DATABASE ORIENTED MODEL FOR PRICE DISCRIMINATION

Prof. Fazal Rehman Shamil

University Of Shamil, Mianwali, Pakistan,
fazalrehmanshamil@gmail.com

ABSTRACT

There have been a lot of interest to sell the product at high prices. Price discrimination is mostly used by E-Commerce websites to offer the different prices of the same product to the different customers. Different techniques of price discrimination are available for web-based the application. Log file and cookies based price discrimination is more common among all. This paper introduces a new database oriented technique for price discrimination. Database oriented model is a model for price discrimination. In the proposed model, an intelligent database is maintained to offers the different prices of the same product to the different customers. This model supports 100% availability for tracking the end user or customer. Price discrimination is done every time a customer makes a transaction and buy the product. This feature makes this model more attractive as compared to other techniques.

KEYWORDS

Price discrimination; dynamic pricing; user discrimination; customer discrimination, browser fingerprinting, cookies, weblog

1. INTRODUCTION:

E-Commerce websites offer different prices to the different customers. Such kind of price discrimination can be achieved by different techniques as discussed in part 2 of the paper. Price discrimination allows a reliable and efficient allocation of prices to different customers of the product [5, 14]. Our paper focus is on price discrimination to set the high, normal and expansive prices for the product. Price discrimination results in low customer welfare for rich people, no welfare for common normal people and more welfare for budget conscious-customers [6]. There are different techniques available to implement the price discrimination on the internet. Weblog data, cookies and javascript browser fingerprinting is most common among all the techniques. The traditional techniques are not always working fine because in some cases if a customer disables the javascript and cookies than websites are failed to discriminate the price. There is no 100% surety in the previously introduced price discrimination techniques that they 100% work or not. By using cookies if customer disables the cookies and javascript then off course website fails to discriminates the price. The solution to this problem is "database oriented model for price discrimination" (DBOPD), that is database oriented price discrimination model for E-Commerce websites. The customer can't disable the tracking because the database is totally on the server side. Every time a customer makes a transaction, it will be counted for tracking the customer information .eg, customer name, customer email id, customer gender, customer city, customer country and customer interests. DBOPD is also very useful because it does not observe or store irrelevant information about the user. e.g, it does not observe the gender, city or country and such kind of irrelevant information. Only the needed details are tracked and stored e.g, it will track that how many times a customer buy the normal, expensive or cheap product. There are different techniques of price discrimination that becomes the base to get the idea of this database oriented price discrimination. These techniques are discussed in the related work discussed below.

2. RELATED WORK

2.1. Product tools based price discrimination

The paper [1] presents the price discrimination technique based on product information tool. Product information tool contains a different kind of information about the product including;

- Individual product reviews and summary of the product reviews.
- Complete specifications for the product.
- View of product from various angles.
- Total number of reviews about the product
- Rating of the product

These all attributes are used in price discrimination on the internet and also these all attributes are observed on ELCO's website.

2.2. Hardware and software based price discrimination

The paper [2] presents the price discrimination technique based on usage of hardware and software. It is observed that customer using expensive hardware and most expensive operating systems are the customers that are victims of price discrimination. Customer web browser details are measured through a javascript fingerprinting method that helps to tracks the information about customer [9].

2.3. Location based price discrimination

The paper [2,5] presents the price discrimination technique based on customer location. Due to the different economic standard of different countries, e-markets offers different rate to the customer of different countries. By detecting the IP address of the customer, E-commerce websites discriminate the price of the product. If we want to know that an E-Commerce website is discriminating the price to different customers of different countries, it can be detected by using the proxy server. One time using the IP address of one country, and other time by changing the IP address from one country to another country and can observe the price discrimination.

2.4. Personal information based price discrimination

The paper [2,5,12] presents the price discrimination technique based on personal information. Persons are categorized into two different categories.

- Affluent customer;
- Budget-conscious customer

If a customer visits the E-Commerce website and the customer is an affluent customer, then high prices are offered to the customer. If a customer visits the E-Commerce website and the customer is a budget conscious customer, then prices with a little concession are offered to the customer.

2.5. Analysis of weblog data

The paper [3,15,20] presents the price discrimination technique on the basis of collecting and observing the weblog data. Customer interest in a product can be achieved by keeping track of all visited web pages. All the web pages visited by an E-Commerce website are recorded in a weblog on the server. A weblog is a big source for getting the data about the customer interests.

Different log files are located in different places for observing the user;

- Client browsers;
- Web servers;
- Web proxy servers

Server side logs provide more accurate data about the visitor of the E-Commerce website. Personal and sensitive information is stored in server side logs[10].

Proxy side servers take the hypertext transfer protocol request from the user and pass them to the website server. After this web server is responsible to return the results to the user.

Client-side logs are maintained by cookies. The cookies are stored on the customer computer and stores all the information and activities of the customer. A special software is needed to install on the computer of the customer. The software is hidden from the customer and works in the background, when cookies stores the customer record, then the hidden software silently copy the data and sent to the E-Commerce website for price discrimination.

2.6. Observing site keyword graph

The paper [4] presents the price discrimination technique based on observing the customer ability and customer wish to pay for the product by maintaining the site keyword graph. Site keyword graph is a graph with the help of which we can count that how many times a customer searches a web page or a keyword. Site keyword graph gives a clear picture about that what the customer wants to visit on the website or what the customer wants to buy on the site.

2.7. Link-based search de-tracking

The paper [7] presents the link based techniques to get the user topic search locality and recommendation related to the prospective search. Product topic locality is a mechanism that is used to find the respective product when a customer tries to search the product. Product locality search generates the results showing the accurate product as searched by the customer. Within these accurate results, E-Commerce sites also recommend some links to open, and the recommended links produce the list of product with the high price [13].

2.8. Query-based search de-tracking

The paper [8] presents a technique to de-track the customer from getting the minimum price product to the high price product. Mostly customer wants to run the navigational query that leads the customer to the product that the customer wants to search. When customer run the navigational query to reach the exact product, results show some extra product with a high price in suggestions[11]. There are different techniques to detect the existence of price discrimination.

2.9. $herrif based price discrimination

The paper [5] presents the technique to find the existence of price discrimination through browser extension $herrif.

- $herrif can enable the user to highlight the price of the product on an e-retailer.
- When the price is highlighted, $herrif extension enables the user to check the variation of prices.
- When the button is clicked, exact URL is sent to different IP addresses.
- The user can observe if there is any variation in the price of the given product.

2.10. Cookies Based price discrimination

Cookies are mostly used by E-Commerce websites where behavior and activities of the user are detected by cookies. Mostly cookies stores on the client side, and after storing the information in cookies, information is leaked to the website [16,17,18, 19]. All techniques studied in section 2 are very common techniques used in E-Commerce websites. We are presenting DBOPD model with the help of a case study.

3. PROPOSED MODEL

We are introducing a database model that can categorize each customer in three different categories as shown in figure 1. Some of the variables used in price discrimination are represented in table 1.

Table 1. Purpose of main variables in price discrimination

Variable	Description	Purpose
ct	Customer token	To store the customer token as new or regular
te	Total expensive	Total transactions of expansive price products
in	Tonal normal	Total transactions of normal price products
to	Total cheap	Total transactions of cheap price products

Every time when a transaction takes place, customer information about his/her transaction is stored in the database.

3.1. Normal category

Normal category is a category that represents the product with normal prices that are most suitable for a common person.

3.2. Expensive category

This category represents the products with expensive prices that are most suitable for a rich person.

3.3. Cheap category

This category represents the products with cheap prices that are most suitable for a poor person.

3.4. Flow Chart

Let understand the DBOPD model with a flowchart;

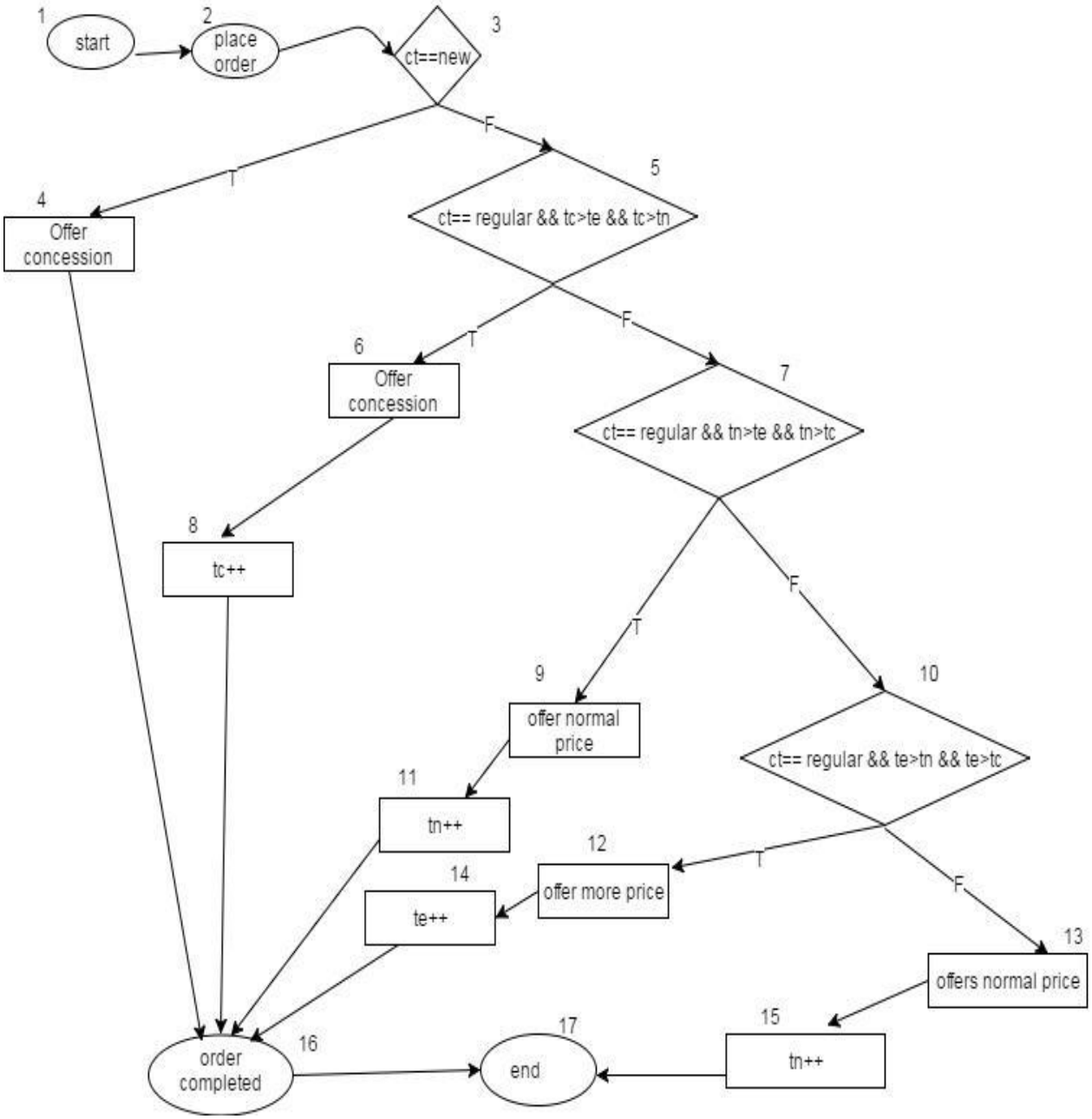

Figure 1: Flowchart of DBOPD model

Here figure 1 represents the flow of the model. First of all the customer start the activity to buy the product online as shown in notation 1. After that customer plays the order shown in notation 2. When a customer places the order, DBOPD checks the token of the customer that customer is new or regular customer shown in notation 3.

- If the condition is True on notation 3, the system offers a product with concession as represented in notation 4. Order completion is represented in notation 16 and activity end is represented in notation 17. If the condition is false in notation 3, then again customer token is checked. If customer token is a regular customer and a total number of cheap product transaction is less than normal or expansive. Offer concession to the customer. A total number of cheap transaction is incremented represented in notation 6 and 8. After that order is completed and activity end is represented in notation 16 and 17.
- If the condition is false on notation 3 and 5 and if the condition is true on notation 7 and customer token is a regular customer. Offers normal prices to the customer. A total number of normal products is incremented as represented in notation 9 and 11. After that order is completed and activity ends is represented in notation 16 and 17.
- If the condition is false on notation 3,5 and 7 and if the condition is true on notation 10 and customer token is a regular customer. Offers high prices to the customer. A total number of high price products is incremented as represented in notation 12 and 14. After that order is completed and activity end is represented in notation 16 and 17.
- If the condition is false on notation 3,5,7 and 10 and customer token is a regular customer. Offers normal prices to the customer. A total number of normal products is incremented as represented in notation 13 and 15. After that order is completed and activity end is represented in notation 15 and 17.

Now, let's have a descriptive look at the model. When any customer orders a product. The product is checked that product belongs to what category as discussed above as normal, expensive and cheap. A total number of normal, expensive and cheap are calculated automatically for each customer. If transactions done against normal price category are more than the transaction done in cheap or expensive, then prices with a normal price are offered to the person. Here normal price means the price nearly equal to the price in competitor market. If transactions done against cheap price category are more than the transaction done at a normal or expensive price, then prices with a cheap price are offered to the person. Here cheap price means the price with a concession of some percentage of the price. This is decided by business requirements that how much percentage of the normal price is reduced. If transactions done against expensive price category are more than the transaction done in normal or cheap, then prices with a more price are offered to the person. Here expensive price means the price with some extra price as compared to the market. This is decided by business requirements that how much percentage of the normal price can be exceeded. The customer is always categorized into 2 main tokens. Tokens are assigned on the basis of customer transactions. A customer with token new is a customer who purchases any product first time. A customer is considered regular customer if the customer is an old customer of the website. Price discrimination works for both kinds of customers. Less price is offered to the new customer. More, less or normal price is offered to the regular customer.

Customer having more cheapest transactions have standard value 3. Customer having more normal transactions have standard value 2. Customer having expansive transactions have standard value 1. We design a database and creates the three different tables.

3.5. Case study

Customer table that stores the information about the customer. Product table that stored the information about the product. Order table that stored the information about the orders. Customer and product tables have a relationship with order table. When an order takes place by the customer, then the database is evaluated to check that the product that is ordered is belonged to what category?

Table 2. Orders

Order id	Customer id	Product id	Price	Date	Time
0001	1	6	19900	01/01/2017	10:00 AM
0002	2	4	20,000	01/01/2017	10:03 AM
0003	3	2	51,000	02/01/2017	11:10 AM

Table 3. Customer

Customer id	Customer name	Expensive	Normal	Cheap	CustomerStandardID
1	Ali	1	2	10	3
2	Bilal	12	15	3	2
3	Zahid	25	17	10	1

Table4. Product

Product id	Product name	Price	Category
1	MobilePhone A	48,000	Expensive
2	MobilePhone B	50,000	Expensive
3	MobilePhone C	22,000	Normal
4	MobilePhone D	20,000	Normal
5	MobilePhone E	10,000	Cheap
6	MobilePhone F	2,000	Cheap

If a customer is NewCustomer or the customer is a regular customer and the Customer Standard is set to 2, then all the products are offered to the customer with NormalPrice. Now, there are three possibilities that customer can buy the cheap, normal or expensive product. If the customer buys a product with normal price, then the value of a normal attribute in the database is incremented. If the customer buys a product with cheap price, the value of a cheap attribute in the database is incremented. If the customer buys a product with expensive price, then the value of an expensive attribute in the database is incremented. If a customer is RegularCustomer and the Customer Standard is set to 1, then all the products are offered to the customer with LowPrice. Now, there are three possibilities that customer can buy the cheap, normal or expensive product. If the customer buys a product with normal price, then the value of a normal attribute in the database is incremented. If the customer buys a product with cheap price, then the value of a cheap attribute in the database is incremented. If the customer buys a product with expensive price, then the value of an expensive attribute in the database is incremented. If a customer is RegularCustomer and the Customer Standard is set to 3, then all the products are offered to the customer with HighPrice. Now, there are three possibilities that customer can buy the cheap, normal or expensive product. If the customer buys a product with normal price, the value of a normal attribute in the database is incremented. If the customer buys a product with cheap price, the value of a cheap attribute in the database is incremented. If the customer buys a product with expensive price, the value of an expensive attribute in the database is incremented.

Table 5: Comparison of DBOPD with cookies and weblog techniques of price discrimination

	Feature	DBOPD	Web Log	Cookies
1	**Client/Server Side**	Server side	Server side	Client side/Server sider(Sessions)
2	**Speed**	Less	Less	High
3	**Always work**	Yes	Yes	Customer can disable
4	**Source code visibility**	No	No	Yes
5	**Event Tracking**	Yes	No	Yes
6	**Time Consuming**	Less	More	Less
7	**Historical Data**	Less in density	More in Density	Very less in density
8	**Capture User Info**	Yes	Yes	Yes
9	**Browser Detection**	No	Yes	Yes
10	**Browser Specific**	No	No	Yes
11	**Store**	In database file	In Log text file	In text file

	information			
12	**Limit of store**	Unlimited	Unlimited	Limited
13	**Require Server resources**	More	More	Less
14	**Deletion of info**	The customer can't delete his info	The customer can't delete	Customer can delete
15	**Disable the info**	The customer can't disable to track the info	The customer can't disable	Customer can disable
16	**Browser storage restriction**	No restriction	No restriction	Restriction on total number of cookies
17	**Availability**	Customer is tracked every time. No way to escape	Customer is tracked every time. No way to escape	Can't track info if cookies are disabled by the customer

3.6. Advantages of DBOPD

- Price discrimination is always done when a customer makes transactions and discrimination can't be disabled by the customer just like the cookies that can be disabled by the customer. DBOPD is fully located and processed on the server side.
- Source code can't be viewed by the customer. It is totally hidden because the code is written in server-side languages like ASP or PHP. All source code written in these languages works and handle the price discrimination.
- All kind of events and transactions are tracked. DBOPD auto manages the prices according to transactions. Every time a user buys a product whether it is normal, cheap or expansive in price, it is counted to calculate the total number of product transactions.
- Less time consuming, because there is no need to separately define any mechanism to discriminate the price. There is only need to design the database according to DBOPD.
- Historical data is less in quantity and more beneficial because only customer-related data and customer transactional data is stored in the database that is used to discriminate the different users. The information that is irrelevant for price discrimination is never stored in the database. e.g, gender, city, address etc.
- It does not matter what browser or what hardware the customer is using. When a customer places an order, the customer transaction is observed and stored in the database. Mostly cookies are browser based but DBOPD don't care about the web browser. It works on all kind of operating systems, devices and on all kind of web browsers.
- Stores information in the database file. Cookies and weblog stores information in text files. Operations on database files are more efficient as compared to operations on text files.
- There are no storage restrictions, unlimited users can be tracked by a single database. When cookies are increased then new cookies replaced the old cookies but DBOPD can store unlimited behavior or transaction records because most websites have more or unlimited space.
- Model ensure 100% availability to track the record when any order takes place. It is no chance that a transaction is done by the user and DBOPD is unable to track the user transactional record. DBOPD works every time a transaction is taking place.

3.7. Limitations of the DBOPD

- After first-time web page loading when the second time web page is loaded, then it is slow through DBOPD but fasts through the cookies because cookies are stored on server side.
- It does not base on browser and hardware detection mechanism as cookies detect the browser and hardware to discriminate the prices. DBOPD is unable to track the operating system, hardware or web browser record.

4. CONCLUSIONS

Price discrimination is very common nowadays. Different techniques are helpful for E-Commerce websites to offer different prices of the same product to the different customers. Weblog data and cookies are used by Amazon and other E-Commerce websites like eBay. DBOPD is a model that auto manage the website and all customers are auto deals with different prices. A person who want to buy the higher class and expansive products are offered at more prices.

A person who wants to buy the economy class and cheapest products are offered at fewer prices. A person who want to buy the neutral class and normal products are offered at normal prices. This proposed technique is easy to manage and easy to implement as compared to other techniques, because only we need to design the database according to this model, and nothing else needed for price discrimination. Further user can't disable the tracking. It is 100% surety that user is tracked. This model contributes in a good way to promote the price discrimination.

5. REFERENCES

[1] Punit Ahluwalia. What is behind price dispersion in e-markets, Int. J. Services and Standards, Vol. 7, Nos. 3/4, 2011.

[2] Jakub Mikians, László Gyarmati, Vijay Erramilli, Nikolaos Laoutaris. Detecting price and search discrimination on the Internet, Proceedings of the 11th ACM Workshop on Hot Topics in Networks, Pages 79-84

[3] K.R. Suneetha, Dr. R. Karishnamoorthi, identifying user behavior by analyzing web server access log file, IJCSNS International Journal of Computer Science and Network Security, VOL.9 No.4, April 2009

[4] Tsuyoshi Murata and Kota Saito, Extracting Users' Interests from Web Log Data, Proceedings of the 2006 IEEE/WIC/ACM International Conference on Web Intelligence, pages 343-346

[5] Jakub Mikians, Laszlo Gyarmati, Vijay Erramilli, Nikolaos Laoutaris, Crowd assisted the search for price discrimination in E-Commerce: First results, Proceedings of the ninth ACM conference on Emerging networking experiments and technologies, pages 1-6

[6] David Liu, A model of optimal consumer search and price discrimination in the airline industry,(2012 15th June) Retrieved from http://economics.mit.edu/grad/davliu/research

[7] Nick Craswell, David Hawking, Stephen Robertson, Effective site finding using link anchor information, Proceedings of the 24th annual international ACM SIGIR conference on Research and development in information retrieval, pages 250-257

[8] Uichin Lee, Zhenyu Liu, Junghoo automatic identification of user goals in web search, 05 proceeding of the 14th international conference on world wide web, pages 391-400

[9] Keaton Mowery, Dillon Bogenreif, Scott Yilek, and Hovav Shachamy, fingerprinting information in JavaScript Implementations, Proceedings of W2SP, 2011

[10] V.Anitha, Dr.P.Isakki, A Survey on Predicting User Behavior Based onWeb Server Log Files in a Web Usage Mining s, Computing Technologies and Intelligent Data Engineering (ICCTIDE), 7-9 Jan. 2016

[11] Zhen Liao, Yang Song, Yalou Huang, Li-Wei He, Qi He, An Effective Segmentation of UserSearch Behavior, IEEE Transactions on Knowledge and Data Engineering, Pages: 3090 - 3102,

[12] Aniko Hannak, Gary Soeller, Measuring Price Discrimination and Steering E-commerce Web Sites, Proceedings of the 2014 Conference on Internet Measurement Conference, November 05 - 07, 2014

[13] Jakub Mikians, László Gyarmati, Vijay Erramilli, Nikolaos Laoutaris, Crowd-assisted Search for Price Discrimination in E-Commerce: First results, Proceedings of the ninth ACM conference on Emerging networking experiments and technologies

[14] Thierry Warin, Homogenous goods markets: an empirical study of price dispersion on the internet, Int. J. Economics and Business Research, Vol. 4, No. 5, 2012

[15] Shuqing Wang, Li She, Algorithm Research on User Interests Extracting via Web Log Data, International Conference on Web Information Systems and Mining, 2009

[16] Max I. Fomitchev, How google analytics and conventional cookie tracking techniques overestimate unique visitors, Proceedings of the 19th international conference on World wide web

[17] Hajime Hotta, Takashi Nozawa, Masafumi Hagiwara, A Design of Client Side Information Management Method for Web Services Collaboration, WI-IATW '07 Proceedings of 2007, IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology - Workshops

[18] Steven Englehardt, Dillon Reisman, Christian Eubank, Peter Zimmerman, Cookies That Give You Away: The Surveillance Implications of Web Tracking, Proceedings of the 24th International Conference on World Wide

[19] Aaron Cahn, Scott Alfeld, Paul Barford, S. Muthukrishnan, An Empirical Study of Web Cookies, Proceedings of the 25th International Conference on World Wide Web.

[20] Hongyan Liu, Jun he, Yingqin Gu, Hui Xiong, Detecting and Tracking Topics and Events from Web Search Logs, Proceedings of the 25th International Conference on World Wide Web, ACM Transactions on Information Systems, Volume 30 Issue 4, November 2012

AUTHORS

Fazal Rehman (Shamil) is working as a professor in "University Of Shamil, Pakistan". The research area of the author is software and web engineering.