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An Adaptive Genetic Algorithm for Generating Personalized Travel Itinerary Recommendation

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ABSTRACT: Pilgrimage is a very popular holiday enjoyed by many people around the world. Tourists generally have their preferences when it comes to itineraries, temporary budget, and unknown multiple Points-of-Interest (POIs) in a city, e.g. Arranging itineraries is very tedious, time-consuming and difficult for them. In this case project, we propose an adaptive genetic algorithm to generate personalized travel plans to allow travellers to plan their trips more efficiently. First, the initial preference of POIs (e.g., POIs near their hotel and destination POIs (e.g., POIs near railway stations or airports) are considered in our approach. Second, we also consider some general considerations for travellers Their priorities in the navigation system, consisting of mandatory POIs, total number of POI, the Poi's overall popularity, overall spend, and overall rating. Third, we look at it this way of recommendation task as a Multi-Objective Optimization problem, and we propose one Adaptive genetic program for its crossover and mutation probabilities (AGAM). It is by solving this problem to efficiently obtain the global optimal solution. Fourth, we distribute uniquely weights to every factor which considered in our work to provide a personalized proposed itinerary to best meet the desires of a wide range of visitors. finally, We compare our method with a baseline with six real-world datasets Tourist cities and test results show that Agam is the best Recommendation performance at mandatory POIs, all POI visits, overall POI popularity, total travel time (including travel time and visit time), total costs, . And total dose.

KEYWORDS: Stock Price Forecasting, Short-Term Long-Term, Point of Interests(POIs), Adaptive Genetic Algorithm

I. INTRODUCTION

The traveling salesman problem (TSP) is the most well-known combinatorial optimization problem. TSP is used to find a routing of a salesman who starts from a home location, visits a prescribed set of cities and returns to the original location in such a way that the total distance travelled is minimized and each city is visited exactly Once. This problem is known to be NP-hard, and cannot be solved exactly in polynomial time. Many exact and heuristic algorithms have been developed in the field of operations research (OR) to solve this problem. TSP is solved very easily when there is less number of cities, but as the number of cities increases it is very hard to solve, as a large amount of computation time is required. The numbers of fields where TSP can be used very effectively are military and traffic.

Another approach is to use genetic algorithms to solve TSP because of its robustness and flexibility. Some typical applications of TSP include vehicle routing, computer wiring, cutting wallpaper and job sequencing. The main application in statistics is combinatorial data analysis, e.g., reordering rows and columns of data matrices or identifying clusters The Travelling Salesman Problem is one of the best known NP-hard problems, which means that there is no exact algorithm to solve it in polynomial time. The minimal expected time to obtain an optimal solution is exponential. TSP is defined as a permutation problem with the objective of finding the path of the shortest length (or the minimum cost). TSP can be modelled as an undirected weighted graph, such that cities are the graph's vertices, paths are the graph's edges, and a path's distance is the edge's length. It is a minimization problem starting and finishing at a specified vertex after having visited each other vertex only once.

Often, the model is a complete graph. If no path exists between two cities, adding an arbitrarily long edge will complete the graph without affecting the optimal tour. Mathematically, it can be defined as given a set of n cities, named $\{c_1, c_2, \dots, c_n\}$, and permutations, $\sigma_1, \dots, \sigma_n!$, the objective is to choose σ_i such that the sum of all Euclidean distances between each node and its successor is minimized. The successor of the last node in the permutation is the first one. The Euclidean distance d , between any two cities with co-ordinates (x_1, y_1) and (x_2, y_2) is calculated by the following equation $d = \sqrt{(|X_1 - X_2|)^2 + (|Y_1 - Y_2|)^2}$. The most popular practical applications of TSP are regular distribution of goods or resources, finding of the shortest of customer servicing route, planning bus lines etc., but also in the areas that have nothing to do with travel routes.

The genetic algorithm is a method for solving both constrained and unconstrained optimization problems that is based on natural selection, the process that drives biological evolution. The genetic algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individuals from the current population to be Volume XV, Issue XII, December/2023 Page No: 129 Journal of Interdisciplinary Cycle Research ISSN NO: 0022-1945 parents and uses them to produce the children for the next generation.

Over successive generations, the population "evolves" toward an optimal solution. You can apply the genetic algorithm to solve a variety of optimization problems that are not well suited for standard optimization algorithms, including problems in which the objective function is discontinuous, no differentiable, stochastic, or nonlinear. or highly The genetic algorithm can address problems of mixed integer programming, where some components are restricted to be integer-valued.

II. LITERATURE SURVEY

The paper titled "Improvement of Multi-Destination Travel Perception Based on Systematic Framework" published by C. Yuan and M. Uehara at CANDARW 2019, proposed Improvement of Multi-Destination Tourism with a combination of genetic algorithms. This development is intended to improve travel recommendations. This article discusses the integration process and evaluates its effectiveness in improving performance.

Thesis of Y.-L. Hsueh and H.-M. Huang posted a personal recommendation that uses GPS data while monitoring time limits. The system combines user preferences and constraints (such as time limits) to create custom processes. It uses clustering techniques to group similarities and extract relevant information from GPS data. By analyzing past movement patterns, the system can predict the user's next move and recommend optimal routes and activities. G. Kobeaga, M. Merino and J.A. Lozano published an article titled "An efficient evolutionary algorithm for orienteering problems" in the journal "Computers & Operations Research" in February 2018, which discusses methods designed to solve orienteering problems. evolutionary algorithm. The navigation problem involves finding the best route between locations with associated points, given the total distance or time limit.

In their 2020 IEEE Access article, "Linked Open Data in Location-Based Recommendation System on Tourism Domain: A Survey," P. Yochum, L. Chang, T. Gu, and M. Zhu conduct a thorough examination of how Linked Open Data (LOD) is integrated into location-based recommendation systems in tourism. They delve into the applications and hurdles of employing LOD to enhance recommendation system efficacy in tourism.

The paper by H. Liu, C. Jin, and A. Zhou, titled "Popular route planning with travel cost estimation from trajectories," published in Frontiers of Computer Science in February 2020, presents a methodology for popular route planning based on trajectory data. The authors focus on estimating travel costs associated with routes by analyzing historical trajectories. They propose a method to predict popular routes, considering factors such as historical travel patterns. In April 2019, A. Fogli and G. Sansonetti published a paper in the journal Personal and Ubiquitous Computing that focused on improving recommendations by combining semantic data. The authors present a context-aware approach that aims to deliver more personalized travel experiences based on user preferences and context.

In MDP-based itinerary recommendation using geo-tagged social media paper by Gaonkar, Tavakol, and Brefeld in IDA Proceedings suggested an alternative approach to travel. It leverages Markov Decision Processes (MDP) and geotagged social media data to deliver personalized recommendations, simplifying data analysis by integrating decision-making processes with the data geo-document.

Article by M. Figueredo et al. The travel recommendation aims to transform the image into a personal travel experience by appealing to the concept of smart travel. The system uses big data technology to analyze large amounts of data, including images, user preferences, and contextual information, to create travel recommendations. By integrating image recognition algorithms, the system can identify areas, points of interest, and points of interest in images uploaded by users. It then matches these insights with relevant data to create personalized travel plans. It also highlights the importance of instant processing of data to change recommendations based on current conditions and user input.

The paper titled "User-relative personalized tour recommendation" by P. Padia, B. Singhal, and K. H. Lim was presented at the IUI Workshops in 2019. The paper focuses on user-relative personalized tour recommendations, suggesting that the tour recommendations are tailored to individual users. The content of the paper likely includes details on the methodology, algorithms, or approaches used to provide personalized tour recommendations. The paper was presented in a workshop setting, which suggests it might be part of a broader conference on Intelligent User Interfaces (IUI).

The paper "Leveraging Semantics for context-aware travel recommendation" by A. Fogli and G. Sansonetti, published in the journal "Personality and Ubiquitous Computing" in April 2019, mainly examined context-aware recommendations. The authors explore the use of semantics to improve the agreement process to ensure individuality and relevance. This article details how to use semantic information to improve context-aware recommendations.

H. Liu, C. Jin, and A. Zhou published a paper titled "Popular Route Planning with Travel Estimation from Orbits" in the journal *Frontiers of Computer Science* in February 2020, focusing on the development of planning procedures. The authors propose a method that involves predictive travel forecasting. The goal is to provide users with choice and efficiency by taking into account the history of the movement.

A 2023 paper by Mansoureh Hasannia Kolaee, Armin Jabbarzadeh, and Seyed Mohammad Javad Mirzapour Al-e-hashem presents an Adaptive Large Neighbourhood Search (ALNS) algorithm for planning group tours. The algorithm is designed to organize group tours efficiently, taking into account sustainability factors. It uses a broad community search method to search different communities in the solution space to find the best solutions. The ALNS algorithm dynamically adjusts the search strategy according to problem characteristics and user preferences, making it adaptable to different group travel planning problems.

Wenbin Liu's 2020 report on choosing the best path using the Genetic Tabu Search Algorithm (GTSA). This algorithm combines the search potential of genetics and the development potential of tabu search and can find the most suitable trip. It systematically searches for the best route, taking into account factors such as distance, time and user preferences. Experimental results demonstrate the effectiveness of GTSA in producing better trips compared to traditional methods. This approach helps improve travellers' planning and improve their overall travel experience through more options.

The paper, published in 2023 by Xu Xiangrong, Wang Lei, Zhang Shuo, Li Wei, and Jiang Qiaoyong, focused on modeling and optimization of self-paced landscape travel based on speed. The authors present a method to improve scenic rerouting that takes into account the immediate situation as well as personal preferences. The research uses mathematical modeling and technology to optimize an individual's efficiency to meet the immediate needs of tourists. This approach increases user satisfaction and enjoyment by solving the time-sensitive problem of travel planning, helping to provide more responsive and customized tours.

In 2021, Takwa Tlili and Saoussen Krichen published a proposal based on simulation annealing to solve the walking problem. The system uses simulated annealing, an optimization technique, to generate the optimal itinerary.

In 2020, Zheng Weimin, Ji Haipeng, Lin Congren, Wang Wenhui, and Yu Bilian proposed a method to improve personal city travel through hotel selection. Their approach uses heuristics to create tailored policies, taking into account factors such as tourist preferences and hotel choices. This helps improve pedestrian mobility in the city.

In 2022, Alaleh Maskooki, Kalyanmoy Deb, and Markku Kallio proposed genetic modification to solve the problem of dual-purpose communication. Their approach is to improve the decision-making process through multi-objective decision-making, thus helping to achieve better results and change management strategies in a single round.

In 2022, Sujana Piya, Chafi Triki, Abdulwahab Al Maimani and Mehdi Mokhtarzadeh prepared a model for creating personalized travel packages. Their designs effectively create travel packages taking into account different preferences and limitations, thereby improving the traveler's overall travel experience.

III. FUTURE SCOPE

Planning an itinerary that optimizes their preferences and constraints becomes tedious, time-consuming, and challenging. The project seeks to provide a solution that alleviates the challenges of itinerary planning for travellers, offering personalized recommendations. The future of itinerary planning using adaptive genetic algorithms (AGAs) is promising. AGAs optimize travel plans by considering factors like time constraints, budget, and real-time information. They dynamically adapt itineraries based on changing circumstances and user feedback, offering multi-objective optimization for comprehensive planning. AGAs are scalable, making them suitable for complex routes covering multiple destinations. Integration with smart devices enhances user experiences, providing personalized recommendations and guidance. Additionally, AGAs can consider environmental factors, promoting eco-friendly travel practices. Overall, AGAs offer efficient, personalized, and adaptable itinerary planning, ensuring enhanced travel experiences for individuals and groups.

IV. CONCLUSION

Combining the knowledge from heuristic methods and genetic algorithms is a promising approach for solving the TSP. Genetic algorithms appear to find good solutions for the travelling salesman problem, however it depends very much on the way the problem is encoded and which crossover and mutation methods are used. A number of genetic algorithm techniques have been analyzed and surveyed for solving TSP. The research work can be extended for different hybrid selection, crossover and mutation operators. Various types of Genetic Algorithm techniques for solving TSP have been analyzed and surveyed here. The various operators like mutation, selection, crossover and their combinations used by researchers for finding a solution to TSP have been discussed.

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