PREGEL: A SYSTEM FOR LARGE-SCALE GRAPH PROCESSING

CREATED BY GRZEGORZ MALEWICZ, MATTHEW H. AUSTERN, AART J. C. BIK, JAMES C. DEHNERT, ILAN HORN, NATY LEISER, AND GRZEGORZ CZAJKOWSKI

BY JESSE OPITZ

03-15-16

MAIN IDEA - PREGEL

- Takes a vertex-centric approach to large-scale graph processing
- Designed for efficient, scalable and fault-tolerant implementation on clusters
- Designed for the Google cluster architecture
- Clusters are interconnected but distributed geographically
- Has predefined aggregators (Ex: min, max or sum)
- Has I/O libraries available
- Can be used with a C++ API

IMPLEMENTATION - PREGEL

- Operations performed in supersteps
- Maintains the state of its portion of graph in memory
- Maintains statistics about the progress of computation and state of the graph
- Messages sent along outgoing edges and any vertex with known identifier
- Halted vertexes won’t execute unless they receive a message
- User-defined function can:
    - Read messages sent to a vertex in superset S – 1
    - Sends messages to other vertices at S + 1
    - Modify the state of vertexes and its outgoing messages

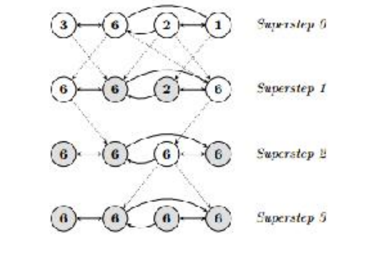

Figure 2: Maximum Value Example. Dotted lines are messages. Shaded vertices have voted to halt.

ANALYSIS - PREGEL

- As the amount of workers increase, Pregel gets exponentially quicker
- Increasing the amount of vertices, decreases the speed
- Works well even with billions of vertices
- Scalable
- Covers fault tolerance well

A COMPARISON OF APPROACHES TO LARGE-SCALE DATA ANALYSIS

CREATED BY ANDREW PAVLO, ERIK PAULSON, ALEXANDER RASIN, DANIEL J. ABADI, DAVID J. DEWITT, SAMUEL MADDEN, AND MICHAEL STONEBRAKER

MAIN IDEA - COMPARISON PAPER

- Compares MapReduce to Parallel DBMS
- Tested MapReduce using Hadoop framework
- Tested Parallel DBMS using DBMS-X

MAPREDUCE IMPLEMENTATION - COMPARISON PAPER

- Consists of only two functions: Map and Reduce
- Input data stored in a collection of partition
- Map function reads, filters and/or transforms a set of “records”
- Map produces hashed output files
- Reduce function processes or combines the records
- Record produces an output file of the records

PARALLEL DBMS IMPLEMENTATION - COMPARISON PAPER

- Two Key Aspects
  - Tables are partitioned over the nodes in a cluster
  - The system uses an optimizer
- Allows joins to execute in parallel at all nodes
- Each node computes the aggregate using its portion of the answer to the join
- “Roll-up” computation must be performed as last step

ANALYSIS - COMPARISON PAPER

- DBMS is one of the oldest forms of data analysis
- DBMS-X is the newest implementation of DBMS
- Vertica is a column-oriented form of DBMS(Supposedly faster)
- Although old still one of the chosen methods by some companies
- Hadoop is the most commonly implemented form of MapReduce
- Both forms of DBMS are faster, in all aspects, than Hadoop
- Vertica is the fastest of all three

PREGEL VS. COMPARISON PAPER

- Pregel takes a completely different approach than MR and Parallel DBMS
- Pregel uses a graph-centric approach
- MR uses a two-function approach with Map and Reduce
- Parallel DBMS is the original approach to large-scale data analytics

ONE SIZE FITS ALL – AN IDEA WHOSE TIME HAS COME AND GONE(2005)

CREATED BY MICHAEL STONEBRAKER AND UGUR CETINTEMEL

MAIN IDEAS - ONE SIZE FITS ALL

- Row stores are no longer good
- Column stores are newer and better
- Complex analytics are now being defined on arrays, not tables
- Steam processing engines and OLTP are dominating the streaming market
- Add streaming to OLTP or add persistence to streaming engine(streaming to OLTP is faster and better)
- Graph analytics can simulate in a column store, array engine, or graph engine
- Networking tends to be the bottleneck for DBMS

ADVANTAGES OF PREGEL

- New, fresh idea
- Can simulate a column store or an array engine
- Doesn’t use row-stores(slower than a column store)
- Vectorization is good when reading more than one record
- Scalable
- Constantly updates if workers are alive or not

DISADVANTAGES OF PREGEL

- Runs slower when there’s less worker tasks
- Problems finding single-source shortest path
- If one or more workers fail, the current state of the partitions assigned to the workers is lost

SOURCES

- http://labouseur.com/courses/db/papers/malewicz.sigmod10.pregel.pdf
- http://labouseur.com/courses/db/papers/pavlo.sigmod09.comparison.pdf
- http://kdb.snu.ac.kr/data/stonebraker_talk.mp4