CommonGraph: Graph Analytics on Evolving Data

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1. Background

- Dynamic Graph Systems
  - Streaming Graph Processing
  - Evolving Graph Processing

2. Problem

- Approaches for query evaluation on Evolving Graphs
  - Naive Approach
  - Incremental Approach
  - CommonGraph Approach

- Naive approach is not efficient because → Solve the query on each snapshots independently

3. Solution

- Our Idea:
  - Transform deletions to additions using CommonGraph
  - Finding the common edges between snapshots
  - CommonGraph Approach → Solve the query on the CommonGraph
  - Add the missing edges and incrementally update the results

4. Direct Hop Algorithm

CommonGraph Query Evaluation:
- Direct Hop Query Evaluation
  - Find each snapshot directly from the CommonGraph
  - Higher number of Addition
  - Better performance compared to conventional method with only additions

5. Work Sharing Algorithm

CommonGraph Query Evaluation:
- Work Sharing Query Evaluation
  - Find each snapshots from CommonGraph
  - Significantly lower number of additions
  - Better performance comparing to the Direct-Hop approach with less additions

6. Scheduling

- Finding the best scheduling in Work-Sharing algorithm
  - Creating the Triangular Grid
  - Steiner Tree Algorithm

7. CommonGraph System

- Evolving Graph Engine
  - Shared CommonGraph
  - Addition delta batches

- CommonGraph Primitives

8. Evaluation

- Benchmarks
  - Algorithms
  - EdgeFunction (VWC P)
  - BFS: CAI(M)/(V,W)+Edged(1k) + stalled(0,5)
  - SOMP: CAI(M)/(V,W)+Edged(1k) + stalled(0,5)
  - SISP: CAI(M)/(V,W)+Edged(1k) + stalled(0,5)
  - Viterbi: CAI(M)/(V,W)+Edged(1k) + stalled(0,5)

- Input Graphs
  - Twitter (TW)
  - 40kM 400M 50.01

- Performance

CommonGraph achieves 1.35× – 1.17× improvement in performance over KickStarter across multiple benchmarks.

9. Sensitivity Analysis

- Sensitivity to the Different Number of Snapshots
  - Work-Sharing outperforms Direct-Hop when we increase the number of snapshots beyond 23 in 36 for different benchmarks.

- Sensitivity to Batch Size
  - Work-Sharing outperforms Direct-Hop when we increase the number of snapshots beyond 23 in 36 for different benchmarks.