Concluding remarks

Conclusion $\neq$ Summary

For example:

> In this paper, we studied the top-k retrieval issue for Conditional Preference Network (CP-Net). We defined the problem of top-k retrieval for CP-Net. We proposed a depth first algorithm to generate top-k results without scanning the database. To support the algorithm, we designed a indexing scheme – Hierarchical Bitmap. We conducted extensive experimental study on both synthetic and real world data to demonstrate the effectiveness of our approach.
>
> — Wang et al., CIKM, 2012.

We don't simply summarize the paper (in past tense). A very common mistake!

- The Conclusion is **not a summary of the paper**.
- It's not a place to pat ourselves on the back ("our work is great!").
- There's no reason to switch to past tense. (It's grammatically okay, but it misses the point.)

More "Conclusion = Summary" examples

> We have developed PACMAN, a database recovery mechanism that achieves speedy failure recovery without introducing any costly overhead to the transaction processing. By leveraging a combination of static and dynamic analyses, PACMAN exploits fine-grained parallelism for replaying logs generated by coarse-grained transaction-level logging. By performing extensive performance studies on a 40-core machine, we confirmed that PACMAN can significantly reduce the database recovery time compared to the state-of-the-art recovery schemes.
>
> — Wu et al., SIGMOD, 2017.

> This paper has focused on providing the database-like support over native array storage, with a specific focus on implementing a number of structural aggregation operations. These operations arise in a number of scientific disciplines. We have demonstrated that by development of nuanced algorithms and cost models, efficient array operations can be supported over native array storage. Detailed performance comparisons with SciDB further confirm this - despite no data ingestion overhead, our aggregation processing costs are lower. We have also shown high parallel efficiency with our algorithms.
>
> — Wang et al., SSDBM, 2014.

Conclusion $\neq$ Summary + Future Work

> This paper introduces a novel approach to query approximation in probabilistic and relational databases via ...
>
> We see several promising directions for future work. We plan to integrate the approximation framework into ...
>
> — Fink and Olteanu, SSDBM, 2014.

There's **a lot of things** we might say in the Conclusion:

- **What now?** What's the situation now that this research is done? What has changed as a result of this research? What can be done now that couldn't be done before?
- What has been learned? And what can be re-used in other contexts?
- What are the major challanges in this research?
- How scalable is it? And how do we come to that conclusion? And could it realistically be used?
- What are the limitations? And What has not been done?
- How can this work be improved? I.e., future research directions.

The conclusion is **not for summarizing the paper**. However, it may help to restate the major results.

It might help to call it "Concluding Remarks" instead of "Conclusion" or "Conclusions".

What now?

The most important topic to write about. **What has changed?**

1. *Stage 1*: Situation before the research.
2. *Stage 2*: New research (what we write in the paper).
3. *Stage 3*: Situation after the research.

- What are (realistic) applications of the research?
  - If the research improves a component of some software package, what is the impact on people who use that software? Why does it matter that ABC is now 50% faster?
  - How would a user, administrator, designer, researcher, etc., use this specific research? Not the whole software—how do the benefit from the improvement in the paper?
- What does the reader need to know to utilize this research?
- What has changed as a result of this research? (Big picture. Implications. Design decisions.)
  - We usually describe the bigger picture in the introduction. How does the research affect this?
  - E.g. if the research is in the area of cloud computing, describe how the research in the paper could be used in cloud computing.

What now? (Examples)

Design decisions:

> When choosing between EPCM and PCCP, we recommend that PCCP be used if memory space is ~~very~~ constrained, since PCCP stores less statistics and [has] less stall time when [the] cache size is small. EPCM should be used if [the] memory size is large, since EPCM [has] less stall time [in] this situation.
>
> — He and Marquez, VLDB J., 2007.

Predicted relevance:

> Given the relevance of fuzzy objects to a wide range of applications, we expect this research to trigger further work in this area, opening a way for other advanced queries such as spatial join queries, reverse nearest neighbor queries and skyline queries.
>
> — Zhang et al., SIGMOD, 2010.

Examples of Implications

How best to describe the implications varies. Two examples are:

> Our results gave us two ways to "simplify" the composition of an arbitrary number of st-tgd mappings. First, we could replace the composition by a single schema mapping, specified by an unnested SO tgd. Second, we could replace the composition by the composition of only two st-tgd schema mappings. A similar comment applies to the composition of an arbitrary number of standard schema mappings.
>
> — Arenas et al., ICDT, 2010.

> Considering the overall results for sketching interval data, we recommend the use of the fast range-summation method with domain partitioning whenever the accuracy is critical and the use of DMAP COUNTS method over F-AGMS sketches in situations where the time to maintain the sketch is critical.
>
> — Rusu and Dobra, ACM T. Database Syst,, 2008.

What are the limitations?

Every piece of research is limited in some way (we haven't solved everything); we **explicitly identify them**.

- It's part of being **academically honest**. What would an impartial scientist write? (Write that!)
  - Imagine someone actually implementing the proposed method; what obstacles will they likely encounter?
  - **How big of a problem are these limitations?**
    - If they're unlikely to be realistically encountered, explain how you come to this conclusion.
- If what's presented **does not apply in certain circumstances**, describe those circumstances.
- Describe **the assumptions made**, and either (a) how they're justified as reasonable assumptions, or (b) how making those assumptions restricts the scope.

Limitations

> In this paper, there are still some issues that can be improved. For example, patients who share their edge devices if edge devices have extra capacity storage. However, there is the issue of security as well as the issue of sacrificing one's battery life and having to deal with a longer processing time if one is to share the edge device. A clear reward algorithm is needed.
>
> — Chen, et al., arXiv:1711.10556, 2017.

- In plain language, the authors...
  - give an example of what they have **not** done, and
  - describe **why they have not done it** (complicated by a trade-off issue).

How can this work be improved?

We describe future research directions.

- We can describe ways to overcome the limitations we listed, but which would require another paper to study in depth.
- We list the ideas that arise during the course of the research. (What if we try XYZ?)
- We discuss "design decisions" which may not be optimal.

If it's possible to easily make a significant improvement, you should do this. Otherwise, the paper will feel underdeveloped.

Don't attempt to predict the future...

We can't predict the future

> We have proposed a game-theoretic framework to investigate the impact of revenue sharing mechanisms on the performance of an Edge-Cloud system in which edge providers and cloud providers compete with each other and game with the system in order to maximize their own utilities. We have found that the revenue sharing based directly on actual contributions of servers can result in significantly worse system-level performance than Shapley value and Ortmann proportional sharing mechanisms at the Nash equilibria of the game between providers. **For future work, we will** conduct a theoretic analysis, study dynamic game playing processes, and conduct large scale experiments of Edge-Cloud systems.
>
> — Cao et al., arXiv:1711.10102, 2017.

- Don't write "we will do XYZ"!!
  - We don't know if it's true.
    - Maybe we don't end up doing it. Maybe someone else does it first. Maybe it doesn't work the way we envisage.
  - It excludes the scientific community.

> Finally, we notice further opportunities to speed up the CA stage or the BigClam community detection algorithm, and suggest these as possible future work. The CA stage could be improved by using a more suitable data structure to represent the set of communities and traversing $\vec{F}_u$ as a sparse vector. Alternatively, it is possible to rewrite BigClam under a distributed computing framework to further scale the algorithm. Saltz et al. implemented a (non-overlapping) community detection algorithm on a Hadoop cluster [34], which opens the possibility of implementing Big-Clam on Hadoop or GraphX on Apache Spark [42]. We believe with a suitable pre-partitioning of the graph (say [4]), we can distribute work to multiple worker nodes in a cluster in a manner that requires little synchronization [15].
>
> — Liu and Chamberlain, arXiv:1712.01209, 2017.

- We give some indication as to how these ideas might be achieved ("with a suitable pre-partitioning of the graph").
- It's clear they will take a lot of effort to implement.
- They don't claim that they are going to do this—they present it as "possible future work".

Critique...

> This paper considers scheduling on MapReduce jobs on machines with different speeds. The precedence constraint between the map tasks and the reduce tasks in MapReduce jobs is captured to give a scheduling algorithm that optimizes the weighted completion time of all jobs. The problem is NP-hard and the proposed solution uses scheduling of different tasks on the servers using a solution of a linear program, that can be solved in polynomial time. The proposed approach is shown to be approximately optimal, with a competitive ratio of $2(1+(m-1)/D)+1$, where m is the number of servers and $D \geq 1$ is the task-skewness product. The competitive ratio is shown to be $2(1+(m-1)/D)$ when all the jobs are released at time 0. The algorithm is implemented on Hadoop framework, and compared with other schedulers. Results demonstrate significant improvement of our proposed algorithm as compared to the baseline schedulers.
>
> — Aggarwal et al., arXiv:1711.09964, 2017.

- This is a summary, not a conclusion.
- That's what you've done; so what?

Critique...

> This report mainly focuses on accelerating Image Encryption algorithm with CUDA-based manner. Experiment results have shown that the performance of the scheme is effective both in encryption results and operation speedup. All the chaotic image encryption algorithms involves in generating chaotic sequences which can be parallelized on GPU. There are several other chaotic image encryption algorithms which are more complex and computationally intensive in nature that can be accelerated using CUDA version. Future work involves parallel implementation of the given Image Encryption Algorithm on OpenCL which is a platform for writing programs on heterogeneous system which are having CPU and GPU devices. GPU devices may be from ATI, Nvidia etc.
>
> — Vihari and Mishra, CUBE, 2012.

- The writing is messy, and the grammar is clunky, but...
- There's a clear discussion on the limitations of the work.
- This is tied in with the discussion of future work.

References

Mostly we write references using BibTeX. **BibTeX has some quirks!** Online BibTeX entries contain many errors; they're also inconsistent.

- All references contain: Author(s), title, year, and page numbers. (If possible.)
- *Journal* references contain abbreviated journal names and journal volume numbers.
- *Conference* references contain a shortened conference name, either:
  - Acronymized: "Proc. ICASSP", "Proc. Internetware", "Proc. NOSSDAV", etc.
  - Abbreviated: "Proc. High Performance Computing and Networking", " Proc. Parallel Computing Technologies", etc.
  - One or the other—not both! Be consistent.
- *Online* references include a URL (`\usepackage{url}`) and "Accessed [date]".
- *Book* references include publisher, but don't include page numbers (if we want page numbers, we use `\cite[p.~30]{bookname}`).

What can go wrong? (Conferences.)

> [3] Z. Ji and S. Qin. Detection of eeg basic rhythm feature by using band relative intensity ratio (brir). In *Acoustics, Speech, and Signal Processing, 2003. Proceedings.(ICASSP'03). 2003 IEEE International Conference on*, volume 6, pages VI–429. IEEE, 2003.
>
> — Chen et al., ICMR, 2016.

Problems:

- Acronyms: "EEG" and "BRIR" are not capitalized.
- Year "2003" stated four times. IEEE stated twice.
- Conference name a total mess. Page numbers nonsensical.
- We don't need the "volume".

What it should look like:

> [1] Z. Ji and S. Qin, "Detection of EEG basic rhythm feature by using band relative intensity ratio (BRIR)," in *Proc. Acoustics, Speech, and Signal Processing*, 2003, pp. 429–432.

BibTeX: Conference

```
@inproceedings{JiQin2003,
  title={Detection of {EEG} basic rhythm feature
    by using band relative intensity ratio {(BRIR)}},
  author={Zhong Ji and Shuren Qin},
  booktitle={Proc. Acoustics, Speech,
    and Signal Processing},
  pages={429-432},
  year={2003}
}
```

> [1] Z. Ji and S. Qin, "Detection of EEG basic rhythm feature by using band relative intensity ratio (BRIR)," in *Proc. Acoustics, Speech, and Signal Processing*, 2003, pp. 429–432.

```
@inproceedings{JiQin2003,
  title={Detection of {EEG} basic rhythm feature
    by using band relative intensity ratio {(BRIR)}},
  author={Zhong Ji and Shuren Qin},
  booktitle={Proc. ICASSP},
  pages={429-432},
  year={2003}
}
```

> [1] Z. Ji and S. Qin, "Detection of EEG basic rhythm feature by using band relative intensity ratio (BRIR)," in *Proc. ICASSP*, 2003, pp. 429–432.

What can go wrong? (Journals.)

> [11] A. Das and R. Srikant, "Diffusion approximations for a single node accessed by congestion-controlled sources," *IEEE Trans. Automat. Contr.*, vol. 45, pp. 1783–1799, Oct. 2000.
> [12] S. Floyd and V. Jacobson, "Random early detection gateways for congestion avoidance," *IEEE/ACM Trans. Networking*, vol. 1, pp. 397–413, Aug. 1993.
>
> — Chang and Liu, IEEE/ACM T. Netw., 2004.

Not bad, except:

- We don't need the month.
- IEEE lists the journal abbreviations as "IEEE Trans. Autom. Control" and "IEEE/ACM Trans. Netw.", respectively. (`www.ieee.org/documents/trans_journal_names.pdf`)

> [8] Kleinberg, J. Authoritative sources in a hyperlinked environment. In Journal of the ACM, 46(5):604-632, 1999.
>
> — Yang et al., CIKM, 2007.

- Should not write "In" (that's for proceedings). Journal abbreviation is "J. ACM".

BibTeX: Journal

```
@article{Kleinberg1999,
   author = {Jon M. Kleinberg},
   title = {Authoritative sources in a
     hyperlinked environment},
   journal = {J. ACM},
   volume = {46},
   year = {1999},
   pages = {604-632}
}
```

[1] J. M. Kleinberg, "Authoritative sources in a hyperlinked environment," *J. ACM*, vol. 46, pp. 604–632, 1999.

Errors in online BibTeX entries

http://doi.acm.org/10.1145/844128.844146.

Timothy Wood, Prashant Shenoy, and Arun. Black-box and gray-box strategies for virtual machine migration. pages 229–242. URL `http://www.usenix.org/events/nsdi07/tech/wood.html`.

T. Yang, E. Berger, M. Hertz, S. Kaplan, and J. Moss. Automatic heap sizing: Taking real memory into account, 2004. URL `citeseer.ist.psu.edu/article/yang04automatic.html`.

Ting Yang, Emery D. Berger, Scott F. Kaplan, and J. Eliot B. Moss. CRAMM: virtual memory support for garbage-collected applications. In *OSDI '06: Proceedings of the 7th symposium on Operating systems design and implementation*, pages 103–116, Berkeley, CA, USA, 2006. USENIX Association. ISBN 1-931971-47-1.

Pin Zhou, Vivek Pandey, Jagadeesan Sundaresan, Anand Raghuraman, Yuanyuan Zhou, and Sanjeev Kumar. Dynamic tracking of page miss ratio curve for memory management. In *ASPLOS-XI: Proceedings of the 11th international conference on Architectural support for programming languages and operating systems*, pages 177–188, New York, NY, USA, 2004. ACM. ISBN 1-58113-804-0. doi: http://doi.acm.org/10.1145/1024393.1024415.

— Zhao and Wang, VEE, 2009.

- Conference name omitted.
- "T. Yang" and "Ting Yang" inconsistent.
- Conference capitalization wrong.
- We don't need location ("New York" etc.). We don't need "ACM".
- Don't cite Citeseer. Don't cite ACM.

Critique...

[5] B. J. Fino and V. R. Algazi, "Classification of Random Binary Sequences Using Walsh-Fourier Analysis," *Proceedings of the IEEE Transactions on Electromagnetic Compatibility, EMC-13(3):74-77, 1971.*

— Wang, Wang, and Liu, IWQoS, 2011.

- It's *IEEE Transactions on Electromagnetic Compatibility*, not *Proceedings of the IEEE Transactions on Electromagnetic Compatibility*.

[13] H. Wang, X. Cheng, and J. Liu, ""The Failure of Possion Arriveal," Tech, Rep. School of Computing Science, Simon Fraser University, 2010," *School of Computing Science, Simon Fraser University, Tech, Rep., 2010.*

— Wang, Wang, and Liu, IWQoS, 2011.

- What a mess! Need to check the .pdf output.

Critique...

[7] M. Girvan and M. E. Newman. Community structure in social and biological networks. *Proceedings of the national academy of sciences*, 99(12):7821–7826, 2002.

— Liu and Wang, Proc. VLDB, 2016.

- Incorrect journal capitalization.
- Abbreviation is: *Proc. Natl. Acad. Sci. U.S.A.*

(`https://en.wikipedia.org/wiki/Proceedings_of_the_National_Academy_of_Sciences_of_the_United_States_of_America`)