Project Synopsis

Train Scheduling System using Heap Queue

The **Train Scheduling System using Heap Queue** is designed to optimize train operations by efficiently managing the allocation of railway tracks for arriving and departing trains. The system uses a heap-based priority queue, ensuring trains are scheduled based on key factors such as arrival time, train type (e.g., express, passenger, freight), and priority. The heap structure ensures efficient, quick access to the highest-priority train, enabling dynamic scheduling adjustments in real-time.

Problem Domain for Train Scheduling System Using Heap Queue

The problem domain for a **Train Scheduling System using Heap Queue** revolves around managing the efficient operation of trains within a railway network. The main objective is to ensure timely arrivals, departures, and optimal use of tracks. The key challenges include:

1. **Train Allocation**: Efficiently assigning limited railway tracks to multiple trains with varying schedules and ensuring no conflicts arise.

2. **Prioritization**: Handling different types of trains (express, local, freight, emergency) by prioritizing them based on criteria like arrival time, train type, and priority levels.

In this problem domain, the **heap-based priority queue** plays a crucial role by ensuring trains are processed in the most efficient order. The heap structure allows fast scheduling adjustments, ensuring smooth operation even as new data is received.

Solution Domain

The solution domain for a **Train Scheduling System using Heap Queue** focuses on implementing a **heap-based priority queue** to manage train schedules effectively within a railway network. The heap queue ensures that trains with the highest priority, based on arrival time and type, are allocated tracks first. By minimizing delays and optimizing track allocation, the system ensures smooth and timely operations.

Software Used

- **Backend Server**: Django (Python Web Framework)
- **Data Structure**: **Heap Queue** (using Python's built-in heapq library)
- **Frontend**: HTML, CSS, JavaScript

Methodology

The methodology for implementing the **Train Scheduling System** using a heap queue involves several steps to ensure efficient scheduling, prioritization, and conflict resolution:

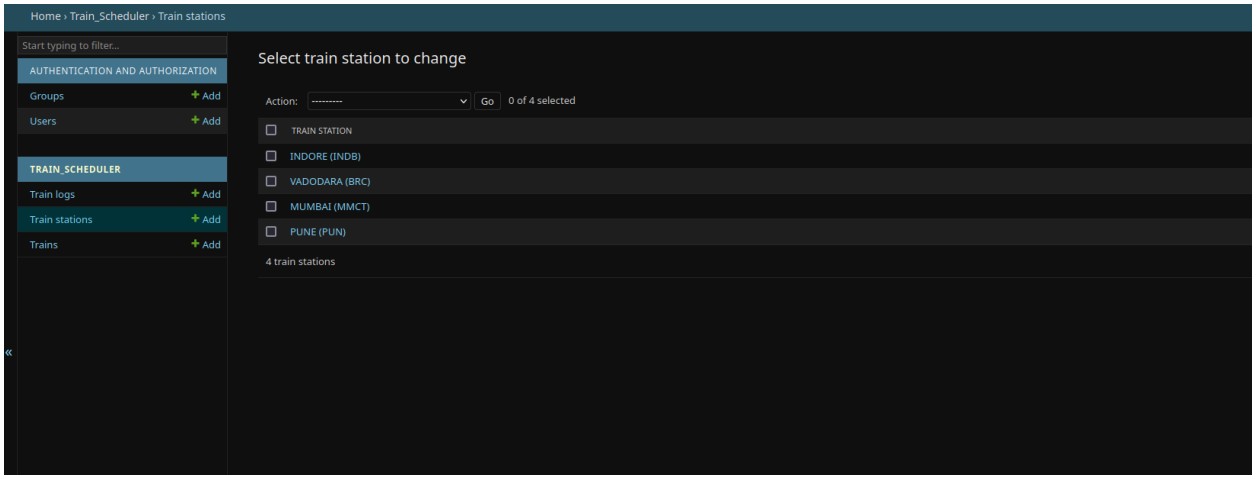
1. **Requirement Analysis and Design**: In this phase, functional and non-functional requirements are identified, such as real-time updates, dynamic adjustments for delays, and efficient train scheduling. The database schema, user interface design, and priority queue structure are also defined to ensure smooth operation.

2. **Backend Development (Django)**: Django is used to manage the backend logic. The system defines models for trains, tracks, and schedules. The **heapq** module is used for implementing the heap-based priority queue to prioritize trains. Django handles core functionalities such as adding, modifying, and removing schedules. Additionally, the **Django Admin Panel** is used for managing train schedules, and real-time logs of train movements across multiple stations are displayed.

3. **Frontend Development (HTML, CSS, JavaScript)**: HTML structures the user interface, and CSS ensures responsive design across various devices. JavaScript dynamically fetches data from the backend, updating the priority queue and track availability in real-time.

Outcomes

- **Efficient Train Scheduling**: The system effectively prioritizes trains using a heap-based priority queue, ensuring high-priority trains are scheduled first, minimizing delays.
- **Optimized Resource Allocation**: Tracks are allocated dynamically, and the scheduling system is capable of adjusting in real-time to accommodate changes such as delays or emergencies.



Select Station:

PUNE | MUMBAI | VADODARA | INDORE

Upcoming Trains

Train	Type	Platform	Arrival	Status	Actions
0002 CHG EXPRESS		1	14:00	Scheduled	Mark Arriving

Recently Departed

Train	Type	Platform	Departure	Delay
19039 SHATADBI EXPRESS		4	09:01	On time
19000 ADI PASSENGER		4	09:01	On time
00001 VADODARA FREIGHT		1	11:27	On time
12283 HAZRAT NIZAMUDDIN		1	11:25	On time

Select Station:

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Select Station:

PUNE | MUMBAI | VADODARA | INDORE

Upcoming Trains

Train	Type	Platform	Arrival	Status	Actions
No upcoming trains scheduled					

Recently Departed

Train	Type	Platform	Departure	Delay
0002 CHG EXPRESS		1	08:22	On time
19039 SHATADBI EXPRESS		4	09:01	On time
19000 ADI PASSENGER		4	09:01	On time
00001 VADODARA FREIGHT		1	11:27	On time
12283 HAZRAT NIZAMUDDIN		1	11:25	On time