Proof of Concept, Lorax Application

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1 Introduction

This document serves as a proof of concept for the development of the application Lorax, meant to be an add-on to the existing ecosystem of Braynr.

2 Problem Statement

In today's educational landscape, **students struggle to identify effective learning strategies**, prioritize content, and sustain engagement.

The main challenge addressed by Lorax is to enable users to learn through methods best suited to their individual needs, thereby maximizing their ability to understand and retain information.

3 Proposed Solution

Our proposal focuses on identifying your own learning pattern, and is composed of three key components: **Organization, Personalization, and Gamification.**

- **Organization**: We generate a dynamic knowledge graph from your study materials, mapping core topics and prerequisites to provide a clear learning path. When multiple sources cover the same topic, the system selects the most suitable one for your needs.
- **Personalization**: AI agents adapt your study material to your preferred style—simplifying concepts, adding examples, or adjusting depth—to make learning more effective and engaging.
- **Gamification**: A test mode lets you challenge friends using a custom flashcard deck. As you study, you unlock new cards, making learning fun, competitive, and focused on active recall.

Lorax's strength lies in its integration with the Braynr ecosystem—not as a separate tool, but as an intelligent Agent that selects and leverages Braynr's resources to rework user-uploaded content and generate personalized learning material..

4 Implementation Details

4.1 Organization

To build the knowledge graph, we extract text from a PDF and split it into chapters. Using BERTopic, we identify topics in each chapter by encoding them into vector embeddings and clustering them. Topics are then mapped to their respective chapters. Chapters sharing at least one topic are connected as nodes in a graph, with edges representing shared themes. The result is a visual structure that reveals thematic links across the document.

4.2 Prerequisites Identification & Time Verification

For each chapter, we use the Gemini API to extract key prerequisite concepts by prompting it with the chapter text. We add three such nodes per chapter to the knowledge graph, linking them as foundational to the chapter.

Tracks time spent on each concept and computes performance stats. If time exceeds expected thresholds (based average reading time on similar content), the Personalization Agent triggers a reassessment and suggests an alternative learning path.

4.3 Personalization

The personalization of the learning experience is a three-step process designed to tailor the study materials to each individual's preferences and learning style. This process involves an Online Recommendation System, an AI Agent for text re-elaboration, and a Tester for evaluating comprehension.

4.3.1 Online Recommendation System (Bandit Algorithm)

The personalization process begins by selecting the most effective prompt for text re-elaboration using the UCB1 bandit algorithm. It dynamically balances exploring new prompts and exploiting the most effective ones, adapting to the user's preferences over time.

4.3.2 AI Agent for Text Re-Elaboration

Once a prompt is selected, the AI agent re-elaborates the study material to match the user's learning style, simplifying the language, adding examples, or adjusting depth for better comprehension.

4.3.3 Tester for Performance Evaluation

After reading the re-elaborated text, the user takes a small test to assess understanding. The test feedback serves as a reward signal for the bandit algorithm, optimizing future prompt selection based on performance.

Prompt examples may include:

- Simplification: "Re-elaborate the text, starting with the general idea, then formalizing it."
- Example: "Re-elaborate the text with a practical example for each concept."
- Visual: "Re-elaborate the text with an image for each concept."

This continuous loop of selection, personalization, and feedback ensures that the learning experience becomes increasingly tailored to the user's needs, enhancing both comprehension and retention.

4.4 Battle Mode

Battle Mode turns studying into a fun, competitive game where you challenge friends using custom flashcard decks. Unlock new cards, AI-generated or self-made, as you learn. In turn-based matches, players quiz each other and score points for correct answers, making active recall and peer feedback part of the game.

4.5 Limitations:

Currently, the system requires integration with Braynr's ecosystem, limiting its standalone use.

The current version is optimized for individual study but not yet designed for group collaboration or shared learning environments.

The time verification system could benefit from more advanced performance tracking for longer-term assessments.