University *of Ljubljana*
Faculty *of Computer and Information Science*

# Analysis and comparison of translation errors and biases in LLMs

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**Abstract**

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**Keywords**
Keyword1, Keyword2, Keyword3 ...

*Advisors: Slavko Žitnik*

## Introduction

LLMs have in recent years proven to be quite promising with regard to their capabilities in solving tasks pertaining to natural language processing, including translation. One of the critical areas of concern remains the occurrence of bias embedded within these models, especially in how they handle gendered language during translation. In 2025, extensive research has been conducted that focuses on gender bias in translation. Our project aims to explore this issue further by focusing on translations from English to Slovene. We expect that within these language pairs, which differ in the prevalence of gender markers, the LLM must have a certain means of introducing gender markers. The project investigates what this means by focusing on whether gender biases are introduced and reinforced during the LLM's translation of ambiguous sentences, more specifically how pronouns are translated from English to Slovene, and analyzes to what degree such instances occur. The dataset on which we have decided to conduct our research includes the WinoBias dataset, as we believe it offers a sufficient number of sentences which have already been selected due to them expressing gender bias.

As mentioned, extensive research has been carried out on this matter as of 2025. One such paper – "Investigating Markers and Drivers of Gender Bias in Machine Translations" by Peter J. Barclay and Ashkan Sami (2024) explores the markers of gender bias within machine translation systems. It shows how automated systems propagate traditional gender stereotypes, particularly in the context of professions and roles. The authors identify specific linguistic markers, such as gendered pronouns, that often align with stereotypical gender associations in a certain job, which can inadvertently perpetuate societal biases.

"Biases in Large Language Models: Origins, Inventory, and Discussion" by Roberto Navigli, Simone Conia, and Björn Ross (2024), published in the ACM Journal of Data and Information Quality, also provides a quality examination of the origins of bias in large-scale models. The authors argue that these biases are more than a result of training data, but also stem from the way LLMs learn and process language patterns.

These two research papers underscore the importance of understanding how LLMs handle gendered pronouns, particularly when translating between languages with different gender structures, such as English and Slovene.

## Methods

Use the Methods section to describe what you did an how you did it – in what way did you prepare the data, what algorithms did you use, how did you test various solutions ... Provide all the required details for a reproduction of your work.

Below are LaTeX examples of some common elements that you will probably need when writing your report (e.g. figures, equations, lists, code examples ...).

### Equations

You can write equations inline, e.g. $\cos \pi = -1$, $E = m \cdot c^2$ and $\alpha$, or you can include them as separate objects. The Bayes's rule is stated mathematically as:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}, \tag{1}$$

where $A$ and $B$ are some events. You can also reference it – the equation 1 describes the Bayes's rule.

### Lists

We can insert numbered and bullet lists:

1. First item in the list.
2. Second item in the list.
3. Third item in the list.

- First item in the list.
- Second item in the list.
- Third item in the list.

We can use the description environment to define or describe key terms and phrases.

**Word**  What is a word?.

**Concept**  What is a concept?

**Idea**  What is an idea?

### Random text

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### Figures

You can insert figures that span over the whole page, or over just a single column. The first one, Figure 1, is an example of a figure that spans only across one of the two columns in the report.
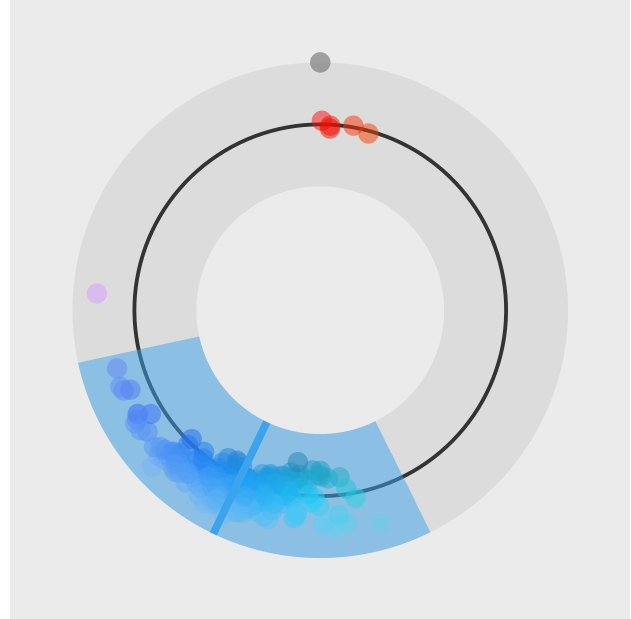


**Figure 1. A random visualization.** This is an example of a figure that spans only across one of the two columns.

On the other hand, Figure 2 is an example of a figure that spans across the whole page (across both columns) of the report.

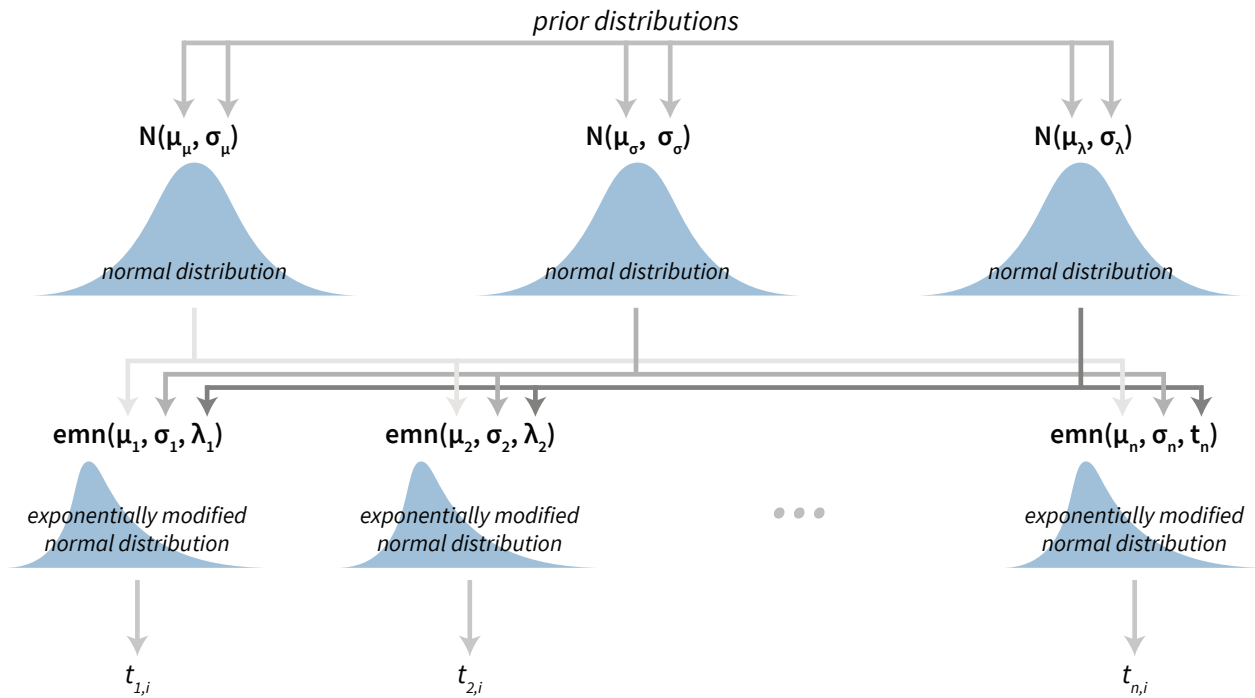### Tables

Use the table environment to insert tables.

**Table 1.** Table of grades.

| Name | | |
|---|---|---|
| First name | Last Name | Grade |
| John | Doe | 7.5 |
| Jane | Doe | 10 |
| Mike | Smith | 8 |

### Code examples

You can also insert short code examples. You can specify them manually, or insert a whole file with code. Please avoid inserting long code snippets, advisors will have access to your repositories and can take a look at your code there. If necessary, you can use this technique to insert code (or pseudo code) of short algorithms that are crucial for the understanding of the manuscript.

**Listing 1.** Insert code directly from a file.

*prior distributions*

$N(\mu_\mu, \sigma_\mu)$       $N(\mu_\sigma, \sigma_\sigma)$       $N(\mu_\lambda, \sigma_\lambda)$

*normal distribution*     *normal distribution*     *normal distribution*

$emn(\mu_1, \sigma_1, \lambda_1)$     $emn(\mu_2, \sigma_2, \lambda_2)$     $emn(\mu_n, \sigma_n, t_n)$

*exponentially modified normal distribution*    *exponentially modified normal distribution*    • • •    *exponentially modified normal distribution*

$t_{1,i}$       $t_{2,i}$       $t_{n,i}$

**Figure 2. Visualization of a Bayesian hierarchical model.** This is an example of a figure that spans the whole width of the report.

```python
import os
import time
import random

fruits = ["apple", "banana", "cherry"]
for x in fruits:
  print(x)
```

**Listing 2.** Write the code you want to insert.

```
import(dplyr)
import(ggplot)

ggplot(diamonds,
       aes(x=carat, y=price, color=cut)) +
  geom_point() +
  geom_smooth()
```

## Results

Use the results section to present the final results of your work. Present the results in a objective and scientific fashion. Use visualisations to convey your results in a clear and efficient manner. When comparing results between various techniques use appropriate statistical methodology.

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## Discussion

Use the Discussion section to objectively evaluate your work, do not just put praise on everything you did, be critical and exposes flaws and weaknesses of your solution. You can also explain what you would do differently if you would be able to start again and what upgrades could be done on the project in the future.

## Acknowledgments

Here you can thank other persons (advisors, colleagues ...) that contributed to the successful completion of your project.

## References

Roberto Navigli, Simone Conia, and Björn Ross. 2023. Biases in Large Language Models: Origins, Inventory, and Discussion. J. Data and Information Quality 15, 2, Article 10 (June 2023). https://doi.org/10.1145/3597307

Barclay, P. J., & Sami, A. (2024). Investigating Markers and Drivers of Gender Bias in Machine Translations. arXiv.Org, abs/2403.11896. https://doi.org/10.48550/arxiv.2403.11896

Hadas Kotek, Rikker Dockum, David Sun. 2023. Gender bias and stereotypes in Large Language Models.