

Adaptive Tour Planning Decision Support System

Pungjai Phichaya-anutarat¹, Surasak Mungsing¹, and Suprasith Jarupathirun²

¹Department of Information Technology
Graduate School, Sripatum University
Bangkok 10900, Thailand

²Faculty of Business Administration
Ramkhamhaeng University
Bangkok 10240, Thailand

Email: pungjai@hotmail.com, surasak.mu@spu.ac.th, jarupat2@gmail.com

Abstract

Having a tour plan is a success factor of tour business. Tour plans are constrained to many factors such as the number of tour members, route of traveling, attractive places to visit, activities during the tour, budget, and time. For a set of requirement constraints, there might not be a tour plan that satisfies all the constraints at all. This paper presents a framework for an adaptive tour planning decision support system that helps tourists creating tour plans based on their requirement constraints. The framework uses combinatorial graph theory and data mining concept to produce a tour plan. The system always adds new produced tour plans together with related constraints into its database for future tour plan mining operation.

Key Words: e-Tourism, Tour planning, Decision support, Graph theory, Data mining

1. Introduction

Tour activities or business will not be successful if there are no suitable or satisfactory tour plans. Creating a tour plan that satisfies all requirement constraints are not an easy task. Very high constraints may not yield any acceptable tour plan. Some decision support may require compromising the constraints.

In mathematics and computer science, graph theory is the study of graphs; mathematical structures used to model pair-wise relations between objects from a certain collection. A "graph" refers to a collection of vertices or 'nodes' and a collection of edges that connect pairs of vertices. A graph may be undirected (see Fig.1(a)), meaning that there is no distinction between the two vertices associated with each edge, or its edges may be directed from one vertex to another. These nodes or vertices in the

graph may represent physical towns, attractive places, gas stations, restaurants, Hotels, or other interesting places on a map. Likewise, connection lines (or arrows) between nodes may represent existing routes from one place to another.

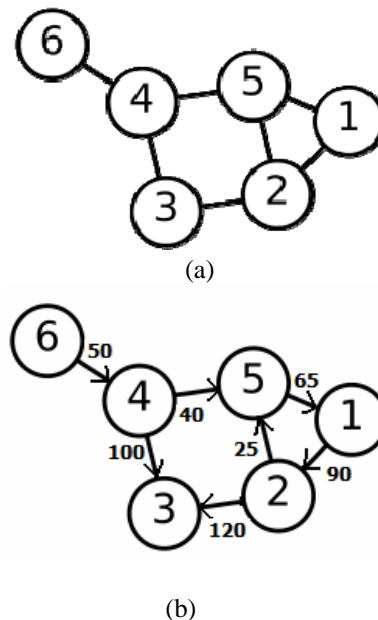


Figure 1 A drawing of (a) Undirected graph,
(b) Weighted digraph

A graph structure can be extended by assigning a weight to each edge of the graph. Graphs with weights, or weighted graphs, are used to represent structures in which pair-wise connections have some numerical values. For example if a graph represents a road network, the weights could represent the length of each road. A digraph with weighted edges in the context of graph theory is called a network. Weighted graphs may represent either cost, benefits, distance, or time required to travel from a node to its adjacent nodes. The weight values are used to solve graph

problems such as finding a shortest path from a given node to other nodes in the graph, or finding a circuit that for a given node one can travel to other node only once, visit all nodes and finally come back to the starting node. A tour plan, hence, can be determined based on graph theory.

Data mining involves sorting through large amounts of data and picking out relevant information. Data mining has been defined as "the nontrivial extraction of implicit, previously unknown, and potentially useful information from data" [1] and "the science of extracting useful information from large data sets or databases" [2]. The concept of data mining can be used to support tour planning to provide a solution that satisfies all the requirement constraints. Though some interaction is required, existing tour plan in database that is close and relevant to the requirement constraints will be offered to tourists for their decision.

2. Tour Planning Techniques and Related Works

There are many ways to create a tour plan. A normal practice for tourist is to gather tour information such as season, traditional events, activities, duration, and budget and then forming tour plan, tour package. Some tourists perform a survey and create a tour plan according to the tourist's requirements. However, these tour package seem like on the shelf products that ready be sold.

In the Internet era, tourists may require a tour plan via web services, in the form of e-tourism, to best suit their requirements. Many tour planning systems have been developed to fulfill this type of demands. Some research have been conducted for finding the best suggestions of travel schedule for new groups of tourists [4] or an intelligent e-tourism based on artificial intelligent techniques such as software agent [3], [5]. Also some systems were developed for mobile devices [5], [6].

In this paper we suggest an adaptive tour planning decision support system, based on combinatorial graph theory and data mining concept, for producing a tour plan. The proposed system dynamically adapts to produce unique tour plans according to current tourist's requirements, by graph algorithm and by data mining algorithm for efficiency enhancement. The system always adds new produced tour plans into its database for future use of pattern matching and tour plans recommendation, based on current pattern format of tourist's requirement.

3. A Framework for creating Tour plans

This paper proposed a conceptual framework for tour plan generation using combination of graph theory and data mining concept. The model

comprises two subsystems, Data preparation algorithm and Finding and generating tour plan algorithm. The data preparation algorithm performs two functions. It take inputs, which are tourist's set of requirements including constraint, and then transforms them to two specific formats, graph algorithm format and pattern format. These inputs are used as the criterion for tour plan generation. The finding and generating tour plan algorithm comprise two subsystems, the graph algorithm and the data mining algorithm. In this model, both the algorithms of the finding and generating tour plans algorithm work concurrently to produce outputs as soon as they receive inputs from the data preparation algorithm as recommended tour plans based on tourist's requirements. Hence the framework is a mechanism for a decision supporting system for tourist in deciding on a tour plan from generated outputs.

The data preparation is the starting point of the data preparation algorithm. It take tourist's requirements and constraints, tourist's criterion, such as the number of tour members, route of traveling, attractive places to visit, activities during the tour, budget, and time as input and then transform them into the graph algorithm format and the pattern format. The graph algorithm format transforms the set of requirements and constraints into the format that can be performed by the graph algorithm. The pattern format reduced the set of requirement and modifies constraint detail to form a pattern of requirement to be used as input for the pattern matching.

The graph algorithm produces main tour plans recommendation, that base on strict constraints of tourist's criterion (e.g. the number of tour members, budget). It takes inputs, the graph algorithm format, then performs calculation to produce tour plans according to the tourist's criterion and collect the tour plans into database, Historical plans, meanwhile data mining process is work concurrently.

The data mining process involves three processes: pattern matching, pattern mining, and historical plans, The data mining process searches for alternative tour plans recommendation, that base on relax constrains of tourist's criterion (e.g. the number of attractive places to visit, the number of activities during the tour.), in the database that match the requirements to consider and decide. The pattern matching is the starting point of the data mining process. It take inputs, the pattern format, then compares to the pattern format of tour plans in historical plans and find matching patterns according to the pattern format of tourist's criterion. The pattern mining performs pattern format of tour plans in historical plans.

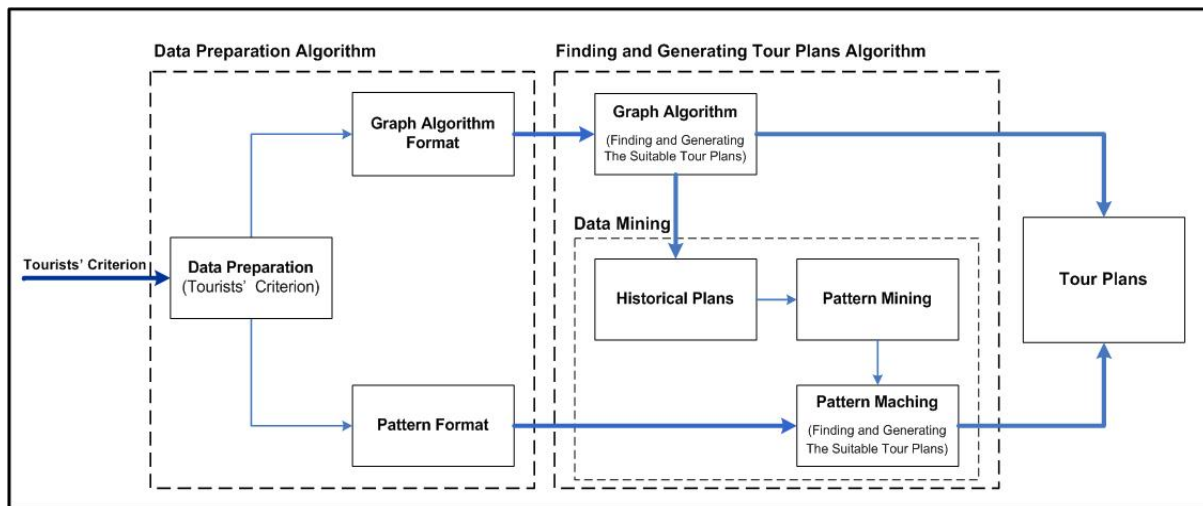


Figure 2 Framework for an adaptive tour planning based on graph theory and data mining concept

4. Implementation Plan

This work is an ongoing research where the implementation are to be conducted in three phases: the implement of data preparation algorithm that transforms tourist's requirement and constraints into input formats that requires by tour plan generating engine (i.e. graph algorithm and data mining process), the implantation of graph algorithm that generates tour plans, and the implementation of data mining to recommend tour plans based on historical tour pattern in database.

The first phase deals with the implantation of the data preparation subsystem where algorithms for transforming inputs to two specific formats: graph format and pattern format before forwarding the inputs to the finding and creating tour plan algorithm. The data format for graph algorithm are in the forms a set of information required to construct a graph (e.g. attractive places, weights, activities and activity duration, and other information that is necessary to produce a tour plan).

The second phase concerns algorithms for finding solutions that satisfy tourist's requirements and constraints. The graph algorithm performs some calculations to find tour routes for specified criterions and maps activities to the routes to form possible tour plans. These possible tour plans will be add to system data base for future reference.

The final phase concern an issue that no solution can be produced by graph calculation, based on the criterion given by tourists. Algorithm for historical pattern search, pattern mining, and pattern matching will be developed on this phase. The data mining subsystem concurrently, with the graph algorithm, perform operations to seek known tour plan in the database and recommend the possible tour plans. The possible tour plans, from both graph algorithm and

data mining operation, will be offered to tourists for decision making.

5. Conclusions

The proposed framework system can be implanted as web base or web services systems for e-tourism business. The system has potential to produce and offer tour plans, based on requirement criterions. The system creates tour plans by using two different techniques: graph theory that is based on graph calculation and activity mapping, and data mining that is based on criterion, historical tour plans, popularity, and pattern matching. The framework provide adaptive behaviors to the system since the historical patterns that stored in system database are always increase each time tour plans are created. Users, either tourists or tour agencies may create tour plans anywhere, any time through Web Services.

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