



Itinerary Optimization

Wanderwise



GROUP 3

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CHANGING LANDSCAPE OF TRAVEL



The travel industry has undergone significant transformation due to **technological advancements** and **evolving consumer preferences**.



The rise of smart booking applications and travel planning tools has streamlined travel planning, offering convenience and personalization.



Travelers now seek personalized and unique experiences tailored to their preferences, moving away from generic itineraries and travel agencies.



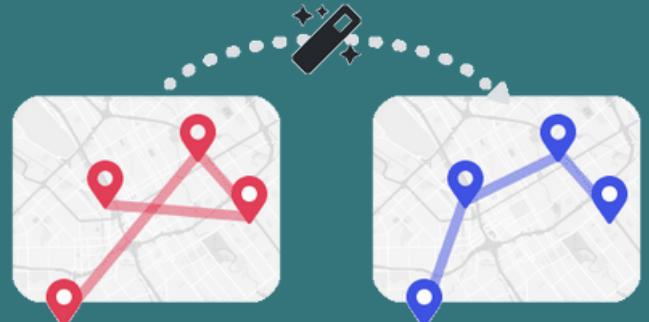
PREMIUM FEATURES

Annual Subscription Fee of SGD\$40.00



OFFLINE ACCESS ON MOBILE

Access your trip plans offline



SMART ITINERARY OPTIMIZER

Automatically rearrange the best route to visit your must-sees.



AUTOMATIC GMAIL SCANNING

Get your flight, hotel, and other types of reservations automatically imported into your trip plan without lifting a finger.

ONLINE REVIEWS



goosed
GOOSED.IE

"I did use (the route optimization feature) once or twice, but found that I could manually do this pretty easily too. A nice idea, **but I'm looking for things to justify a hefty subscription cost.** This isn't the feature to do it."



REDDIT

"I often want to plan more than one activity in a day, as it stands, there is not a clear way to visualize how much time I anticipate needing for a particular activity and whether it will put me over the top for the day. **I don't mind entering my expected time spent or restrictions, but there is no way to see the bare or overcommitted spots right now.**"



BUSINESS OPPORTUNITIES

ADDRESS CORE INEFFICIENCIES

Work on existing gaps in Wanderlog's premium features, specially optimization feature, to increase customer satisfaction.

ENHANCE PREMIUM MEMBERSHIP

Introduce new premium features to better align with user expectations, improving subscription rates and reducing customer churn.



PROPOSED SOLUTION

WANDERWISE



FORMULATION OF LOP MODEL



PLAN AN ITINERARY WITH CUSTOMER SATISFACTION AS THE TOP PRIORITY

What To
Decide

Objectives

- Which attractions to include (select feasible subset attractions)
 - The order in which to visit them with the limited time
-
- Maximise the **satisfaction level** of the user from the selected attractions
 - Minimising the **travelling distance** between the attractions
 - A feasible itinerary within the **time period** (avoid disappointment due to operating hours)



OUR LOP MODEL

PLAN AN ITINERARY WITH CUSTOMER SATISFACTION AS THE TOP PRIORITY



Parameters

1. let N be the set of nodes, $N = \{\text{hotel}\} \cup \{\text{attraction}_1, \text{attraction}_2, \dots, \text{attraction}_n\}$
2. let d_{ij} be the travel distance (in meters) node i and node j
3. let $t_{ij} = \frac{d_{ij}}{\text{average speed}}$, here we assume a constant average speed of 800m/minute
4. let O_i be the opening time of attraction i (calculated in minutes from midnight)
5. let C_i be the closing time of attraction i (calculated in minutes from midnight)
6. let p_i be the preferred visit duration of attraction i
7. let S_i be the start visiting time of attraction i (in minutes from midnight)
8. let r_i be the interest rank of node i, lower rank indicates higher interest

9. let b_i be the bonus of node i. bonus is calculated with the following equation:

$$b_i = 100 \times (r_{max} - r_i + 1)$$

Where r_{max} is the maximum rank among the attractions. This system is set up to ensure that the system prioritizes the higher-ranking attractions.

10. let D be the departure time from the hotel (in minutes from midnight)
11. let R be the return time back to the hotel (in minutes from midnight)
12. let M be the big M constant, here we fix M to be 10000
13. let λ be a constant that penalize each additional distance needs to be travelled, here we set λ to be 0.01. The reason behind this number is because the distance between each attraction ranges from 4 to 5-digit numbers while the bonus point ranges from 3 to 4 digit, therefore to ensure a proportional trade off between the two an additional distance penalty of 0.01 is set

OUR LOP MODEL

PLAN AN ITINERARY WITH CUSTOMER SATISFACTION AS THE TOP PRIORITY



Decision Variables

1. Let y_i be a binary variable to indicate whether attraction in node i is visited in the tour.
 $y_i = 1$ if node i is visited during the tour and $y_i = 0$ if not visited.
2. Let X_{ij} be a binary variable to indicate the path from node i to node j . $X_{ij} = 1$ if the path is selected and $X_{ij} = 0$ if not selected.

Objective Function

$$\max \sum_{i \in N \setminus \{depot\}} (b_i \times y_i) - \lambda \sum_{(i,j): i \neq j} d_{i,j} \times X_{i,j}$$

OUR LOP MODEL

PLAN AN ITINERARY WITH CUSTOMER SATISFACTION AS THE TOP PRIORITY



Path Continuation Constraints

$$\sum_{j \neq hotel} X_{hotel,j} = 1 \quad \sum_{i \neq hotel} X_{i,hotel} = 1$$

$$\sum_{i \neq j} X_{i,j} = y_i \quad , \forall i \neq hotel$$

$$X_{i,j} \leq y_i \quad , \forall (i,j), i \neq j$$

Time Ordering Constraints

$$S_j \geq S_i + p_i + t_{i,j} - M(1 - X_{i,j}) \\ , \forall (i,j) \text{ where } j \neq hotel$$

$$S_i + p_i + t_{i,hotel} \leq R + M(1 - X_{i,hotel}) \\ , \forall (i,j)$$

$$\sum_{i \neq j} X_{j,i} = y_i \quad , \forall i \neq hotel$$

$$X_{i,j} \leq y_j \quad , \forall (i,j), i \neq j$$

Opening Hours Constraints

$$S_i \geq O_i - M(1 - y_i) \\ , \forall i \in \{1,2, \dots, n\}$$

$$S_i + p_i \geq C_i - M(1 - y_i) \\ , \forall i \in \{1,2, \dots, n\}$$

OUR LOP MODEL

PLAN AN ITINERARY WITH CUSTOMER SATISFACTION AS THE TOP PRIORITY



THE TRAVELLING SALESMAN PROBLEM

WHAT'S THE SHORTEST ROUTE TO VISIT ALL LOCATIONS AND RETURN?



This model **maximises** the “score” of visited attractions (weighted by rank) while respecting:

- Operating hours per attraction,
- Start/finish time constraints at the depot,
- A single continuous route, and
- A cost for total distance.

All constraints remain standard
TSP-style + time windows.

DEMONSTRATION (SIMPLIFIED CASE)



 WanderWise



Travel Itinerary Planner

Start Time from Hotel (24-hour clock, e.g. 23:59):

Return Time to Hotel (24-hour clock, e.g., 23:59):

Select Attractions:

Gardens by the Bay	Singapore Zoo	Singapore Flyer	Universal Studios Singapore	Singapore Botanic Garden
Lau Pa Sat	Fort Canning Heritage Gallery	National Gallery Singapore	River Safari Singapore	Night Safari Singapore
Haw Par Villa	ArtScience Museum	Chinese Garden Singapore	Thian Hock Keng Temple	Bird Paradise
S.E.A. Aquarium	Madame Tussauds Singapore	Trickeye Singapore	Adventure Cove Waterpark	Buddha Tooth Relic Temple

Attraction Ranking Preferred Time Spent

Attraction	Ranking	Preferred Time Spent
Singapore Zoo	1 <input type="button" value="▼"/> <input type="button" value="▲"/>	1 <input type="button" value="▼"/> H <input type="button" value="▼"/> 0 <input type="button" value="▼"/> M <input type="button" value="▲"/>

ooo

DEMONSTRATION (EXTENSIVE CASE)



WanderWise

Travel Itinerary Planner

Start Time from Hotel (24-hour clock, e.g. 23:59):

Return Time to Hotel (24-hour clock, e.g., 23:59):

Select Attractions:

Gardens by the Bay	Singapore Zoo	Singapore Flyer	Universal Studios Singapore	Singapore Botanic Garden
Lau Pa Sat	Fort Canning Heritage Gallery	National Gallery Singapore	River Safari Singapore	Night Safari Singapore
Haw Par Villa	ArtScience Museum	Chinese Garden Singapore	Thian Hock Keng Temple	Bird Paradise
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Attraction Ranking Preferred Time Spent





LIMITATIONS

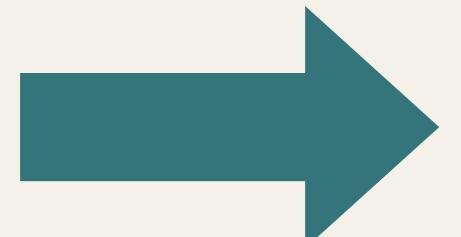


SOLUTION

1

Fixed Attractions

- Users unable to enter locations not included in the list of attractions



- Integrate a location-based API such as the Google Geocoding API
- User input new location → API will retrieve its latitude and longitude



LIMITATIONS

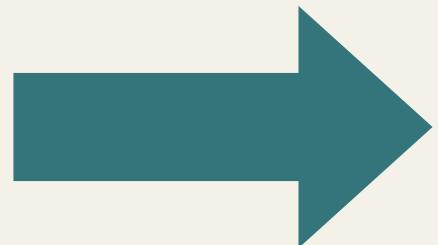


SOLUTION

2

Fixed Average Speed

- Our model uses a fixed average speed based on typical traffic conditions to estimate travel time
- Does not reflect real-time traffic condition



- Integrate advanced API such as google maps that can reflect real-time traffic condition



CONCLUSION

- With WanderWise, we demonstrated that it is possible to address the limitations of Wanderlog by striking a balance between user preferences and shortest travel paths.
- Applying Optimization technique concepts to a real-world challenge was a valuable and insightful learning experience.

