Large Scale Data Processing CSE3025

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Distributed File System

- Mostly computing is done on a single processor, with its main memory, cache, and local disk $\rightarrow$ compute node.
- Applications that called for Parallel processing such as large scientific calculations were executing on special-purpose parallel computers with many processors and specialized hardware.
- The prevalence of large-scale Web services has caused more and more computing to be done on thousands of computing nodes operating more or less independently.
- Moores law suited $\rightarrow$ building bigger and bigger servers is no longer necessarily the best solution to large-scale problems. $\rightarrow$ An alternative that has gained popularity is to tie together many low-end/commodity machines together as a single functional distributed system.
- Distributed system $\rightarrow$ Scale-Out

SIMPLE SCENARIO

A high-end machine with four I/O channels each having a throughput of 100 MB/sec will require three hours to read a 4 TB data set! With Hadoop, this same data set will be divided into smaller (typically 64 MB) blocks that are spread among many machines in the cluster via the Hadoop Distributed File System (HDFS). With a modest degree of replication, the cluster machines can read the data set in parallel and provide a much higher throughput. And such a cluster of commodity machines turns out to be cheaper than one high-end server

Distributed File System

- The compute nodes are commodity hardware, which greatly reduces the cost compared with special-purpose parallel machines.
- New computing facilities have given support to a new generation of programming systems. $\rightarrow$ the power of parallelism.
- problem: At the same time avoid the reliability problems that arise when the computing hardware consists of thousands of independent components, any of which could fail at any time.
- Design of specialized file system that have been developed to take advantage

- **Physical Organization of Computing Nodes:**
  - new parallel-computing architecture → sometimes called as "Cluster Computing".
  - Compute nodes are stored on racks, perhaps 864 on a rack.
  - The nodes on a single rack are connected by a network → Gigabit Ethernet
  - There can be many racks of compute nodes, and racks are connected by another level of network or a switch.
  - The bandwidth of inter-rack communication is somewhat greater than the intrarack Ethernet,
- problems:
  - Failure of Computing nodes → loss of single node
  - Failure of Interconnection networks → loss of entire rack
- Difficult to restart or abort the computation for every component failure.
- Solutions to this problem:
  - Files must be stored redundantly
  - Computation must be divided into tasks.

Hadoop -Introduction

- An Open source software framework (Apache Project)
- In this Framework, users can write and run the distributed applications that process massive dataset.
- what makes it especially useful
  - Scalable: It can reliably store and process petabytes.
  - Economical: It distributes the data and processing across clusters of commonly available computers (in thousands).
  - Efficient: By distributing the data, it can process it in parallel on the nodes where the data is located.
  - Robust and Reliable: Hadoop is architected with the assumption of frequent hardware malfunctions. It automatically maintains multiple copies of data and automatically redeploys computing tasks based on failures.
  - Simple and Accessible: It runs on large clusters of commodity machines or on cloud computing services