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Blocking Anonymity Threats Raised by Frequent Itemset Mining

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Speaker: Maurizio Atzori

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What we want

The Purpose

We want to publish datamining results (frequent itemsets and related supports in our case)

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The Purpose

What we want

We want to publish datamining results (frequent itemsets and related supports in our case)

What we DON'T want

- We DON'T want to release information related to few people, that can help to trace single individuals
- We don't want to have to specify any other information (such as what is sensitive and what is not)

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The Problem

Does this set of itemsets violate the anonymity of individuals in DB?

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An Association Rule Can Be Used to Break Anonymity

Example

$$a_1 \wedge a_2 \wedge a_3 \Rightarrow a_4 \quad [sup = 80, \ conf = 98.7\%]$$

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An Association Rule Can Be Used to Break Anonymity

Example

$$a_1 \wedge a_2 \wedge a_3 \Rightarrow a_4$$
 [sup = 80, conf = 98.7%]

$$sup(\{a_1, a_2, a_3\}) = \frac{sup(\{a_1, a_2, a_3, a_4\})}{conf} \approx \frac{80}{0.987} = 81.05$$

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In other words, we know that there is just one individual for which the pattern $a_1 \wedge a_2 \wedge a_3 \wedge \neg a_4$ holds.

Now we know that...

Fact

 Even if we mine with a large support threshold, we can infer patterns holding in the original database which are not intentionally released

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Now we know that...

Fact

- Even if we mine with a large support threshold, we can infer patterns holding in the original database which are not intentionally released
- They can regards very few individuals

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Fact

- Even if we mine with a large support threshold, we can infer patterns holding in the original database which are not intentionally released
- They can regards very few individuals
- The support value of such patterns can be inferred without accessing the database

In our past work [PKDD05], we showed that data mining results can contain information related to very few individuals (i.e., true only in a small set of transactions)

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In our past work [PKDD05], we showed that data mining results can contain information related to very few individuals (i.e., true only in a small set of transactions)

Possible solutions

k-anonymize the database, i.e., removing any information regarding only few transactions from the *input* of the mining algorithm

In our past work [PKDD05], we showed that data mining results can contain information related to very few individuals (i.e., true only in a small set of transactions)

Possible solutions

- k-anonymize the database, i.e., removing any information regarding only few transactions from the *input* of the mining algorithm
- k-anonymize the set of frequent itemsets, i.e., removing any information regarding only few transactions from the output of the mining algorithm

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Suppressive Strategy Experiments

The Framework



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Suppressive Strategy to k-anonymize Itemsets

- Our approach, named Suppressive Strategy, consist in ignoring (not considering during mining) the transactions that bring outlier information appearing in the original output.
- We obtain an output with the same frequent itemsets (or a subset of them) with some supports slightly decreased.

Measures of Distortion

We conduced a set of experiments by varying both σ (support) and *k* (anonymity threshold) on the RETAIL dataset:

- Fraction of itemsets distorted
- Average distortion
- Number of transactions involved (virtually suppressed)

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Itemsets Distorted



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Average Distortion



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For Further Reading

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