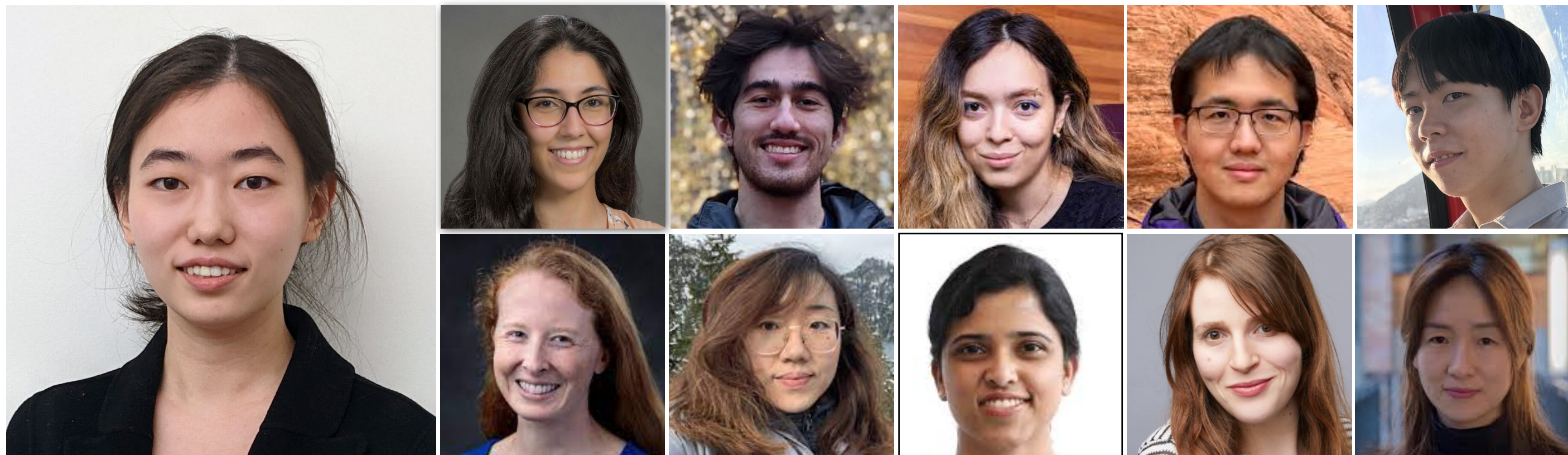


AI as Humanity's Salieri:

Quantifying Linguistic Creativity of Language Models via Systematic Attribution of Machine Text against Web Text

Ximing Lu, **Melanie Sclar**, Skyler Hallinan, Niloofar Miresghallah, Jiacheng Liu, Seungju Han, Allyson Ettinger, Liwei Jiang, Khyathi Chandu, Nouha Dziri, Yejin Choi



Ximing Lu



How linguistically creative are LLMs?

How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



ChatGPT

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...

... a significant increase in the use of artificial intelligence (AI) in various fields, including language generation. One ...

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



ChatGPT

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...

... a significant increase in the use of artificial intelligence (AI) in various fields, including language generation. One ...

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

... such as chat GPT-3 to assist in the process. However, the question remains: can AI fully replace human recruiters? ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



ChatGPT

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...

... a significant increase in the use of artificial intelligence (AI) in various fields, including language generation. One ...

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

... such as chat GPT-3 to assist in the process. However, the question remains: can AI fully replace human recruiters? ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



ChatGPT

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...

... a significant increase in the use of artificial intelligence (AI) in various fields, including language generation. One ...

... more important point here about the complexity of poetry and the limitations that critics and readers impose upon it ...

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

... such as chat GPT-3 to assist in the process. However, the question remains: can AI fully replace human recruiters? ...

Reference Corpus

Verbatim Match

Near Verbatim Match

How linguistically creative are LLMs?



Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



ChatGPT

... with a more intellectual brain. The advancement of technology has led to the creation of an of electronic ...

... a significant increase in the use of artificial intelligence (AI) in various fields, including language generation. One ...

... more important point here about the complexity of poetry and the limitations that critics and readers impose upon it ...

The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

... That partnership led to the integration of artificial intelligence (AI) in various apps, making them smarter ...

... such as chat GPT-3 to assist in the process. However, the question remains: can AI fully replace human recruiters? ...

... narrowly limited and inflexible in its ability to comprehend and apply all the relevant facts in order to ...

Reference Corpus

Verbatim Match

Near Verbatim Match

Have LLMs reached a new level of linguistic sophistication?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



This paper critically examines the intersection of literature, particularly poetry, and artificial intelligence (AI). It analyses the subject in two major aspects: exploring concepts of 'optimization' in the context of AI and investigating how literature, specifically poetry, poses a significant challenge to AI's understanding due to its multifaceted nature, rich with figurative language, deep metaphors, and emotional subtext. The paper also explores the broader implications regarding machine learning and the humanities. Through this lens, it raises thought-provoking questions about the limits of AI, the enduring importance of human creativity, and whether or not there can ever genuinely be an AI poet or AI literature.

How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



This paper critically examines the intersection of literature, particularly poetry, and artificial intelligence (AI). It analyses the subject in two major aspects: exploring concepts of 'optimization' in the context of AI and investigating how literature, specifically poetry, poses a significant challenge to AI's understanding due to its multifaceted nature, rich with figurative language, deep metaphors, and emotional subtext. The paper also explores the broader implications regarding machine learning and the humanities. Through this lens, it raises thought-provoking questions about the limits of AI, the enduring importance of human creativity, and whether or not there can ever genuinely be an AI poet or AI literature.

How linguistically creative are LLMs?

Please draft an abstract for a paper with the following title:
"Poetry Will Not Optimize; or, What Is Literature to AI?"



... similar examples of wisdom in art, literature, poetry, and other forms of human discourse. As a result, when I...

... via tools including popular DALL-E. Similarly, large language models like GPT-3 and PaLM are producing ...

Literature, poetry, and other forms of noncommercial creative expression challenge the techno-instrumentalist approaches to language, the predictive language generation, informing NLP (large natural language processing models) such as GPT-3 or -4 as well as, more generally, generative AI (text to image, video, audio). Claims that AI systems automate and expedite creativity reflect industry and research priorities of speed, scale, optimization, and frictionlessness driving much artificial intelligence design and application ...



Prof. Michele Elam

How linguistically creative are LLMs?



The advancement of technology has led to the integration of artificial intelligence (AI) in various fields, including literature. However, the question remains: can AI truly understand and create poetry? This paper delves into the complexities of poetry and the limitations of AI in its ability to comprehend and replicate the nuanced emotions and intricacies of language. Through a critical analysis of the relationship between poetry and AI, this paper argues that while AI may be able to generate text that resembles poetry, it lacks the ability to truly ...

This paper critically examines the intersection of literature, particularly poetry, and artificial intelligence (AI). It analyses the subject in two major aspects: exploring concepts of 'optimization' in the context of AI and investigating how literature, specifically poetry, poses a significant challenge to AI's understanding due to its multifaceted nature, rich with figurative language, deep metaphors, and emotional subtext. The paper also explores the broader implications regarding machine learning and the humanities. Through this lens, it raises thought-provoking questions about the limits of AI, the enduring importance of human creativity, and whether or not there can ever genuinely be an AI poet or AI literature.



Literature, poetry, and other forms of noncommercial creative expression challenge the techno-instrumentalist approaches to language, the predictive language generation, informing NLP (large natural language processing models) such as GPT-3 or -4 as well as, more generally, generative AI (text to image, video, audio). Claims that AI systems automate and expedite creativity reflect industry and research priorities of speed, scale, optimization, and frictionlessness driving much artificial intelligence design and application ...



Prof. Michele Elam

We present ***Creativity Index***, a metric that quantifies a text's **linguistic creativity** by reconstructing it from existing text snippets on the web

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

x =

The advancement of technology has led to the integration of artificial intelligence in various fields, including literature.

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

x = The advancement of technology has led to the integration of artificial intelligence in various fields, including literature.

$$4\text{-uniqueness}(x) = \frac{8}{17}$$

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

x = The advancement of technology has led to the integration of artificial intelligence in various fields, including literature.

$$4\text{-uniqueness}(x) = \frac{8}{17}$$

$$5\text{-uniqueness}(x) = \frac{5}{17}$$

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

x = The advancement of technology has led to the integration of artificial intelligence in various fields, including literature.

$$4\text{-uniqueness}(x) = \frac{8}{17}$$

$$5\text{-uniqueness}(x) = \frac{5}{17}$$

$$6\text{-uniqueness}(x) = \frac{0}{17}$$

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

Defining the Creativity Index

L -uniqueness(x) = proportion of x 's words that do not belong to any n -grams ($n \geq L$) found in the reference corpus C

$$\text{CreativityIndex}(x) = \sum_{L=a}^b L\text{-uniqueness}(x)$$

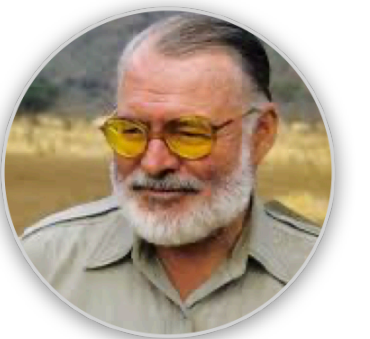
Have LLMs reached a new level of linguistic sophistication?

Please write a few paragraphs of novel starting with the following prompt: "He was an old man who fished alone in a skiff in the Gulf Stream and he had gone eighty-four days now without taking a fish."



His name was Santiago, a man of the sea, whose weathered face told tales of storms weathered and battles with beasts of the deep. Each day he would rise with the sun, a silent silhouette against the soft pink hues of dawn. His skiff, although worn and marked with the passage of time, was his steadfast partner in this dance with the sea. He'd untie her from the old wooden dock behind his humble cottage, her worn wooden hull lightly creaking as if singing a familiar tune that only they understood. Every day, he ventured out into the seemingly infinite expanse ...

... In the first forty days a boy had been with him. But after forty days without a fish the boy's parents had told him that the old man was now definitely and finally *salao*, which is the worst form of unlucky, and the boy had gone at their orders in another boat which caught three good fish the first week. It made the boy sad to see the old man come in each day with his skiff empty and he always went down to help him carry either the coiled lines or the gaff and harpoon and the sail that was furled around the mast. The sail was patched with flour sacks and, furled, it looked ...



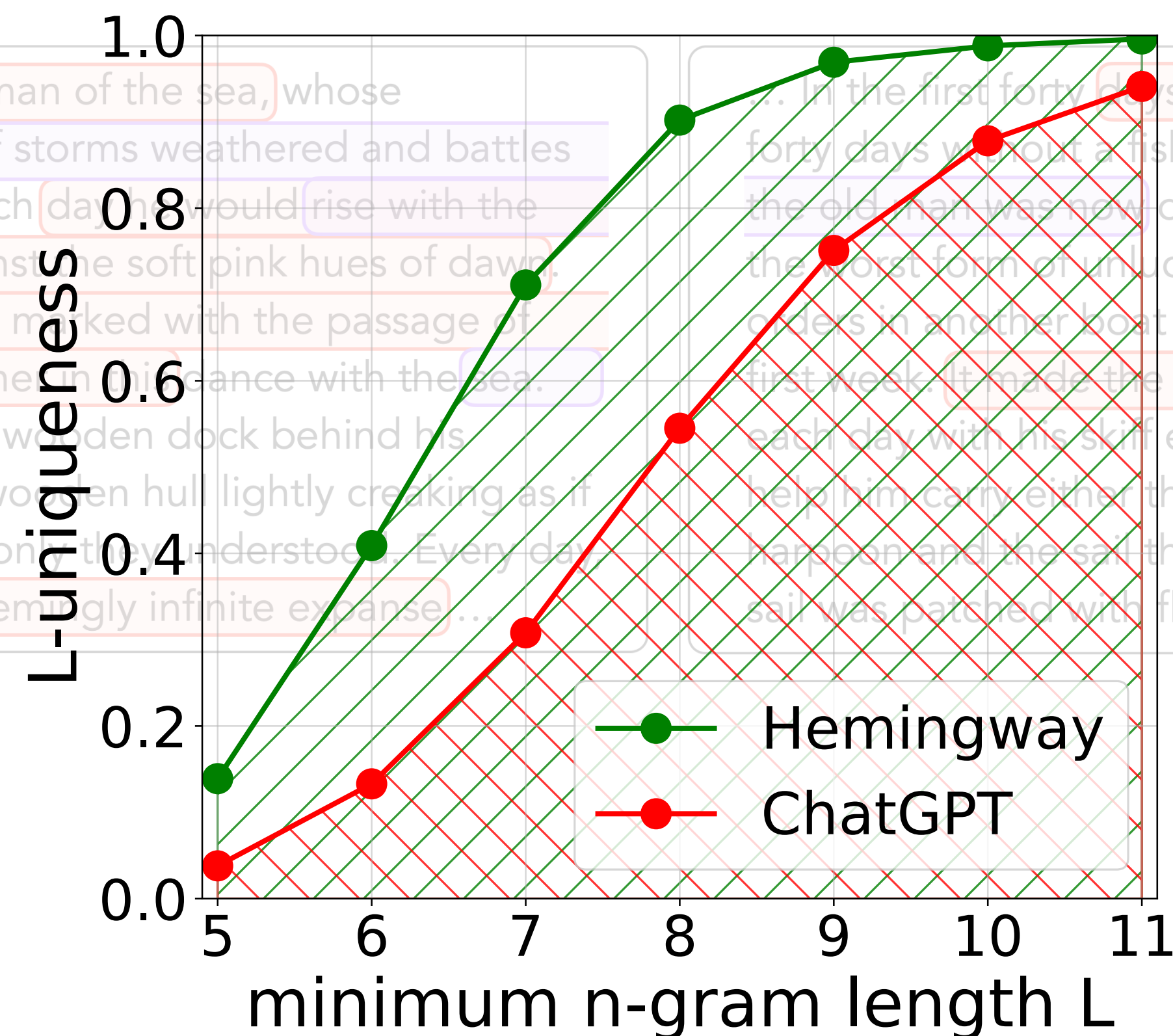
Ernest Hemingway

Have LLMs reached a new level of linguistic sophistication?

Please write a few paragraphs of novel starting with the following prompt: "He was an old man who fished alone in a skiff in the Gulf Stream and he had gone eighty-four days now without taking a fish."



His name was Santiago, a man of the sea, whose weathered face told tales of storms weathered and battles with beasts of the deep. Each day would rise with the sun, a silent silhouette against the soft pink hues of dawn. His skiff, although worn and marked with the passage of time, was his steadfast partner in his dance with the sea. He'd untie her from the old wooden dock behind his humble cottage, her worn wooden hull lightly creaking as it singing a familiar tune that only they understood. Every day he ventured out into the seemingly infinite expanse...



Ernest Hemingway

DJ Search: Making Creativity Index computationally feasible

DJ Search: Making Creativity Index computationally feasible

Goal: compute for every n -gram \mathbf{x} whether it occurs in training data C
($f(\mathbf{x}, C)$), either **verbatim** or **near verbatim**

DJ Search: Making Creativity Index computationally feasible

Goal: compute for every n -gram \mathbf{x} whether it occurs in training data C (" $f(\mathbf{x}, C)$ "), either **verbatim** or **near verbatim**

- Make each $f(\mathbf{x}, C)$ call as fast as possible

verbatim matches



InfiniGram (Liu et al., 2024)

near verbatim matches



Word Movers' Distance (Kusner et al., 2015)

DJ Search: Making Creativity Index computationally feasible

Goal: compute for every n -gram \mathbf{x} whether it occurs in training data C ($f(\mathbf{x}, C)$), either **verbatim** or **near verbatim**

- Make each $f(\mathbf{x}, C)$ call as fast as possible

verbatim matches



InfiniGram (Liu et al., 2024)

near verbatim matches



Word Movers' Distance (Kusner et al., 2015)

- WMD measures n -grams distances by combining word embedding distances, **thus enables reuse of computations**
- We reduce C to only the most similar documents according to BM25

DJ Search: Making Creativity Index computationally feasible

Goal: compute for every n -gram \mathbf{x} whether it occurs in training data C (" $f(\mathbf{x}, C)$ "), either **verbatim** or **near verbatim**

- Make each $f(\mathbf{x}, C)$ call as fast as possible

verbatim matches



InfiniGram (Liu et al., 2024)

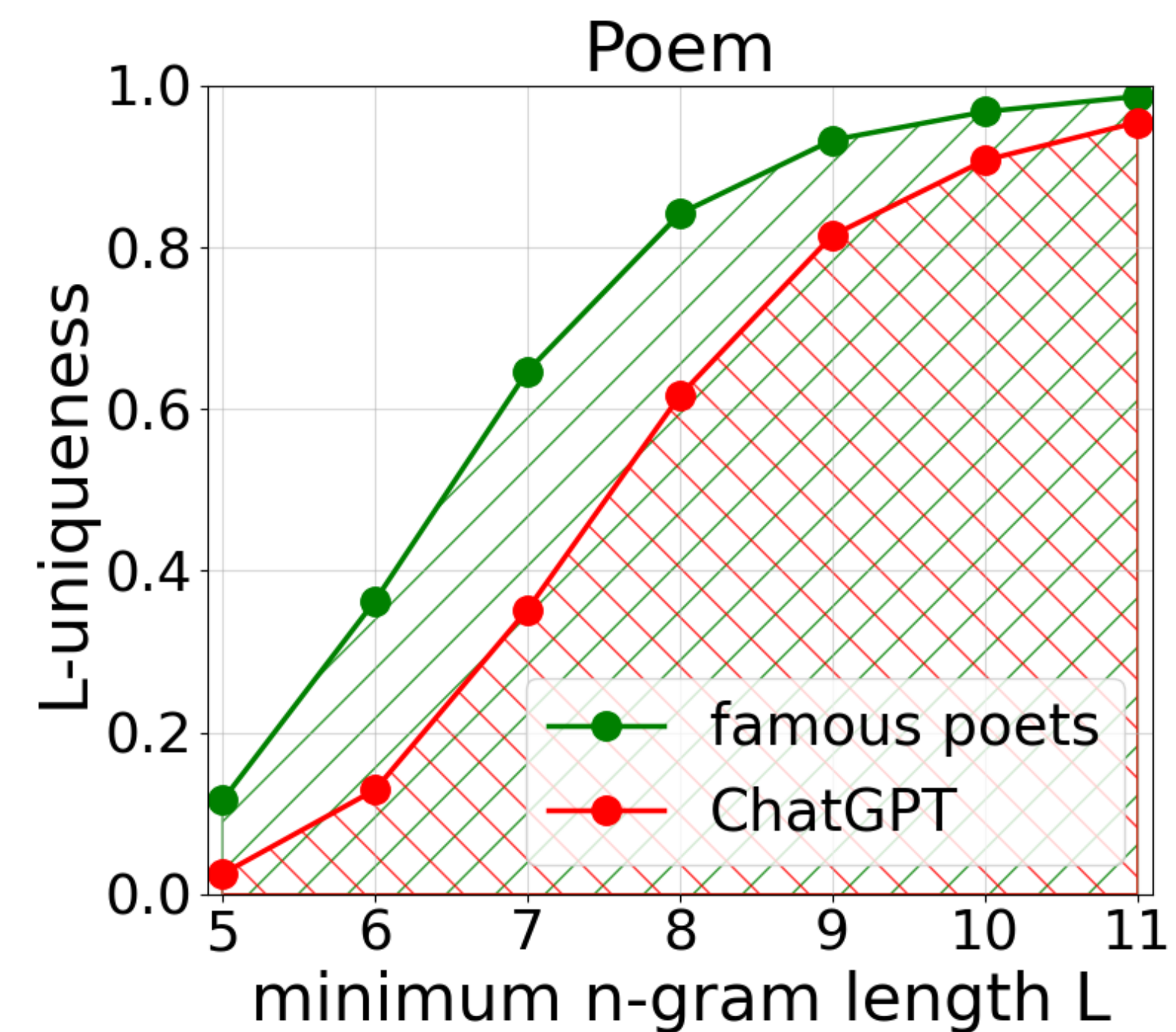
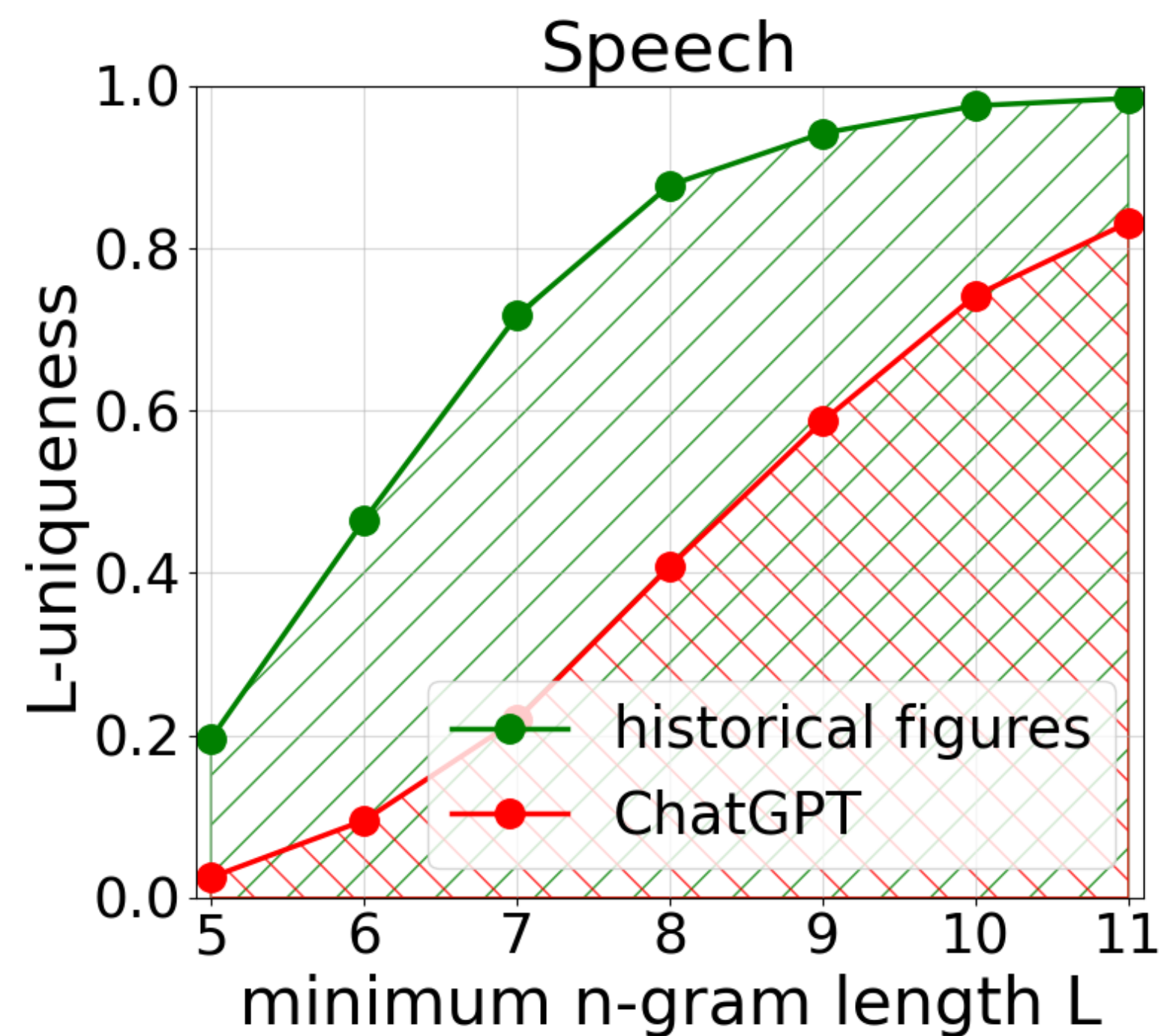
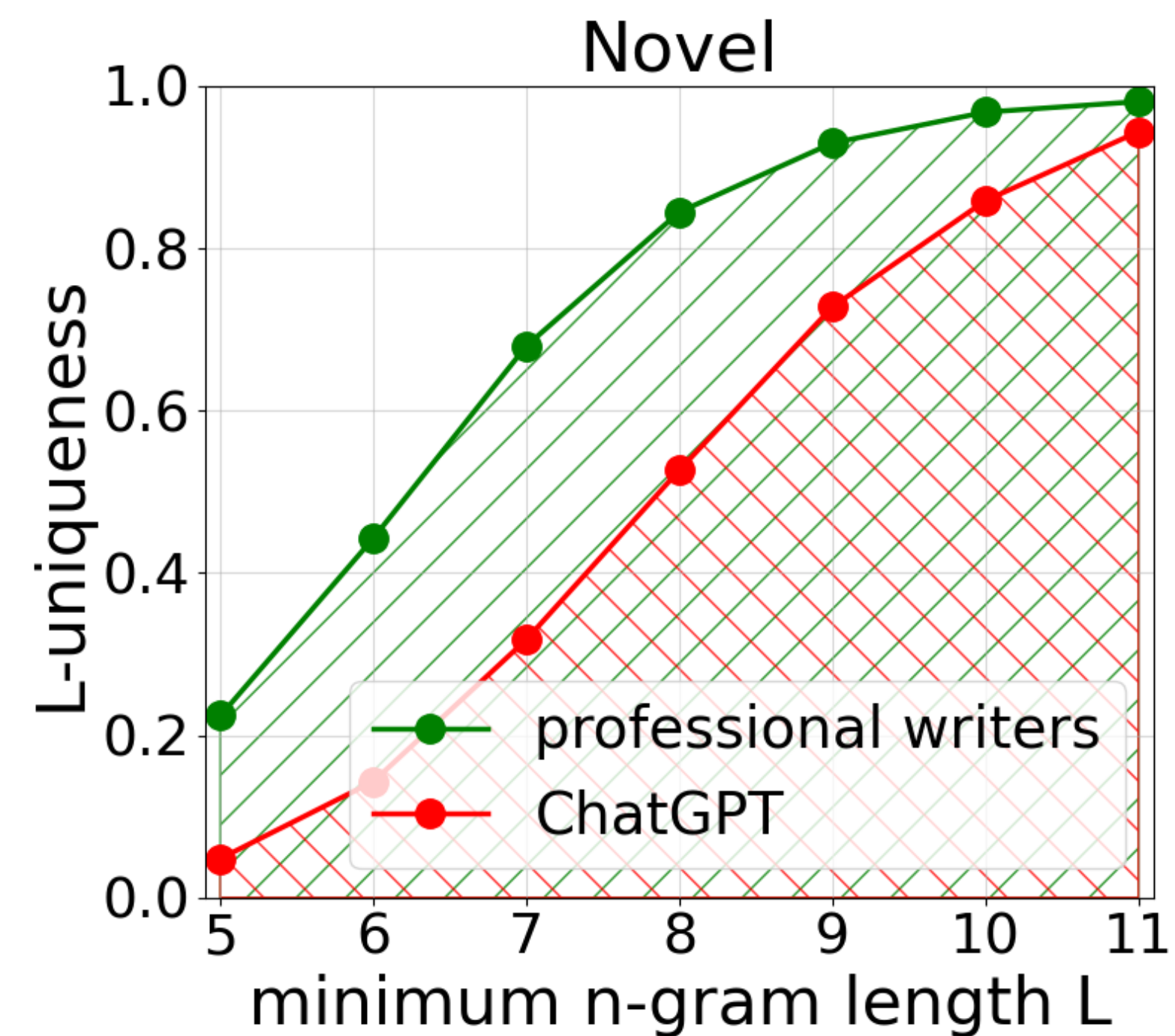
near verbatim matches



Word Movers' Distance (Kusner et al., 2015)

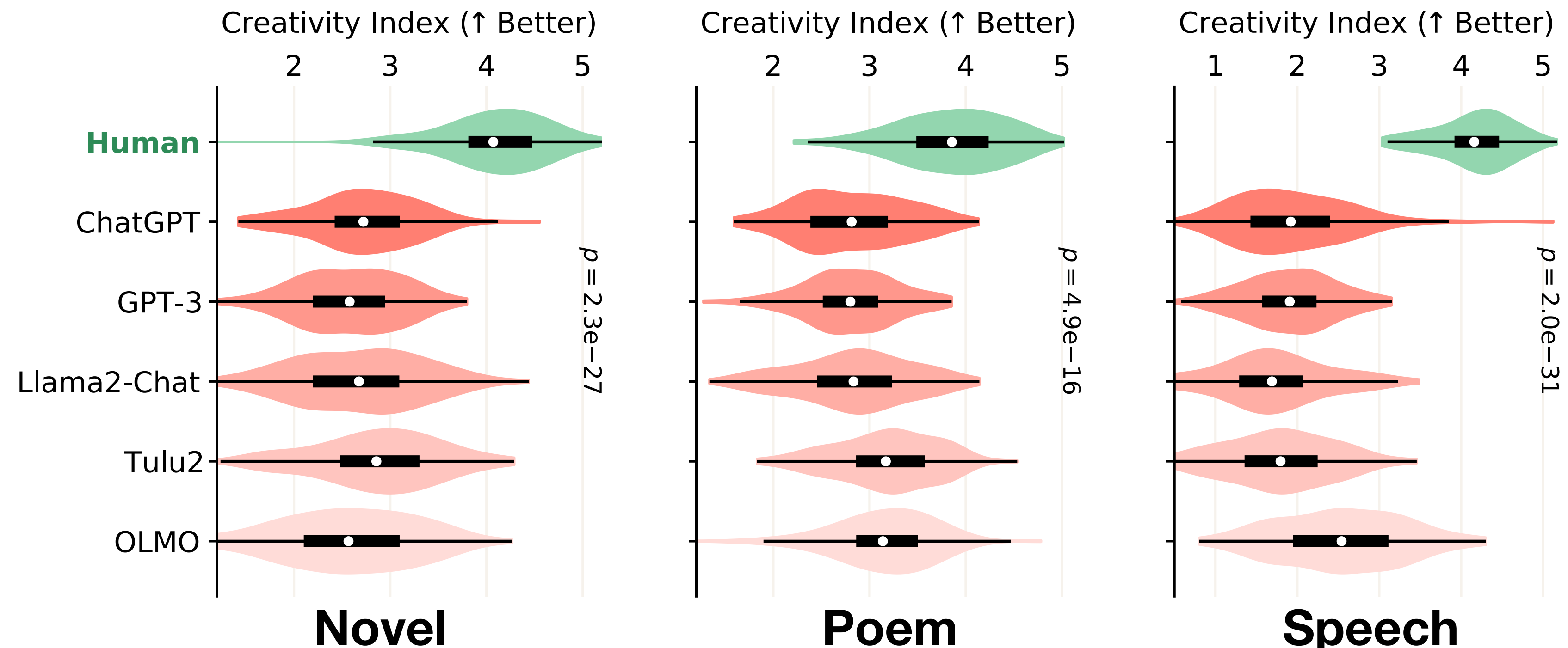
- Minimize # of $f(\mathbf{x}, C)$ calls: **two-pointer approach**

Professional human writers are more linguistically creative than LLMs

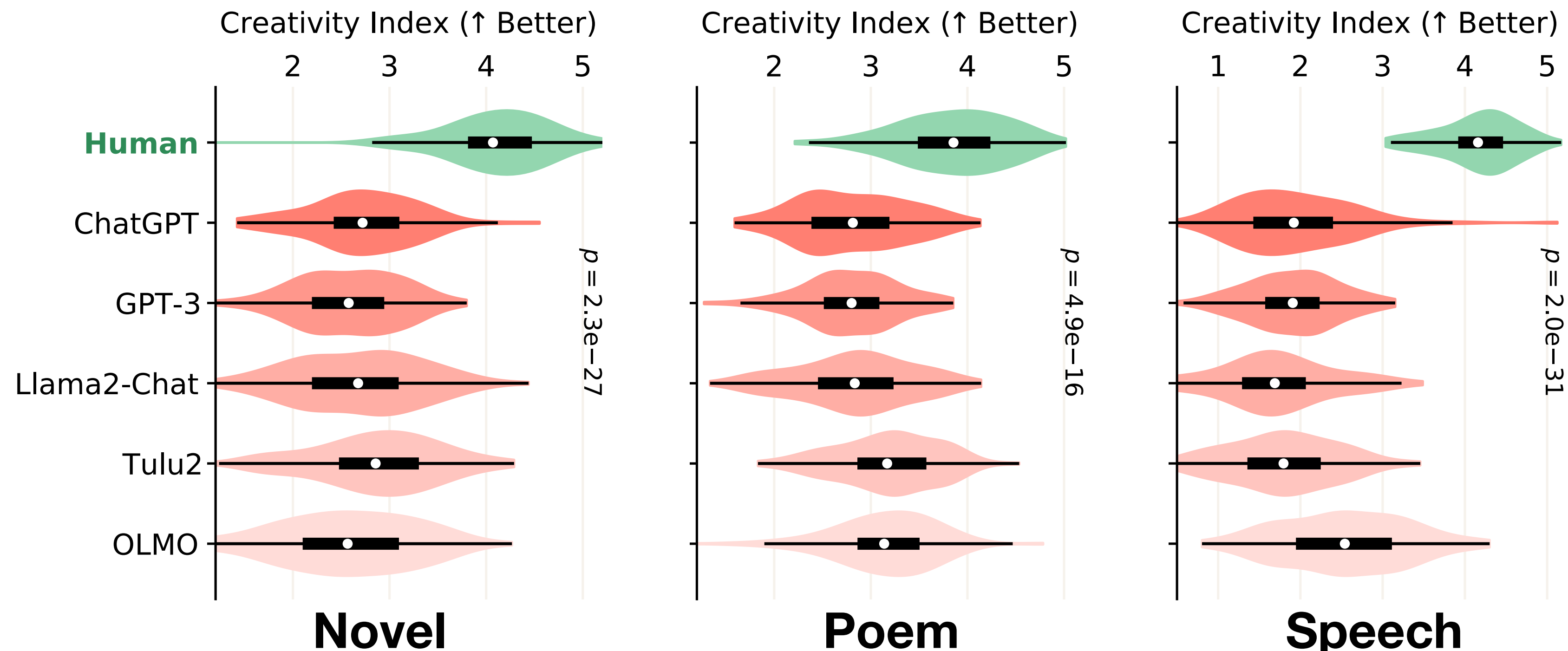


**Professional human writers are more
linguistically creative than LLMs**

Professional human writers are more linguistically creative than LLMs



Professional human writers are more linguistically creative than LLMs



Professional writers and historical figures show
+66.2% CREATIVITY INDEX than LLMs on average

Creativity varies widely among humans

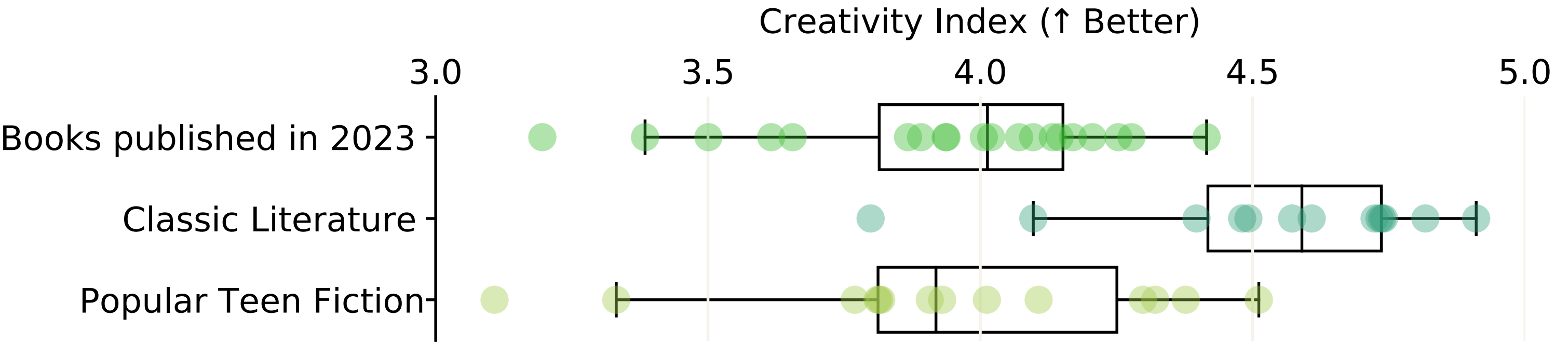
Books published in 2023



Classic Literature



Popular Teen Fiction



Creativity varies widely among humans

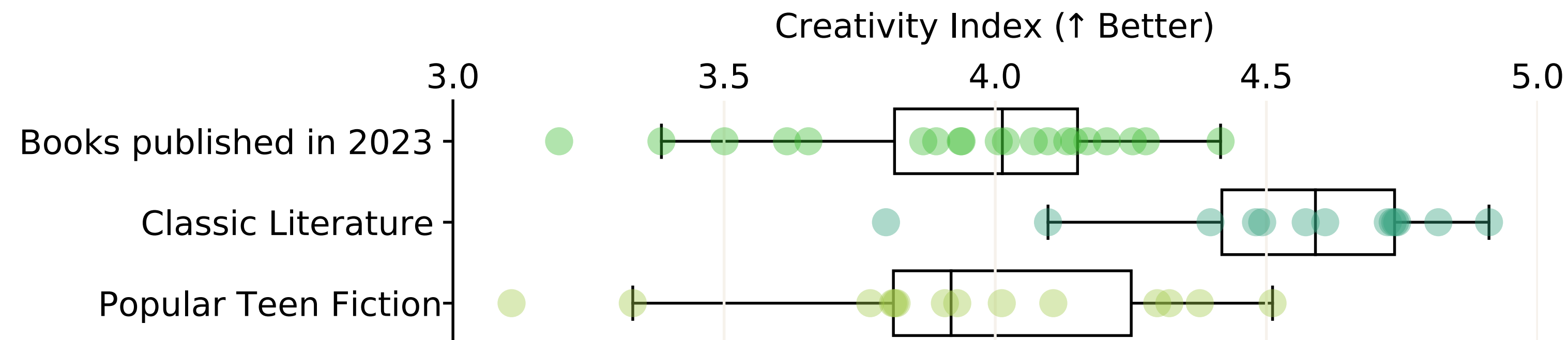
Books published in 2023



Classic Literature

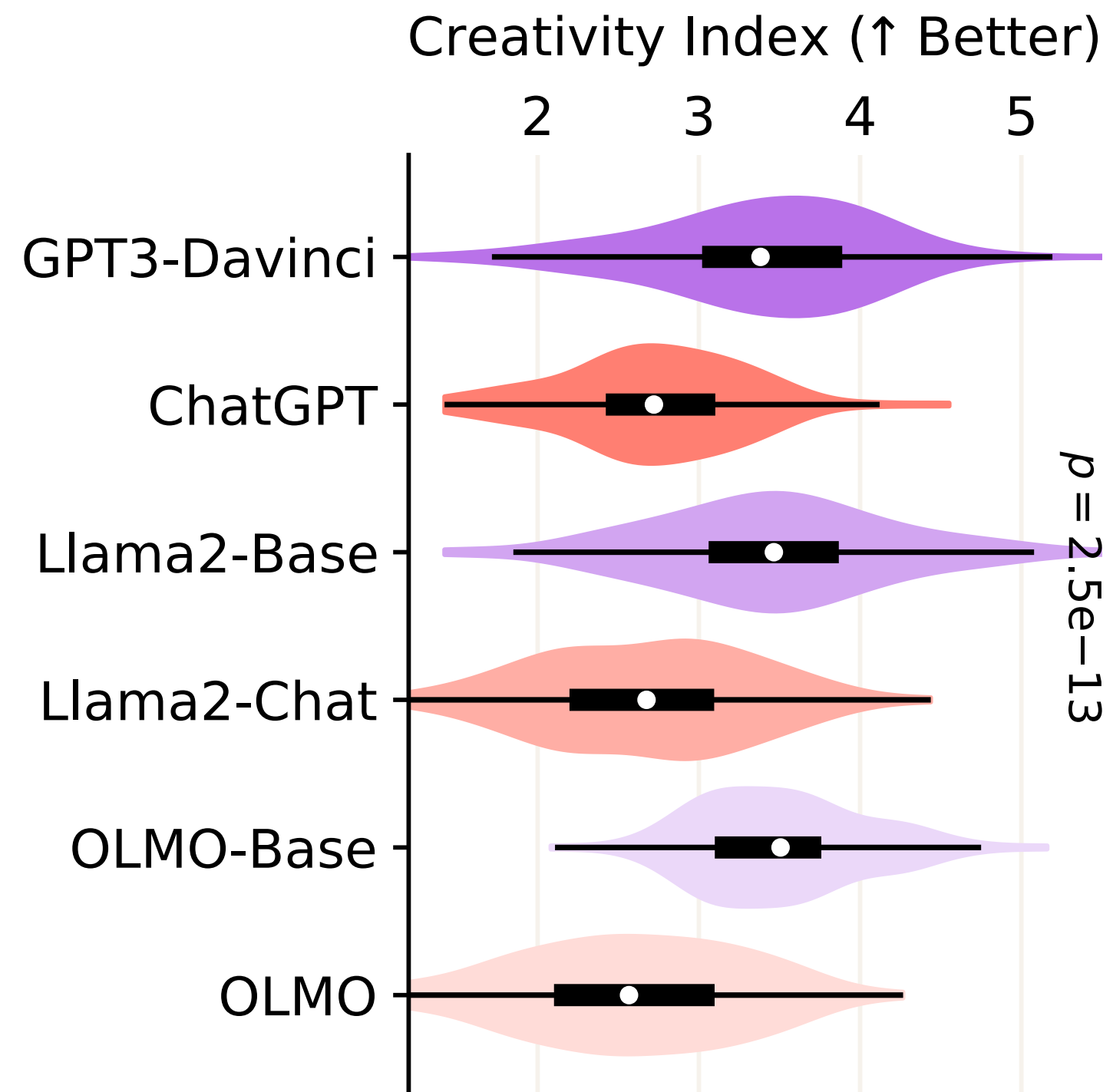


Popular Teen Fiction

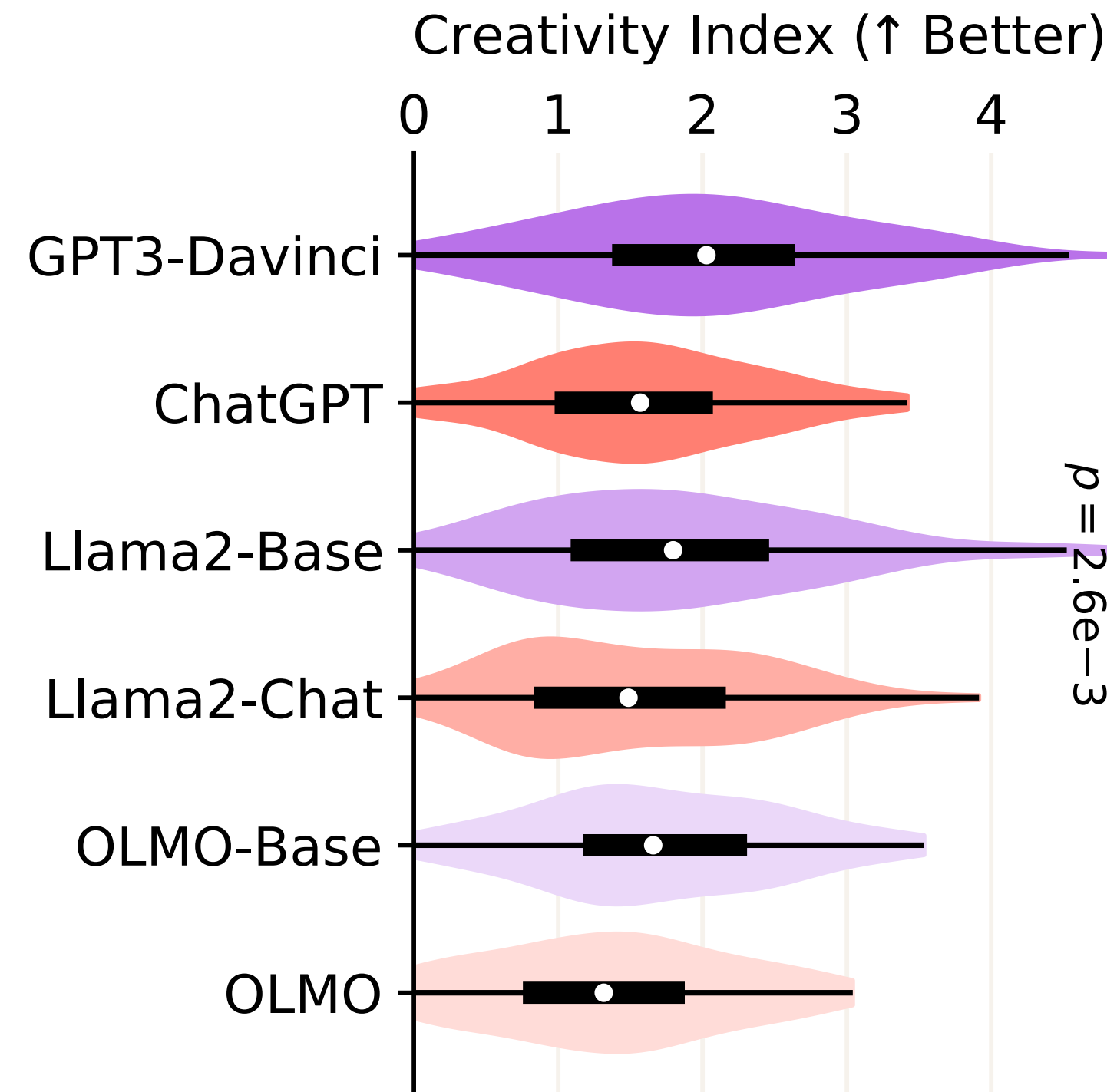


Despite the in-group variance, the **CREATIVITY INDEX** of classic literature is **17.7%** higher than the other two categories

RLHF greatly reduces LLMs' linguistic creativity

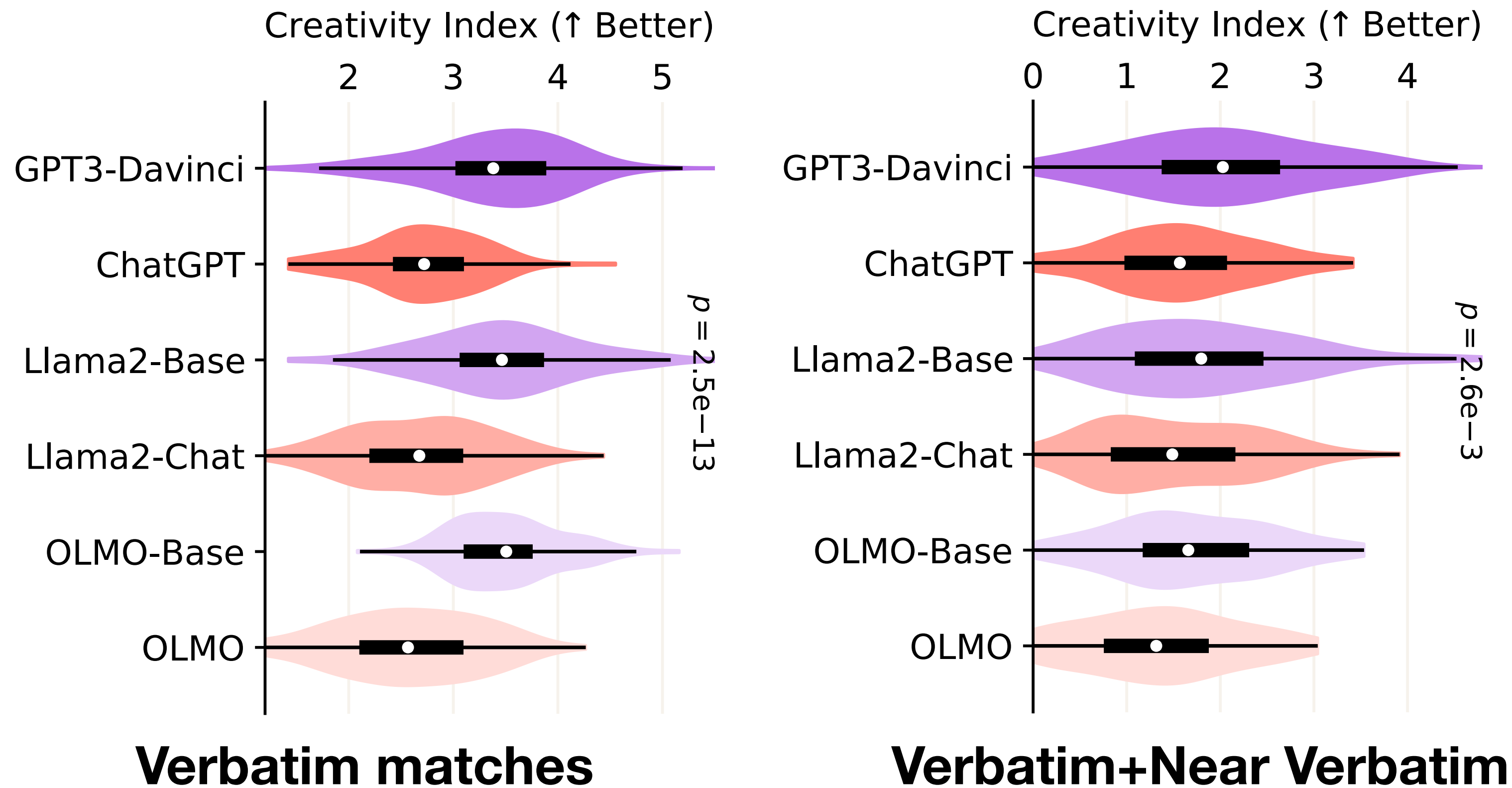


Verbatim matches



Verbatim+Near Verbatim

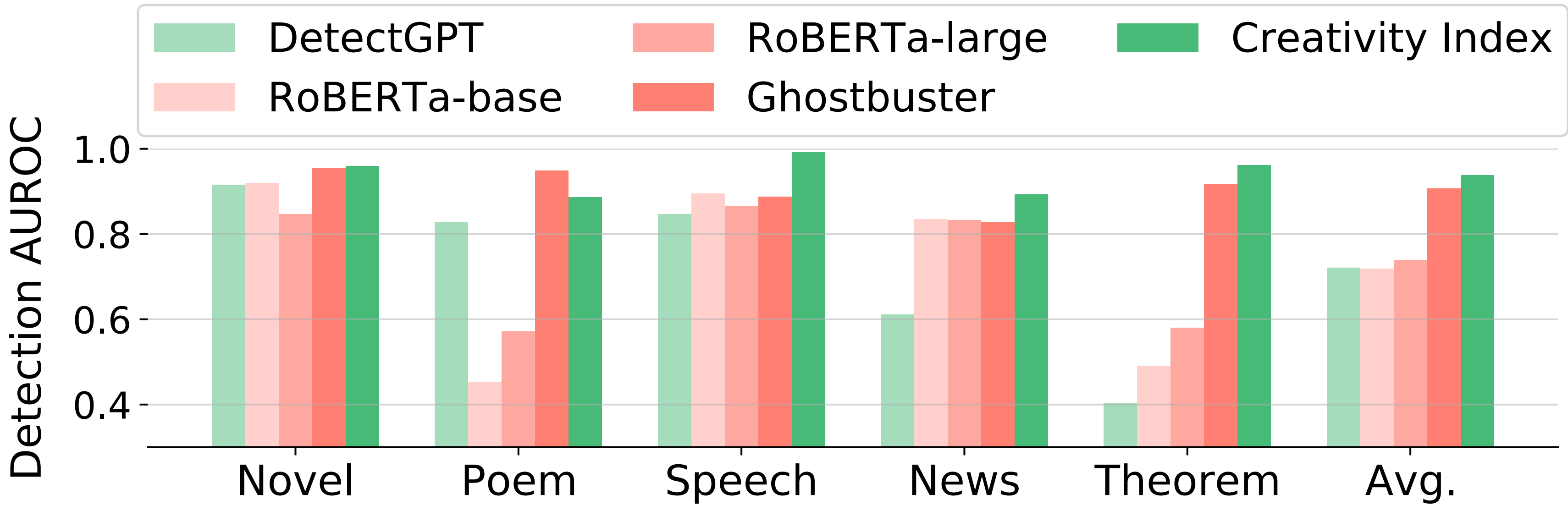
RLHF greatly reduces LLMs' linguistic creativity



RLHF reduces the **CREATIVITY INDEX** of LLMs by **30.1% on average**; the reduction is much larger when looking at verbatim matches only.

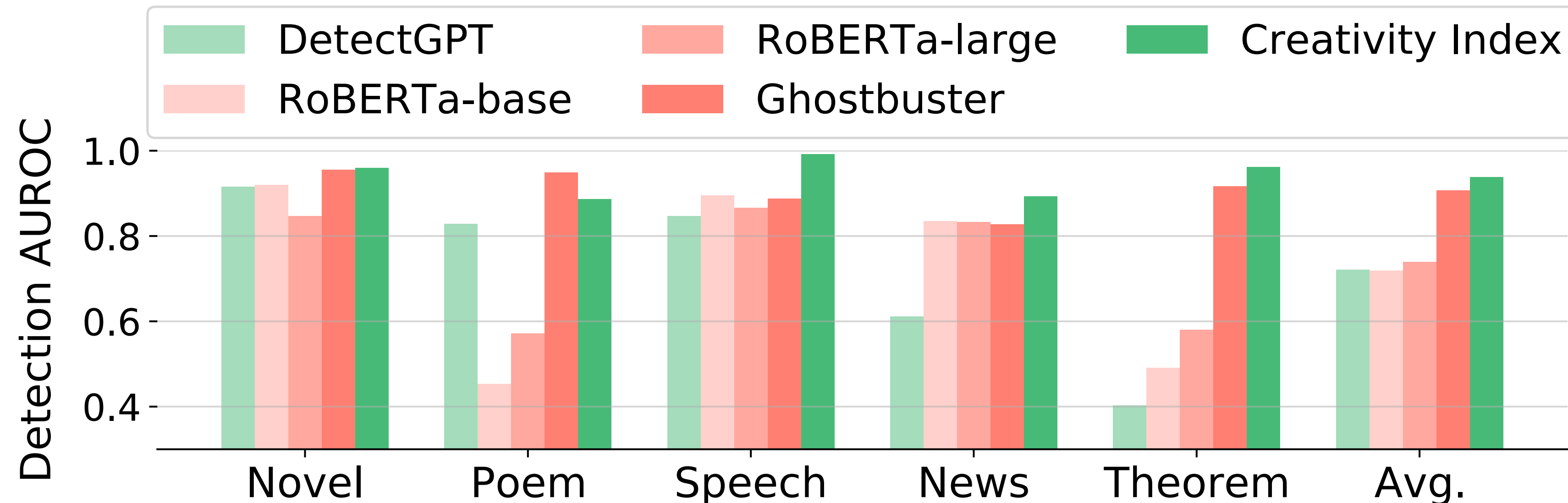
CREATIVITY INDEX for Zero-shot Machine Text Detection

Intuition: $P(\mathbf{x} \in \text{human texts}) \propto \text{CREATIVITY INDEX}(\mathbf{x})$



CREATIVITY INDEX for Zero-shot Machine Text Detection

Intuition: $P(\mathbf{x} \in \text{human texts}) \propto \text{CREATIVITY INDEX}(\mathbf{x})$



We beat the strongest **zero-shot system** by 30.2%, and outperform the strongest **supervised system** in five out of six domains

Thanks for listening!

Poster: **Fri 25th 3pm @ Hall 3 + Hall 2B #618**

Creativity Index resources:

- **Code:** github.com/GXimingLu/creativity_index
- **Demo:** huggingface.co/spaces/liujch1998/creativity