

Qrlew: automatic differential privacy for SQL queries

Anonymous submission

Abstract

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Useful links

PPAI

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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 also significantly increased (IBM

2023). And governments have introduced stricter data protection laws. Yet, the collection, sharing, and utilization of data hold the potential to generate significant value across various industries, including healthcare, finance, transportation, and energy distribution.

To realize these benefits while managing privacy risks, researchers have turned to differential privacy (DP) (Wood et al. 2018; Dwork, Roth et al. 2014), which has become the gold standard in academia since its introduction by Dwork et al. in 2006 (Dwork et al. 2006) due to its provable and automatic privacy guarantees.

Despite the availability of open-source tools, DP adoption remains limited. This In summary, our main contributions are as follows:

Motivation DP Solutions existantes Problème non résolu et nécessité de Qrlew

Preparing an Anonymous Submission

This document details the formatting requirements for anonymous submissions. The requirements are the same as for camera ready papers but with a few notable differences:

- Anonymous submissions must not include the author names and affiliations. Write “Anonymous Submission” as the “sole author” and leave the affiliations empty.
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- AAAI’s copyright notice should not be included as a footer in the first page.
- Only the PDF version is required at this stage. No source versions will be requested, nor any copyright transfer form.

You can achieve all of the above by enabling the submission option when loading the `aaai24` package:

```
\documentclass[letterpaper]{article}
\usepackage[submission]{aaai24}
```

The remainder of this document are the original camera-ready instructions. Any contradiction of the above points ought to be ignored while preparing anonymous submissions.

Camera-Ready Guidelines

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The instructions herein are provided as a general guide for experienced \LaTeX users. If you do not know how to use \LaTeX , please obtain assistance locally. AAAI cannot provide you with support and the accompanying style files are **not** guaranteed to work. If the results you obtain are not in accordance with the specifications you received, you must correct your source file to achieve the correct result.

These instructions are generic. Consequently, they do not include specific dates, page charges, and so forth. Please consult your specific written conference instructions for details regarding your submission. Please review the entire document for specific instructions that might apply to your particular situation. All authors must comply with the following:

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In the \LaTeX source for your paper, you **must** place the following lines as shown in the example in this subsection. This command set-up is for three authors. Add or subtract author and address lines as necessary, and uncomment the portions that apply to you. In most instances, this is all you need to do to format your paper in the Times font. The `helvet` package will cause Helvetica to be used for sans serif. These files are part of the PSNFSS2e package, which is freely available from many Internet sites (and is often part of a standard installation).

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Figures, drawings, tables, and photographs should be placed throughout the paper on the page (or the subsequent page) where they are first discussed. Do not group them together at the end of the paper. If placed at the top of the paper, illustrations may run across both columns. Figures must not invade the top, bottom, or side margin areas. Figures must be inserted using the `\usepackage{graphicx}`. Number figures sequentially, for example, figure 1, and so on. Do not use `minipage` to group figures.

If you normally create your figures using `pgfplots`, please create the figures first, and then import them as pdfs with proper bounding boxes, as the bounding and trim boxes created by `pgfplots` are fragile and not valid.

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Figure Captions. The illustration number and caption must appear *under* the illustration. Labels and other text with the actual illustration must be at least nine-point type. However, the font and size of figure captions must be 10 point roman. Do not make them smaller, bold, or italic. (Individual words may be italicized if the context requires differentiation.)

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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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Low-Resolution Bitmaps. You may not use low-resolution (such as 72 dpi) screen-dumps and GIF files—these files contain so few pixels that they are always blurry, and illegible when printed. If they are color, they will become an indecipherable mess when converted to black and white. This is always the case with gif files, which should never be used. The resolution of screen dumps can be increased by reducing the print size of the original file while retaining the same number of pixels. You can also enlarge files by manipulating them in software such as PhotoShop. Your figures should be 300 dpi when incorporated into your document.

L^AT_EX Overflow. L^AT_EX users please beware: L^AT_EX will sometimes put portions of the figure or table or an equation in the margin. If this happens, you need to make the figure or table span both columns. If absolutely necessary, you may reduce the figure, or reformat the equation, or reconfigure the table. **Check your log file!** You must fix any overflow into the margin (that means no overfull boxes in L^AT_EX). **Nothing is permitted to intrude into the margin or gutter.**

Using Color. Use of color is restricted to figures only. It must be WACG 2.0 compliant. (That is, the contrast ratio must be greater than 4.5:1 no matter the font size.) It must be CMYK, NOT RGB. It may never be used for any portion of the text of your paper. The archival version of your paper will be printed in black and white and grayscale. The web version must be readable by persons with disabilities. Consequently, because conversion to grayscale can cause undesirable effects (red changes to black, yellow can disappear, and so forth), we strongly suggest you avoid placing color figures in your document. If you do include color figures, you must (1) use the CMYK (not RGB) colorspace and (2) be mindful of readers who may happen to have trouble distinguishing colors. Your paper must be decipherable without using color for distinction.

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

Algorithm 1: Example algorithm

Input: Your algorithm's input

Parameter: Optional list of parameters

Output: Your algorithm's output

```
1: Let  $t = 0$ .
2: while condition do
3:   Do some action.
4:   if conditional then
5:     Perform task A.
6:   else
7:     Perform task B.
8:   end if
9: end while
10: return solution
```

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.

Photographs and Images. Photographs and other images should be in grayscale (color photographs will not reproduce well; for example, red tones will reproduce as black, yellow may turn to white, and so forth) and set to a minimum of 300 dpi. Do not prescreen images.

Resizing Graphics. Resize your graphics **before** you include them with LaTeX. You may **not** use trim or clip options as part of your \includegraphics command. Resize the media box of your PDF using a graphics program instead.

Fonts in Your Illustrations. You must embed all fonts in your graphics before including them in your LaTeX document.

Algorithms. Algorithms and/or programs are a special kind of figures. Like all illustrations, they should appear floated to the top (preferably) or bottom of the page. However, their caption should appear in the header, left-justified and enclosed between horizontal lines, as shown in Algorithm 1. The algorithm body should be terminated with another horizontal line. It is up to the authors to decide whether to show line numbers or not, how to format comments, etc.

In L^AT_EX 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 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.

References

The AAAI style includes a set of definitions for use in formatting references with BibTeX. These definitions make the bibliography style fairly close to the ones specified in the

Listing 1: Example listing quicksort.hs

```
1 quicksort :: Ord a => [a] -> [a]
2 quicksort [] = []
3 quicksort (p:xs) = (quicksort lesser) ++
  [p] ++ (quicksort greater)
4 where
5   lesser = filter (< p) xs
6   greater = filter (>= p) xs
```

Reference Examples appendix below. To use these definitions, you also need the BibTeX style file “aaai24.bst,” available in the AAAI Author Kit on the AAAI web site. Then, at the end of your paper but before `\enddocument`, you need to put the following lines:

```
\bibliography{bibfile1,bibfile2,...}
```

Please note that the `aaai24.sty` class already sets the `\bibliographystyle` for you, so you do not have to place any `\bibliographystyle` command in the document yourselves. The `aaai24.sty` file is incompatible with the `hyperref` and `navigator` packages. If you use either, your references will be garbled and your paper will be returned to you.

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
```

You must reduce the size equally for both font size and line spacing, and may not reduce the size beyond `{9.0pt}{10.0pt}`.

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:

`\cite`: Cites the given reference(s) with a full citation. This appears as “(Author Year)” for one reference, or “(Author Year; Author Year)” for multiple references.

`\shortcite`: Cites the given reference(s) with just the year. This appears as “(Year)” for one reference, or “(Year; Year)” for multiple references.

`\citeauthor`: Cites the given reference(s) with just the author name(s) and no parentheses.

`\citeyear`: Cites the given reference(s) with just the date(s) and no parentheses.

You may also use any of the *natbib* citation commands.

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Please check all the pages of your PDF file. The most commonly forgotten element is the acknowledgements — especially the correct grant number. Authors also commonly forget to add the metadata to the source, use the wrong reference style file, or don’t follow the capitalization rules or

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Additional Resources

L^AT_EX 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 L^AT_EX 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

For the most up to date version of the AAAI reference style, please consult the *AI Magazine* Author Guidelines at <https://aaai.org/ojs/index.php/aimagazine/about/submissions#authorGuidelines>

Acknowledgments

AAAI is especially grateful to Peter Patel Schneider for his work in implementing the original `aaai.sty` file, liberally using the ideas of other style hackers, including Barbara Beeton. We also acknowledge with thanks the work of George Ferguson for his guide to using the style and BibTeX files — which has been incorporated into this document — and Hans Guesgen, who provided several timely modifications, as well as the many others who have, from time to time, sent in suggestions on improvements to the AAAI style. We are especially grateful to Francisco Cruz, Marc Pujol-Gonzalez, and Mico Loretan for the improvements to the BibTeX and L^AT_EX files made in 2020.

The preparation of the L^AT_EX 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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