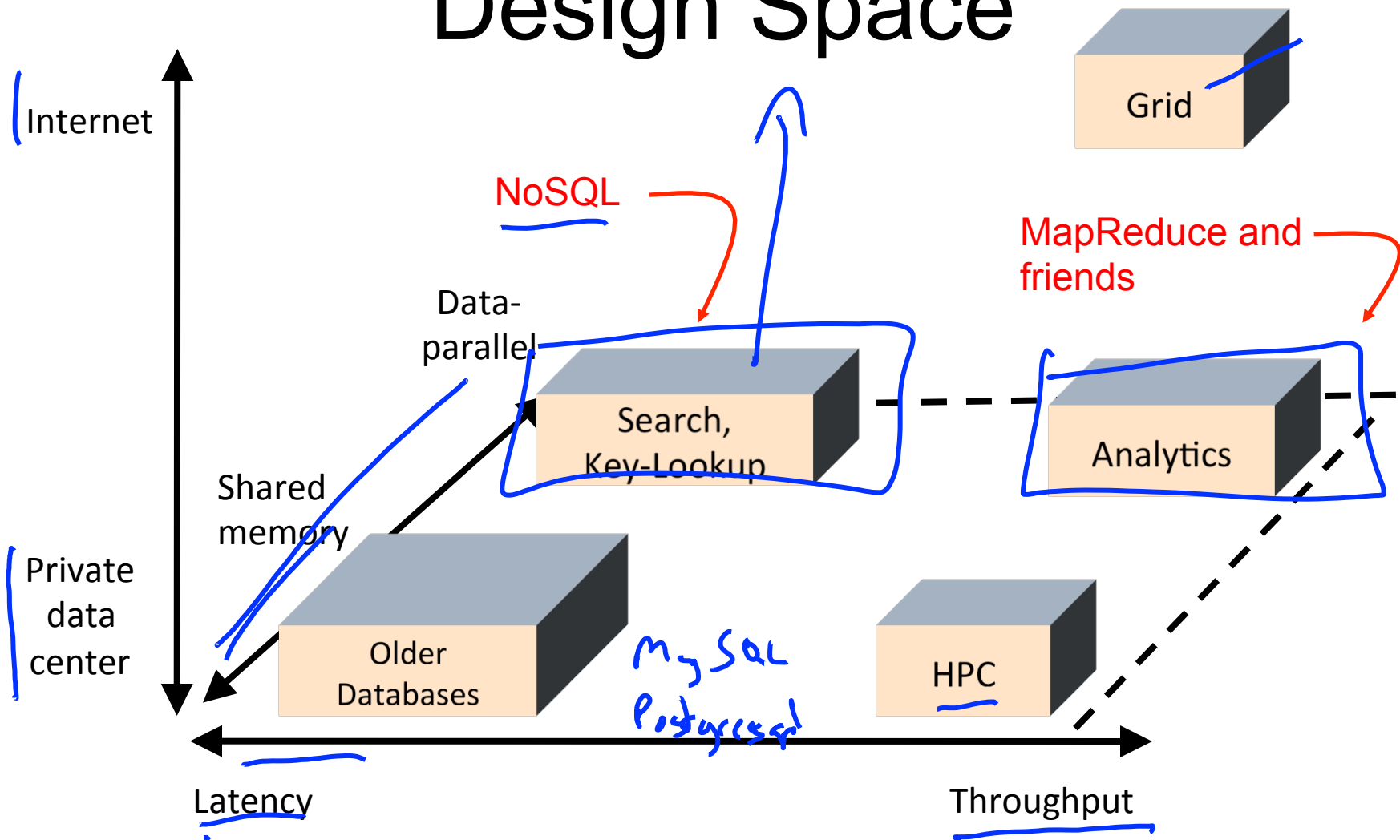


Design Space



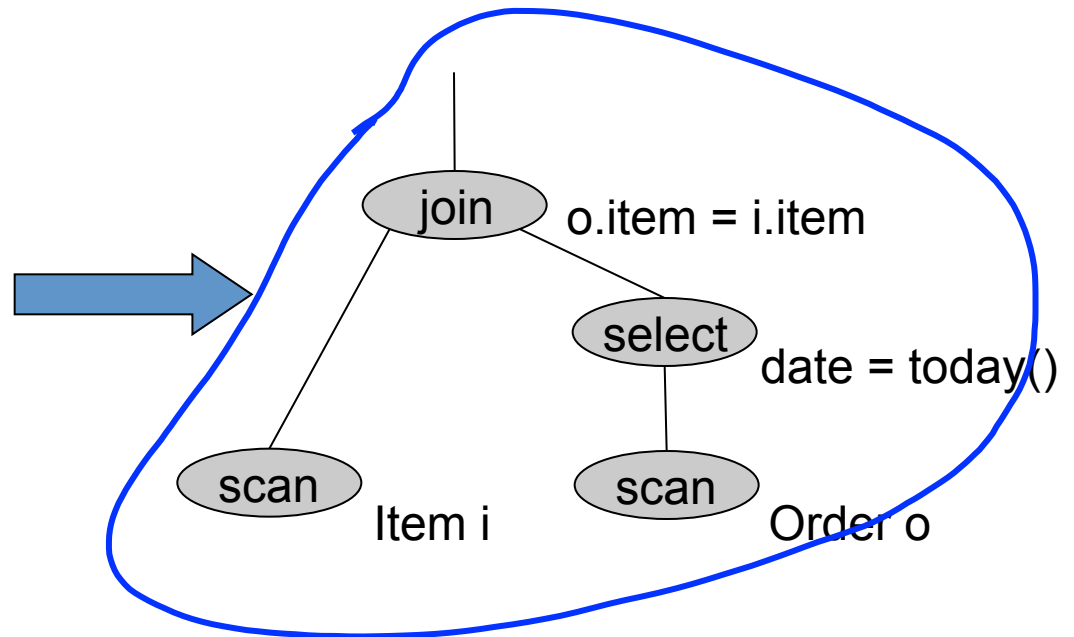
Large-Scale Data Processing

- Many tasks process big data, produce big data
- Want to use hundreds or thousands of CPUs
 - ... but this needs to be easy
 - **Parallel databases** exist, but they are expensive, difficult to set up, and do not necessarily scale to hundreds of nodes.
- MapReduce is a *lightweight* framework, providing:
 - **Automatic parallelization and distribution**
 - **Fault-tolerance**
 - **I/O scheduling**
 - **Status and monitoring**

Key Idea: Declarative Languages

Find all orders from today, along with the items ordered

```
SELECT *  
  FROM Order o, Item i  
 WHERE o.item = i.item  
    AND o.date = today()
```



Two notions of parallel query processing

- “Distributed Query”
 - Rewrite the query as a union of subqueries
 - Workers communicate through standard interfaces, so compatible with federated, heterogeneous, or distributed databases
- “Parallel Query”
 - Each operator is implemented with a parallel algorithm

Distributed Query Example

```
CREATE VIEW Sales AS
```

```
SELECT * FROM JanSales
```

```
UNION ALL
```

```
SELECT * FROM FebSales
```

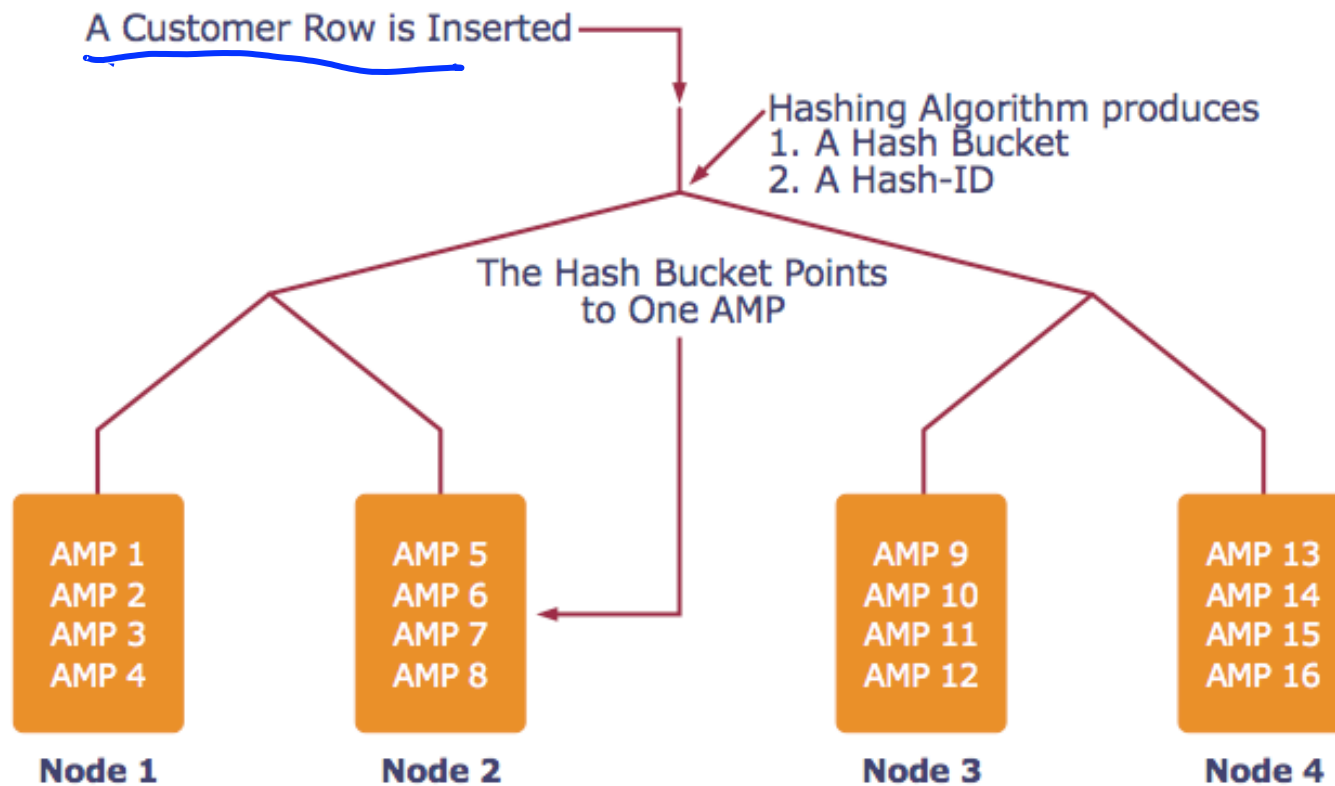
```
UNION ALL
```

```
SELECT * FROM MarSales
```



```
CREATE TABLE MarSales (  
  OrderID      INT,  
  CustomerID   INT      NOT NULL,  
  OrderDate    DATETIME  NULL  
  CHECK (DATEPART(mm, OrderDate) = 3),  
  CONSTRAINT OrderIDMonth PRIMARY KEY(OrderID)  
)
```

Parallel Query Example: Teradata

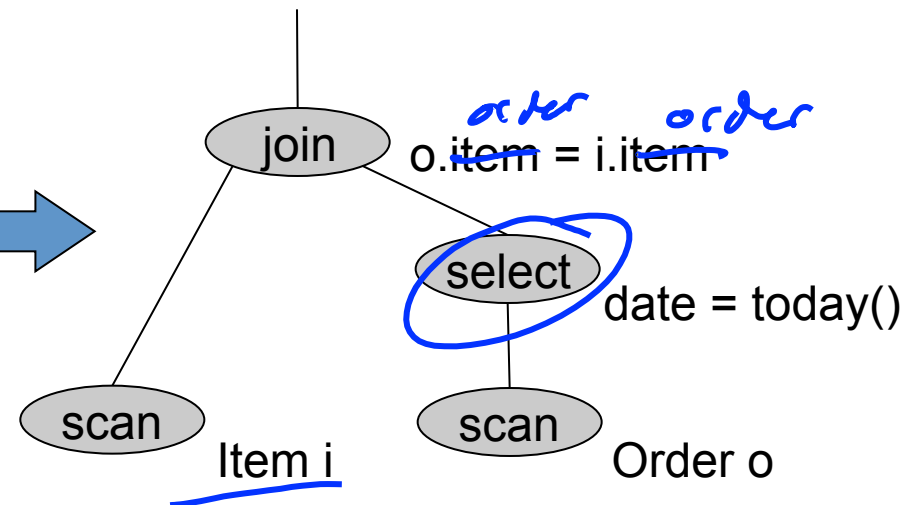


AMP = unit of parallelism

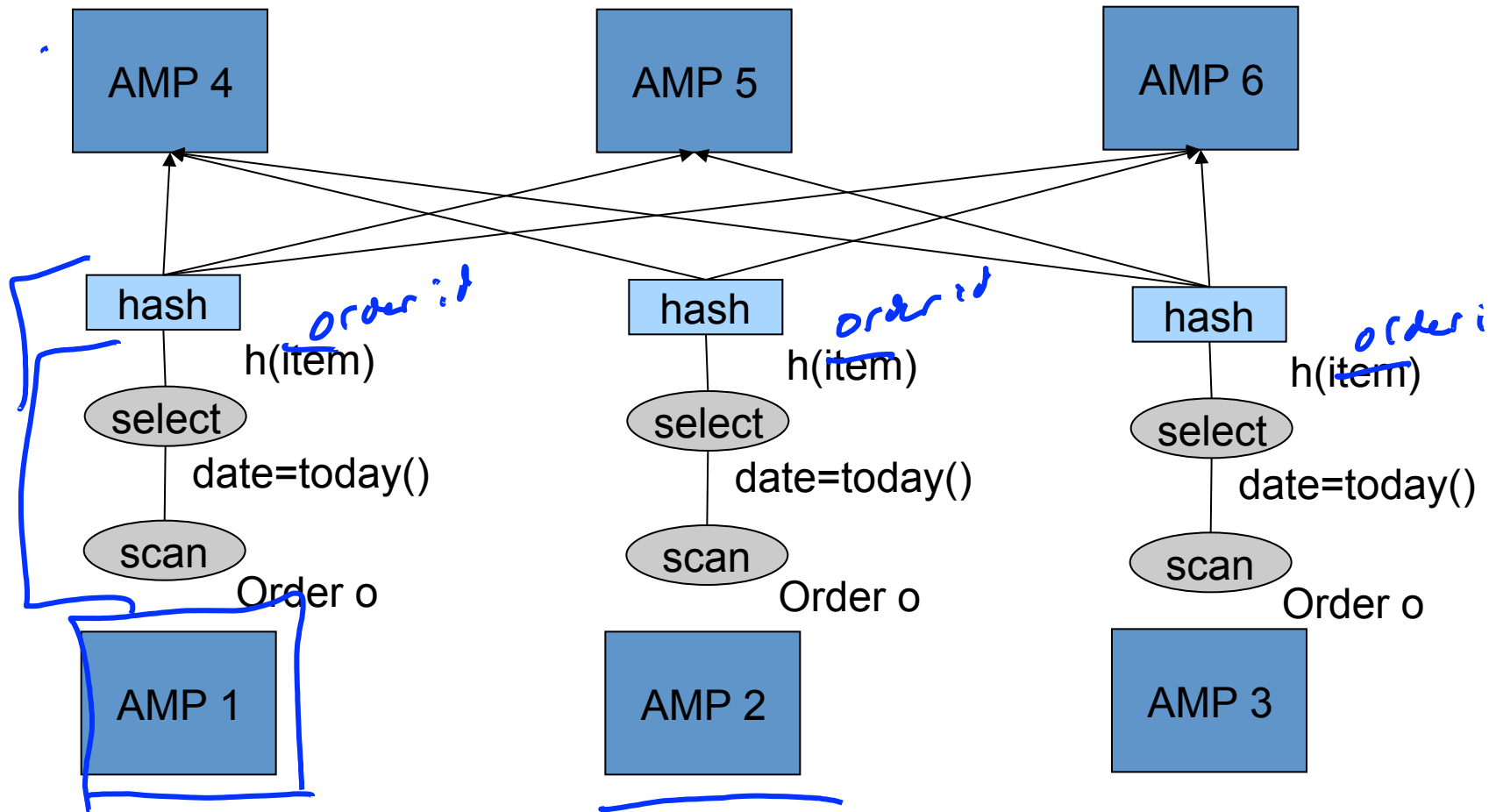
Example System: Teradata

Find all orders from today, along with the items ordered

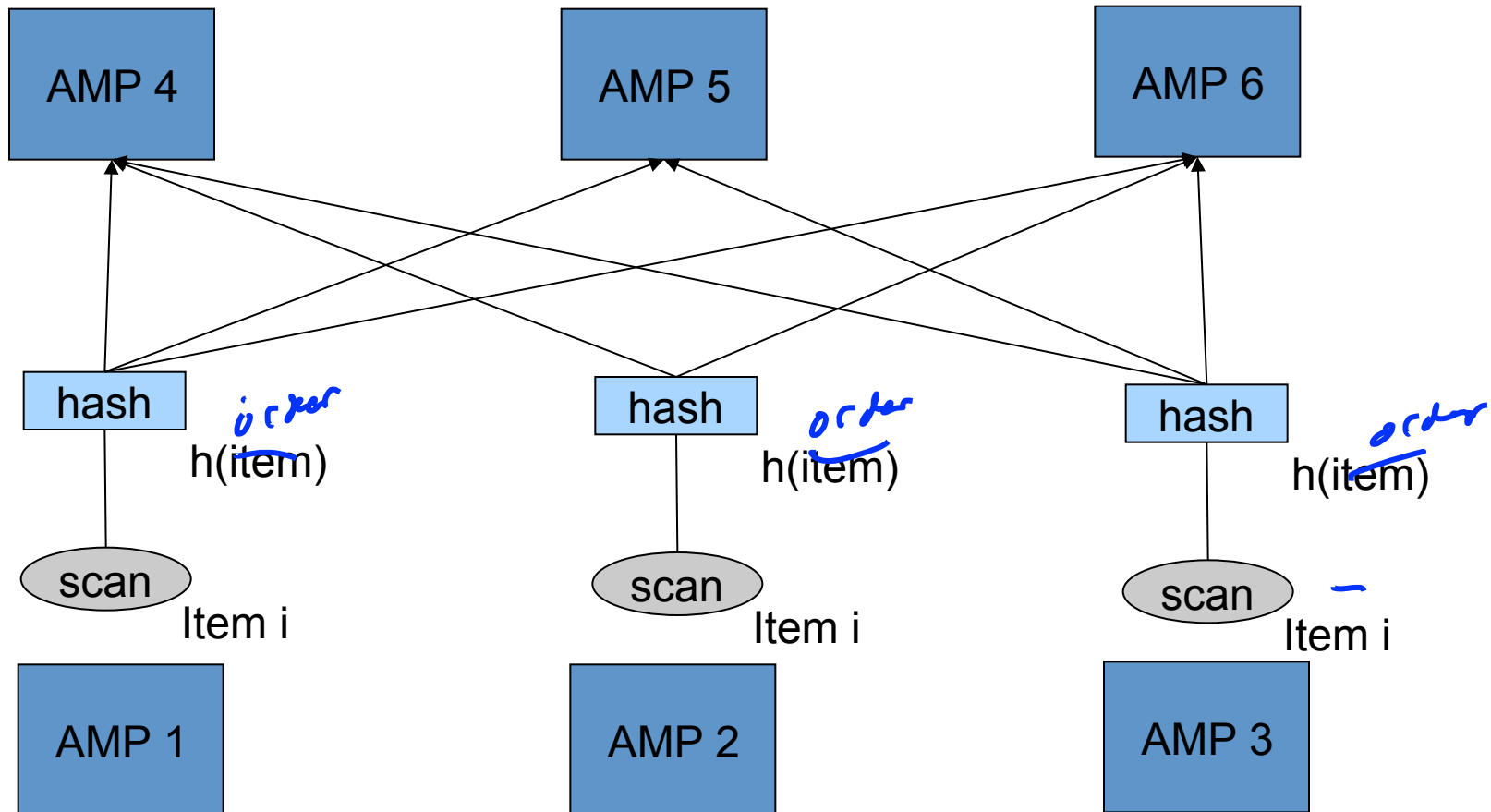
```
SELECT *  
  FROM Orders o, Lines i  
 WHERE o.item = i.item  
    AND o.date = today()
```



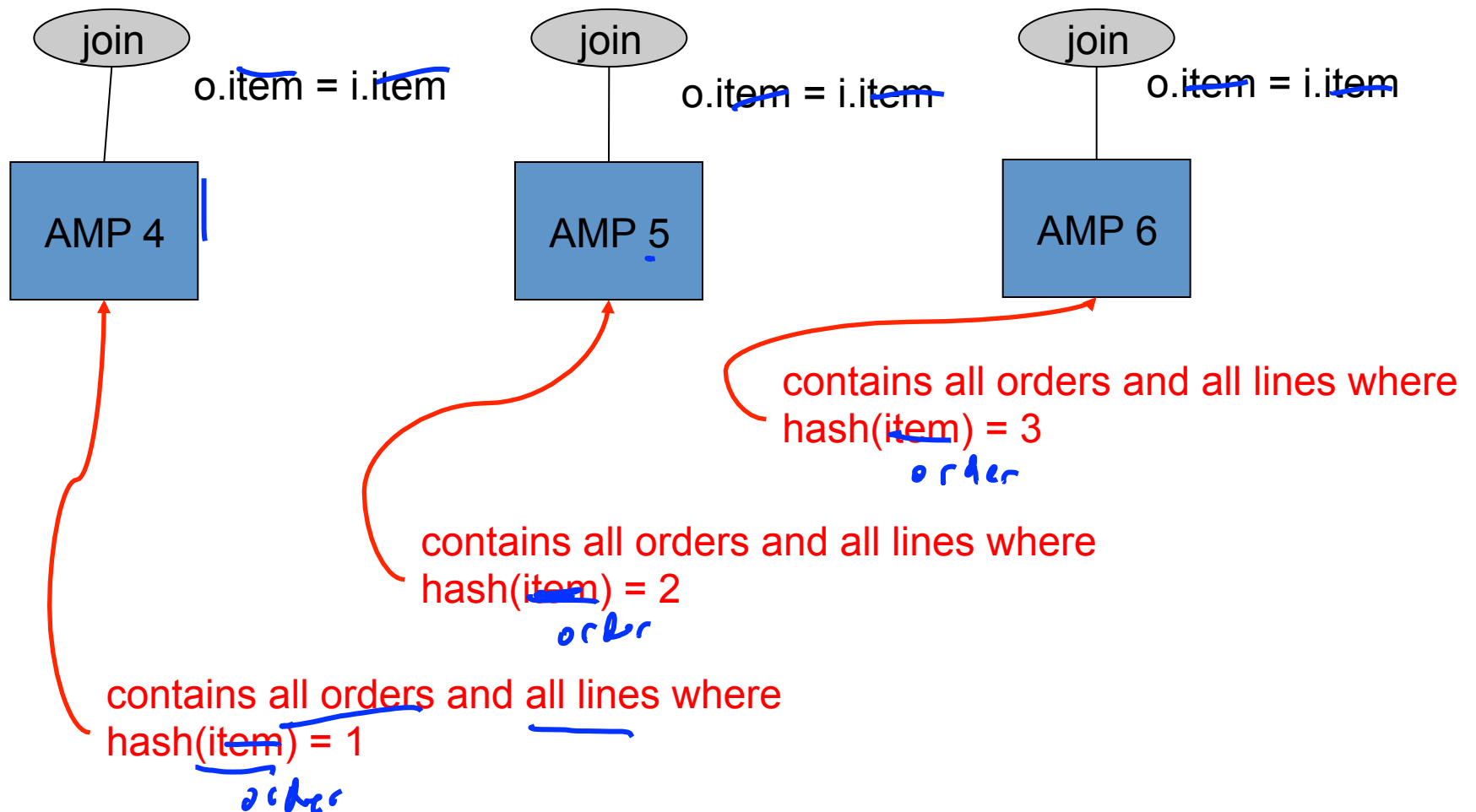
Example System: Teradata



Example System: Teradata



Example System: Teradata



MapReduce Extensions and Contemporaries

- Pig (Yahoo, available open source)
 - Relational Algebra over Hadoop
- HIVE (Facebook, available open source)
 - SQL over Hadoop
- Impala *Cloudera*
 - SQL over HDFS; uses some HIVE code
- Cascading
 - Relational Algebra
- Dryad (Microsoft, sadly not available)
 - Relational Algebra
- Clustera (U of Wisconsin, not available)
 - Relational Algebra