Fast top-k frequent itemset mining under Local Differential Privacy*

*Note: Sub-titles are not captured in Xplore and should not be used

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Abstract—This is the abstract.

Index Terms—This is the keywords

I. INTRODUCTION

Differential privacy(DP) [7] was named one of the world's top 10 breakthrough technologies in 2020 by the MIT technology review. DP is a means in cryptography that aims to provide a way to maximize the accuracy of data queries when querying from statistical databases while minimizing the chances of identifying their records. As a mathematical technique, it can add noise to the data while quantifying the extent of the increase in privacy, thus making the process of adding "noise" more rigorous.

Due to its unique advantages, DP has been widely studied by the academia and industry. For example, Google, Microsoft, apple and other companies use this technology to protect users' privacy, and at the same time, mobile phones aggregate data, so as to improve service quality. And the U.S. government is to complete a census of 330 million U.S. residents by 2020, keeping their identities secret, in what would be the largest census ever.

There are two types of differential privacy - Centralized differential privacy(CDP) and Local differential privacy(LDP). Compared with CDP, the LDP does not require the assumptions of a trusted third party and provides stronger privacy guarantees. DP's research has involved many aspects, in recent years, the work in data mining(DM) has attracted the attention. A lot of work [3]–[6] has been done to solve DM problems in CDP.

The LDP, by contrast, has no reliance on third party assumptions. The main challenge with a DM task is that the data analyst does not hold the user's original sensitive information, so it is quite difficult to mine useful information with noise data.Qin et al. [1] proposed LDPMiner protocol for heavy hitter estimation over set-valued data and left data mining as an open problem. Wang et al. [2] solved the top-k frequent itemset mining(FIM) task for the first time with **padding-and-sampling-based frequency oracle**(PSFO). In [2], the

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Set-Value Item Mining(SVIM) protocol had been proposed to handles set values under the LDP setting, with the purpose of finding the k most frequent items and their frequencies. To mine frequent itemsets , a core technique is what we call "Speculate the Frequency(SF)". That is, the analyst first calculated the frequency of a given itemset X for all candidate itemsets by formula (1),

$$\varphi(X) = \prod_{x \in X} \mu(x), \mu(x) = \frac{0.9 \times \tilde{\theta}(x)}{\max_{x \in S'} \tilde{\theta}(x)}$$
(1)

where $\varphi(X)$ represents the speculative frequency of itemset X, S' and $\tilde{\theta}(x)$ are denoted separately the top-k frequent items and the frequency of a given item x.

II. BACKGROUND

A. Local Differential Privacy(LDP)

B. FP-growth

III. EASE OF USE

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- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive".
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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

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 word alternatively is preferred to the word "alternately"
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- In your paper title, if the words "that uses" can accurately replace the word "using", capitalize the "u"; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones "affect" and "effect", "complement" and "compliment", "discreet" and "discrete", "principal" and "principle".
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- There is no period after the "et" in the Latin abbreviation "et al.".
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An excellent style manual for science writers is [14].

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TABLE I
TABLE TYPE STYLES

Table	Table Column Head		
Head	Table column subhead	Subhead	Subhead
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^aSample of a Table footnote.

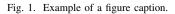


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ACKNOWLEDGMENT

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REFERENCES

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Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [13].

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