Seminar Large-scale Data Engineering (LDE)
01 Structure of Scientific Papers

Dr.-Ing. Patrick Damme
Technische Universität Berlin
Berlin Institute for the Foundations of Learning and Data
Big Data Engineering (DAMS Lab)

Last update: Apr 14, 2024

[**Credit:** Based on "Introduction to Scientific Writing"/ "01 Structure of Scientific Papers" by Matthias Boehm (TU Graz, winter 2021/22)]

Announcements/Org

- **Hybrid Setting with Optional Attendance**
  - In-person in TEL 811 (~20 seats)
  - Virtual via zoom
    https://tu-berlin.zoom.us/j/67376691490?pwd=NmlvWTM5VUVWRjU0UGI2bXhBVkxzQT09

About Me

- **Since 10/2022: Postdoc at TU Berlin**, Germany
  - FG Big Data Engineering (DAMS Lab) headed by Prof. Matthias Böhm
  - Continuing work on integrated data analysis pipelines
  - Research interests in the fields of database and ML systems (especially compiler & runtime techniques, extensibility)

TECHNISCHE UNIVERSITÄT BERLIN

DAPHNE

BIFOLD

- **2021-2022: Postdoc at TU Graz & Know-Center GmbH**, Austria
  - Data Management group headed by Prof. Matthias Böhm
  - Started work on integrated data analysis pipelines

TU Graz

DAPHNE

Know Center

- **2015-2020: PhD student at TU Dresden**, Germany
  - Dresden Database Research Group headed by Prof. Wolfgang Lehner
  - PhD thesis on making complex analytical database queries more efficient through lightweight compression of intermediate results

TECHNISCHE UNIVERSITÄT DRESDEN

MorphStore & TVL

Dresden Database Research Group

BIFOLD

FG Big Data Engineering (DAMS Lab) – Teaching

Architecture of Database Systems (ADBS, **WiSe**)

DB system internals
+ prog. project

Architecture of ML Systems (AMLS, **SoSe**)

ML system internals, data science lifecycle
+ prog. project

SE Joint ML and DM (MLDM, **SoSe+WiSe**)

Master

Bachelor

Data Integration and Large-Scale Analysis (DIA, **WiSe**)

Distributed Data Management

SE/PR Large-scale Data Engineering (LDE, **SoSe+WiSe**)

Intro to Scientific Methods (WiSe)

Data Management / Databases (DM, **SoSe+WiSe**)

Data management from user/application perspective

PP Prog.-Practicals Data Systems (PPDS, **SoSe+WiSe**)

Agenda

- **Course Organization, Outline, and Deliverables**
- **Structure of Scientific Papers**
- **List of Seminar Topics**

Course Organization, Outline, and Deliverables

Large-scale Data Engineering: Module Overview

20 places in total

bachelor + master

#41086: LDE Seminar + Project (12 ECTS) — 10 students

10 students — #41095: Seminar LDE (3)

#41183: Project LDE (9 ECTS) — 8 students

bachelor-only

bachelor-only

Mon, 14:00-16:00
TEL 811 & zoom

Seminar LDE
- Reading & writing scientific papers
- Giving presentations on papers
- Summary paper
- Presentation
- Lecturer & seminar mentor

Mon, 16:00-18:00
TEL 811 & zoom

Project LDE
- Building & evaluating prototypes
- Giving presentations on prototypes
- Prototype design/impl/tests/doc
- Presentation
- Project mentors

→ In the context of systems for data engineering, data management, machine learning

→ In combination: Ideal preparation for a bachelor/master thesis with our group

Course Organization

- **General Contact Person**
  - Dr.-Ing. Patrick Damme (patrick.damme@tu-berlin.de)
- **Course Website**
  - https://pdamme.github.io/teaching/2024_summer/lde/lde_summer2024.html
  - One site for seminar and project
  - All material, schedule, **deadlines**
- **ISIS course**
  - https://isis.tu-berlin.de/course/view.php?id=37443
  - Announcements, discussion forum, polls for topic selection
- **Language**
  - Lectures and slides: **English**
  - Communication: **English**/**German**
  - Submitted paper and presentation: **English**
  - **Informal language** (first name is fine), immediate feedback is welcome

Semester Schedule & Deadlines

- **Three Introductory Lectures** (optional)
  - Apr 15: Structure of Scientific Papers
  - Apr 22: *no lecture, office hour in TEL 814*
  - Apr 29: Scientific Reading and Writing
  - May 06: Experiments, Reproducibility, and Giving Presentations
- **Self-organized Seminar Work**
  - Office hours for any questions (optional)
- **Final Presentations** (mandatory)
  - Jul 01, 14:00-18:00: Session #1
  - Jul 15, 14:00-18:00: Session #2

- **List of Seminar Topics**
  - Presented today, take your time to select afterwards
- **Topic Selection**
  - **Deadline: Apr 29, 23:59 CET** (in 2 weeks)
  - Ranked list of **5 topics** via poll on the ISIS course
  - Global topic assignment based on preferences
  - **Notification of assigned topics: May 06** (in 3 weeks)
- **Submission of Summary Paper**
  - **Deadline: Jun 24, 23:59 CET** (in 10 weeks)
  - Summary paper (PDF) by email to Patrick Damme
- **Submission of Presentation Slides**
  - **Deadline: The day before you present, 23:59 CET**
  - Presentation slides (PDF) by email to Patrick Damme

Seminar Deliverables

- **Individual Seminar Work**
  - 1 student = 1 paper, no team work
- **Summary Paper** (in English)
  - Read and understand selected paper
  - Search for related work to provide some context
  - Write summary paper (**4 pages**, excl. references)
    - including related work
    - make sure relation to umbrella topic is conveyed
  - LaTeX with given template
- **Presentation**
  - Summarize your paper
  - **15 min talk + 5 min discussion** (stay in time)
  - Audience: engage in the discussion
- **Grading**
  - Graded portfolio exam
  - **#41086 (seminar + project)**
    - 25 pts: summary paper
    - 15 pts: presentation
    - 50 pts: design/impl/tests/doc
    - 10 pts: presentation
  - **#41095 (seminar-only)**
    - 65 pts: summary paper
    - 35 pts: presentation
- **Academic Honesty / No Plagiarism** (incl LLMs like ChatGPT)

LaTeX Paper Template

ACM acmart template
document class sigconf (double-column)

https://www.acm.org/publications/proceedings-template

The Name of the Title Is Hope

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G.K.M. Tobin*
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Figure 1: Seattle Mariners at Spring Training, 2010.

ABSTRACT

A clear and well-documented LaTeX document is presented as an article formatted for publication by ACM in a conference proceedings or journal publication. Based on the "acmart" document class, this article presents and explains many of the common variations, as well as many of the formatting elements an author may use in the preparation of the documentation of their work.

CCS CONCEPTS

• **Computer systems organization → Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

*Both authors contributed equally to this research.

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Conference acronym 'XX, June 03–05, 2018, Woodstock, NY
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ACM ISBN 978-1-4503-XXXX-X/18/06...$15.00
https://doi.org/XXXXXXX.XXXXXXX

KEYWORDS

datasets, neural networks, gaze detection, text tagging

ACM Reference Format:
Ben Trovato, G.K.M. Tobin, Lars Thørväld, Valerie Béranger, Aparna Patel, Huifen Chan, Charles Palmer, John Smith, and Julius P. Kumquat. 2018. The Name of the Title Is Hope. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation emai (Conference acronym 'XX)*. ACM, New York, NY, USA, 6 pages. https://doi.org/XXXXXXX.XXXXXXX

1 INTRODUCTION

ACM's consolidated article template, introduced in 2017, provides a consistent LaTeX style for use across ACM publications, and incorporates accessibility and metadata-extraction functionality necessary for future Digital Library endeavors. Numerous ACM and SIG-specific LaTeX templates have been examined, and their unique features incorporated into this single new template.

If you are new to publishing with ACM, this document is a valuable guide to the process of preparing your work for publication. If you have published with ACM before, this document provides insight and instruction into more recent changes to the article template.

CCS concepts
(ACM Computing Classification System)
Select concepts at http://dl.acm.org/ccs.cfm
and insert generated code:

```
%%
%% The code below is generated by the tool at http://dl.acm.org/ccs.cfm.
%% Please copy and paste the code instead of the example below.
%%
\begin{CCSXML}
<ccs2012>
 <concept>
  <concept_id>10010520.10010553.10010562</concept_id>
  <concept_desc>Computer systems organization~Embedded systems</concept_desc>
  <concept_significance>500</concept_significance>
 </concept>
 <concept>
  <concept_id>10010520.10010575.10010755</concept_id>
  <concept_desc>Computer systems organization~Redundancy</concept_desc>
  <concept_significance>300</concept_significance>
 </concept>
 <concept>
```

Copyright notice
Just keep as it is (ignore the dummy data)

Teaser image
Not required (especially no photograph)

Keywords
Specify meaningful keywords

```
%% Keywords. The author(s) should pick words that accurately describe
%% the work being presented. Separate the keywords with commas.
\keywords{datasets, neural networks, gaze detection, text tagging}
```

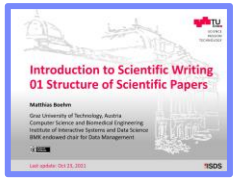
ACM reference format
Just keep as it is (ignore the dummy data)

Portfolio Exam Registration

- **Portfolio exam registration: May 06 – Jun 03**
  - Binding registration in Moses/MTS
  - Including selection of seminar presentation date (first-come-first-serve)
- **Portfolio exam de-registration**
  - **Until 3 days before the first graded exam part**
    - Modules "LDE"/"Seminar LDE": until **Jun 21**
    - Module "Project LDE": until **Jul 26**
    - De-register yourself in Moses/MTS
  - **With sufficient reason: Until the day of the exam**
    - In case of sickness etc.
    - Modules "LDE"/"Seminar LDE": until **Jun 24**
    - Module "Project LDE": until **Jul 29**
- **Missing deadlines/exam without de-registration**
  - Zero points in the respective exam part (!)
  - **Approach us early in case of problems**
- **If you don't want to take LDE anymore**
  - Let me know asap to give students in the queue a chance to fill in

Structure of Scientific Papers

In Computer Science (Data Management)



[**Credit:** Based on “Introduction to Scientific Writing”/ ”01 Structure of Scientific Papers” by Matthias Boehm (TU Graz, winter 2021/22)]

Overview Types of Scientific Writing

- **Classification of Scientific/Technical Documents**
  - Formal vs informal writing, cumulative?, single vs multi-author, archival vs non-archival publications
- **Scientific Writing Skills are crucial**
  - Different types of docs share many similarities

Monographs
- BS Thesis
- MS Thesis
- PhD Thesis
- Habilitation

Scientific Papers

by pub. channel
- Preprint
- Conference
- Journal
- Tech Report

by contents
- Research
- Industry
- Survey
- E&A
- Vision

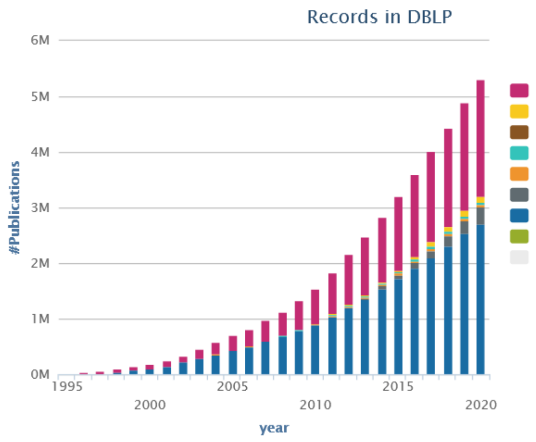
Others
- Grant Proposal
- Design doc
- White Paper
- Blog
- Website

Preparation

- **Know your Audience**

- **Get your Workflow in Order**
  - Writing: **LaTeX** (e.g., Overleaf, TeXnicCenter), **versioning** (e.g., git), **templates**
  - Plotting: **R** (e.g., plot, ggplot), **Python** (e.g., matplotlib, seaborn), **Gnuplot**, **LaTeX** (e.g., pgfplots)
  - Figures: e.g., MS Visio/**MS Powerpoint**, **Inkscape** → pdf, eps, svg (vector graphics)

- **Mindset: Quality over Quantity**
  - Aim for top-tier conferences/journals (act as filter)
  - Make the paper useful for others (ideas, evidence, code)



Paper Writing and Publication Process

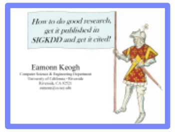
- **Research – Writing Cycle**
  - Read lots of papers
  - ~~Idea → Research → Writing → Document~~
  - Idea → Writing/Research → Document
  - Incremental refinement of drafts

- **Paper Submission Cycle**
  - Blind vs double-blind submission
  - Revisions and Camera-ready
  - **Similar: bachelor/master** thesis
    → drafts to advisor / final version

- **Example: SIGMOD 2024: Paper Submission Round 2**
  - **April 15, 2023**: Paper submission
  - **May 26 - 28, 2023**: Author feedback phase
  - **June 20, 2023**: Notification of accept/reject/review again
  - **July 20, 2023**: Revised paper submission
  - **August 23, 2023**: Final notification of accept/reject
  - **tba, 2023**: Camera ready due

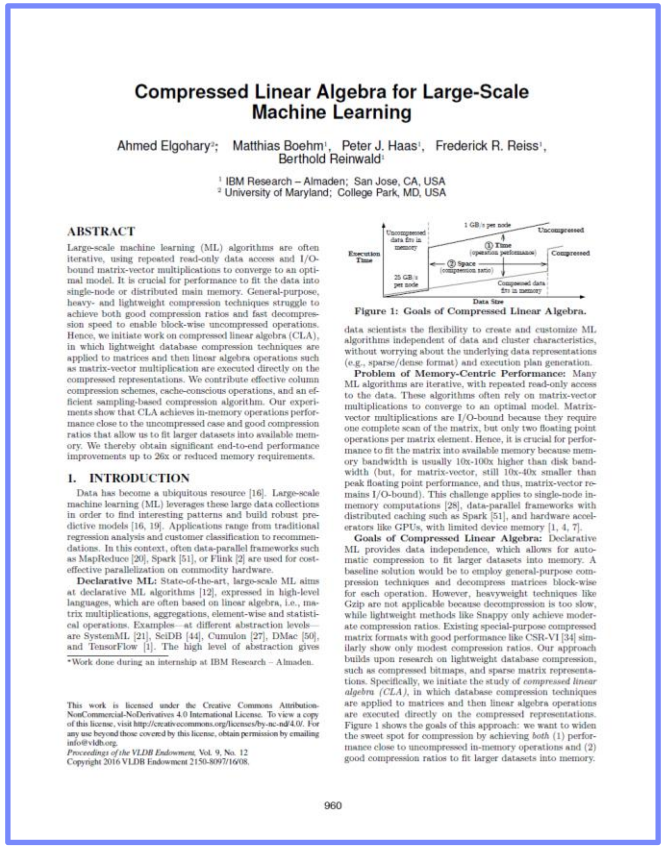
[Recommended Reading]

[Eamonn Keogh: How to do good research, get it published in SIGKDD and get it cited!, **KDD 2009**]



[Simon Peyton Jones: How to write a great research paper, MSR Cambridge]

Running Example


Compressed Linear Algebra for Large-Scale Machine Learning

Ahmed Elgohary[2]; Matthias Boehm[1], Peter J. Haas[1], Frederick R. Reiss[1], Berthold Reinwald[1]

[1] IBM Research – Almaden; San Jose, CA, USA
[2] University of Maryland; College Park, MD, USA

ABSTRACT

1. INTRODUCTION

Figure 1: Goals of Compressed Linear Algebra.

960

- **Example paper used in the following**
  - Ahmed Elgohary, **Matthias Boehm**, Peter J. Haas, Frederick R. Reiss, Berthold Reinwald: **Compressed Linear Algebra** for Large-Scale Machine Learning. **PVLDB 2016**

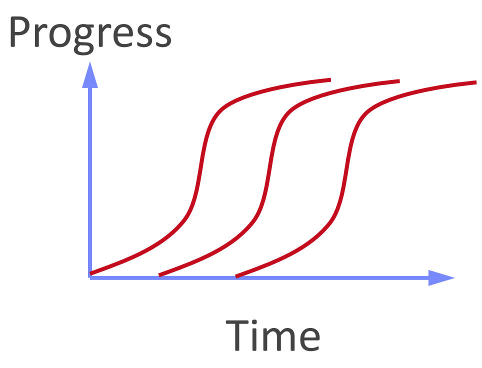
[Ahmed Elgohary, Matthias Boehm, Peter J. Haas, Frederick R. Reiss, Berthold Reinwald: Scaling Machine Learning via Compressed Linear Algebra. **SIGMOD Record 2017 46(1)**]

[Ahmed Elgohary, Matthias Boehm, Peter J. Haas, Frederick R. Reiss, Berthold Reinwald: Compressed Linear Algebra for Large-Scale Machine Learning. **VLDB Journal 2018 27(5)**]

[Ahmed Elgohary, Matthias Boehm, Peter J. Haas, Frederick R. Reiss, Berthold Reinwald: Compressed Linear Algebra for Large-Scale Machine Learning. **Commun. ACM 2019 62(5)**]

Ideas and Topic Selection

- **Problem-Oriented Research**
  - Focus on problem/observation first, not your solution
  - **Discuss early ideas** with collaborators and friends
  - Develop your taste for good research topics
  - Topic selection needs time → **pipeline model**



- **Ex. Compressed Linear Algebra**
  - **Problem:** Iterative ML algorithms + memory-bandwidth-bound operations
    → crucial to fit data in memory → automatic lossless compression
  - **Sub-problems:** #rows>>#cols, column correlation, column characteristics
    → column-wise compression w/ heterogeneous encoding formats

Prototypes and Experiments

- **Worst Mistake: Schrödinger's Results**
  - Postpone implementation and experiments till last before the deadline
  - No feedback, no reaction time (experiments require many iterations)
  - **Karl Popper:** falsifiability of scientific results
- **Continuous Experiments**
  - Run experiments during survey / prototype building
  - Systematic experiments → observations and ideas for improvements
  - Don't be afraid of throwíng away prototypes that don't work
- **Ex. Compressed Linear Algebra**
  - Data characteristics inspired overall design of encoding schemes
  - Initially slow compression → dedicated sampling schemes and estimators
  - Initially slow compressed operations → cache-conscious operations, selected operations with better asymptotic behavior

Prototypical Structure of a Scientific Paper

- **Title & Authors**
- **Sections and Subsections**
  - Abstract → short overview of problem and solution (part of meta data)
  - Introduction → context, problem, contributions
  - Background / Preliminaries → necessary background for understanding
  - Main Part → your technical core contributions
  - Main Part 2
  - Experiments → setting, micro benchmarks, end-to-end benchmarks
  - Related Work → areas of related work, differences to your own work
  - Conclusions → summary, conclusions, and future work
  - Acknowledgments → funding agencies, helpful people beyond co-authors
  - References → list of other works referenced throughout the paper
  - (Appendix) → any additional contents (e.g., proves of theorems, more results)

Title and Authors

- **List of Authors**
  - E.g., by contribution (main, …, advisor)
  - E.g., by last name
  - Affiliations, contact (corresponding author)

- **Title**
  - Descriptive yet concise
  - Short name if possible → easier to cite and discuss

Compressed Linear Algebra for Large-Scale Machine Learning

Ahmed Elgohary[2]*, Matthias Boehm[1], Peter J. Haas[1], Frederick R. Reiss[1], Berthold Reinwald[1]

[1] IBM Research – Almaden; San Jose, CA, USA
[2] University of Maryland; College Park, MD, USA

SPOOF: Sum-Product Optimization and Operator Fusion for Large-Scale Machine Learning

Tarek Elgamal[2]*, Shangyu Luo[3]*, Matthias Boehm[1], Alexandre V. Evfimievski[1], Shirish Tatikonda[4]*, Berthold Reinwald[1], Prithviraj Sen[1]

[1] IBM Research – Almaden; San Jose, CA, USA
[2] University of Illinois; Urbana-Champaign, IL, USA
[3] Rice University; Houston, TX, USA
[4] Target Corporation; Sunnyvale, CA, USA

MNC: Structure-Exploiting Sparsity Estimation for Matrix Expressions

Johanna Sommer, IBM Germany
Matthias Boehm, Graz University of Technology
Alexandre V. Evfimievski, IBM Research – Almaden
Berthold Reinwald, IBM Research – Almaden
Peter J. Haas, UMass Amherst

SliceLine: Fast, Linear-Algebra-based Slice Finding for ML Model Debugging

Svetlana Sagadeeva*, Graz University of Technology
Matthias Boehm, Graz University of Technology

[**Credit:** sliceline, Silicon Valley, HBO]

Abstract

% 1. State the problem

Large-scale machine learning (ML) algorithms are often iterative, using repeated read-only data access and I/O-bound matrix-vector multiplications to converge to an optimal model. It is crucial for performance to fit the data into single-node or distributed main memory.

% 2. Say why it's an interesting problem

General-purpose, heavy- and lightweight compression techniques struggle to achieve both good compression ratios and fast decompression speed to enable block-wise uncompressed operations.

% 3. Say what your solution achieves

Hence, we initiate work on compressed linear algebra (CLA), in which lightweight database compression techniques are applied to matrices and then linear algebra operations such as matrix-vector multiplication are executed directly on the compressed representations. We contribute effective column compression schemes, cache-conscious operations, and an efficient sampling-based compression algorithm. Our experiments show that CLA achieves in-memory operations performance close to the uncompressed case and good compression ratios that allow us to fit larger datasets into available memory.

% 4. Say what follows from your solution

We thereby obtain significant end-to-end performance improvements up to 26x or reduced memory requirements.

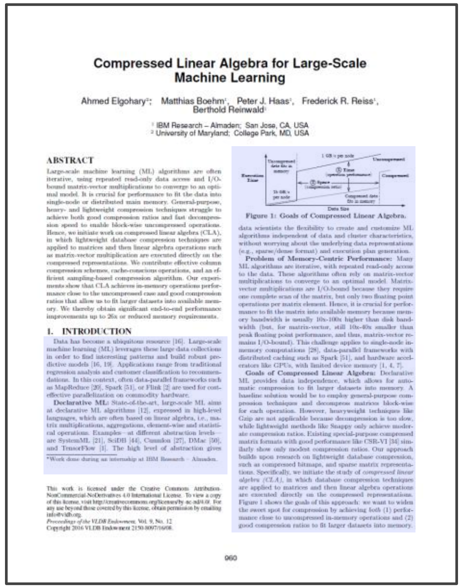
[Simon Peyton Jones: How to write a great research paper, MSR Cambridge]

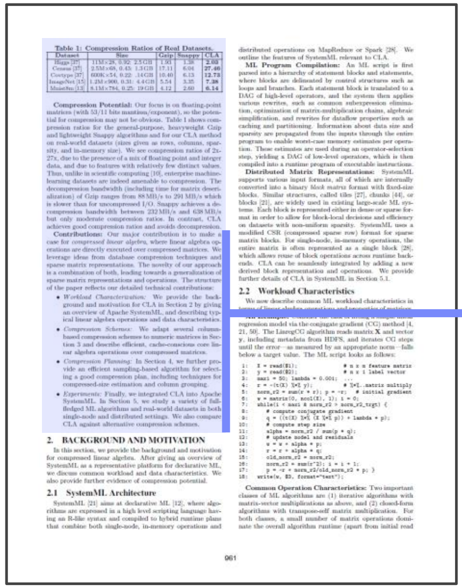
ABSTRACT

Large-scale machine learning (ML) algorithms are often iterative, using repeated read-only data access and I/O-bound matrix-vector multiplications to converge to an optimal model. It is crucial for performance to fit the data into single-node or distributed main memory. General-purpose, heavy- and lightweight compression techniques struggle to achieve both good compression ratios and fast decompression speed to enable block-wise uncompressed operations. Hence, we initiate work on compressed linear algebra (CLA), in which lightweight database compression techniques are applied to matrices and then linear algebra operations such as matrix-vector multiplication are executed directly on the compressed representations. We contribute effective column compression schemes, cache-conscious operations, and an efficient sampling-based compression algorithm. Our experiments show that CLA achieves in-memory operations performance close to the uncompressed case and good compression ratios that allow us to fit larger datasets into available memory. We thereby obtain significant end-to-end performance improvements up to 26x or reduced memory requirements.

Introduction

- **Prototypical Structure**
  - Context (1 paragraph)
  - Problems (1-3 paragraphs)
  - [Existing Work (1 paragraph)]
  - [Idea (1 paragraph)]
  - Contributions (1 paragraph)



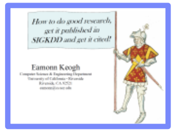


Contributions: Our major contribution is to make a case for *compressed linear algebra*, where linear algebra operations are directly executed over compressed matrices. We leverage ideas from database compression techniques and sparse matrix representations. The novelty of our approach is a combination of both, leading towards a generalization of sparse matrix representations and operations. The structure of the paper reflects our detailed technical contributions:

- *Workload Characterization:* We provide the background and motivation for CLA in Section 2 by giving an overview of Apache SystemML, and describing typical linear algebra operations and data characteristics.
- *Compression Schemes:* We adapt several column-based compression schemes to numeric matrices in Section 3 and describe efficient, cache-conscious core linear algebra operations over compressed matrices.
- *Compression Planning:* In Section 4, we further provide an efficient sampling-based algorithm for selecting a good compression plan, including techniques for compressed-size estimation and column grouping.
- *Experiments:* Finally, we integrated CLA into Apache SystemML. In Section 5, we study a variety of full-fledged ML algorithms and real-world datasets in both single-node and distributed settings. We also compare CLA against alternative compression schemes.

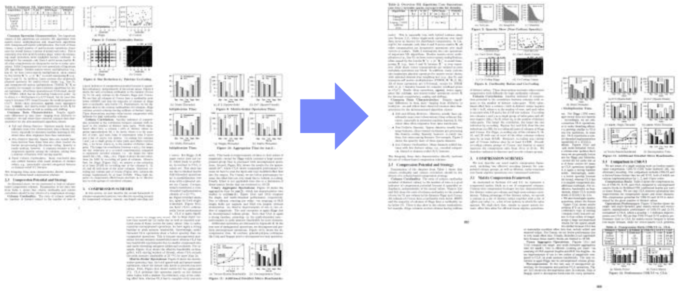
- **Introduction Matters**
  - **Anchoring**: most reviewers reach their opinion after reading introduction and motivation and then look for evidence

[Eamonn Keogh: How to do good research, get it published in SIGKDD and get it cited!, **KDD 2009**]



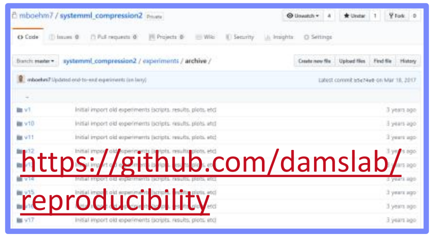
Writing the Paper (and more Experiments)

- **Easily Readable: Quality ∝ Time**
  - **Make it easy to skim the paper**
    → paragraph labels, self-explanatory figures (close to text), and structure
  - Avoid unnecessary formalism → as simple as possible
  - Shortening the text in favor of structure improves readability
  - **Ex. Compressed Linear Algebra**
    - Initial SIGMOD submission: **12+3 pages**
    - Final PVLDB submission: **12 pages**
      (+ more figures, experiments, etc.)



→ **02 Scientific Reading and Writing**

- **Solid, Reproducible Experiments**
  - Create, use, and share dedicated benchmarks / datasets
  - Avoid weak baselines, start early w/ baseline comparisons
  - Automate your experiments as much as possible
  - Keep repository of all scripts, results, and used parameters



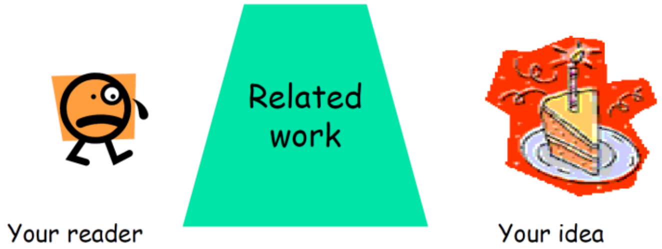
https://github.com/damslab/reproducibility

→ **03 Experiments, Reproducibility, and Giving Presentations**

Related Work

[Simon Peyton Jones: How to write a great research paper, MSR Cambridge]

- **Purpose of a "Related Work"-Section**
  - **Not** a mandatory task or to show you know the field
  - Put you work in context of related areas (~ 1 paragraph each)
  - Discuss closely related work
  - **Crisp separation from existing work** (what are the differences)
- **Placement**
  - Section 2 or **Section n-1**
  - Throughout the paper



- **Give Credit**
  - Cite broadly, **give credit to inspiring ideas**, create connections
  - Honestly acknowledge **limitations of your approach**

References

- **Setup**
  - Use LaTeX **\cite**{} and BibTeX
  - Use a consistent source of bibtex entries (e.g., DBLP)

```
inproceedings{StonebrakerBPR11,
  author    = {Michael {Stonebraker et al.}},
  title     = {{The Architecture of SciDB}},
  booktitle = {{SSDBM}},
  year      = {2011}
}
```

VLDB2016.bib

```
\bibliographystyle{abbrv}
\bibliography{VLDB2016}
```

- **Different References Styles**
  - But, **not in footnotes** (unless required)
  - **8. REFERENCES**

[1] M. Abadi et al. TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems. *CoRR*, 2016.

[2] A. Alexandrov et al. The Stratosphere Platform for Big Data Analytics. *VLDB J.*, 23(6), 2014.

References

[Al14] Alexandrov, A. et al.: The Stratosphere platform for big data J. 23/6, 2014.

[AS14] Arap, O.; Swany, M.: Offloading MPI Parallel Prefix Scan the NetFPGA. CoRR abs/1408.4939/, 2014.

References

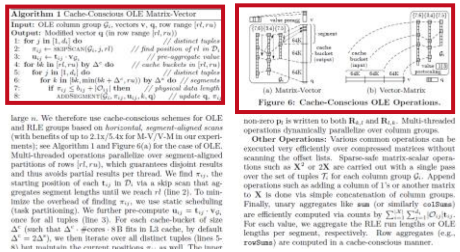
Jaume Amores. 2013. Multiple instance classification: Review, taxonomy and comparative study. *Artificial Intelligence*.

Dealing with Feedback / Criticism

- **Different Kinds of Feedback**
  - Casual discussion of early ideas
  - Comments on paper drafts
  - Reviewer comments (good and bad)

  - Always welcome feedback/criticism
  - Address all feedback w/ sincere effort

- **Example Compressed Linear Algebra**
  - SIGMOD Reviewer 2 (REJECT)
    - "The rewriting for q=Xv seems wrong: To compute q, one takes each row of the matrix X and multiplies it with the vector v."
  - PVLDB Reviewer 3 (WEAK ACCEPT)
    - "I kinda disagree with the broad definition of declarative ML […]."



[Matthias Boehm et al.: Declarative Machine Learning - A Classification of Basic Properties and Types. **CoRR 2016**.]

- **Paper Rebuttal and/or Revision**
  - **Rebuttal**: seriously consider all feedback (in doubt agree), and answer with facts / ideas how to address the comments
  - **Revision** (conditional accept): address all revision requests

List of Seminar Topics

See list at https://pdamme.github.io/teaching/2024_summer/lde/SeminarTopics.pdf

Summary and Q&A

- **Course Organization, Outline, and Deliverables**
- **Structure of Scientific Papers**
- **List of Seminar Topics (Proposals)**

- **Remaining Questions?**

- **Next Lectures**
  - 02 **Scientific Reading and Writing** [Apr 29]
  - 03 **Experiments, Reproducibility, and Giving Presentations** [May 06]