Comparative Analysis of Classical Polish Literature Using Small Language Models

Patrycja Wysocka, Tomasz Krupiński, Łukasz Jaremek, Mieszko Mirgos

Warsaw University of Technology

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Agenda

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2. Dataset generation
3. Methods
4. EDA
5. Experiments
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Introduction

Research Overview

- **Problem:** Gap in understanding small LLMs' effectiveness for non-English literature
- **Approach:** Evaluation of 4 models on Polish classical texts
- **Innovation:**
  - Focus on smaller, accessible models (7B parameters)
  - Comprehensive evaluation framework

Dataset generation

Dataset Construction - Source Material

Corpus Composition:

- 11 seminal Polish works
- Mix of genres:
  - Poetry (Pan Tadeusz, Sonety)
  - Drama (Dziady, Kordian)
  - Novels (Lalka, Quo Vadis)
- Public domain sources (Wikisource)

Evaluation Task

- **Q&A Generation**
  - Question-Answer Pairs was a main task for all models.
  - Questions were generated using GPT-4
  - Duplicate questions were filtered out to ensure variety.
  - Books where splitted for 100 chunks and one question was asked to every chunk.
  - The final output consisted of Polish language question-and-answer pairs.
  - Generated questions focused on themes, characters, and key events in the texts.

Methods

Models Under Evaluation

- **General Multilingual:**
  - Qwen2.5 (7B parameters)
    - 128k context window
    - Broad domain coverage
  - LLaMA3.1 (8B parameters)
    - 128k context window
    - Instruction-tuned
  - Mistral v0.3 (7B parameters)
    - Designed for instruction-following tasks
    - High performance on multilingual benchmarks
- **Polish-Specific:**
  - Bielik (7B parameters)
    - 36B tokens training (22B Polish)
    - Mistral 7B base

Evaluation Framework

Primary Metrics:

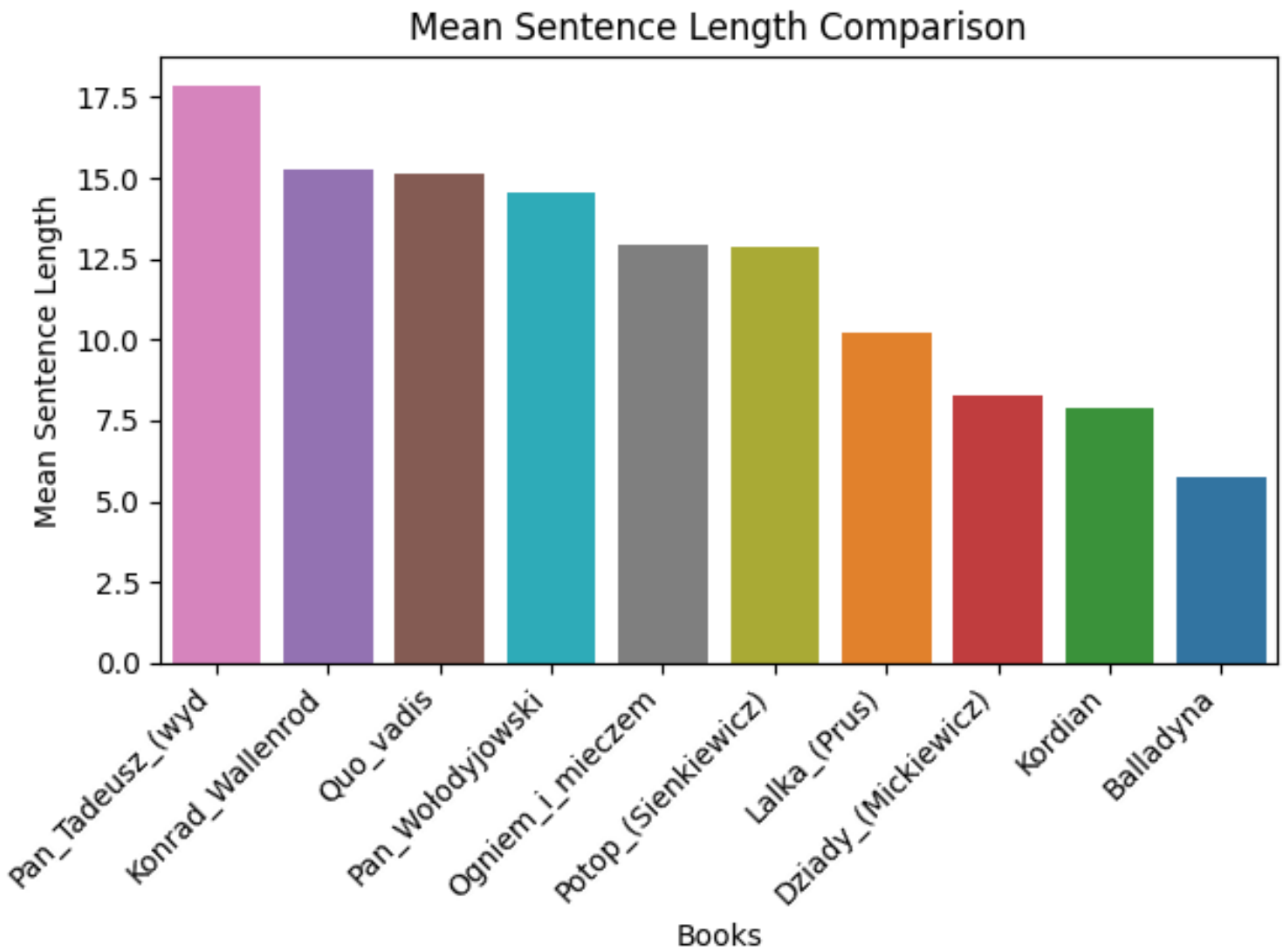
- **BLEU Score**
  - N-gram precision
  - Brevity penalty
- **METEOR**
  - Synonym matching
  - Word order evaluation
- **ROUGE Variants**
  - ROUGE-1

Followup Metric:

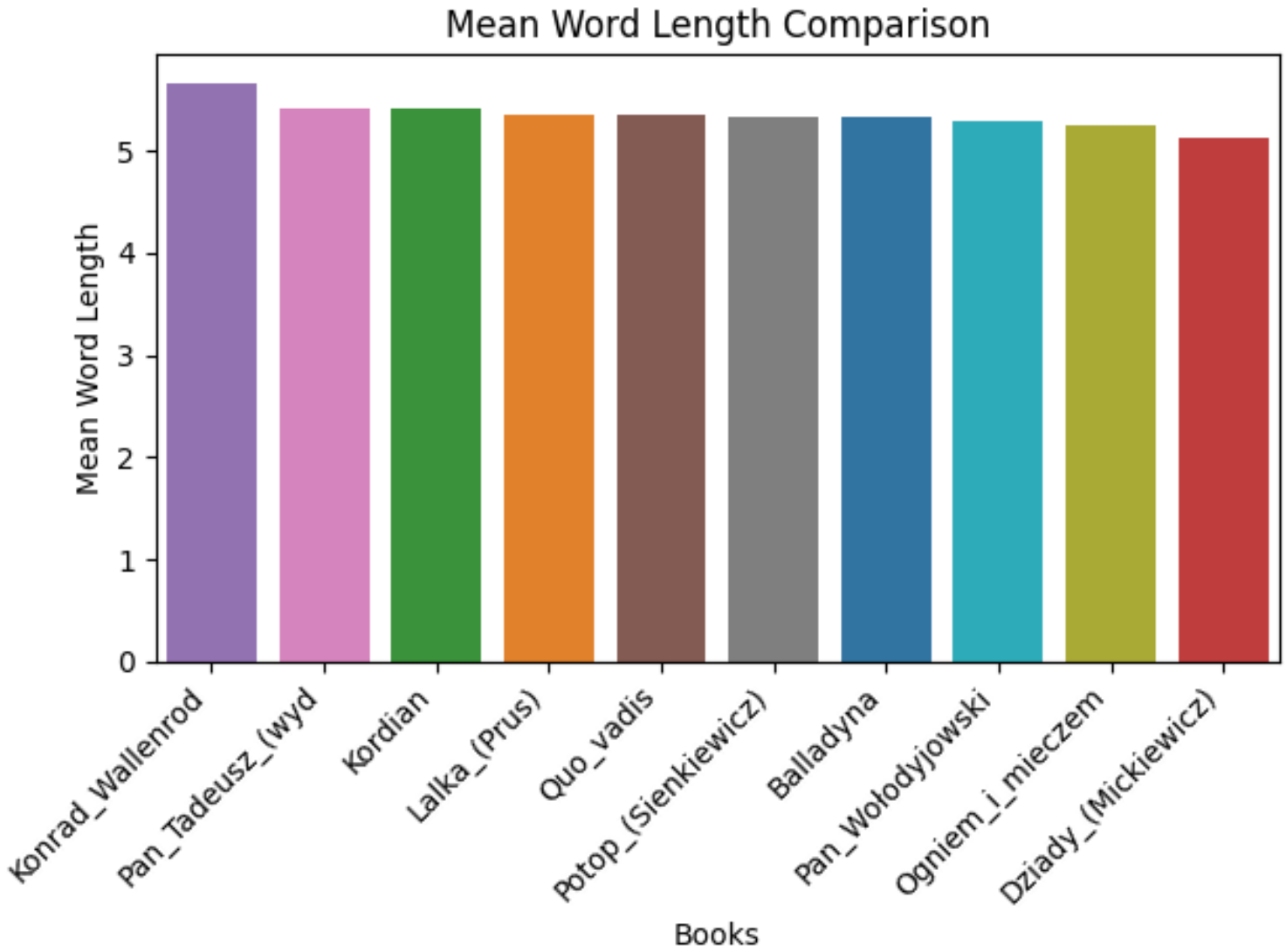
- **BERT-score**
  - Similarity evaluation
  - Transformer based evaluation

EDA

Mean Sentence Length Across Works

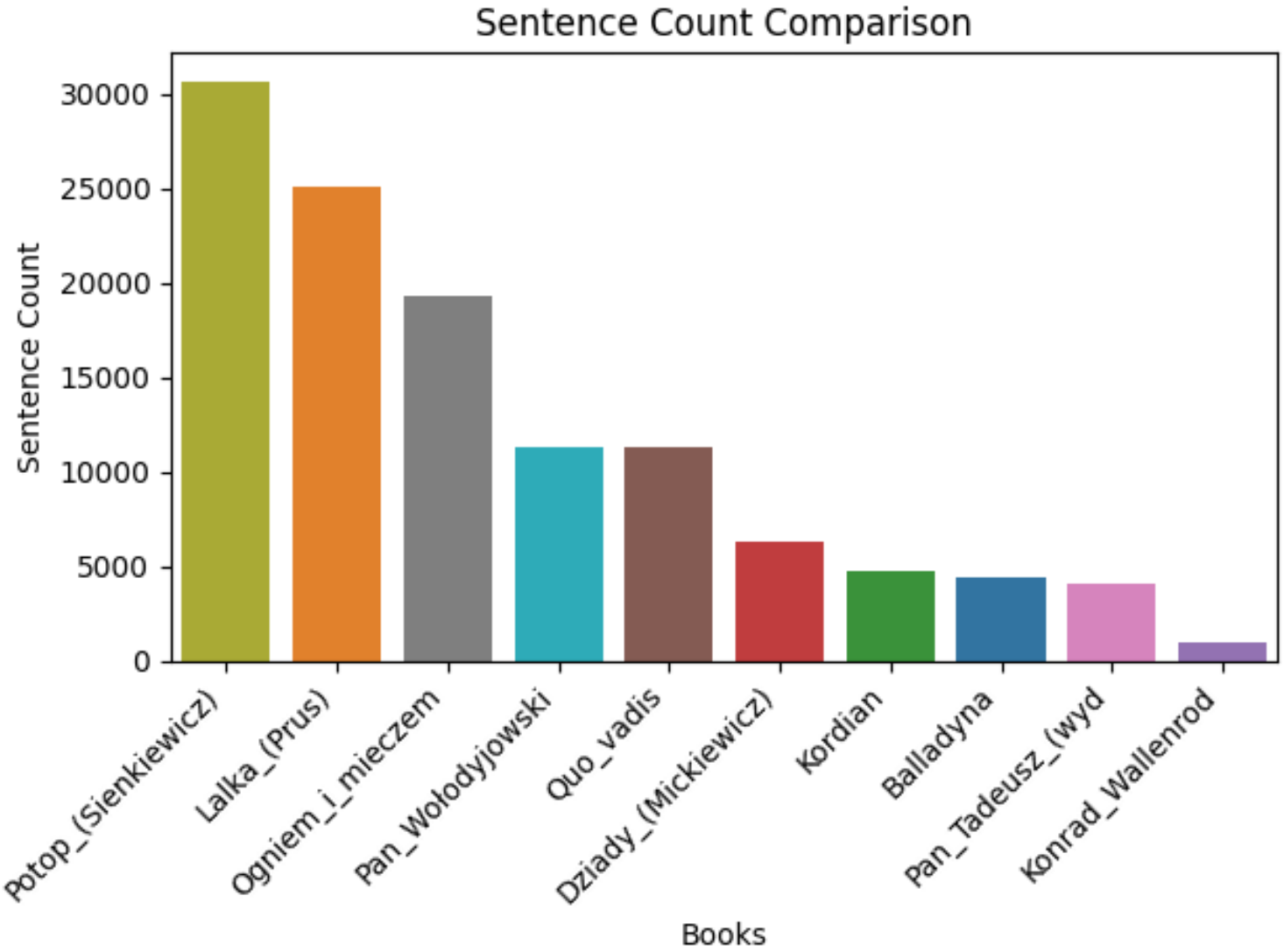


Mean Word Length



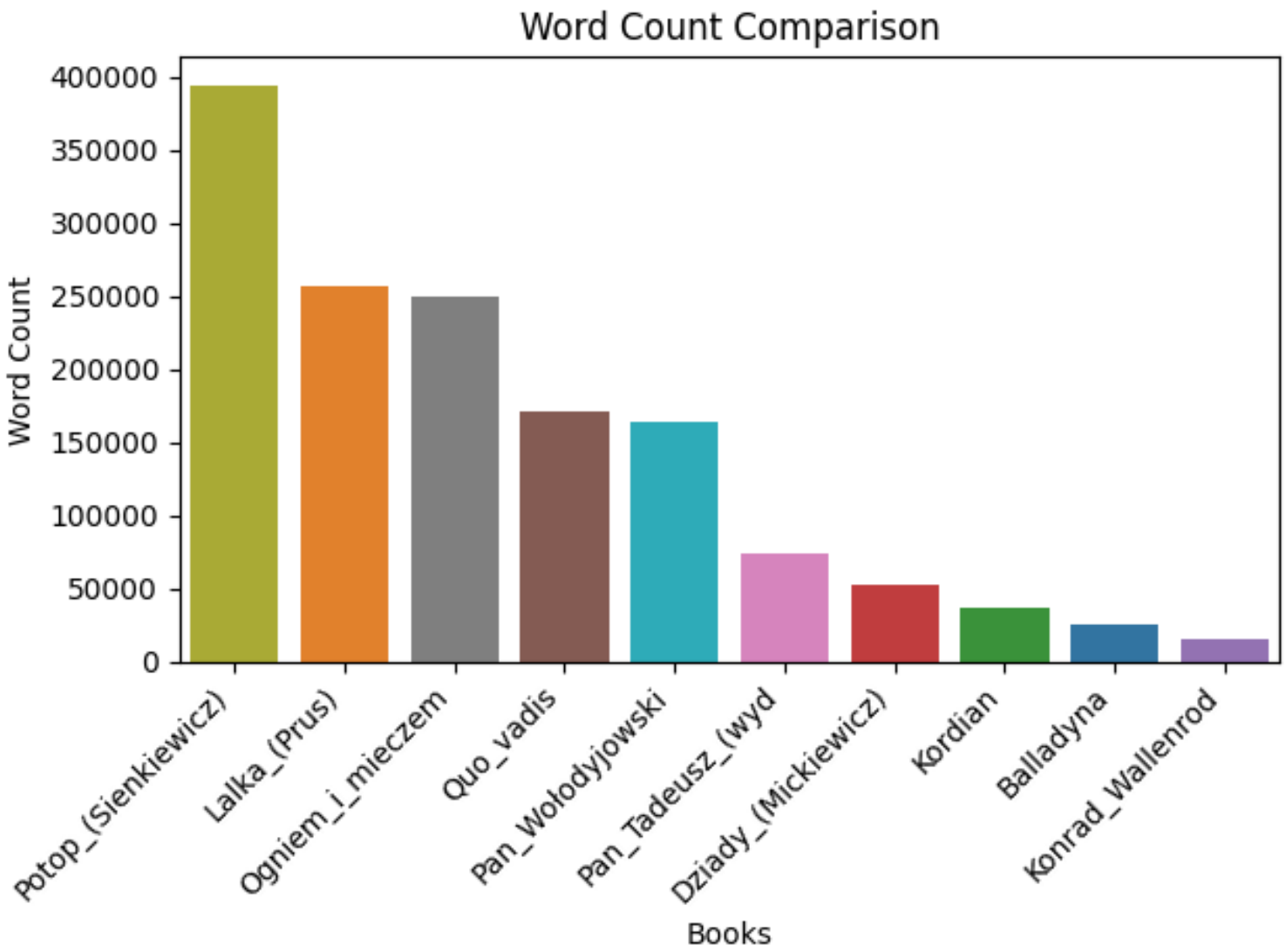
- Consistent across genres

Sentence Count Distribution



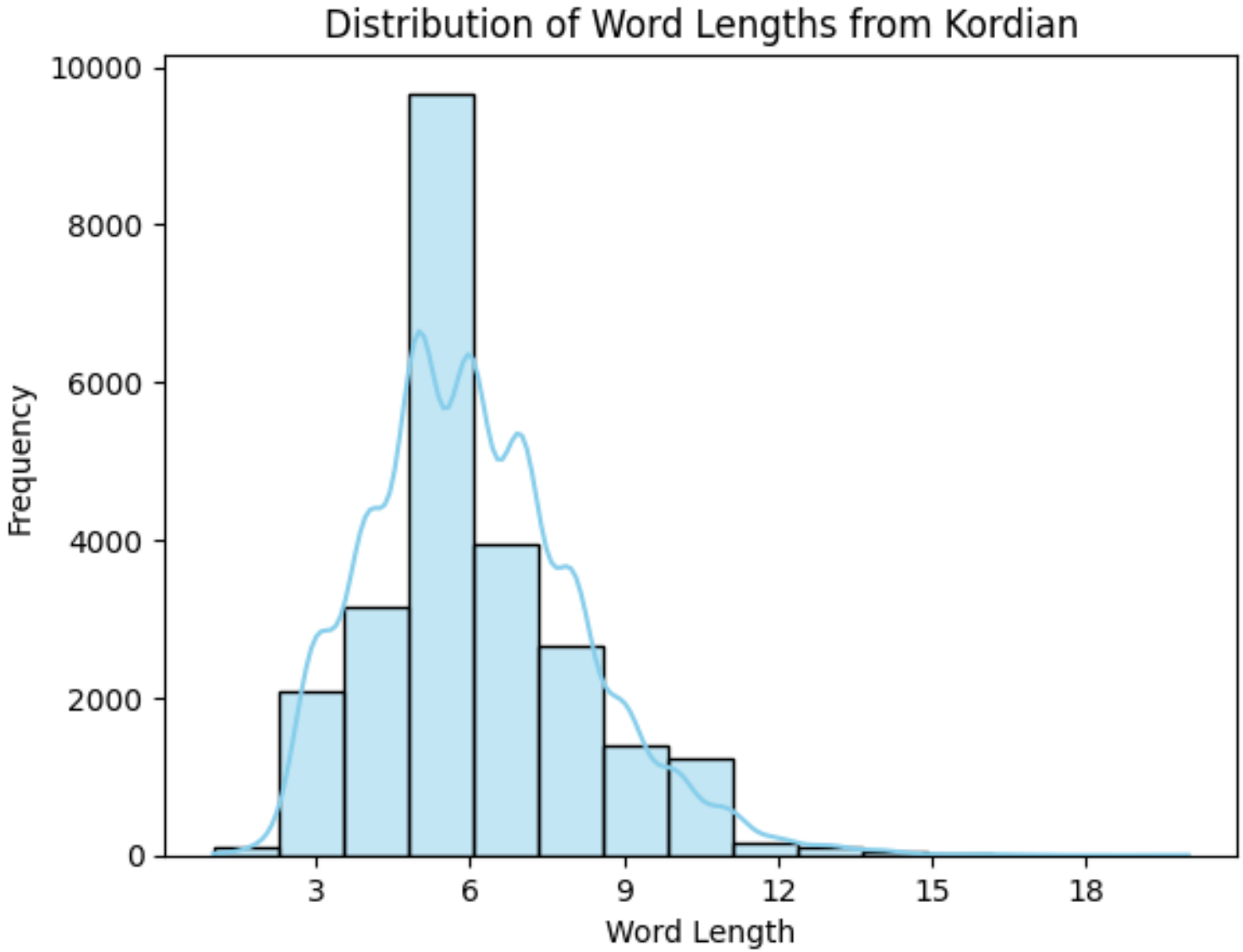
- Novels show highest sentence counts
- Poetry and drama more concise

Word Count Distribution



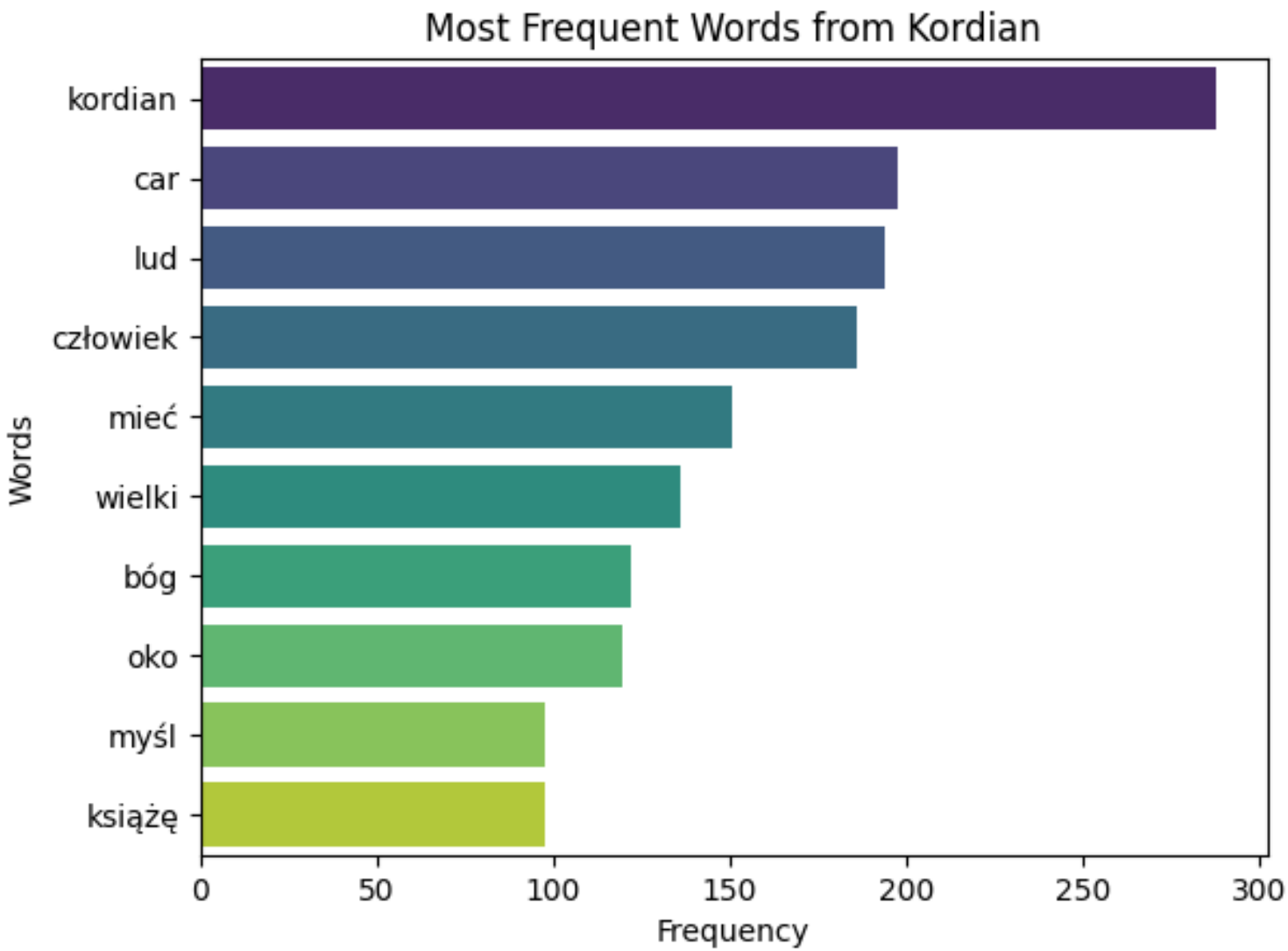
- Clear genre-based clustering
- Trilogy dominates corpus size

Word Length Distribution in Kordian



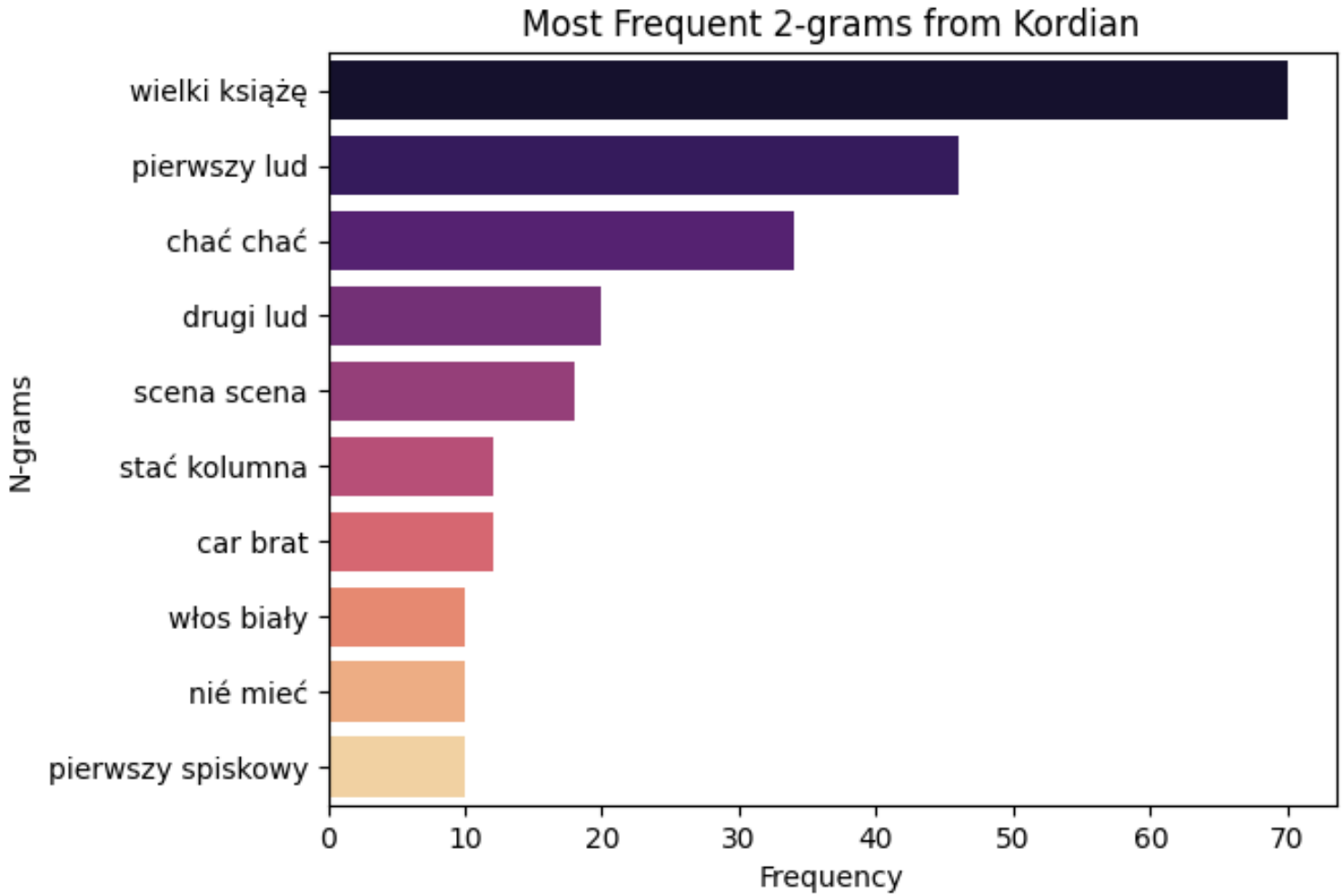
- Normal distribution pattern, peak at 5-6 charactes

Most Common Words in Kordian



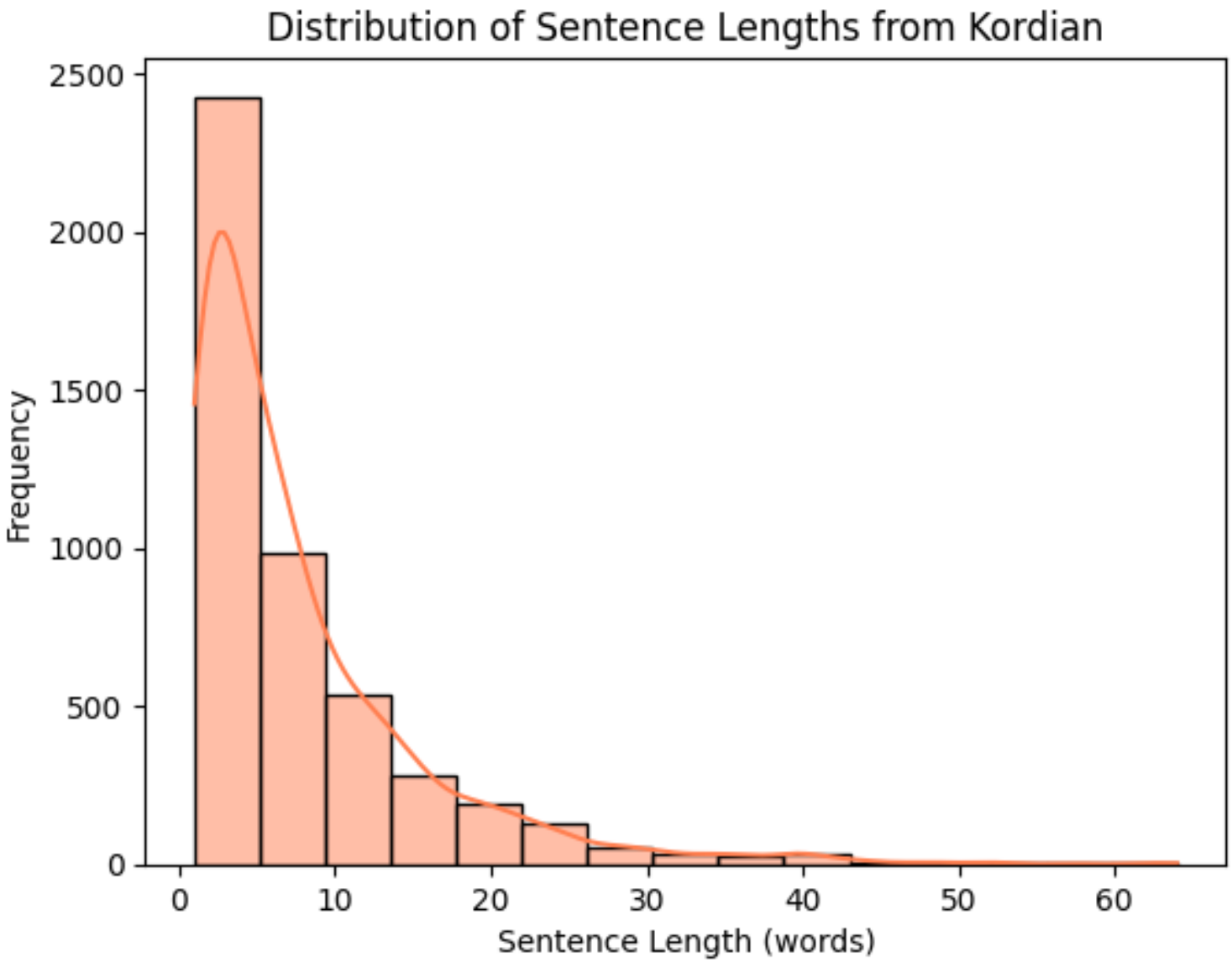
- Function words dominate
- Reflects dramatic dialogue

Most Frequent 2-grams in Kordian



- Common phrase patterns
- Stage directions present

Sentence Length Distribution in Kordian



Experiments

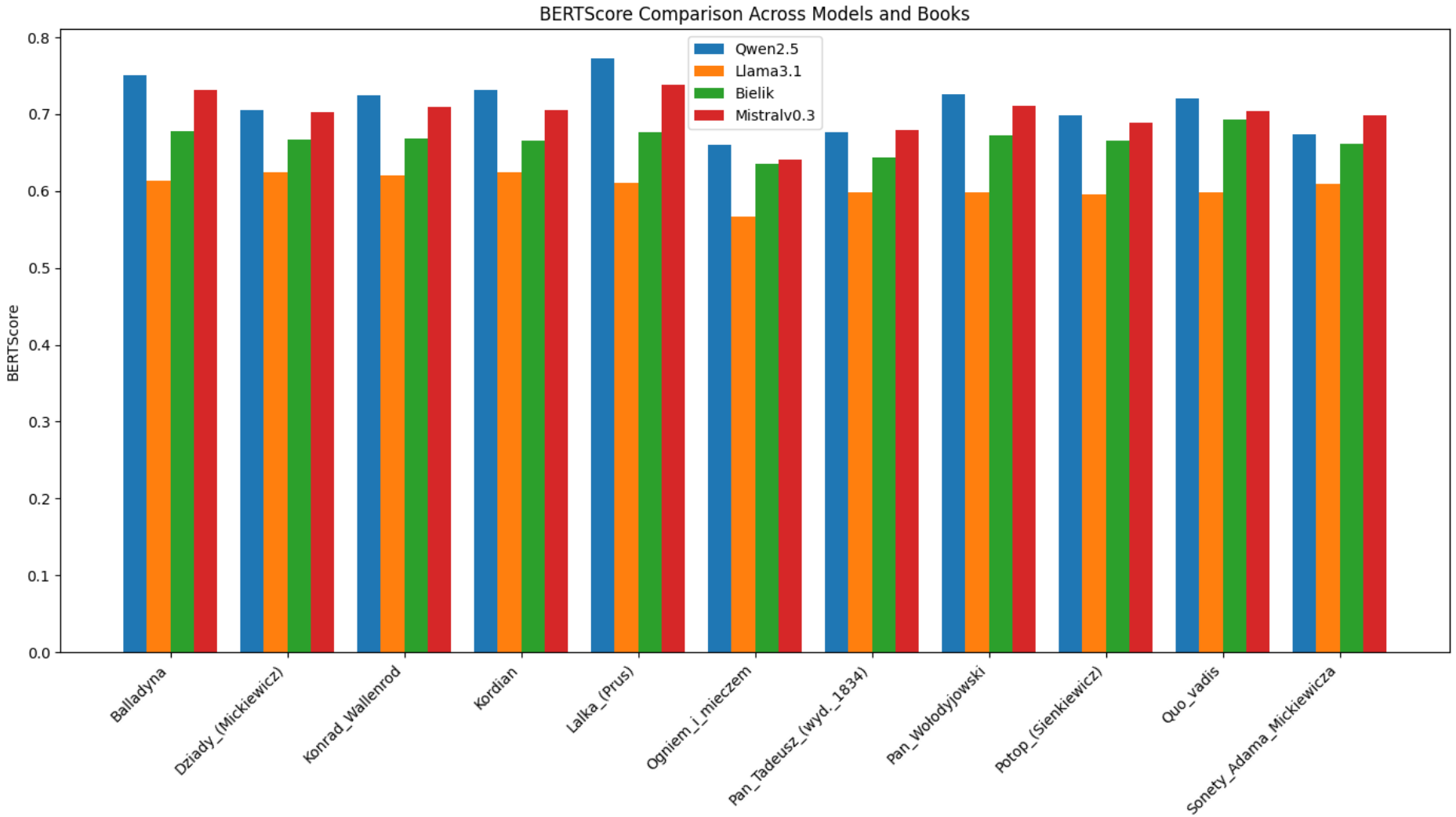
Performance Overview

- 11 datasets, all had 100 questions
- Metrics: BLEU, METEOR, ROUGE1, BERT-score
- Models: QWEN, Llama, Bielik, Mistral

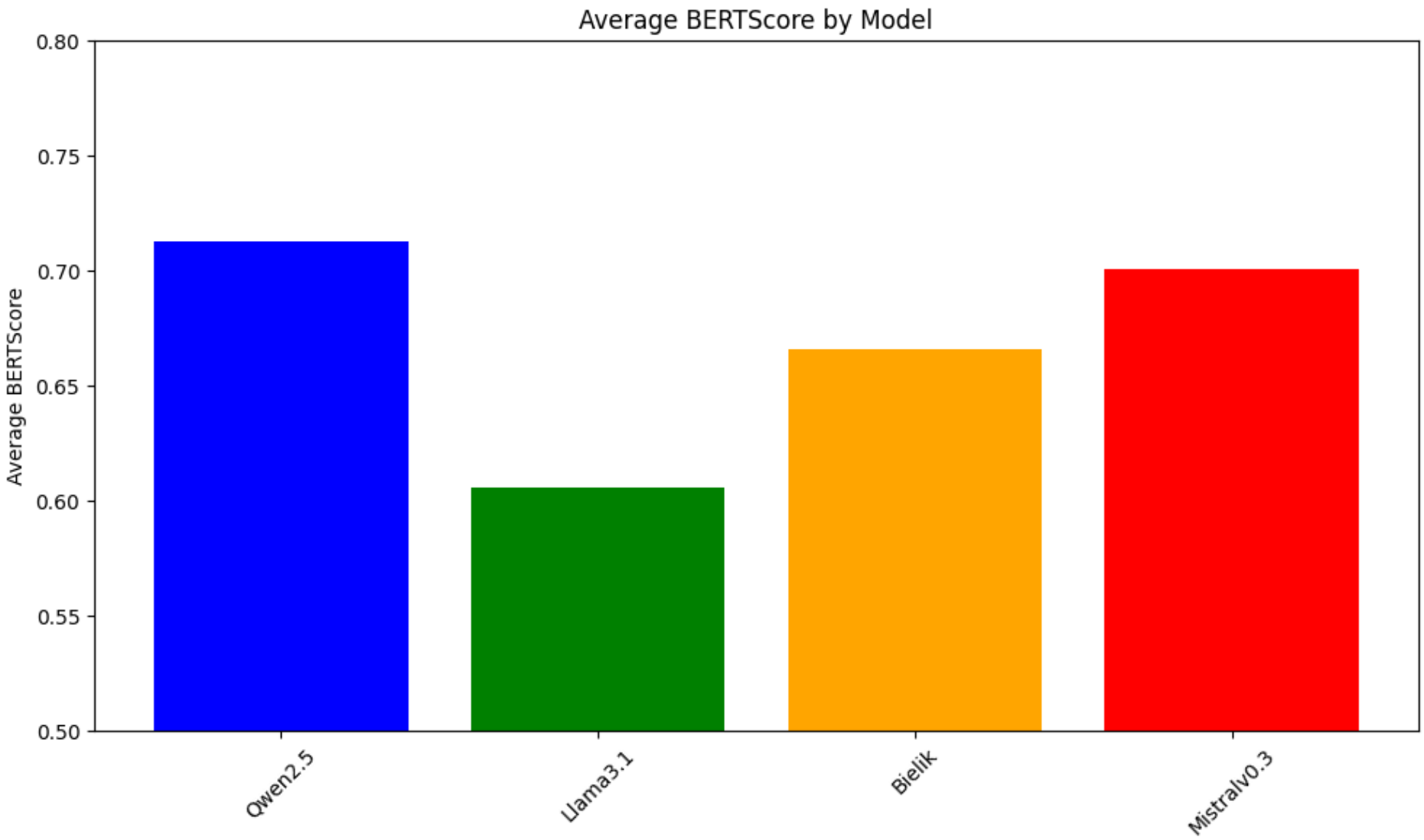
Performance Overview - QWEN

Dataset	BLEU	METEOR	ROUGE1	BERT-score
Balladyna	0.252	0.000	0.310	0.751
Dziady_(Mickiewicz)	0.155	0.000	0.221	0.705
Konrad_Wallenrod	0.158	0.000	0.234	0.724
Kordian	0.180	0.000	0.251	0.732
Lalka_(Prus)	0.305	0.000	0.368	0.772
Ogniem_i_mieczem	0.038	0.000	0.097	0.660
Pan_Tadeusz_(wyd._1834)	0.093	0.000	0.138	0.676
Pan_Wołodyjowski	0.149	0.000	0.235	0.726
Potop_(Sienkiewicz)	0.124	0.000	0.191	0.699
Quo_vadis	0.135	0.000	0.215	0.721
Sonety_Adama_Mickiewicza	0.085	0.000	0.135	0.674

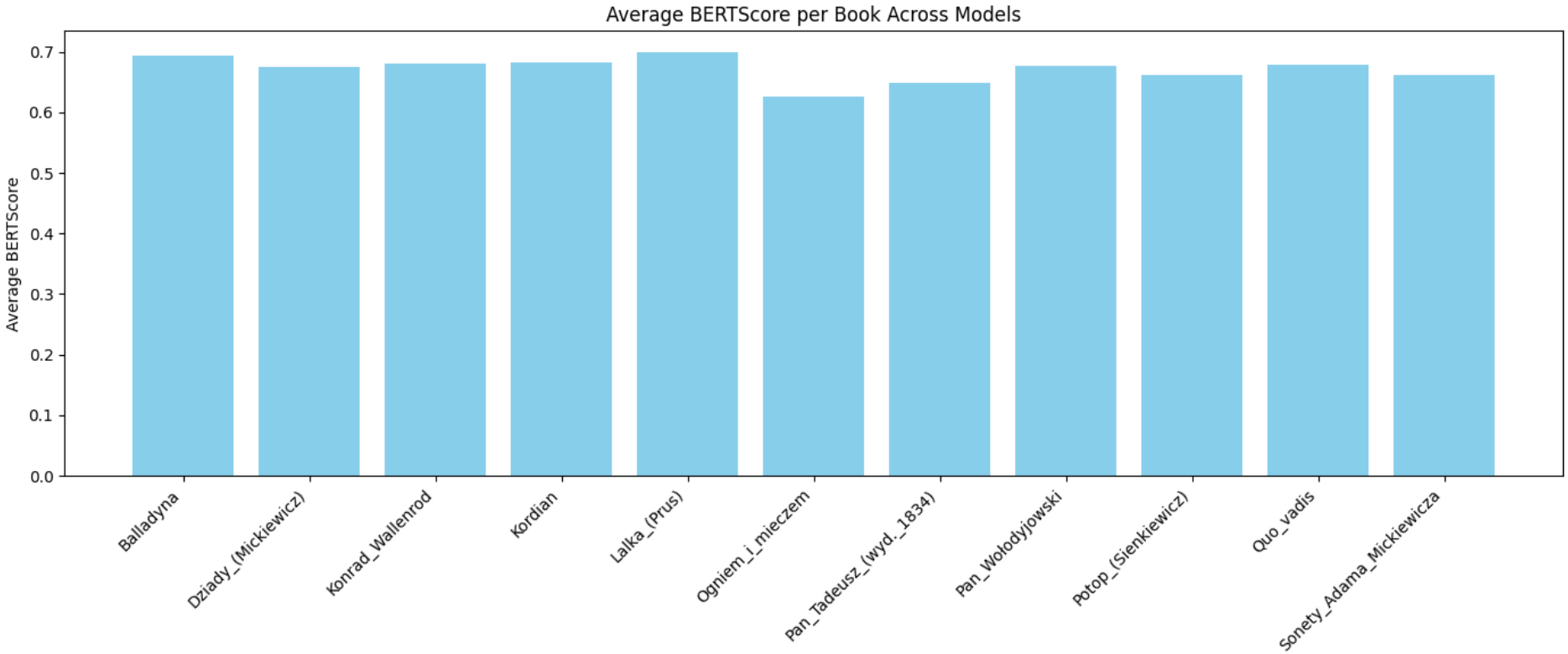
Results


BERTScore Comparison Across Models and Books
Qwen2.5
Llama3.1
Bielik
Mistralv0.3
BERTScore
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Balladyna
Dziady_(Mickiewicz)
Konrad_Wallenrod
Kordian
Lalka_(Prus)
Ogniem_i_mieczem
Pan_Tadeusz_(wyd._1834)
Pan_Wołodyjowski
Potop_(Sienkiewicz)
Quo_vadis
Sonety_Adama_Mickiewicza

Results - models



Results - books



Key Findings

- Qwen2.5 emerged as the most effective model for Polish texts, surpassing both Mistralv0.3 and the Polish-specific model Bielik, which was unexpectedly in third place.
- There is a clear need for improvement in Polish-specific LLMs and evaluation methods tailored to the language, emphasizing the importance of advanced contextual metrics.
- Future work should focus on fine-tuning Polish-specific models like Bielik with additional high-quality data and expanding datasets to address complex linguistic structures and historical vocabulary.

Key Findings

- More reference answers might increase the results, however one can do only so many references
- The results of the primary metrics are not as good as we predicted
- Traditional metrics like BLEU, METEOR, and ROUGE1 are insufficient for evaluating Polish texts due to the language's lexical diversity, highlighting the need for advanced metrics like BERTScore.
- Polish language is pretty hard to evaluate using basic metrics, more complex ones are much better

References

- Vaswani et al. (2017). "Attention Is All You Need"
- Devlin et al. (2018). "BERT: Pre-training of Deep Bidirectional Transformers"
- Ociepa et al. (2024). "Bielik 7B v0.1: A Polish Language Model"