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Genetic Algorithmic Linking By Using Cellular Automata and the Communication Protocols

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KeyWords:
Genetic Algorithm, Cellular Automata, Communication Protocols, Mutations, 2-D.

Abstract: *This paper is reported the Genetic Algorithmic Linking By Using Cellular Automata and The Communication Protocols with the formulation of a constructive theory for modeling a two dimensional computer networks. The central idea on which the work carried out is that the network of computers is treated as 2D lattice of cellular automata and the communication protocols as genetic algorithmic linking. The central point on which the work cellular automaton reported here in this paper is that a complex computer network is modeled as a lattice of nodes consisting of active and dummy nodes and their connectivity and performance as a nonlinear dynamical system behavior. The performance of the connection established is observed the behavior of the algorithm in a rectangular lattice is complex and nonlinear. The forward path is traversing from source to destination and the backward path is traversing from destination to source yields a bit string of 0's and 1's and reported.*

1. Introduction:

Recent advances in technology and the large quantity of data requires the development of more sensitive detection methods. This problem has attracted researchers' interest from a variety of backgrounds ranging between image processing, signal processing, simulated annealing and Bayesian filtering. Most of the literature is concentrated in three areas: image processing, neural networks, and statistical models such as the Hidden Markov model.

The difficulty of information communication in a computer network is dependable communication of bits across channel, routing, and directing information to the correct destination within the destination computers operating system and demands an overarching concept of how to organize information rescue. No unique set of rules satisfies the various constraints communication channels and network organization place on information transmission. A protocol is a set of rules that governs how information is delivered. For example, to use the telephone network, the protocol is to pick up the phone, listen for a dial tone, dial a number having a specific number of digits, wait for the phone to ring, and say hello.

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In radio, the stations use amplitude or frequency modulation with a specific carrier frequency and transmission bandwidth and know to turn on the radio and tune in the station. In technical terms, no one protocol or set of protocols can be used for any communication situation. 'Cellular automata' is defined by dynamical systems which are discrete in space and time, operate on a uniform, regular lattice - and are characterized by "local" connections.

Several researchers done several works in the comparable line i.e: Alexandre, L, M et al [1] presented a novel approach for multi spectral image contextual classification by combining iterative combinatorial optimization algorithms. The pixel-wise decision rule is defined using a Bayesian approach to combine two MRF models: a Gaussian Markov Random Field (GMRF) for the observations (likelihood) and a Potts model for the a priori knowledge, to regularize the solution in the presence of noisy data. The classification problem is stated according to a Maximum a Posteriori (MAP) framework. In order to approximate the MAP solution we apply several combinatorial optimization methods using multiple simultaneous initializations, making the solution less sensitive to the initial conditions and reducing both computational cost and time in comparison to Simulated Annealing, often unfeasible in many real image processing applications. Markov Random Field model parameters are estimated by Maximum Pseudo-Likelihood (MPL) approach, avoiding manual adjustments in the choice of the regularization parameters. Mauro Mezzini and Marina Moscarini [2] proposed a simple algorithm called CliqueMinTriang for computing a minimal triangulation of

a graph and shows how the algorithm can be adapted to perform a backward stepwise selection of decomposable Markov networks. Thomas, A, L and Simon, E, M, O [3] presented the detection of tracks in spectrograms and it is an important step in remote sensing applications such as the analysis of marine mammal calls and remote sensing data in underwater environments. Ajay Jasra and Chao Yang [4] reported a solution a Markov chain on measurable space with unique stationary distribution. Pavitsos, A and Kyriakidis, E, G [5] reported the optimal maintenance of a production unit with an upstream buffer. J.G. Sumner and P.D. Jarvis [6] showed how the isotropy subgroup of leaf permutations on binary trees can be used to systematically identify tree-informative invariants relevant to models of phylogenetic evolution. Alan W. Johnson and Sheldon H. Jacobson [7] Generalized hill climbing (GHC) algorithms have been presented as a modeling framework for local search strategies applied to address intractable discrete optimization (minimization) problems. Yang Yu and Zhi-Hua Zhou [8] analyzed Evolutionary algorithms with different configurations, including three mutation operators, with/without population, a recombination operator and a time variant mutation operator, on a hard problem. Rajeev Alur and David L. Dill [9] proposed timed (finite) automata to model the behavior of real-time systems over time. Our definition provides a simple, and yet powerful, way to annotate state-transition graphs with timing constraints using finitely many real-valued clocks. A timed automaton accepts timed wordsinfinite sequences in which a real-valued time of occurrence is associated with each symbol. We study timed automata from the perspective of formal language theory: Mario Bravetti and Roberto Gorrieri [10] introduced the calculus of interactive generalized semi-Markov processes (IGSMPs), a stochastic process algebra which can express probabilistic timed delays with general distributions and synchronizable actions with zero duration, and where choices may be probabilistic, non-deterministic and prioritized. Josée Desharnais et al [11] introduced a new class of labeled transition systems, labeled Markov processes and define bisimulation for them. Labeled Markov processes are probabilistic labeled transition systems where the state space is not necessarily discrete.

Tele traffic engineering of IP networks requires the characterization and modeling of network traffic on multiple time scales due to the existence of several statistical properties that are invariant across a range of time scales, such as self-similarity, LRD and multifractality. These properties have a significant impact on network performance and, therefore, traffic models must be able to incorporate them in their mathematical structure and parameter inference procedures. Genetic algorithms work on the principle of natural selection of solution from a solution space called population. Candidate solutions are treated as chromosomes and the operations on them are carried out using mutation. The natural selection and mutation are the genetic operators that are used in reproduction. The possibility of using Genetic Algorithm (GA) in automatic fixing of paths between two arbitrarily specified computers embedded in a cellular automaton lattice. In the design and operation of such telecommunications and computer networks, the important problems usually faced are determining the optimum configurations and dimensions of the systems for providing a given performance or grade of service.

Most of the teletraffic models are represented either as Markov, A.A [12] or non M Markov type models. The defining equations pertaining to all the traditional models are complex resulting in more processing time. Most of the hardware and the software meant for teletraffic are also based on these traditional models and there is a requirement of seeking an alternative model which would demand less computation time when compared to the old ones. It is in this connection, some effort was made and 2-D cellular automata models are developed. Using GA based path fixing the path between source and destination nodes is fixed.

2.Theoretical description

The teletraffic theory developed incorporating recent advances in operations research and queuing theory. Markov [12] teletraffic models with interarrival and service time both exponentially distributed have been studied for a long time as Markov loss systems, Markov Delay systems and Extended Markov Models. Alternately Non- Markov teletraffic models have also been studied as Renewal Processes, Poison input General Service time models, Poison input constant service time models, Renewal input Exponential server models and Renewal input single server models. In addition, Integrated Services Digital Network (ISDN) and Local Area Network (LAN) have been studied as Multi-Class input models like Batch Arrival Models, Priority Queue Models, Multi-Dimensional Models, Mixed Loss and Delay Models and Multi-Queue Models. The 2-D free cyber space model observations are shown in Table.1.

This work is concerned with the formulation of a constructive theory for modeling two dimensional computer network communications using the concepts of Cellular Automata and Algorithms related to Genomes. The basic idea on which the work carried out is that the network of computers is treated as 2-D lattices of cellular automata and the communication protocols as genetic algorithmic linking. The basic point on which the work

reported here in this research is that a complex computer network is modeled as a cellular automaton lattice of nodes consisting of active and dummy nodes and their connectivity and performance as a nonlinear dynamical system behavior.

Table1: 2-D free cyber space model Observations

Mutations	Search Spaces							
	6x6	9x9	12x12	15x15	18x18	21x21	23x22	24x24
1	45	74	81	82	88	91	54	95
5	69	85	91	86	93	93	58	93
10	69	93	95	94	93	96	67	100
15	64	90	93	96	88	94	59	96
20	69	94	98	95	97	95	68	97
25	84	92	94	97	95	94	73	97
50	69	97	98	98	100	99	83	96
75	96	95	98	98	98	99	90	100
100	91	96	99	97	100	100	94	100
125	93	90	96	100	100	100	91	100
150	89	94	94	98	98	100	94	100
175	91	94	99	96	100	100	93	100
200	93	96	96	97	100	98	93	100
250	96	96	99	100	99	100	92	100
300	91	93	96	98	100	100	96	100
350	90	93	96	100	99	99	87	100
400	93	92	98	99	100	100	90	100
450	96	93	96	99	100	100	94	100
500	89	93	98	97	100	99	88	99

Thus the network performance could be studied as extended genetic algorithmic fixing of network paths in between desired nodes. The research has been catered to the needs of reorganizing communication protocols for a very complex system like internet. The assumption of exponential services time fairly agrees with actual telephone conversation time. Furthermore, because of the simplicity for theoretical analysis it has been widely used in telephone traffic theory. The stochastic behavior of a communication phenomenon after (future) time 'X' is only dependent on the state at time 'X' (present) and independent of progress before (past) time 'X'. This characteristic is called Markov property and only exponential distribution has this property in continuous distribution. A model with interarrival time and service time both exponential distribution is called 'Markov model' otherwise it is called non- Markov model.

3. Methodology

The fixing of the communication links between two computers is very much easy by using Genetic algorithms. Usually the length of a chromosome (candidate solution) is fixed and the best fit chromosome among a population is chosen based on a fitness function. On the other hand, the length of the chromosome corresponding to a link length would vary as the genetic algorithm generates more populations (evolutions) depending on the complexity of the search space inside the cyber space. Figure.1 shows the model of a 2-D cyber space where the hypothetical links can be formed by a square lattice cellular automaton.

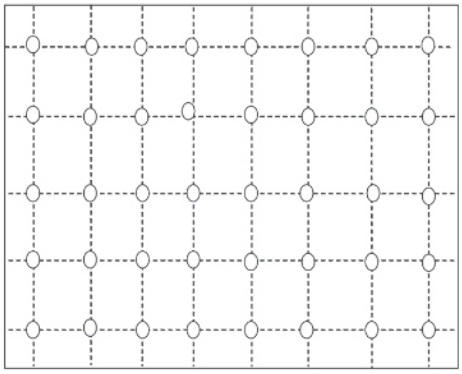

Figure 1: A Cyber Space Model

4. Link fixing for 2-D cyber space

The path of the 2-D cyber space could be established between a source computer and a destination computer and the procedure for the path establishment is explained in three steps i.e: (i) The H-V connection may be established by choosing the horizontal path and then a vertical path (ii) The V-H connection may be established by choosing a vertical path and then a horizontal path (iii) The zig - zag connection may be established in any arbitrary manner using horizontal and vertical links. Figure 2 shows a screen in which the connection is established.

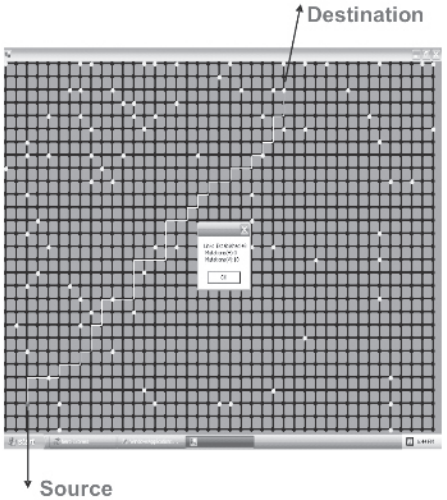

Figure 2. A 2-D Screen showing connection establishment

As per the principle element '0' represents for H-connection and '1' represents for the V-connection. The forward path is traversing from source to destination yields a bit string of 0's and 1's as shown as follows

---
11000100 10110110 00111000
11100101 01001001 01011011

Where as the backward path is traversing from destination to source yields a bit string of 0's and 1's as shown below:

```
________ ________ ________
11000100 10110110 00111000

________ ________ ________
11100101 01001001 01011011
```

From the observation, the backward path can be obtained by traversing from destination to source and the two paths will be compliment of each other. Once a link is established, the chromosome length reduces and thus the entire connection is said to be established when the length of the chromosome reduces to 0. The genetic operator's Natural selection and Mutation are carried out in the chromosome in order to speed up the operation of establishing the connection.

5. Results

The performance of the connection established is observed from the graphs drawn between the number of mutations (Horizontal or Vertical) performed in achieving the connectivity and the number of connections established for different search spaces like 6x6, 9x9, 12x12 and 24x24 is shown in figure 3 to figure 6.

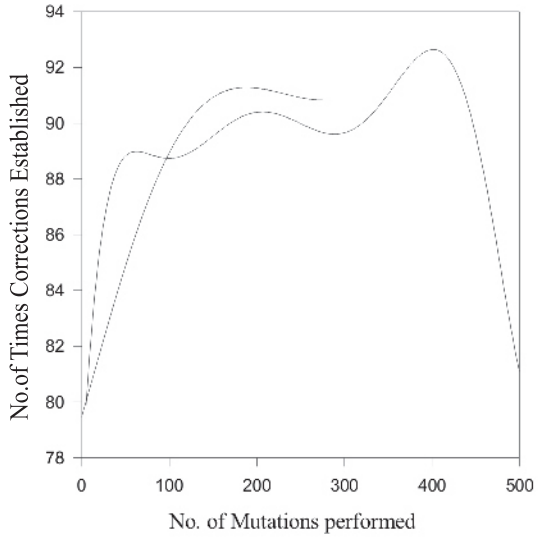

Figure 3. Plot for 6 x 6 search space

For each mutation value 100 experiments are conducted and the observations are noted (i.e. the number of mutations and the number of times connection is established). Then the mutation value is varied for the next set of observations. In these graphs the mutation is varied from 1 to 500 and number of times connections established are varied and shown in figure 3 to figure 6. These graphs reveal that the behavior of the algorithm in a rectangular lattice is complex and the research has been catered to the needs of reorganizing communication protocols for a very complex system like internet.

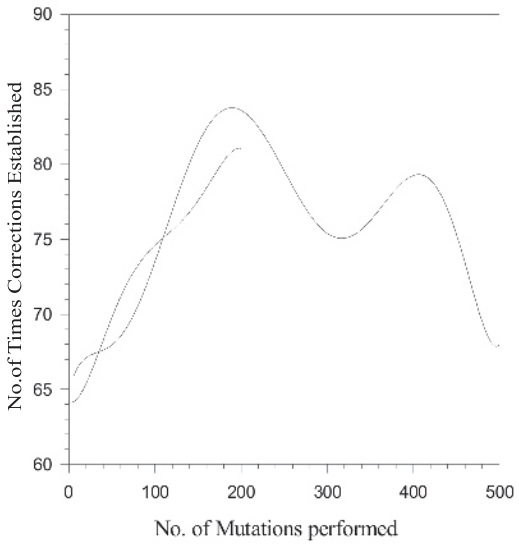

Figure 4. Plot for 9 x 9 search space

The Genomic based algorithm works fairly well for a complex network. The connectivity also reduces as the number of random connections increases in a busy cyber space. The blue curve in the plot is the graph plotted taking Mutations on x axis and Number of times connection established on y-axis, where as the red curve is the curve fitting on the graph shows the complexity in mutations performance.

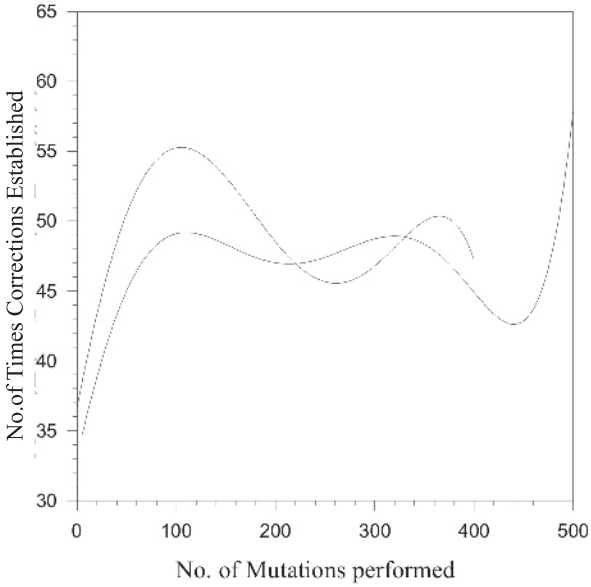

Figure 5. Plot for 12 x 12 search space

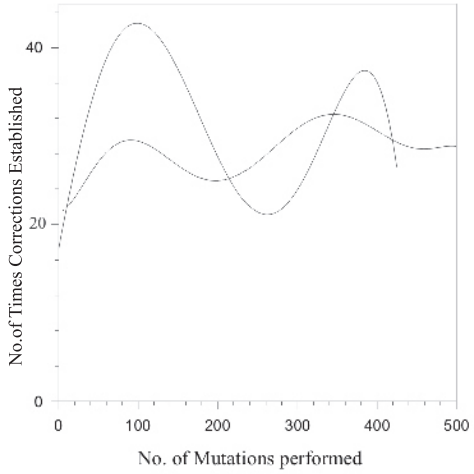

Figure 6. Plot for 24 x 24 search space

6. Conclusion

The Genetic Algorithmic Linking By Using Cellular Automata and The Communication Protocols with the formulation of a constructive theory for modeling a two dimensional computer networks. The central idea on which the work carried out is that the network of computers is treated as 2D lattice of cellular automata and the communication protocols as genetic algorithmic linking. The performance of the connection established is observed the behavior of the algorithm in a rectangular lattice is complex and nonlinear. The forward path is traversing from source to destination and the backward path is traversing from destination to source yields a bit string of 0's and 1's and reported.

7. Nomenclature

X = Time variable
2D = Two Dimensional
0 = Bit string for H- Connection
1 = Bit string for V- Connection
H = Source
V = Destination

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