Principles of Distributed and Parallel Database Systems: Part 2

Introduction to Query Processing in a Distributed Database

Ira A. Fulton Schools of Engineering
Arizona State University

Objective

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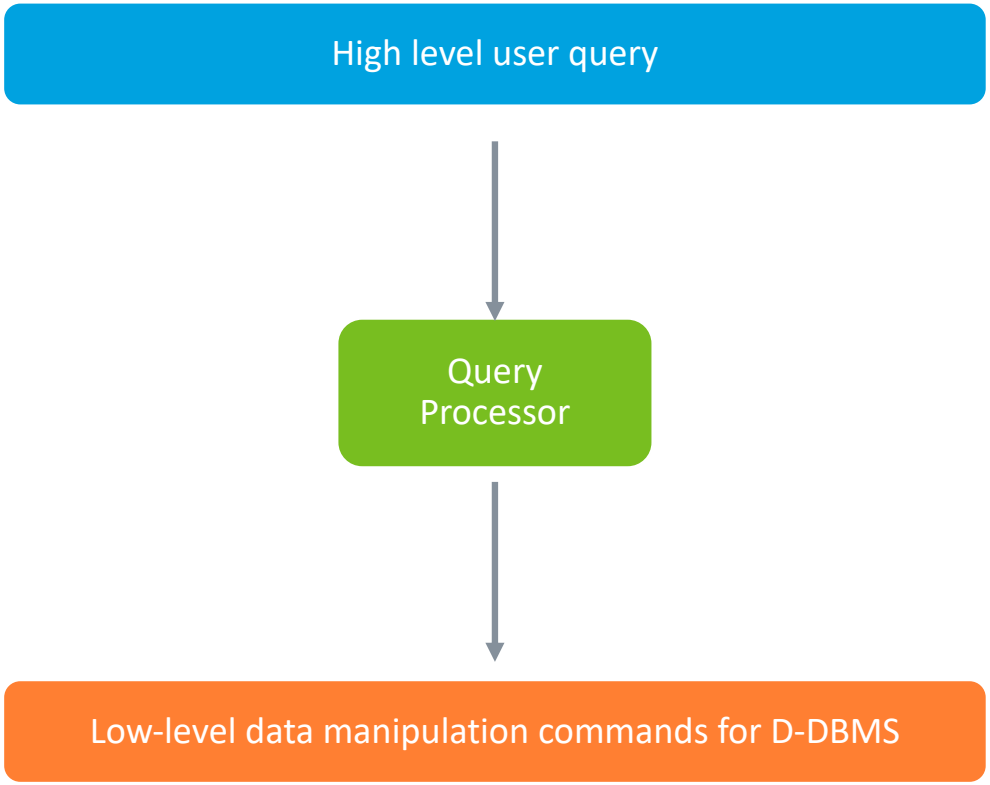
Illustrate how concurrency control is achieved in distributed databases

Query Processing in a DDBMS



Query Processing Components

- **Query language that is used**
  - SQL
- **Query execution methodology**
  - The steps that one goes through in executing high-level (declarative) user queries
- **Query optimization**
  - How do we determine the “best” execution plan?

Selecting Alternatives

```
SELECT ENAME
FROM       EMP,ASG
WHERE      EMP.ENO = ASG.ENO
AND        RESP = "Manager"
```

Strategy 1

$$\Pi_{ENAME}(\sigma_{RESP=\text{“Manager”} \wedge EMP.ENO=ASG.ENO}(EMP \times ASG))$$

Strategy 2

$$\Pi_{ENAME}(EMP \bowtie_{ENO} (\sigma_{RESP=\text{“Manager”}}(ASG))$$

Strategy 2 avoids Cartesian product, so may be “better”

Assume 20 Managers

What is the Problem?

Site 1	Site 2	Site 3	Site 4	Site 5
$ASG_1 = \sigma_{ENO \leq \text{"E3"}}(ASG)$	$ASG_2 = \sigma_{ENO > \text{"E3"}}(ASG)$	$EMP_1 = \sigma_{ENO \leq \text{"E3"}}(EMP)$	$EMP_2 = \sigma_{ENO > \text{"E3"}}(EMP)$	Result

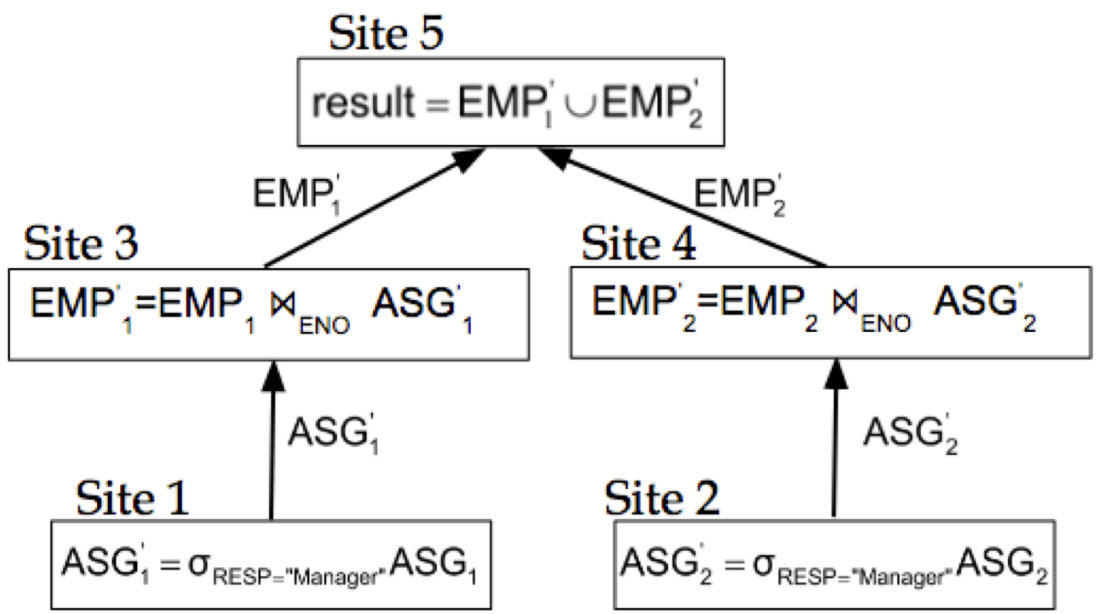
Site 5

$$result = (EMP_1 \cdot EMP_2) \bowtie_{ENO} \sigma_{RESP=\text{"Manager"}}(ASG_1 \times ASG_2)$$

ASG_1 ← Site 1, ASG_2 ← Site 2, EMP_1 ← Site 3, EMP_2 ← Site 4

What is the Problem?

Site 1	Site 2	Site 3	Site 4	Site 5
$ASG_1 = \sigma_{ENO \leq \text{"E3"}}(ASG)$	$ASG_2 = \sigma_{ENO > \text{"E3"}}(ASG)$	$EMP_1 = \sigma_{ENO \leq \text{"E3"}}(EMP)$	$EMP_2 = \sigma_{ENO > \text{"E3"}}(EMP)$	Result



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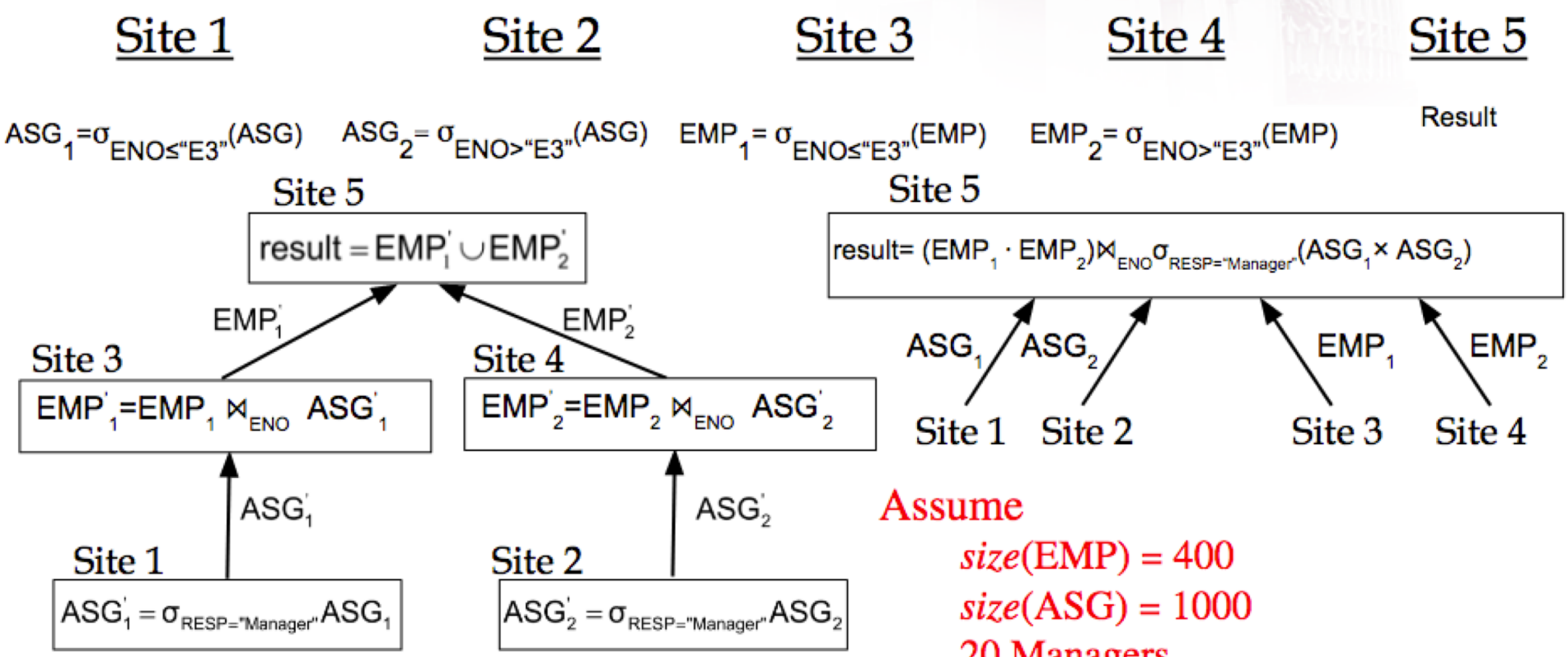


Assume

size(EMP) = 400

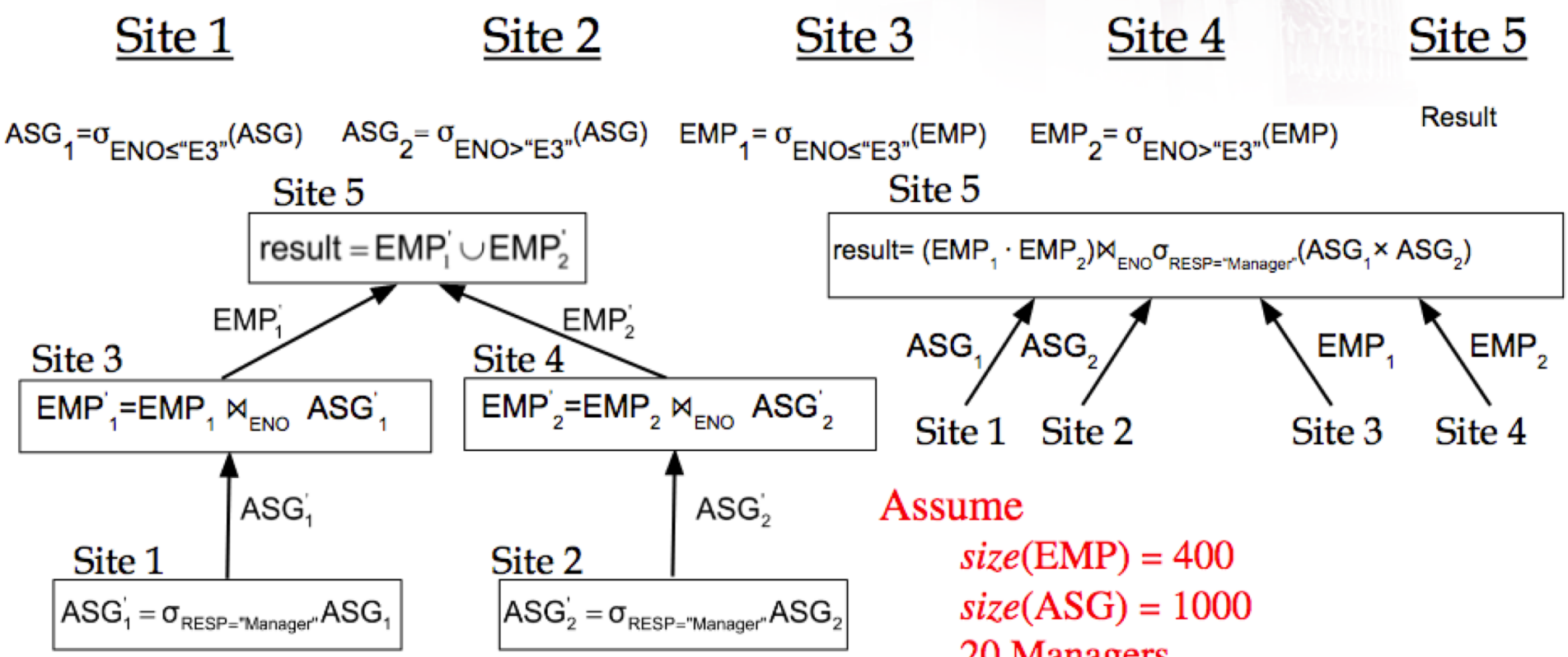
size(ASG) = 1000

20 Managers

tuple access cost = 1 unit;

tuple transfer cost = 10 units

What is the Problem?



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Cost of Alternatives

Assume

- *size*(EMP) = 400, *size*(ASG) = 1000
- Tuple access cost = 1unit; tuple transfer cost = 10 units

Strategy 1

– produce ASG': (10+10) ∗ tuple access cost	20
– transfer ASG' to the sites of EMP: (10+10) ∗ tuple transfer cost	200
– produce EMP': (10+10) ∗ tuple access cost ∗ 2	40
– transfer EMP' to result site: (10+10) ∗ tuple transfer cost	200
Total Cost	460

Cost of Alternatives

Assume

- *size*(EMP) = 400, *size*(ASG) = 1000
- Tuple access cost = 1unit; tuple transfer cost = 10 units

Strategy 2

– transfer EMP to site 5: 400 ∗ tuple transfer cost	4,000
– transfer ASG to site 5: 1000 ∗ tuple transfer cost	10,000
– join EMP and ASG': 400 ∗ 20 ∗ tuple access cost	8,000
Total Cost	22,000