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Machine Learning Techniques II

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Leveraging Hidden Markov Models for Adaptive Financial Literacy

Project Idea/Mission

This project aims to develop an adaptive learning platform empowering abused and displaced women in their financial recovery. By leveraging Machine Learning, the platform guides users beyond basic financial stability towards wealth creation and long-term investment, offering personalized, empathetic, and contextually relevant financial education. The ultimate goal is to foster financial independence and resilience, acknowledging their unique challenges.

Hidden Markov Model (HMM) Implementation

The HMM utilizes measurable **observations** derived from user interactions, including **discretized quiz scores** ("low," "medium," "high"), **categorized module completion times** ("very short," "average," "long")**, binary module completion status, identification of specific incorrect answers or struggled concepts, learning behaviors** like revisiting modules or retaking quizzes, and **broader engagement metrics such as login frequency and active platform time**. This constitutes a **Learning Problem**

(specifically Unsupervised Learning) for the HMM, as the user's true hidden financial knowledge states (e.g., "Novice Investor") are unknown in advance, while sequences of these observable interactions are available.

The **Baum-Welch algorithm** (an EM algorithm) is used for training. At the start, the **known values** are the **collected sequences of categorized user interaction data**, a **predefined number of hidden states** (e.g., 5-7 levels of financial understanding), and the **established discrete categories for the observable symbols**. The **unknown values** that the algorithm learns are the **core HMM parameters**: the Initial State Probabilities (π), representing the likelihood of starting in each hidden state; the Transition Probabilities (A), defining the likelihoods of moving between hidden states; and the Emission Probabilities (B), indicating the likelihood of observing each specific symbol given a particular hidden state. The Baum-Welch algorithm iteratively updates all three of these parameter sets (π, A, and B) to maximize the likelihood of the observed data.