Water Resource Management System

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Water Resource Management Simulation

This project implements a **Water Resource Management Simulation** using reinforcement learning principles, where the primary objective is to efficiently manage a water reservoir by balancing supply and demand. The simulation is designed to model the decision-making process for water allocation, considering various factors such as **water demand**, **reservoir capacity**, and **rainfall probability**.

The system operates in a **dynamic environment** where the user is tasked with allocating water to meet the demand for each time step. The simulation environment models the reservoir, rainfall events, and the effects of water allocation, while also providing feedback in the form of **rewards** and **penalties** based on the decisions made. These rewards are calculated based on several factors:

- **Over-allocation** of water (penalty for allocating more water than available).
- **Under-allocation** (penalty for allocating less water than required).
- **Matching the demand** (reward for meeting the demand closely).
- **Stabilizing the water level** (reward for maintaining the water level within optimal limits, especially when close to full capacity).

The project utilizes **Streamlit** for an interactive user interface, allowing users to input key simulation parameters, such as:

- **Reservoir capacity**
- **Water demand per time step**
- **Rainfall probability** and **rainfall amount**

Users can run the simulation for a specified number of steps and observe how the reservoir's water level changes over time, in response to both allocated water and rainfall events. The simulation also produces visual outputs, such as:

1. **Animated Bar Chart**: Shows real-time updates of the water level in the reservoir after each step of the simulation.
2. **Line Graph**: Displays the relationship between water allocation, demand, and the rewards over time using **Plotly**.
3. **Detailed Results**: Provides users with a summary of the final water level, average reward, and an interpretation of the results, including insights on successful decision-making.

4. **Action History**: Users can view a detailed table of actions taken throughout the simulation, showcasing the choices made and their outcomes.

This project serves as an educational tool for understanding the complexities involved in water resource management, emphasizing the need for balancing water allocation to meet demand, maintaining reservoir stability, and responding to environmental changes like rainfall. The incorporation of **rewards** and **penalties** mirrors real-world constraints in water management systems, offering valuable insights into decision-making under uncertainty.

Screenshots: