AI Curriculum Planner:
Adaptive Academic Advising Using Graphs and Reinforcement Learning

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This project presents a personalized academic advising system designed to simulate optimal course paths for university students. It combines graph-based curriculum modeling with reinforcement learning (Q-learning) to adaptively recommend courses based on interests, GPA, and graduation progression.

1. Curriculum Graph Schema

The university curriculum is modeled as a directed graph where foundational courses like **CS101** serve as entry points to more advanced courses. This is a summary of key dependency paths:

- **Nodes**: Courses (e.g., CS101, AI401) and **Edges**: Prerequisite relationships

- **CS101** is the foundational course required for **CS102** and **CS103**.

- **CS102** and **CS103** are prerequisites for **CS201**, while **CS102** alone unlocks **CS202**.

- **CS201** leads to **CS301**, and **CS202** leads to **CS302**.

- Advanced specialization courses such as:

    - **AI401** and **DS401** require **CS301** and **SEC401** requires **CS302**
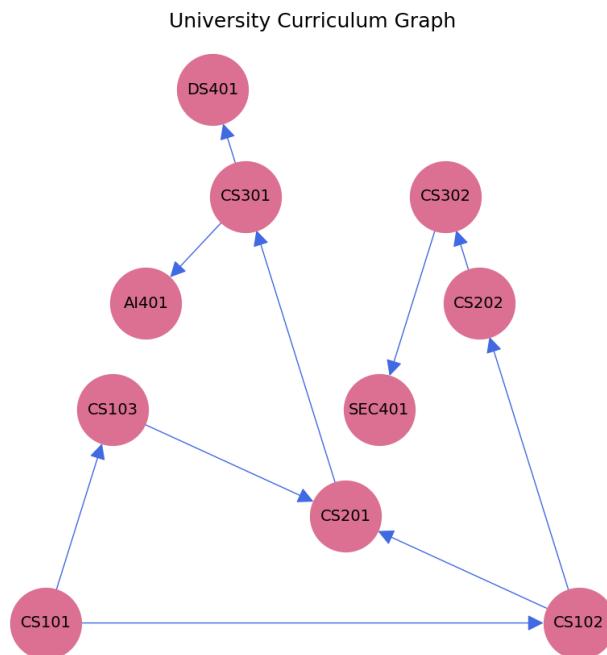

Figure 1: Curriculum Graph Visualization

2.   Simulated Student Generation

Each simulated student is initialized with:

- A random subset of passed courses
- A GPA between 2.0 and 4.0
- Grades per course
- A declared interest: AI, Data Science, or Security

3.   Q-Learning Personalization Strategy

We apply Q-learning to recommend courses per term based on student states. The model learns to maximize long-term academic success while respecting constraints.

- **State**: Bitstring of completed courses + GPA bucket + interest
- **Action**: Selecting a set of eligible courses (max 3)
- **Reward**: Based on interest alignment, GPA improvement, and course level

4.   Training Setup and Performance

We train the agent over 100 epochs using 10 fixed students, recommending multiple courses per term. The epsilon value decays over time to shift from exploration to exploitation.
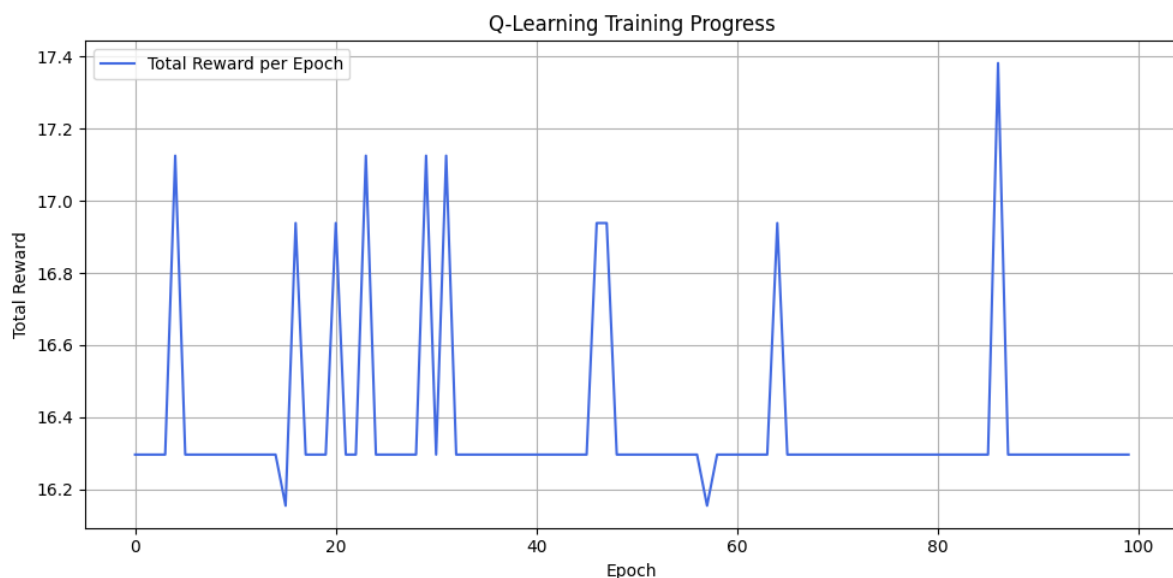

Figure 2: Q-Learning Total Reward per Epoch

5.   Example Results

Here are top course recommendations generated for a few simulated students after Q-learning training:

- **Student 20 (Interest: AI)**
  GPA: 3.74, Passed: SEC401, CS301, AI401, CS202
  Recommended: CS101, CS302, DS401

- **Student 21 (Interest: Security)**
  GPA: 3.00, Passed: CS103, CS101, CS302, CS201, CS202, DS401
  Recommended: CS102, CS301, SEC401

- **Student 22 (Interest: Data Science)**
  GPA: 2.76, Passed: CS101, CS201
  Recommended: CS102, CS103, CS301

GitHub Repository: https://github.com/GannaMohamed1/AI-Curriculum-Planner/tree/main