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Dynamic Routing for ATM Networks Using Genetic Algorithm

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Abstract
The prominent issues which have a significant influence on network performance is routing, optimal routing plays a major role for ATM networks. This paper deals with problem of finding shortest path. Minimal cost path which contains the designated source and destination nodes are formulated by shortest path. To find shortest path we need to develop a strategy based on genetic algorithm. This paper explores various methods utilized for genetic algorithm in ATM networks & also compares results of them.

1. INTRODUCTION

Asynchrous Transfer Mode (ATM) is often described as technology that will allow total flexibility and efficiency to be achieved in high speed, multi service, multimedia networks both for military and civilian applications. ATM is quickly evolving to enable the full use of Broadband Integrated Service Digital Network (BISDN). ATM is high bandwidth, low delay, packet like switching and multiplexing technique. ATM will allow various services to utilize the same transfer network. ATM is connection oriented and converts user data in various formats to uniformly sized cells for transport. Each cell consists of 53 bytes. Out of these 53 bytes, 5 bytes are reserved for header field and 48 bytes are reserved for data field. The cells are dynamically configured through the ATM network utilizing virtual circuits and paths. This dynamic routing help to minimizing average cell delay[1]. The voice service will benefit from the high speed transmission of these short cells and face only very short delays.
Users can also negotiate with the network manager in the call set-up procedure and adjust the service quality so that network can accommodate as many service requirements as possible.

2. GENETIC ALGORITHM

Genetic Algorithms (GAs) are search algorithms based on the mechanics of the natural selection process (biological evolution)[2]. The most basic concept is that the strong tend to adapt and survive while the weak tend to die out. That is, optimization is based on evolution, and the "Survival of the fittest" concept. GA have the ability to create an initial population of feasible solutions, and then recombine them in a way to guide their search to only the most promising areas of the state space. Each feasible solution is encoded as a chromosome (string) also called a genotype, and each chromosome is given a measure of fitness via a fitness (evaluation or objective) function. The fitness of a chromosome determines its ability to survive and produce offspring. The method learns by producing offspring that are better and better as measured by a fitness function, which is a measure of the objective to be obtained (maximum or minimum). Genetic Algorithms are a type of machine learning for representing and solving complex problems. They provide a set of efficient, domain-independent search heuristics for a broad spectrum of applications.

GA consists of following steps:

i) Encoding

The process of representing the solution in the form of string that conveys the necessary information.
The different encoding methods are

- Binary encoding
- octal encoding
- Hexadecimal encoding
- Permutation encoding
- Value encoding.

In this paper we have taken consideration Binary encoding in which Chromosomes are strings of 1s and 0s and each position in the chromosome represents a particular characteristic of the problem.
Ex:
Chromosome A 10110010110011100101
Chromosome B 11111110000000011111

ii) Initialization

This step uses the encoding method to create a random initial population by randomly generating a suitable number of chromosomes.
Chromosome length = number of nodes in the original network
The chromosome represents binary string.

Number of populations

Various population sizes were used while running Genetic algorithm in each level.

iii) Selection

The process of choosing one or more parents for reproduction. In this paper we have taken consideration the Roulette wheel selection, Rank selection, Tournament selection.

- **Roulette wheel selection (RWS)**

In proportional roulette wheel, chromosome are individually selected with a probability that is directly proportional to their fitness values. i. e an individual's selection corresponds to a portion of a roulette wheel. This can be worked as in the following steps

Step 1: Find the fitness value (fv) for each chrosome in the population using fitness function.
Step 2: Calculate sum fitness (sf) for all the chrosomes in the population Sf.
Step 3: Calculate average fitness in the population
Af = Sf/n
Step 4 : Find the expected fitness (Ef) for each chrosome in the population
Efi = fvi/Af
Step 5 : Calculate sum expected fitness for all the chrosomes in the population
Step 6 : Generate random number (G) in the range [0, sum Ef]
Step 7 : Select the chromosome that added its
Fitness value to the previous chromosomes fitness value's to make (sum Ef >= G)
Step 8 : Go to step 6, repeat n times, where n is a population size

- **Rank selection**

Rank selection is the selection strategy where the probability of a chromosome being selected is based on its fitness rank relative to the entire population. This can be worked as in the following steps

Step 1: Sort the individuals in the population according to their fitness values
Step 2: Assign a rank value to each chromosome according to its arrangement in the set
Step 3: Calculate the new fitness value for each chromosome

Table 1. Rank selection

Individual fitness value	Rank
64	1
169	2
361	3
576	4

- **Elitism selection**

The idea is to arrange the chromosomes in the decreasing ordering to their fitness values. Then apply the selection with each two chromosomes in the arranged set. In this way, genetic algorithm will be applied between strong chromosomes or between weak chromosomes. This means there is no chance to apply genetic algorithm between weak and strong chromosomes.

- **Stochastic universal sampling**

Instead of spinning the routlette wheel n times as described in roulette wheel selection. In this technique one can spin the roulette wheel just once, but after determining n points in the wheel, where n is a population size, then choose n chromosomes that are situated in front of the determined points.

- **Binary tournament selection**

In tournament selection, n individuals are selected randomly from the larger population and the selected individuals compete against each other[3]. The individuals with the highest fitness wins and will be included as one of the next generation population. The number of individual competing in each tournament is referred to as tournament size, commonly set to 2. Tournament selection also gives a channel to all the individuals to be selected and thus it preserves diversity.

iv) Crossover

The process in which two chromosomes combine their genetic material to produce new offspring which possesses both their characteristics.

The different methods of cross over are

- Single point crossover method

A random point is chosen on the individual chromosomes (strings) and the genetic material is exchanged at this point.
Chromosome1 11011 |00100110110
Chromosome2 11011 |11000011110
Offspring1 1101111000011110
Offspring 2 11011 | 00100110110

- Two point crossover method: Two random points are chosen on the individual chromosomes (strings) and the genetic material is exchanged at these points.

Chromosome1 11011|00100|110110
Chromosome 2 11101|11000|011110
Offspring1 10101 |11000|011110
Offspring2 11011 | 00100|110110

- Uniform crossover method: Each gene (bit) is selected randomly from one of the corresponding genes of the parent chromosomes.

Chromosome1 11011|00100|110110
Chromosome 2 10101|11000|011110
Offspring 10111 | 00000 |110110

v) Mutation

The process by which a string is deliberately changed so as to maintain diversity in the population set.
The different methods of mutation are

- Flipping
- Interchanging
- Reversing

vi) Fitness function

The fitness function is computed by using which cost factor is considered.
Fitness= total cost from source to destination
Since our objective is to minimize the distance, the lesser the total distance, the fitter the solution.

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vii) Terminating condition
Staring with initial population, the evolution process is repeated until the satisfaction of the end condition[4].
There exist three termination condition type

- The found solution satisfies the minimum criteria.
- A fixed number of generations reached.
- Allocating budget(ex:time, money) reached

3. NETWORK MODEL
Consider ATM network which consists of 7 nodes with 14 links.

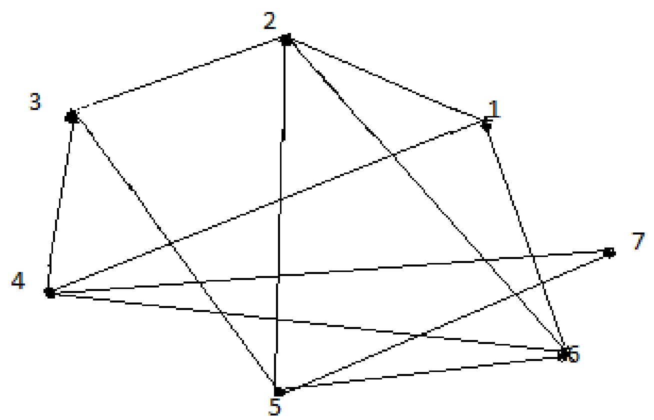

Figure 1. Network model

Each network link is characterized by a set of attributes, these attributes for a given link(i) from the flow (f_i) and the capacity (c_i). f_i is defined as the effective quantity of information transported by link i. The capacity (c_i) defined as the measure of the maximal quantity of information that can be transmitted by link i.
GA is optimizes to find the best values of (f_i) such that the overall delay is minimized.

4. PROBLEM STATEMENT
The Problem defined as 'We are given a set of nodes and a symmetric distance matrix that indicates the cost of travel from each node to every other node. The goal is to find the shortest path, visiting every node exactly once, so as to minimize the total travel cost, which includes the cost of traveling from the last node back to the first node'.
Genetic algorithm has been used to optimize the ATM network.

5. COMPUTATIONAL EXPERIMENTS AND RESULTS
5. 1 Experimental Set-Up
This section will focus on computational experiment that uses three GA selection schemes discussed in this paper to obtain optimal solution for shortest path routing. The performance of GA is tested at 10 nodes with distance between nodes which are randomly generated. The objective of the experiment is to investigate the performance of GA with different selection strategies in terms of number of generations and iteration time to come out with the optimal solution.

5. 2. Experimental Results
The traffic matrix for nodes table 1 has been considered for the evaluation of the algorithm and flow capacities have also been listed in the network model.

Table 2. Traffic specification

Link id	1	2	3	4	5	6	7	8	9	10
1	0	15	10	0	0	0	0	0	0	0
2	15	0	3	8	0	0	0	0	0	0
3	10	3	0	0	9	0	0	0	0	0
4	0	8	0	0	0	7	5	0	0	0
5	0	0	9	0	0	6	2	0	0	0
6	0	0	0	7	6	0	0	12	0	0
7	0	0	0	5	2	0	0	0	10	0
8	0	0	0	0	0	12	0	0	0	8
9	0	0	0	0	0	0	10	0	0	8
10	0	0	0	0	0	0	0	8	8	0

Parameters for running GA are

- Initital population is generated using randint function
- Here 4xnvar paths are generated between m0 to m1
- Cross over is two point cross over

Mutation: here source and destination are just replacing at 1st and last node

- After mutation selection is performed using ranking and feasibility of path
- No. of iterations=100

GA step by step results for finding shortest path
Initial population
7 4 3 6 3
2 1 6 7 2
4 2 3 1 2
2 3 2 7 2
after Crossover
7 5 6 7 3
2 0 3 6 2
4 3 2 7 2
2 2 3 1 2
after Mutation
2 5 6 7 2
2 0 3 6 2
2 3 2 7 2
2 2 3 1 2
after Raking
2 2 3 1 2
2 0 3 6 2
2 3 2 7 2
2 5 6 7 2
Shortest path is 1 3 5 6 8
Shortest path weight is 37
Fitness value is 0. 027027
The parameters used in the network are presented in the following:

Table 3. Parameter Specification

Population size	100
Encoding	Binary
selection	Stochastic, Tournment, Uniform
Crossover	Single point, Intermediate
Mutation	Constraint dependent, Adaptive fesible
Scaling function	Rank, Propotional, Top
Stopping criteria	No of generations

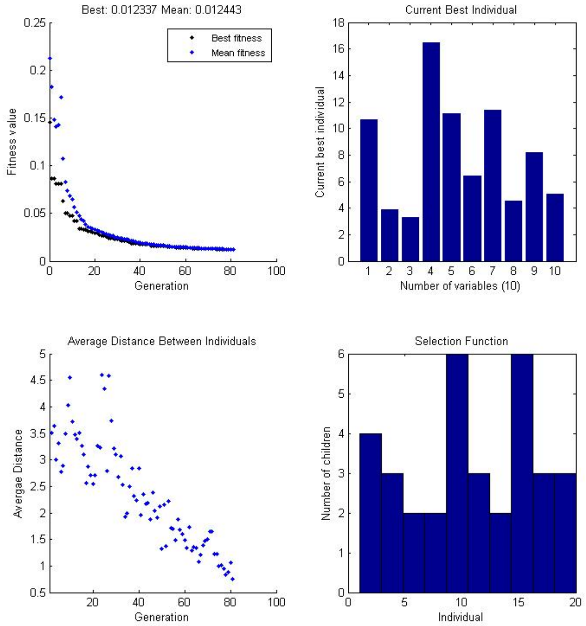

Figure2. Stochastic Selection

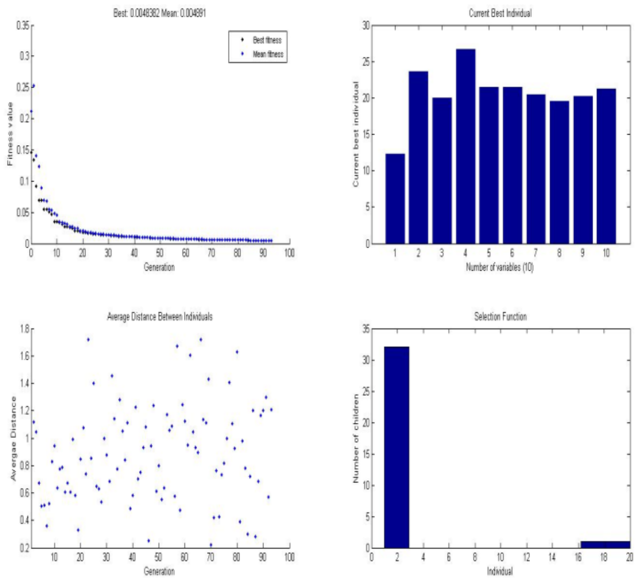

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Figure4. Uniform Selection

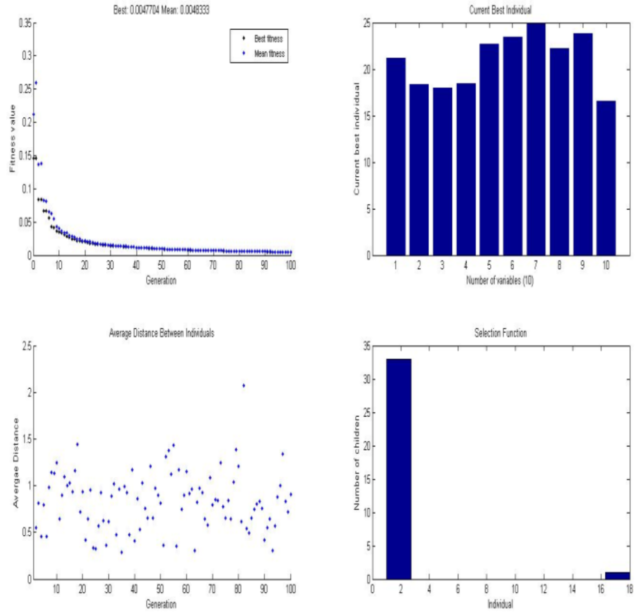

Figure5. Tournament Selection

CONCLUSION

In this paper we have described different types of selection strategies in the GA procedure to solve dynamic routing between nodes in ATM networks and compare their performance in terms of minimum time delay and number of generations to come out with the best solution. The results also revealed that the GA based tournament selection is more efficient in obtaining minimum total distance with less number of generations and fastest iteration time. compared to other strategies. Therefore it can be concluded that tournament selection is more appropriate for small size problems. This work is helpful for updating routing table at each node in ATM networks.

REFERENCES

[1] L. Painton and J. Campbell, "Genetic algorithms inoptimization of systemreliability, "IEEETransactions on Reliability, vol. 44, pp. 172–178, 1995.

[2] R. Susmi, A. M. Sherry, and B. V. Reddy, "ATMnetwork planning: A genetic algorithm approach, "Journal of Theoretical and Applied Information Technology, vol. 1, pp. 74–79, 2007.

[3] B. L. Miller and D. E. Goldberg, "Genetic algorithms, selection schemes, and the varying effects of noise, "Evolutionary Computation. vol. 4, no. 2, pp. 113–11, 1996.

[4] K. Walkowiak, "Genetic algorithms for backup virtual path routing in survivable ATM networks, " In Proceedings of MOSIS 99, vol. 2, pp. 123–130, 1999.