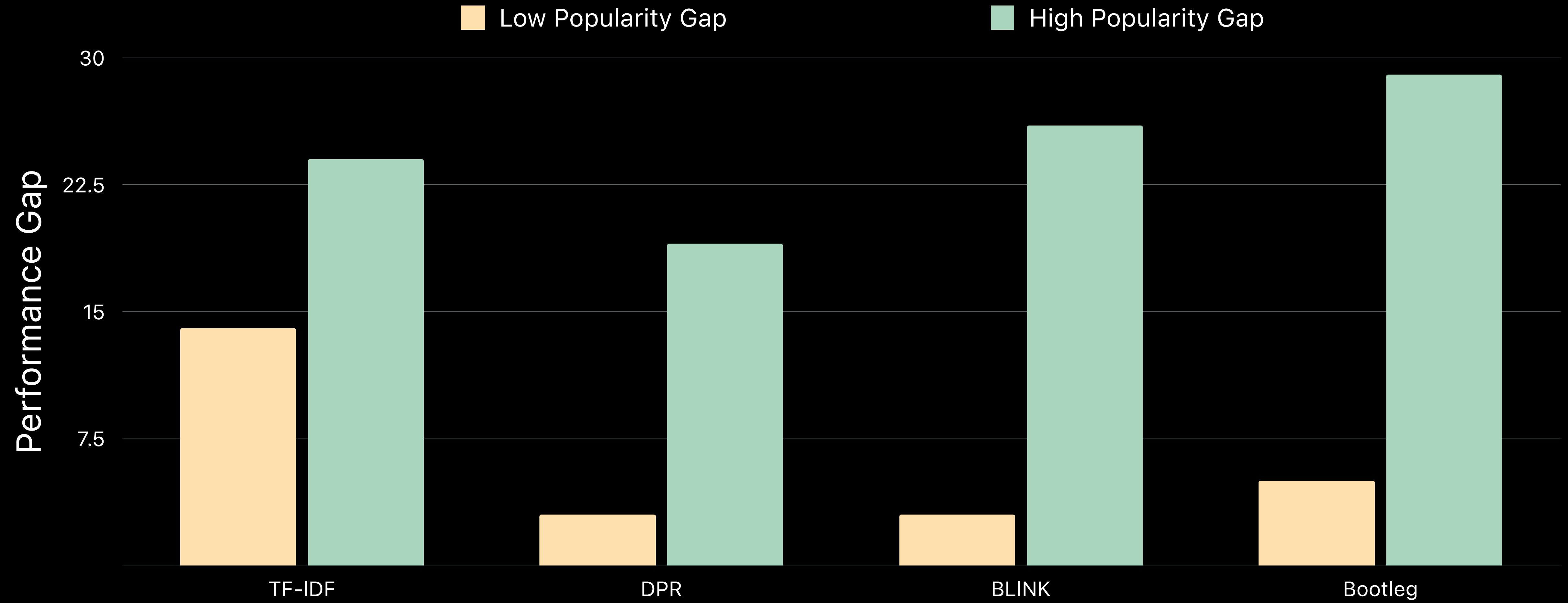
Bootleg



Does size of popularity gap affect size of performance gap?







Conclusions

- The ability to disambiguate entities is vital for retrievers, yet is understudied.
- Existing resources oversample head entities.
- Use AmbER sets to evaluate the robustness of your retrievers on the long-tail!

github.com/anthonywchen/AmbER-Sets



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