M.Tech (IS)

Reasoning Systems Project Report

Intelligent Rapid Shuttle (IRS)



Team Members

SUDALAIANDI RAJA SUDALAIMUTHU

JAYARAMAN REVATHI

JAYASRI RAGHUNATHAN

SUNIL VARGHESE

# EXECUTIVE SUMMARY

In Singapore shuttle services to ferry students from their home to school and back is quite common. Probably every Singaporean would have travelled in a shuttle service during their student days.

Our team of 4 Singapore residents have also gone through the process of selecting shuttle services for our school going children and the biggest challenge we found was to find a service which takes the shortest distance to reach the school from our house at a reasonable cost.

We believe that many other Singapore parents would also be finding similar difficulties in selecting shuttle services for their children for a nominal cost. This provides a greater opportunity to address the gap in the market and thus we decided to embark on this project. In this project, we are assuming that we are a service provider having few depots operating shuttle buses at our disposal. We would be providing shuttle services optimized through the implementation of Reasoning Systems **Optimization** techniques using **KIE workbench**, **Drools** and **OptaPlanner**.

We felt that the scale and scope of the project was such that many more options for optimization could have been explored e.g. the amount of time taken for students to reach school taking traffic conditions in to consideration on top of travel distance optimized. However, given the time limitations we were happy with the solution we were able to achieve as part of this project.

# BUSINESS PROBLEM BACKGROUND:

There is a demand for shuttle services which would ferry children from their home to the school and vice versa optimised to take the shortest distance in doing so. At the same time the prices charged for this service should be competitive compared to the current service providers. This can only be achieved by selecting optimized route along with correct distribution of students in to the available vehicles based on their starting locations and the schools.

# PROJECT OBJECTIVE

Having defined the business problem our group’s aim was:

To develop an optimizer (Intelligent Rapid Shuttle - IRS) in which the route taken by a given shuttle should be the minimum overall distance travelled resulting in lower cost of operation for the service provider. This would make the services offered to the students for a lower shuttle service charge. The optimizer would take the inputs as the No. of students, the No. of Vehicles and the No. of Schools to take the shortest route between a student location and their respective schools as well as the overall shortest route for a vehicle. The routes would be shown visually on the google map to enable the service provider to navigate easily and follow the recommended route map by the IRS Optimizer.

# PROJECT SOLUTION

## BACKGROUND KNOWLEDGE AND USER INPUTS

For this project, below data/input are given/predefined:

User Input :

* The number of students
* The number of schools
* The number of vehicles

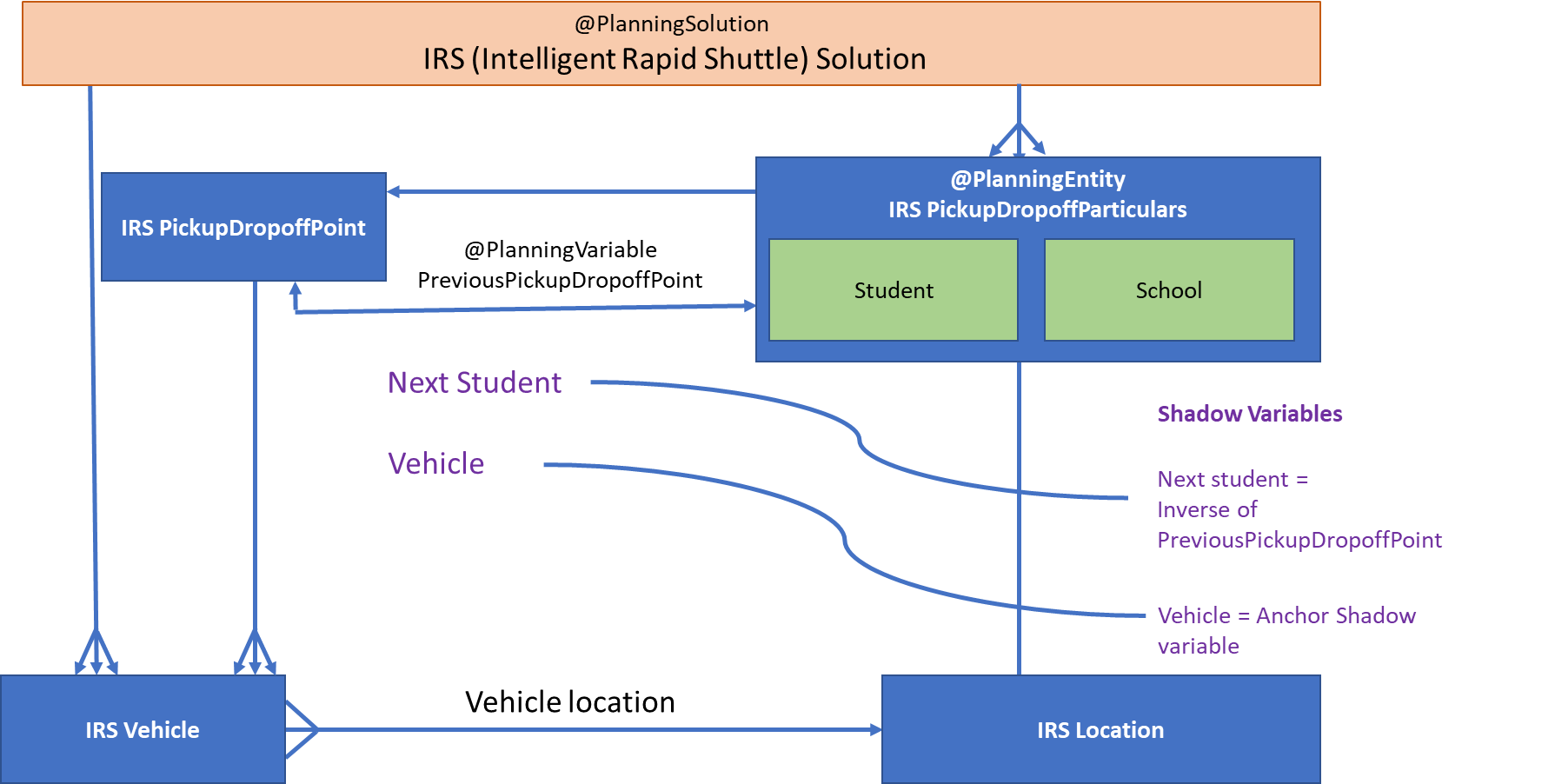
Data Collected from public sites using ParseHub web scrapping tool :

* A predefined list of schools and their locations (postal codes)
* A predefined list of student locations (postal codes)
* A predefined list of vehicle locations (postal codes)

Google Geocoding API is used to obtain longitude and latitude of location of postal codes.

## DOMAIN MODELING

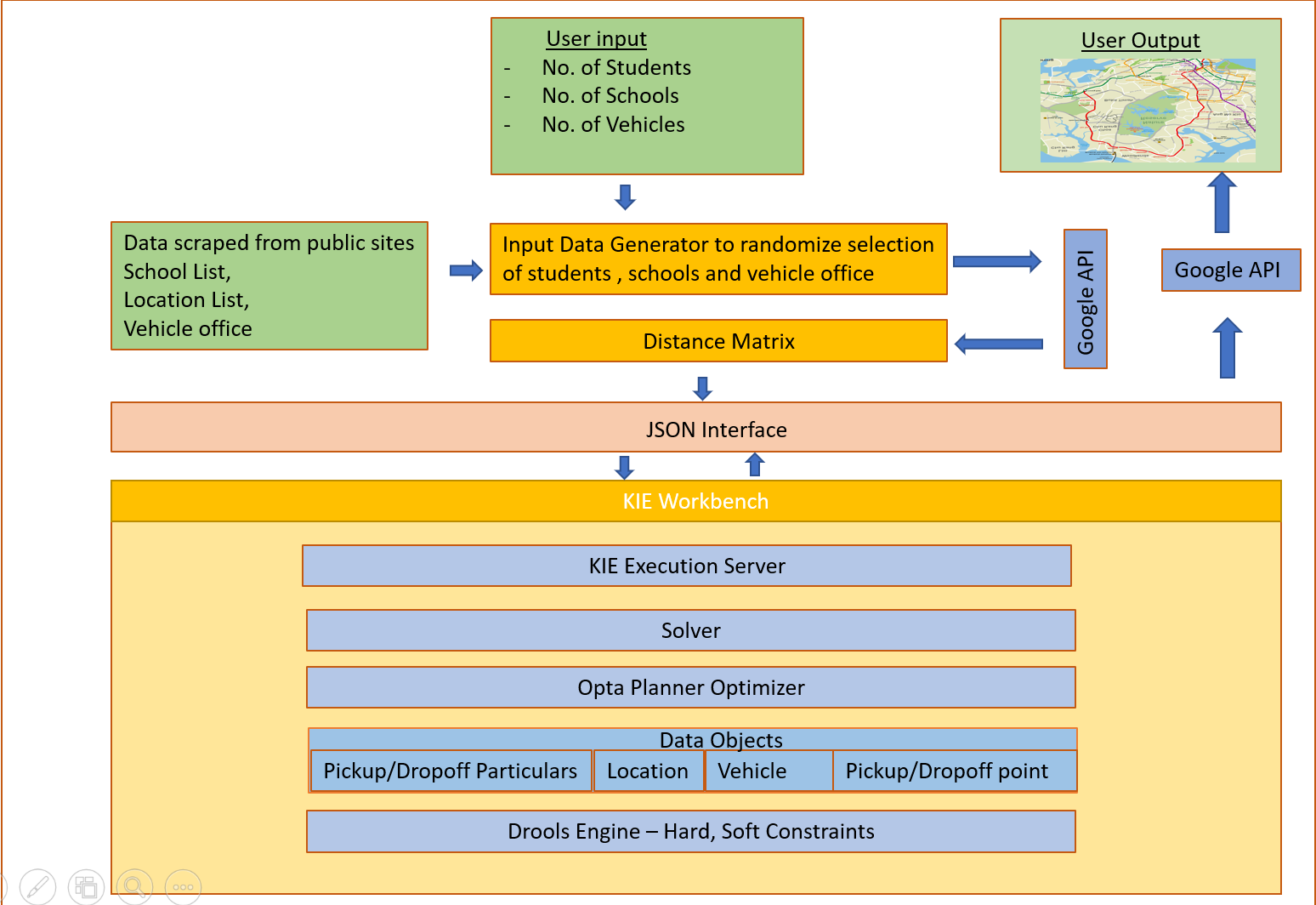
The UML class diagram is shown below. The planner concepts are already annotated.



* Planning Solution: IRS Solution Data Class contains the list of the class that represents a data set and contains all planning entities. In this example that is the class **Solution**.
* Planning entity: the class (or classes) that changes during planning. In this example, it is the class **PickupDropoffParticulars**.
* Planning variable: the property (or properties) of a planning entity class that changes during planning. In this example, it is the property **prevPickupDropoffPoint** on the class **PickupDropoffParticulars**.

## SYSTEM ARCHITECTURE

The system architecture diagram, illustrates how the application in the front-end has been interfaced with the back-end rule-based system.



-To be updated

# PROJECT SCOPE

-To be added

# SYSTEM’S FEATURES

Despite the limitations, the team went through an in-depth thought process to implement significant features in the Intelligent Rapid Shuttle system which can substantially add value to potential students as well as to the shuttle service provider.

* The system optimizes the route between the student’s location and his school such that the distance travelled is the least. This would help the student to reach his school in the shortest time.
* The overall distance travelled by all the vehicles on a given day is optimized such that the least distance is travelled. This would help the service provider to minimize his cost and hence price his services competitively.
* The capacity of the vehicles is optimized dynamically, such that at any given point of time capacity is maximized without crossing the capacity limit. This in turn helps in maximising the profit for the service provider.
* The system is designed for scalability, i.e. it caters for multiple vehicles with multiple locations as well as multiple student locations. The system is catered to have these inputs scaled up.

# LIMITATIONS

-to be added

# CONCLUSION

Our team had a great time working on this project, and we definitely picked up some useful skills along the way. Understanding the configuration of OptaPlanner and class design of the solution with integration of web interface using Java was part of the entire process. Without a sound knowledge base taught in the lectures, we wouldn’t have been able to build on system based on all the different rules. Building the system itself presented a whole new set of learning points. We got to apply practical knowledge of the KIE Server, OptaPlanner, as well as tap on our team’s existing expertise in Java. Working on the exercise together allowed everyone to learn some or the other skills from one another.

# IMPROVEMENTS

If we had a longer time frame to work on this project, we would have worked upon the following points of improvement:

-to be added

* Traffic conditions.

Annex1

Class Data Model(excel)

Input (xml example)

Output (xml example)