MapReduce: Simplified Data Processing on Large Clusters

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Main idea of the paper

- MapReduce is a simple, hardy database system
- Used by Google
- Driven by programmers
- Multiple commodity computers used on a distributed network to handle large amounts of data, in a bandwidth efficient way
- Problems with large datasets are broken into many smaller datasets.
  - Each small dataset is processed on its own machine
  - Problems are processed in two phases
    - Map – small dataset produces intermediate data
    - Reduce – combines the intermediate data for the final result

How it is implemented

- It uses many (typically thousands) of commodity computers that function together to handle large datasets
- Uses Linux on many 2 to 4 gb machines
- Similar to the master slave protocol in scatternets, MapReduce uses a master machine which does the scheduling , and assigns maps to work on.
- Programmer inputs data and maintains the system
  - MapReduce splits the input into many smaller datasets, assigns the mapping function to one of the worker computers, coordinates sending the map results to the reduce worker computers and assures that the process is resistant to hardware and software faults

Analysis of the idea

- Excellent implementation for large scale database analysis
  - Easy to maintain and run.
  - Great for programmers who are experts at parallel processing, since it is simple to use.
  - Can be used for very large pools of data, such as whole populations, census, etc
  - Requires massive hardware resources

Advantages and disadvantages

- Advantages
  - Uses inexpensive hardware
  - Fault tolerant
  - User does not need to be expert in parallel processing
  - Speed – much faster than serial processing
  - Since the data is broken into small pieces, the entire data for one map process can be kept in memory
  - Scales well
- DIsadvantages
  - Problem must be capable of parallel processing
    - Intermediate steps can not talk to each other
  - Relatively slow network communication
  - Not useful for *ad hoc* queries
  - Not useful for real time processing

Real world uses

- Google – creates index for web search
- Pattern based searching
- Sorting large datasets
- Creating an inverted indices
- Counting URL access frequency