Accelerating Joins with Filters: Keeping a Limited Memory is Robust

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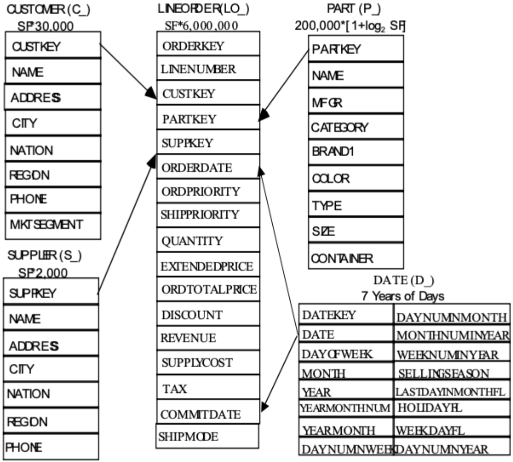
Star Schema



CUSTOMER (C_)
SF*30,000
CUSTKEY
NAME
ADDRESS
CITY
NATION
REGION
PHONE
MKTSEGMENT

SUPPLIER (S_)
SF*2,000
SUPPKEY
NAME
ADDRESS
CITY
NATION
REGION
PHONE

LINEORDER (LO_)
SF*6,000,000
ORDERKEY
LINENUMBER
CUSTKEY
PARTKEY
SUPPKEY
ORDERDATE
ORDPRIORITY
SHIPPRIORITY
QUANTITY
EXTENDEDPRICE
ORDTOTALPRICE
DISCOUNT
REVENUE
SUPPLYCOST
TAX
COMMITDATE
SHIPMODE

PART (P_)
200,000*[1+$\log_2$ SF]
PARTKEY
NAME
MFGR
CATEGORY
BRAND1
COLOR
TYPE
SIZE
CONTAINER

DATE (D_)
7 Years of Days
DATEKEY
DATE
DAYOFWEEK
MONTH
YEAR
YEARMONTHNUM
YEARMONTH
DAYNUMINWEEK
DAYNUMINMONTH
MONTHNUMINYEAR
WEEKNUMINYEAR
SELLINGSEASON
LASTDAYINMONTHFL
HOLIDAYFL
WEEKDAYFL
DAYNUMINYEAR

- Gigantic intermediate tables
- Filtering ahead of time before join

Lookahead Information Passing (LIP)

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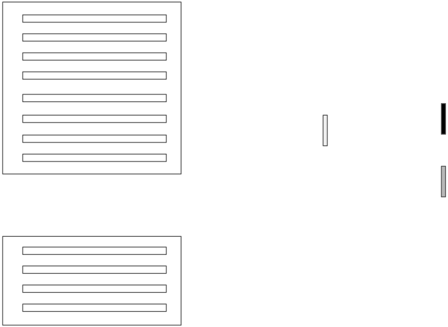

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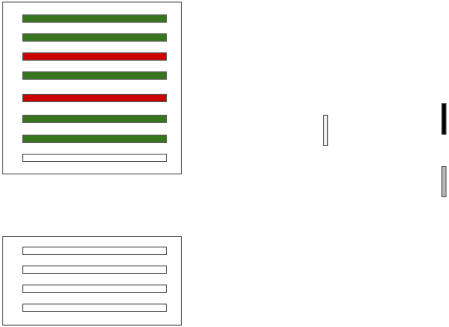

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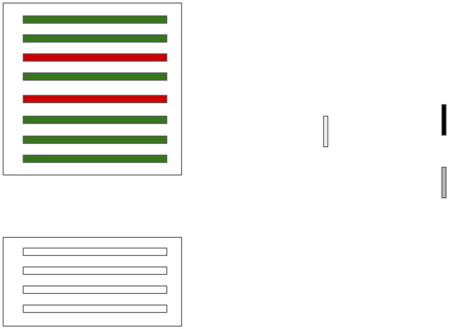

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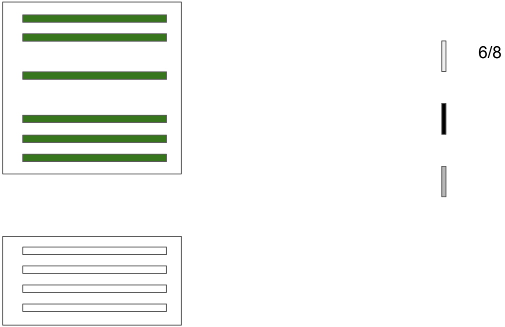

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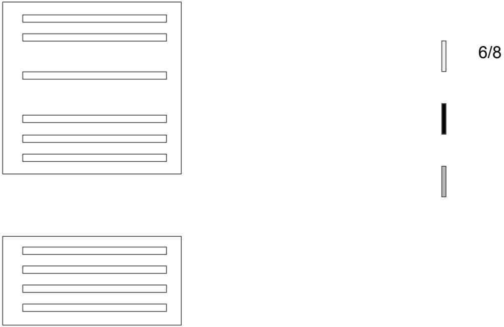

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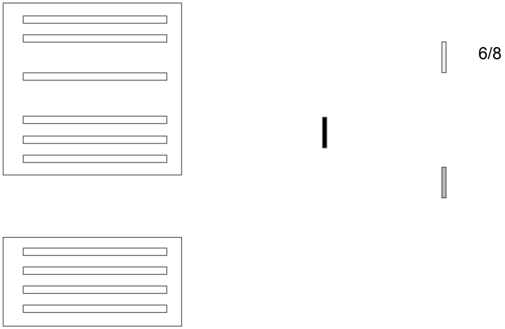

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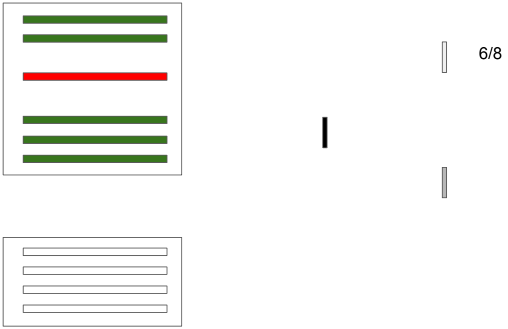

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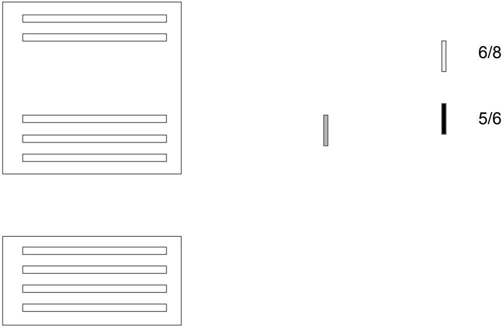

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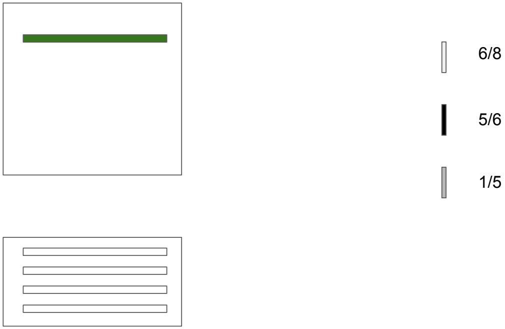

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Lookahead Information Passing (LIP)

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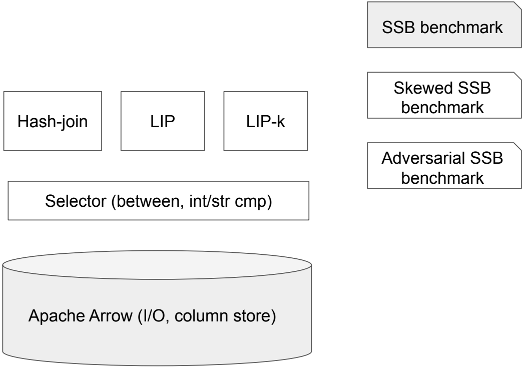
- Using statistics from all previous batches
- Just the previous k

Lookahead Information Passing (LIP)

- Using statistics from all previous batches
- Just the previous k — LIP-k

Implementation and benchmarking



SSB benchmark

Skewed SSB benchmark

Adversarial SSB benchmark

Hash-join

LIP

LIP-k

Selector (between, int/str cmp)

Apache Arrow (I/O, column store)

Experiments

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

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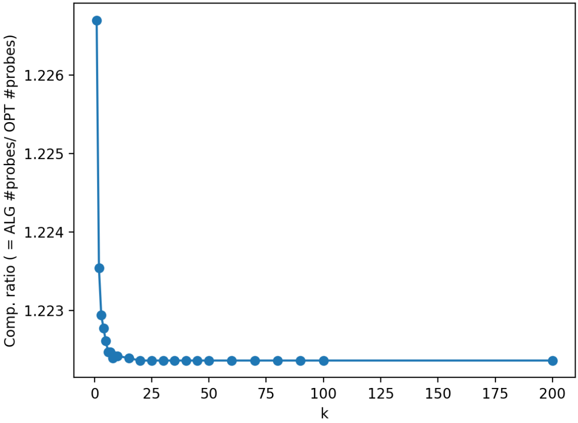
Theorem

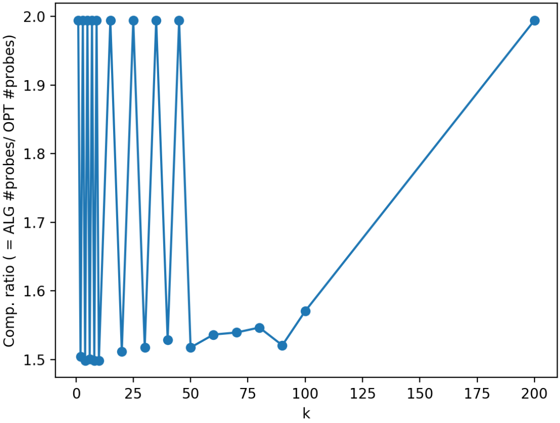
Let n be the number of filters in the LIP problem. There is no deterministic mechanism $\mathcal{M}$ achieving a competitive ratio less than n for the LIP problem.

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

Competitive ratio vs. *k* on Uniform



Competitive ratio vs. *k* on Adversarial



Conclusion

- Implemented LIP and its variant LIP-k
- LIP-k is better than LIP in the adversarial/skewed settings
- Randomness to achieve better robustness guarantee

Thank you!

Questions?