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International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume – 5 Issue -04 April, 2016 Page No. 16162-16166

A Survey on Antidiscrimination using Direct and Indirect Methods in Data Mining

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ABSTRACT

Data mining is the study of data for relationships that have not previously been discovered. In sociology, discrimination is the hurtful treatment of an individual based on the group, class or category to which that person or things belongs rather than on individual merit: racial and religious intolerance and discrimination. Along with confidentiality, discrimination is a very essential issue when considering the legal and ethical aspects of data mining. It is more than obvious that most people do not want to be discriminated because of their race, gender, religion, nationality, age etc, especially when those attributes are used for making decisions about them like giving them a job, loan, education, insurance etc. Because of this reason, antidiscrimination techniques with discrimination discovery as well as discrimination prevention have been introduced in data mining. Discrimination can be either direct or indirect. Direct discrimination occurs when decisions are taken by considering sensitive attributes. Indirect discrimination occurs when decisions are taken on the basis of nonsensitive attributes which are strongly associated with biased sensitive ones. Here, discrimination prevention in data mining is tackle as well as propose new techniques applicable for direct or indirect discrimination prevention individually or both at the same time. Several decision-making tasks are there which let somebody use themselves to discrimination, such as education, life insurances, loan granting, and staff selection. In many applications, information systems are used for decision-making tasks.

Keywords

Data mining, direct and indirect discrimination prevention.

1. INTRODUCTION

In sociology, discrimination is the damaging treatment of an individual based on their membership in a certain category or class. It involves denying to members of one group opportunities that are available to other groups. Anti-discrimination also plays a significant role in cyber security where computational intelligence technologies may be used for different decision making scenarios i.e. data mining. Discrimination is nothing but unfairly treating people on the basis of a specific group to which they belonging, namely gender, race, ideology (beliefs), etc. By law, economics and social sciences, discrimination has been considered over the last decades and antidiscrimination laws have been credit and life insurance, training and employment, access to public services, etc.). Few examples are the US Employment the Non-Discrimination Act (United States Congress 1994), the UK Sex Discrimination Act (Parliament of the UK 1975). Given a set of information items, an automated system decides whether the customer is to be recommended for a credit or a certain type of life insurance if customer is a normal customer. Thus the workload of the staff of banks and insurance companies is reduced among other organizations due to automated decisions are generated. Types of Discrimination are direct and indirect. Direct discrimination consists of procedures or rules that openly states minority or underprivileged groups those are based on sensitive discriminatory attributes related to group membership. Indirect discrimination consists of procedures or rules that, not openly mentioning discriminatory attributes, directly or indirectly generate discriminatory decisions. Here an example of indirect discrimination is refusing to grant mortgages or health insurances in urban areas they consider as weakening although certainly not the only one. To prevent data mining itself a source of discrimination, some data mining tasks generating discriminatory models from biased data sets as part of the automated decision making. It is verified that data mining can be both a source of discrimination and a means for discovering discrimination.

This paper is organized as follows. Section II introduces existing work with comparison. Section III shows methodology used for discrimination prevention, Section IV describes application areas

And, Section V summarizes conclusions of discrimination prevention.

2. RELATED WORK

In this section we discussed various existing approaches for discrimination prevention in data mining technology. In data mining Direct and indirect discrimination methodologies are used. They can be used individually but it performs better while using both approaches altogether.

A. Discrimination Aware Data Mining Dino Pedreschi S. Ruggieri, and F. Turini [1] proposed to address the discrimination problem in data mining models. The class attribute in the original dataset DB to be binary (e.g. denying or granting credit). The database of discriminatory and redlining rules as output of a discrimination measurement discovery phase based on measures proposed. Discrimination measurement is performed to identify discriminatory and redlining rules then a data transformation phase is needed to transform the data in order to remove all evidence of direct or indirect discriminatory biases associated to discriminatory or redlining rules. The discriminatory itemsets (i.e. A) and the non-discriminatory itemsets (i.e. D) to be categorical. Hence the system have modeled both direct and indirect discrimination, introduced (strong) α-protection as a measure of the discriminatory power of a rule, and, as far as indirect discrimination is concerned, devised an inference model as a formal result that is able to infer discriminatory rules from apparently safe ones and some background knowledge.

B. Discrimination Prevention in Data Mining for Intrusion and Crime Detection

S. Hajian, J. Domingo-Ferrer, and A. Martinez-Balleste [2]

In the crime investigation, discrimination prevention could impact on cyber security applications, especially Intrusion Detection System (IDS). In this research a running example the training dataset is used. It corresponds to the data collected by an internet provider to detect subscribers possibly acting as intruders. The dataset consists of nine attributes, the last one (Intruder) being the class attribute. Each record corresponds to a subscriber of a telecommunication company determined by SubsNum attribute. Other than personal attributes (Gender, Age, Zip, Race), the dataset also includes the few other attributes, DownProf used for downloading profile and measures average quantity. P2P indicates use of peer-to-peer software by subscriber and PortScan use of a port scanning utility by subscriber. To evaluate the success of this method IDS shares its report, this report should be sanitized to avoid inducing biased discriminatory decisions in other IDS. This new discrimination prevention method based on data transformation and the measures to evaluate the success in discrimination prevention and its impact on data quality was introduced for intrusion and crime detection. This system concentrates on producing training data which are free or nearly free from discrimination while preserving their usefulness to detect real intrusion or crime. The drawback is only direct discrimination was addressed.

C. Rule protection for indirect discrimination prevention in data mining. S. Hajian, J. Domingo-Ferrer, and A. Martinez-Balleste[3] proposed this approach. **I**n the information society different types of services are used to collect automatically grand amounts of data. That data are used to train classification rules to make automated decisions, like loan granting, insurance premium computation, etc. If the training datasets are partial against sensitive attributes like gender, nationality, race, religion, etc. then discriminatory decisions may occur. Direct discrimination occurs at what time when decisions are made based on biased sensitive attributes. Indirect discrimination occurs at what time when decisions are made based on non-sensitive attributes which are strongly correlated by biased sensitive attributes. This paper discusses how to clean training datasets so that consequential datasets does not give indirect discriminating rules. Core contribution of this paper is proposed new pre-processing approach based method for indirect discrimination that is based on data transformation. It also introduced some measure for finding out accomplishment of proposed method and impact on data quality. The method transforms source data by removing indirect discriminatory biases so that no unfair decision rule can be indirectly mined from the transformed data. This proposed solution is based on the fact that the dataset of decision rules would be free of indirect discrimination if it contained no redlining rule. The major drawback of this method is that only preface experiments are conducted

D. Direct and Indirect Discrimination Prevention Methods Sara Hajian and Josep Domingo-Ferrer[4]. It involves denying to members of individual group opportunities that are available to other groups. Like privacy, discrimination could have negative social impact on recognition and dissemination of data mining technology. Discrimination prevention in data mining is an innovative idea of research to focus on this issue. One of the research questions is, whether it can adapt and it uses the preprocessing approaches of data transformation and hierarchy-based generalization from the privacy preservation literature for discrimination prevention? In response to this question, try to inspire on the data transformation techniques for knowledge (rule) hiding in privacy preserving data mining and it devise new data transformation methods for converting direct and/or indirect discriminatory decision rules to genuine (nondiscriminatory) classification rules; the current results are realistic in terms of discrimination removal and information loss.

E. Methodology for Direct and Indirect Discrimination Prevention in data mining

Sara Hajian and Josep Ferror [5] proposed pre-processing approach for discrimination prevention. In that approach they introduced new data transformation method like rule protection and rule generalization. It is a new data transformation handles direct and indirect discrimination. It can handle several discriminatory item sets also. Thus, based on various issues and limitations discussed in various existing approaches for discrimination prevention, new data transformation technique need to be designed. The method which prevent direct and indirect discrimination or both at same time also prevent discrimination nearby on right hand side of classification rule, because of discriminatory item sets near on right hand side of classification rule whose confidence and support are greater than lowest confidence and lowest support of classification rule, so it can be grant discriminatory decision. To meet this objective following steps given below are need to be carried out.

a. Measure discrimination of both types i.e. direct and indirect discrimination. In decision making process Make groups of individuals that have been directly and indirectly discriminated.

b. Transformation of data in proper way to eliminate discriminatory biases.

c. Dataset which is discrimination free generated by using data transformation technique without harming data quality.

Thus, this technique is quite successful in both goals of removing discrimination and preserving data quality as compared to previous work.

DOI: 10.18535/ijecs/v5i4.18

Table 1: COMPARATIVE SURVEY ON EXISTING APPROACH FOR DISCRIMINATION PREVENTION

Sr. No.	Author	Title	Publication year	Remark
1	Dino Pedreschi S. Ruggieri, and F. Turini	Discrimination Aware Data Mining	2008	Proposed to address the discrimination problem in data mining models. The class attribute in the original dataset DB to be binary. The database of discriminatory and redlining rules as output of a discrimination measurement. Hence the system have modeled both direct and indirect discrimination, introduced (strong) α-protection as a measure of the discriminatory power of a rule.
2	S. Hajian, J. Domingo-Ferrer, and A. Martinez-Balleste,	Discrimination Prevention in Data Mining for Intrusion and crime Detection.	2011	Focuses on the discrimination that could impact on cyber security applications, mainly IDSs. IDSs use computational intelligence technologies such as data mining.
3	Sara Hajian et al.	Rule Protection for Indirect Discrimination Prevention in Data Mining	2011	Propose new pre-processing approach for indirect discrimination prevention. Does not consider direct discrimination prevention. New pre-processing approach based scheme for indirect discrimination which is based on data transformation.
4	Sara Hajian and Josep Domingo-Ferrer	Direct and Indirect Discrimination Prevention Methods	2012	It involves denying to members of one group opportunities that are available to other groups. Like privacy, discrimination could have negative social impact on acceptance and dissemination of data mining technology.
5	Sara Hajian et al.	A Methodology for Direct and Indirect Discrimination Prevention in Data Mining	2013	Develop a new preprocessing discrimination prevention methodology including different data transformation methods that can evade direct discrimination, indirect discrimination or both of them at the same time.

3. METHODOLOGY

Discrimination can be either direct or discrimination:
Direct discriminatory rules indicate biased rules that are directly indirect or inferred from discriminatory items (e.g. Foreign worker = Yes).
Indirect discriminatory rules (redlining rules) specify biased rules which are indirectly inferred from non-discriminatory items (e.g. Zip = 02816) because of their correlation with discriminatory ones.
Indirect discrimination could happen because of the availability of some background knowledge (rules).
Steps involved in Discrimination Prevention Process:
Step 1: Measure discrimination and identify categories and groups of individual that have been directly and/ or indirectly discriminated in decision making process.
Step 2: The transform data in the proper way to remove all those discriminatory biases.
Step3: Without seriously damaging data quality, Discrimination free data models can be produced from the altered data set.

DOI: 10.18535/ijecs/v5i4.18

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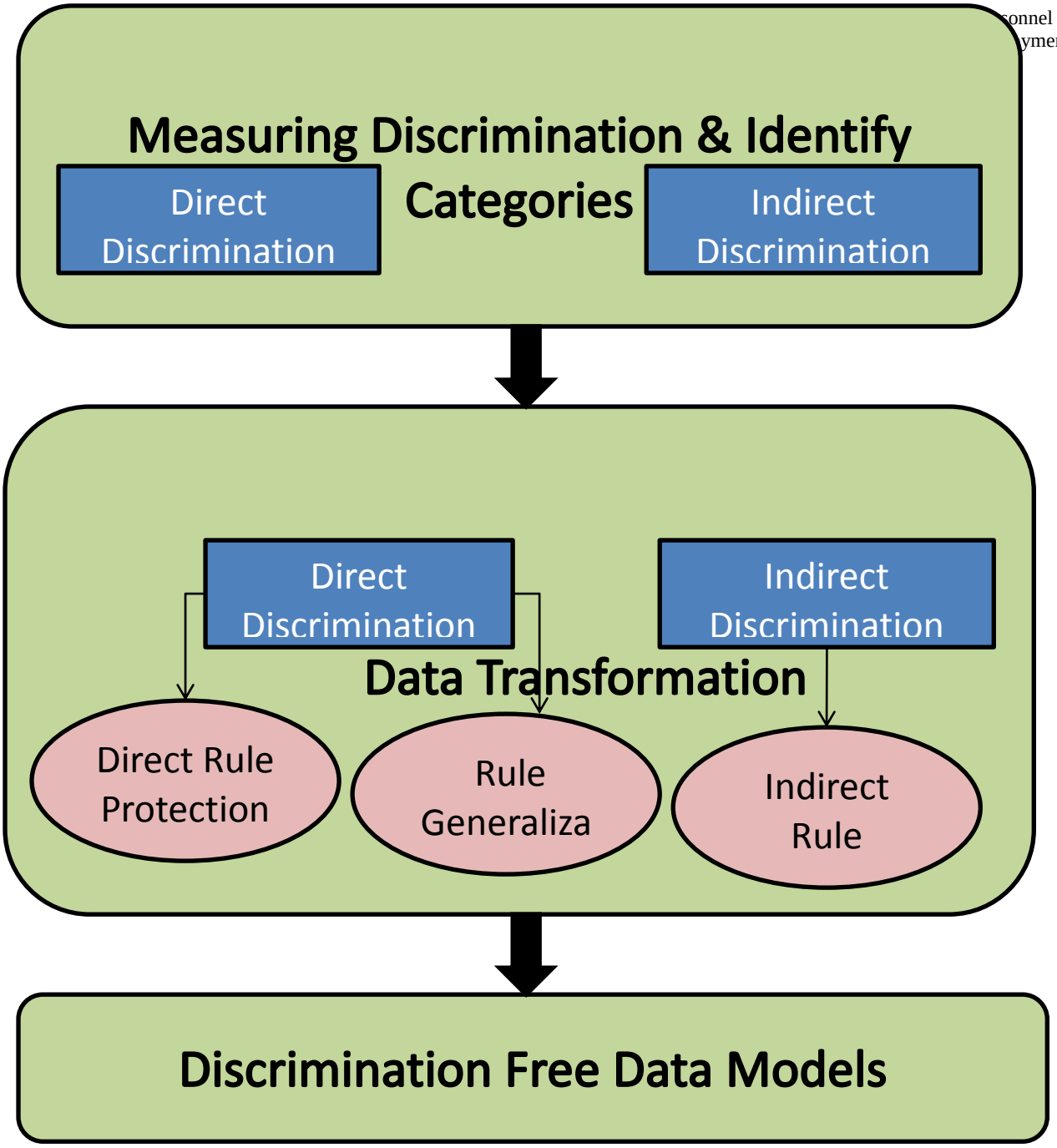

Fig 1: Discrimination Prevention Steps

APPLICATION AREA

Discrimination prevention is applicable in various areas as it involves denying to members of one assembly opportunities that are available to other assemblies. Anti-discrimination also plays a significant role in cyber security Intrusion and crime detection i.e. IDS where computational intelligence technologies may be used for different decision making scenarios i.e. data mining.

In Banking sector where all category of people are involved for getting facilities or services provided for them i.e. Loan Granting / Denial Insurance premium computation, insurance premium computation

Services in the society of information allow for automatic and routine collection of large amounts of data. Those data are often used to instruct association/classification rules in

Sale, Rental and Financing of housing (Fair housing Act), Equal Pay Act.

4. CONCLUSIONS

This paper is addressing the discrimination problem in data mining models. Along with privacy, Discrimination is all about being treated differently to people because of something about you that someone doesn't respect. Discrimination can be done on attributes like race, religion, nationality, marital status and age. Particularly when those attributes are used for making decisions about them like giving a job, loan, insurance etc to the people. The intention of this paper was to develop a new preprocessing. In

Discrimination prevention different data transformation methods that are direct discrimination, indirect discrimination or both at the same time. The awareness of discrimination, just like the awareness of privacy, strongly depends on the legal and cultural conventions of a society, and finally, we want to discover the relationship between discrimination prevention and privacy preservation in data mining.

5. ACKNOWLEDGMENTS

I express my sincere thanks to my guide Prof. Mrs. Ujwala M. Patil, the faith & confidence shown by her in me, boosted me and motivated me to perform better.

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