The Evolution of Analytic Scalability

Introduction- The Convergence of the Analytic and Data Environment

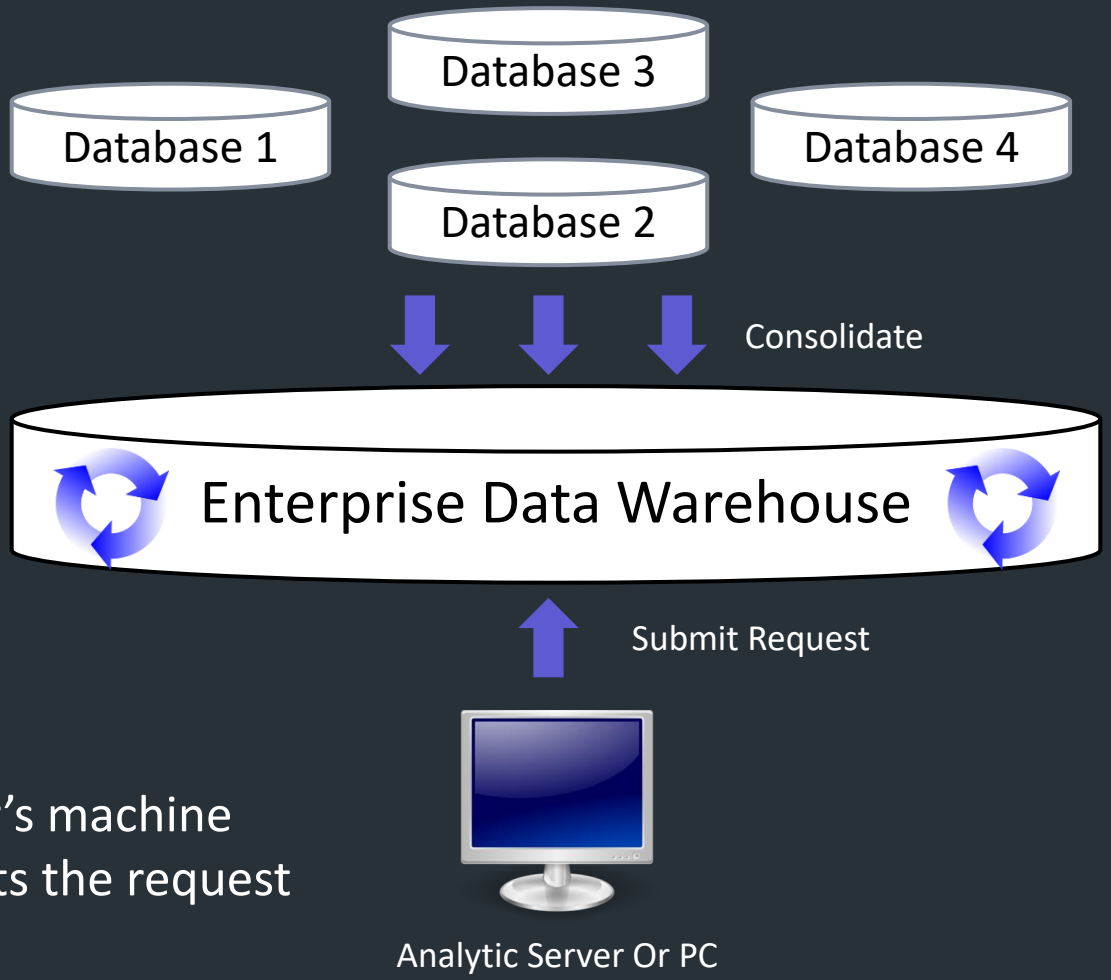
- The amount of data organizations process continues to increase

- Important technologies to tame the big data tidal wave possible

MPP | The cloud | Grid computing | MapReduce

Traditional Analytic Architecture

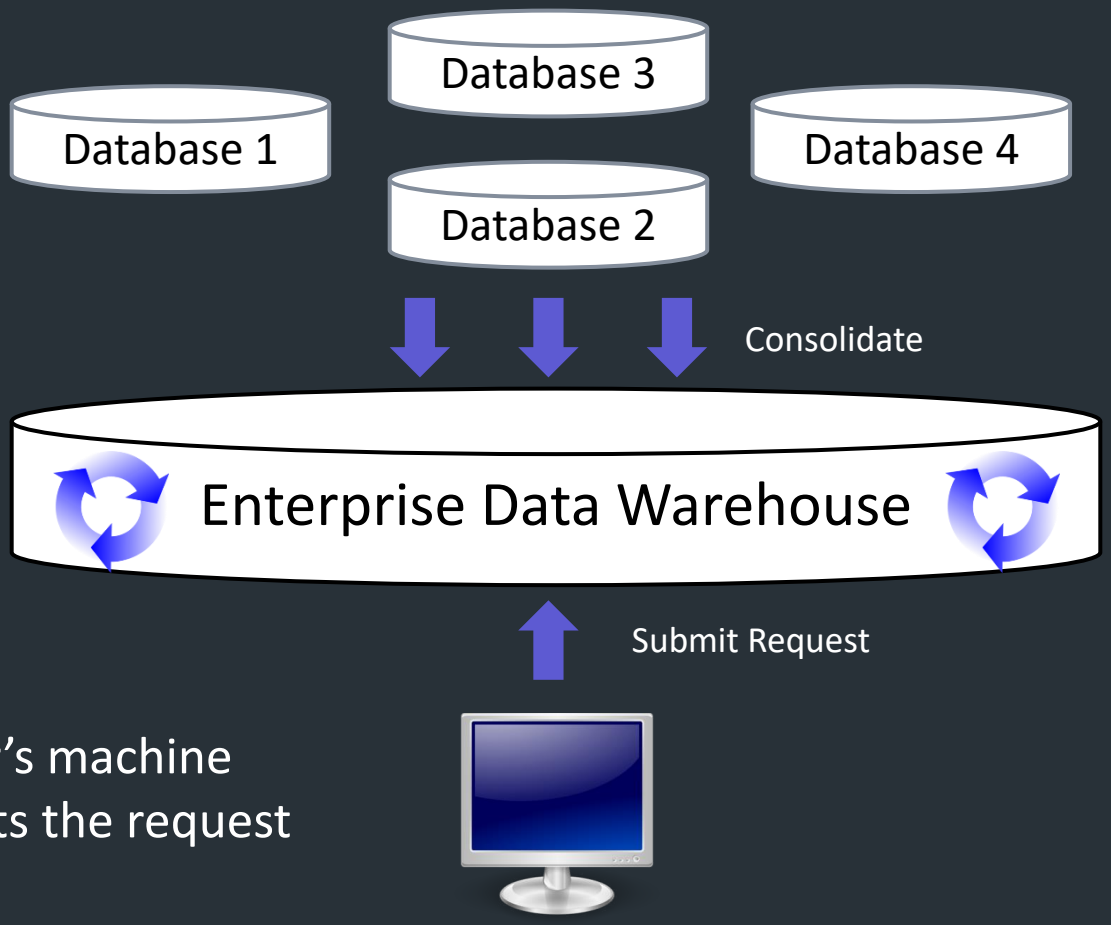
- We had to pull all data together into a separate analytics environment to do analysis



The user's machine just submits the request

Modern In-Database Architecture

- The processing stays in the database where the data has been consolidated



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)

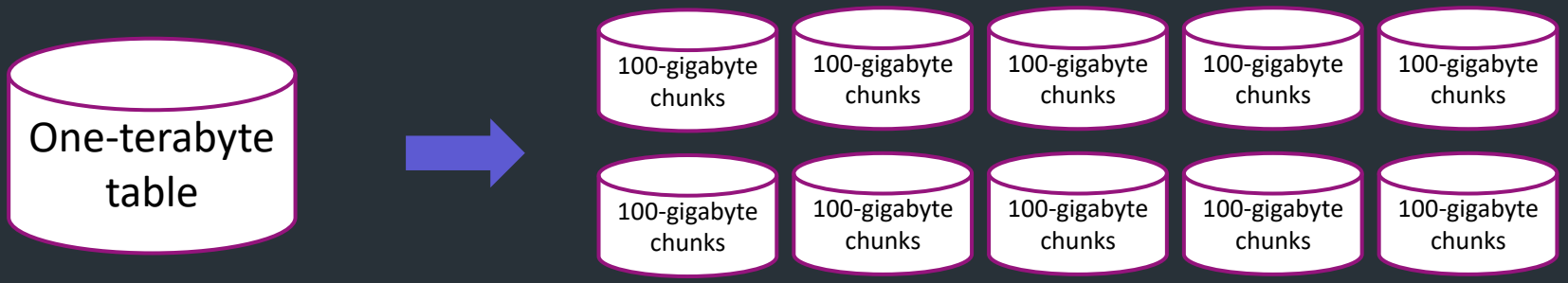
What is an MPP Database?

- An MPP database breaks the data into independent chunks with independent disk and CPU

Single overloaded server

Multiple lightly loaded servers

Shared Nothing!



A Traditional database will query a one-terabyte table one row at time

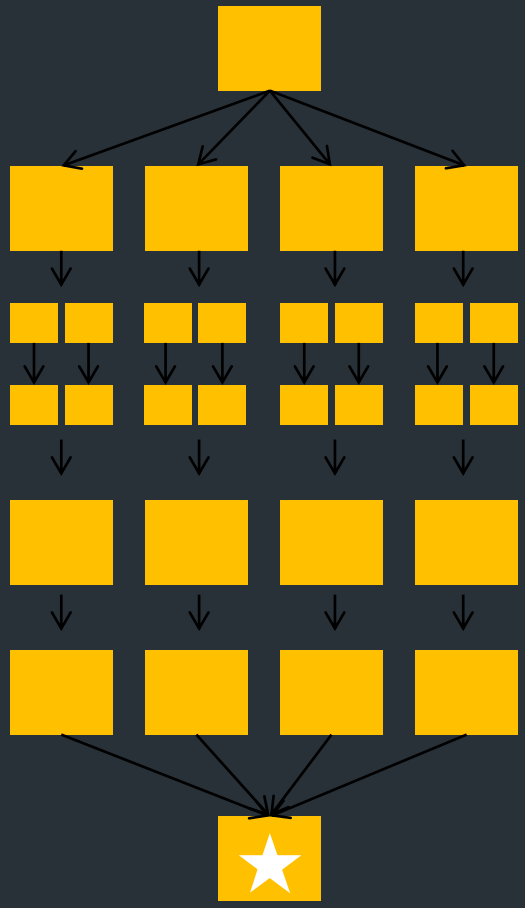
10 simultaneous 100-gigabyte queries

Concurrent Processing

- An MPP system allows the different sets of CPU and disk to run the process concurrently

Single Threaded Process

An MPP system breaks the job into pieces



Parallel Process

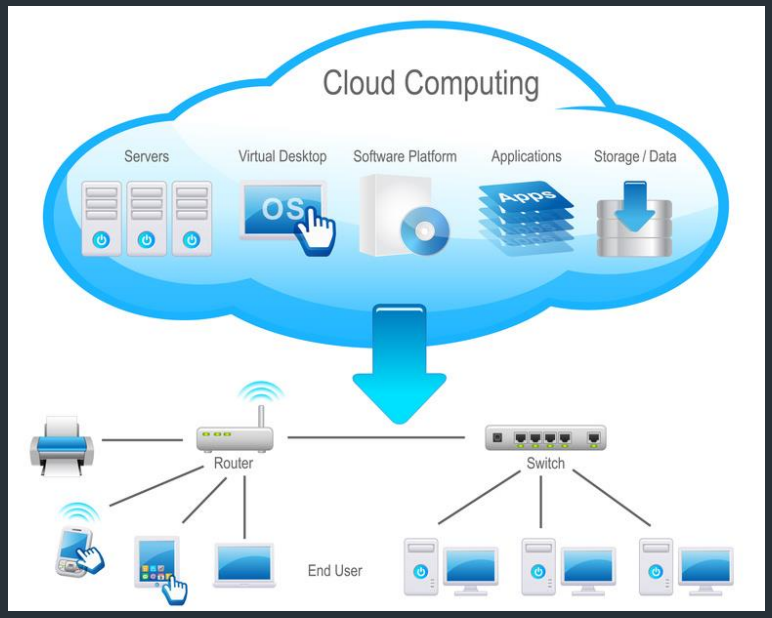
Others

- MPP systems build in redundancy to make recovery easy
- MPP systems have resource management tools
  - Manage the CPU and disk space
  - Query optimizer

What is Cloud Computing?

- McKinsey and Company paper from 2009[1]
  - Mask the underlying infrastructure from the user
  - Be elastic to scale on demand
  - On a pay-per-use basis

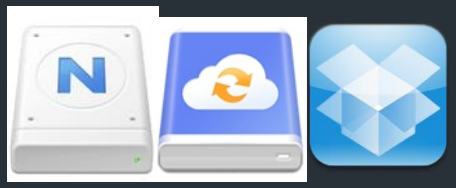
- National Institute of Standards and Technology (NIST)
  - On-demand self-service
  - Broad network access
  - Resource pooling
  - Rapid elasticity
  - Measured service



[1] McKinsey and Company, 'Clearing the Air on Cloud Computing," March 2009.

Two Types of Cloud Environment

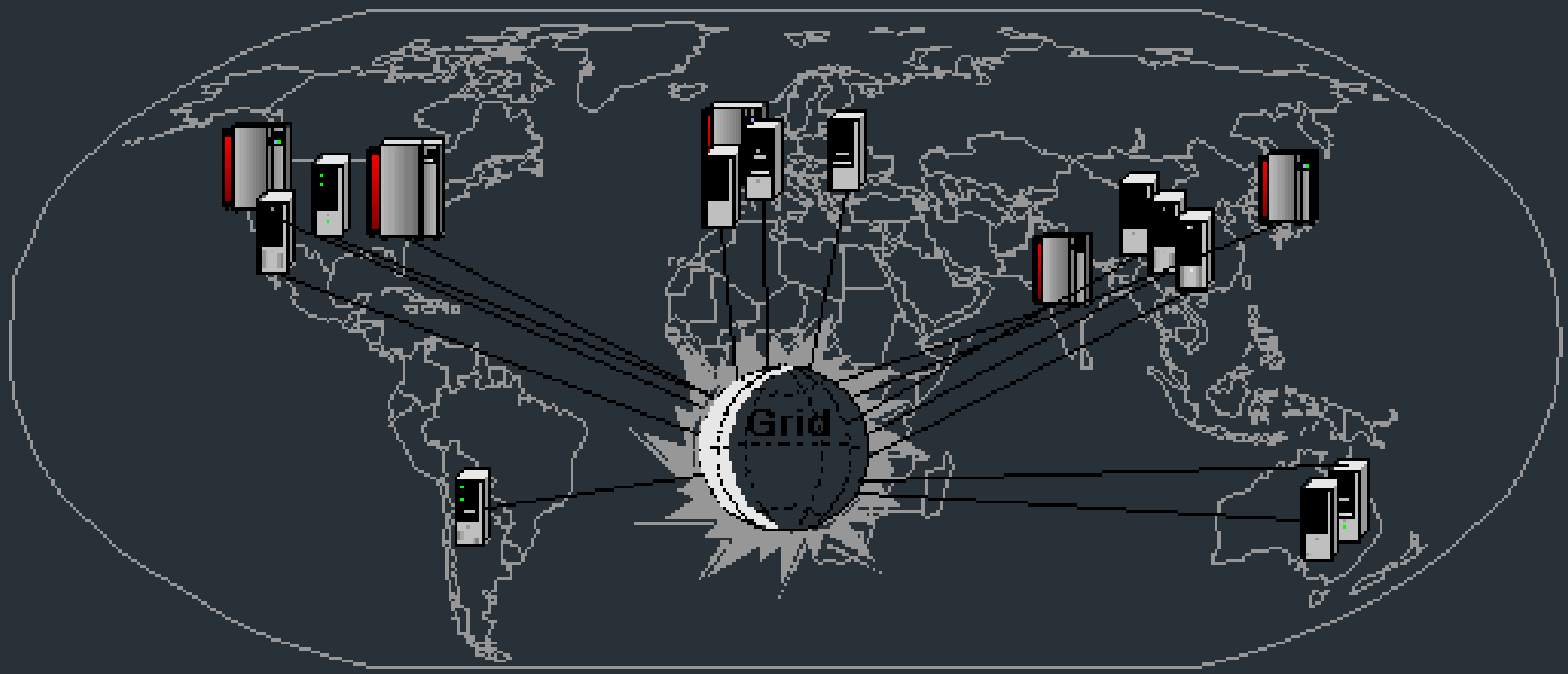
1. **Public Cloud**
   - The services and infrastructure are provided off-site over the internet
   - Greatest level of efficiency in shared resources
   - Less secured and more vulnerable than private clouds



2. **Private Cloud**
   - Infrastructure operated solely for a single organization
   - The same features of a public cloud
   - Offer the greatest level of security and control
   - Necessary to purchase and own the entire cloud infrastructure

Grid Computing

- The federation of computer resources to reach a common goal
  - E.g., SETI@Home (Search for Extraterrestrial Intelligence)
    - An Internet-based public volunteer computing project

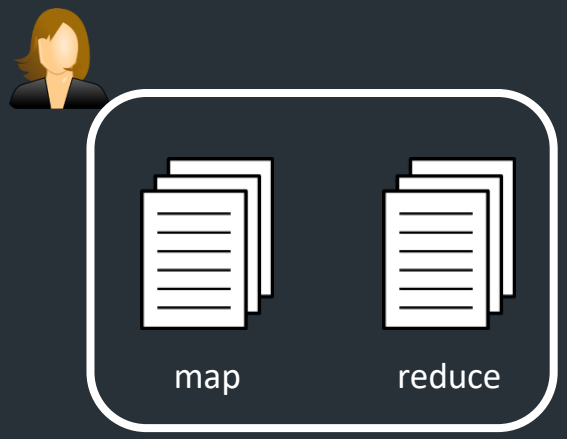


What is MapReduce?

- A Parallel programming framework[1]

Library

Parallelization
Fault-tolerance
Data distribution
Load balancing
……



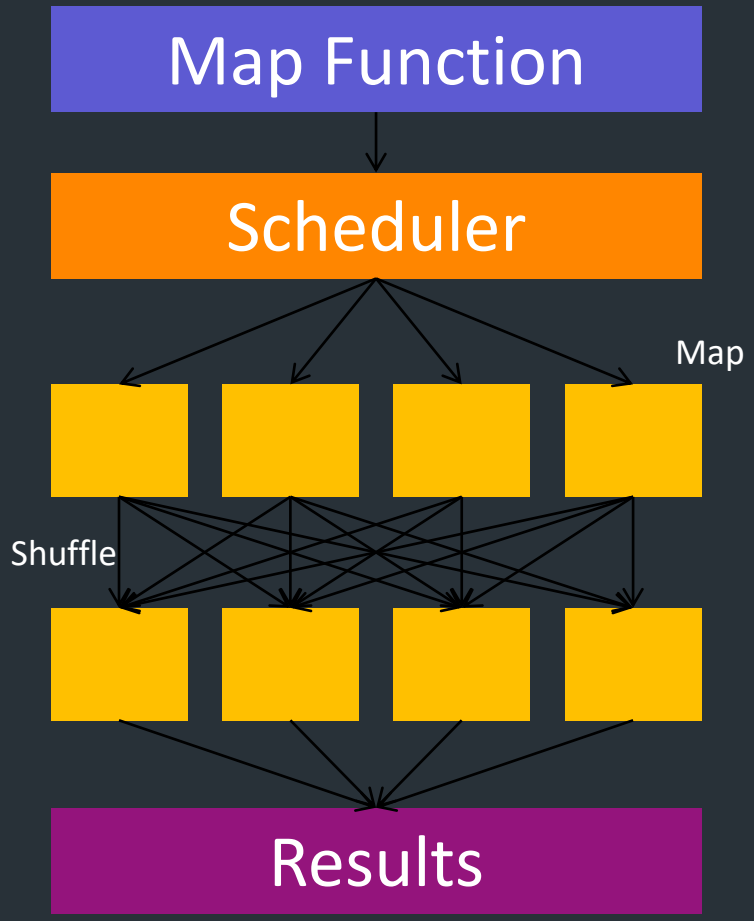
- *Map function*
  - Processing a key/value pairs to generate a set of intermediate key/value pairs
- *Reduce function*
  - Merging all intermediate values associated with the same intermediate key

[1] MapReduce: Simplified Data Processing on Large Clusters – OSDI 2004

How MapReduce Works

- Let's assume there are 20 terabytes of data and 20 MapReduce server nodes for a project

1. Distribute a terabyte to each of the 20 nodes using a simple file copy process
2. Submit two programs(Map, Reduce) to the scheduler
3. The map program *finds the data* on disk and *executes* the logic it contains
4. The results of the map step are then passed to the reduce process to *summarize* and *aggregate* the final answers



Strengths and Weaknesses

- **Good for**
  - Lots of input, intermediate, and output data
  - Batch oriented datasets (ETL: Extract, Load, Transform)
  - Cheap to get up and running because of running on commodity hardware

- **Bad for**
  - Fast response time
  - Large amounts of shared data
  - CPU intensive operations (as opposed to data intensive)
  - NOT a database!
    - No built-in security
    - No indexing, No query or process optimizer
    - No knowledge of other data that exists

The Evolution of Analytic Processes

Analytic Sandbox Benefits

View of Analytic Professionals

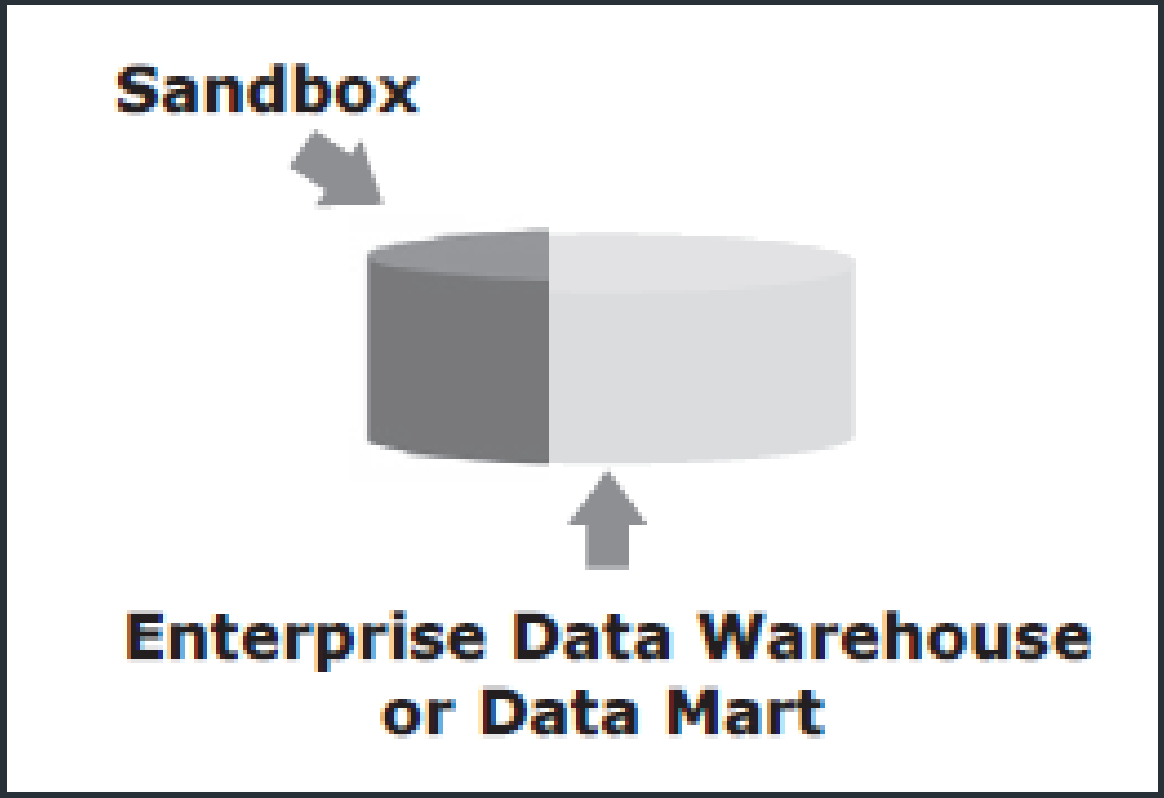
- Independence
- Flexibility
- Efficiency
- Freedom
- Speed

Analytic Sandbox Benefits

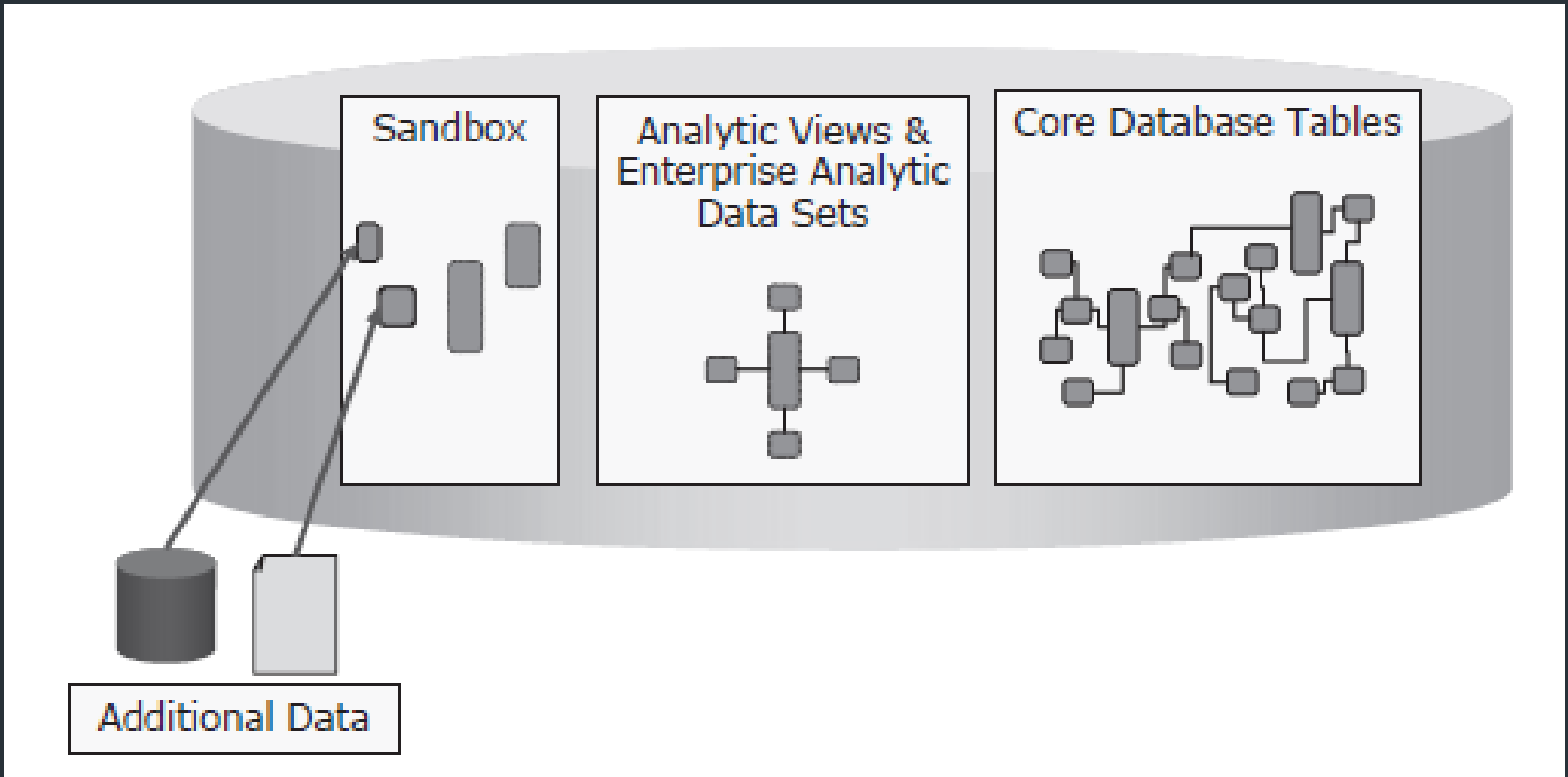
View of IT

Centralization.
Streamlining
Simplicity.
Control.
Costs:

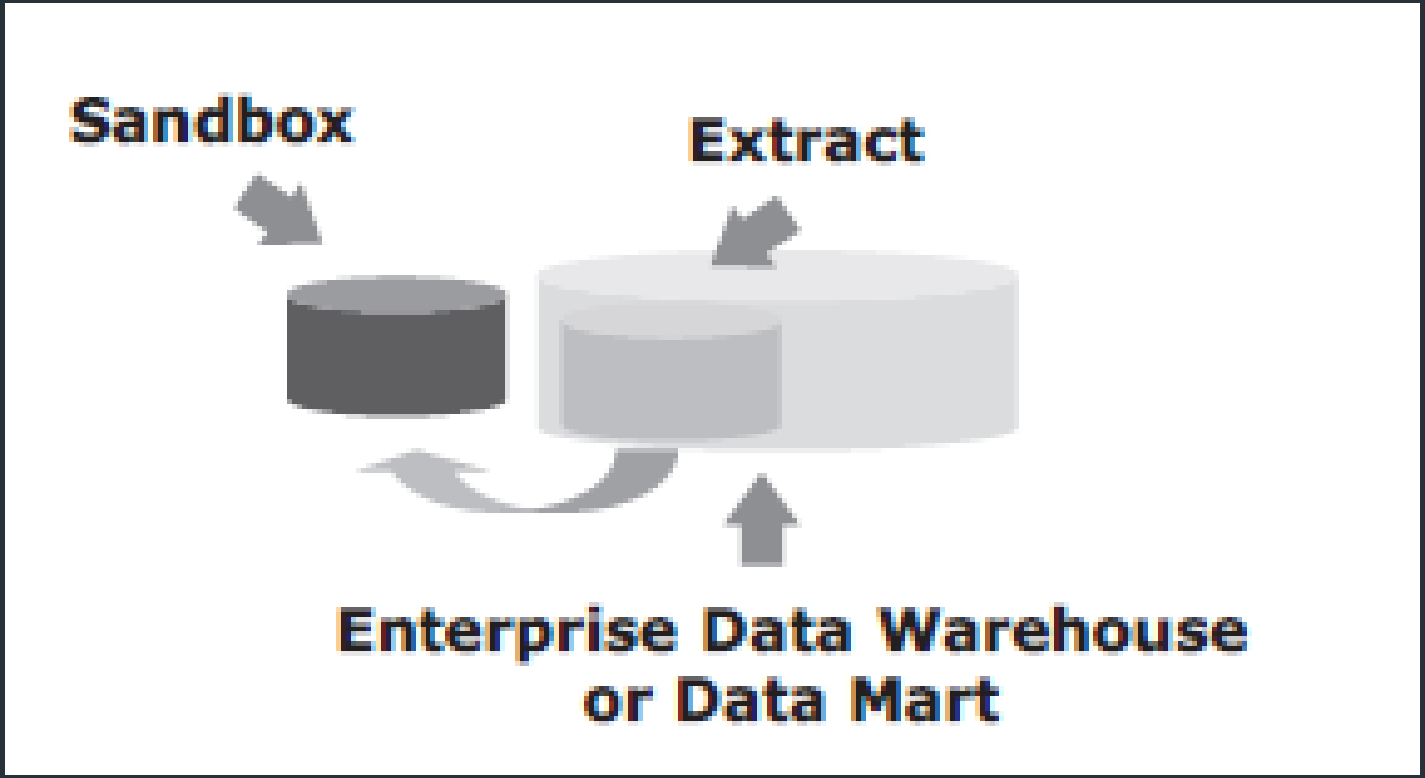
An Internal Sandbox



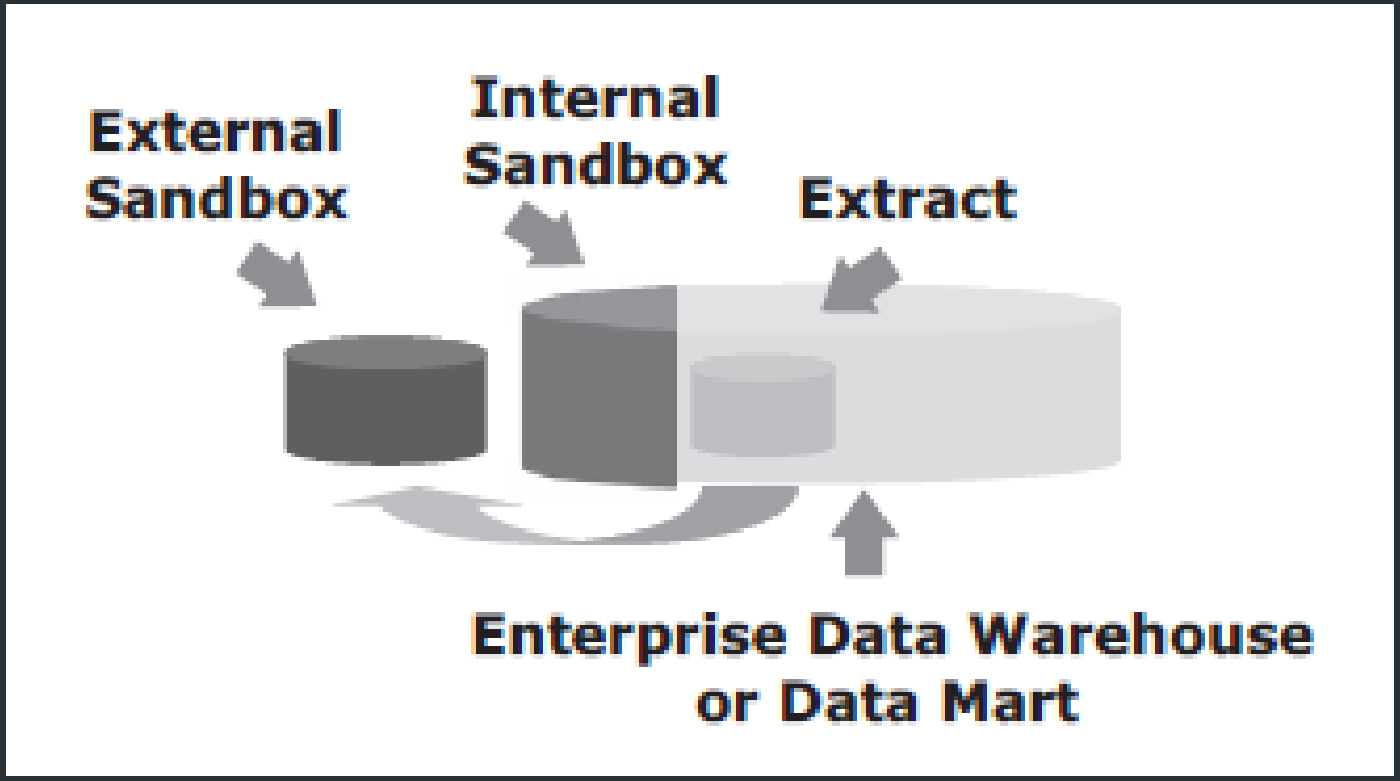
Internal Sandbox View



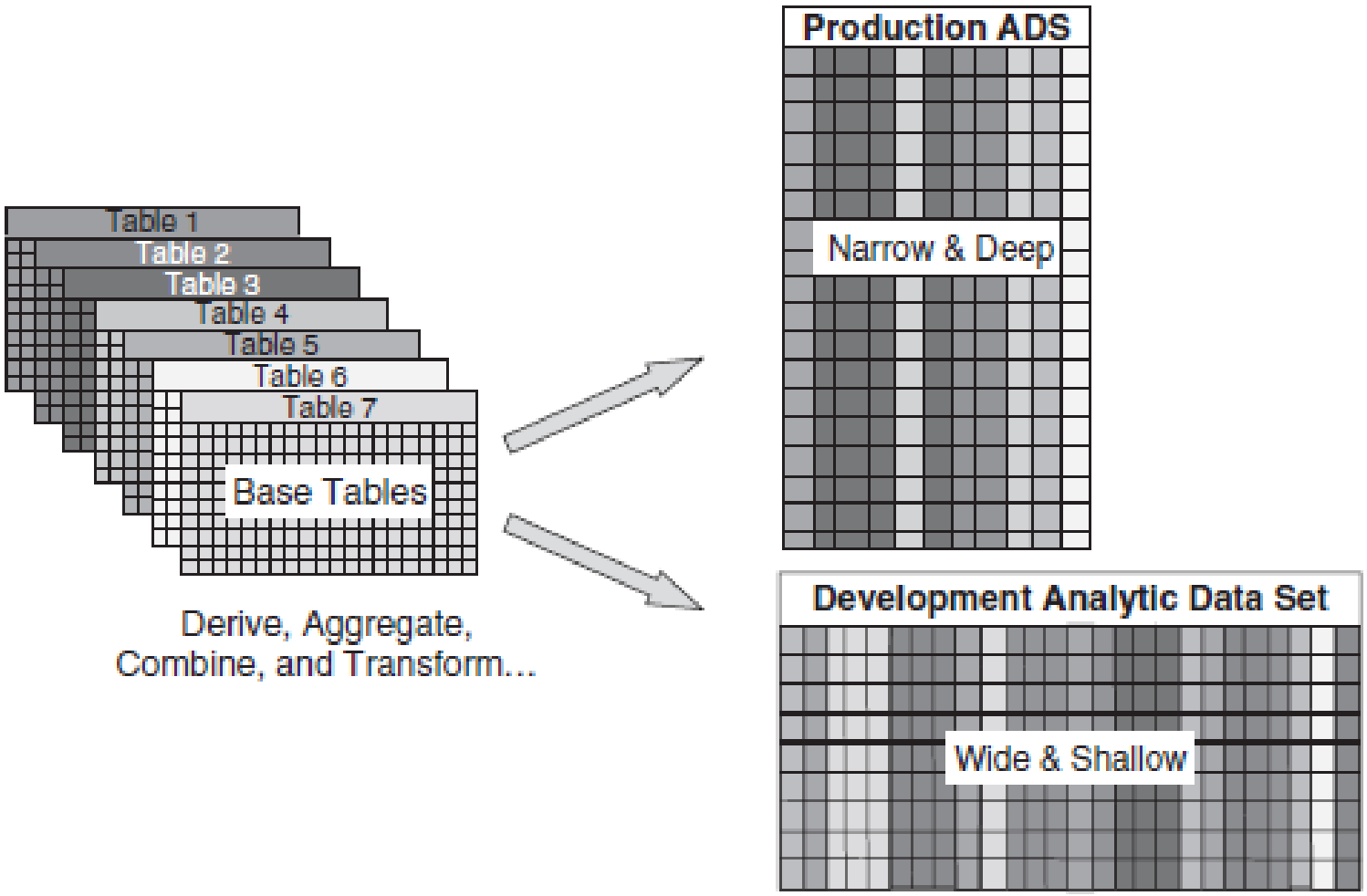
An External Sandbox



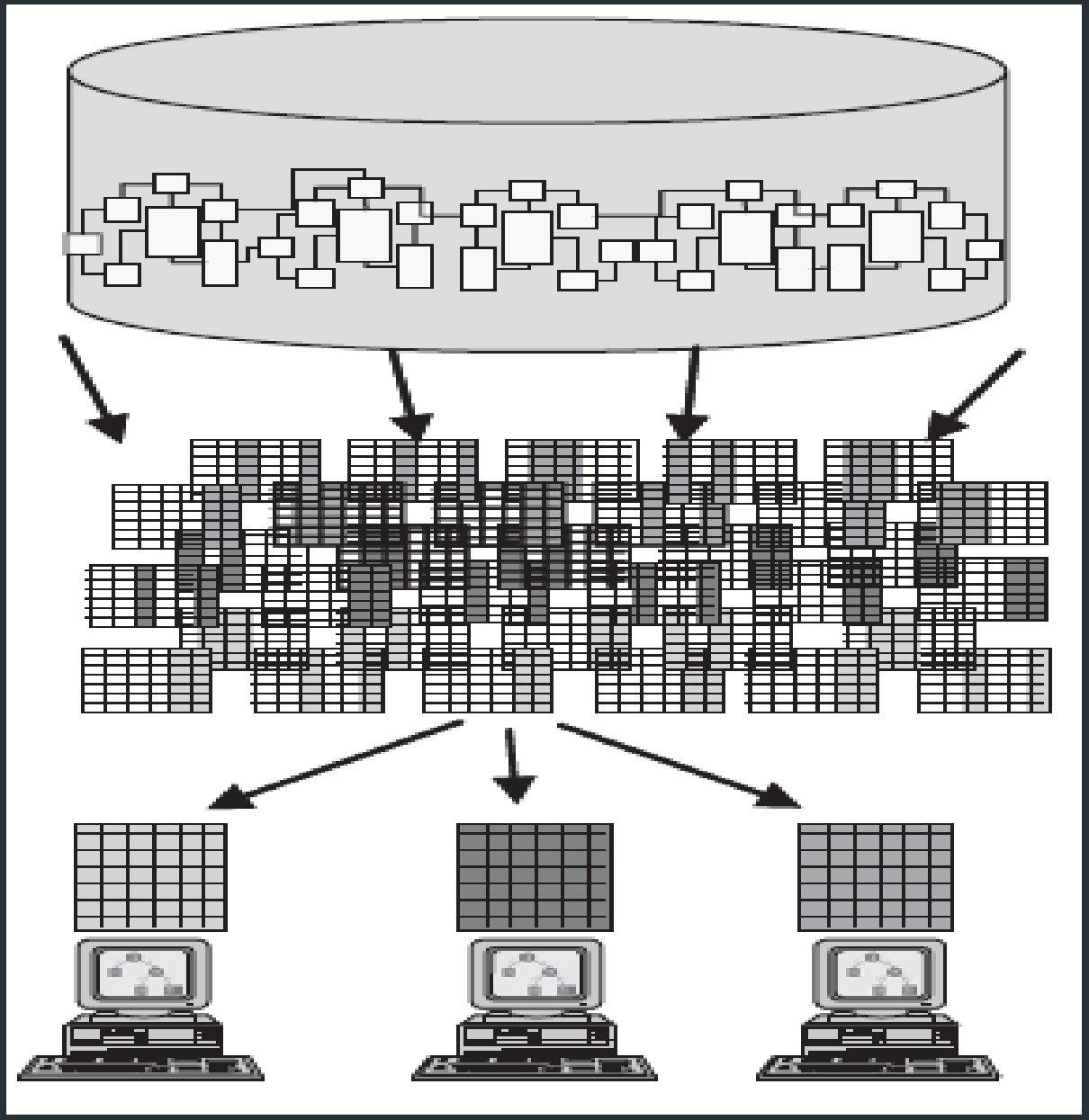
Hybrid Sandbox



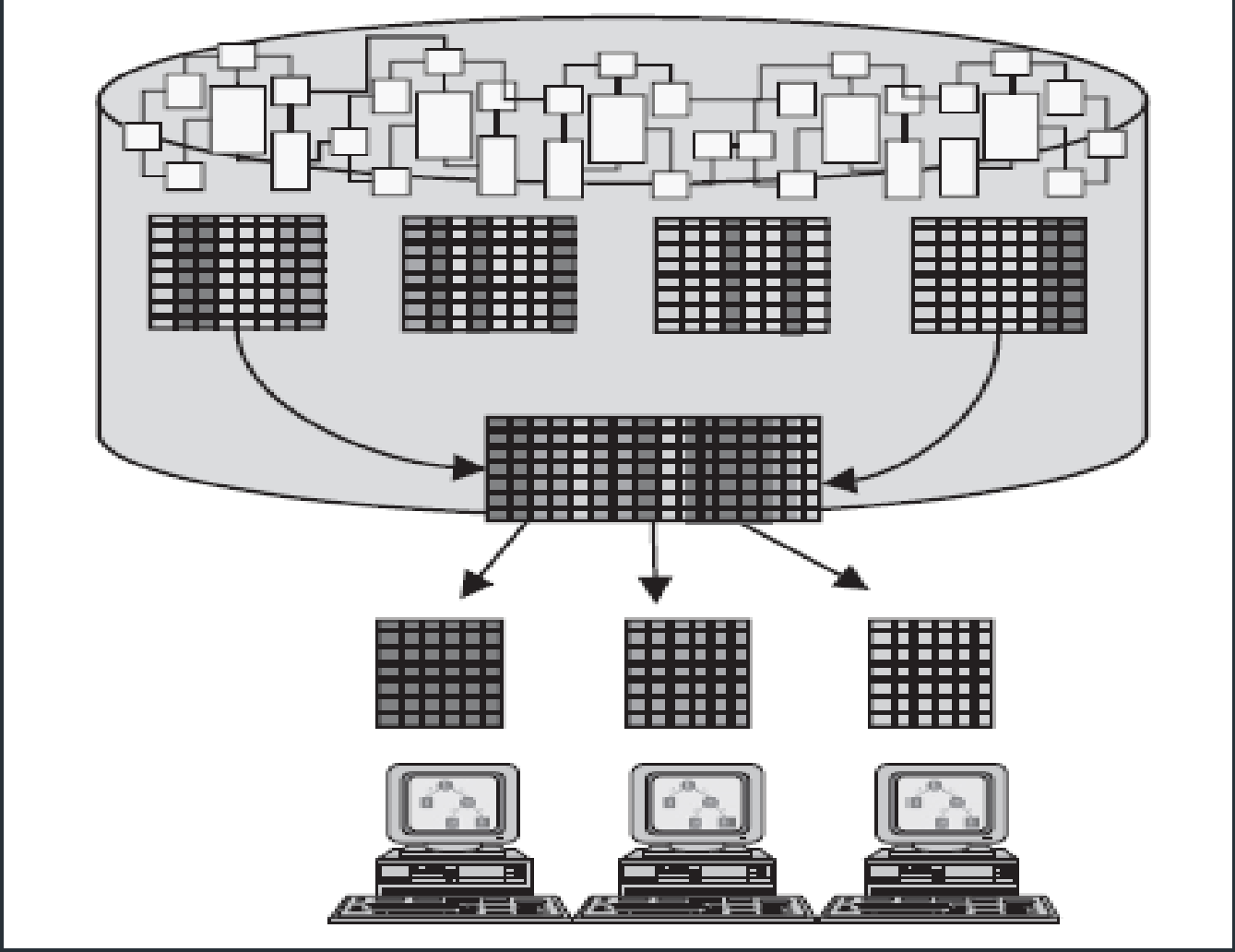
Development versus Production Analytic Data Sets



Traditional Analytic Data Set Process



Enterprise Analytic Data Set Process



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Conclusion

- These technologies can integrate and work together
  - Databases running in the cloud
  - Databases including MapReduce functionality
  - MapReduce can be run against data sourced from a database
  - MapReduce can also run against data in the cloud

[Cloud Database]

[SQL-MapReduce]

[In-Database MapReduce][1]

[Running MapReduce in Database]

[Running MapReduce in Cloud][2]

[1] https://blogs.oracle.com/datawarehousing/entry/in-database_map-reduce
[2] http://code.google.com/p/cloudmapreduce/
Cloud mapreduce: a mapreduce implementation on top of a cloud operating system – CCGRID 2011, IEEE Computer Society