*International Journal of Engineering Science Invention*
*ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726*
*www.ijesi.org Volume 3 Issue 5‖ May 2014 ‖ PP.27-29*

# Solving Travelling Salesman Problem Using CSP Cross Over

Karishma Mendiratta[1], Ankush Goyal [2]
[1](M.tech(Persuing),Shri Ram College of Engineering and Management, Palwal, Haryana,India)
[2](M.tech(Assistant Professor),Shri Ram College of Engineering and Management, Palwal, Haryana,India)

***ABSTRACT:*** *In this paper an optimization of crossover operator in genetic algorithm to solve travelling salesman problem TSP has been proposed. A new cross over operator named Common Sub Paths Crossover CSP is introduced to solve TSP. CSP crossover consider the importance of common sub path in parents to generate a new child. The performance of new crossover operator is compared against classical one point crossover. New operator is implemented for a random population and results has been analyzed. The experimental result justify that new crossover operator is better than classical crossover in GA.*

***KEYWORDS:*** *chromosomes, crossover operator, fitness function, genetic algorithm, Travelling salesman problem*

## I. INTRODUCTION

In travelling salesman problem a salesman person has to visit different cities for his business purpose. All the cities are connected together. Salesman can start his journey from any headquarter visit all the cities and returned back to headquarter. For n-city TSP problem there exist ((n-1)!)/2 possible ways to solve it. TSP has been proved as NP-Complete problem [1]. So there is no way to find best solution to solve a TSP for large value of n(no of cities).So Genetic Algorithm is a best heuristic way to find the near optimal solution for a TSP. Goldberg and Lingle define a new operator named as PMX cross over ( partially mapped cross over) to solve TSP. They solve it for 33-node problem. Davis suggest OX(ordered crossover) which use a very different way to generate children from parents[5] . Olever suggest CX cyclic crossover [6] generate child such that each node and it's position come from one of it's parent.In this paper, a new crossover operator named Common Sub Path crossover (CSP) has been proposed for solving the TSP.

### Genetic Algorithms

Genetic algorithms (GAs) [7] are search techniques based on principles of natural selection and genetics – a concept taken from medical science (Fraser, 1957; Bremermann, 1958; Holland, 1975). Let us start with a brief introduction of genetic algorithms and terminology.GAs encode the decision variables of a search problem into finite-length strings . These strings are candidate solutions to the search problem and are referred to as chromosomes, these alphabets are referred to as genes and the values of these genes are called alleles. Once the problem is encoded in a chromosomal form and a fitness function for discriminating good solutions from bad ones has been selected. GA process can be started to evolve solutions to the search problem by using the following steps:

[1] **Initialization.** The initial population of candidate solutions (chromosomes) is usually generated randomly from the search space. However, domain-specific knowledge or other information can be easily incorporated in finding the initial population.

[2] **Evaluation.** In this step the fitness values of the candidate solutions are evaluated by using the fitness function.

[3] **Selection.** Selection allocates more copies of those solutions in to mating pool with higher fitness values and thus imposes the survival-of-the-fittest mechanism. The main idea of selection is to prefer better solutions, and many selection procedures have been proposed by different researchers to accomplish this idea, including roulette-wheel selection, stochastic universal selection, rank based selection and tournament based selection.

[4] **Recombination.** In this step parents have been selected and recombined to generate children. There are many ways of doing this (some of which are discussed in the next chapter in literature review ), and competent performance depends on a properly designed recombination mechanism.

[5] **Mutation.** While recombination operates on two or more chromosomes, it locally but randomly modifies a solution. Again, there are many different variations of mutation, but it usually involves one or more changes being made. In other words, mutation performs a random walk in the domain of a candidate solution.

[6] **Replacement.** The new population created by selection, recombination, and mutation replaces the original chromosomes in the parental population. Some replacement techniques like elitist replacement, steady-state replacement methods and generation-wise replacement are used in GAs.

**Repeat** steps 2–6 until a terminating criteria is met.

**Procedure GA**
begin
Generate N random chromosomes {N is the population size}
Evaluate tour length produced by each path and store each one
store best-path-so-far
repeat
for each chromosome of the population
Select two parents using any of the selection methods
apply crossover operator to produce new offspring
apply mutation to offspring of the population
evaluate tour length produced by offspring in the current population
if offspring is better than weaker parent then it replaces it in population
if offspring is better than best-path-so-far then it replaces best-path-so-far
end for
until stopping criteria satisfied
print best-path-so-far
end

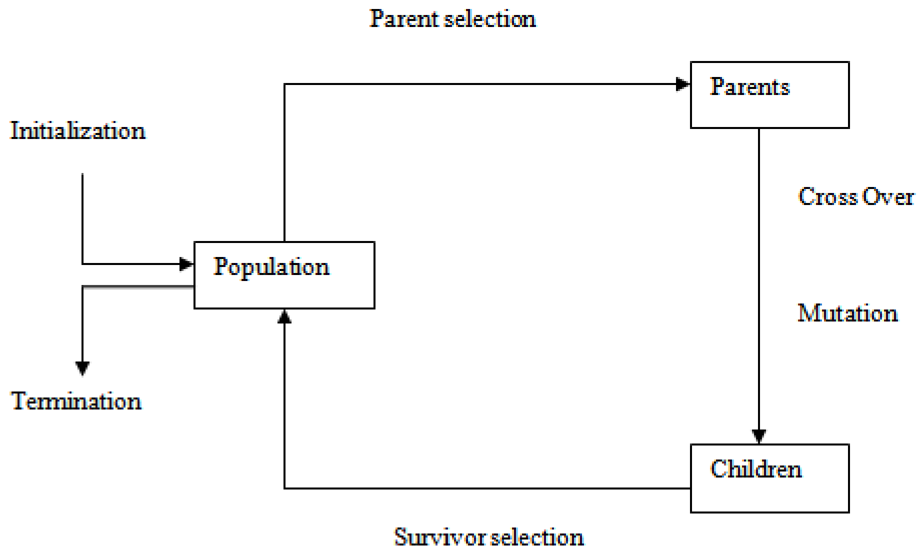


Figure 1 The general scheme of Genetic Algorithm

The evolutionary cycle for genetic algorithm is shown in fig-1. The cycle starts with the generation of initial population of chromosomes which are the candidate solution for the given problem. The initial population can be generated randomly. After that a cycle of selection, crossover, mutation and next population generation or supervisor selection will be repeated until a terminating condition does not meet.

## II. PROPOSED WORK

**Common Sub Path crossover (CSP)**

This cross over operator generate new child by taking in to consideration of common sub path in two paths. The key idea is that cities which are close to each other must be visited one after the other thus making sub path in the TSP problem. If these sub path are modified by any of the GA operator then it may increase the overall cost of the route and thus generate the child which are less fit. By not disturbing the sequence of the

cities in the sub path we have tried to generate child with high fitness values. Example explaining Common Sub path crossover is as follows:
Let No of citizens= 15

Path p1 : 1-13-12-8-9-10-11-4-7-3-6-5-2-14-15-1
Path p2 : 1-8-9-10-11-13-14-2-12-4-3-6-5-7-15-1

It can be seen that in both the parents a common sub route exist which are 8-9-10-11 and 3-6-5. The child generated after CSP cross over must have this sub route. The generated child will be

Child c1 : 1-8-9-10-11-3-6-5-13-12-4-7-2-14-15-1

The common sub paths must be added first after that remaining nodes will come in the order of the parent p1.
The algorithm for CSP cross over is as follows:
Algorithm: CSP()
// This algorithm take two paths as parents and generate a new path (child_path)
Step 1 : Place node-1 on to child_path.
Step 2 : set current node = node-2
Step 3 : Find common sub route starting from current node in both of the parents. If such a common sub route exists then go to step 3 otherwise exit.
Step 4 : Place all the cities from common route onto child_path.
Step 5 : set current node = current node + no of the cities in the common sub route.
Step 6 : if current node = last node then exit otherwise goto step 2.

## III. CONCLUSION AND FUTURE WORK

In this paper we have proposed a new crossover operator named common subroute cross over(CSP) for a genetic algorithm for the Travelling Salesman Problem (TSP). The algorithm use the concept that cities which are close to each other must be visited one after another. For example if a salesman have to visit cities in north, south,west of India. If the salesman visit cities which are in north such as Delhi, Chandigarh, Jalandhar one after another and then move to cities in the west or south, the path length will be minimized. The proposed algorithm have to be implemented and tested for the results. Further there is a future scope to solve some well known TSP problems such as bayg29, kroA100 etc and compare the performance of the algorithm.

## REFERENCES


[1] C.H. Papadimitriou and K. Steglitz.*"Combinatorial Optimization: Algorithms and Complexity"*.Prentice Hall of India Private Limited, India, 1997.

[2] C.P. Ravikumar. *"Solving Large-scale Travelling Salesperson Problems on Parallel Machines"*.Microprocessors and Microsystems 16(3), pp. 149-158, 1992.

[3] R.G. Bland and D.F. Shallcross.*"Large Travelling Salesman Problems arising form Experimentsin X-ray Crystallography: A Preliminary Report on Computation"*. Operations Research Letters 8, pp. 125-128, 1989.

[4] D.E. Goldberg and R. Lingle.*"Alleles, Loci and the Travelling Salesman Problem"*.In J.J.Grefenstette (ed.) Proceedings of the 1st International Conference on Genetic Algorithms andTheir Applications.Lawrence Erlbaum Associates, Hilladale, NJ, 1985.

[5] L. Davis. *"Job-shop Scheduling with Genetic Algorithms"*. Proceedings of an InternationalConference on Genetic Algorithms and Their Applications, pp. 136-140, 1985.

[6] I.M. Oliver, D. J. Smith and J.R.C. Holland. *"A Study of Permutation Crossover Operators on theTravelling Salesman Problem"*.In J.J. Grefenstette (ed.). Genetic Algorithms and TheirApplications: Proceedings of the 2nd International Conference on Genetic Algorithms. LawrenceErlbaum Associates, Hilladale, NJ, 1987.

[7] TSPLIB,http://www.iwr.uni- heidelberg.de /iwr/comopt/software/TSPLIB95/


## AUTHORS


**First Author** – Karishma Mendiratta, M.Tech. (perusing) Shri Ram College of Engineering and Management, Palwal, Haryana.

**Second Author** – Ankush Goyal, Assistant Professor (M.Tech.), Shri Ram College of Engineering and Management, Palwal, Haryana