Meet Hadoop

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desiderata

- operate scalably
  - petabytes of data
  - larger than RAM, disk i/o required
- operate economically
  - minimize $ per cycle, ram, & i/o
  - thus use network of commodity PCs
- operate reliably

problem: seeks are expensive

- CPU & transfer speed, RAM & disk size
  - double every 18-24 months
- seek time nearly constant (~5%/year)
- time to read entire drive is growing
- moral:
  - scalable computing **must** go at transfer rate

two database paradigms: seek versus transfer

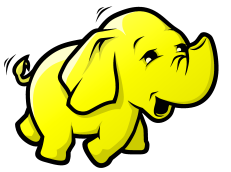
- B-Tree (Relational Dbs)
  - operate at seek rate – log(N) seeks/access
- sort/merge flat files (Lucene, MapReduce)
  - operate at transfer rate – log(N) transfers/sort
- caveats:
  - sort & merge is batch based
    - although possible to work around
  - other paradigms (memory, streaming, etc.)

example: updating a terabyte DB

- given:
  - 10MB/s transfer
  - 10ms/seek
  - 100B/entry (10B entries)
  - 10kB/page (1B pages)
- updating 1% of entries (100M) takes:
  - 1000 days with random B-Tree updates
  - 100 days with batched B-Tree updates
  - 1 day with sort & merge

problem:
scaling reliably is hard

- need to process 100TB datasets
- on 1 node:
  - scanning @ 50MB/s = 23 days
  - MTBF = 3 years
- on 1000 node cluster:
  - scanning @ 50MB/s = 33 min
  - MTBF = 1 day
- need framework for distribution
  - efficient, reliable, easy to use



MapReduce: sort/merge based distributed computing

- best for batch-oriented, offline
- naturally supports ad-hoc queries
- sort/merge is primitive
  - operates at transfer rate
- simple programming metaphor:
  - `input | map | shuffle | reduce > output`
  - `cat * | grep | sort | uniq -c > file`
- distribution & reliability
  - handled by framework

comparison of current scalable database strategies

	partitioned RDBMS	MapReduce	HBase/ BigTable
access:	+online	-offline	+online
distribution:	-custom	+native	+native
partitioning:	-static	+dynamic	+dynamic
updates:	-slower	+fastest	+faster
schema:	-static	+dynamic	-static
joins:	-slow/hard	+fast/easy	-slow/hard

Hadoop

- Apache project
- includes:
  - HDFS – a distributed filesystem
  - MapReduce – offline computing engine
  - HBase (pre-alpha) – online data access
- Y! is biggest contributor
- still pre-1.0 release
  - but already used by many

over to Eric...