

# Exploring AI-Driven Interactive Chart Transformation and Visualization Creation

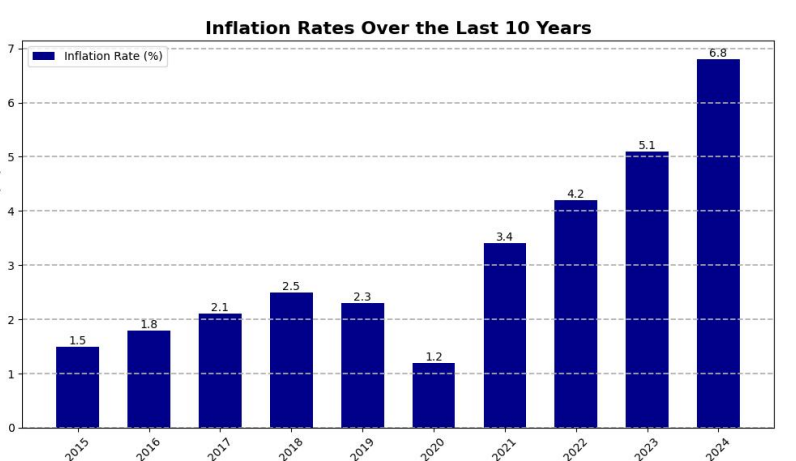
Bijesh Shrestha, Roe Shraga, Lane Harrison

### Interactive Chart Transformation and Report Generation

Interact, transform, and create custom reports

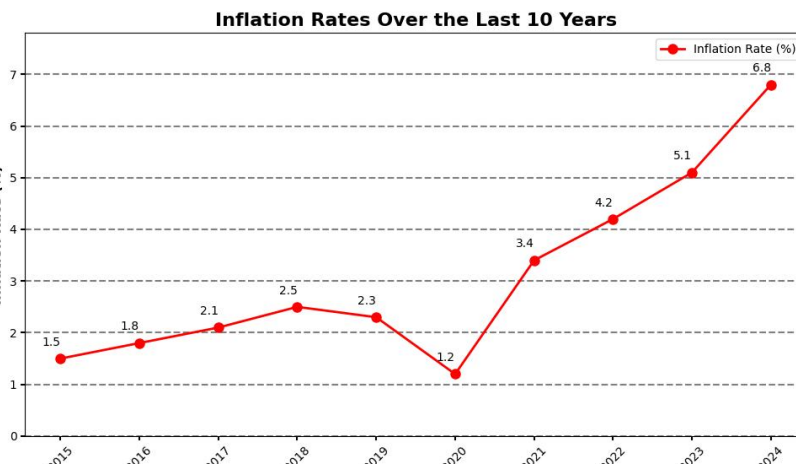
**Query:** Change the bar chart color to dark blue

**Response:** temp\_img/inflation\_Rates\_Over\_Time\_2024-06-20-11-30-01.png



**Query:** Change the chart type to line chart in red

**Response:** temp\_img/inflation\_Rates\_Over\_Time\_2024-06-20-11-30-02.png

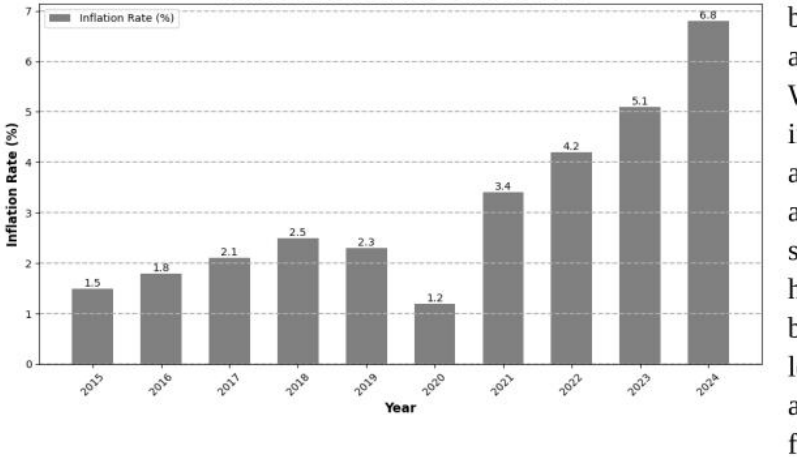


Enter your query here.

### Inflation 2024: A Year of Economic Challenge

In 2024, inflation reached 6.8%, the highest level in over a decade, driven by post-pandemic demand, supply chain disruptions, and geopolitical tensions. This sharp rise has significantly impacted global markets and households, with rising prices for essentials such as food, energy, and housing. The mismatch between supply and demand, particularly in the energy and manufacturing sectors, created bottlenecks that pushed inflation upward.

The accompanying chart highlights this dramatic spike in 2024, a stark contrast to the more stable inflation rates of previous years. This visualization emphasizes how unique the pressures of 2024 have been, underscoring the impact of inflation on both economies and consumers.



To combat inflation, central banks worldwide implemented aggressive interest rate hikes. While necessary to temper inflation, these measures have also increased borrowing costs and slowed consumer spending. The housing market has been particularly affected by higher mortgage rates, leading to reduced affordability. Businesses have faced rising production costs, forcing them to either absorb the costs or pass them on to consumers, further driving inflation in basic commodities like food and energy.

Looking ahead, policymakers are divided on whether inflationary pressures will ease. Some are optimistic that inflation will moderate as supply chains stabilize and consumer demand cools. However, risks remain. If geopolitical tensions persist, or energy transitions continue to cause disruptions, inflation may stay elevated for longer than anticipated. Experts also caution that entrenched inflation expectations could prolong the cycle, making it harder for economies to recover quickly.

Addressing inflation remains a top priority for governments and central banks, as they balance the need to control inflation with sustaining economic growth. The ability to navigate these challenges will shape economic stability in the years to come.

## Chat View

Users can modify charts in real-time, ask questions, and request explanations.

## Source View

Displays the uploaded document.

## Using report context, leverage AI to query, transform visualizations, and generate custom reports

Ask **Direct Queries** related to the document's content.

Perform **Chart Transformations** such as changing chart types, adjusting data points, or altering visual properties (e.g. colors).

Generate **Tailored Reports** integrating both transformed charts and modified text.

## How can AI be leveraged to query and modify charts interactively during report generation?

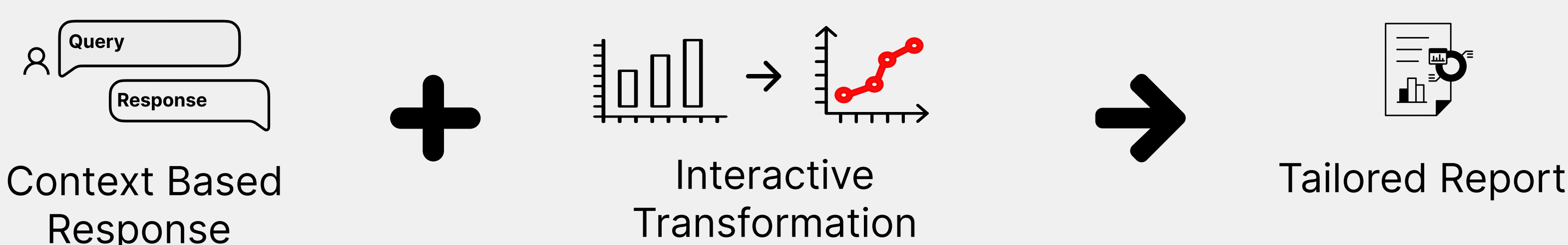
Charts often contain important information not captured in report text, and report text often contains important context not contained in the chart. We explore the use of LLMs to query text and chart data, transform existing charts, and create new visualizations to support tailored report generation.

## Challenges

### Context-Driven Insights with Dynamic Feedback:

Existing CQA systems generate real-time text and visualizations based on data<sup>[1,2]</sup>, but they do not fully capture the contextual relationship between text and charts<sup>[4]</sup>. Current systems also lack dynamic feedback mechanisms for users to iteratively refine both text and visualizations, supporting tailored report generation<sup>[5]</sup>.

## Project Goals

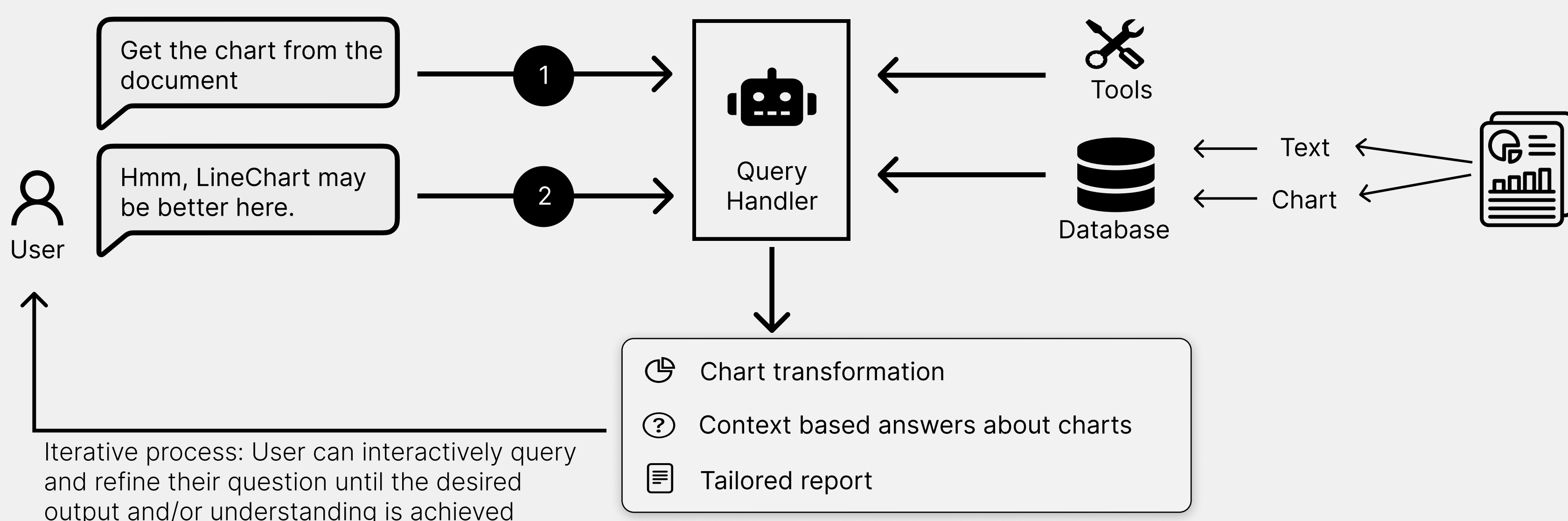


**Context Based Response:** Deliver responses tailored to the specific context of user queries.

**Interactive Transformation:** Through query/response transform and interact with charts data for deeper insights.

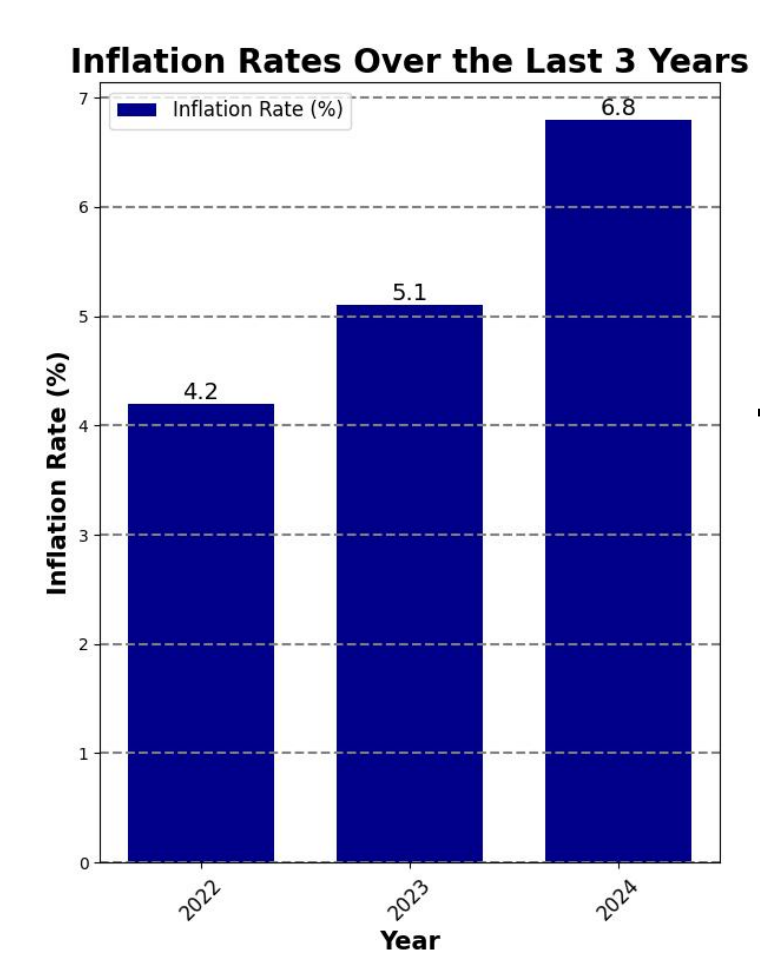
**Tailored Reports:** Enable the generation of reports based on user-modified charts and text.

## Workflow



**Response:** Based on the chart data and report, inflation began rising noticeably in 2022. The inflation rate increased from 4.2% in 2022 to 5.1% in 2023 and then surged further to 6.8% in 2024. The chart highlights that inflation has been steadily increasing over the last three years, with the sharpest rise occurring between 2023 and 2024.

Users could ask direct queries that required both chart and text data for comprehensive answers. For example, a query like "When did inflation start rising?" would pull information from both the chart and report to provide a complete response.



Re-generated summary based on the previously generated chart(s)

**Query:** When did the inflation start rising?

**Response:** [List icon]

**Query:** Only include last 3 year data in the bar chart

**Response:** [Bar chart icon]

**Query:** Rewrite the summary focusing on last 3 years and include the last bar chart

**Response:** [Bar chart icon]

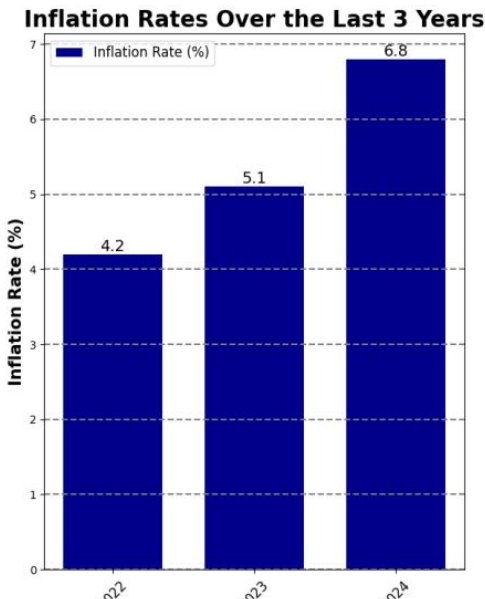
Users can create new visualizations from the original report's data, specifying chart type, attributes, and data range interactively.

Users can interactively transform visualizations and text (e.g., summaries) and request a tailored report based on the original report, including the custom visualizations created interactively.

### Inflation from 2022 to 2024: A Period of Escalating Economic Pressure

The period from 2022 to 2024 has been marked by a steady rise in global inflation, climbing from 4.2% in 2022 to a decade-high of 6.8% by 2024. This increase has been fueled by a combination of lingering supply chain issues, geopolitical instability, and post-pandemic consumer demand, which has far outpaced global production capacities.

The accompanying chart clearly illustrates the rapid inflationary rise over these three years. Beginning with a significant jump in 2023, inflation accelerated as industries struggled to keep up with demand, and global conflicts caused disruptions in key sectors like energy and transportation. This spike underscores how quickly inflationary pressures can escalate under unfavorable conditions.



By 2024, inflation reached its highest point in a decade, as central banks implemented aggressive monetary policies to contain the situation. Interest rate hikes intended to curb inflation have led to higher borrowing costs, particularly affecting the housing market and basic consumer goods. The rapid increase in prices has disproportionately impacted lower-income households, exacerbating financial inequality.

Looking forward, experts are divided on whether inflation will subside or persist. While some believe that supply chains will stabilize and inflation will ease, others warn that unresolved geopolitical tensions and ongoing energy crises could prolong these elevated inflation rates. Policymakers must navigate these complexities carefully to prevent long-term economic instability.

## Contributions

- Using LLMs to empower users to transform charts interactively (e.g., change chart types, focus on specific data points) to iteratively refine and customize.
- Enabling report tailoring by integrating transformed charts with updated text and context.

## Opportunities for LLMs + Visualization

- AI Inaccuracies:** Errors in interpreting complex queries, causing incorrect visual transformations.
- Limited Chart Types:** Support is limited to a few chart types, requiring expansion for broader applications.
- LLM Hallucinations:** Inconsistent or irrelevant responses from the language model affected result accuracy (Context Window).

## Future Work

- Enhance capabilities for deeper visual customization using a high-level grammar such as Vega-Lite<sup>[3]</sup>.
- Expand the system's ability to handle large datasets and multiple transformations simultaneously.
- Test integration aspects of tailored report generation into user workflows for improved efficiency.

[1] Y. Han, C. Zhang, X. Chen, X. Yang, Z. Wang, G. Yu, B. Fu, and H. Zhang. Chartllama: A multimodal llm for chart understanding and generation. arXiv

[2] E. Hoque, P. Kavehzadeh, and A. Masry. Chart question answering: State of the art and future directions. In Computer Graphics Forum, vol. 41, pp. 555–572. Wiley Online Library, 2022

[3] H.-K. Ko, H. Jeon, G. Park, D. H. Kim, N. W. Kim, J. Kim, and J. Seo. Natural language dataset generation framework for visualizations powered by large language models, 2023.

[4] V. Setlur and L. Birnbaum. Can nuanced language lead to more actionable insights? Exploring the role of generative AI in analytical narrative structure. GenAICHI: CHI 2024 Workshop on Generative AI and HCI, 2024.

[5] V. Setlur and M. Tory. How do you converse with an analytical chatbot? Revisiting Gricean maxims for designing analytical conversational behavior. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems, pp. 1–12, 2022