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SHORTEST PATH ALGORITHMS FOR TRAVELLING SALESMAN PROBLEM

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Abstract*— In this paper, different improved shortest path optimized algorithm surveyed. The travelling salesman problem (TSP) is problem tasked to find the shortest path between a set of nodes and locations that must be visited. The nodes are the cities a salesman might visit. Both the travel costs and the distance travelled should be as low as possible. It widely and successfully applied the practical cases in which multiple travelling individuals (salesmen) shared the common workspace (city set).Multiple travelling salesperson problems MTSP unable to share a group of tasks with each other so a genetic algorithm (GA) with dual-chromosome coding for Colored travelling salesperson problems CTSP was proposed. Further a new CTSP was proposed in which each city had one to all salesmen's colors and formulated its integer programming model. VNS was addressed for CTSP. CTSP was examined and newly called S-CTSP. The basic scheduling problems of MBMS was modeled by S-CTSP. Then DTSP was addressed and ACO-based memetic. Algorithm was proposed. A new class of discretization based look-ahead algorithms (DLAAs) for the Dubins travelling salesperson problem (DTSP) was presented. Then transformation of the multi-region inspection into a clustered travelling salesman problem (CTSP) developed a fast branch-and-bound CTSP solver .A new CTSP was proposed in which each city has one to all salesmen's colors and formulates its integer programming model.

Keywords— MTSP algorithm, CTSP algorithm, S-CTSP algorithm, MBMS problem, GA, VNS algorithm, ACO algorithm.

I. INTRODUCTION

A shortest-path algorithm finds a path containing the minimal cost between two vertices in a graph. Generally, in order to represent the shortest-path problem we use graphs. There are different shortest path algorithms are Dijkstras algorithm, Bellman-Ford algorithm, A star algorithm, Travelling Salesman algorithm, etc. This paper presents a survey of various shortest paths calculate using different algorithms and how it has been used for application. The rest of the paper is organized as follows. Section II gives a study about different shortest paths algorithms done till date. Section III provides a brief description of our problem statement along with the methodology we would adopt to solve our stated problem. Finally Section IV presents the conclusion and future work to be done.

II. Related Work

In [4] K Shortest Paths with Diversity (KSPD) problem that identifies top-k shortest paths such that the paths are dissimilar with each other and the total length of the paths is minimized. Algorithm Find KSPD correctly returns the top-k shortest paths with diversity. [5] GA describes Darwinian evolution theory. The genetic algorithm interpret evolutionary process and it mostly use to solve optimization problem. Goldberg was first use in the expanse of genetic process to get optimize solution. In optimization technique GA gives set of possible solution. In each iteration it performs three steps namely selection, reproduction and mutation to produce next generation solution. The crossover and mutation steps ensures that the genetic algorithm can produce new features that may not be included yet in population. [6] The GA is not fit for balance structures which close to optimal solution. The memetic algorithm is composition of population-based global technique and a local search create from each of the individual. It is a distinct GA with local hill climbing. But this algorithm has faster magnitude than GA for some problem of domains. In this algorithm the population is set to random variable or using a trial and error basis. Then each one perform local search to improve its accuracy value. Same as that of GA for next generation it select the individual using fitness value. Also it perform crossover same as GA. Then for enhancement algorithm use local search technique. Here the role of local search is to identify the local optimal more efficiently than the GA. [7] A colored traveling salesman problem (CTSP) is a generalization of the well-known multiple traveling salesman problem and a class of CTSP is also called as serial CTSP (S-CTSP). The population-based incremental learning (PBIL) aims to generate a real-valued probability vectors that created high-quality solution with higher probability. A PBIL algorithm is combination of GAS and competitive algorithm. In PBILD +2-Opt for S-CTSP algorithm pij represents the probability that salesman k selects a city i as his jth to-be-visited city. [8]A discretization-based look-ahead algorithms (DLAAs) for the Dubins traveling salesperson problem (DTSP) is presented with an existing algorithms from the literature. The DLAAs are the two parameters that uniquely determine and depending on the application in hand. Their values can be easily modified to strike a balance between the execution time and the length of the resulting admissible tour. The time complexity of a DLAA is the sum of two terms, one linear in the number of targets (cities) and second that corresponding to the specification of an initial order for the targets.

III. Methodology

Genetic algorithm:

Step 1: While maximum generation and current generation are same calculate fitness value for individual.
Step 2: Select string from current to create new generation.
Step 3: Make crossover selected paired parents.
Step 4: check for mutation rate and assign child for mutation accordingly.
Repair child if required.
Add offspring to new generation.
Step 5: terminate by calculating best chromosomes.

Memetic algorithm:

Step 1: Determine the ith and mth salesman are same or different. If so, terminate.
Step 2: From city chromosome "a" select two city genes assigned to the ith salesman. Exchange them and now we get individual " a' ".
Step 3: Determine if the fitness value of " a' "is greater than that of "a". If true assign " a' " to "a" and otherwise, remain "a".
Step 4: Let i = i + 1, and repeat to step 1.

Finding k-shortest paths with diversity algorithm:

FindKSPD(G,s,t,Sim(.,.),k,t)

1. **Input:** Graph G, source s, destination t similarity function Sim(.,.), k and t.
2. **Output:** The top-k shortest simple paths with diversity from s to t.
3. Create an empty result set Ψ for k shortest diversified simple paths.
4. Create priority queue Q and local priority queues LQ[.]
5. P ← the shortest path from s to t
6. Now add P to the empty result set Ψ
7. For each path P’ in LQ[v], we keep pieces of information besides lb, including the detail route rt of P which is from source to v, the path length len = L(rt), and cls referring to its path classification.
8. while |φ| < k and Q is not empty do
9. Then find the next path
10. If all P’ belongs to empty result set and sim(p’, P) less than and equal to threshold t then insert P into empty result set.
11. Return empty result set φ.

DISCRETIZED LOOK-AHEAD algorithm:

1. Order the targets {T1,..., Tn} by finding a feasible solution for the corresponding ETSP.
2. Choose values for L ∈ {3,..., n}, h ∈ H, and ρ.
3. For iteration m = 1,..., M, the following holds.

a) If m = 1, calculate an open DDTSP path for the first L targets (T1,..., TL) to obtain {(Ti, θi)}i∈{1,...,L}, where θi∈ H.

b) If 2 ≤ m ≤ M − 1, calculate an open DDTSP path for the last two targets of iteration m − 1 and the next L − 2 targets from T , i.e., for the sequence (T1+(m−1)·(L−2),..., Tm ·(L−2)+2) of targets, to obtain {(Ti, θi)}i∈{1+(m−1)·(L−2),...,m ·(L−2)+2}, where θi∈ H. During each iteration m, the configuration (position and heading) of the Dubins vehicle at the first target T1+(m−1)·(L−2) of the sequence is the one already computed in the previous iteration, and the position of the last target Tm ·(L−2)+2 is determined according to the ETSP visiting order from Step 1).

c) If m = M such that m · (L − 2) + 1 ≥ n, set (Tn+1, θn+1) := (T1, θ1) and calculate an open DDTSP path for the last two targets of iteration M − 1 and for the remaining targets from T , i.e., (T1+(M−1)·(L−2),..., Tn+1), to obtain {(Ti, θi)}i∈{1+(M−1)·(L−2),...,n+1}, where θi∈ H.

4. Return the sequence of configurations {(Ti, θi)}i∈{1,...,n}.

PBILD +2-Opt for S-CTSP algorithm:

1 **Input:** City partition for salesmen n1, n2,. . . ,nm, population size
2 Popsize, and algorithm parameters θ , α, β
3 Initialization: Pk = [1/nk],∀k ∈Zm .
4 While (Termination Condition not met)
5 While (Population Size not greater than Popsize)
6 For k = 1,. . . ,m // Select cities for salesman k
7 While (no more than nk cities searched)
8 Select city a for salesman k with Roulette according to

$$p'_{ji} = \frac{p_{ji}^{\alpha}\eta_{jx}^{\beta}}{\sum_{l\in N_k} p_{li}^{\alpha}\eta_{lx}^{\beta}}, \forall i \in Z_{n_k}$$

```
If a ∈Uk, then
If a assigned to salesman k, then
]Add a into Rk
End If
Else If a not assigned, then
Add a into Rk
End If
Nk := Nk\{a}
End While
End For
Calculate fitness value of R
End While
Perform 2-opt on the best individual to obtain Rˆ
Update and normalize Pk.
End While
Output : the best route sequence Rˆ = (Rˆ 1, Rˆ 2,..., Rˆ m)
```

Result analysis

Sr.no	Algorithm	Time Complexity	Variable
1	Cluster-Based Discretization Look Ahead Algorithm	O(h^2(L-1)!)	h=discretization level L=Look ahead horizon
2	Genetic Algorithm	O(g(nm + nm + n))	g= number of generations n= population size m= size of the individuals
3	K Shortest Paths with Diversity	O(kn(m + n log n))	m,n=cardinality of edge set E and vertex set V k = number of shortest simple paths.
4	Unstringing and stringing (US) operator	O(n^5)	n=number of iteration
5	Memetic algorithm	O(n(log(n)))	n = number of the function parameters

IV. CONCLUSIONS

Focused on optimization, TSP is often used to find the most efficient route for data to travel between various nodes. After survey conclusion made that CDLAA is better than DLAA .Then stability analysis was done.
Later genetic algorithm was proposed and resulted that if size increases time consumption increases .It achieved the best solution by SAGA and good quality solution in HCGA in short time. Further memetic framework used to maintain good balance between computation time and solution quality. Later as the city size increases PBILD is better and better was concluded. Also PBILD is better than GA was given .As city size increases time consumption increases .So PBIL and GA have same execution time.

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Biography

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