Fluid Interfaces and Fixed Patterns: Understanding LLM Behavior in Educational Contexts

A Master's Thesis by Aayush Kucheria

Aalto University, 2024

Overview

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- **Research Focus: Behavioral Patterns in LLM Tutoring**

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- **Key Question: How do LLM Tutoring Patterns differ from human tutors?**

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- Key Question: How do LLM Tutoring Patterns differ from human tutors?
- **Methodology: Analysis of CIMA Dataset comparing human and LLM tutoring interactions**

Theoretical Background

Evolution of Educational Technology

- **Historical Constraints in Tutoring Systems**

Evolution of Educational Technology

- Historical Constraints in Tutoring Systems
- **The QWERTY Phenomenon in Edtech**

Evolution of Educational Technology

- Historical Constraints in Tutoring Systems
- The QWERTY Phenomenon in Edtech
- **Shift from tools to mediums**

LLMs as Educational Mediums

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- **Promise of Natural Interaction**

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- Promise of Natural Interaction
- **Tension between flexibility and fixed patterns**

LLMs as Educational Mediums

- Promise of Natural Interaction
- Tension between flexibility and fixed patterns
- **Current Capabilities and Limitations**

Research Questions

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- **How do artificial tutoring systems naturally behave given the same context as human tutors?**

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- **What systematic differences emerge in interaction structure?**

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- How do artificial tutoring systems naturally behave given the same context as human tutors?
- What systematic differences emerge in interaction structure?
- **How do AI tutors adapt teaching strategies to student behaviors?**

Methodology

Dataset: CIMA

- 391 exercises, 77 students
- 2880 tutor responses from 209 tutors
- Italian preposition learning context
- Multiple valid responses per interaction

Model Implementation

- Models: GPT-4, Gemini Pro, LLaMA 405b
- Consistent Prompting structure
- Action Labeling framework

Analysis Framework

- **Action Distribution Analysis**

Analysis Framework

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- **Action Combination Patterns**

Analysis Framework

- Action Distribution Analysis
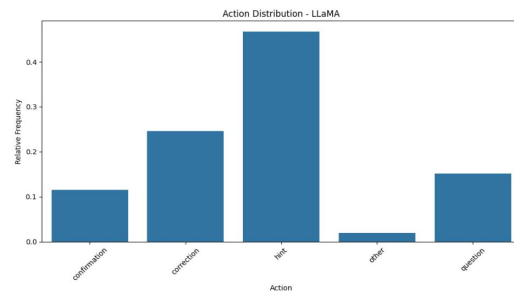- Action Combination Patterns
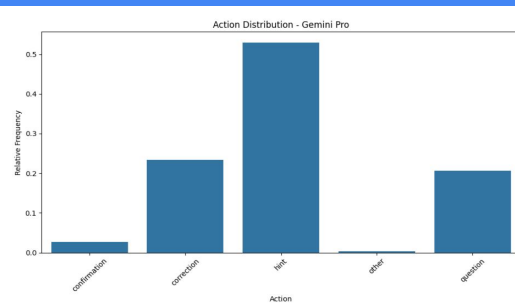- **Conditional Response Analysis**
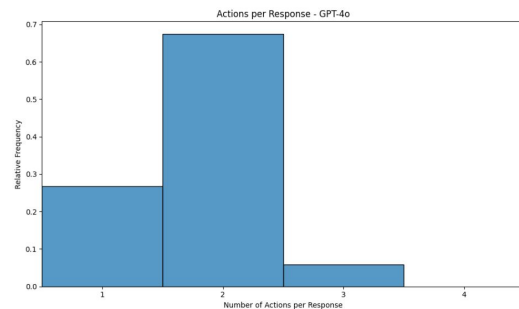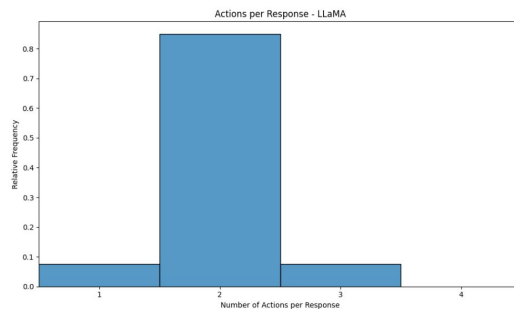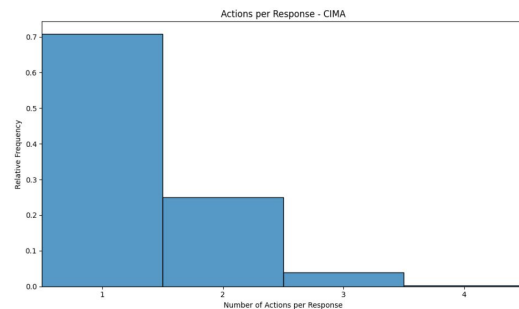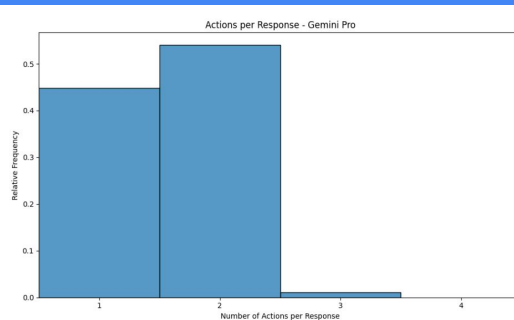
Key Findings

Action Distribution Patterns

- Similar Preference for hints as primary teaching action
- (Roughly) similar ranking and distribution of actions
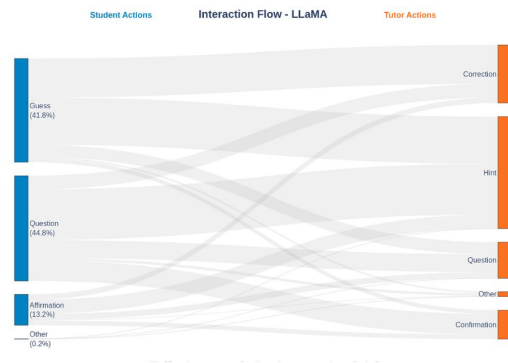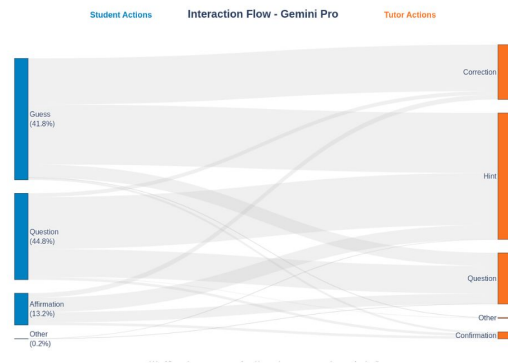- Model-specific personalities
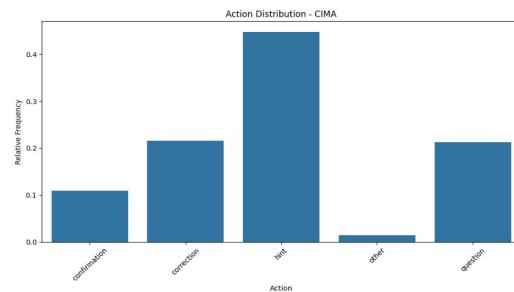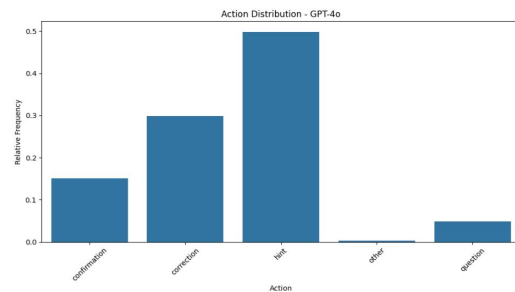
Response Complexity

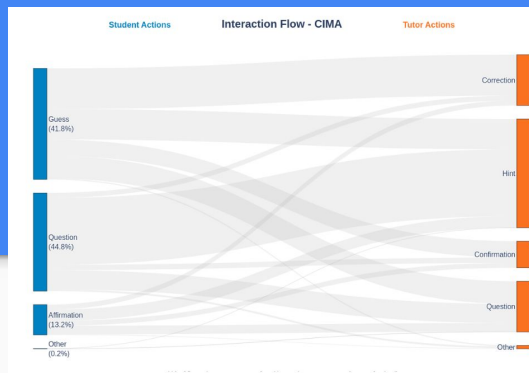- Human tutors: Strong Preference for single-action responses
- AI Tutors: Consistent tendency Toward multi-action responses
- Pattern persistence across different models

Key Findings

Interaction Flows

- Human tutors: (Somewhat) consistent teaching strategies
- AI Models: (Somewhat) more distributed interaction patterns
- Development of model-specific systematic patterns

Implications

Theoretical

- **Tension between fluid interfaces and fixed patterns**

Theoretical

- Tension between fluid interfaces and fixed patterns
- **Natural emergence of AI-specific teaching behaviors**

Practical

- **Design considerations for AI tutoring systems**

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- **Balance between adaptation and consistency**

Practical

- Design considerations for AI tutoring systems
- Balance between adaptation and consistency
- **Role of model choice in teaching style**

Future Directions

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- **Expanding beyond current dataset limitations**

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- **Investigating base model behaviors**

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- Investigating base model behaviors
- **Examining learning outcomes**

Future Directions

- Expanding beyond current dataset limitations
- Investigating base model behaviors
- Examining learning outcomes
- **Exploring intervention strategies**

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Thank you