Qrlew: automatic differential privacy for SQL queries

Anonymous submission

Abstract

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Comparable open-source projects

- Paszke et al. 2017 - Automatic differentiation in PyTorch https://openreview.net/pdf?id=BJJsrmfCZ
- Frostig et al. 2018 - Compiling machine learning programs via high-level tracing https://mlsys.org/Conferences/2019/doc/2018/146.pdf

Comparable DP SQL papers

- Lessons Learned: Surveying the Practicality of Differential Privacy in the Industry (Garrido et al. 2022)
- Tumult Analytics: a robust, easy-to-use, scalable, and expressive framework for differential privacy (Berghel et al. 2022)
- Differentially Private SQL with Bounded User Contribution (Wilson et al. 2019)
- CHORUS: a Programming Framework for Building Scalable Differential Privacy Mechanisms (Johnson et al. 2020)
- Towards Practical Differential Privacy for SQL Queries (Johnson, Near, and Song 2018)

Introduction

In recent years, the importance of safeguarding privacy when dealing with personal data has continuously increased. Traditional anonymization techniques have proven vulnerable to re-identification, as demonstrated by numerous works (Archie et al. 2018; Dwork et al. 2017; Narayanan and Shmatikov 2008; Sweeney, Abu, and Winn 2013). The total cost of data breaches has significantly increased (IBM 2023). And governments have introduced stricter data protection laws. Yet, collecting, sharing and exploiting data has the potential of creating imense value in many industries such as health care, finance, transportation or energy sistribution.

To realize these benefits while managing privacy risks, researchers have turned to differential privacy (DP), which has become the gold standard in academia since its introduction by Dwork et al. in 2006 [28] due to its unique privacy guarantees.

Despite the availability of open-source tools, DP adoption remains limited, primarily among a few tech companies [6, 7, 24] and the US Census Bureau [58]. Our work aims to bridge this research gap by facilitating the integration of DP into organizational workflows and achieving broader adoption. While Dwork et al. [27] partially addressed this gap by interviewing DP experts, our study complements this by focusing on non-experts. We conducted interviews with 24 practitioners, including 19 analysts and 5 data stewards, from nine major companies that have not yet implemented DP. In summary, our main contributions are as follows:

Motivation DP Solutions existantes Problème non résolu et nécessité de Qrlew

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```
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Tables should be presented in 10 point roman type. If necessary, they may be altered to 9 point type. You may not use any commands that further reduce point size below nine points. Tables that do not fit in a single column must be placed across double columns. If your table won't fit within the margins even when spanning both columns, you must split it. Do not use minipage to group tables.

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Algorithm 1: Example algorithm

Input: Your algorithm's input
Parameter: Optional list of parameters
Output: Your algorithm's output

```
Let t = 0.
while condition do
    Do some action.
    if conditional then
        Perform task A.
    else
        Perform task B.
    end if
end while
return solution
```

Drawings. We suggest you use computer drawing software (such as Adobe Illustrator or, (if unavoidable), the drawing tools in Microsoft Word) to create your illustrations. Do not use Microsoft Publisher. These illustrations will look best if all line widths are uniform (half- to two-point in size), and you do not create labels over shaded areas. Shading should be 133 lines per inch if possible. Use Times Roman or Helvetica for all figure call-outs. **Do not use hairline width lines** — be sure that the stroke width of all lines is at least .5 pt. Zero point lines will print on a laser printer, but will completely disappear on the high-resolution devices used by our printers.

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In LaTeX algorithms may be typeset using the `algorithm` and `algorithmic` packages, but you can also use one of the many other packages for the task.

Listings. Listings are much like algorithms and programs. They should also appear floated to the top (preferably) or bottom of the page. Listing captions should appear in the header, left-justified and enclosed between horizontal lines

Listing 1: Example listing `quicksort.hs`

```
quicksort :: Ord a => [a] -> [a]
quicksort []     = []
quicksort (p:xs) = (quicksort lesser) ++
     [p] ++ (quicksort greater)
  where
    lesser  = filter (< p) xs
    greater = filter (>= p) xs
```

as shown in Listing 1. Terminate the body with another horizontal line and avoid any background color. Line numbers, if included, must appear within the text column.

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References may be the same size as surrounding text. However, in this section (only), you may reduce the size to \small if your paper exceeds the allowable number of pages. Making it any smaller than 9 point with 10 point linespacing, however, is not allowed. A more precise and exact method of reducing the size of your references minimally is by means of the following command:

\fontsize{9.8pt}{10.8pt} \selectfont

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The list of files in the \bibliography command should be the names of your BibTeX source files (that is, the .bib files referenced in your paper).

The following commands are available for your use in citing references:

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LaTeX is a difficult program to master. If you've used that software, and this document didn't help or some items were not explained clearly, we recommend you read Michael Shell's excellent document (testflow doc.txt V1.0a 2002/08/13) about obtaining correct PS/PDF output on LaTeX systems. (It was written for another purpose, but it has general application as well). It is available at www.ctan.org in the tex-archive.

Reference Examples

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The preparation of the LATEX and BibTEX files that implement these instructions was supported by Schlumberger Palo Alto Research, AT&T Bell Laboratories, Morgan Kaufmann Publishers, The Live Oak Press, LLC, and AAAI Press. Bibliography style changes were added by Sunil Issar. \pubnote was added by J. Scott Penberthy. George Ferguson added support for printing the AAAI copyright slug. Additional changes to aaai24.sty and aaai24.bst have been made by Francisco Cruz and Marc Pujol-Gonzalez.

Thank you for reading these instructions carefully. We look forward to receiving your electronic files!

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