

# MoDS: Moderating a Mixture of Document Speakers to Summarize Debatable Queries in Document Collections

**Nishant Balepur**, Alexa Siu, Nedim Lipka, Franck Dernoncourt, Tong Sun,


Jordan Boyd-Graber, Puneet Mathur



# We often want answers to debatable queries


should I buy an electric car

All Videos Shopping News Forums Images Books More Tools

 U.S. News & World Report  
<https://cars.usnews.com> › Cars › Car Advice

## Should I Buy an Electric Car?

**No, Don't Buy:** Despite the Claims, They're Not Self-Driving. While many electric cars offer high levels of driver assistance and semi-automated driving, none ...

 Washington Post  
<https://www.washingtonpost.com> › ... › Green Living

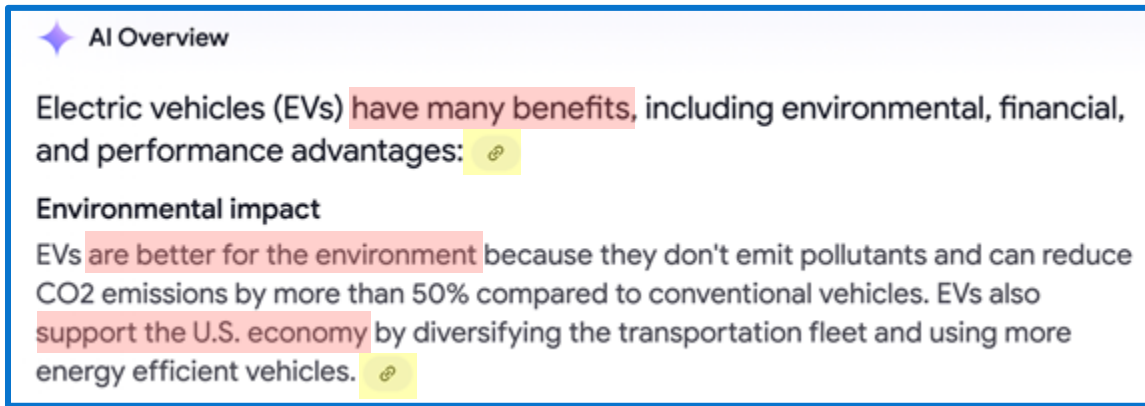
## Buy an electric vehicle now or wait? Here's how to decide.

Apr 11, 2023 — Then EVs can have a **significantly lower lifetime cost and emissions**. **Electricity is generally cheaper and cleaner.** Maintenance like brake pads ...

← **No, you shouldn't...**

← **Yes, you should!**

# Can we summarize these documents to answer the query?



Google's Gemini

When asked to summarize:

| *Are electric vehicles beneficial?*

broken down into topics, models:

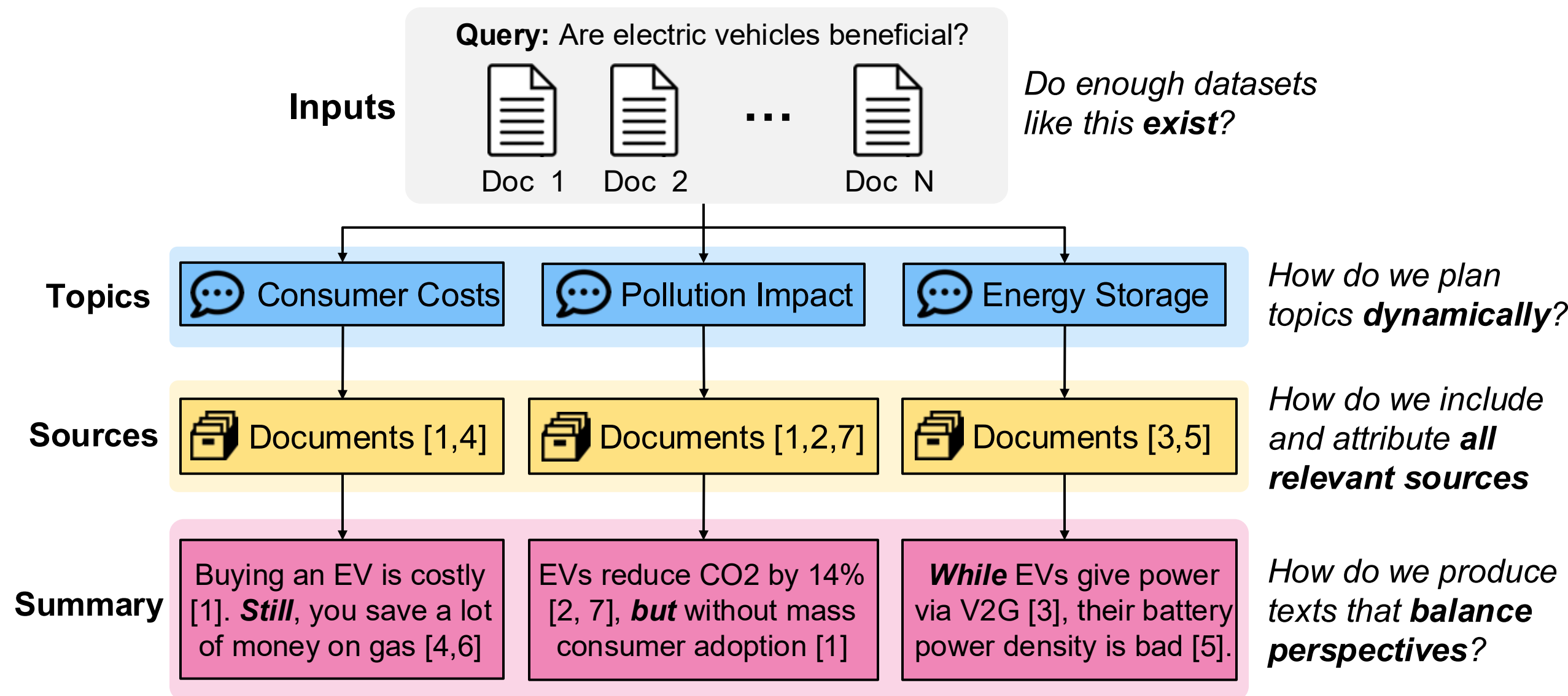


do not **balance** support and refute perspectives



do not use perspectives from **all input documents**

# A New Task: Debatable Query-Focused Summarization



# Existing approaches are insufficient

## Input Data

Query: Are electric vehicles beneficial?



Doc 1



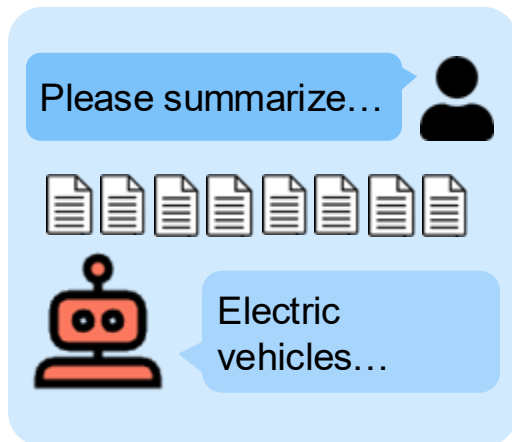
Doc 2

...



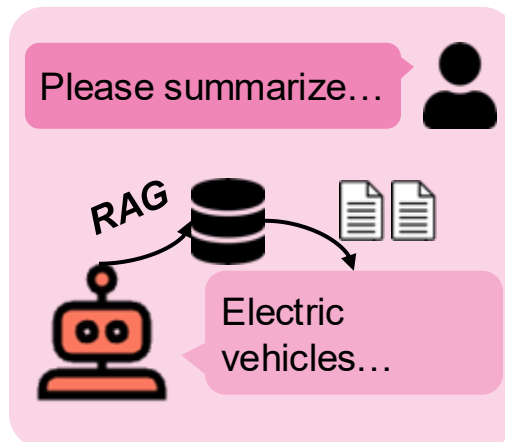
Doc N

### 1) Prompt over all docs



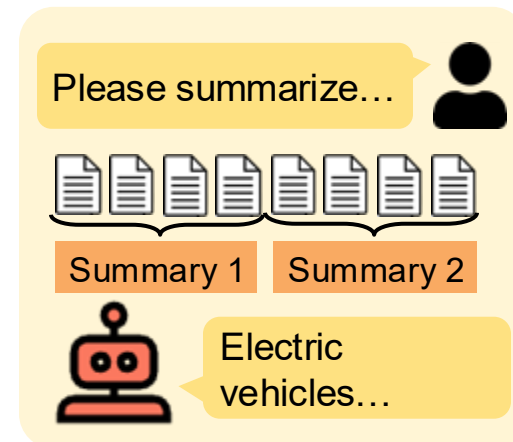
- Fails to cover documents in the middle of prompts
- Doesn't treat docs equally!

### 2) Retrieve + Generate



- Uses the same generic query for each document
- Misses perspectives specific to each document's content

### 3) Hierarchical Merging

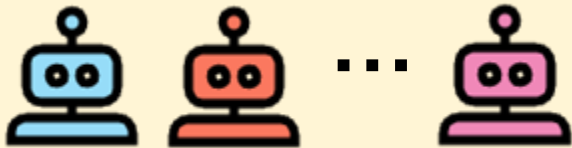


- Intermediate summaries are unstructured + hard to balance

# Solving these issues with MoDS: A Mixture of Document Speakers

To fairly treat documents...

*Are electric cars beneficial?*



**MoDS: Mixture of Document Speakers**

1

Agenda Planning

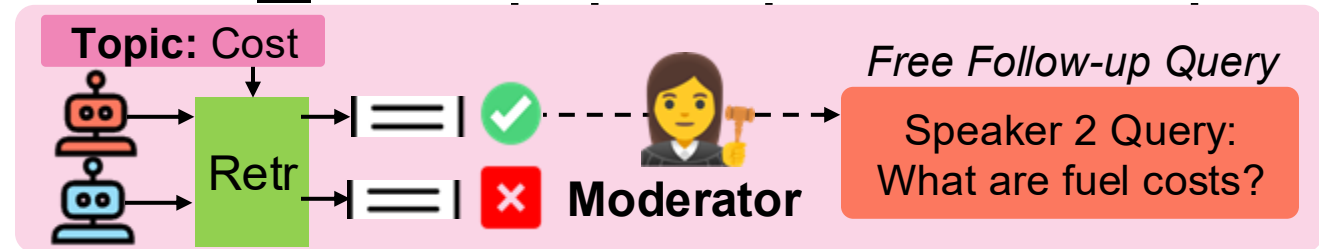
To plan discussion points... create a **topic agenda**



2

Speaker Selection

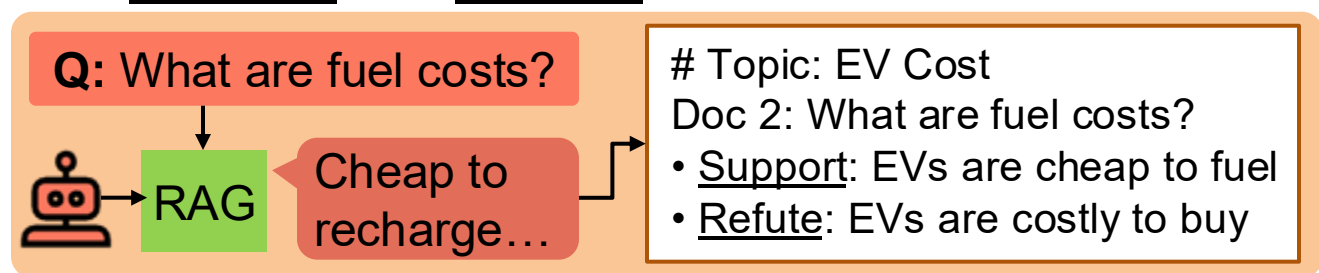
To cover all docs...



3

Speaker Discussion

For structure and balance



*3-Step Multi-Agent Panel Discussion*

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

Neatly Organizes:

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Neatly Organizes:

➤ Topics



# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Doc 1:

Doc 7:

Neatly Organizes:

- Topics
- Documents

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Doc 1:

Yes: EVs act as energy stores for power grids

Doc 7:

Yes: GM chose them for durability

Neatly Organizes:

- Topics
- Documents
- Yes Perspectives

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Doc 1:

Yes: EVs act as energy stores for power grids

Doc 7:

Yes: GM chose them for durability

No: A kg store 0.4% energy vs. a kg of gas

No: 175-lbs are needed to go just 90 miles

Neatly Organizes:

- Topics
- Documents
- Yes and No Perspectives

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Doc 1: How can EVS be used for power grids?

Yes: EVs act as energy stores for power grids

Doc 7: Why did GM choose lead-acid batteries?

Yes: GM chose them for durability

No: A kg store 0.4% energy vs. a kg of gas

No: 175-lbs are needed to go just 90 miles

Neatly Organizes:

- Topics
- Documents
- Yes and No Perspectives
- Follow-up queries

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

### 1. EVs as Energy Storage

Doc 1: How can EVS be used for power grids?

Yes: EVs act as energy stores for power grids

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Yes: GM chose them for durability

No: A kg store 0.4% energy vs. a kg of gas

No: 175-lbs are needed to go just 90 miles

### 2. EV Affordability and Market

... [for all topics] ...

Neatly Organizes:

- Topics
- Documents
- Yes and No Perspectives
- Follow-up queries

# Solving these issues with MoDS: A Mixture of Document Speakers

## Outline

Debate Question: Are electric vehicles beneficial?

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### 2. EV Affordability and Market

... [for all topics] ...

### 1. EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [7]. This limits their potential effectiveness as mobile energy solutions.

### 2. EV Affordability and Market

... [for all topics] ...

Neatly Organizes:

- Topics
- Documents
- Yes and No Perspectives
- Follow-up queries

Content plan for generating  
comprehensive, balanced summaries!

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## Outline

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### 2. EV Affordability and Market

... [for all topics] ...

## Final Summary

### 1. EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [7]. This limits their potential effectiveness as mobile energy solutions.

### 2. EV Affordability and Market

... [for all topics] ...

Neatly Organizes:

- Topics
- Documents
- Yes and No Perspectives
- Follow-up queries

Content plan for generating  
comprehensive, balanced summaries!

# A dataset to evaluate MoDS: DebateQFS

We curate a new dataset from **Debatepedia**<sup>[1]</sup>, the “Wikipedia of debates”

High-quality  
debate queries

Debate: High-speed rail

Is high speed rail development generally good policy?

[Edit] [Facebook] [Twitter] [Reddit] [StumbleUpon]

...

Pro/con sources

[Up] [Down] [X] [Edit] [Edit]

Pro

[Edit] [Add New]

- David Grossman. "The case for high speed rail in America." USA Today. September 25th, 2008
- Tim Halbur. "The Case for High-Speed Rail in the Northeast." The Railist. March 8th, 2011
- James Forsyth. "Making the case for high-speed rail." The Spectator. February 24th, 2011
- "The case for high-speed rail." Royal Automobile Club Foundation for Motoring. October 2009
- "HSR Opponents Make the Case for High-Speed Rail." Yglesias. November 2nd, 2010
- Philip Hammond. "High Speed Rail: the case for." The Telegraph. November 26th, 2010
- "The case for high speed rail grows." Telegraph
- US High-Speed Rail Association

Con

[Edit] [Add New]

- George Monbiot. "What's not to like about high-speed rail? The case simply hasn't been made." Guardian. May 17th, 2010
- Samuel Staley. "The Pragmatic Case Against High-Speed Rail." Reason Foundation. June 22, 2009
- "On the wrong track: Why high-speed trains are not such a green alternative." Guardian. April 29th, 2010
- "A Destininite makes the case for rejecting high-speed rail 'gift'." The Destin Log March 6th, 2011
- Jack Mobley. "A case against high-speed rail." Merced Sun Star. December 11th, 2010
- "Making the case for high speed rail." Birmingham Post. Dec 3, 2010
- No To High Speed 2

- 183 high-quality document collections
- 9.47 documents per collection
- 60/40 average support/refute split



# Evaluating MoDS: Citation Metrics

How do you measure if this summary is useful?



Doc 1



Doc 2



Doc 3

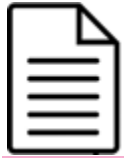
**Debatable Query:** Are electric vehicles beneficial?

## **Topic 1: EVs as Energy Storage**

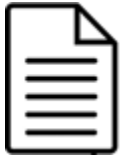
EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

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**Debatable Query:** Are electric vehicles beneficial?

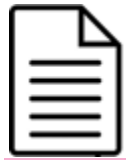
## Topic 1: EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

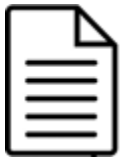
Look at citations!

# Evaluating MoDS: Citation Metrics

How do you measure if this summary is useful?



Doc 1



Doc 2



Doc 3

**Debatable Query:** Are electric vehicles beneficial?

## Topic 1: EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

Look at citations!

- **Document Coverage:** Proportion of documents cited  $(2 \text{ cited} / 3 \text{ total}) = 0.667$

# Evaluating MoDS: Citation Metrics

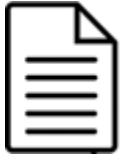
How do you measure if this summary is useful?

Yes



Doc 1

Yes



Doc 2

No



Doc 3

**Debatable Query:** Are electric vehicles beneficial?

## Topic 1: EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

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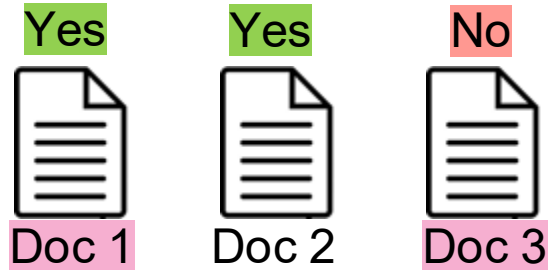
- **Document Coverage:** Proportion of documents cited
- **Fairness:** Even split of yes/no citations

$$(2 \text{ cited} / 3 \text{ total}) = 0.667$$

$$KL([0.5, 0.5], [0.5, 0.5]) = 0.000$$

# Evaluating MoDS: Citation Metrics

How do you measure if this summary is useful?



**Debatable Query:** Are electric vehicles beneficial?

## Topic 1: EVs as Energy Storage

EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

Look at citations!

- **Document Coverage:** Proportion of documents cited
- **Fairness:** Even split of yes/no citations
- **Faithfulness:** Yes/No citation split mirroring the inputs

$$(2 \text{ cited} / 3 \text{ total}) = 0.667$$

$$KL([0.5, 0.5], [0.5, 0.5]) = 0.000$$

$$KL([0.5, 0.5], [0.33, 0.67]) = 0.057$$

# Evaluating MoDS: Citation Metrics

How do you measure if this summary is useful?

Yes

Doc 1

Yes

Doc 2

No

Doc 3

Debatable Query: Are electric vehicles beneficial?

**Topic 1: EVs as Energy Storage**  
EVs can serve as valuable energy storage units when idle, contributing to the stability of the power grid [1]. However, early EVs like the GM EV1 had technical limitations. GM used lead-acid batteries due to their reliability, but these batteries had poor energy density—requiring over 1,100 pounds to travel just 90 miles [3]. This limits their potential effectiveness as mobile energy solutions.

Look at citations!

- **Document Coverage:** Proportion of documents cited (2 cited / 3 total) = 0.667
- **Fairness:** Even split of yes/no citations  $KL([0.5, 0.5], [0.5, 0.5]) = 0.000$
- **Faithfulness:** Yes/No citation split mirroring the inputs  $KL([0.5, 0.5], [0.33, 0.67]) = 0.057$

\*We also verify citations are accurate to avoid cheating

# MoDS excels at summarizing debatable queries

MoDS has the best:

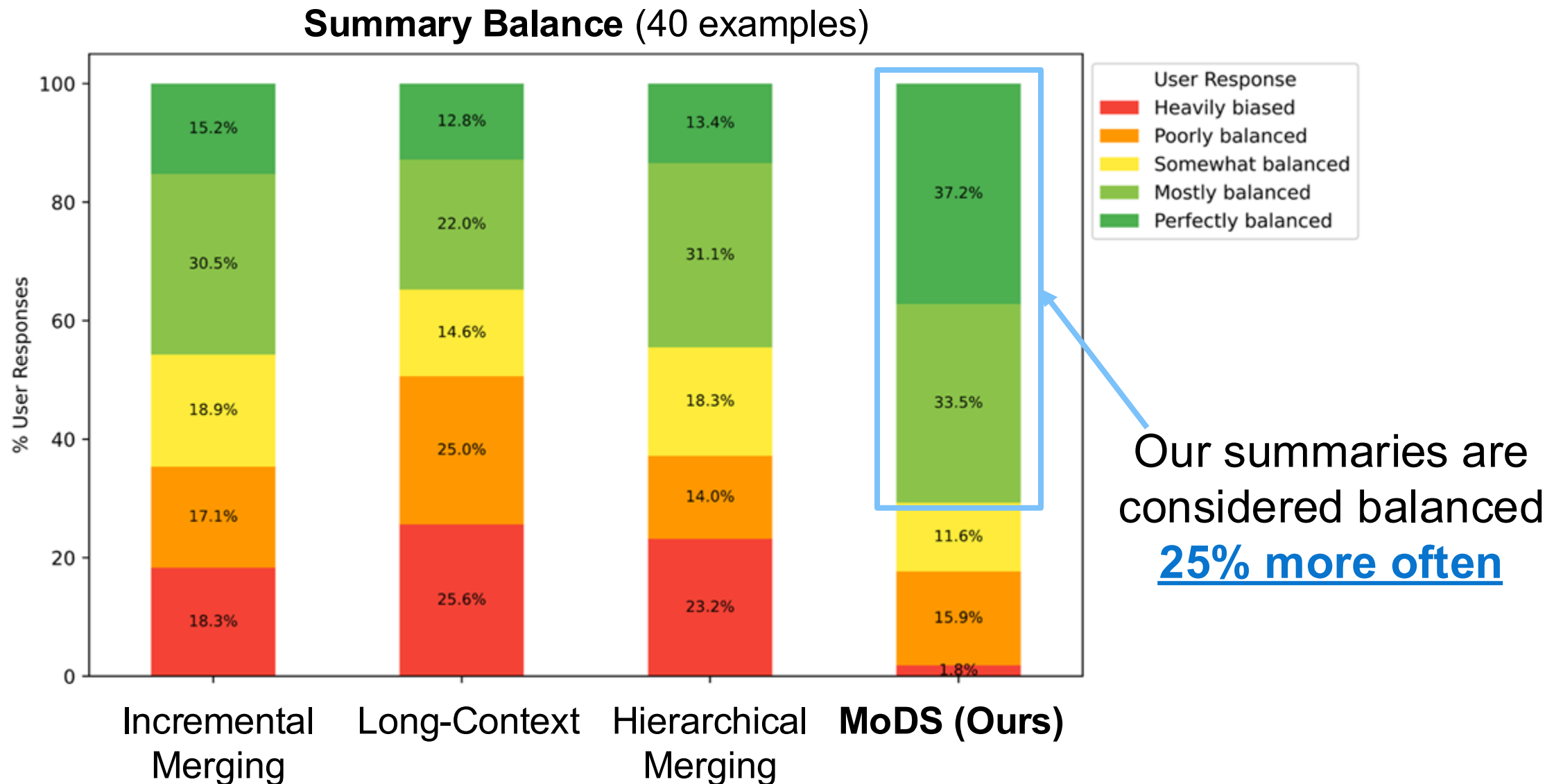
- **Document Coverage**: Includes perspectives from more documents
- **Fairness**: Balances “support” and “refute” perspectives
- **Faithfulness**: Reflects the perspectives of the input documents

Overall Summary

# Top.	Model	DC (↑)	Fair (↓)	Faithful (↓)
3	MoDS-Topic (Ours)	0.8724*	0.0701*	0.0235*
	MoDS-All (Ours)	0.8457*	0.0786*	0.0273*
	Long-Context	0.5877	0.2094	0.1790
	RAG-All	0.6125	0.1544	0.1040
	RAG-Doc	0.7171	0.1180	0.0664
	Hierarchical	0.7868	0.0907	0.0374
	Incremental-All	0.5566	0.2579	0.2089
	Incremental-Topic	0.6152	0.2415	0.1970
	Cluster	0.7102	0.1106	0.0725
RAG+Cluster	0.6811	0.1405	0.0894	
5	MoDS-Topic (Ours)	0.9137*	0.0651*	0.0208*
	MoDS-All (Ours)	0.8847*	0.0640*	0.0236*
	Long-Context	0.6686	0.1724	0.1392
	RAG-All	0.6721	0.1423	0.0912
	RAG-Doc	0.7765	0.1053	0.0618
	Hierarchical	0.8565	0.0761*	0.0239*
	Incremental-All	0.6122	0.2000	0.1629
	Incremental-Topic	0.6767	0.1659	0.1198
	Cluster	0.8098	0.1116	0.0624
RAG+Cluster	0.7811	0.1233	0.0738	

We surpass SOTA by **38-59%** in topic paragraph coverage and balance!

# And humans agree!





# Qualitative Comparison

**Query:** Should all public transport be free?

**Discussion Topic:** Economics

## MoDS (Ours)

Eliminating public transport fares can lead to increased ridership, more efficient use of existing capacity, and savings in fare collection costs, potentially improving quality of life and accessibility for low-income groups [1][2][3][5][6][9]. However, fare-free systems may face sustainability challenges due to increased operational costs, dependency on public funding, and potential service quality degradation due to higher demand and limited resources [7][12][13][14].

Our Model...

## Long-Context

Eliminating public transport fares without improving services is not cost-effective for increasing patronage [13]. Free public transport primarily aids the already well-served and may not justify the financial cost, as seen in Hasselt's experience [13].

# Summary + Takeaways

In this paper, we have:

- Tackled the unexplored task of summarizing debatable queries => DQFS
- Collected a new, high-quality dataset => DebateQFS
- Designed and thoroughly evaluated a multi-agent panel discussion framework => MoDS
  - **One LLM Speaker per document** => all perspectives are *treated equally*
  - **Moderator-tailored queries** => cater to relevant docs to *find all perspectives*
  - **Outline planning** => *better balance perspectives* in the final summary

Check out our paper!

## **MoDS: Moderating a Mixture of Document Speakers to Summarize Debatable Queries in Document Collections**

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**Tong Sun<sup>2</sup>    Jordan Boyd-Graber<sup>1</sup>    Puneet Mathur<sup>2</sup>**

<sup>1</sup>University of Maryland    <sup>2</sup>Adobe Research

`nbalepur@umd.edu    puneetm@adobe.com`

# Is saying “Thank You” the best way to conclude a presentation?

**Nishant Balepur**, Alexa Siu, Nedim Lipka, Franck Dernoncourt, Tong Sun,

Jordan Boyd-Graber, Puneet Mathur

