A REPORT

ON

Developing an Android Application for Route Optimization and Inventory Management

BY

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PREPARED IN PARTIAL FULLFILLMENT OF

PRACTICE SCHOOL-1

AT

NATIONAL TEXTILE CORPORATION LIMITED, DELHI

A PRACTICE SCHOOL-1 STATION

OF

BIRLA INSTITUTE OF TECHNOLOGY AND SCINCE, PILANI

21ST MAY – 13TH JULY

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ACKNOWLEDGEMENT

We pay our deep sense of gratitude to, who has given us the opportunity to perform our Practice School-I at NTCL Delhi. We are also thankful to the management who has been very cooperative and helpful towards us.

We express our sincere thanks to ***SH. Vivek Plawat (Executive Director, NTCL Delhi)*** and ***Mr. Amit Shukla (IT Head, NTCL Delhi)*** for their guidance and support at times whenever necessary during the project. We would like to thank ***Dr. Nithin Tom Mathew (Prof. Mechanical, BITS Pilani)*** for giving me this opportunity to undergo training in such a reputed organization and his constant guidance and motivation.

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

PRACTICE SCHOOL DIVISION

Station: NTCL, Delhi **Duration:** 8 Weeks

Date of Start: 23rd May **Date of Submission:** 13th July

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Name of Expert	Designation
Sh. Vipin Plawat	Executive Director, NTCL
Mr. Amit Shukla	Head (IT), NTCL Delhi

PS Instructor	Designation
Mr. Nithin Tom Mathew	Prof. Mechanical, BITS Pilani

ABSTRACT

Combinatorial optimization seeks to find the best solution to a problem out of a very large set of possible solutions. Here are some examples:

Vehicle routing: Find optimal routes for vehicle fleets that pick up and deliver packages given constraints.

Scheduling: find the optimal schedule for complex set of tasks, some of which need to be performed before others, on a fixed set of machines, or other resources.

Bin packing: pack as many objects of various sizes as possible into a fixed number of bins with maximum capacities.

Our focus will only be upon developing applications to solve **Route Optimisation** ***(Vehicle routing)***and **Inventory management** ***(bin packing)***.

And to solve such problems we use **Google OR Tools** because in most cases, problems like these have a vast number of possible solutions—too many for a computer to search them all. To overcome this, OR-Tools uses state-of-the-art algorithms to narrow down the search set, in order to find an optimal (or close to optimal) solution. We will be using **Java**, **XML** and **Android Studio** for the development of the android application.

Signature of Students

Date: 12.07.2019

Signature of PS Faculty

Date: 12.07.2019

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INTRODUCTION

Our project goes around ***Combinatorial Optimisation***. So, we try to optimize problems with two variables using Google OR Tools and then moving further to multi variable problems. We apply this method to solve real life problem such as:

- ROUTE OPTIMIZATION
- CONTAINER PACKAGING (or Inventory Management)

We find out the problems faced by organization and how we can try to solve those using Google OR Tools and coding algorithms to get solutions.

In future we plan to develop an accessible platform to solve these problems and make them available to individuals of an organisation. The platform could be an android application.

We pressurise on solving the problem efficiently. And to solve such problems we use Google OR Tools because in most cases, problems like these have a vast number of possible solutions—too many for a computer to search them all. To overcome this, OR-Tools uses state-of-the-art algorithms to narrow down the search set, in order to find an optimal (or close to optimal) solution. We will be using Java, XML and Android Studio for the development of the android application.

MOTIVATION

At present NTCL is working under loss and loan acing the stress in profit earned. It needs to reformulate its manufacturing process and take part in modernization of industry in India. Adopting Cost saving methods is one of the well versed path of modernization. Optimising is the best way to cut costs and save money. Thus we focus upon combinatorial optimisation techniques such as Routing and Container Packaging.

Route optimisation will help in having ease at choosing the most optimum path from bunch of possible delivery route.

Inventory management will help upgrade the transportation system well and cut losses thus filling the holes in investments which were suffered previously.

BACKGROUND

Technology is the current trend in transforming our industries and modernising our industries with new efficient machinery, etc. The competitive environment forces the organisation in every industry to switch to more optimum techniques and methods to survive in the market.

NTCL had made some decisions in past of importing machinery which were more capital intensive and it had helped them reduce loses. Maybe that is the reason they could survive in the market. But despite those changes NTCL still goes on to face some huge losses and now it is high time to start modernising the already present methods with the most optimised techniques to reduce losses. Thus we have a need of combinatorial optimisation, which is the base of our project.

METHODOLOGY ADOPTED

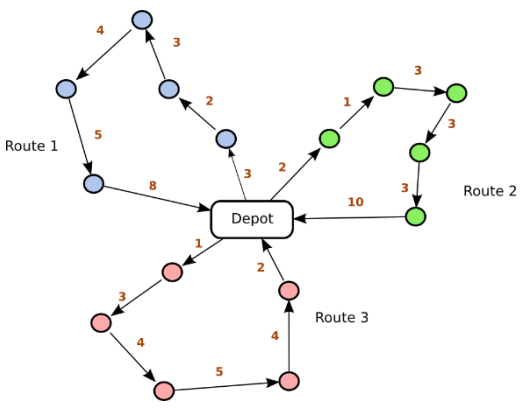
ROUTING

Overview

Routing network is usually represented by a graph like the one below.

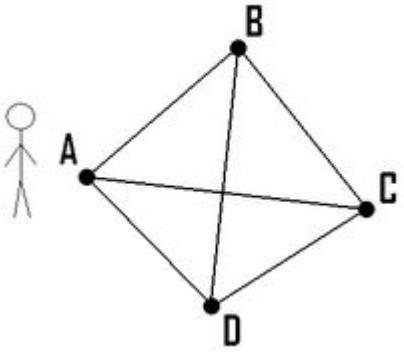
Each node represents a location, and a route is a path through a set of vertices. Node routing problem is a subpart of routing problem which governs the principle for vehicle routing. A major step in implementing an efficient system over reducing loss is by solving the issue and make it accessible by the workforce through app.

The purpose of our project is to optimize the delivery system using the algorithm based problems travelling salesman (for single delivery system) and vehicle routing (for multiple delivery system).



TRAVELING SALESMAN PROBLEM (TSP)

Mathematically, traveling salesman problems can be represented as a graph, where the locations are the nodes and the edges (or arcs) represent direct travel between the locations. The weight of each edge is the distance between the nodes. The goal is to find the path with the shortest sum of weights. Below, we see a simple four-node graph and the shortest cycle that visits every node and with OR tools we can solve issues regarding asymmetric cost problems, time constraints etc.



VEHICLE ROUTING

The goal is to find optimal routes for multiple vehicles visiting a set of locations. Solving the VRP example with OR-Tools:

1. **Create the data:** Where the data contains location of coordinates of locations.

2. **Add the distance dimension**: which calls the shortest distance possible. Access the distance through NxN matrix.

3. **Print the optimal solution**.

Resource: *https://developers.google.com/optimization/routing/vrp*

INVENTORY MANAGEMNT

Overview

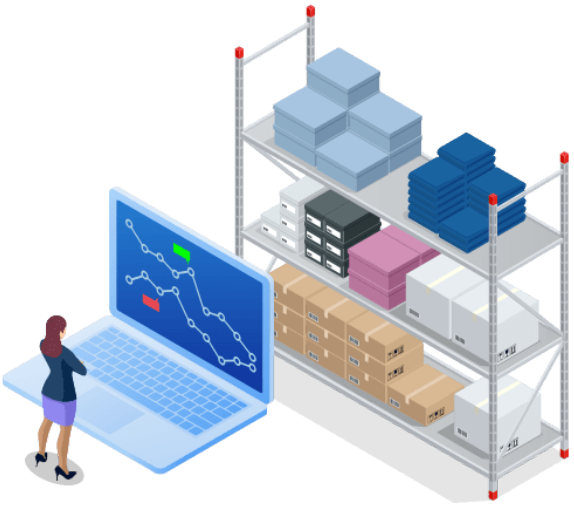
It is the supervision of non-capitalized assets (inventory) and stock items. A component of supply chain management, inventory management supervises the flow of goods from manufacturers to warehouses and from these facilities to point of sale.

Our main purpose is to increase efficiency in transporting good by dealing with position assigned to each good. Giving importance to the mainly three aspects:

1. Angles and dimension of each package.

2. Loading and unloading of packages at location nearby.

3. Special care of packages to be kept in mind.



Knapsack

It is a puzzle wherein we have to fit in things keeping in mind the preferences and requirements. A soldier backpack is an example of such kind of problem faced in real life where in he has to decide upon things having maximum utility for him in his journey.

Here we learn the algorithm to optimize the utility and generate a flow paradigm for it. There after it could be converted into code and used via app or web whatever suits our requirements.

ANDROID APP DEVELOPMENT

Learning Java

If you want to build applications for mobile devices, desktop computers, or the web, you need to know Java. Learning Java SE (Standard Edition) will help you build your first apps or start exploring the language on your own. It helps you control program flow with conditional logic and loops, store data with the Java Collections Framework, and understand how Java implements object-oriented coding principles such as inheritance and polymorphism.

Learning Agendas:

- Understanding the history and principles of Java
- Installing Java, IntelliJ IDEA, and BlueJ
- Creating a Java project
- Working with variables, values, and expressions
- Working with object data types
- Building, comparing, and parsing strings
- Debugging and exception handling
- Creating loops and reusable code
- Passing arguments by reference or value
- Using simple and complex arrays
- Creating custom classes

- Understanding inheritance and polymorphism
- Managing files with Java libraries
- Documenting code with Javadoc
- Packaging classes in JAR files

Learning Android Studio

Android studio is the official IDE (Integrated Development Environment) or tool (layman terms) for developing application exclusively for Android platform.

It has a strong editor tool for developing creative UI and emulators for different versions to test and simulate sensors without having actual Android devices.

It also has a very useful Gradle plugin using which you can create application files (apks) with different configurations. Moreover it makes exporting and uploading apk on playstore is easy with a single click. It also has ANT build if you prefer that.

In the recent updates Android studio has brought instant run which makes testing even faster and easier.

For any difficulties with Android Studio refer to the link below:

https://drive.google.com/drive/folders/183kezo_JDw5t4XopPVk6V0Xiu4wKAb28?usp=sharing

DISCUSSION

Creating a server and then merging front end code with back end is very difficult for an individual or an amateur. Thus we were not fluent with the programming of back end functions as well as the IDE used for app development that is Android Studio. However, we have planned and designed the **layout** or say the **front end interface** for our interactive android app.

We were able to create the layout for the app and code the front end part of the application.

We did learn to enable the GPRS connection to the app but unable to implement it. We mainly have problem in implementation, given the logic and source code it was difficult to interpret it and fit in the studio environment.

We did found other sources which offers app, given the idea and layout, we prepared one which you can install.

Link: https://snappy.appypie.com/index/app-download/app_id/bc308da6de57

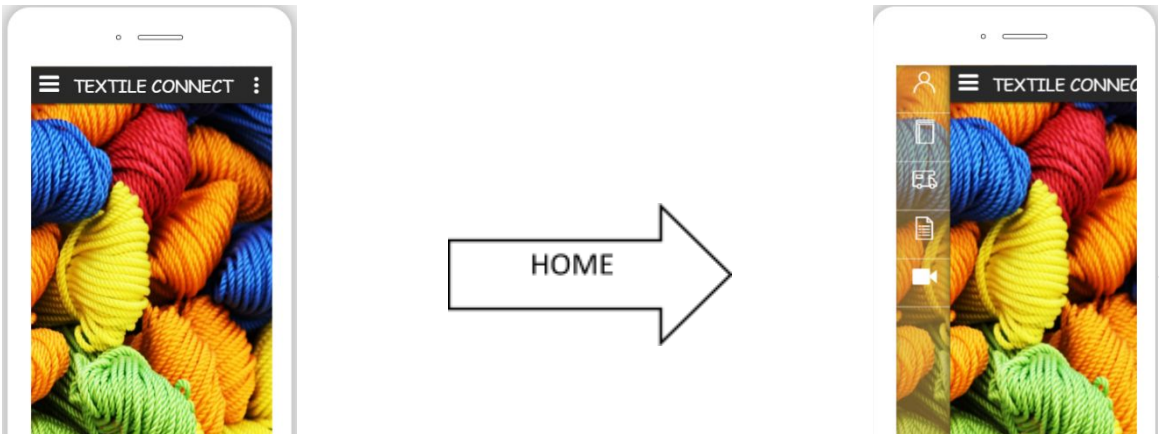
RESULTS

Meet “Textile Connect”

We name our combinatorial optimisation android app “Textile Connect”.

Textile Connect will be an app which can prevent textile industries from losing on lot of resources and thus investing those into other projects helping them compete with foreign goods.

From Routing and Inventory management if we can cover all the combinatorial optimisation problems and algorithms for their solution in future it can save us the hard work of manual estimations and reduce errors drastically.



CONSTRAINTS & LIMITATIONS

The first step in development is brainstorming, which we did very well. But the later which is the actual development being as important as ideation was where we lacked.

Designing both front end & back end of an app followed by linking them together on a platform to complete the app is way too difficult for a newbie. Despite having the resources we couldn't complete the app. The major limitation for us was time.

LIMITATION IN WORKING OF THE APPLICATION: Combinatorial Optimization has huge costs of data collection, expensive computer machinery, analyst's time, and the training of employees to use such sophisticated tools are simply too high.

VISION (FUTURE SUGGESTIONS)

After we have an android app which can help us find the most optimum route or help us in packing all the packages into a container in the most optimised way possible.

We dream to make an app which will have the solution of all the combinatorial optimization methods, available to every individual.

It's APPLICATIONS:

- Developing the best airline network of spokes and destinations
- Deciding which taxis in a fleet to route to pick up fares
- Determining the optimal way to deliver packages

- Working out the best allocation of jobs to people
- Determining the right attributes of concept elements prior to concept testing
- Logistics
- Supply chain optimization

It's TYPE:

- Integer programming
- Knapsack problem
- Minimum relevant variables in linear system
- Minimum spanning tree
- Nurse scheduling problem
- Set cover problem
- Traveling salesman problem
- Vehicle rescheduling problem
- Vehicle routing problem
- Weapon target assignment problem

LEARNINGS

So far at NTCL Delhi we have learnt 2 different optimization techniques using Google OR Tools. We have also learned the basics of Android App development using JAVA and XML on Android Studio.

We also learned to manage our time and communicate with our team mates patiently. We learned the value of a corporation's work ethics and team work.

HARD SKILLS:

- JAVA
- XML

- Android Studio
- Google OR Tools

SOFT SKILLS:

- Time Management
- Team Work
- Communication
- Patience
- Work Ethics
- Problem Solving Ability

BENEFITS TO THE ORGANISATION

With the growth of the Internet, more people have access to sophisticated tools and information that ever before. Now organizations are faced with an environment marked by increasing complexity, economic pressure and customer expectations. The need for cost reduction and the need for fast product development is imperative. Customers have come to expect high product reliability and sophisticated functionality at a low cost. The need to accomplish these new demands has required that companies focus on their internal business processes and to create relationships with suppliers and their customers so as to achieve maximum efficiency and integration along the entire supply chain. Clearly, optimization can

play an important role in these activities. Cost savings can occur by limiting inventory, by continually evaluating all of the logistics costs, and by examining how to minimize the capital tied up in the supply chain. By reducing the cumulative time between product development and delivery to the customer and by elimination of duplication of effort in the supply chain, one can obviously increase long-term profitability.

REFRENCES

https://developers.google.com/optimization/introduction/overview

https://developer.android.com/studio

https://homepages.cwi.nl/~lex/files/dict.pdf

GitHub Codes

https://github.com/google/or-tools

Google OR Tools

https://developers.google.com/optimization/bin/bin

Android Studio

https://developer.android.com/studio/?gclid=Cj0KCQjwov3nBRDFARIsANgsdoGFofiQ-yF_gm-OVuR60tsHC_gLNmAtM01aEcowhRjObbTcw6xmVwwaAs4rEALw_wcB

STUDY MATERIAL

https://drive.google.com/drive/u/0/folders/183kezo_JDw5t4XopPVk6V0Xiu4wKAb28

https://www.lynda.com/Java-tutorials/Java-8-Essential-Training-2015/377484-2.html