Evaluating Graph Analysis Algorithms on Evolving Graphs Using GraphChi

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What Are Evolving Graphs?

- Also known as “iterative” or “dynamic”
- Where processing must be performed on graphs whose edges are constantly updating
- Algorithms perform incremental updates rather than re-computing values for the entire graph in batch

Motivation

- Why compute graph properties (PageRank, etc.) incrementally rather than statically?
- Performance
  - Most of the graph does not change, so properties will be the same
    - Thus wasteful
- Timely updates
  - Graph updates visible rapidly

Approaches

- Still a relatively new area, with not much work
- Kineograph
- Naiad
- GraphChi

Why GraphChi?

- Interesting new algorithm
- Impressive Performance
- However paper seemed to present the evolving graphs as an afterthought
  - Therefore an interesting area for further work

The Dataset

- Amazon products
- Edges are “similar” products linked to from product detail pages
- 542,684 nodes; 1,231,398 edges
- The evolving property can be simulated by a script that incrementally builds up a new graph from this existing one

Test Algorithms

- GraphChi has many *static* graph processing algorithms that Amazon would likely want to compute on products
  - PageRank
  - Community Detection
  - Connected Components
- Plan to implement my own
  - Betweenness Centrality

Test Machine

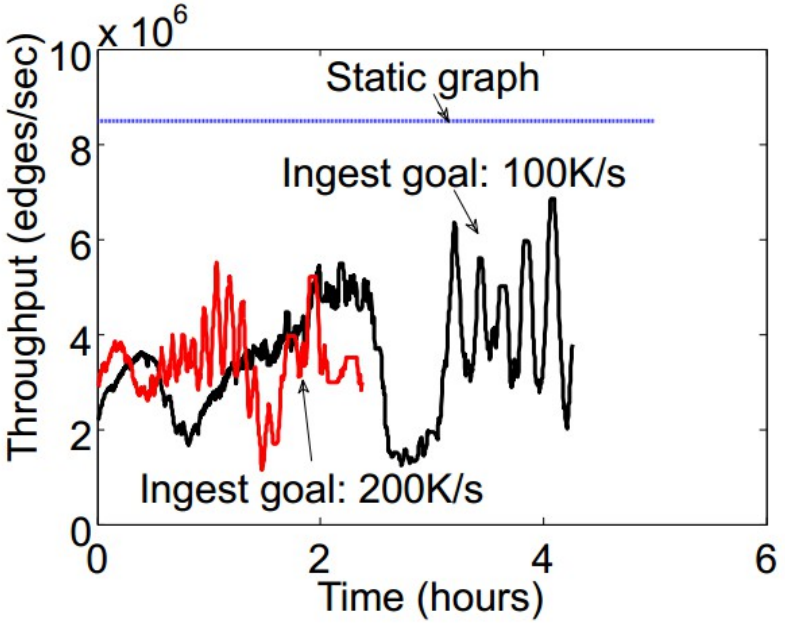
- My Laptop!
- Exactly what GraphChi is targeted at

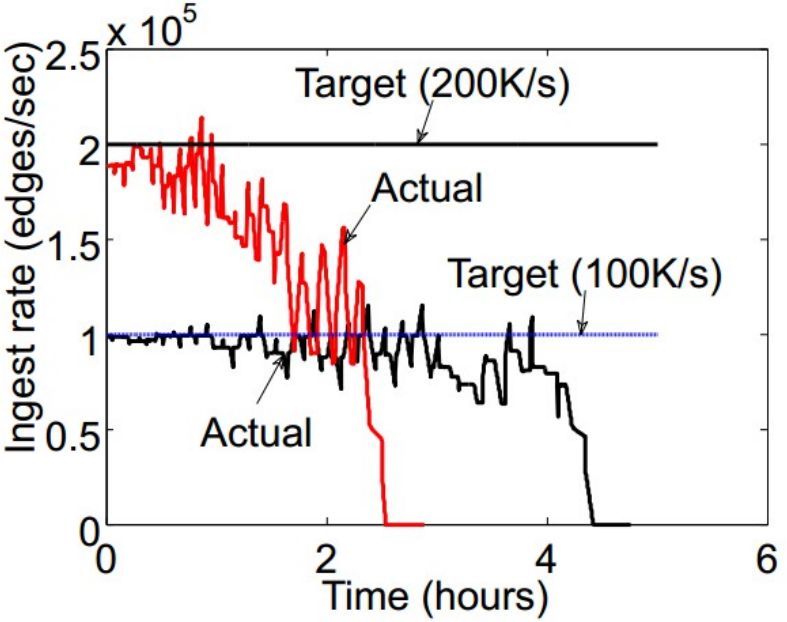
Planned Tests

- One test to measure the maximum number of streaming edges per second (e/s) the algorithm can handle
  - GraphChi paper does this, but only with a single algorithm
  - Can be plotted as a line with nodes e/s against iteration time
- Can control for rate of update as well as number of edges in each update

Planned Tests

- Example from GraphChi Paper (PageRank)





Planned Tests

- For the optimal edges e/s stream, I will measure the time taken to ingest the entire graph, as opposed to running it statically at varying intervals.
  - For this I can plot the point at which the evolving graph method overtakes the static method
- Will combine relative performances of all algorithms into a single graph for easier comparison

Expectations

- Some algorithms will perform well on a streaming graph, others will be extremely slow if all combinations edges/nodes are used in calculating properties
- These slower algorithms are unlikely to ever beat static graph analysis

Possible Extensions

- Compare results with another system that supports evolving graphs (Naiad)
  - May be able to test on a cluster to play to Naiad's strengths
- Try other centrality measures:
  - Louvain method
  - k-clique percolation method
- Huge number of other algorithms I could test

Any questions/suggestions?