Accelerating Joins with Filters: Keeping a Limited Memory is Robust

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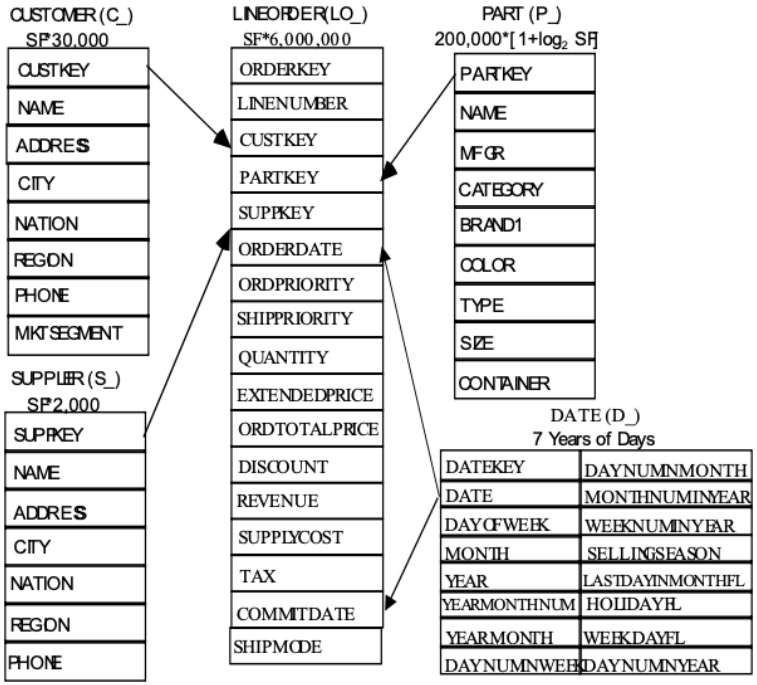
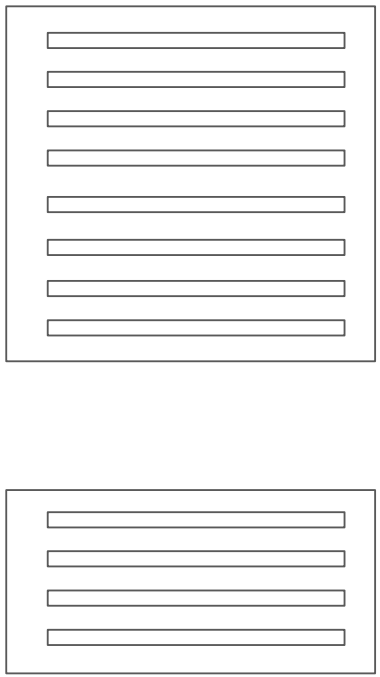
University of Wisconsin-Madison

Star Schema



- If the query optimizer chooses a poor join order, intermediate join results may be unnecessarily large.
- Solution: try to filter out extraneous tuples before performing joins

Lookahead Information Passing (LIP)



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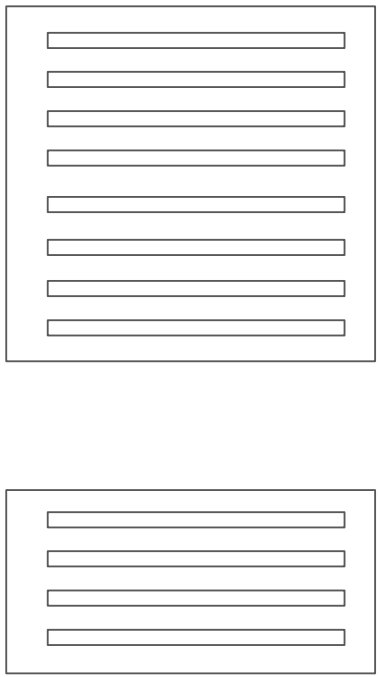

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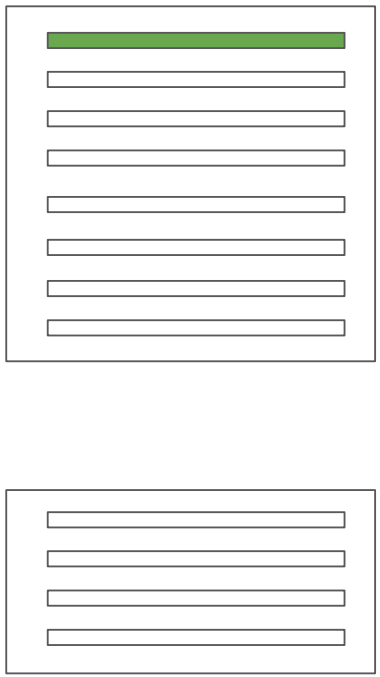

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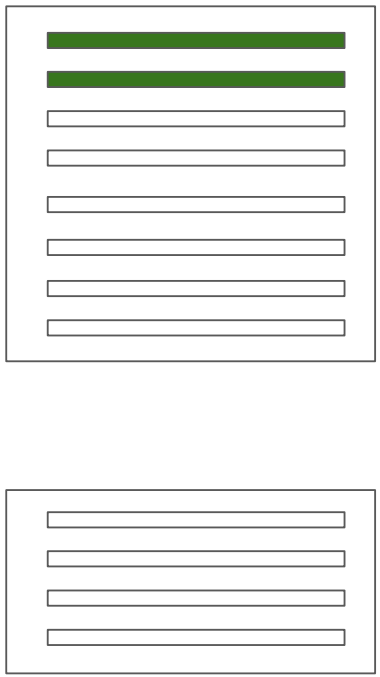

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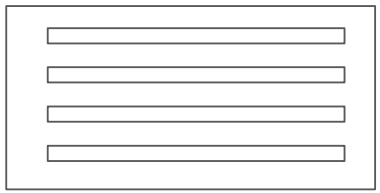

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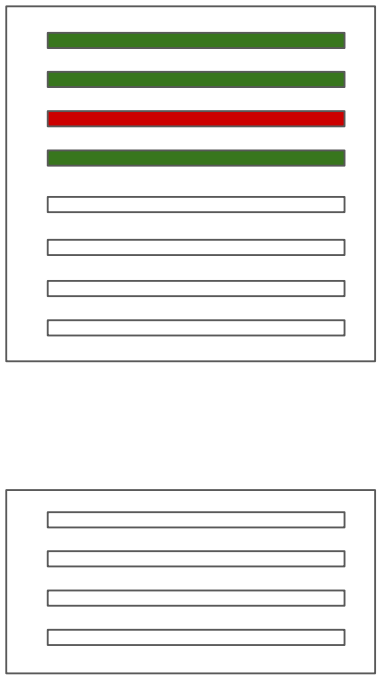

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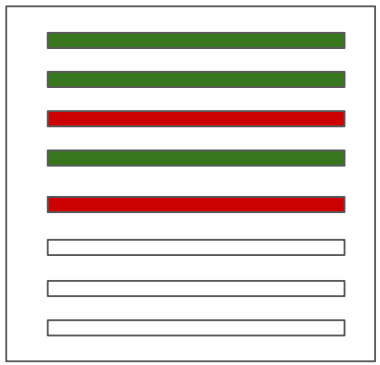

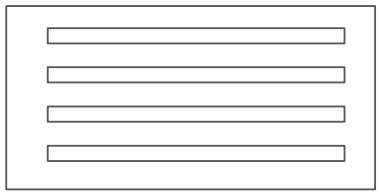

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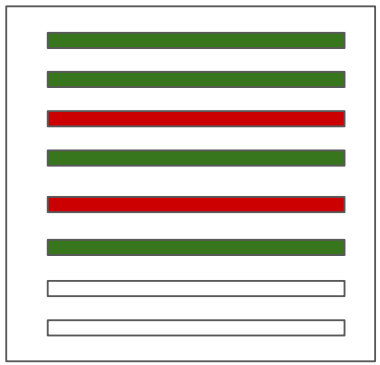

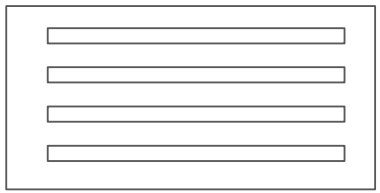

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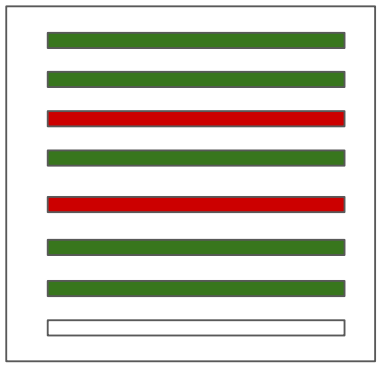

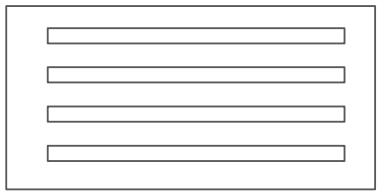

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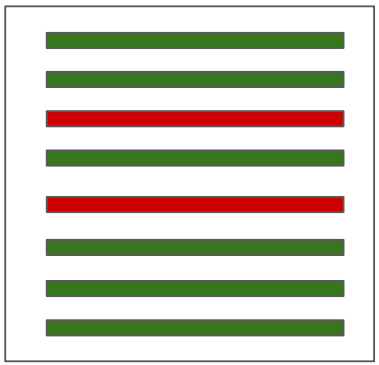

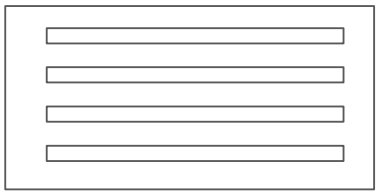

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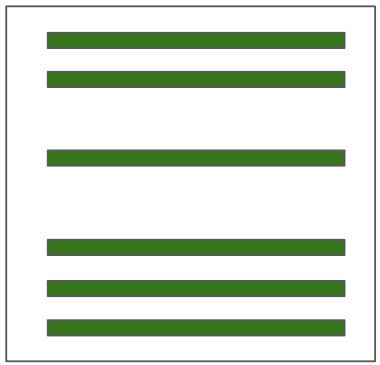

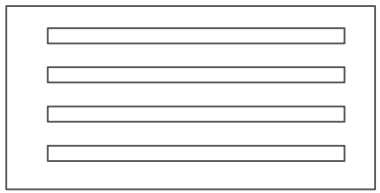

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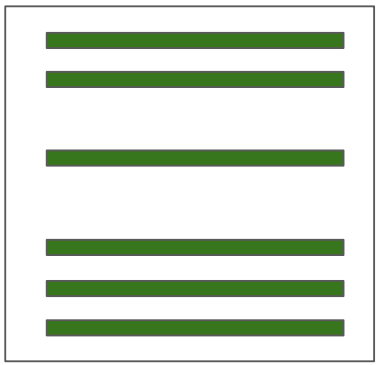

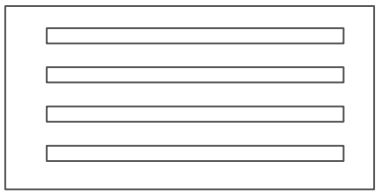

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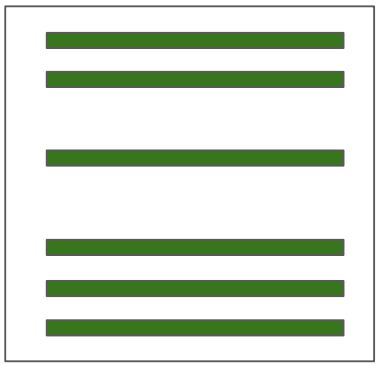

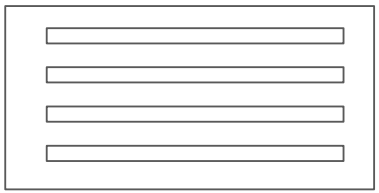

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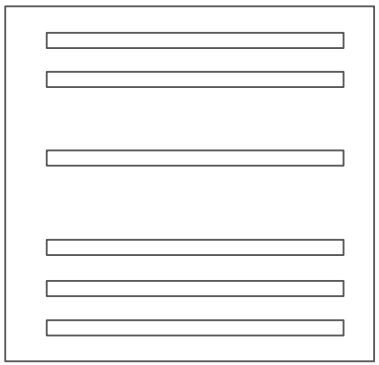

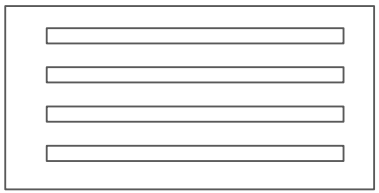

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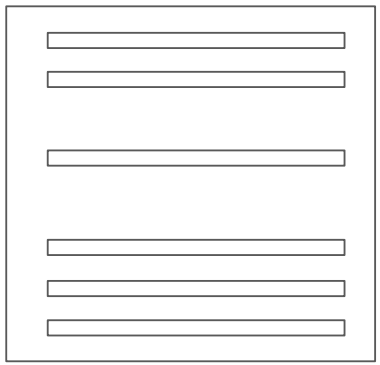

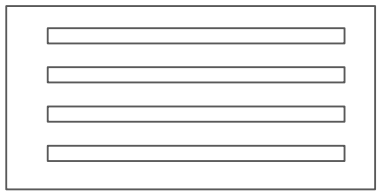

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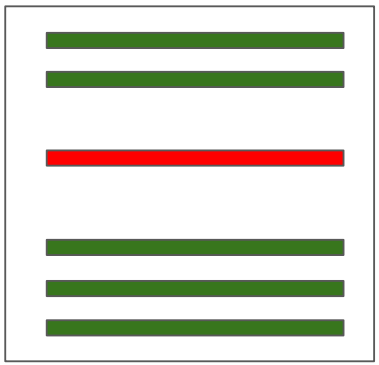

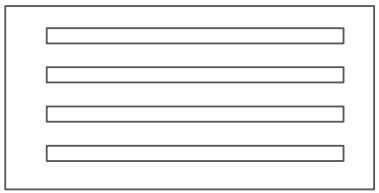

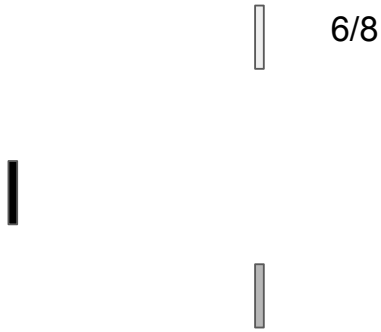

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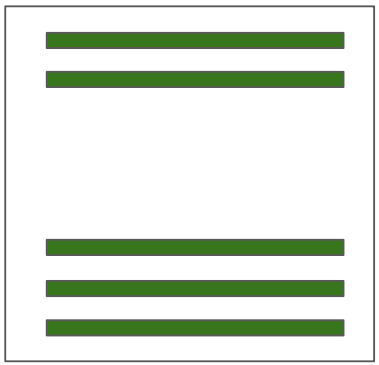

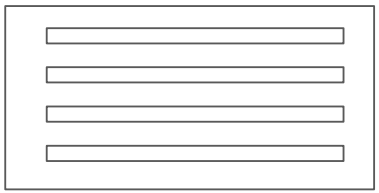

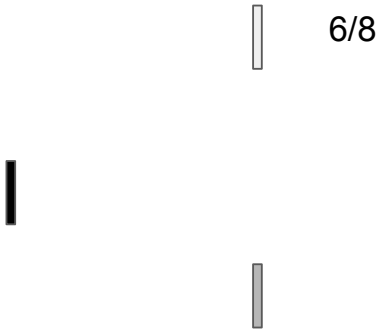

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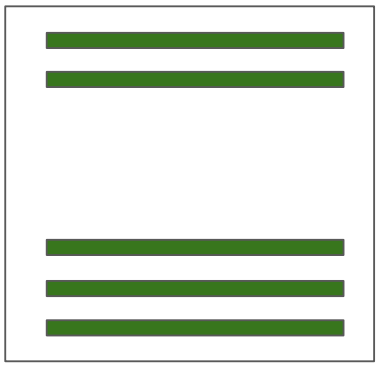

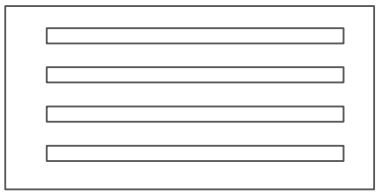

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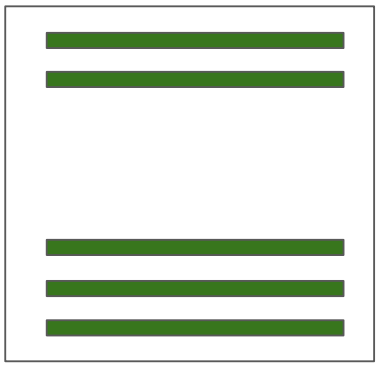

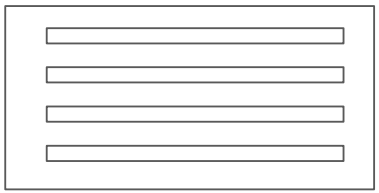

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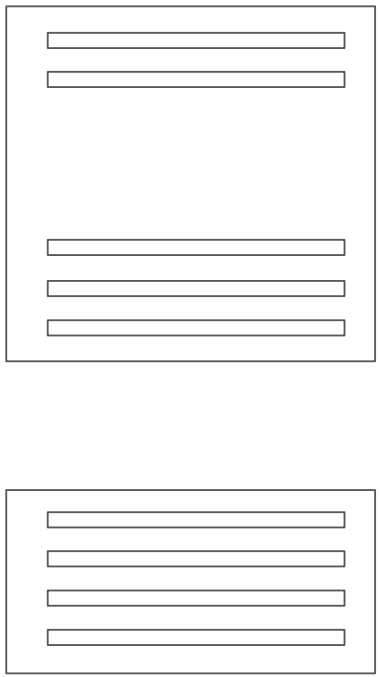

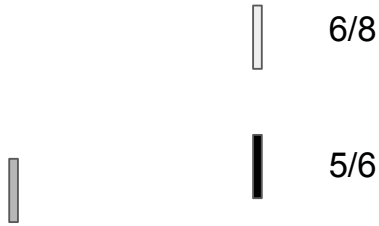

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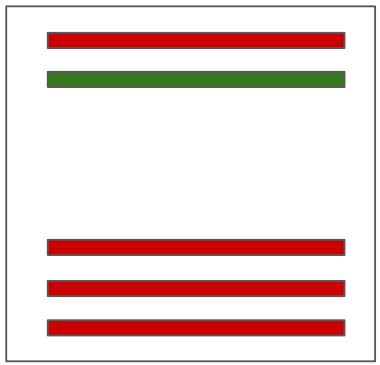

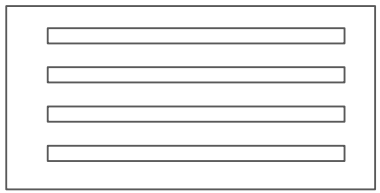

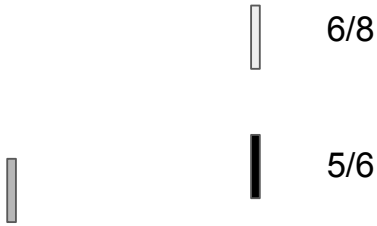

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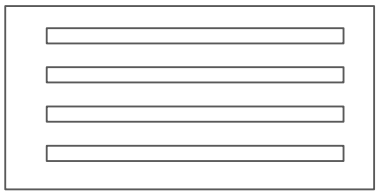

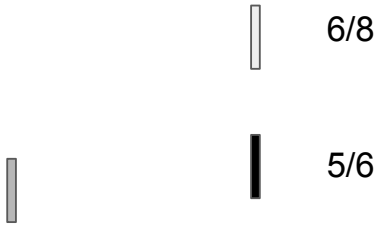

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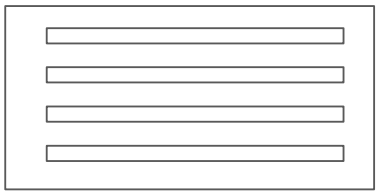

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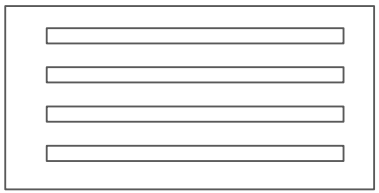

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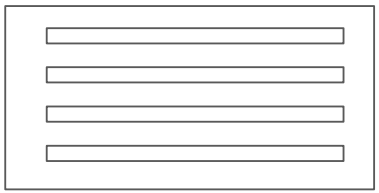

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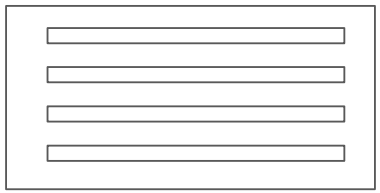

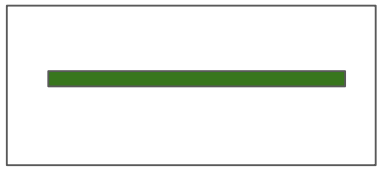

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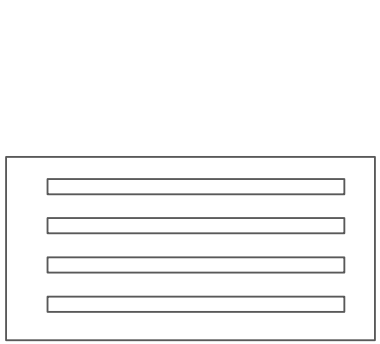
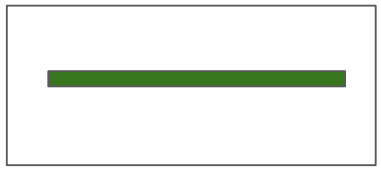
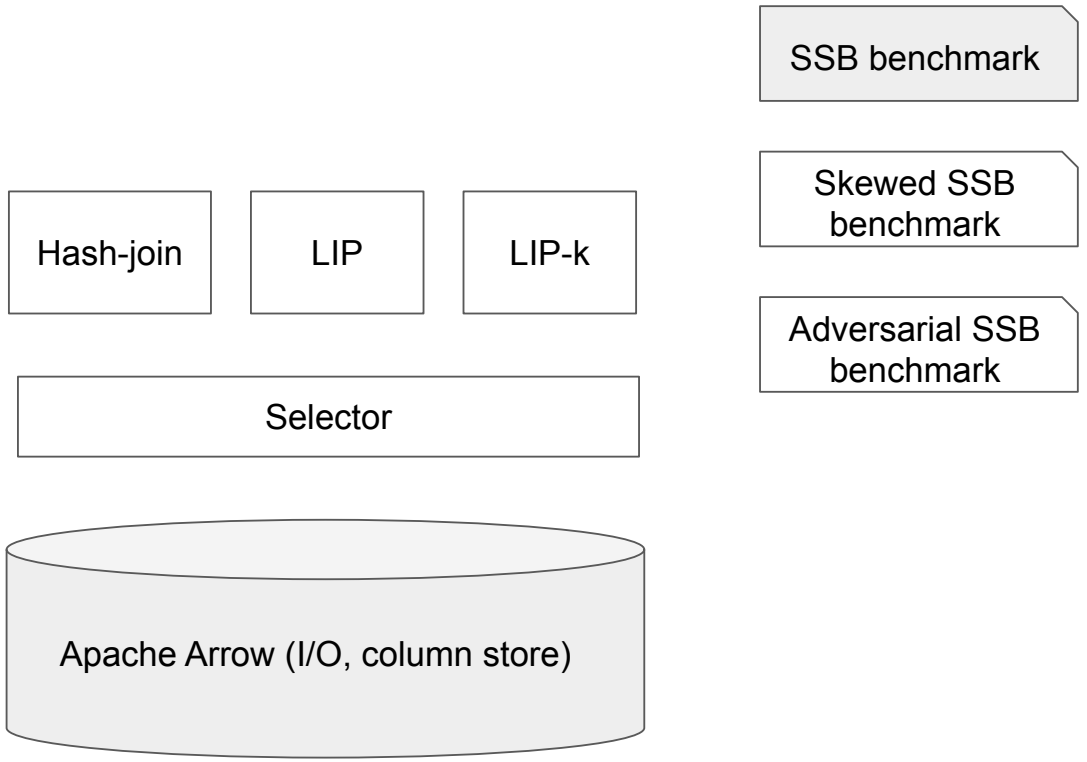


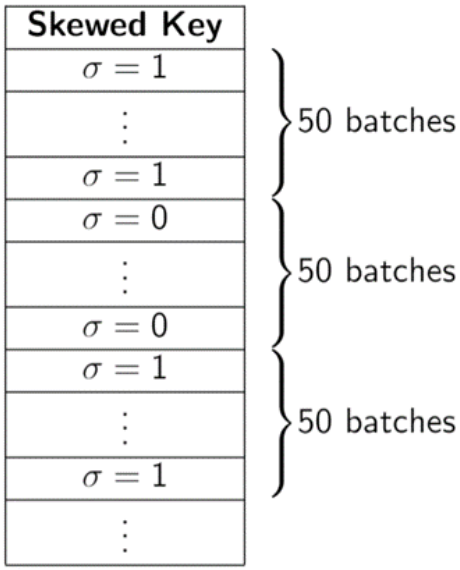


- LIP uses statistics from all previous batches to compute σ
  - Slow response to local changes in key distributions
- **LIP-k**: Only use the previous k batches to compute σ

Implementation and benchmarking



An Example Experiment



An Example Experiment

Skewed Key	
$\sigma = 1$	50 batches
⋮	
$\sigma = 1$	
$\sigma = 0$	50 batches
⋮	
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$\sigma = 1$	50 batches
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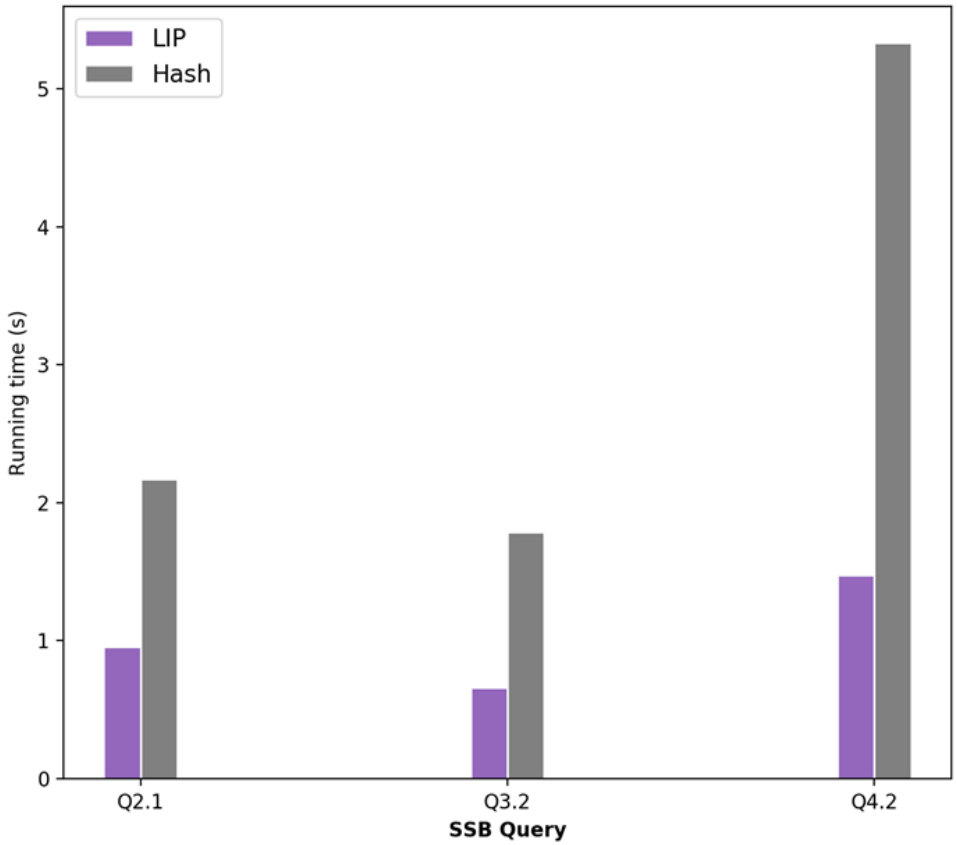
⋮	



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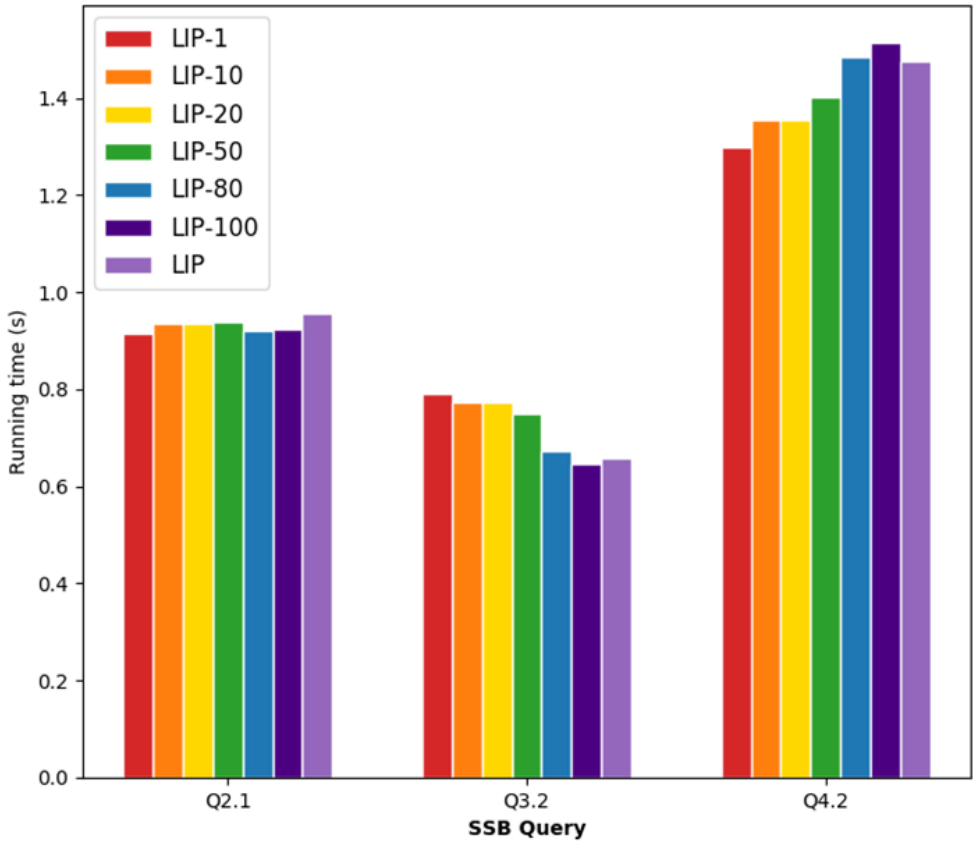

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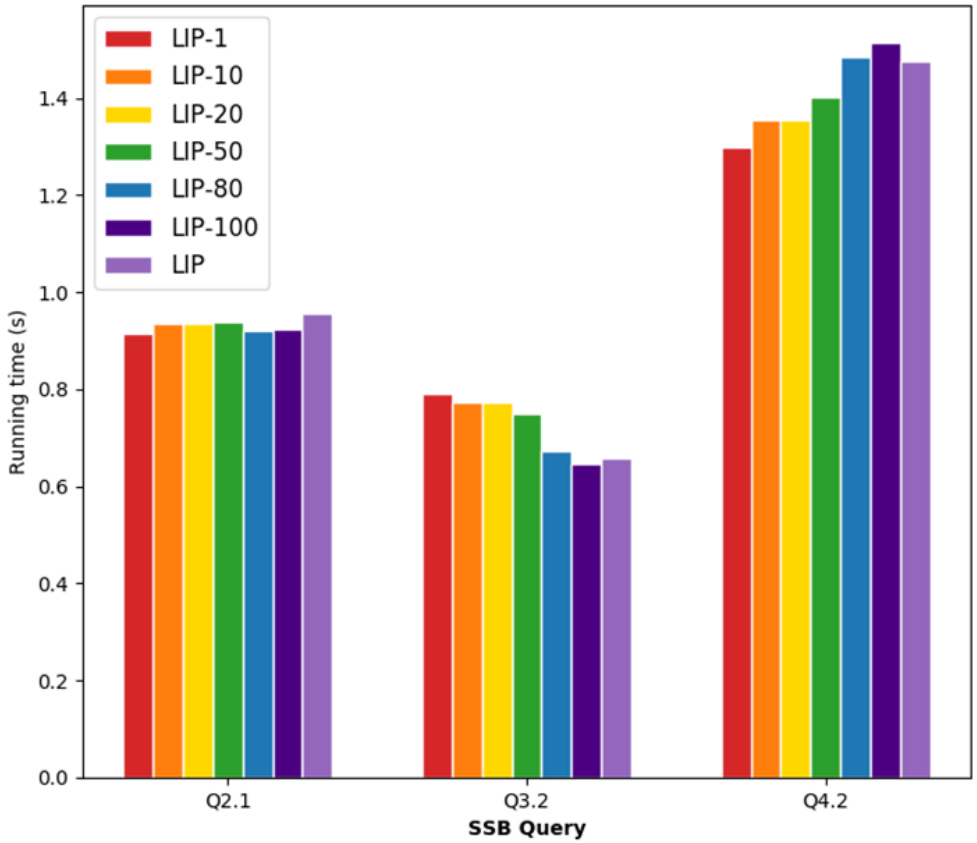

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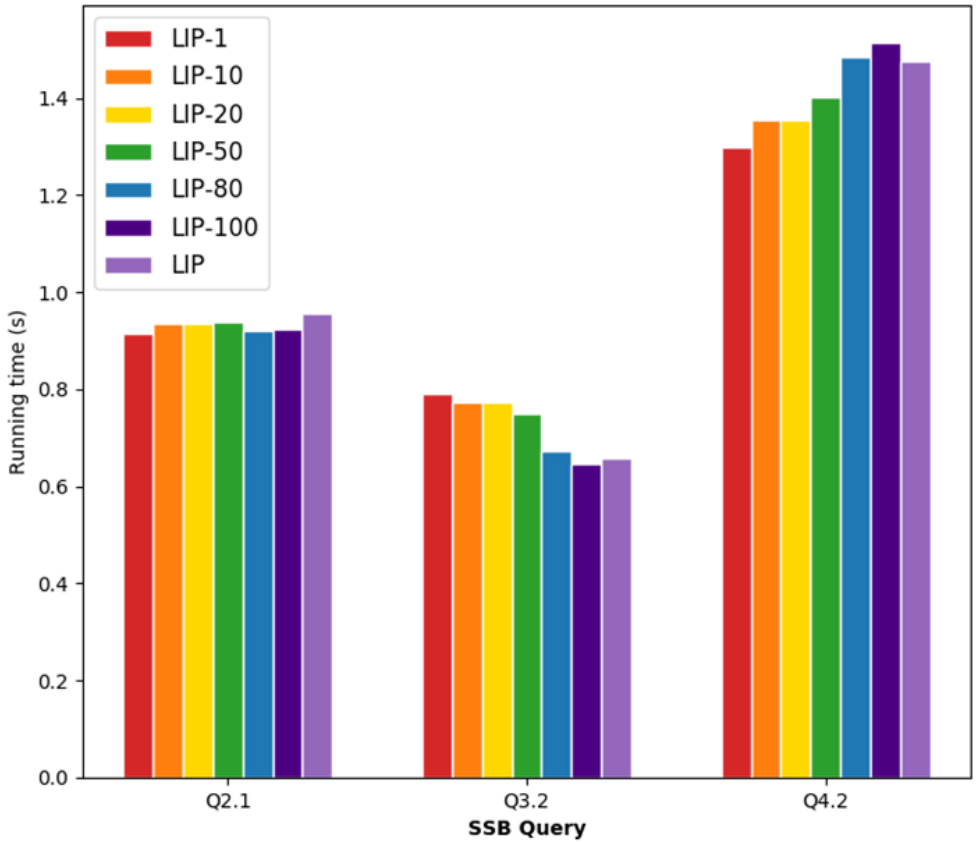

- LIP-k performs better than LIP on some queries...
- ...but LIP performs better on others

LIP is solving an online problem

- Tuples arriving one at a time
- Upon arrival, decide a sequence of filters
- Minimize the total probes
- Deterministic!

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Theorem

There is no deterministic mechanism $\mathcal{M}$ for LIP *achieving a competitive ratio less than N, where N is the number of filters used in* LIP.

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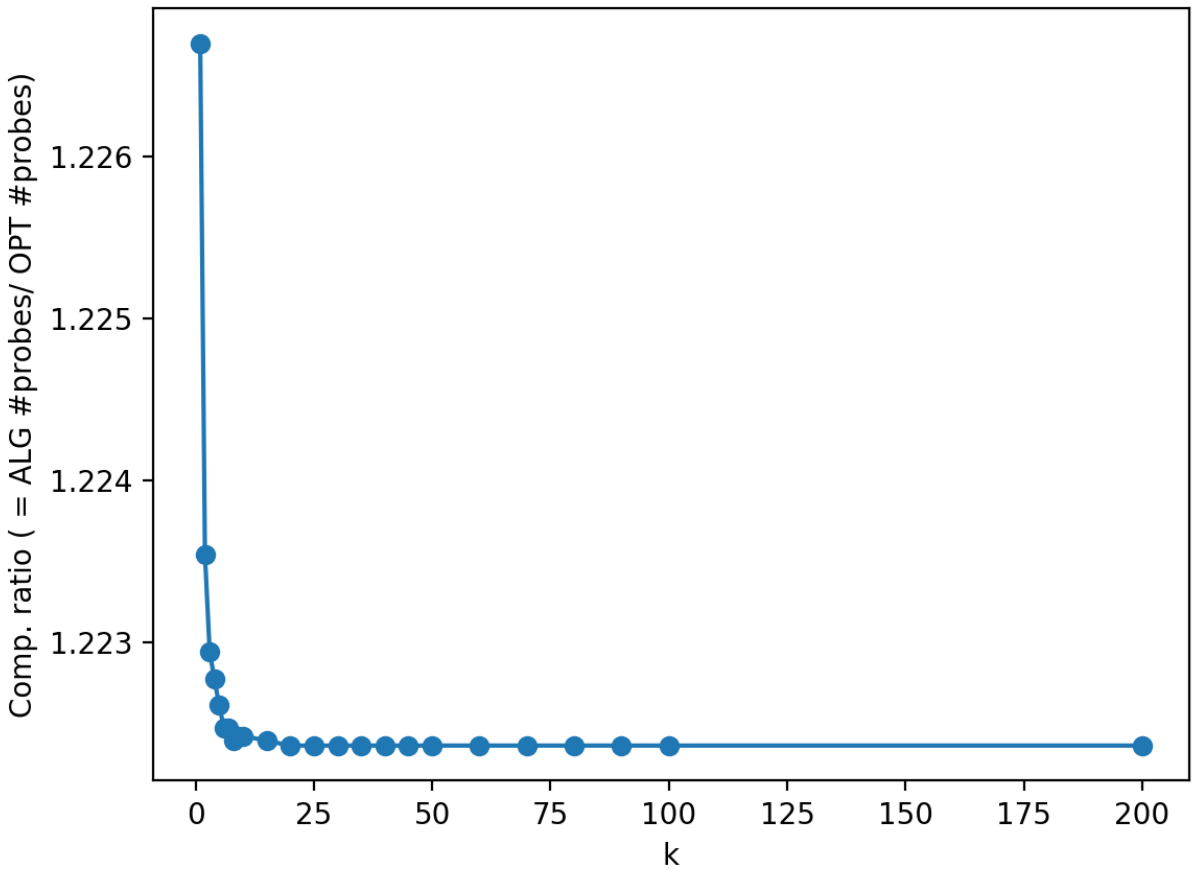
- Deterministic!

Theorem

There is no deterministic mechanism $\mathcal{M}$ for LIP *achieving a competitive ratio less than N, where N is the number of filters used in* LIP.

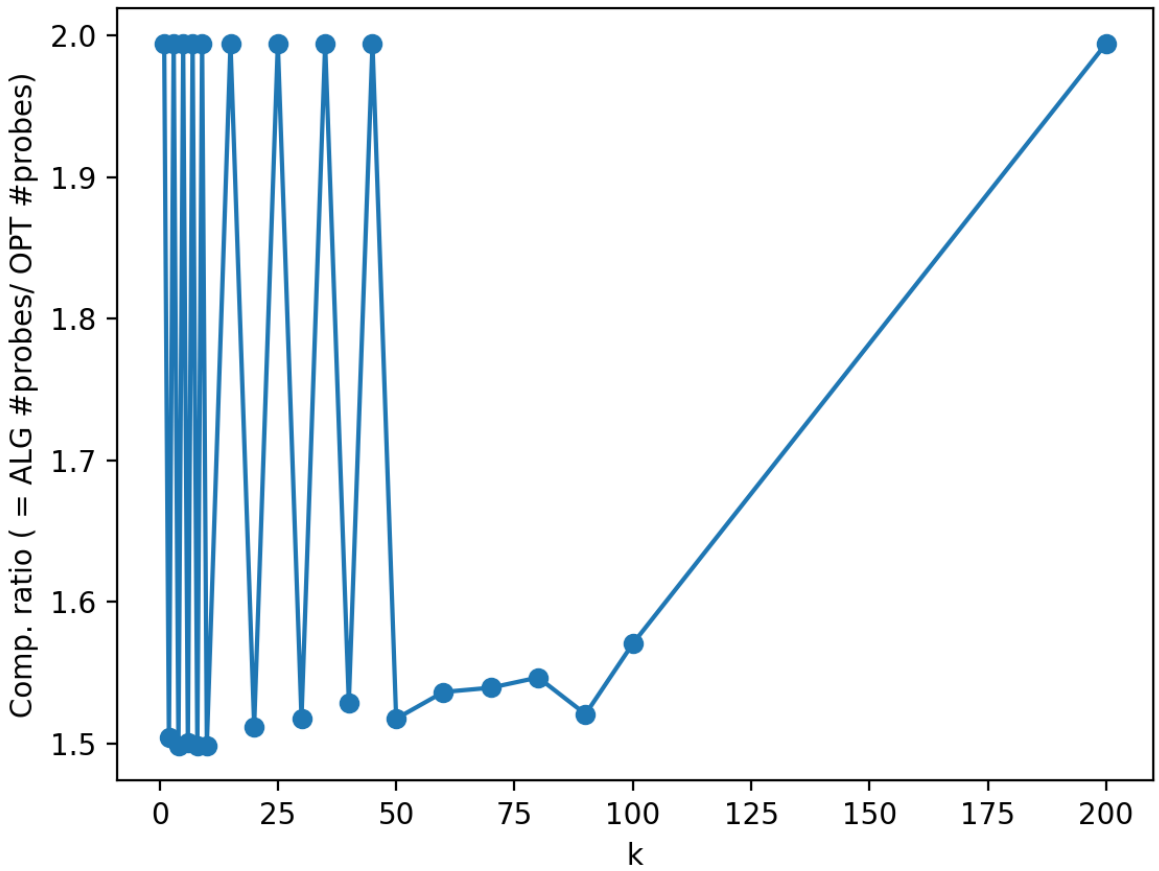
- Not observed in practice, but a theoretical lower bound
- Randomness?

Competitive Ratio vs. k on Uniform Data



Competitive Ratio vs. k on Adversarial Data

- Adversarial data set constructed such that LIP-k has worst case performance for odd k
- Run on query with $N = 2$ joins



Conclusion

- Implemented LIP and its variant LIP-k
- Relative performance of LIP and LIP-k depends on the query
- Can we use randomness to achieve a better robustness guarantee?

Thank you!

Questions?