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Submission date: 29-May-2020 08:38PM (UTC+0700)
Submission ID: 1334151846
File name: Jurnal_Scopus_januari_2020.pdf (1.27M)
Word count: 2869
Character count: 13980

Journal of Critical Reviews
ISSN- 2394-5125 Vol 7, Issue 1, 2020

Traveling Salesman Problem Solution using Genetic Algorithm

Hariyadi[1], Putri Mutira[2], Phong Thanh Nguyen[3*], Iswanto Iswanto[4], Dadang Sudrajat[5]
[1]Universitas Muhammadiyah Sumatera Barat, Padang, Indonesia. Email: hariefamily@yahoo.co.id
[2]Universitas Pembangunan Jaya, Banten, Indonesia
[3]Department of Project Management, Ho Chi Minh City Open University, Vietnam. Email: phong.nt@ou.edu.vn
[4]Department of Engineer Profession Program, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia
[5]STMIK IKMI Cirebon, Cirebon, Indonesia

Received: 06.10.2019 Revised: 07.11.2019 Accepted: 08.12.2019

Abstract:
Artificial intelligence is significantly increased with technological advancements. It can be seen in many applications of artificial intelligence in technological development. Many artificial intelligence technologies solve cases. One of the problems that can be solved by artificial intelligence is the Traveling Salesman Problem. In the Traveling Salesman Program, a salesperson must travel to several destinations with optimal mileage. For a small amount of destination, the optimum distance can be reached with a minimum distance. However, in more extensive cases, the optimum distance can be obtained with a very minimal distance in the search process. The genetic algorithm can find the optimum distance by regenerating each population so that it produces the minimum value. This value is not the minimum value in all points, but it can be the optimum global value. By applying the science of artificial intelligence in the case of Traveling Salesman Problem, the amount of mileage will be optimized.

Key Words: artificial intelligence, TSP, shortest path, optimum

INTRODUCTION

Artificial intelligence is often used in daily life. The purpose of artificial intelligence is to carry out optimizations that can improve the efficiency of resource use. One case that can be seen in artificial intelligence is the Traveling Salesman Problem [1]. This case is where a traveling merchant must go to peddle his wares and return to the place where he left. If there are a few destinations to be visited, the calculation can be done manually. However, if there are many objectives to be pursued, it is doubtful that this is done by manual calculation. For cases like this, we need an algorithm that can solve this problem. The algorithm that can be used is a genetic algorithm. This algorithm works by creating random values naturally so that the predicted results that are issued cannot be known. Each trial of the genetic algorithm produces a different output. Genetic algorithms cannot produce the minimum mileage in the case of Traveling Salesman Problem, but this algorithm can provide the optimum global value[2]. The smallest value obtained is according to how long this genetic algorithm performs a fitness search. The longer the search process, the smaller the error value [3], [4]. By implementing this algorithm, it is hoped that the Traveling Salesman Program case can be optimally resolved.

THEORIES

2.1 Artificial Intelligence

The technology was created to help and facilitate human activities and work. One technology that is being intensively created to create sophisticated devices is Artificial Intelligence. Many artificial intelligence developers who create implementations of artificial intelligence that are super sophisticated and applied to the real world[5]. Artificial intelligence has the opportunity and potential to be developed further with qualified resources. One technique of artificial intelligence can be seen in the field of film. Many films have used AI technology so that the film looks real. One of the films that can be seen is Iron Man, produced by Marvel.

Artificial Intelligence is a field of science that is used to create or add effects to an object to make it look more alive. This activity is often done by humans to create a better atmosphere from time to time. Artificial intelligence is done by giving intelligence to a machine or computer to be able to think and solve a problem with logia values as done by humans. Computers can be used to find perpetrators of artificial intelligence by doing programming and providing data that will be used as interpreters of commands given by humans. All data will be stored in a database. In addition, computers will be given the ability to learn and add data themselves without having to be given commands again (machine learning). The data will be studied and trained so that it becomes a benchmark for comparison. Training and learning this data will make the system able to provide the results of calculations and carry out preprogrammed activities and make it easier for humans in the future [6].

The function of artificial intelligence is the ability to rationalize and take actions that have the best chance of achieving specific goals. The first thing term people usually heard that AI is a future robot. Because of movies and popular novels that tell about human-like machines that wreak havoc on Earth. While Artificial Intelligence is based on the principle that human intelligence can be defined in such a way that machines can easily imitate and carry out tasks, from the simplest to the more complex. The goals of artificial intelligence include learning, reasoning, and perception. As technology advances, the previous benchmarks that define artificial intelligence are obsolete. For example, machines that calculate essential functions or recognize text through optical character recognition are no longer considered artificial intelligence because this function is now considered an inherent computer function. AI continues to evolve to benefit many different industries. Machines are transferred using an interdisciplinary approach based on mathematics, computer science, linguistics, psychology, and more.

2.2.1 The Story of Artificial Intelligence

The story of artificial intelligence began in the mid-1950s in the US. At the scientific conference at Dartmouth, M. Minsky, J. McCarthy, A. Newell, and HA Simon were the first to express of "artificial intelligence." The frequently cited definition for artificial intelligence was given by one of the founders of the problem, Marvin Minsky, in 1966: "Artificial Intelligence is the science of making machines do things that would require intelligence if done by humans." So, it was determined that artificial intelligence is an art and science that computers can take over the job of humans that requires personal intelligence. The first outcome of artificial intelligence was a general problem solver from researchers Newell, Shaw, and Simon from the 1960s. It solved simple problems. However, the results of the research apparatus cannot be generalized. In the late 1960s, another

performance was written with ELIZA. In this case, Joseph Weizenbaum, an MIT researcher, invented a therapy session [7].

2.2.2 Implementation of Artificial Intelligence

Artificial Intelligence can be implemented in various fields, including [8]:
Automation: it lets the system works without the control of humans.
Machine learning: it embeds the program to computer to let the computer add the code by itself.
Machine vision: it enables the program to analyze the system .
Natural Language Processing (NLP): it processese the human language by computer programs.
Robotics: it focuses on the creature and manufacture of how to build a robot.
Automated car driver: it combines many subject of artificial intelligence to create automatic driving.

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2.2 Traveling Salesman Problem

Traveling Salesman Problem (TSP) is a dilemma that is quite old in the environment of optimization [9]. On this issue, there is a first city and several cities to visit. A salesman is required to start a journey from the first city to the entire city, which must be visited exactly once [10].
In summary, here are the characteristics of the TSP problem:
The journey begins and ends from and to the initial city
There are several cities, all of which must be visited exactly once
Travel must not return to the initial city before all the destination cities visited
The purpose of this problem is to reduce the distance visited by salesperson by arranging the order of cities to be visited

2.3 Genetic Algorithms

The genetic algorithm is a optimization technique that is suited to the genetic process of biological organisms based on Charles Darwin's theory of evolution [11]. John Holland first discovered the genetic algorithm. The book is "Adaption in Natural and Artificial Systems". It was published in 1960. It wasa developed with his students and coworkers at the University of Michigan in the 1960s to 1970s. The purpose of Holland to develop Genetic Algorithms at that time was not to design an algorithm that could solve a problem, but rather to study the phenomenon of adaptation in nature and try to apply the mechanism of natural adaptation into computer systems [12].
The Genetic Algorithm made by Holland is a method for separating a population of chromosomes (consisting of bits 1 and 0) to a new population using "natural selection" and genetic operators such as crossovers, mutations, inversions. Crossover swaps small parts of two chromosomes, and mutations randomly replace gene values at several locations on a chromosome. Inversion reverses the sequence of several successive genes in a chromosome. The basic theory is the basis of most programs that use genetic algorithms today.
The things that must be done in using genetic algorithms are:
Set initial population
Calculate the fitness
Calculate the probabilty and cumulative probability
Generate random number for selection
Perform the roulette wheel selection
Generate random number for crossover
Perform the crossover
Perform the mutation
Keep the good chromosome
Repeat step 2 to 9.

METHODOLOGY

In the genetic algorithm, the encoding process produces a string which is then called a chromosome consisting of a collection of bits. These bits are known as genes making up a chromosome. A chromosome consists of some genes. The step of genetic algorithms techniques used in the Traveling Salesman Problem are selection, crossover and mutation. The chromosomes represent the order of cities visited by salesmen. For example P = (C1, C2, C3, ..., Cn) means the salesmen move from city C1 to C2, C2 to C3, C3 to Cn. There are five cities that a salesperson will pass. The cities are A, B, C, D, and E. The journey starts from A and ends at A as well. The distance between cities is shown in Figure 1 .

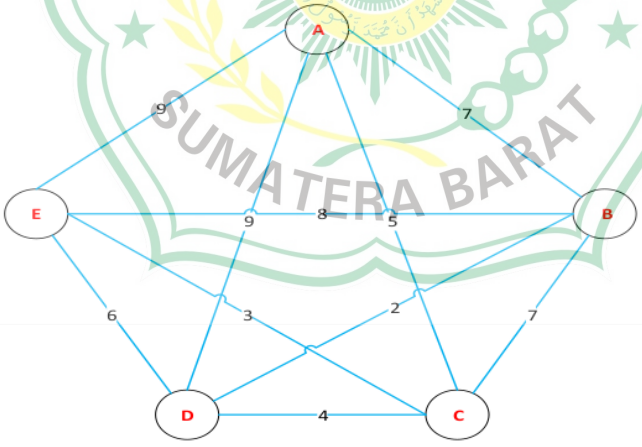

Figure 1. Graf of TSP

1	A	B	7
2	A	C	5
3	A	D	9
4	A	E	9
5	B	C	7
6	B	D	2
7	B	E	8
8	C	D	4
9	C	E	3
10	D	E	6

RESULT AND DISCUSSION

This section will try to find the smallest global optimum value. Chromosome initialization is done. The following is an explanation of Genetic algorithm calculations.

Initial Chromosomes

	Chromosomes			
1	B	D	E	C
2	D	B	E	C
3	C	B	D	E
4	E	B	C	D
5	E	C	B	D
6	C	D	E	B

Initial Fitness

	Route					Fitness
1	AB	BD	DE	EC	CA	
	7	2	6	3	5	23
2	AD	DB	BE	EC	CA	
	9	2	8	3	5	27
3	AC	CB	BD	DE	EA	
	5	7	2	6	9	29
4	AE	EB	BC	CD	DA	
	9	8	7	4	9	37
5	AE	EC	CB	BD	DA	
	9	3	7	2	9	30
6	**AC**	**CD**	**DE**	**EB**	**BA**	
	5	**4**	**6**	**8**	**7**	**30**

Selection

The chromosome selection is made because of the TSP problem desirably that chromosomes with smaller fitness will have a higher probability of being reealected

	Chromosome		
1	1	23	0.043478
2	1	27	0.037037
3	1	29	0.034483
4	1	37	0.027027
5	1	30	0.033333
6	1	30	0.033333
Total			0.208692

	Probabilty		
1	0.043478	0.208692	0.208337
2	0.037037	0.208692	0.177472
3	0.034483	0.208692	0.165233
4	0.027027	0.208692	0.129507
5	0.033333	0.208692	0.159725
6	0.033333	0.208692	0.159725

	Cumulative		
1	0.208337	0	0.208337
2	0.208337	0.177472	0.38581
3	0.38581	0.165233	0.551043
4	0.551043	0.129507	0.68055
5	0.68055	0.159725	0.840275
6	0.840275	0.159725	1

	Random
1	0.312
2	0.112
3	0.340
4	0.744
5	0.523
6	0.421

Crossover

Crossover is done to produce children from two mothers who are mated. The resulting chromosomes are expected to increase the value of fitness. The number of chromosomes that experience crossover is determined by crossover probability. The crossover probability value is 0.25.

	Random
1	0.452
2	0.209
3	0.221
4	0.875
5	0.770
6	0.133

Old	New	Chromosomes			
1	2	D	B	E	C
2	1	B	D	E	C
3	3	C	B	D	E
4	6	C	D	E	B
5	5	E	C	B	D
6	4	E	B	C	D

Mutation

This section will be carried out of the mutation process. This mutation works to exchange genes for genes on other chromosomes. Expected results increase the value of fitness to be achieved. If a gene is exchanged at the end of a chromosome, this gene will be exchanged for the first gene. There is a parameter to determine how many genes will be mutated. The mutation rate is 0.2.

	Chromosomes			
1	D	B	E	C
2	B	D	E	C
3	C	B	D	E
4	C	D	E	B
5	E	C	B	D
6	E	B	C	D

Fitnes Value

	Route					Fitness
1	AD	DB	BC	CE	EA	
	9	2	7	3	9	30
2	AB	BD	DE	EC	CA	
	7	2	6	3	5	23
3	AC	CE	ED	DB	BA	
	5	3	6	2	7	23
4	AE	EC	CB	BD	DA	
	9	3	7	2	9	30
5	AD	DB	BC	CE	EA	
	9	2	7	3	9	30
6	AE	ED	DB	BC	CA	
	9	6	2	7	5	29

In the first generation, it has been seen that there is the smallest fitness value that does not change. If the calculation is continued up to the N^{th} generation, then it is assumed that the lowest fitness value will remain unchanged. Although the calculation is sufficiently elaborated up to the 1st generation, a near-optimal solution has been found, from the genetic algorithm process above, the final result the route with the shortest optimal distance is A, B, D, E, C, A.

CONCLUSION

The problem of the Traveling Salesman Program can be adequately solved using genetic algorithms. This algorithm can determine the optimal sample path with several iterations. Although the optimal problem is encountered in a large number of cities, this algorithm can find the optimum global value of the entire mileage. The starting point or initial route of a journey does not have to start from city A only but can start from another city. The optimum generation lies in the generation that has been determined by the user. The generation will end if, after several successive generations, the lowest fitness value is obtained and does not change for the better. Fitness determines when a generation ends. Determination of the fitness value depends on the random value generated because the Genetic algorithm works by using natural selection.

REFERENCES

1. A.-H. Zhou *et al.*, "Traveling-Salesman-Problem Algorithm Based on Simulated Annealing and Gene-Expression Programming," *Information*, vol. 10, no. 1, p. 7, Dec. 2018.
2. M. Sobri Sungkar, O. Somantri, M. Taufik Qurohman, Romadani, V. Kurnia Bakti, and R. Rahim, "A proposed method using neural network for electricity price prediction

base on genetic algorithm," in *Journal of Physics: Conference Series*, 2019, vol. 1175, no. 1.
3. Y. Deng, Y. Liu, and D. Zhou, "An Improved Genetic Algorithm with Initial Population Strategy for Symmetric TSP," *Math. Probl. Eng.*, vol. 2015, pp. 1–6, 2015.
4. Iswanto, A. Ataka, R. Inovan, O. Wahyunggoro, and A. I. Cahyadi, "Disturbance rejection for quadrotor attitude control based on PD and fuzzy logic algorithm," *Int. Rev. Autom. Control*, vol. 9, no. 6, pp. 405–412, 2016.
5. S. Russell, *Artificial Intelligence: A Modern Approach*. London: Pearson, 2015.
6. Winston, *Artificial Intelligence (3rd Edition)*. London: Pearson, 1992.
7. J. Gabriel, *Artificial Intelligence: Artificial Intelligence for Humans*. California: CreateSpace Independent Publishing, 2016.
8. I. Millington and J. Funge, *Artificial Intelligence for Games*. London: Elsevier, 2009.
9. H. Tabatabaee, "Solving the Traveling Salesman Problem using Genetic Algorithms with the New Evaluation Function," *Bull. Environ. Pharmacol. Life Sci.*, vol. 4, no. 11, pp. 124–131, 2015.
10. H. El Hassani, S. Benkachcha, and J. Benhra, "New Genetic Operator (Jump Crossover) for the Traveling Salesman Problem," *Int. J. Appl. Metaheuristic Comput.*, vol. 6, no. 2, pp. 33–44, Apr. 2015.
11. S. Kusumadewi, *Artificial Intelligence (Teknik dan Aplikasinya)*. Yogyakarta: Graha Ilmu, 2003.
12. T. Sutojo, E. Mulyanto, and V. Suhartono, *Kecerdasan Buatan*. Yogyakarta: Andi Offset, 2011.

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