

Hamiltonian circuit for travelling in Chiang Rai

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Abstract: Chiang Rai is a famous province in Thailand. The weather is cool all year round, local food is delicious and climate of Chiang Rai attracts many tourists to flock to visit each year. Past problems, tourist can't visit every place in one day. In this research, mathematical application of the path graph theory was used in the Hamiltonian circuit form, for designing how to visit important places in one day and visit anywhere only one time each trip. This research started by looking for places that tourist should visit from internet, then represent the map of the way as a weight graph. Finally, the distance and time were calculated to design circuit for travelling in one day.

Key words: Hamiltonian circuit, graph, Tourism, Time

1. INTRODUCTION

Chiang Rai, Thailand's northernmost province, was once the seat of kingdom which became, briefly, an empire. It is a magnificent place, with strong cultural traditions, ethnic group diversity. Attractive scenarios, hilly teak jungles which dominated the area remained into modern times, as have legends of secret magic and holy people born to save their people from dire events. Most things indeed remained as of old, up to just a generation ago.

Nowadays, Thailand government is focusing on tourism industry. Many policies which support and improve about tourism are set, announced and impact to people in the country. Chiang Rai is one of the provinces where tourist and traveller always visit. Database of Tourism Authority of Thailand (TAT) announced that the average number of tourists who visit Chiang Rai is around 2.5 million per year.

It also showed efficiency of charming and attraction of Chiang Rai. However some problems for tourist were happened. Chiang Rai has large area and complex of landscape. These factors are problem for tourist could not visit attraction place and sometimes tourist lost the way including could not find someplace. Although Thai tourist quite acquaint in Chiang Rai but they have limited time. The mathematical tool, graph theory, was applied to design the special routes for such a good tour guide (Bollobás, 1979; Dirac, 1952).

A map was made to show the route and time on the road for explain plan in one day. The map is proper for tourist and traveller who have limited time especially tourists who fly from Bangkok to Chiang Rai and spend time here for only one day. Our goals are tourist could completely visit attraction place in Chiang Rai in 1 day, the route could be guide tourist and make them impress and enjoyed in a trip, the route and model would improve tourist industry of Chiang Rai.

2. METHODOLOGY

Our goal is to suggest users a short and pleasant path for their current route to visit attraction places and destination in Chiang Rai. We meet this goal in five steps:

1. Study about tourist attractions. Find out flight time and schedule of air line for set model conditions.
2. Select some suitable to visit in one day.
3. Build a graph whose nodes are all places that we selected from step 2.
4. Calculate to obtain a shortest Hamiltonian circuit.
5. Design a tour guide from the graph of step 4.

2.1 Tourist attraction and flight schedule

Research has learnt and paid attention in studying of more and more information about the tourist places in Chiang Rai, because it is very important for next methodology step. The definite place cannot be selected without information. The most important sources of information are from the website of Tourism Authority of Thailand (TAT). Moreover, by collecting from ten tourist attractions of Chiang Rai from several websites which are shown in table 1.

Table 1. Ten Tourist Attraction Websites in Chiang Rai.

No.	Website Name	URL
1	Kapook	www.kapook.com
2	Sanook	www.sanook.com
3	Painaidii	www.painaidii.com
4	Chilpainai	www.chilpainai.com
5	Edtguide	www.edtguide.com
6	Chiang Rai Focus	www.chiangraifocus.com
7	Tourism Thailand	www.tourismthailand.com
8	Tour Chiang Rai	www.tourchiangrai.com
9	TAT Contact Center	www.tatcontactcenter.com
10	Wikipedia	www.wikipedia.co.th

From table 1, it was found that the places which was suggested are White temple, Singha Park, Wat Huai Pla Kung, Choui Fong Tea farm, Maesai, Hall of opium, Golden Triangle, Phu Chi Fah, Doi Tung, Wat Phra Khaew, Doi Mae Salong, Rai Mae Fa Luang and Doi Pha Tung. The important information of places is position, time to spend and environment.

The target group in this research is tourists who fly from Bangkok and go back in one day and travel in Chiang Rai by car. So, the schedule flight has to be checked. The earliest flight from Bangkok arrive Chiang Rai at 7.40 a.m. and the last flight departure from Chiang Rai to Bangkok at 21.40 p.m. So, there is 14 hours to live in Chiang Rai, approximately.

2.2 Selected places

From item 2.1 above, twelve places are suggested to visit in Chiang Rai, then, time limited becomes important and awareness. The trip route was created under time limited in 1 day. Finally, 7 in 12 places were selected and show on the map in figure 1. White temple, Singha Park, Wat Huai Pla Kung, Choui Fong Tea, Maesai, Hall of opium and Golden Triangle are suitable to visit for Chiang Rai in one day trip.



Fig. 1. Show the position of suggested places.

2.3 Building a Graph

From figure 1, the representing map was used to build the graph and could be separated in 4 steps;

Step 1: 7 points were plotted as the representative to 7 places. Each point is call "vertex".



Fig. 2. Result of 1st step.

Step 2: Connect each pair of 2 points with straight line if there is a route connect between each other place directly.

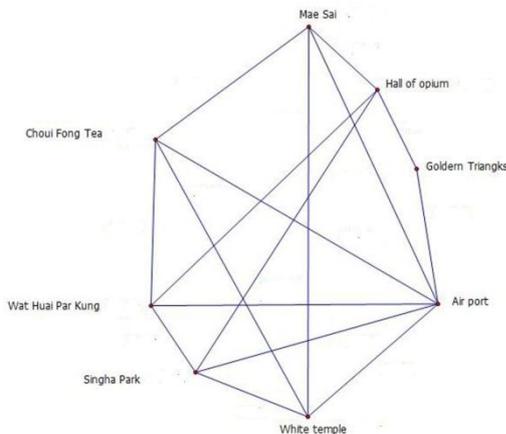


Fig. 3. Result of 2nd step.

Step 3: Put the number of time that spend for driving on each path near the line. Call each number is the weight of line.

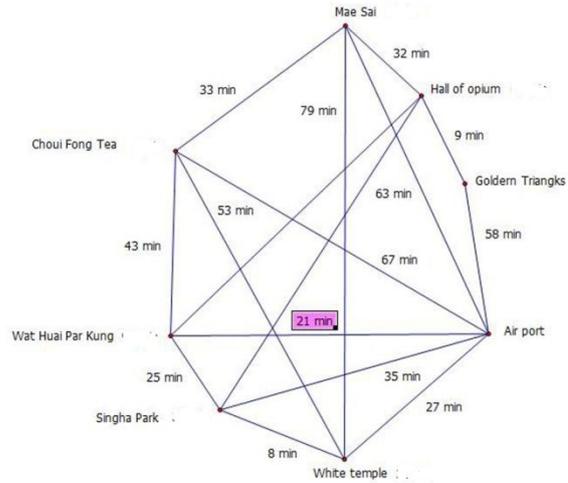


Fig. 4. Result of 3rd step.

Step 4: Put the number of time that tourist should spend each place near the point. The represent graph denote by "G" is shown in figure 5.

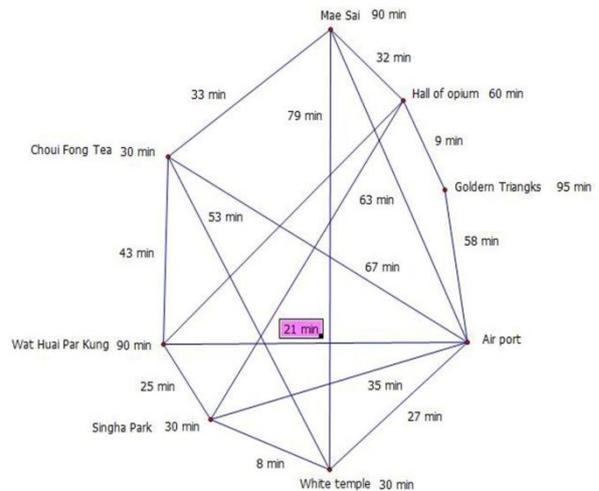


Fig. 5. Result of 4th step.

2.4 Hamiltonian Circuit

From the theory of Sir John Hamilton (1755-1835), a cycle that pass through every vertex, once in a graph is called a Hamiltonian circuit. A path that link to every vertex, once, is called a Hamiltonian path. While, Graph "G" is represented the map of tourist attractions (Figure 5)(Melissa, 2000: Mehendale, 2008).

From figure 5 above, we simplify to term of table which the left is weight of each line form non-decreasing sequence in the downward and the right is line associated with weight in the left column as following in table 2.

From table 2, Hamiltonian circuit was built by select line by line carefully from the top row of table and avoids line that combine circuit with the line selected before, and make sure that the point can be passed at most two times. The result of all routes can be shown in figure 6.

Table 2. Weight Graph Ordering

8 min	White Temple - Singha Park
9 min	Hall of opium - Golden Triangle
21 min	Air port - Wat Huai Pla Kung
25 min	Singha Park - Wat Huai Pla Kung
27 min	Air port - White Temple
32 min	Maesai - Hall of opium
33 min	Choui Fong Tea - Maesai
35 min	Airport - Singha Park
43 min	Wat Huai Pla Kung - Choui Fong Tea
53 min	White temple - Choui Fong Tea
58 min	Airport - Golden Triangle
63 min	Airport - Maesai
67 min	Airport - Choui Fong Tea
76 min	Wat Huai Pla Kung - Hall of opium
79 min	White Temple - Maesai
88 min	Singha Park - Hall of opium

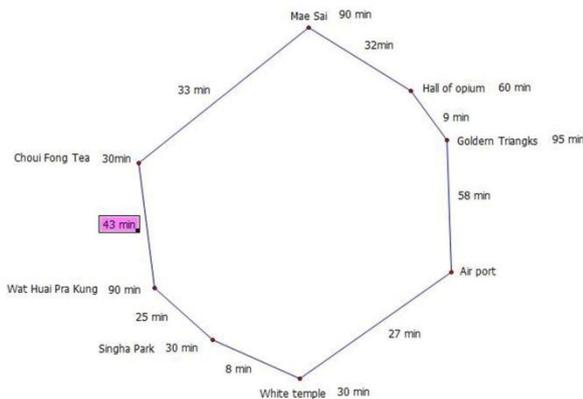


Fig. 6. The Hamiltonian circuit

2.5 Tour Guide

From the graph in figure 6, total time for driving is 235 minutes or almost 4 hours and total time to spend sightseeing is 425 minutes or almost 7 hours. It was found that both driving time and sightseeing time is less than 14 hours. So, it is quite suitable to suggest to travel in Chiang Rai by these routes.. However, the trip cannot be ended with the location of White Temple, due to; it will be closed at 6 p.m. So, the trip should start from Chiangrai International Airport to the first destination, Wat Rong Khun [White Temple]. Then, move to other place following to clockwise direction in the circuit.

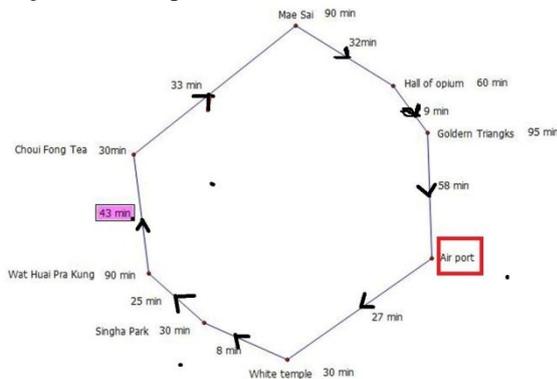


Fig. 7. The Hamiltonian circuit with direction

3. RESULTS AND DISCUSSIONS

The trip would be started at Chiang Rai Airport at 9 a.m. and move to another place with the direction in a map from figure 7. White Temple is the first place to visit within 30 minutes, after that, Singha Park becomes the second place, follow by, Wat Huai Pla Kung, Choui Fong Tea, Maesai, Hall of Opium, Golden Triangle and turn back to Chiang Rai Airport, respectively, with different time to visit which is shown in table 3 below.

Table 3. Time Schedule of Tourist Places in Chiang Rai.

Places	Arrival Time	Time to visit	Departure Time
Chiang Rai Airport	-	-	9.00 a.m.
White Temple	9.27 a.m.	30 min	9.57 a.m.
Singha Park	10.05 a.m.	30 min	10.35 a.m.
Wat Huai Pla Kung	11.00 a.m.	90 min	12.30 p.m.
Choui Fong Tea	13.13 p.m.	30 min	13.43 p.m.
Maesai	14.16 p.m.	90 min	15.46 p.m.
Hall of Opium	16.18 p.m.	60 min	17.18 p.m.
Golden Triangle	17.27 p.m.	95 min	19.02 p.m.
Chiang Rai Airport	19.02 p.m.	-	-

4. CONCLUSIONS

Chiang Rai is a famous province in Thailand. The weather is cool all year round, local food is delicious and climate of Chiang Rai attracts many tourists to flock to visit each year. Past problems, tourist can't visit every place in one day. In this research, mathematical application of the path graph theory was used in the Hamiltonian circuit form, for designing how to visit important places in one day and visit anywhere only one time each trip.

After using Hamiltonian Circuit, it was found and obtain the route to travel in Chiang Rai completely. Finally, the distance and time were calculated to design circuit for travelling in one day.

5. ACKNOWLEDGEMENTS

The authors would like to thanks Faculty of Science and Technology, Chiang Rai Rajabhat University. We extremely try and hard practice for this project under expectation that could improve tourism industry in Chiang Rai and then people who is in tourism supply chain could shift their living life standard up. For respond Thai government strategy about support and promote tourism industry in Thailand. I wish to express this study and the ideas for announce all of our skill and ability including our deepest appreciation to all the participants at 22nd Tri- University International Joint Seminar and Symposium 2015 in Jiangu University, P.R. China.

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“我爱镇江”