

Credal Prediction for Large Language Models

Liam Heppner

February 6, 2026



Department of Mathematics,
Informatics and Statistics
Institute of Informatics



Artificial Intelligence and
Machine Learning

Bachelor's Thesis

Credal Prediction for Large Language Models

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Supervisors Eyke Hüllermeier and Paul Hofman

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Artificial Intelligence and Machine Learning (AIML)

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80799 Munich

Abstract

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Abstract (different language)

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Introduction

“ You can’t do better design with a computer, but you can speed up your work enormously.

— Wim Crouwel
(Graphic designer and typographer)

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1.1 Postcards: My Address

Ricardo Langner
Alfred-Schrapel-Str. 7
01307 Dresden
Germany

1.2 Motivation and Problem Statement

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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1.3.1 Some References

Free Software Foundation, Inc. [@Fre10] describe interesting things. We base our work on interesting prior work [@Mie11a]. There is also some work on interesting stuff [Jür00; Jür95; Mie11b; KJ11; App10a; App10b; App10c], which is related to ours.

1.4 Thesis Structure

This section should give a brief overview of this thesis and explain how this document is organized. A simplified example description is given below. We start by discussing the related work in the field in Chapter 3, followed by the system design in Chapter 4...

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Background

This chapter will discuss the key concepts essential for understanding this thesis.

...

2.1 Large Language Models and Generation

Large Language Models (LLMs) represent a class of deep learning models designed to process, understand, and generate human language. At their core, modern LLMs are built upon the Transformer architecture [Vas+17; Nav+24], utilizing mechanisms such as self-attention to model complex dependencies between words across long sequences. While they demonstrate capabilities in reasoning and coding, their fundamental operation remains probabilistic. They predict the likelihood of the next token in a sequence based on the preceding context.

2.1.1 Transformers and Next-token prediction

The primary objective of an autoregressive LLM is to model the probability distribution of a target sequence of tokens $y = (y_1, y_2, \dots, y_T)$ given an input context or prompt x . The model decomposes the joint probability of the sequence into a product of conditional probabilities using the chain rule of probability.

$$P(y|x) = \prod_{t=1}^T P(y_t|x, y_{<t})$$

Where y_t is the token at step t and $y_{<t}$ represents all preceding tokens in the generated sequence.

To compute these probabilities, the Transformer processes the input x and the generated history $y_{<t}$ to produce a vector of non-normalized scores, known as logits, for every token in the vocabulary V . Let z_i be the logit corresponding to the i -th token in the vocabulary. The model converts these logits into a valid probability distribution using the Softmax function.

$$P(y_t = v_i|x, y_{<t}) = \frac{\exp(z_i)}{\sum_{j \in V} \exp(z_j)}$$

This process is repeated iteratively, where the token selected at step t is appended to the input for step $t + 1$.

2.2 Uncertainty in Machine Learning

2.3 Imprecise Probabilities and Credal Sets

Related Work

3.1 Semantic Entropy

System

“ Innovation distinguishes between a leader and a follower.

— Steve Jobs
(CEO Apple Inc.)

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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4.1 System Section 1

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Fig. 4.1.: Figure example: (a) example part one, (c) example part two; (c) example part three

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4.2 System Section 2

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Fig. 4.2.: Another Figure example: (a) example part one, (c) example part two; (c) example part three

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4.4 Conclusion

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Concepts: This text is here to test a very long title, to simulate the line break behavior, to show that an extremely long tilte also works

“ Users do not care about what is inside the box, as long as the box does what they need done.

— Jef Raskin
about Human Computer Interfaces

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5.1 Concepts Section 1

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5.2 Concepts Section 2

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5.3 Concepts Section 3

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5.4 Conclusion

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Conclusion

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6.1 System Section 1

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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6.2 System Section 2

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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6.3 Future Work

After this fourth paragraph, we start a new paragraph sequence. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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A

Example Appendix

This is the second paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

A.1 Appendix Section 1

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Alpha	Beta	Gamma
0	1	2
3	4	5

Tab. A.1.: This is a caption text.

A.2 Appendix Section 2

After this fourth paragraph, we start a new paragraph sequence. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like

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Alpha	Beta	Gamma
0	1	2
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Tab. A.2.: This is a caption text.

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Colophon

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