SWAG: An Experimental Study of Exact and Approximate Window-Based Non-Incremental Aggregations

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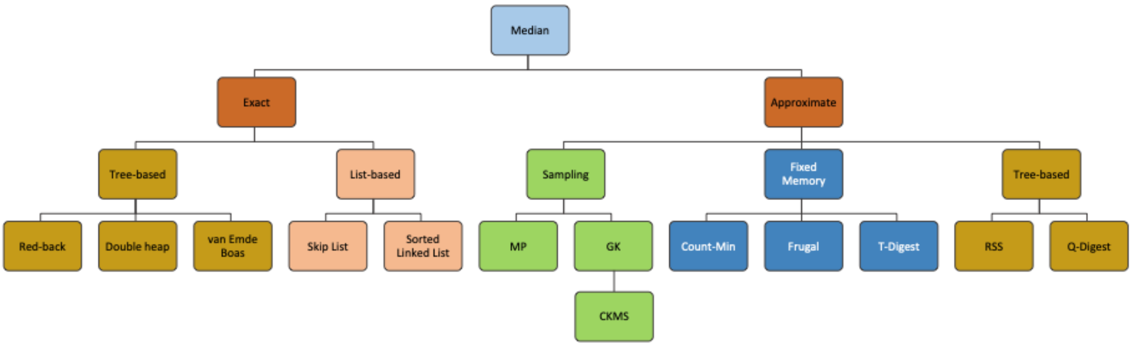
In addition, the project will be carried on in collaboration with Prof. Ahmed Awad from the University of Tartu, Estonia.

Context

Computing aggregations is one of the most common applications on data streams. Moving averages of trade markets, temperature sensor readings, and heart-beat monitoring are just a few examples of well-known scenarios where a user needs to receive moving averages, maximum values, and quantiles of the incoming data. In practice, sliding windows are the most common approach to slicing an unbounded data stream. Thus, several algorithms have been developed to compute aggregates over such windows efficiently. However, most of these algorithms focus only on aggregates that can be incrementally computed (e.g., sum, average, count). Little to nothing is known about the performance of non-incremental aggregates (e.g., median and quantiles) in general. In this context, key efficiency factors include incremental, pre-aggregation, and sharing of values among overlapping windows.
Moreover, in some instances with memory restrictions, sketch-based and approximate techniques are used to meet this constraint by sacrificing accuracy. In this paper, we present a comprehensive evaluation for "sum-like," "max-like," and "median-like" aggregations concerning performance and value calculation, i.e., exact vs. approximate.

Objectives



The goal of this project is to design an experimental study for non-incremental aggregations over streams. The project requires

- implementing state-of-the-art algorithms (see figure above) on top of Apache Flink, the state-of-the-art stream processing system, and Scotty, a recent library for efficient window aggregate computation.
- designing experiments for a systematic evaluation using both synthetic and real-world data.

Methodology

- Familiarise yourself with the concepts related to stream processing and streaming analytics
- Familiarise yourself with the distributed stream processing engine Flink and the library Scotty
- Familiarise yourself with a cloud environment for executing experiments in distributed settings
- Design and execute extensive experimentation measuring throughput, latency, and memory consumption for the selected aggregation algorithms.

References

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