

# Topological Parallax

Shape Analytics for the Explainability of LLMs



# GDA

GEOMETRIC DATA ANALYTICS, INC.



# Hallucinations

## *Query to the LLM:*

When did The New York Times first report on “artificial intelligence”?

### MICROSOFT'S BING

Based on web search results, the earliest mention of artificial intelligence in the New York Times seems to be from a book review published on March 5, 1956. <sup>1</sup> The book is called “The Human Use of Human Beings” <sup>2</sup> by Norbert Wiener, and the reviewer is John R. Pierce. <sup>3</sup> The review mentions artificial intelligence as one of the topics covered by Wiener, who is described as “a pioneer in cybernetics”.:  
<https://www.nytimes.com/1956/03/05/archives/the-human-use-of-human-beings-cybernetics-and-society-by-norbert.html> <sup>4</sup>

### NEW YORK TIMES ANALYSIS

- <sup>1</sup> The Times published a review of a book by Mr. Wiener **one day earlier, on March 4, 1956.**
- <sup>2</sup> This seminal book was **published in 1950, not 1956.** The March 4 review was of Mr. Wiener’s book “I Am A Mathematician: The Later Life of a Prodigy.”
- <sup>3</sup> The **March 4 review was not written by John R. Pierce,** a noted electrical engineer. It was written by **John G. Kemeny,** a mathematician.
- <sup>4</sup> The format of this URL is consistent with Times archives for articles in this period, but **this exact webpage never existed.**



# Shape Analytics for Word Embeddings

■ soc.religion.christian

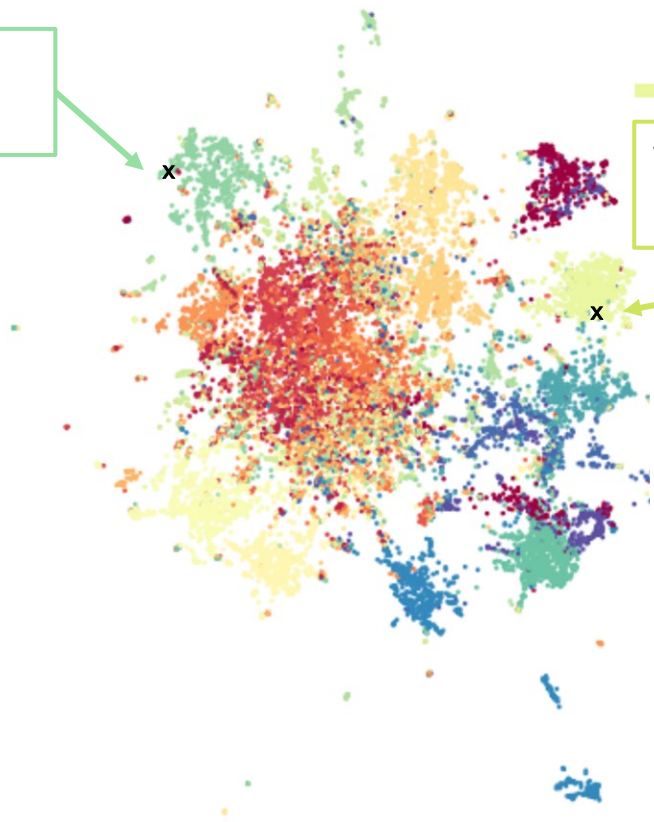
I think I need to again post the Athanasian Creed, which pretty well delineates [sic] orthodox Christian belief on the Trinity, and on the Incarnation.

x

■ sci.crypt

The Skipjack encryption algorithm F, an 80-bit family key that is common to all chips N, a 30-bit serial number U.

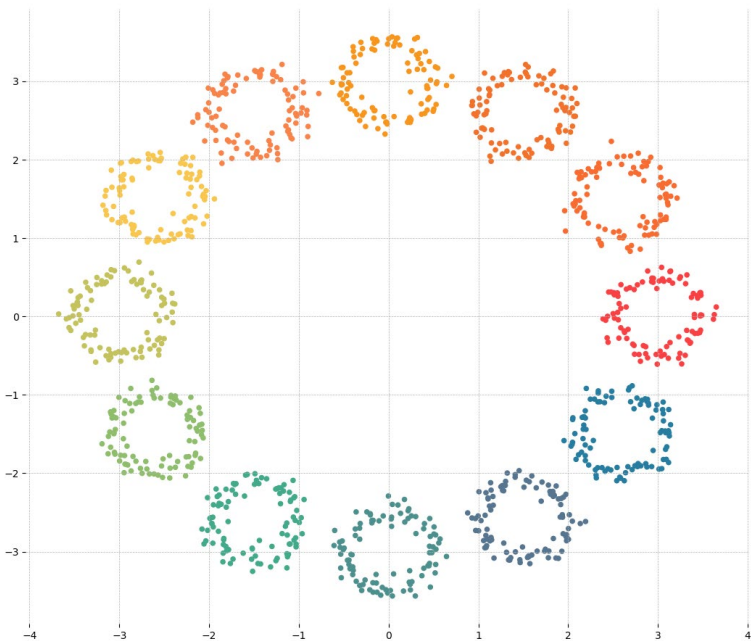
x



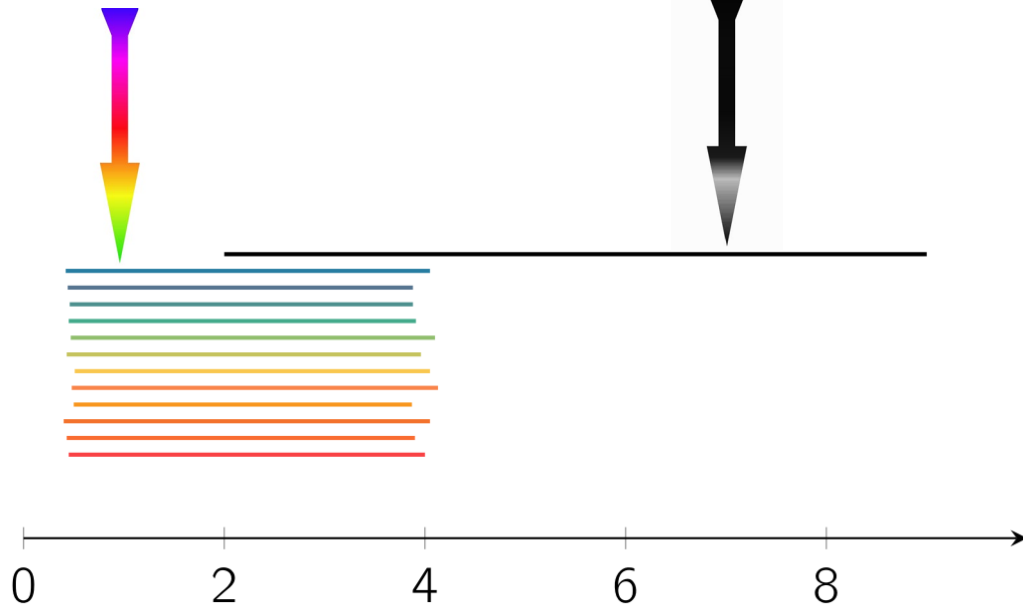


# Shape Analytics for Interpretability

## Topological Data Analysis



geometry of  
the local circles



geometry of the  
global circle



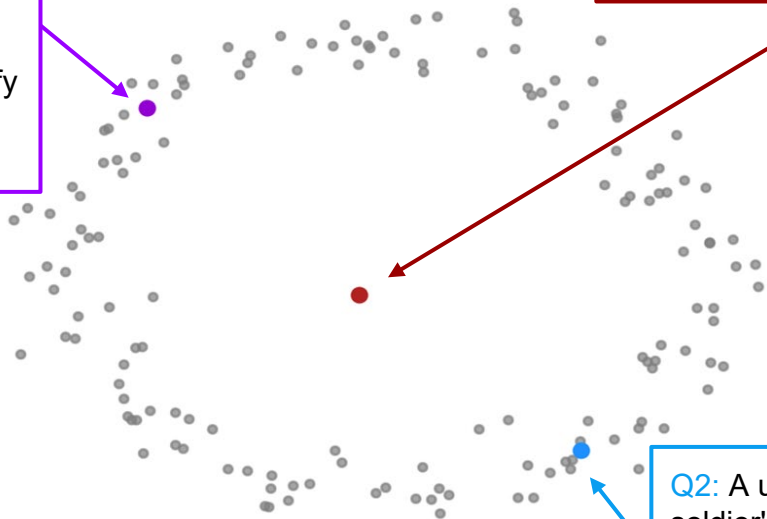
# Is the LLM Hallucinating?

**Q1:** A soldier left the base on Monday and came back Friday, but the database shows 5 days of work for that week. How can we remedy the database?

**A1:** The soldier forgot to clock out, modify their time sheet appropriately.

**Q3:** A soldier left the base on Monday and did not return until the following Monday, but the database shows 7 days of work for that week. How can we remedy the database?

**A3:** Drop the soldier from the database.



**Q2:** A user error accidentally duplicated a soldier's entry in the database. How can we remedy the database?

**A2:** Drop the duplicates from the database.



# The Solution: Topological Parallax

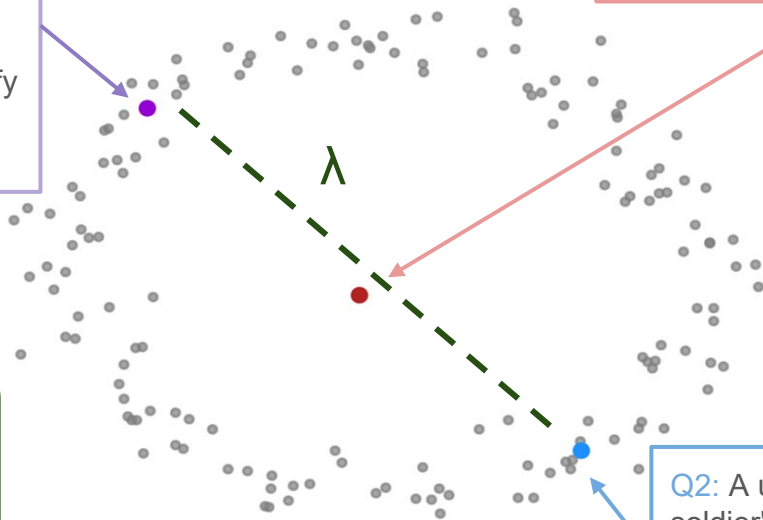
**Q1:** A soldier left the base on Monday and came back Friday, but the database shows 5 days of work for that week. How can we remedy the database?

**A1:** The soldier forgot to clock out, modify their time sheet appropriately.

**Q3:** A soldier left the base on Monday and did not return until the following Monday, but the database shows 7 days of work for that week. How can we remedy the database?

**A3:** Drop the soldier from the database.

Topological Parallax  
can identify regions  
where hallucinations  
are likely.



**Q2:** A user error accidentally duplicated a soldier's entry in the database. How can we remedy the database?

**A2:** Drop the duplicates from the database.