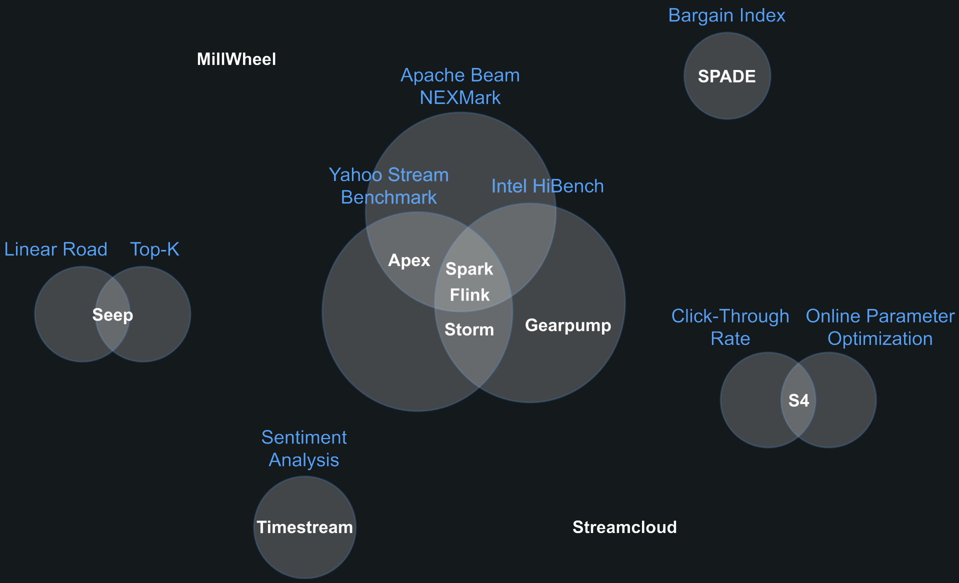
# Implementation of a Benchmark Suite for Strymon

Nicolas Hafner

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

inf | Informatik
Computer Science

Systems@ETH Zürich



Bargain Index

MillWheel

SPADE

Apache Beam NEXMark

Yahoo Stream Benchmark

Intel HiBench

Linear Road

Top-K

Apex

Spark

Flink

Seep

Storm

Gearpump

Click-Through Rate

Online Parameter Optimization

S4

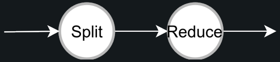
Sentiment Analysis

Timestream

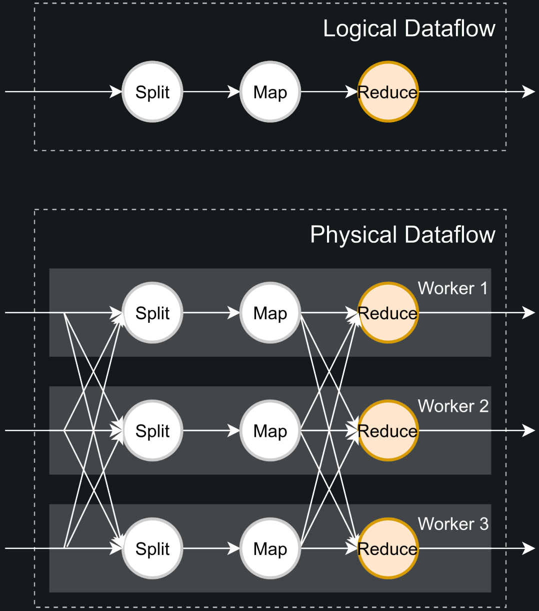
Streamcloud

# Current Publications

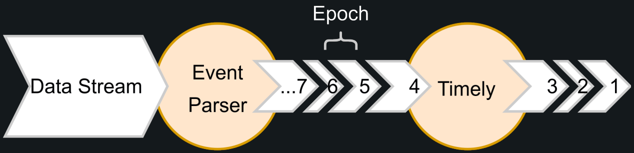
- Investigated current practises in published papers
- Almost no paper used a standardised benchmark
- Code and data often not published
- Often very simple benchmarks like Word Count:



# Timely


Logical Dataflow
Split
Map
Reduce
Physical Dataflow
Worker 1
Split
Map
Reduce
Worker 2
Split
Map
Reduce
Worker 3
Split
Map
Reduce

# Timely



# Benchmarks

- We implemented three benchmarks:

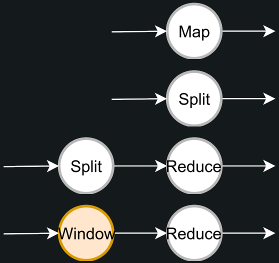
1. Intel's HiBench
2. Yahoo's Streaming Benchmark
3. Apache Beam's NEXMark

- Comparable against many other systems

# Intel’s HiBench[1]

- Big Data micro-benchmark
- Only four data flows:

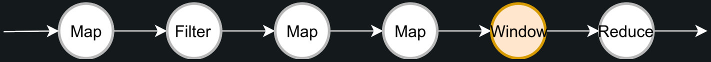
1. Identity
2. Repartition
3. Word Count
4. Window Reduce



[1] https://github.com/intel-hadoop/HiBench

# Yahoo Stream Benchmark[2]

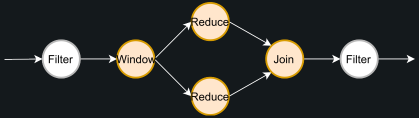
- Count ad views for ad campaigns
- Only one, relatively simple data flow:

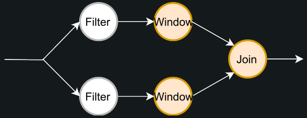


[2] Sanket Chintapalli et al. "Benchmarking streaming computation engines: Storm, Flink and Spark streaming". In: Parallel and Distributed Processing Symposium Workshops, 2016 IEEE International. IEEE. 2016, pp. 1789–1792.

# Beam's NEXMark[3]

- Implements an "auctioning system"
- 13 data flows in total
- Uses filter, map, reduce, join, window, session, partition
- Dataflows for Query 5 and 8:





[3] Based on original paper: Pete Tucker et al. NEXMark–A Benchmark for Queries over Data Streams (DRAFT). Tech. rep. Technical report, OGI School of Science & Engineering at OHSU, Septembers, 2008.

# Testing Framework

- Implemented a general framework for benchmarks
- Generic components for input/output handling
- New, reusable operators for join, window, reduce, filtermap, session, partition
- Implemented HiBench, YSB, NEXmark using this framework

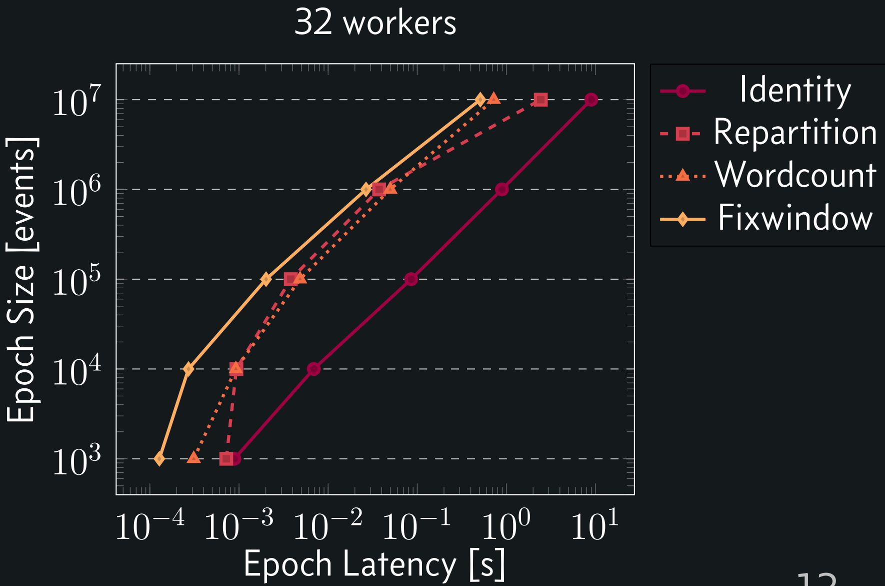
# Evaluation System

- Run on sgs-r815-03 (AMD, 64 cores, 2.4GHz)
- Data generated directly in memory
- Generation re-implemented in Rust
- No foreign systems like Kafka used

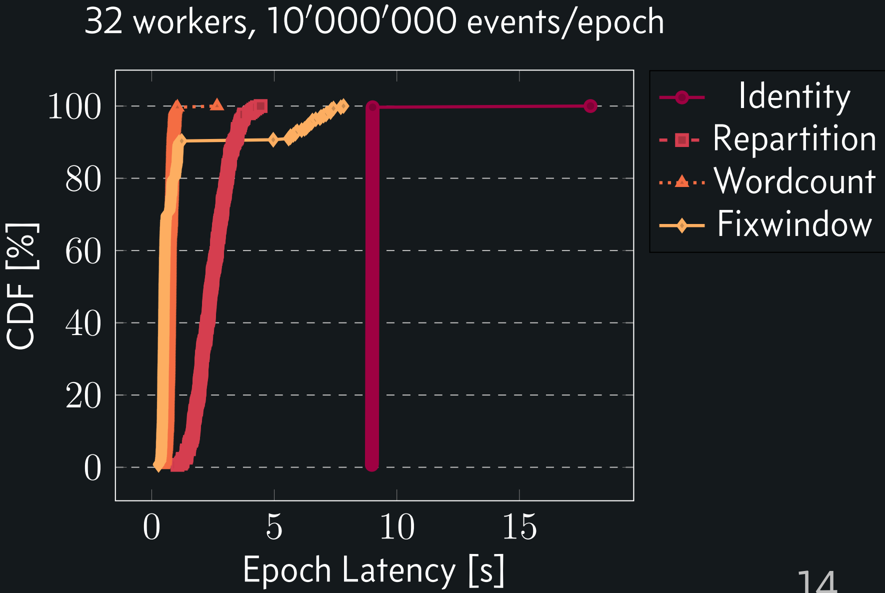
# Evaluation Setup

- Measured closed-loop per-epoch latency
- One epoch encompasses a logical second of data
- Workload varied between 1K-10Me/s, 1-32 workers, 10-120s windows

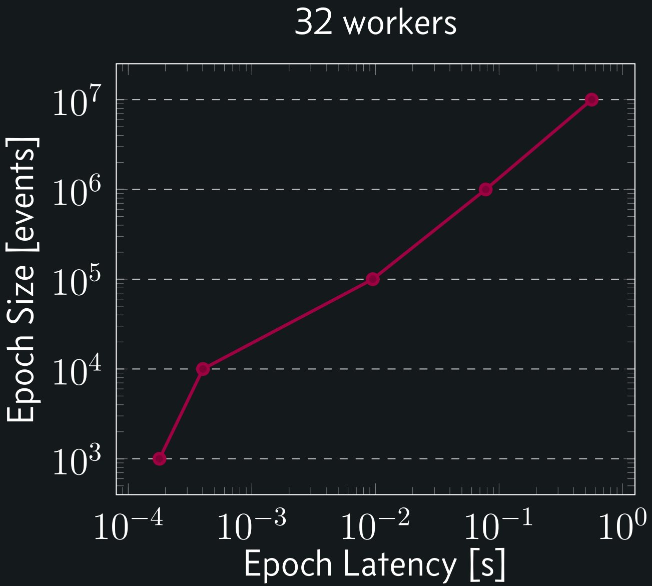
# HiBench Latency / Epoch



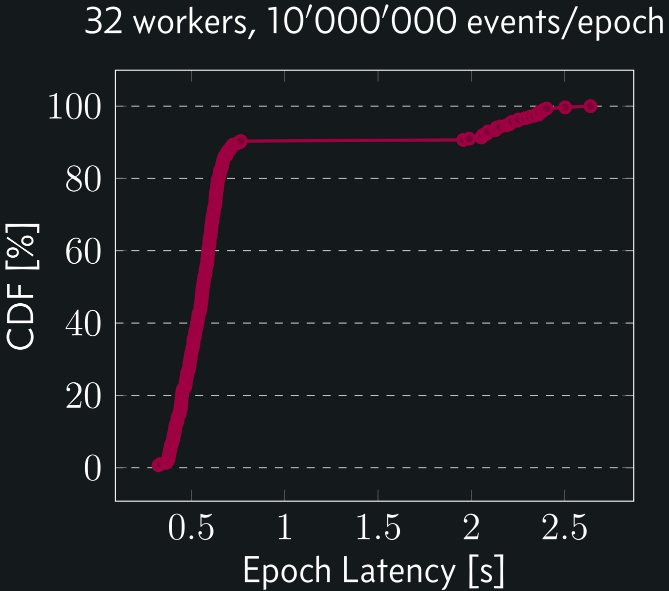
# HiBench Latency CDF



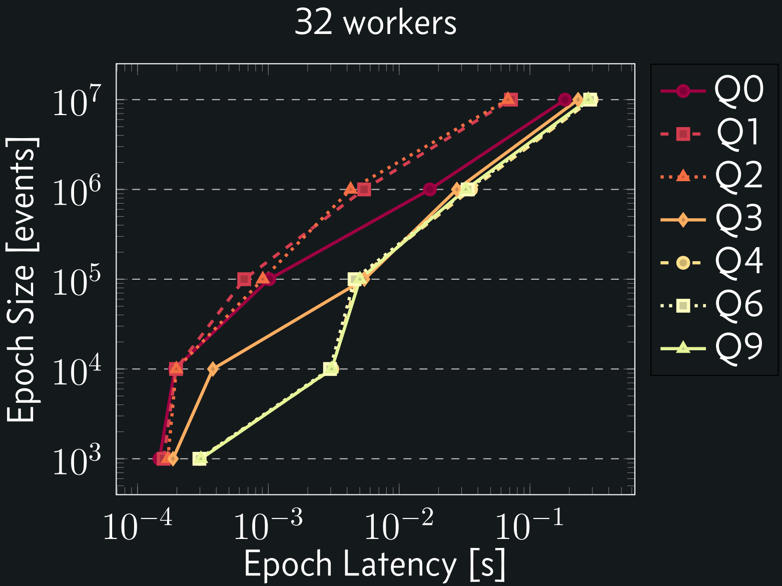
# YSB Latency / Epoch



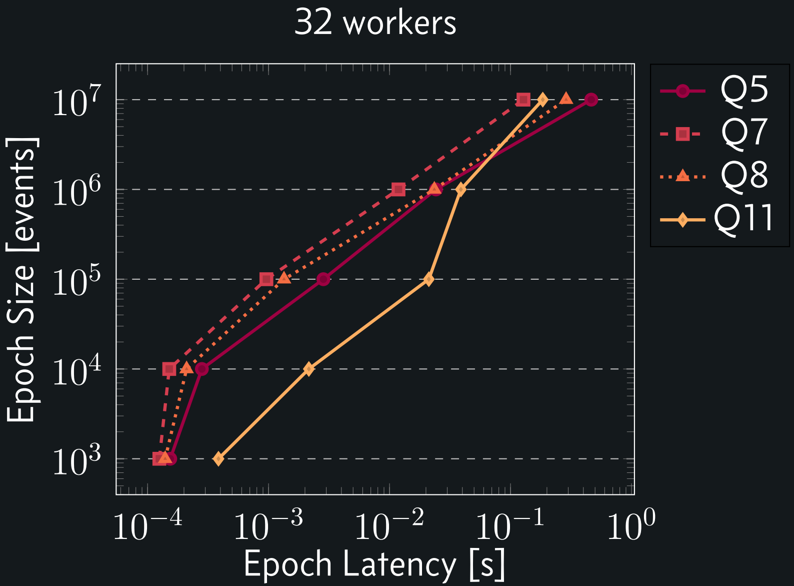
# YSB Latency CDF



# NEXMark Latency / Epoch

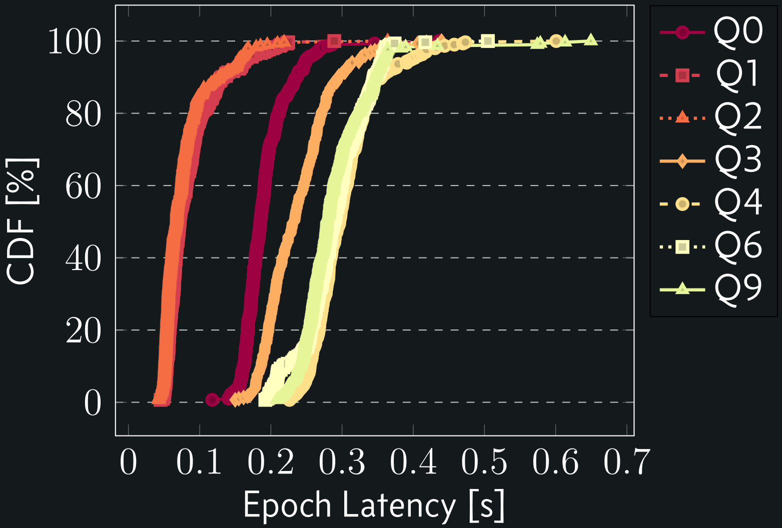


# NEXMark Latency / Epoch

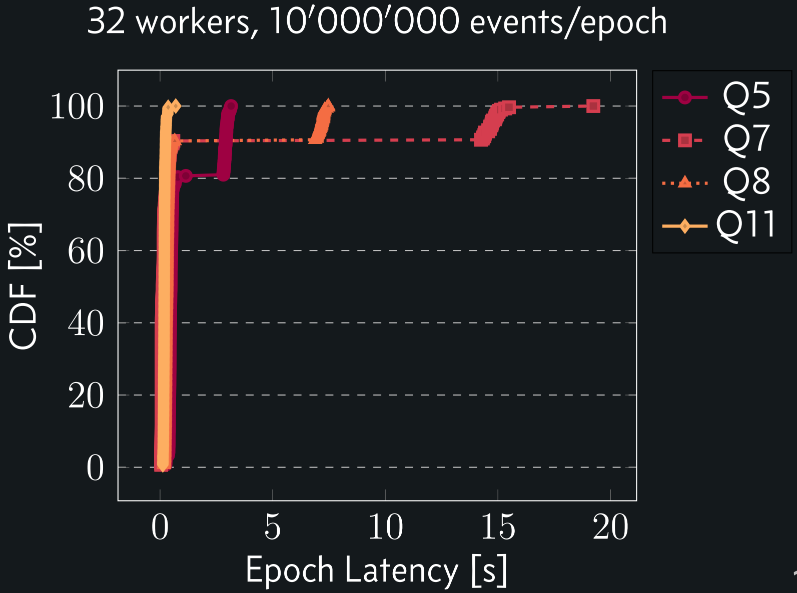


# NEXMark Latency CDF

32 workers, 10′000′000 events/epoch



# NEXMark Latency CDF



# Benchmark Evaluation

- Benchmarks are underspecified and undocumented

# Benchmark Evaluation

- Benchmarks are underspecified and undocumented
- No result verification

# Benchmark Evaluation

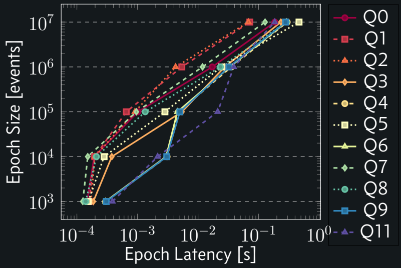
- Benchmarks are underspecified and undocumented
- No result verification
- External systems compound complexity

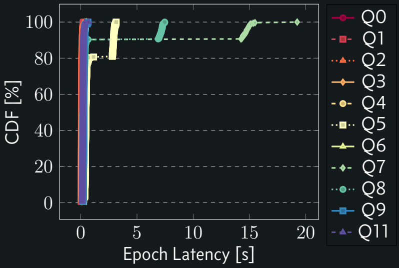
# Benchmark Evaluation

- Benchmarks are underspecified and undocumented
- No result verification
- External systems compound complexity
- No tests for load balancing, fault-tolerance, etc.

# Benchmark Suggestions

- Abstract model definitions for data flows
- Correctness verification tools
- Deterministically generated workloads
- Various short and long data flows
- Tests for both latency, *and* fault-tolerance, etc.

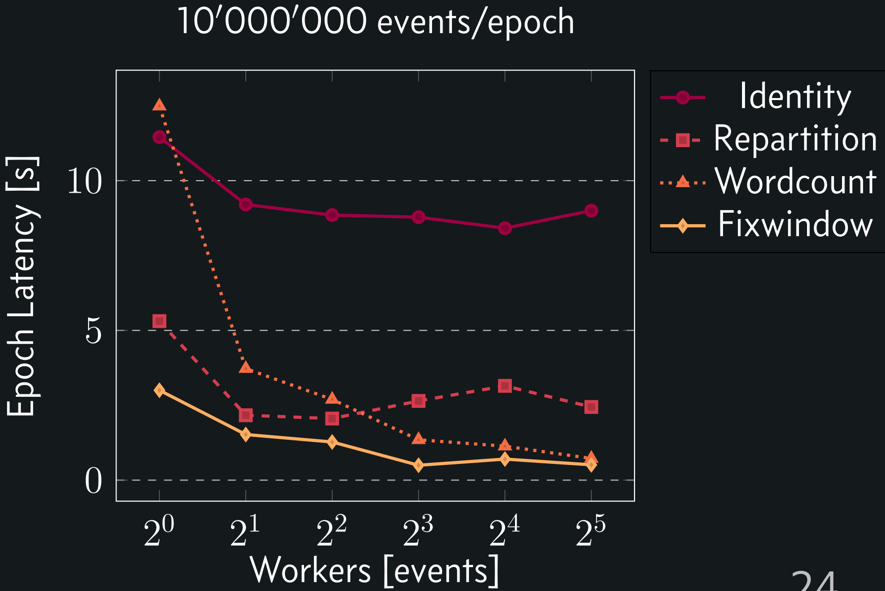

32 workers


32 workers, 10′000′000 events/epoch

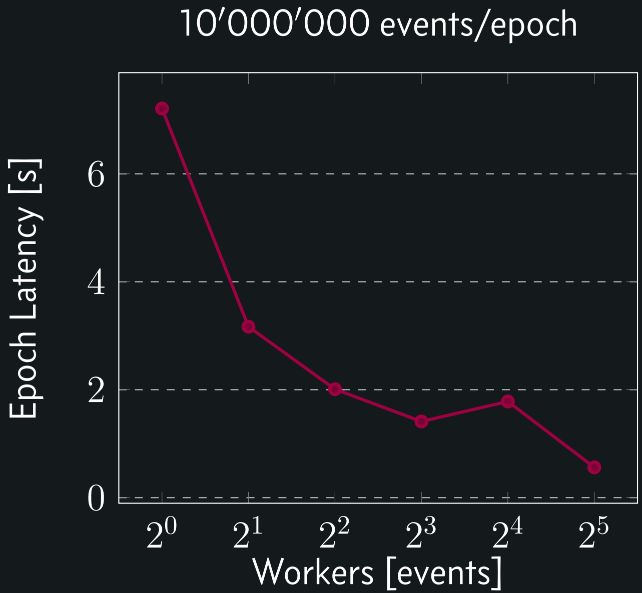
http://strymon.systems.ethz.ch/

https://github.com/Shinmera/bsc-thesis

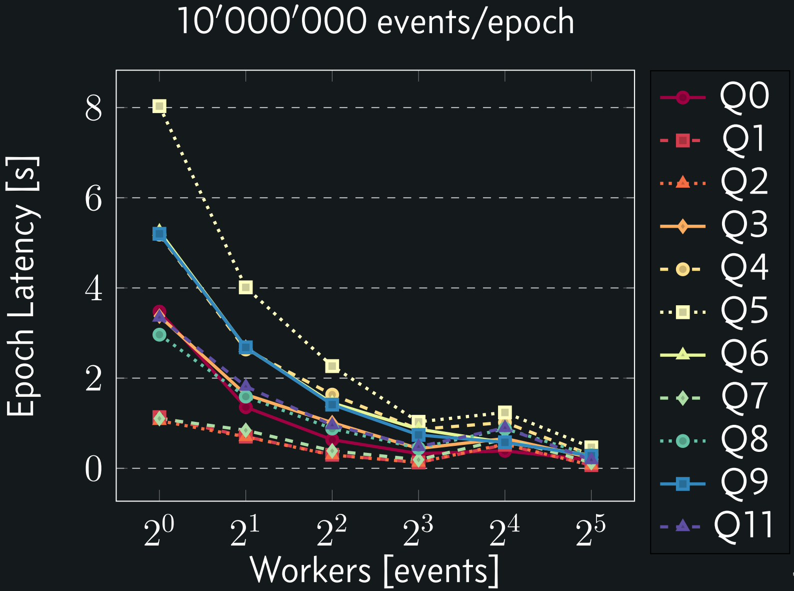
# HiBench Worker Scaling



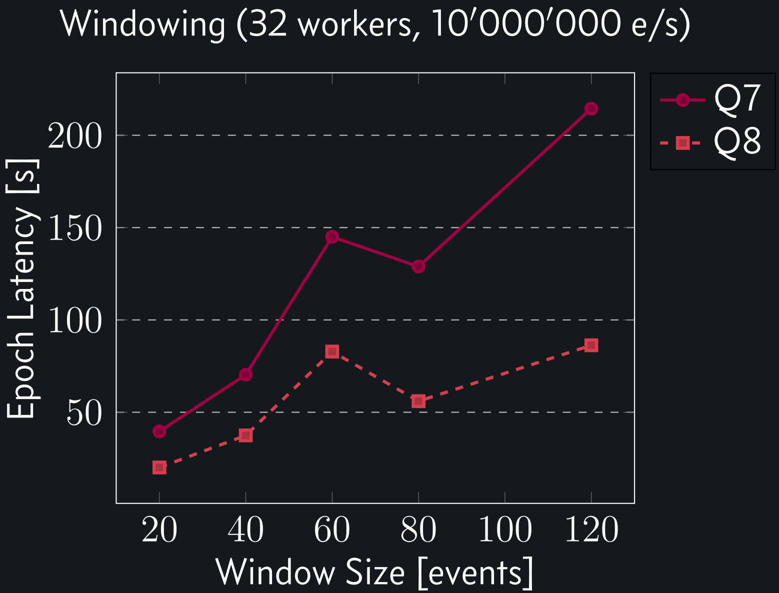
# YSB Worker Scaling



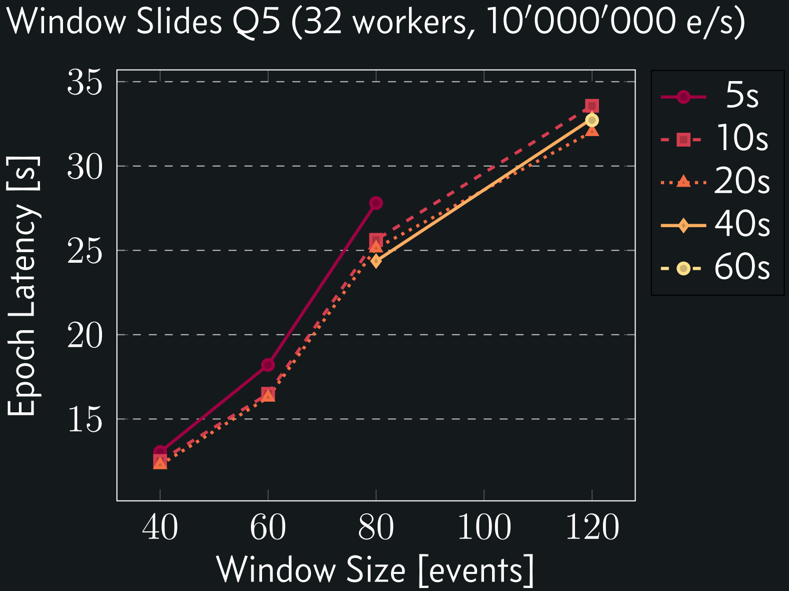
# NEXMark Worker Scaling



# NEXMark Window Scaling



# NEXMark Slide Scaling


Window Slides Q5 (32 workers, 10′000′000 e/s)
Epoch Latency [s]
Window Size [events]
5s
10s
20s
40s
60s