Contextual Alchemy: A Framework for Enhanced Readability through Cross-Domain Entity Alignment

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Introduction

Prior to the development of Large Language Models (LLMs), the pursuit of creative writing or content adjustment mainly focused on tailoring tonality, style, and lexicon [7, 8, 3] to suit reader preferences. In addition, there have been frameworks aimed at simplification like 'Explain it to me like I'm five' and targeted explanation like 'Explain to me like I'm a scientist' [1, 4].

In this work, we present **Contextual Alchemy**, a framework that identifies examples and its context in a document and suggests alternate examples for different topic of interest, time, and region. Consider that you are reading a document that mentions Magnavox Odyssey (refer to the highlighted yellow text in Fig 1). From the surrounding context, we recognize that even though Magnavox Odyssey was the first to enter the market, it did not sustain the first mover advantage. However, the example does not resonate with all readers and they might lose relevance over time. Our framework aims to retrieve other *replacable* entities in similar context, for example, in the sports domain Reebok has faced a similar outcome to Magnavox Odyssey. In this manner, our work utilises LLMs to enhance readability by adapting entities and context within a document to align closely with varied reader interests, ensuring reading is more engaging, relatable, and factually consistent for diverse readers.

Figure 1: Illustration of alternate examples for Magnavox Odyssey for a different domain (Sports: Reebok), time (1990s: IBM PCs), and region (India: Micromax Mobiles). Such resonating examples can improve readability of long documents and keep readers engaged.

Approach

In this method, we utilize a step-by-step process and *first* identify entity of interest along with their context within a given document. *Next*, we align them with an array of interest vocabulary with domain, time, and regional terms to generate appropriate replacements. *Finally*, we verify the adapted entities and their statements against credible references, and present reader with examples of their interest. The step-by-step workflow of Creative Alchemy is shown in figure 2.
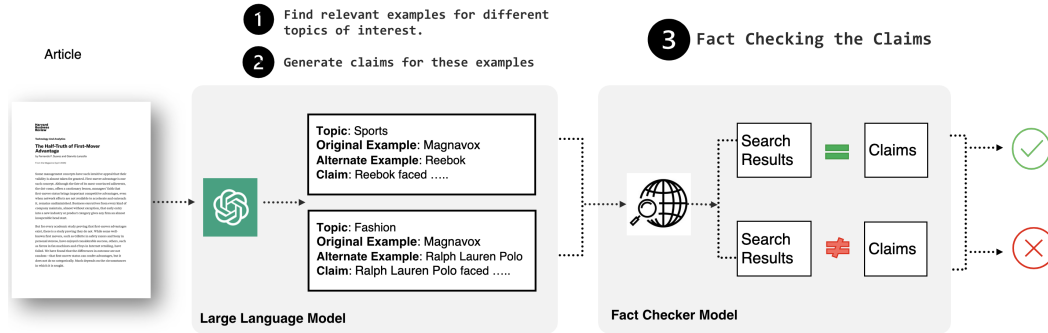

Figure 2: Step-by-step approach

Step 1 - Identifying Specific Entities and Their Context: In the initial step, the document is analyzed by an LLM of choice. The model's role is to detect specific entities and understand their related context within the document. We use OpenAI's GPT-3.5 for our study.

Step 2 - Creating Alternative Entities Connected to Relevant Topic of Interest: Once entities and their contexts are identified, they are coupled with topics of interest for the readers and is coupled together in another prompt to the LLM. The model is guided to generate some examples along with their respective claims, both of which can be treated as alternative suggestion in the context of the original example. We provide the prompt in the Appendix.

Step 3 - Validating the Alternative Entities and Their Statements: The factual validation step is further divided into the following two steps:

Step 3.1 - Claim Reference Retrieval: To validate the claims of the alternative entities, top references are obtained using a search engine for each claim. We retreive the top 20 results and extract their corresponding text and break it into paragraph chunks. These chunks will be used to substantiate the alternative example's claim. We keep the paragraph chunks which are similar to the claim to reduce the number of comparisions for factual consistency in the next step.

Step 3.2 - Fact-Verification: We leverage the filtered paragraph chunks to we verify the factual correctness of the claims generated in Step 2. For this we employ a Natural Language Inference (NLI) model, which has been previously used in literature to fact-check LLM generations [2, 5, 6]. If any chunk-claim entailment probability is beyond a specified threshold, we conclude that the claim is factually correct. However, if the chunks within all the retrieved documents are inadequate, the claim is regarded as unverified, and we discard these alternate examples. We use the ROBERTA-LARGE model trained on the MNLI dataset. In this manner, **Contextual Alchemy** provides alternate examples for domain, time, and region shift along with relevant claims and references to readers and enhances document readability.

We provide alternate examples from different interest types for Magnavox Odyssey and Osborne 1 from the HBR article on First Mover Advantage in the Appendix.

Ethical Implications

Any content generated by an LLM is liable to be biased and factually incorrect. LLMs may also overcompensate for personalisation by including stereotypes about the people the content is being personalised for. We believe that restricting the sources against which content is fact-checked can reduce the likelihood that stereotypes are identified as consistent with the references and filter them out. However, this is not entirely foolproof. Additionally, fact-checking is as good as the reliability of the souces cited as references. Determining the factual correctness of our references obtained from search engines is outside of the scope of this work and has its own area of research. The long-term effects of users being exposed to AI-generated personalised content has not been studied. Further, content ownership of partially-authored AI content must be discussed and resolved before use.

References

[1]   Aman Agarwal. "Explain to me like I am five–Sentence Simplification Using Transformers". In: *arXiv preprint arXiv:2212.04595* (2022).

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[7]   Emily Reif et al. "A recipe for arbitrary text style transfer with large language models". In: *arXiv preprint arXiv:2109.03910* (2021).

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Appendix

Model Hyperparameters

For determining the similarity of text chunks with the claim, we used a similarity threshold of 0.7. In order to consider a claim as being factually correct, we set the threshold for entailment probability with the reference claim as 0.5. We also ensure that there are at least 5 references for each claim for it to be factually correct.

Prompt

Without loss of generality, the LLM can refer to any generative textual model chosen based on trade-offs between resource availability, cost constraints, and accuracy.
The instruction provided to the LLM in step 2 is outlined below.

> **Prompt:**
> Given the entity [ENTITY HERE] within the context [CONTEXT HERE], generate 5 substitute entities that have appeared in a similar context. These substitutes should align with the specified [TOPIC OF INTEREST]. Additionally, provide a claim for each generated entity, elucidating their experiences or circumstances comparable to the original entity.
> Please format the output as follows:
> *Generated Entity:*
> *Claim:*

Additional Results

We provide alternate examples for Magnavox Odyssey and Osborene 1 from the HBR article on First Mover Advantage below.

Source URL: https://hbr.org/2005/04/the-half-truth-of-first-mover-advantage

Examples for Magnavox Odyssey

Magnavox Odyssey context: Entered the gaming console market in 1972, experiencing rapid succession of technology generations and competition from new entrants.

<u>Topic of Interest:</u> India

Figure 3: Qualitative Examples

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<u>Topic of Interest:</u> India

Figure 3: Qualitative Examples

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Topic of Interest: Finance

PayPal

Similar to Magnavox Odyssey

PayPal was a pioneer in the world of online payments. It created a new category for digital transactions and quickly became popular. However, as the market evolved, many other companies such as Square, Stripe, and even banks and credit card companies began to offer similar services. Despite the competition, PayPal continues to be a prominent player, but it no longer holds the monopoly in online payments.

Reference:

https://www.forbes.com/advisor/business/software/top-paypal-alternatives/

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Topic of Interest: America

Blockbuster

Similar to Magnavox Odyssey

Blockbuster was one of the first major brands in the home video rental industry in the U.S. It had significant market share in the 90s and early 2000s, but couldn't adapt quickly enough to the changes in the industry brought on by the advent of online streaming and rental services like Netflix. Thus, it lost its position in the market despite being a first mover, similar to Magnavox Odyssey.

Reference:

https://www.drift.com/blog/netflix-vs-blockbuster/

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Figure 4: Qualitative Examples

Topic of Interest:
Technology

IBM Personal Computer   👍 👎

Similar to Magnavox Odyssey

IBM's PC, while not the first, popularized the home computer market. Its open architecture allowed manufacturers to create compatible hardware and software, spurring competition and innovation. However, as companies like Dell, HP, and Lenovo introduced their own PCs, IBM's market dominance gradually diminished, similar to Magnavox Odyssey.

Reference:

https://en.wikipedia.org/wiki/IBM_Personal_Computer

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Topic of Interest:
Entertainment

Netflix   👍 👎

Similar to Magnavox Odyssey

Netflix was one of the first companies to offer a subscription-based streaming service for movies and television shows. However, as the market for streaming services grew, many other companies such as Hulu, Amazon Prime Video, and Disney+ entered the scene, creating a highly competitive market. Despite being a first mover, Netflix continually faces the challenge of retaining its market share against these later entrants.

Reference:

https://www.forbes.com/sites/danafeldman/2019/08/21/netflix-is-expected-to-lose-us-share-as-rivals-gain/?sh=f30b9d566d67

Get Relevant Examples for these topics:

Sports	Technology	Finance
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Figure 5: Qualitative Examples

Topic of Interest: Sports

Reebok's Insta Pump Technology 👍 👎

Similar to Magnavox Odyssey

In the '90s, Reebok introduced the innovative Pump technology, enabling customized shoe inflation. Similar to Magnavox Odyssey's reception, despite initial enthusiasm, Reebok's early lead dwindled as competitors like Nike introduced alternatives like Air technology, undermining Reebok's pioneering advantage in tech-advanced sports footwear.

Reference:

https://www.retaildive.com/news/reebok-was-meant-to-be-a-nike-killer-how-the-brand-lost-its-no-1-spot-adidas-sale-of-reebok/603733/

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Figure 6: Qualitative Examples

Examples for Osborne 1

OSBORNE 1 context: The Osborne 1, considered the first commercially available portable computer, quickly became outdated as laptop technology rapidly evolved, with each successor achieving temporary dominance before being surpassed itself.

<u>Topic of Interest:</u> Entertainment

Figure 7: Qualitative Examples

Topic of Interest:
Technology

Spotify
👍 💬

Similar to Osborne 1

Spotify was among the first platforms to offer a large library of streamable music for a monthly subscription, changing the way we consume music. However, the rapid evolution of technology and shifts in consumer behaviors has led to other entrants like Apple Music, Amazon Music, and YouTube Music who offer similar services. While Spotify maintains a significant share of the market, the introduction of new players has made the industry more competitive and its future position less certain.

Reference:

https://www.cnbc.com/2022/11/10/how-spotify-stayed-no-1-in-streaming-music-vs-apple-youtube-amazon.html

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Topic of Interest: India

Tata Nano
👍 👎

Similar to Osborne 1

Tata Motors' Nano was a revolutionary product when it was launched as the world's most affordable car. It generated a lot of buzz initially, but failed to sustain its appeal due to various factors including quality concerns, lack of aspirational value, and a growing second-hand car market. Despite being a first mover, Tata Nano couldn't dominate the market segment it created, much like Osborne 1's predicament.

Reference:

https://www.peppercontent.io/blog/why-tata-nano-branding-was-a-failure/

Get Relevant Examples for these topics:

Sports	Technology	Finance
Entertainment	India	America

Figure 8: Qualitative Examples