NTS : New Train Scheduler

A Digitized way to Schedule Planning

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Motivation

Creating a time table for trains on a busy network like the Indian Railways is an extremely challenging task. We filed a couple of **RTIs** to

- know the basic procedure of introducing new train
- gain detailed knowledge about guidelines for designing new schedule

Crux of the RTI replies

- Schedule Planning is done manually
- Planners in the Zonal Railways work independently and then collaboratively with other Zonal level planners
- India has **17 Railway Zones**, thus making the task even more difficult and cumbersome when train runs across multiple Zones

Problem

Figure 1: An Indian Railway Train

A new train would have various characteristics like –

- Source Station with Departure Time
- Destination Station with Arrival Time
- Intermediate Stations with Halt Duration
- Week Days of Departure from Source
- Day Number of Arrival at Destination
- Maximum Speed
- Train Type (Rajdhani, Superfast, etc.)

Our objective is to find an optimum schedule schedule for such a train without disturbing existing traffic.

Suppose a new train has to scheduled between **Patna (PNBE)** and **Mughalsarai (MGS)**. We have

- Departure Time at Patna
- Arrival Time at Mughalsarai
- Week Days of Departure from Source
- Maximum Speed (Km/h)
- Day Number of Arrival at Mughalsarai
- Train Type - Supaerfast

Station	Halt Duration (hh:mm)
Patna	-
Danapur	00:02
Ara	00:02
Buxar	00:04
Mughalsarai	-

Table 1: Stations with Halt

Challenges

1. **No Publicly Available Dataset**
   - Developed script to crawl through **http://indiarailinfo.com/**
   - Many advantages over other websites such as details about **unreserved trains, intermediate stations, no. of platforms**, etc.
   - Script needs to be run once for every train
   - Script also adds details about stations visited by the train

4 halts. 167 intermediate Stations between Rajendra Nagar Terminal (Patna) and New Delhi
Show ALL intermediate Stations
No Change in Time-Table. Show OLD Time-Table

#	Trk	Code	Station Name	X/O	Note	Arrives	Avg	Departs	Avg	Halt	PF	Day#	Km	Speed	Elev
#1	/==/	RJPB	Rajendra Nagar Terminal (Patna)»				-	19:00	+0		1	1	0.0	10	55m
			0 intermediate stations				*00:15*						*2.6*		
#2	/==/	PNBE	Patna Junction			19:15	-1	19:25	+1	10m	4	1	2.6	70	57m
			49 intermediate stations				*03:00*						*211.5*		
#3	/==/	MGS	Mughal Sarai Junction		¶	22:25	-8	22:35	+3	10m	4	1	214.1	83	84m
			20 intermediate stations				*01:50*						*152.7*		
#4	/==/	ALD	Allahabad Junction	X	¶	00:25	+6	00:28	+7	3m	1	2	366.8	96	100m
			29 intermediate stations				*02:02*						*194.3*		
#5	/==/	CNB	Kanpur Central	X	¶	02:30	+10	02:35	+14	5m	1	2	561.1	87	129m
			65 intermediate stations				*05:05*						*440.3*		
#6	/==/	NDLS	New Delhi●			07:40	+31		-		14	2	1001.4	-	216m

Figure 2: Scehdule of a Train on indiarailinfo.com (Source : indiarailinfo.com)

2. **Identifying Trains in Patna-Mughalsarai Network**
   - Restricted our work to Railway Network between Patna and Mughalsarai
   - Only Trains that use Patna or Mughalsarai or any other Station between them are considered
   - **502 Trains** and **51 Stations** in the Network

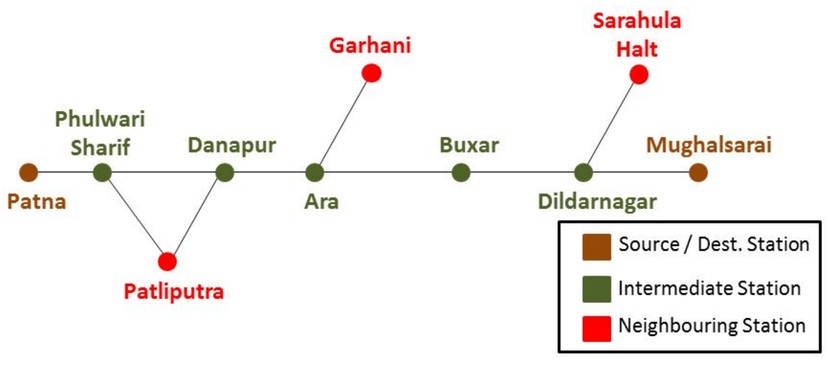

Figure 3: Railway Network Being Considered

3. Trains may be running on **Multiple Days in a Week**. Traffic on each day needs to be considered while finding Itineraries.
4. **Y Overtake** - Overtaking Scenarios get more complex when trains come from a neighboring stations (Red Stations in the Figure 2).

Proposed Scheduling

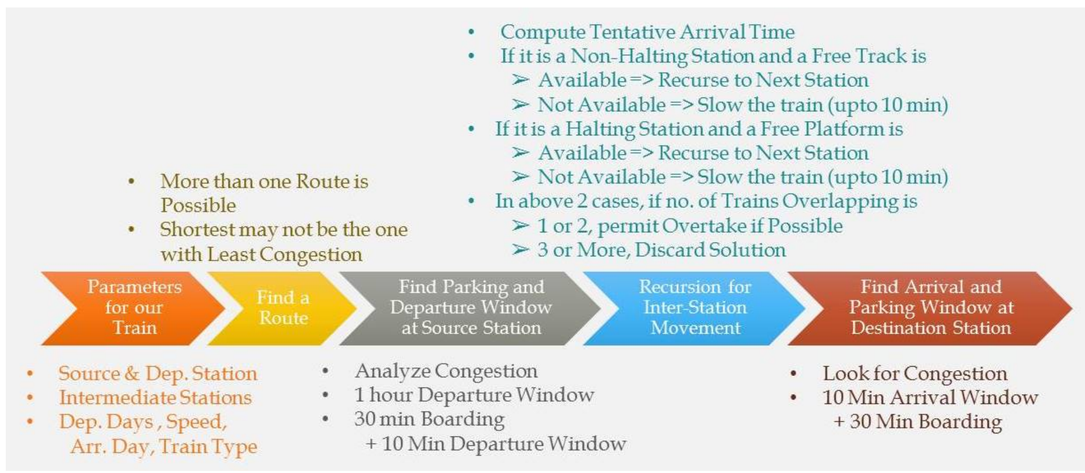

Figure 4: Scehduling Schematics

Y-Overtake

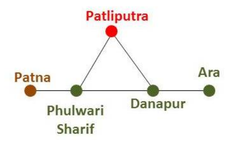

Figure 5: Y-Overtake Scenario

A train may join our route at some Intermediate Station.

- Trains coming from **Patliputra** create such scenario.
- How to identify direction of such trains?
- If such train visits **Ara**, then in same direction as ours.
- If in same direction, consider for overtaking.

Itinerary Recommendation

- May have more than one itinerary
- Best to use that itinerary which produces least strain on the network
- Itinerary with the least value of **Occupancy** is desired

$$\textbf{Occupancy} = \sum_{\forall stations} \frac{\textbf{No. of Occupied Tracks at Station}}{\textbf{Total No. of Tracks at Station}} \quad (1)$$

Results

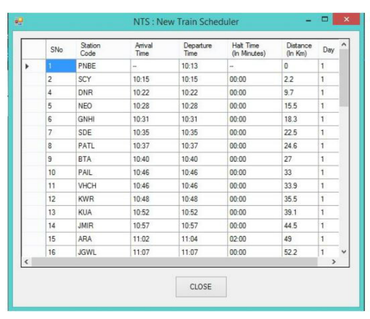

Figure 6: Patna(PNBE)-Mughalsarai(MGS)

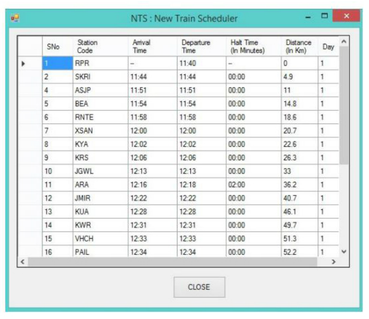

Figure 7: Raghunathpur(RPR)-Patna(PNBE)

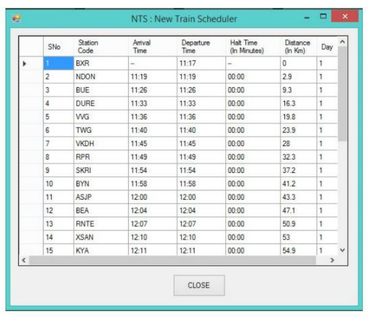

Figure 8: Buxar(BXR)-Patna(PNBE)

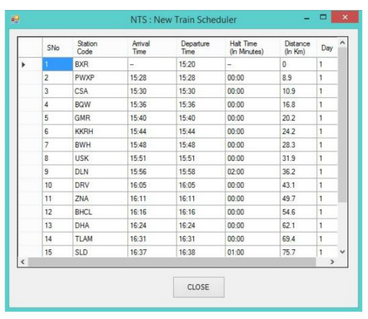

Figure 9: Buxar(BXR)-Mughalsarai(MGS)

Figure	Source	Destination	Dep-Time (hh:mm)	Arr-Time (hh:mm)	Distance (km)	No. of Stations	Overlapping Trains	No. of Solutions	Run-Time (seconds)
6	PNBE	MGS	10:10	13:55	211	51	5	10	56.49
7	RPR	PNBE	11:10	12:50	85	25	4	3	27.43
8	BXR	PNBE	11:10	13:15	118	31	5	6	60.26
9	BXR	MGS	15:10	16:50	94	20	3	20	28.71

Table 2: Analysis of Schedules Obtained.

Our script processes input to find possible itineraries. Key observations

- Run-Time increases with increase in No. of Stations in the Route
- No. of solution do not always increase with decrease in No. of Overlaps
- No. of Solutions depend more on the way the Overlappings occur

Conclusion

Implemented Automated Scheduling that takes care of Congestion at Station as well as also Overtaking between trains.