Estimating percentiles (efficiently)

t-digest & ddsketch

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Links

https://github.com/tvondra/percentiles-talk

TLC Trip Record Data

https://www1.nyc.gov/site/tlc/about/tlc-trip-record-data.page

percentile_cont / percentile_disc

```
SELECT
    percentile_cont(0.5)
        WITHIN GROUP (ORDER BY total_amount)
FROM yellow_cabs;


SELECT
    percentile_disc(0.5)
        WITHIN GROUP (ORDER BY total_amount)
FROM yellow_cabs;
```

percentile_cont / percentile_disc

```
SELECT
    percentile_cont(ARRAY[0.5, 0.99])
        WITHIN GROUP (ORDER BY total_amount)
FROM yellow_cabs;

SELECT
    percentile_disc(ARRAY[0.5, 0.99])
        WITHIN GROUP (ORDER BY total_amount)
FROM yellow_cabs;
```

percentile_cont / percentile_disc

- accurate results
- has to keep and sort all the data
- difficult to parallelize
- can't be precalculated

:-(

Alternative approach(es)

- approximate results are fine
- ideally with some guarantees
- can be parallelized
- can be precalculated (and stored)

=> averaging percentiles does not work!

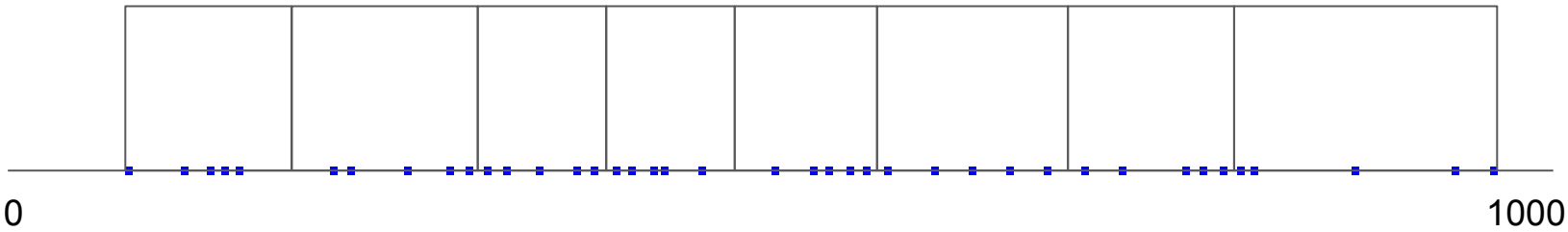
=> tdigest and ddsketch

https://github.com/tvondra/tdigest

t-digest

- published in 2013 by Ted Dunning
- approximation of CDF (cumulative distribution function)
- essentially a histogram
  - represented by centroids, i.e. each bin is represented by [mean, count]
  - requires data types with ordering and mean
- intended for stream processing
  - but hey, each aggregate is processing a stream of data
- higher accuracy on the tails (close to 0.0 and 1.0)


0
1000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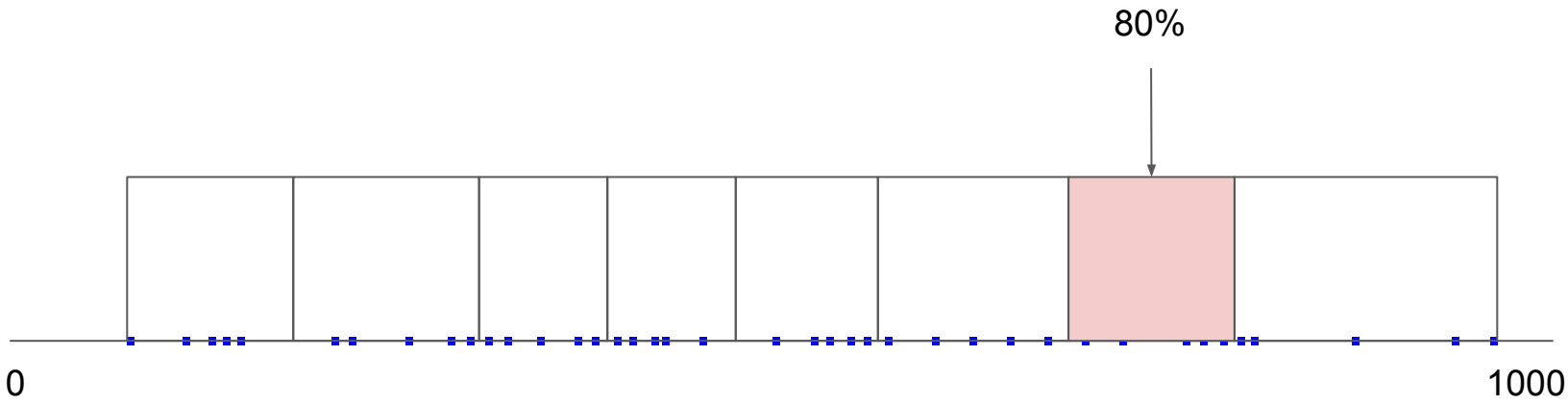
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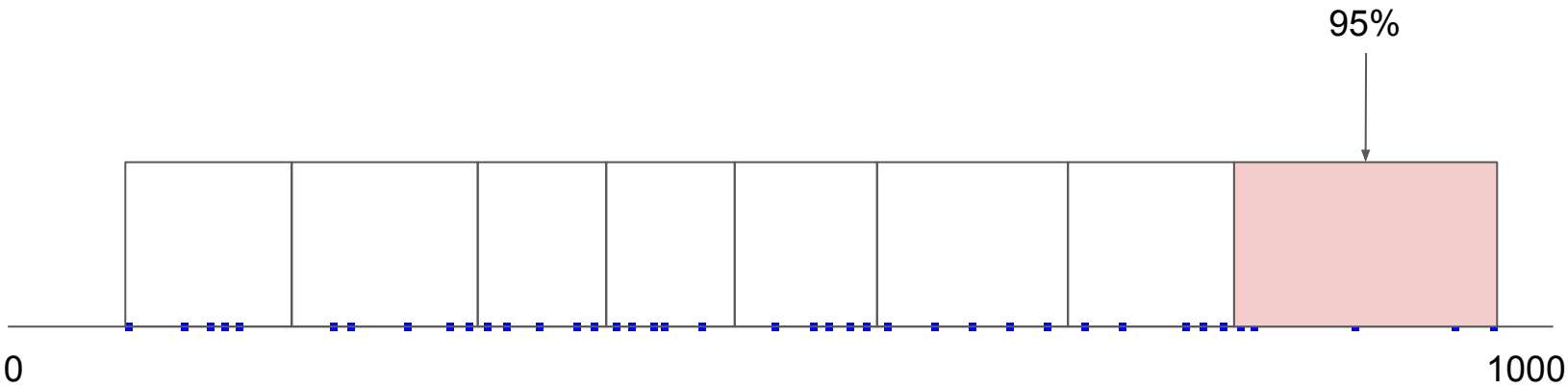
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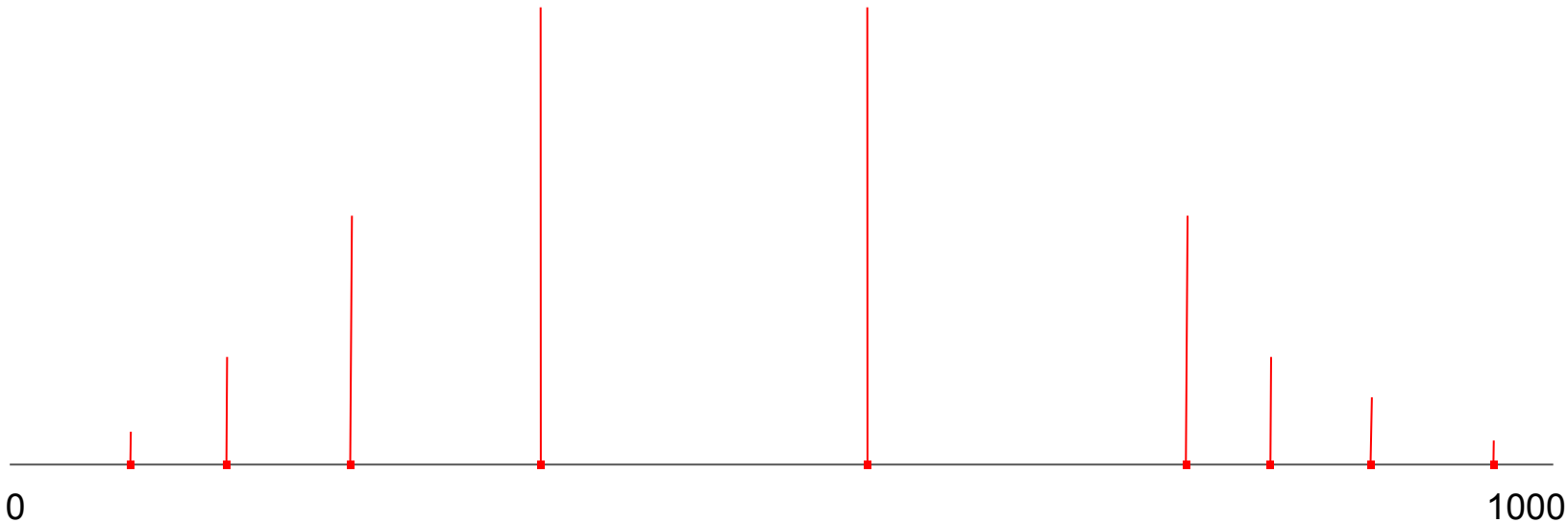
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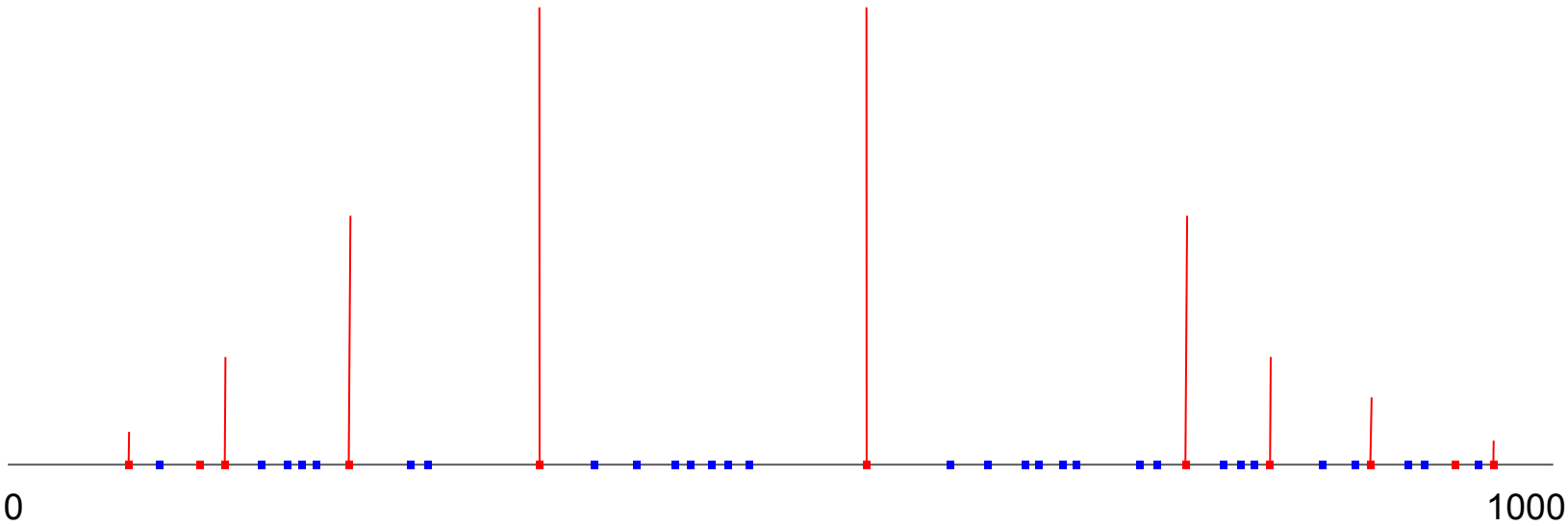
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DEMO

https://github.com/tvondra/ddsketch

ddsketch

- VLDB 2019
  - Charles Masson, Jee E. Rim, Homin K. Lee (Datadog)
  - http://www.vldb.org/pvldb/vol12/p2195-masson.pdf
- similar to HdrHistogram (2012)
  - http://hdrhistogram.org/
- somewhat similar to t-digest
  - another "form" of histogram, approximating CDF, stream processing, ..
- But internally works very differently!
- Provides interesting *actual* formal guarantees.

relative accuracy guarantee

$$|E(X_q) - X_q| \leq \alpha X_q$$

e.g. $\alpha = 0.05$


0
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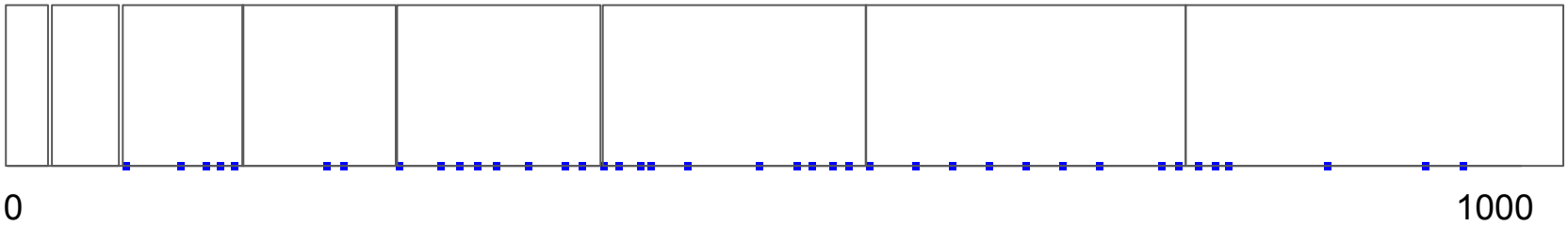
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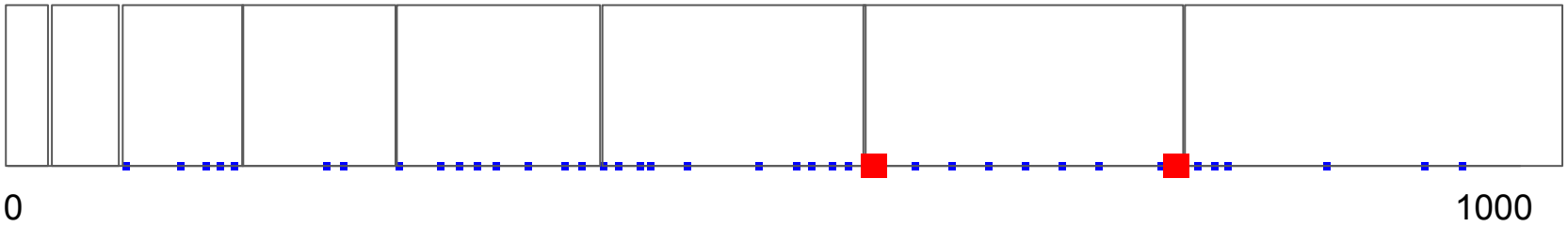
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