EXAMPLE 1

Query

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

EMP vertically fragmented into two pieces:

EMP_A (Site 1)

- ENO
- ENAME
  (400 tuples)

EMP_B (Site 2)

- ENO
- DNO, Salary
  (400 tuples)

ASG vertically fragmented:

ASG_A (Site 3)

- ENO
- RESP
  (1000 tuples → 20 with RESP='Manager')

ASG_B (Site 4)

- ENO
- ProjectNo, Hours
  (1000 tuples)

Costs

- Access cost = 1
- Transfer cost per tuple = 10

STRATEGY 1:

Reconstruct ASG first → then filter → then join EMP

Step 1 — Transfer ASG_A to Site 4 to reconstruct

ASG_A = 1000 rows
Transfer cost = 1000 × 10 = **10,000**

Step 2 — Join vertical fragments

Cost = 1000×1000 (worst-case) = **1,000,000** access

Result = full ASG table (reconstructed)

Step 3 — Filter RESP='Manager'

20 rows remain
Access = 1000

Step 4 — Transfer results to Site 1

20 × 10 = **200**

Step 5 — Join with EMP_A

400×20 = **8,000** access

Total Cost Strategy 1

```
10,000 (transfer)
+ 1,000,000 (reconstruction)
+ 1,000 (filter)
+ 200 (transfer)
+ 8,000 (join)
= 1,019,200
```

STRATEGY 2 :

Filter early on ASG_A → transfer only 20 rows → join with EMP_A only

Step 1 — Filter ASG_A at Site 3

Access = 1000

Step 2 — Transfer only 20 manager rows to Site 1

20 × 10 = 200

Step 3 — Join EMP_A (Site 1) with filtered ASG_A

400×20 = 8,000 access

Total Cost Strategy 2

```
1000 (filter)
+ 200 (transfer)
+ 8000 (join)
```

= 9,200 units **RESULT:** Strategy 2 is **110× cheaper**.

EXAMPLE 2

Query

```
SELECT C.CNAME
FROM COURSE C, TEACH T, PROF P
WHERE C.CID = T.CID
  AND T.PID = P.PID
  AND P.DEPT = 'CS';
```

PROF vertically fragmented:

Site 1 — PROF_A

- PID
- DEPT

(200 rows, 50 rows with DEPT='CS')

Site 2 — PROF_B

- PID
- Salary, Rank
  (200 rows)

TEACH vertically fragmented:

Site 3 — T_A

- CID
- PID

(1000 rows)

Site 4 — T_B

- CID
- Semester, Hours
  (1000 rows)

COURSE (not fragmented)

Site 5 — COURSE (200 rows)

Costs

- Access = 1
- Transfer per tuple = 10

STRATEGY 1

Reconstruct PROF → reconstruct TEACH → do full joins

Step 1 — Reconstruct PROF at Site 1

Transfer PROF_B (200 rows) to Site 1
Cost = 200×10 = 2000

Join PROF_A with PROF_B = 200×200 = 40,000 access

Step 2 — Reconstruct TEACH at Site 3

Transfer T_B (1000 rows)
Cost = 1000×10 = 10,000

Join TEACH_A+TEACH_B = 1000×1000 = 1,000,000 access

Step 3 — Filter by DEPT='CS'

50 rows remain
Cost = 200 access

Step 4 — Join filtered PROF with TEACH (size huge)

1000×50 = 50,000

Step 5 — Join with COURSE (200 rows)

200×50 = 10,000

Total Cost Strategy 1

```
2,000 (transfer)
+ 40,000 (join)
+ 10,000 (transfer)
+ 1,000,000 (join)
+ 200 (filter)
+ 50,000 (join)
+ 10,000 (join)
= 1,112,200
```

STRATEGY 2

Filter PROF first → transfer 50 rows → join with TEACH_A only → bring COURSE last

Step 1 — Filter PROF_A for CS profs

Access = 200
Result = 50 rows

Step 2 — Transfer only 50 rows to TEACH Site (Site 3)

50×10 = 500

Step 3 — Join with TEACH_A

1000×50 = 50,000

Result ≈ 150 rows

Step 4 — Transfer 150 rows to COURSE site (Site 5)

150×10 = 1,500

Step 5 — Join with COURSE

200×150 = 30,000

Total Cost Strategy 2

```
200 (filter)
+ 500 (transfer)
+ 50,000 (join)
+ 1,500 (transfer)
+ 30,000 (join)
= 82,200 units
```

RESULT:

Strategy 2 is **13.5× cheaper**.

EXAMPLE 3

Query

```
SELECT E.ENAME, D.DNAME
FROM EMP E, DEPT D, ASSIGN A, PROJECT P
WHERE E.ENO = A.ENO
  AND A.PNO = P.PNO
  AND E.DNO = D.DNO
  AND P.LOC = 'NY';
```

EMP vertically fragmented:

- EMP_A (Site 1): ENO, ENAME (400 rows)
- EMP_B (Site 2): ENO, DNO, Salary (400 rows)

ASSIGN vertically fragmented:

- A_A (Site 3): ENO, PNO (1000 rows)
- A_B (Site 4): ENO, Hours (1000 rows)

PROJECT vertically fragmented:

- P_A (Site 5): PNO, LOC (300 rows → 40 in NY)
- P_B (Site 6): PNO, Budget (300 rows)

DEPT not fragmented: Site 7, 40 rows

Costs

- Access = 1
- Transfer = 10

STRATEGY 1

Reconstruct everything → huge joins**

Reconstruct EMP

Transfer EMP_B → Site 1
400×10 = 4000
Join = 400×400 = 160,000

Reconstruct ASSIGN

Transfer A_B → Site 3
1000×10 = 10,000
Join = 1,000×1,000 = 1,000,000

Reconstruct PROJECT

Transfer P_B → Site 5
300×10 = 3000
Join = 300×300 = 90,000

Filter P.LOC='NY'

Access = 300
Remaining = 40

Join huge EMP × ASSIGN × PROJECT

≈ 400×1000×40 = 16,000,000

Join with DEPT

16,000,000×40 = 640,000,000

Total Strategy 1

= **641 million cost units (approx)**

STRATEGY 2

Filter → Partial reconstruct only necessary parts → staged joins

Step 1 — Filter P_A for NY

300 access → 40 rows

Step 2 — Transfer these 40 to ASSIGN site (Site 3)

40×10=400

Step 3 — Join with A_A

1000×40=40,000
Output maybe 120 rows

Step 4 — Transfer 120 rows to EMP_A site (Site 1)

120×10=1200

Step 5 — Join with EMP_A

400×120=48,000
Output ~130 rows

Step 6 — Need DNO → fetch matching EMP_B rows

Transfer 130 keys to Site 2
130×10=1300
Access EMP_B = 400

Step 7 — Join with DEPT at Site 7

40×130=5200
Transfer 130 results
130×10=1300

Total Strategy 2

```
300 (filter)
+ 400 (transfer)
+ 40,000 (join)
+ 1,200 (transfer)
+ 48,000 (join)
+ 1,300 (transfer)
+ 400 (EMP_B scan)
+ 5,200 (join)
+ 1,300 (transfer)
= 98,100 units
```

RESULT

Strategy 2 is **6,500× cheaper**.