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A PROGNOSIS ON THE SEARCH ENGINE QUERY PRACTISING BACK PROPAGATION ALGORITHM

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ABSTRACT

The World Wide Web is a staggeringly rich knowledge base with more than two billion pages contrived by millions of web page writers and organizations. The cognition comes out not only from the content of the pages themselves, but also from the unique endowments of the web, such as hyperlink structure and its diversity of content and languages. The visitor is dependent on the search engine to retrieve the particular information and therefore the search engines act as a prediction system to predict the next query entered by the user. Neural network, one of the web mining techniques is used for this purpose. In this manuscript, a peculiar approach is highlighted to make the search engine work as a prediction system using the concept of back propagation algorithm.

1. INTRODUCTION

The size of the web and its unstructured content as well as the multilingual nature, make the extraction of useful knowledge a challenging research problem.Machine learning techniques represent one accessible approach to address this problem Lakhs of visitors use Internet via search engine. The visitor inputs the query into the search engine to find the relevant information. The queries may be distinct depending upon the needs of the user. Fig 1.1shows the categorization of the search queries.

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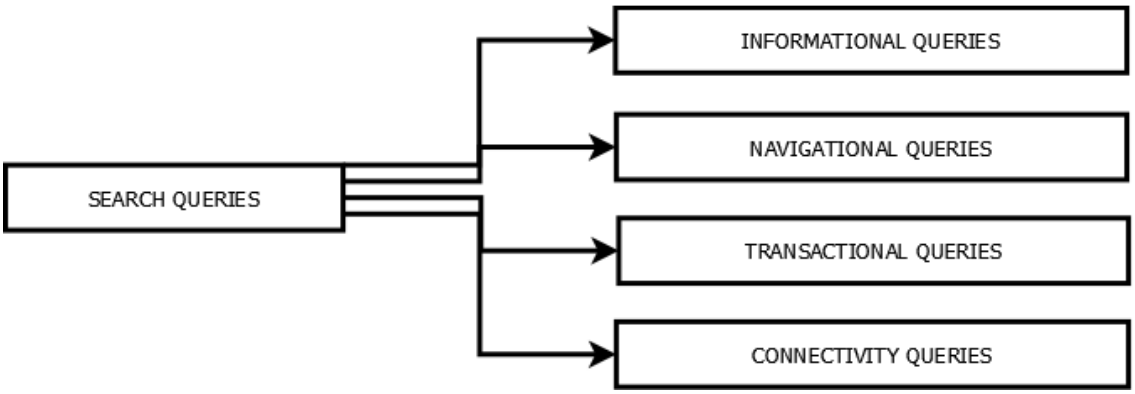

Fig 1.1 Types of Search Queries

- Informational Queries: these queries are generally used and cover a wide topic and give thousands of relevant answers.
- Navigational Queries: these queries are in the form of a single website.
- Transactional Queries: these queries are referred to a particular action, like shopping or downloading a screen saver.
- Connectivity Queries: these queries are based on the connectivity of the indexed web graph.

The act of search engine is confined to the problem of "Information Overkill". Thus there is string requirement to develop a procedure to predict the next query. Machine learning techniques represent one possible approach to address this problem. The next section highlights the concept of back propagation neural network, one of the machine learning technique.

The neural networks offer the ability to predict market directions more precisely than current techniques with their ability to discover patterns in non-linear systems. Traditional statistical approaches require considerable training data to estimate the probabilities of word sequences, and many parameters to memorize the probabilities. In this manuscript, a novel approach is used which uses a term PMI, Point wise mutual information, is used to make the prediction system

2. PROPOSED WORK

This manuscript presents a peculiar approach to predict the expected query on the search engine using neural network. This proposed system helps us to generate the forthcoming query. The proposed prediction system follows these steps:

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Step 1: Select the Domain Name

The following four domains have been selected for the proposed prediction system:

1. Entertainment
2. Education
3. Travel
4. Sports

Step 2: Queries asked by the user for each selected domain

A survey has been conducted among the Facebook users. They have been asked for their favourite queries or area of interest in each particular domain.

- **Entertainment**
  - Reading Books
  - Playing Games
  - Shopping Clothes
  - Reading newspaper
  - Reading Novels
  - Watching Cartoons
  - Watching WWE
  - Listening Music
  - Watching Movies
  - Watching Television
  - Joining Clubs
  - Classical Dancing
  - Bollywood Gossips
  - Paging Facebook
  - Playing Guitar
- **Education**
  - Mass Communication
  - Business Management
  - Open Learning
  - Bachelors of Technology
  - Physical Education
  - Learning Computers
  - Network Engineering

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  - Physics Facts
  - Maths Facts
  - Programming Language
  - Medical Science
  - Masters of Technology
  - Chartered Accountant
  - Doctor of Philosophy
  - Electronics Engineering
- **Travel**
  - Long Journey
  - Travel by Bus
  - Trips on Bike
  - Hill Stations
  - Ancient Places
  - Religious Places
  - Travel to US
  - Travel to Italy
  - Flights to UK
  - Travel to Iraq
  - Tour to Shimla
  - Travel to Ladakh
  - Travel by Train
  - Flights to London
  - Hotels in Mumbai
- **Sports**
  - Martial Arts
  - Badminton Games
  - Indian Cricket
  - Board Games
  - Cricket Stadium
  - Soccer Games
  - Tennis Stadium
  - Sports in India
  - Table Tennis
  - Dangerous Games
  - Racing Cars
  - Football Match

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- Common Wealth Games
- Long Jumps
- Olympic Games

Step 3: Training the neural network

Training and testing the artificial neural network for user queries based on frequency and PMI (Point Wise mutual Information) value. Finally 15 queries from all the domains have been selected for testing and training the neural network. The queries now have been triggered at Google search browser and frequency of these queries has been kept in the database for further processing. All the queries are further broken into the individual keywords and the frequency of individual keywords count has also been taken in account. The PMI (Point Wise mutual Information) of each query has been calculated, which basically defines the maximum probability of the event. In the neural network each queries identified by their PMI value.

In the neural network the PMI values are taken as inputs among twenty five queries. Twenty queries have been used for training the neural network and rest of all queries has been taken as testing inputs to test the efficiency of the neural network. Due to the usage of back propagation algorithm (supervised learning algorithm) the target values has been required. The target values have been tagged as 0,1,2,3 on the basis of PMI values of training dataset (maximum the PMI value tagged). Once the neural network has been trained by the given training data, it can be used further for mining the large data sets.

Step 4: Prediction of next query

This last step shows oncoming query for next user. This proposed model has prediction factor which is easier to search to next query for the user.

The crawler maintains a list of unvisited URLs called the frontier. The list is initialized with seed URLs which may be provided by a user or another program. Crawler crawls all web pages stored in the repository. Indexer indexes all the keywords stored in the local repository.

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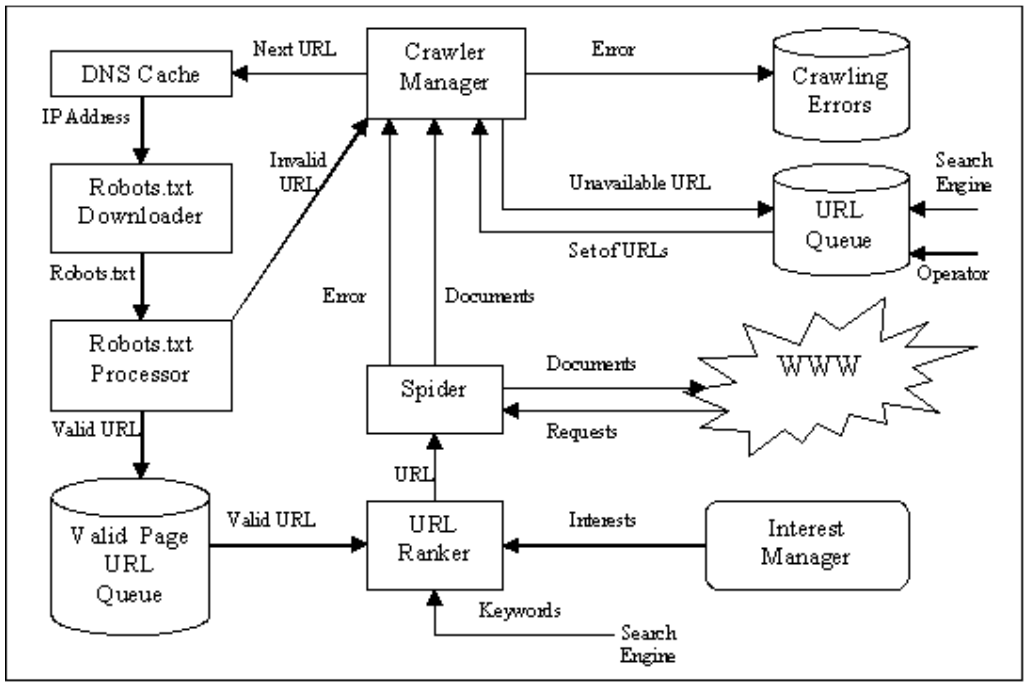

Fig 2.1 working of crawler

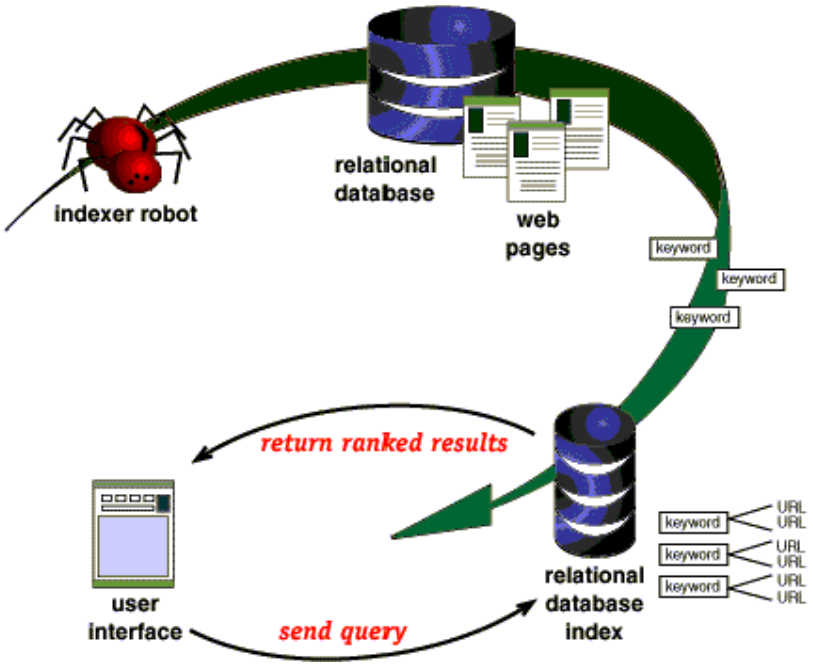

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Fig 2.2 sending query

The user sends a query through user interface and query processor processes the query and identifies the domain name. Find the PMI value of each query. The neural network is the tool which learns using some rules and conditions invented by incoming queries and work for oncoming queries. In the present work neural network is being used for prediction of the oncoming data on the bases of incoming queries.

3. CALCULATION OF PMIs FOR PROPOSED NEURAL NETWORK

Neural Network Model Specifications

Number of inputs = 10X4 = 40

Number of neurons in Input Layer = 4

Number of neurons in Hidden Layer = 5

Number of neurons in Output Layer = 1

Biases Used

At input layers = 4

At hidden layers = 5

At output layer = 1

Activation functions used

For input layer = piece-wised linear

For hidden layer = sigmoid

For output layer = sigmoid

Error criteria used = mean square error

Target accuracy = 0.00000015

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Extract all the queries (that are mentioned in step 2 of the proposed architecture) into keywords and count the frequency of individual keywords. The calculation of PMI (Point wise mutual information) for each query is shown in the below tables.

Table 3.1 Hit-Ratio and PMI for Entertainment Query

S.No.	Main Query	Hit Ratio (p+q)	Sub-query1	Hit Ratio (p)	Sub-query2	Hit Ratio (q)	PMI (p+q)/(p*q)
1.	Reading Books	$145X10^{7}$	Reading	$39.4X10^{7}$	Books	$69.3X10^{7}$	$5.31X10^{-9}$
2.	Playing Games	$116X10^{7}$	Playing	$35.7\ X10^{7}$	Games	$120\ X10^{7}$	$2.70\ X10^{-9}$
3.	Shopping Clothes	$43.1X10^{7}$	Shopping	$77.3\ X10^{7}$	Clothes	$71.9\ X10^{7}$	$0.77\ X10^{-9}$
4.	Reading Newspaper	$53.3X10^{7}$	Reading	$39.4\ X10^{7}$	Newspaper	$51.1\ X10^{7}$	$2.64\ X10^{-9}$
5.	Reading Novels	$46.1X10^{7}$	Reading	$39.4\ X10^{7}$	Novels	$8.13\ X10^{7}$	$14.39\ X10^{-9}$
6.	Watching Cartoons	$7.6X10^{7}$	Watching	$44\ X10^{7}$	Cartoons	$23.2\ X10^{7}$	$0.74\ X10^{-9}$
7.	Watching WWE	$3.75X10^{7}$	Watching	$44\ X10^{7}$	WWE	$4.87\ X10^{7}$	$1.75\ X10^{-9}$
8.	Listening Music	$48.7X10^{7}$	Listening	$11.3\ X10^{7}$	Music	$830\ X10^{7}$	$0.519\ X10^{-9}$
9.	Watching Movies	$52.4X10^{7}$	Watching	$44\ X10^{7}$	Movies	$313\ X10^{7}$	$0.38\ X10^{-9}$
10.	Watching Television	$32.9X10^{7}$	Watching	$44\ X10^{7}$	Television	$26.3\ X10^{7}$	$2.84\ X10^{-9}$
11.	Joining Clubs	$2.18X10^{7}$	Joining	$18.1\ X10^{7}$	Clubs	$90.1\ X10^{7}$	$0.133\ X10^{-9}$
12.	Classical Dancing	$26.9X10^{7}$	Classical	$25.2\ X10^{7}$	Dancing	$38.7\ X10^{7}$	$2.75\ X10^{-9}$
13.	Bollywood Gossips	$0.25X10^{7}$	Bollywood	$41.7\ X10^{7}$	Gossips	$0.62\ X10^{7}$	$0.96\ X10^{-9}$
14.	Paging Facebook	$0.79X10^{7}$	Paging	$3.95\ X10^{7}$	Facebook	$366\ X10^{7}$	$0.05\ X10^{-9}$
15.	Playing Guitar	$162X10^{7}$	Playing	$35.7\ X10^{7}$	Guitar	$41.9\ X10^{7}$	$10.83\ X10^{-9}$

Table 3.2 Hit-Ratio and PMI for Education query

S.No.	Main Query	Hit Ratio (p+q)	Sub-query1	Hit Ratio (p)	Sub-query2	Hit Ratio (q)	PMI (p+q)/(p*q)
1.	Mass Communication	$7.8X10^{7}$	Mass	$78.2X10^{7}$	Communication	$25.5X10^{7}$	$0.39\ X10^{-9}$
2.	Business Management	$157X10^{7}$	Business	$767X10^{7}$	Management	$278X10^{7}$	$0.073X10^{-9}$
3.	Open Learning	$108X10^{7}$	Open	$109X10^{7}$	Learning	$78.2X10^{7}$	$1.26\ X10^{-9}$
4.	Bachelors of	$7.76X10^{7}$	Bachelors	$15.4X10^{7}$	Technology	$71.3X10^{7}$	$0.70\ X10^{-9}$

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	Technology						
5.	Physical Education	$32.3X10^7$	Physical	$50.3X10^7$	Education	$257X10^7$	$0.24\ X10^{-9}$
6.	Learning Computers	$39.3X10^7$	Learning	$28.3X10^7$	Computers	$27X10^7$	$5.14\ X10^{-9}$
7.	Network Engineering	$32.5X10^7$	Network	$290X10^7$	Engineering	$27.4X10^7$	$0.40\ X10^{-9}$
8.	Physics Facts	$3.39X10^7$	Physics	$19.2X10^7$	Facts	$46.5X10^7$	$0.37\ X10^{-9}$
9.	Maths Facts	$1.18X10^7$	Maths	$1.97X10^7$	Facts	$46.5X10^7$	$1.28\ X10^{-9}$
10.	Programming Language	$3.91X10^7$	Programming	$48.5X10^7$	Language	$16.3X10^7$	$0.49\ X10^{-9}$
11.	Medical Science	$99.4X10^7$	Medical	$181X10^7$	Science	$197X10^7$	$0.27\ X10^{-9}$
12.	Masters of Technology	$17.6X10^7$	Masters	$27.4X10^7$	Technology	$69.2X10^7$	$0.928X10^{-9}$
13.	Chartered Accountant	$1.38X10^7$	Chartered	$7.79X10^7$	Accountant	$14.5X10^7$	$1.22\ X10^{-9}$
14.	Doctor of Philosophy	$2.91X10^7$	Doctor	$55.8X10^7$	Philosophy	$18.5X10^7$	$0.28\ X10^{-9}$
15.	Electronic Engineering	$14.9X10^7$	Electronic	$92.1X10^7$	Engineering	$27.4X10^7$	$0.59\ X10^{-9}$

Table 3.3 Hit-Ratio and PMI for Travel Query

S.No.	Main Query	Hit Ratio (p+q)	Sub-query1	Hit Ratio (p)	Sub-query2	Hit Ratio (q)	PMI (p+q)/(p*q)
1.	Long Journey	$45.8\ X10^7$	Long	$500\ X10^7$	Journey	$12.6\ X10^7$	$0.72\ X10^{-9}$
2.	Travel by Bus	$85.9\ X10^7$	Travel	$330\ X10^7$	Bus	$120\ X10^7$	$0.21\ X10^{-9}$
3.	Trips on Bike	$3.03\ X10^7$	Trips	$27\ X10^7$	Bike	$44.4\ X10^7$	$0.25\ X10^{-9}$
4.	Hill Station	$34.8\ X10^7$	Hill	$150\ X10^7$	Station	$146\ X10^7$	$0.15\ X10^{-9}$
5.	Ancient Places	$18\ X10^7$	Ancient	$8.42\ X10^7$	Places	$194\ X10^7$	$1.10\ X10^{-9}$
6.	Religious Places	$12\ X10^7$	Religious	$48.2\ X10^7$	Places	$194\ X10^7$	$0.12\ X10^{-9}$
7.	Travel to US	$650\ X10^7$	Travel	$330\ X10^7$	US	$395\ X10^7$	$0.49\ X10^{-9}$
8.	Travel to Italy	$104\ X10^7$	Travel	$330\ X10^7$	Italy	$147\ X10^7$	$0.21\ X10^{-9}$
9.	Flights to UK	$13.2\ X10^7$	Flights	$49.6\ X10^7$	UK	$531\ X10^7$	$0.05\ X10^{-9}$
10.	Travel to Iraq	$39\ X10^7$	Travel	$330\ X10^7$	Iraq	$49.8\ X10^7$	$0.23\ X10^{-9}$
11.	Tour to Shimla	$0.49\ X10^7$	Tour	$205\ X10^7$	Shimla	$2.52\ X10^7$	$0.094\ X10^{-9}$
12.	Travel to Ladakh	$0.48\ X10^7$	Travel	$330\ X10^7$	Ladakh	$1.16\ X10^7$	$0.12\ X10^{-9}$
13.	Travel by Train	$104\ X10^7$	Travel	$330\ X10^7$	Train	$98\ X10^7$	$0.32\ X10^{-9}$
14.	Flights to London	$11.7\ X10^7$	Flights	$49.6\ X10^7$	London	$39.2\ X10^7$	$0.60\ X10^{-9}$
15.	Hotels in Mumbai	$9.82\ X10^7$	Hotels	$167\ X10^7$	Mumbai	$38.2\ X10^7$	$0.15\ X10^{-9}$

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Table 3.4 Hit-Ratio and PMI for Sports Query

S.No.	Main Query	Hit Ratio (p+q)	Sub-query1	Hit Ratio (p)	Sub-query2	Hit Ratio (q)	PMI (p+q)/(p*q)
1.	Martial Arts	$9.96 X10^{7}$	Martial	$10.3 X10^{7}$	Arts	$164 X10^{7}$	$0.58 X10^{-9}$
2.	Badminton Games	$6.28 X10^{7}$	Badminton	$9.94 X10^{7}$	Games	$441 X10^{7}$	$0.14 X10^{-9}$
3.	Indian Cricket	$21.1 X10^{7}$	Indian	$141 X10^{7}$	Cricket	$32.2 X10^{7}$	$0.46 X10^{-9}$
4.	Board Games	$69.9 X10^{7}$	Board	$211 X10^{7}$	Games	$441 X10^{7}$	$0.07 X10^{-9}$
5.	Cricket Stadium	$6.93 X10^{7}$	Cricket	$32.2 X10^{7}$	Stadium	$19.5 X10^{7}$	$1.10 X10^{-9}$
6.	Soccer Games	$69.6 X10^{7}$	Soccer	$69.2 X10^{7}$	Games	$441 X10^{7}$	$0.22 X10^{-9}$
7.	Tennis Stadium	$13.1 X10^{7}$	Tennis	$65.9 X10^{7}$	Stadium	$19.5 X10^{7}$	$1.01 X10^{-9}$
8.	Sports in India	$136 X10^{7}$	Sports	$118 X10^{7}$	India	$265 X10^{7}$	$0.43 X10^{-9}$
9.	Table Tennis	$13.2 X10^{7}$	Table	$44.7 X10^{7}$	Tennis	$65.9 X10^{7}$	$0.44 X10^{-9}$
10.	Dangerous Games	$25.5 X10^{7}$	Dangerous	$38.3 X10^{7}$	Games	$441 X10^{7}$	$0.14 X10^{-9}$
11.	Racing Cars	$30.7 X10^{7}$	Racing	$49.9 X10^{7}$	Cars	$197 X10^{7}$	$0.31 X10^{-9}$
12.	Football Match	$46.8 X10^{7}$	Football	$133 X10^{7}$	Match	$105 X10^{7}$	$0.33 X10^{-9}$
13.	Common Wealth Games	$0.331X10^{7}$	Common Wealth	$31.5 X10^{7}$	Games	$441 X10^{7}$	$0.002 X10^{-9}$
14.	Long Jump	$109 X10^{7}$	Long	$500 X10^{7}$	Jump	$9.6 X10^{7}$	$2.27 X10^{-9}$
15.	Olympic Games	$33.6 X10^{7}$	Olympic	$28.9 X10^{7}$	Games	$441 X10^{7}$	$0.26 X10^{-9}$

The extracted frequency of the data has been classified and necessary moderation has been carried out. The point wise mutual information-PMI-has been calculated from the moderated data (table 3.1, 3.2, 3.3, 3.4). The obtained PMI for all the eighty queries have been applied to the neural network model. The model is trained to the following specifications:

Maximum number of iterations = 5000

Maximum allowed mean square error = 0.0150

Number of training inputs = 10

Number of testing inputs = 5

The input matrix given to the model: 10 inputs for 4 commodities

Column 1 through 5 (training)

[Ent]	$5.31X10^{-9}$	$2.70X10^{-9}$	$0.77 X10^{-9}$	$2.64 X10^{-9}$	$14.3X10^{-9}$
[Edu]	$0.39 X10^{-9}$	$0.073 X10^{-9}$	$1.26 X10^{-9}$	$0.70 X10^{-9}$	$0.24 X10^{-9}$
[Trv]	$0.72 X10^{-9}$	$0.21 X10^{-9}$	$0.25 X10^{-9}$	$0.15 X10^{-9}$	$1.10X10^{-9}$

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[Spt]	0.58 $X10^{-9}$	0.14 $X10^{-9}$	0.46 $X10^{-9}$	0.07 $X10^{-9}$	1.10 $X10^{-9}$

Column 6 through 10 (training)

[Ent]	0.74 $X10^{-9}$	1.75 $X10^{-9}$	0.52$X10^{-9}$	0.38 $X10^{-9}$	2.9$X10^{-9}$
[Edu]	5.14 $X10^{-9}$	0.40 $X10^{-9}$	0.37 $X10^{-9}$	1.28 $X10^{-9}$	0.49 $X10^{-9}$
[Trv]	0.12 $X10^{-9}$	0.49 $X10^{-9}$	0.21 $X10^{-9}$	0.05 $X10^{-9}$	0.23 $X10^{-9}$
[Spt]	0.22 $X10^{-9}$	1.01 $X10^{-9}$	0.43 $X10^{-9}$	0.44 $X10^{-9}$	0.14 $X10^{-9}$

Column 11 through 15 (testing)

[Ent]	0.13$X10^{-9}$	2.75$X10^{-9}$	0.96$X10^{-9}$	0.05$X10^{-9}$	10.83 $X10^{-9}$
[Edu]	0.27 $X10^{-9}$	0.93 $X10^{-9}$	1.22 $X10^{-9}$	0.28 $X10^{-9}$	0.59 $X10^{-9}$
[Trv]	0.094 $X10^{-9}$	0.12 $X10^{-9}$	0.32 $X10^{-9}$	0.60 $X10^{-9}$	0.15 $X10^{-9}$
[Spt]	0.31 $X10^{-9}$	0.33 $X10^{-9}$	0.002 $X10^{-9}$	2.27 $X10^{-9}$	0.26 $X10^{-9}$

Here

[Ent] = Entertainment

[Edu] = Education

[Trv] = Travel

[Spt] = Sports

The target matrix given to the model:

T = [1 0 2 3 1 0 3 1 2 0]

Here,

0: Entertainment

1: Education

2: Travel

3: Sports

4. CONCLUSION

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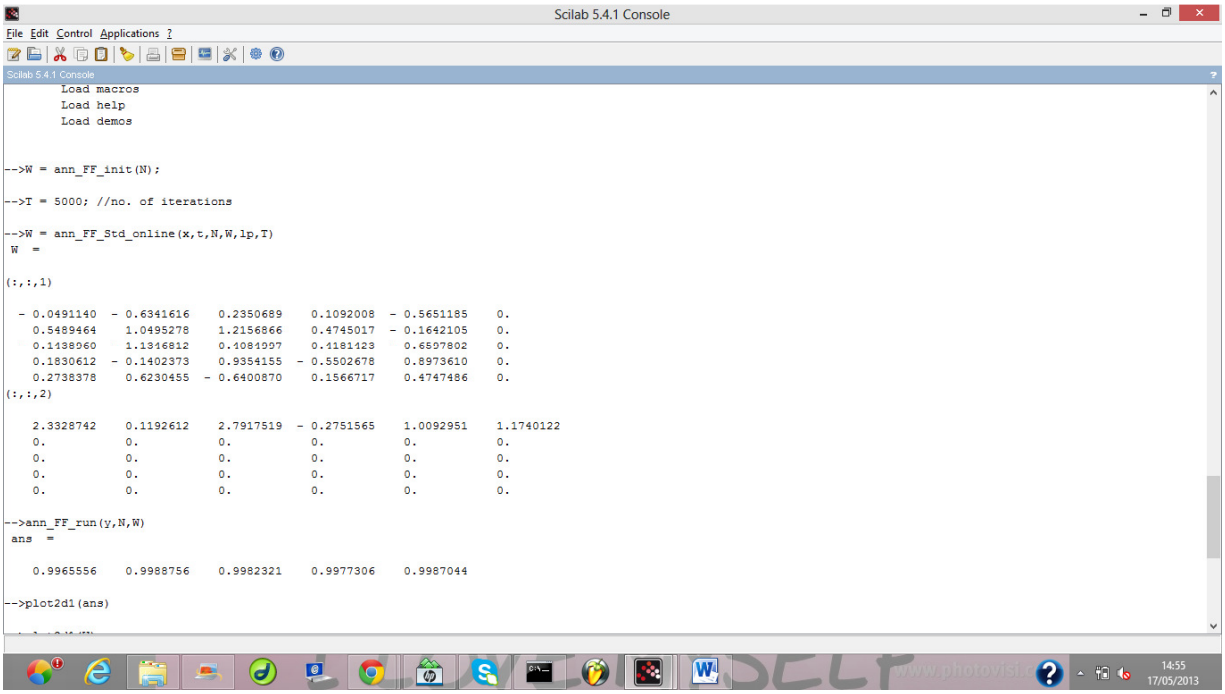
The weight matrix calculated:



The training matrix x:

[Ent]	5.31	2.7	0.77	2.64	14.39	0.74	1.75	0.519	0.38	2.84
[Edu]	0.39	0.073	1.26	0.7	0.24	5.14	0.4	0.37	1.28	0.49
[Trv]	0.72	0.21	0.25	0.15	1.1	0.12	0.49	0.21	0.05	0.23
[Spt]	0.58	0.14	0.46	0.07	1.1	0.22	1.01	0.43	0.44	0.14

The training curve obtained:

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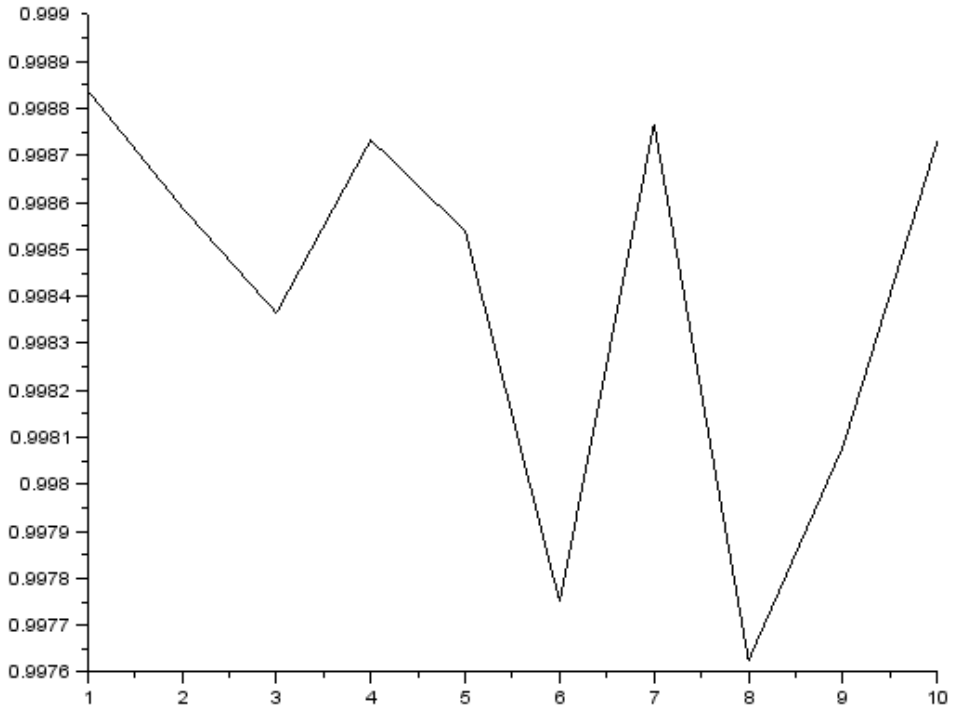

The testing matrix y:

[Ent]	0.133	2.75	0.96	0.05	10.83
[Edu]	0.27	0.928	1.22	0.28	0.59
[Trv]	0.094	0.12	0.32	0.6	0.15
[Spt]	0.31	0.33	0.002	2.27	0.26

The testing curve obtained:

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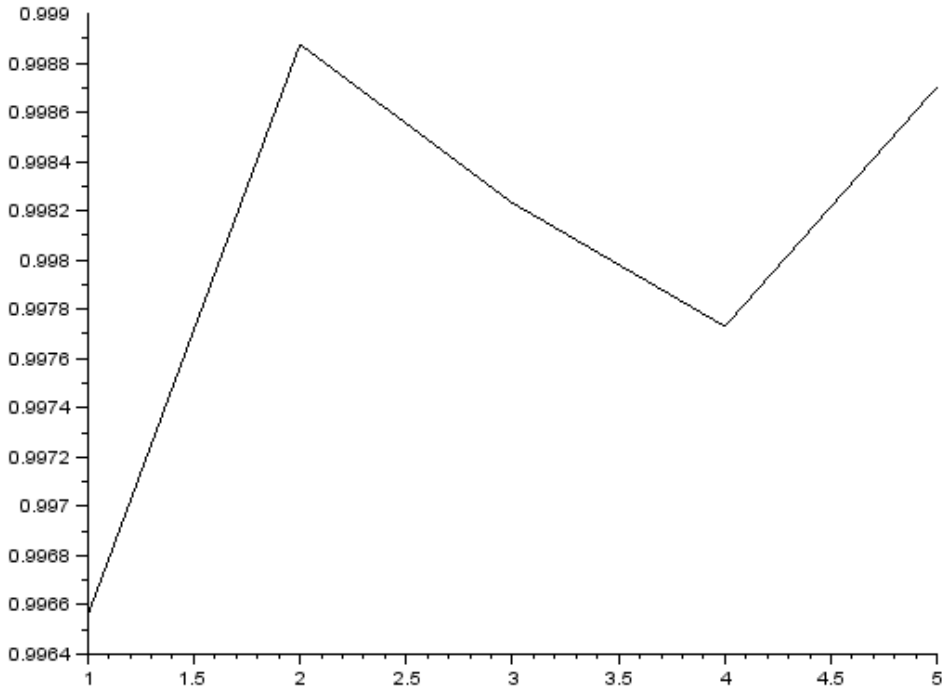

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