

# Pre-Post Processing of Discriminated Data

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**Abstract**— Discrimination means, selecting a statement on unfair decision. For example, hiring a candidate on the basis of their sex or race. Discrimination occurs in data mining when an unfair condition is applied during the mining process on data. There are some sensitive attribute and some insensitive attribute in data on which discrimination can be performed. If discrimination happens because of sensitive attributes then it is called direct discrimination else it is called indirect discrimination. Indirect discriminated are rules are correlated with insensitive attributes. Sara Hajian and Josep Domingo-Ferrer[13] has proposed some algorithms for the prevention of discrimination. But these techniques were at preprocessing of the data. The proposed paper is an extension of discrimination prevention at preprocessing. The proposed framework works on discrimination prevention at preprocessing as well as at postprocessing. For discrimination prevention at postprocessing, Classification based Predictive Association Rule Mining(CPAR) has been used.

**Index Terms**— Association Rule Mining, Data-Mining, Discrimination, Drp, Classification Using Predictive Association Rule (Cpar)

## I. INTRODUCTION

As said earlier, discrimination is unfair decision made while mining from data. Discrimination can be made on sensitive attributes for example race, sex, country etc. For example, a loan has not been granted by a bank to a person because of his/her black color or because he/she is not from the native country. These kind of unfair decisions need to be removed. Discrimination can be direct or indirect. For the prevention of the discrimination there can be three possible domains where discrimination can be prevented.

- Preprocessing
- Inprocessing
- Postprocessing

Preprocessing is processing of data before mining process. The data to mined is checked whether there is any discriminated transaction or not. If discriminated transaction is found then the data is changed so that there is no discriminated transaction left in the data set. Sara Hajian and Josep Domingo Ferrer[13] has proposed a system in which discrimination prevention has been mention at prepossing domain for the data set. They proposed an algorithm for the removal of discrimination for direct discriminated data as well as indirect discriminated data.

For the removal of discrimination at inprocessing the algorithm which is used to mine the transactions is changed so that there should not be any discriminated transaction. This technique is not dynamic because each data set have different techniques for mining process.

In postprocessing, the data is processed after completion of mining process. If there is any discriminated transaction occurs

after the mining process then that transaction is removed or changed according to some used defined conditions. CPAR algorithm[14] has been proposed in the paper for the removal of discrimination.

The proposed architecture performs postprocessing and preprocessing techniques for discrimination prevention on the given data set.

## II. RELATED WORK

The discrimination problem in data mining model was first addressed in [6]. Also how discrimination may be hidden in data mining models was considered. But still the issue of anti-discrimination in data mining did not receive much attention. The discovery of discriminatory decisions was proposed by Pedreschi [2], the initial idea of anti-discrimination for cyber security application based on data mining using rule protection and rule generalization for direct discrimination prevention. The use of rule protection in a different way for preventing indirect discrimination in a dataset was introduced [3]. Discrimination measures for classification rules was introduced [5] were a systematic framework for measuring discrimination, based on the analysis of the historical decision records stored out of a socially-sensitive decision task, e.g., credit approval. A notion of statistical significance was included and combined with the discrimination measures with association rule mining to work with direct and indirect discrimination in datasets of decisions for rule-based classifiers. The Preprocessing technique for prevention of discrimination prevention includes different data transformation methods that can prevent direct discrimination, indirect discrimination or both of them at the same time was proposed.

## III. PROPOSED FRAMEWORK

First of all association rule mining is done the given data set which gives frequent rules from the data set. These rules are processed to find potentially discriminated (PD) and potentially non discriminated(PND) rules. Apriori algorithm has been used to mine the frequent rules from the data set. PD rules has those rules which can give direct discrimination and is made on sensitive attributes of the data set. PND rules are those rules whose attributes are related to the sensitive attributes of the given data set means they are somehow related to PD rules. Sara Hajian and Josep Domingo-Ferrer[13] has already proposed some algorithms for the removal of discriminated rules form PD and PND rules. Those algorithm are:

1. For direct discrimination prevention
  - Direct Rule Protection method 1
  - Direct Rule Protection method 2

- Direct Rule Protection and Rule Generalization
- 2. For indirect discrimination prevention
  - Indirect Rule Protection method 1
  - Indirect Rule Protection method 2
- 3. Indirect Rule Protection and direct rule protection for Indirect and direct discrimination prevention.

All these algorithms work at preprocessing domain. The original data set is modified to remove discriminated transaction. Due to modifications on the data set there is information loss problem. The proposed application deals with this problem by implementing postprocessing technique. Implementing postprocessing technique, the information loss problem avoided because original data set is not changed by the CPAR algorithm. Hence there is no chance of information loss in postprocessing.

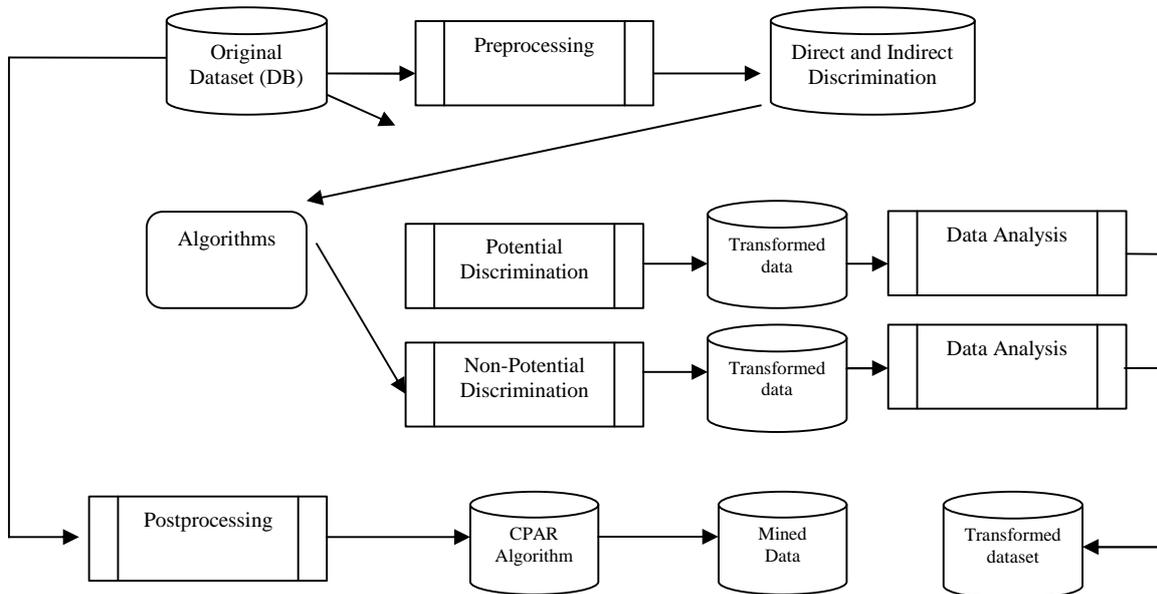
There are some assumptions common to all algorithms in this section. First, we assume the class attribute in the original data set DB to be binary. Second, we consider classification rules with negative decision to be in FR. Third, we assume the discriminatory item sets and the nondiscriminatory item sets to be binary categorical means the data set is in 0s or 1s format.

Even though preprocessing approach is easy and very flexible to remove discrimination from the dataset still it would cause much information loss. Therefore postprocessing approach is used in order to maintain data quality and improve the accuracy.

Fig.1 shows the block diagram of discrimination processing for preprocessing and postprocessing approach. Here the objective is to reduce the information loss by maintaining the data quality in the proposed application. For performing this, we are using transformation techniques and utility measures and algorithms like Direct Rule Protection, Direct Rule Generalization, Direct and Indirect Discrimination Prevention and CPAR algorithm. Out of which CPAR is more efficient than remaining algorithms in terms of information loss and improving the accuracy of algorithm.

CPAR are just like Apriori algorithm. Both are used for frequent pattern mining but there is a big difference between their implementation works. Apriori do normal search for each pattern whether it is frequent or not but CPAR uses classification based frequent pattern mining. The data set required for CPAR algorithm should have a class attribute as its last attribute. Based on that class attribute, frequent patterns are generated. But Apriori does not require any class attribute.

The reason behind using CPAR algorithm is because it generates small number of rules than apriori algorithm and it became easier to pic and remove discriminated transaction.



**Fig.1 Block Diagram of Discrimination processing for Pre-Processing and Post-Processing**

#### IV. ALGORITHM DESCRIPTION

Algorithms for direct and indirect discrimination prevention i.e. Rule Protection method 1, Rule Protection method 2 and Rule generalization for direct and indirect discrimination prevention has been explained by Sara Hajian and Josep Domingo-Ferrer in their proposed framework for discrimination prevention in preprocessing [13].

The main idea of this paper is to implement CPAR algorithm. As CPAR algorithm is more efficient than FOIL (First Order Inductive Learner) and PRM (Predictive Rule Mining) algorithms, the basic difference in these strategies is in rule generation process. FOIL generates rules which are not redundant but to achieve this, it loses some important rules. So PRM extracted these rules also but with cost of redundancy. Some rule may be extracted more than ones. CPAR also uses similar concept of PRM as to generate more rule with some redundant rules, but it can test more than one attribute at a time to judge whether this attribute can also give some useful rule or not. So more rules and less computation is needed in CPAR for comparison to the PRM algorithm. To implement these algorithms, following three steps are used;

1. Rule Generation.
2. Estimate Accuracy of rules.
3. Classification of rules
4. Result analyses.

The main difference between CPAR and PRM is that instead of choosing only one attribute to obtain best gain on each iteration(as in FOIL and PRM),CPAR choose a number of attributes if those attributes have similar best gain. This is done by applying GAIN\_SIMILARITY\_RATIO and by calculating the minimum gain.

CPAR takes input as (space separated) binary valued dataset R and produces a set of CARs. It also requires minimum gain constant which is user defined value, decay factor and TOTAL\_WEIGHT\_THRESHOLD. The resulting data is in the form of linked-list of rules ordered according to Laplace accuracy. The implementation of CPAR algorithm has been shown by Xiaoxin Yin and Jiawei Han[14] with description of differences between CPAR, FOIL and PRM.

#### IV. RESULTS

Data set: All computations has been done on adult data set. All algorithms have been implemented on seven attributes of the data set. These attributes are:

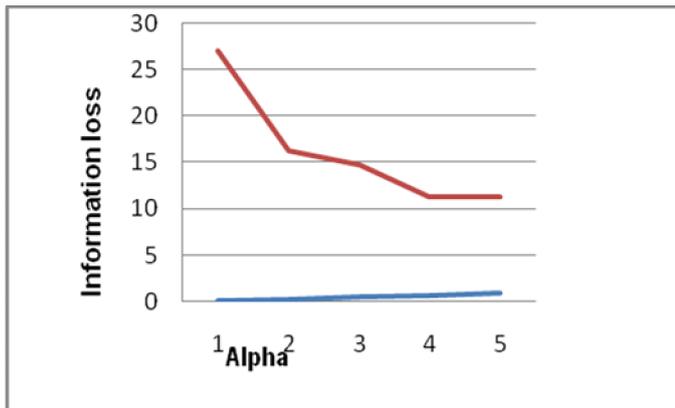
- workclass,
- education,
- marital-status,
- race, sex,
- native country,
- salary(<=50k , >50k).

Race = black attribute is considered as discriminated attribute and salary attribute is considered as class attribute. All the attributes are transformed into binary form and are separated with comma(.). Total number of transaction in data set are 30529.

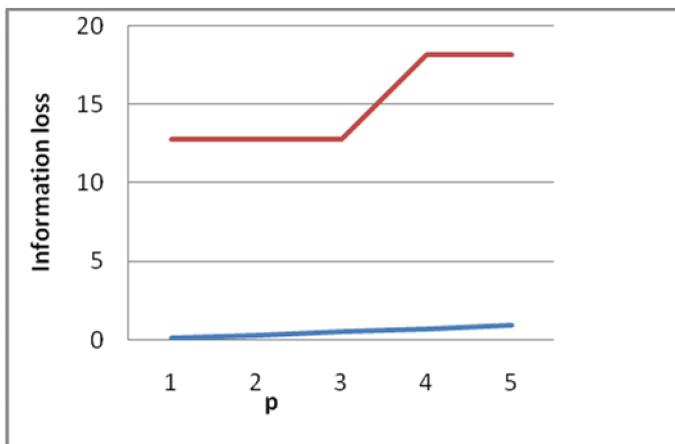
Result set: It is the transformation of the original data set which is output after applying the preprocessing algorithms. This data is exactly same in format as original data set. Result set contains the transactions which are free from discrimination. Due to change in the original dataset, information loss occurs. This can be shown with the help of graphs.

Methods	ALPHA	P	Indirect Alpha Discriminatory Rules	Direct Alpha Discriminatory Rules	Direct Discrimination Removal	Indirect Discrimination Removal
DRP 1	0.2	na	na	4	100	na
DRP 2	0.2	na	na	4	100	na
DRP AND RG	na	0.4	na	4	100	na
IRP	0.2	na	6	na	na	100

Results Generated by preprocessing algorithms



Information loss in Direct Rule Protection



Information loss in Rule generalization

There is no information loss in CPAR algorithm as it does not change the original data.

## VI. CONCLUSION

The purpose of this paper was to propose a system for preventing data mining from discrimination. A new preprocessing and postprocessing discrimination prevention including different data transformation methods that can prevent direct discrimination, indirect discrimination along

with both at the same time with information loss and without information loss. In postprocessing domain, CPAR achieves high accuracy and efficiency, because it gives no information loss. This paper was introduced for minimizing information loss during the prevention of discriminated data.

The proposed architecture works only for binary format data set. In future the proposed architecture will be extending to support all types of data set so that it can be made dynamic.

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