APPLICATION OF MATHEMATICAL MODELS AND OPTIMIZATION APPROACHES IN TOURISM FIRMS ISSUE KOMMIVOYAJYOR

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Annotatsiya: The issue of Kommivoyajer (Travel sales I am the problem — TSP) is one of the issues expansions for eigenvalues of classic discrete optimization, if the minimum distance to all the cities with the cost or one-time visit, return to the starting point requires. The tsp's mathematical formulalashuvi in this article, the main methods or specific (bruteforce, dynamic programming, tarmoqlash-limiting) and approximate (genetic algorithm, near methods) approaches will be covered. Also, the practical issue is to be applied and the complexity is analyzed.TSP his full kombinatorika features and high-level complexity is popular. Kommivoyajer expansions for the eigenvalues of discrete optimization problems is one of the classic issues, if the minimum distance to all the cities with the cost or one-time visit, return to the starting point requires. The tsp's mathematical formulalashuvi in this article, the main methods or specific (bruteforce, dynamic programming, tarmoqlash-limiting) and approximate (genetic algorithm, near methods) approaches will be covered. Also, the complexity of the issue is to be practical and applied analysis this problem is np-complete problem, that is, find its exact solution, it becomes very complicated as the number of issues have increased. The computer algorithm is developed to find the solution through the different, in particular, network search algorithm of genetic algorithm and simulation annealing methods been.Kommivoyajyor the issue of in practice in many areas, for example, logistics, transportation, robotics, and is used in the management of different resources. It also used as a means to increase productivity, optimize and theoretical issues is very important.

Annotation:I am the travel your sales problem (TSP) is one of the most well-known and studied problem in computer science and mathematical optimization. The objective of the problem is to find the shortest possible travel router that allows a specified set of your sales to

the city that I visit, your visit each city only once, and return to its ultimate point your lovely starti. Is famous for its high combinatorial complexity of nature and a full TSP. It is classified as an np-problem, completed me that technique becomes increasingly difficult as the number grows of the city that you find an exact solution. Various algorithms have been using computers to find solutions developer, including network search algorithms, genetic algorithms, simulated annealing and the metho. I applied in many practical problem is the travel of your sales area, such as logistics, transportation, robotics, and various resource management systems. It is also of great theoretical importance for use as a tool for improving the optimization and premium.

Annotasiya:kommivoyajera far zada president (TSP) — I v matematicheskoy zada president has features to track an samix izvestnix izuchennix when I optimizasii computer science. Zada president who tselsiy — nayti kratchayshiy route, posetit pozvolyayutshiy kommivoyajeru zadannie much more productive, posetiv kajdiy odin tolko raz gorod, v I v to a section isxodnuyu tochka konsov kontserni. TSP izvestna I svoystva I polnostyu svoimi kombinator visokoy slojnostyu. Zada president will far yavlyaetsya NP-polnoy, chto oznachaet, chto vsyo po naxojdenie tochno cargo resheniya stanovitsya slojnee uvelicheniya chislo gorodov is merry. Razlichnie kompyuterov razrabotani pomotshyu s naxojdeniya resheniy beginning of the algorithm, the algorithm vklyuchaya poisk v, a set of algorithm to simulirovannogo otj I geneticheskie method. Zada president razlichnix oblastyax far kommivoyajera primenyaetsya v, takix kak logistics, transport, robotics I sistem upravleniya of resources to me. Teoreticheskoe I znachenie imeet takje kak instrument bolshoy mother optimizasii povisheniya effektivnosti the beginning.

Keywords: Kommivoyajer issue, TSP, optimization, kombinatorika, tarmoqlash-limiting, dynamic programming, heuristik methods, genetic algorithm, either'lni to reduce, the calculation complexity, operations research. resources management, simulation made annealing, genetic algorithm, network search algorithm, the solution you find.

Keywords: travel I am your sales problem (TSP), optimization, combinatorics, NP-completed problem, shortest path algorithms, logistics, transportation, robotics, resource management, simulated annealing, genetic algorithms, network security, algorithms, please find solution.

Klyuchevie slovo: kommivoyajera far zada president (TSP), optimizasiya, kombinatorika, NP-zada president polnaya far, put kratchayshiy, algorithm, logistics, transportation, robotics, resources upravlenii me, I simulirovanniy otj, geneticheskie algorithm, the algorithm in the set of poisk v, naxojdenie resheniya.

To enter. The issue of Kommivoyajer (Travel sales I am the problem — TSP) is one of the most popular and the most studied optimization problems kombinatorika. The essence of the matter that iboratki, traders visit multiple cities exactly once, and return to the starting city along the way to a minimum distance or the total cost is required. In practice this issue is logistics, marshrutlash, chip design, used in many areas such as genetic research.TSP is np-complex belongs to the class if the exact solution requires very large computing resources to find the largest sized cases. For this reason, various mathematical models in solving this issue

visible and near the algorithm developed. In this article, the tsp's theoretical basis is a detailed analysis of solution methods and their advantages and disadvantages.

Withdrawal methods: Bruteforce (full review),dynamic programming (Held-Karp algorithm),the greedy algorithm (Greedy Algorithm),genetic algorithm, simulyatsiyalangan tavlanish (simulated annealing), linear programming and be chess (Branch and bound).

Purpose: the purpose of kommivoyajyor issues – given to the city to visit the field-provides the shortest and most effective way to find mivoyajyorning. Thus, each city must be visited once and only at the end of the field-mivoyajyor should come back to the starting city. The main purpose of the issue, a minimum distance to beijing to visit the city, and thus in reducing the time and costs is. TSPni solving, the goal through the optimization in the real world, transport, logistics and resource management to increase efficiency in areas such as it is. Also, the developed optimization algorithm for solving the issues of tspni and many other methods can also be applied.

Given a short time to visit each city only once with n units(path, cost) turned out for find sik lee. Thus, with a lot of cycle number $(n-1)!$ one. This issue with the issue of finding a long-term cycle gamilton minimal bound. Problem solving Kommivoyajyor "network and borders"can you apply the method. This method is a cycle and you are bound sirtmoq graf, and drafting is conducted using tables.

The standard option. Will put bring the concept of the table. To do this, the table is coming from the line of earlier, that is, each row of the table of elements of the same row is removed the small isolated respectively. After that we also do other than follow the column of the table were the same, and come to the table columns. All are listed on the table are referred to as rows and columns are listed. The smallest the sum of h elements were defined by the table of rows and columns, bring it charts the coefficient is called. For example the following schedule around the world to travel by air transport will review the historical city.

<u>Will put belgilashlar</u>

1. Paris-China-8200   China-Paris-8100
2. Paris-Agri-6550   China-Agri-3900
3. Paris-Egypt-3200   China-Egypt-7500
4. Paris-Berlin-1050   China-Berlin-7300
5. Paris-Rome-1100   China-Rome-9600
6. Paris-Istanbul-2250   China-Istanbul-7800
7. Agri-Paris-6650   Egypt-Paris-3000
8. Agri-China-3700   Egypt-China-7600
9. Agri-Egypt-5000   Egypt-Agri-5100
10. Agri-Berlin-6200   Egypt-Berlin-2900
11. Agri-Rome-6900   Egypt, Rome-2150
12. Agri-Istanbul-6000   Egypt-Istanbul-1300
13. Berlin-Paris-1000   Rome-Paris-1200
14. Berlin-China-7100   Rome-China-9500

15. Berlin-Agri-6000   Roman-Agri-6800
16. Berlin-Egypt-2800   Roman-Egyptian-2100 From
17. The Rome-Berlin-1180   Rome-Berlin-1080
18. Berlin-Istanbul-1600   Rome-Istanbul-1370
19. Istanbul-Paris-2200 Anniversary
20. Istanbul-China-7900
21. Istanbul-Agri-6100
22. Istanbul-Egypt-1250
23. Istanbul-Berlin-1700
24. Istanbul-Rome-1270

B/S	1	2	3	4	5	6	7	on the line of the smallest
1		8200	6550	3200	1050	1100	2250	1050
2	8100		3900	7500	7300	9600	7800	3900
3	6650	3700		5000	6200	6900	6000	3700
4	3000	7600	5100		2900	2150	1300	1300
5	1000	7100	6000	2800		1180	1600	1000
6	1200	9500	6800	2100	1080		1370	1080
7	2200 anniversary	7900	6100	1250	1700	1270		1250

1 table.

1-row table to bring his will write out the smallest element to the right side of the corresponding row and the row of the element following it isolated from 2-you will be able to schedule.

B/S	1	2	3	4	5	6	7
1		7150	5500	2150	0	50	1100
2	4200		0	3600	3400	5700	60
3	860	0		1300	2500	3200	2300
4	1700	6300	3800		1600	850	0
5	0	6100	5000	1800		180	600
6	120	8420	5720	1020	0		290
7	950	6650	4850	0	450	20	
on the column of the smallest	0	0	0	0	0	20	0

2-table

The yield of 2-the column of the table in order to bring themselves under the table to fit the column and the smallest element is isolated from the column element've written, as a result, the following 3-table is formed.

$$h = come.\,row + come.\,column$$

B/s	1	2	3	4	5	6	7
1		7150	5500	2150	$0^{(30)}$	30	1100
2	4200		$0^{(3900)}$	3600	3400	5680	60
3	860	$0^{(7400)}$		1300	2500	3180	2300
4	1700	6300	3800		1600	per 830	$0^{(1120)}$
5	$0^{(280)}$	6100	5000	1800		160	600
6	120	8420	5720	1020	$0^{(1of\,20)}$		290
7	950	6650	4850	$0^{(1020)}$	450	$0^{(30)}$	

1-picture.

3-the table is listed, there is at least one element in every row and column zero. The following charts coefficient h equal to the number of people you bring

h=1050+3900+3700+1300+1000+1080+1250+20+6*0=13300

$$c_{32} = 0^{(7400)} => c_{23} = \infty$$

$$h^{'} = h + \ 7400 \ = \ 13300 + 7400 = 20700$$

In general, the network consists of two important stages of the method of limits and is from:
1) tarmoqlash;
2) determine the lower limit.

Both stages is conducted in parallel for solving the issue. For the implementation of this stage, the following sequence must complete the work. A) primary come to the table; B) to determine h koeffitsenti to come; C) to determine the level of zero elements in the table given; D) on the basis of this level tarmoqlash implementation; E) determine the lower limits of tarmoqlanish the results of the cycle components; f) reduce the size of the table to one; and g) the full cycle of harvest remain to keep from; H) this process (2x2) continue until the table is formed; I) determine the final results corresponding to a cycle network; (J) all limits (ho ba) to compare; K) is a necessity the results can restore the table to the minimum boundary tarmoqlash fit to continue.

During the application of this method, all the calculations are conducted using the table given, and its results will go far in showing graf configured separately. Perfect at the end of this process(lowest cost) cycle is determined.

If doiracha graf consists of combined mutual, each one of them will determine a certain xossali collection cycle. This doiracha written by the border-while the number of the same circle indicates that belongs to a cycle corresponding to the lower limit of the costs. Part 1 of the primary graf-picture is in view. Thus, the first cycle of primary package which includes all doiracha define the number of cycle costs go on a voluntary means that h is small. Seen in the example above, h=13300 it was, therefore, a cycle that is small costs from 13300 it's not.

Located on the zero line, which is great most of the level i and superior j are being found, (i,j) on there. Mabodo, if nollar is a multiple senior level, one of them optional is selected. Thus, the transition from city I to city j doiracha in the right side and it means a collection of cycles covering all (i,j) is set, doiracha in the left side, while on the contrary, the transition from city j to city I did not include the route that it means the collection of (i,j) is set.

The most senior levels of zero elements 7400 $c_{32} = 0^{(7400)}$, therefore, tarmoqlanish grafi1-rasmko'rinishidabo'ladi.Bring the lowest costs Chapdoirachayoniga coefficient $h = 13300$ 20700 formed by adding zero to the number of the biggest 7400 level is recorded.$(h_1^{'})$ in the right side to determine the lower limit of costs doiracha compatible 3-remove the 2nd row and the 3rd column of the table(off)will be sent(therefore, the size of the table is reduced to one). Thus,it should be noted that this particular, of course, the city preserved the order of the numbers(and written)qolishishart,aksholdachalkashliklarkelib out. After that,all he prohibited the harvest of the full cycle,the issue $i \rightarrow j \rightarrow I(I \rightarrow j$sign-shahardanj-means to the city) is the loss of to do this c_{ji} element ∞ change icon will be recorded in two, $c_{23} = \infty$).

Again he made the statements we can continue our work.

B/S	1	3	4	5	6	7	on the line of the smallest
1		5500	2150	0	30	1100	0
2	4200		3600	3400	5680	3900	3400
4	1700	3800		1600	per 830	0	0
5	0	5000	1800		160	600	0
6	120	5720	1020	0		290	0
7	950	4850	0	450	0		0

B/S	1	3	4	5	6	7
1		5500	2150	0	30	1100
2	4200		3600	3400	5680	3900
4	1700	3800		1600	830 per	0
5	0	5000	1800		160	600
6	120	5720	1020	0		290
7	950	4850	0	to 450	0	
on the column most small of	0	3800	0	0	0	

$$h_1 = h + 3400 + 3800 = 20500$$

B/s	1	3	4	5	6	7
1		1700	2150	0	30	1100
2	800		200	$0^{(200)}$	2280	500
4	1700	$0^{(1050)}$		1600	per 830	$0^{(290)}$
5	$0^{(280)}$	1200	1800		160	600
6	120	1920	1020	$0^{(120)}$		290
7	950	1050	$0^{(200)}$	450	$0^{(30)}$	

Have a delete on the 3 line 4 on the column.

$$h_1^1 = h_1 + 1050 = 20500 + 1050 = 21150$$

$$C_{43} = 0^{1050} = C_{34} = \qquad\qquad C_{24} =$$

B/S	1	4	5	6	7	on the line of the smallest
1		2150	0	30	1100	0
2	800		0	2280	500	0
5	0	1800		160	600	0

6	120	1020	0		290	0
7	950	0	450	0		0
kich column	0	0	0	0	290	

$$h_2 = h_1 + 290 = 20790$$

B/s	1	4	5	6	7
1		2150	$0^{(30)}$	30	810
2	800		$0^{(800)}$	2280	210
5	$0^{(280)}$	1800		160	310
6	120	1020	$0^{(0)}$		$0^{(210)}$
7	950	$0^{(1020)}$	450	$0^{(30)}$	

On line 7 column 4 in a row off.

$$C_{74} = 0^{1020} = C_{47} =$$

$$h_2' = h_2 + 1020 = 20790 + 1020 = 21810$$

B/s	1	5	6	7	on the line of the smallest
1		0	30	810	0
2	800	0	2280	210	0
5	0		160	310	0
6	120	0		0	0
column kich	0	0	30	0	

$$h_3 = h_2 + 30 = 20790 + 30 = 20870$$

B/s	1	5	6	7
1		$0^{(0)}$	$0^{(130)}$	810
2	800	$0^{(800)}$	2250	
5	$0^{(250)}$		130	310
6	120	$0^{(0)}$		$0^{(310)}$

On row 2 and column 5 in a row off.

$$C_{25} = 0^{800} = C_{52} =$$

$$h_3' = h_3 + 800 = 20820 + 800 = 21620$$

B/s	1	6	7	of the smallest on line
1		0	810	0
5	0	130		0
6	120		0	0

column kich	0	0	0	

$$C_{57} =$$

$$h_4 = h_3 + 0 = 20820$$

B/s	1	6	7
1		$0^{(940)}$	810
5	$0^{(250)}$	130	
6	120		$0^{(930)}$

Toe the line'1 column 6 in a row on the citizens and off.

$$h_4' = h_4 + 940 = 20820 + 940 = 21760$$

$$C_{16} = 0^{(940)} = C_{61} =$$

B/s	1	7	of the smallest on line
5	0		0
6		0	0
column kich	0	0	

$$C_{61} =$$

$$h_5 = h_4 + 0 = 20820$$

$$h_5' = h_5 + 0 = 20820 + 0 = 20820$$
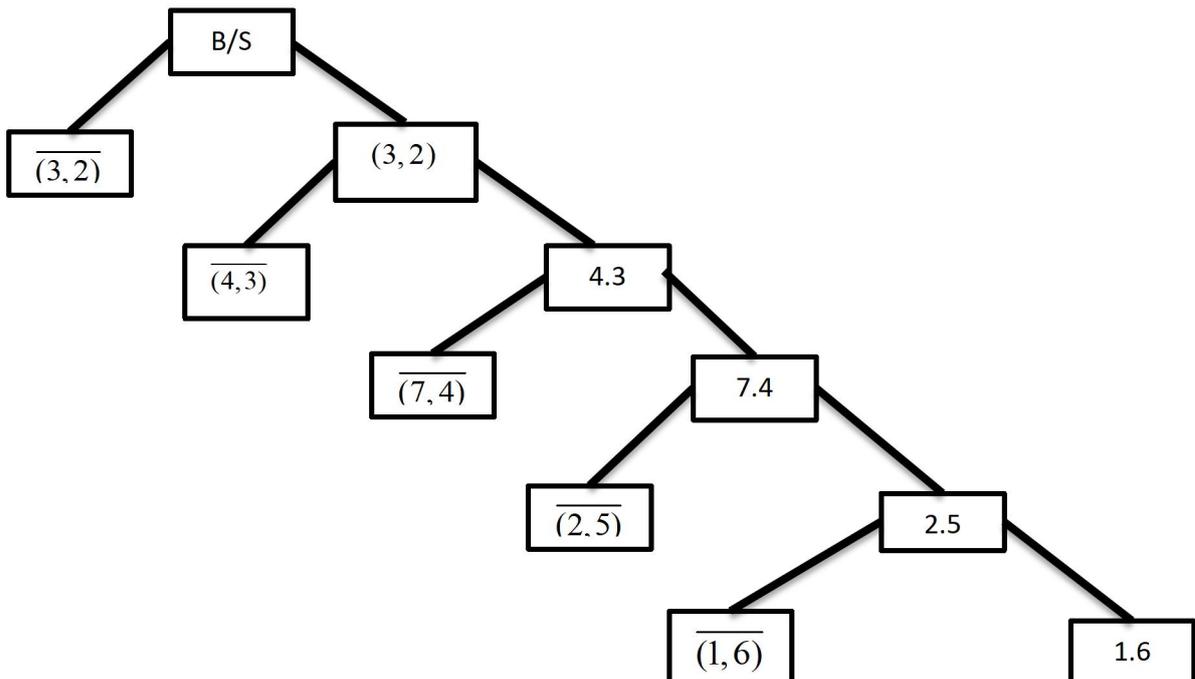
The shortest way (optimal route): $1 \rightarrow 6 \rightarrow 7 \rightarrow 4 \rightarrow 3 \rightarrow 2 \rightarrow 5 \rightarrow 1$
Minimum distance: 20820 unit.

Conclusion. Kommivoyajyor issues of mathematical modeling of many real-life problems and used for the optimization of a classic issue. Due to the complexity of much of the calculation of the optimal solution found, in many cases the approximate algorithm or approach heuristik apply.

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