Today's Reading, Pavlo 2009

MR VS. DATABASES

Pavlo et al. 2009

Hadoop vs. RDBMS

- Comparison of 3 systems
  - Hadoop
  - Vertica (a column-oriented database)
  - DBMS-X (a row-oriented database)
    - rhymes with “schmoracle”
- Qualitative
  - Programming model, ease of setup, features, etc.
- Quantitative
  - Data loading, different types of queries

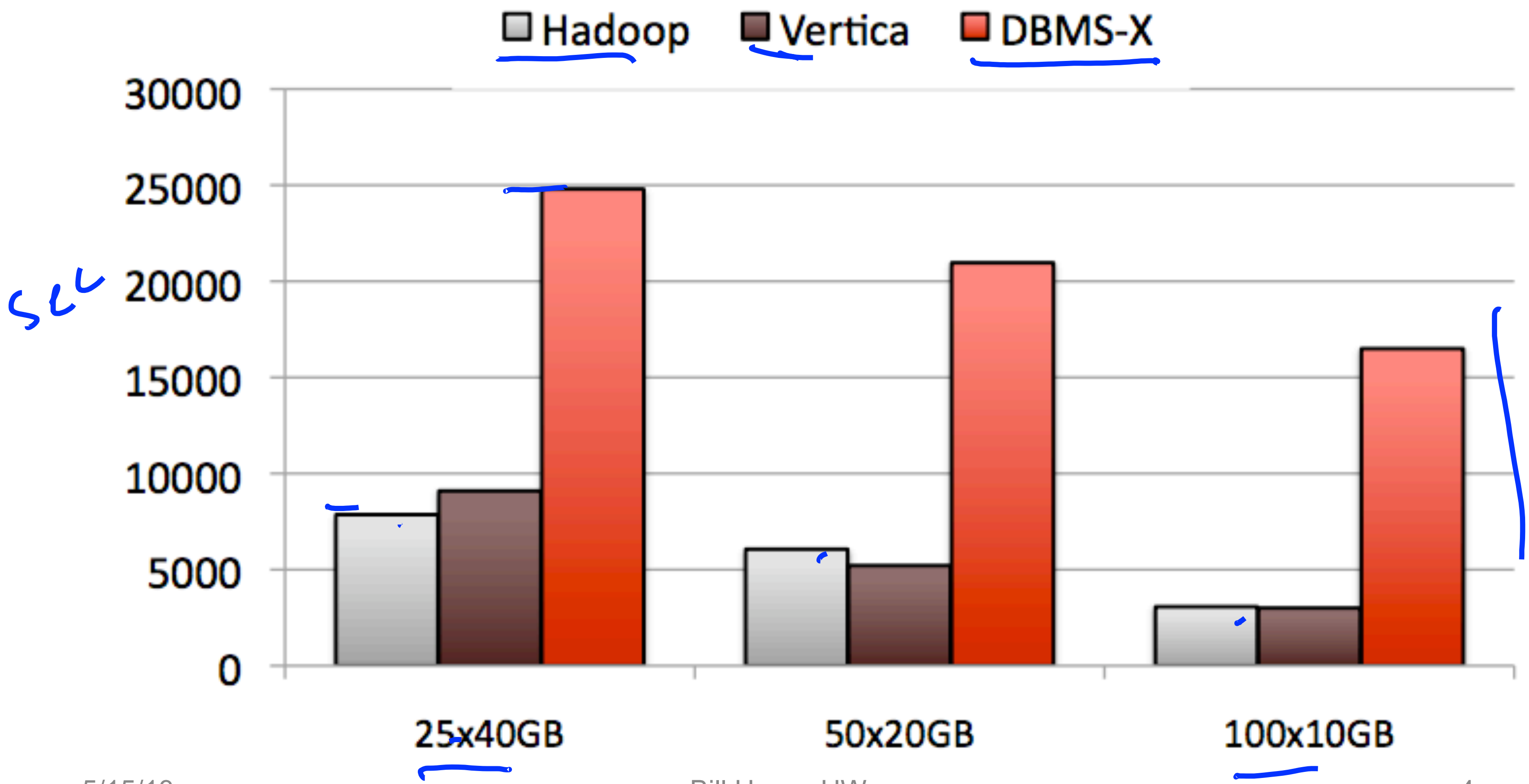
Grep Task

- Find 3-byte pattern in 100-byte record
  - *1 match per 10,000 records*

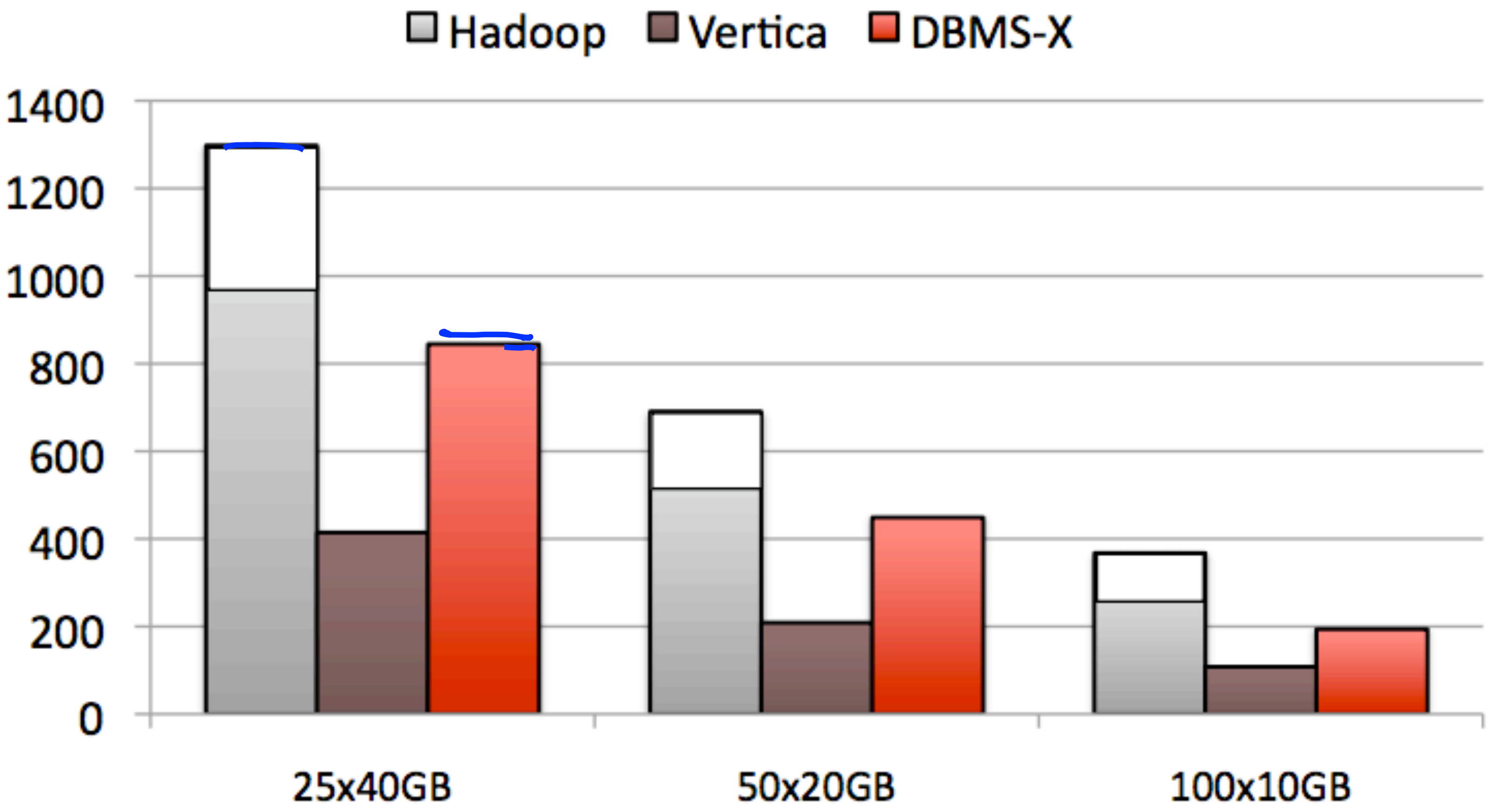
- Data set:
  - *10-byte unique key, 90-byte value*
  - *1TB spread across 25, 50, or 100 nodes*
  - *10 billion records*

- Original MR Paper (Dean et al. 2004)

Grep Task Loading Results

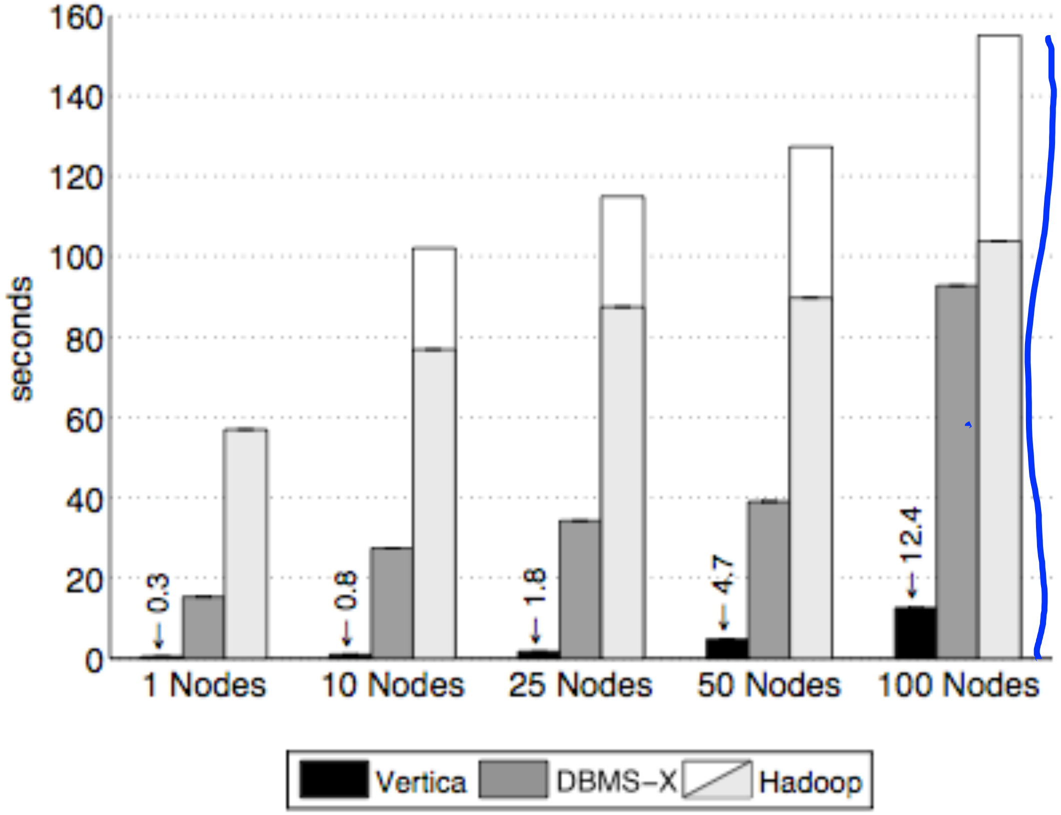


Grep Task Execution Results

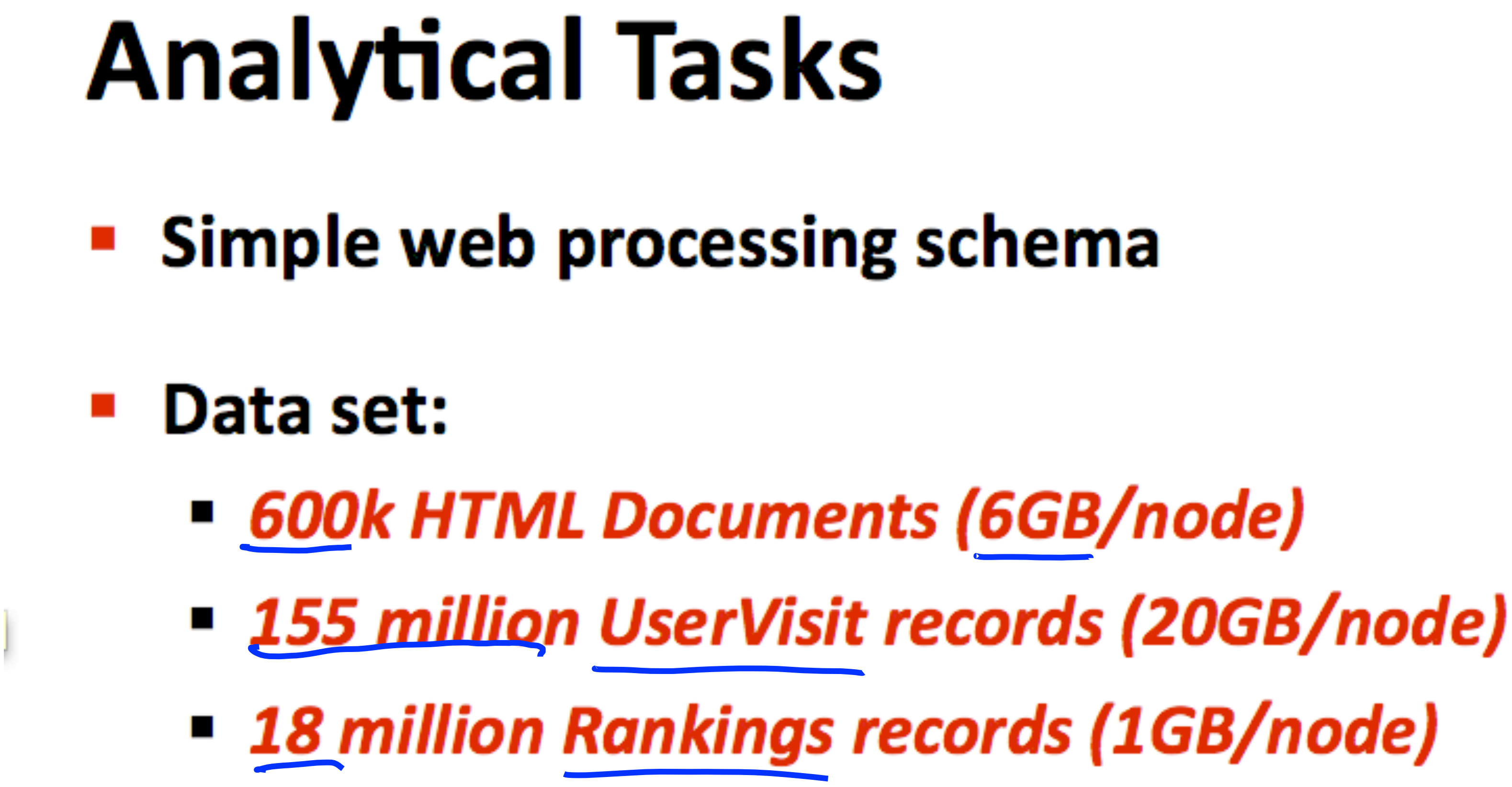


Selection Task

```
SELECT pageURL, pageRank
FROM Rankings WHERE pageRank > X
```



1 GB / node



Analytical Tasks

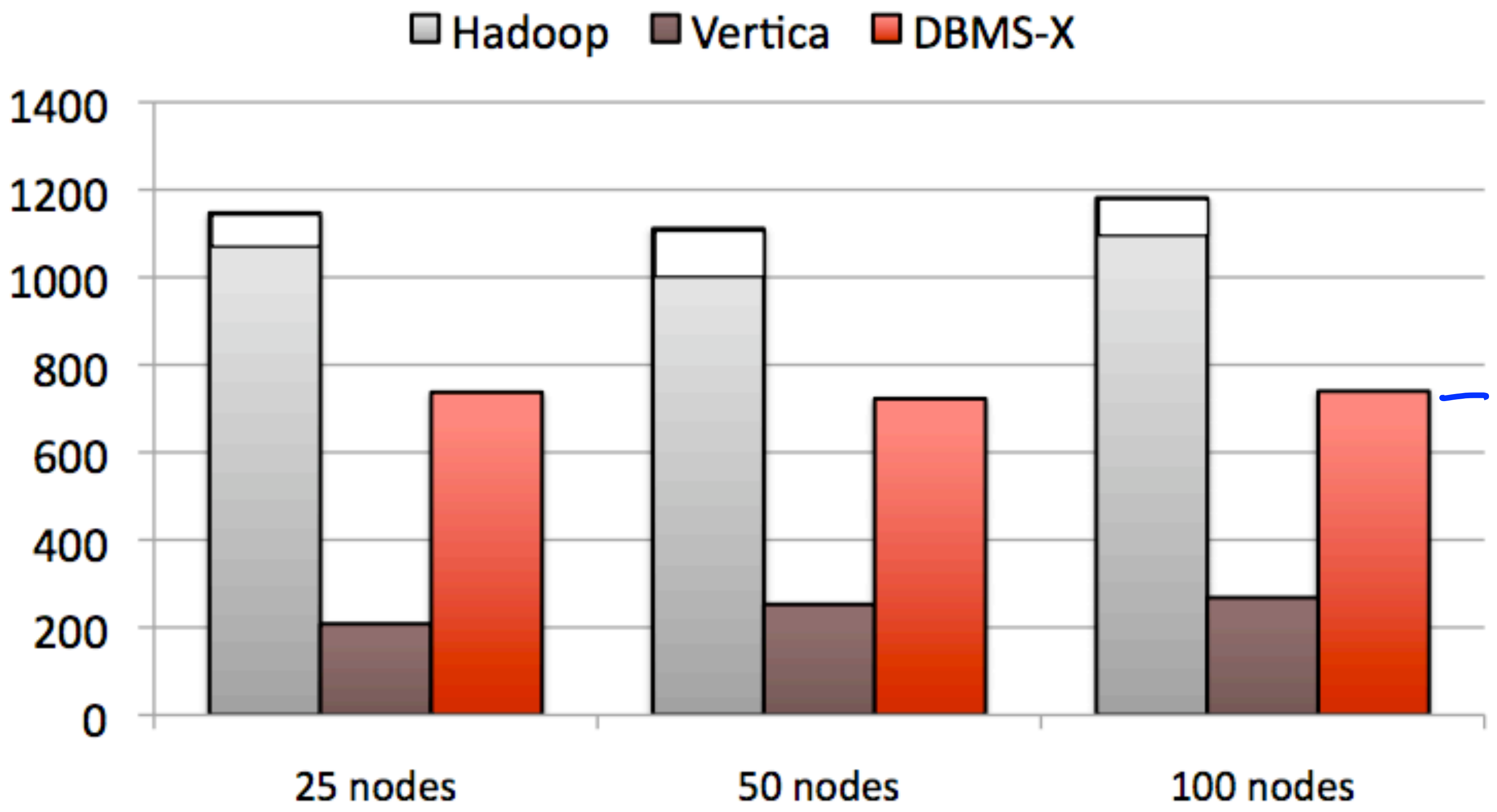
- Simple web processing schema
- Data set:
  - *600k HTML Documents (6GB/node)*
  - *155 million UserVisit records (20GB/node)*
  - *18 million Rankings records (1GB/node)*

Aggregate Task

- Simple query to find adRevenue by IP prefix

```
SELECT SUBSTR(sourceIP, 1, 7),
       SUM(adRevenue)
  FROM userVistits
 GROUP BY SUBSTR(sourceIP, 1, 7)
```

Aggregate Task Results



Join Task

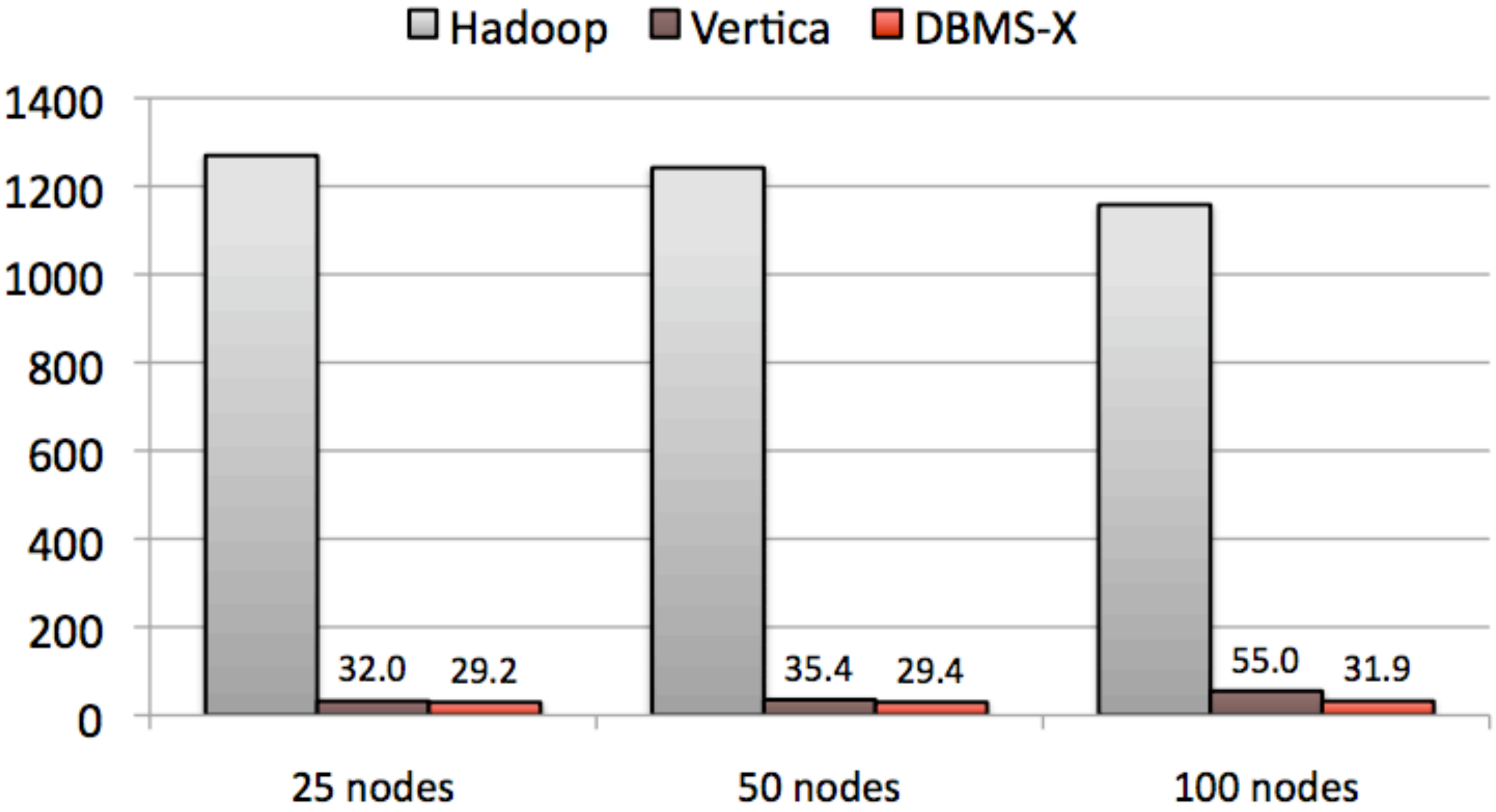
- Find the sourceIP that generated the most adRevenue along with its average pageRank.
- Implementations:
  - *DBMSs – Complex SQL using temporary table.*
  - *MapReduce – Three separate MR programs.*

Join Task

```
SELECT INTO TempsourceIP,
            AVG(pageRank)as avgPageRank,
            SUM(adRevenue)as totalRevenue
FROM RankingsAS R
   , UserVisitsAS UV
WHERE R.pageURL = UV.destURL
AND UV.visitDate
  BETWEEN ‘2000-01-15’
  AND ‘2000-01-22’
GROUP BY UV.sourceIP;

SELECT sourceIP,
       totalRevenue,
       avgPageRank
FROM Temp
ORDER BY totalRevenueDESC
LIMIT 1;
```

Join Task Results



Problems with this analysis?

- Other ways to avoid sequential scans?
- Fault-tolerance in large clusters?
- Tasks that cannot be expressed as queries?

Google's Response: Cluster Size

- Largest known database installations:
  - *Greenplum – 96 nodes – 4.5 PB (eBay) [1]*
  - *Teradata – 72 nodes – 2+ PB (eBay) [1]*
- Largest known MR installations:
  - *Hadoop – 3658 nodes – 1 PB (Yahoo) [2]*
  - *Hive – 600+ nodes – 2.5 PB (Facebook) [3]*

[1] **eBay's two enormous data warehouses** – April 30th, 2009
http://www.dbms2.com/2009/04/30/ebays-two-enormous-data-warehouses/

[2] **Hadoop Sorts a Petabyte in 16.25 Hours and a Terabyte in 62 Seconds** – May 11th, 2009
http://developer.yahoo.net/blogs/hadoop/2009/05/hadoop_sorts_a_petabyte_in_162.html

[3] **Hive - A Petabyte Scale Data Warehouse using Hadoop** – June 10th, 2009
http://www.facebook.com/note.php?note_id=89508453919

Concluding Remarks

- What can *MapReduce* learn from *Databases*?
  - *Declarative languages are a good thing.*
  - *Schemas are important.*
- What can *Databases* learn from *MapReduce*?
  - *Query fault-tolerance.*
  - *Support for in situ data.*
  - *Embrace open-source.*

Other Benchmarked Systems

- HadoopDB (Abadi ’09 - Yale)
  - *Replaced Hadoop filesystem with Postgres.*
  - *Makes JDBC calls inside of MR functions.*
- Hive (Thusoo ’09 - Facebook)
  - *Data warehouse interface on top of Hadoop.*
  - *Converts SQL-like language to MR programs.*