# Network Efficiency - Optimized Automaton Approach 

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#### Abstract

A sperner's grid is thought of a finite state system, where in the model gives rise to an optimal network through characterization of paths .the automation graphs of the various states gives rise to different groomable light paths in network.


Keywords—Automaton; Network; Efficiency; Characterization

## I. InTRODUCTION

In recent years with the use of different kinds of communication, the network has gained popularity. Automaton traffic engineering is an effective solution to control network conjestion. Automaton traffic engineering comprises of scientific principles thus providing optimal characterization in network.

A network is represented by a set of nodes, inks between the nodes interconnecting them Destination nodes refer to traffic entering or leaving a node, transit nodes refer to nodes were no traffic can enter or leave the node.

## A. Network via Automata

A finite state system represents a mathematical model of a system with certain input. The model finally gives a certain output. The input given to the machine is processed by various states; these states are called intermediate states. This intermediate state leads to final state.

A finite state Automata or simply a network consists of directed graphs composed of states and arcs. We start with a single initial state and could have any number of final states. A path is observed as a sequence of arcs or links from start state to final state.

## B. Network through Directions

Consider a directed graph as $\mathrm{D}=(\mathrm{V}$ (D), X (D), $\chi_{\mathrm{D}}$ ), Consisting of nonempty set V (D), X (D) being disjoint from $V(D)$ and $\chi_{D}$ a function which associates $V(D)$ and $X(D)$. The set $V(D)$ is called the vertex set of $D$ and $X$ (D) its link set Elements of $V(D)$ are taken as nodes of D and elements of $X(D)$ are called links of (D).

$a=(A, B)$ is a link of directed graph $D$ then ' $a$ ' is said to join $A$ and $B$. We consider only links through directions.


Consider a network as a triangular grid having nodes 0,1 , 2. Nodes could be taken within this grid. We consider only one node taken inside this grid. This single node can be either of 0,1 or 2 . In this paper we consider a single node within the grid. Considering a node within the grid, then the edged would be in order $0-1,1-2,2-0$. We consider ' 0 ' as a single node taken inside the grid, the direction 0 to 1 is taken as traffic in and 1 to o as out traffic. Similar aspects could be thought with regards to the other two namely 1 and 2 . Edges with similar nodes are taken as ignored links.

If ' $n$ ' is the number of nodes taken on the side of triangular grid having end nodes 0 and 1 , the number networks having 010 is $2 \mathrm{n}+1$, the number of nodes having nodes 01010 is ' n ' and the number having nodes 0101010 is ( $\mathrm{n}-1$ ).

The maximum of 3 would exits as combination of 01 , as we consider a triangular grid. Considering 010, 01010, 0101010 we would have a graph of $\mathrm{P}_{2}, \mathrm{P}_{4}$, and $\mathrm{P}_{6}$ where $\mathrm{P}_{\mathrm{K}}$ refers to directions in the graph $K$ being even. Finite Automaton is obtained for each of the graphs of 010, 01010, and 0101010. The finite automaton associated with a directed graph is called a transition graph. The vertices of the graph correspond to the states.

## C. Nomenclature

$\mathrm{q}_{\mathrm{i}}$ State
$\alpha$ - Number of directions towards the starting node of a path C-Total number of networks
S- Number of directions towards the ending. Node of a path $\bar{p}$ - Efficiency

## D. Note

1) Efficiency the ratio of the number of directions, towards the starting node with respect to the different between the total number of the networks of networks and number of directions, towards the ending node of the path.
2) Self loops are considered as ignored only in graphical representation self looping is considered in state diagrams.
II. Generation and Efficiency of 010 Network


The automation for the above graph has the starts $\mathrm{q}_{0}, \mathrm{q}_{1}$ as described below
A. State $-q_{0}$

$\mathrm{q}_{0}$ is the initial state infers the path 0 to $1 \&$ is in itself under 01
B. State $-q_{1}$

$\mathrm{q}_{1}$ is the state inferring 1 to 0 under the state $\mathrm{q}_{0}$. Thus $\mathrm{q}_{0}$ goes to $\mathrm{q}_{1}$ under 10

$$
\left.\begin{array}{c} 
\\
\mathrm{q}_{0} \\
\mathrm{q}_{1}
\end{array} \begin{array}{cc}
01 & 10 \\
\mathrm{q}_{0} & \mathrm{q}_{1} \\
--- & \mathrm{q}_{1}
\end{array}\right)
$$

$\mathrm{q}_{0}$ goes to itself under $01 \& \mathrm{q}_{1}$ is in itself under 10


K 1 represents the node $1 \& \mathrm{~K} 2$ represents the node 0
C. Characterization of the path K2 to K1
$\mathrm{C}=2$
$\alpha \rightarrow \mathrm{K} 2=1$
$\mathrm{S} \rightarrow \mathrm{K} 1=1$
$\bar{p}=1$
III. GEnERATION AND EfFiciency of 01010


K1 represents 1; K2 represents 0; K3 represents 1 the above graph represents 0 to $1 ; 1$ to $0 \& 0$ to $1 \& 1$ to 0 thus giving the networks 01010. The automation for the above graph has the states $\mathrm{q}_{0}, \mathrm{q}_{1}, \mathrm{q}_{2}$, and $\mathrm{q}_{3}$.
A. State $-q_{0}$

$\mathrm{q}_{0}$ is the initial state infers the path 0 to 1 and is in itself under 01 .
B. State $-q_{1}$

$\mathrm{q}_{1}$ is the state inferring 1 to 0 under the state $\mathrm{q}_{0}$. Thus $\mathrm{q}_{0}$ goes to $\mathrm{q}_{1}$ under $10, \mathrm{q}_{1}$ remains in itself under 10 .
C. State- $q_{2}$

$\mathrm{q}_{2}$ is a state inferring 0 to 1 under the state $\mathrm{q}_{1}$, thus $\mathrm{q}_{1}$ goes to $\mathrm{q}_{2}$ under $01, \mathrm{q}_{2}$ remains in itself under 10 .

## D. State $-q_{3}$

1

$\mathrm{q}_{3}$ is the state inferring 1 to 0 under the state $\mathrm{q}_{2}$, Thus $\mathrm{q}_{2}$ goes to $q_{3}$ under $10, q_{3}$ remains in itself under 10 .


The matrix of the states with regards to the path $01 \& 10$

$$
\begin{gathered}
q_{0} \\
q_{1} \\
q_{2} \\
q_{3}
\end{gathered}\left(\begin{array}{ll}
10 & 01 \\
q_{0} & q_{1} \\
q_{1} & q_{2} \\
q_{2} & q_{3} \\
q_{2} & q_{0}
\end{array}\right)
$$

Efficiency of the network 01010

## $\mathrm{C}=4$

E. Characterization of the path $K 1$ to $K 2$
$\mathrm{C}=4$
$\alpha \rightarrow \mathrm{K} 1=2$
$\mathrm{S} \rightarrow \mathrm{K} 2=2$
$\bar{p}=1$
F. Characterization of the path $K 2$ to $K 3$
$\mathrm{C}=4$
$\alpha \rightarrow K 2=2$
$\mathrm{S} \rightarrow \mathrm{K} 3=2$
$\bar{p}=1$
G. Characterization of the path K2to K1
$\mathrm{C}=4$
$\alpha \rightarrow \mathrm{K} 2=2$
$\mathrm{S} \rightarrow \mathrm{K} 1=2$
$\bar{p}=1$
H. Characterization of the path K3to K1
$\mathrm{C}=4$
$\alpha \rightarrow \mathrm{K} 3=2$
$\mathrm{S} \rightarrow \mathrm{K} 1=2$
$\bar{p}=1$

IV. Generation and Efficiency of 0101010 Network

K1 Represents 1; K2 represents 0; K3 Represents 1; K4 Represents 1.The automation for the above graph has the states $\mathrm{q}_{0}, \mathrm{q}_{1}, \mathrm{q}_{2}, \mathrm{q}_{3}$, and $\mathrm{q}_{4}$.
A. State $-q_{0}$

$\mathrm{q}_{0}$ is the initial state infers the path 0 to $\mathrm{q}_{0}$ is in itself under 01.

$\mathrm{q}_{1}$ is the state inferring 1 to 0 under the state $\mathrm{q}_{0}$. Thus $\mathrm{q}_{0}$ goes to $\mathrm{q}_{1}$ under $10, \mathrm{q}_{1}$ remains in itself under 10 .
C. State- $q_{2}$

$\mathrm{q}_{2}$ is a state inferring 0 to 1 under the state $\mathrm{q}_{1}$, thus $\mathrm{q}_{1}$ goes to $\mathrm{q}_{2}$ under $01, \mathrm{q}_{2}$ remains in itself under 10 .
D. State $-q_{3}$


1
$\mathrm{q}_{3}$ is the state inferring 1 to 0 under the state $\mathrm{q}_{2}$, Thus $\mathrm{q}_{2}$ goes to $\mathrm{q}_{3}$ under $10, \mathrm{q}_{3}$ remains in itself under 10 .
E. State- $q_{4}$

$\mathrm{q}_{4}$ is a state inferring 0 to 1 under the state $\mathrm{q}_{3}$, thus $\mathrm{q}_{3}$ goes to $\mathrm{q}_{4}$ under $01, \mathrm{q}_{4}$ remains in itself under 10 .
F. State $-q_{5}$

1

$\mathrm{q}_{5}$ is a state inferring 0 to 1 under the state $\mathrm{q}_{4}$, thus $\mathrm{q}_{4}$ goes to $\mathrm{q}_{5}$ under $01 . \mathrm{q}_{5}$ remains in itself under 10 .

The matrixes of the states are as fallows


$$
\begin{gathered}
q_{0} \\
q_{1} \\
q_{2} \\
q_{3} \\
q_{4} \\
q_{5}
\end{gathered}\left(\begin{array}{ll}
01 & 10 \\
q_{0} & q_{1} \\
q_{1} & q_{2} \\
q_{3} & q_{3} \\
q_{4} & q_{5} \\
q_{5} & q_{0}
\end{array}\right)
$$

Efficiency of the network 0101010
G. Characterization of K1 to K2

K2 to K1
K3 to K2
K2 to K3
K2 to K4
K4 to K2

## $\mathrm{C}=6$ <br> $\alpha \rightarrow \mathrm{K} 1=3$ <br> $\alpha \rightarrow \mathrm{K} 2=3$ <br> $\alpha \rightarrow \mathrm{K} 3=3$ <br> $\alpha \rightarrow K 4=3$ <br> $\mathrm{S} \rightarrow \mathrm{K} 1=3$ <br> $S \rightarrow K 2=3$ <br> $S \rightarrow K 3=3$ <br> $S \rightarrow K 4=3$

## H. Characterization of K1 to K2

K2 to K1
K3 to K2
K2 to K3
K2 to K4
K4 to K2
In the of the above case we obtain $\bar{p}=1$
I. Result

We observe from the automation of the graphs $010 ; 01010$; 0101010 the state $q_{i} ; i=1,2,3,4$ goes to $q_{i}+1$

In the Graphical representation we observe


In general $\mathrm{K}_{\mathrm{i}} \rightarrow \mathrm{K}_{\mathrm{i}+1}$ under the path 01

## V. CONCLUSION

We observe that in the graphical representation of the graphs 010; 01010; 0101010; we observe in the characterization of the path $\mathrm{K}_{1}$ to $\mathrm{K}_{2} \& \mathrm{~K}_{2}$ to $\mathrm{K}_{1}$ efficiency is 1.In the graphical representation of $01010 \& 0101010$ we observe the characterization of the path $\mathrm{K}_{2}$ to $\mathrm{K}_{3} \& \mathrm{~K}_{3}$ to $\mathrm{K}_{2}$ the efficiency is 1.Both the networks are of the source and destination groom able light paths, Wherein the termination is at the node $0 \&$ could be routed towards other nodes, \& can also originate from other nodes. When we consider efficiency we observe that destination is at the node $0 \& 1$ according to the consideration of the path automata is applied to paths of a network there by giving ideas for better groom ability

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