ICS 421 Spring 2010

Parallel & Distributed Databases 2

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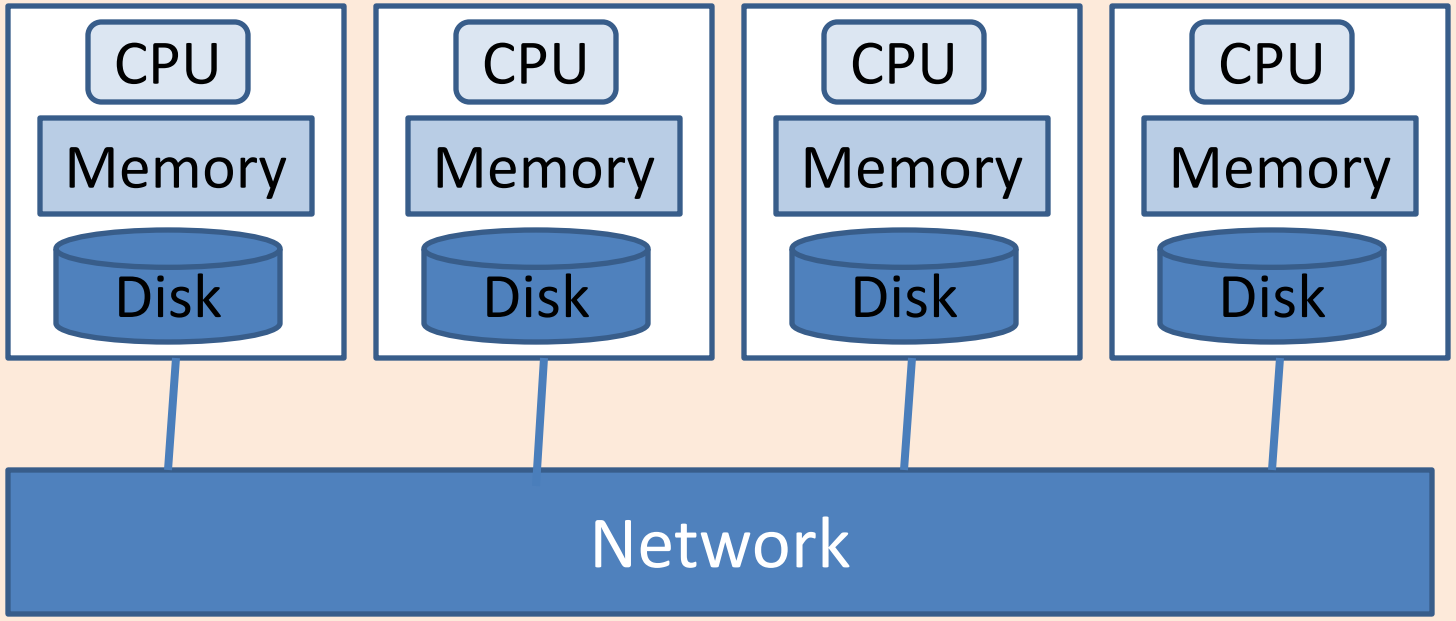
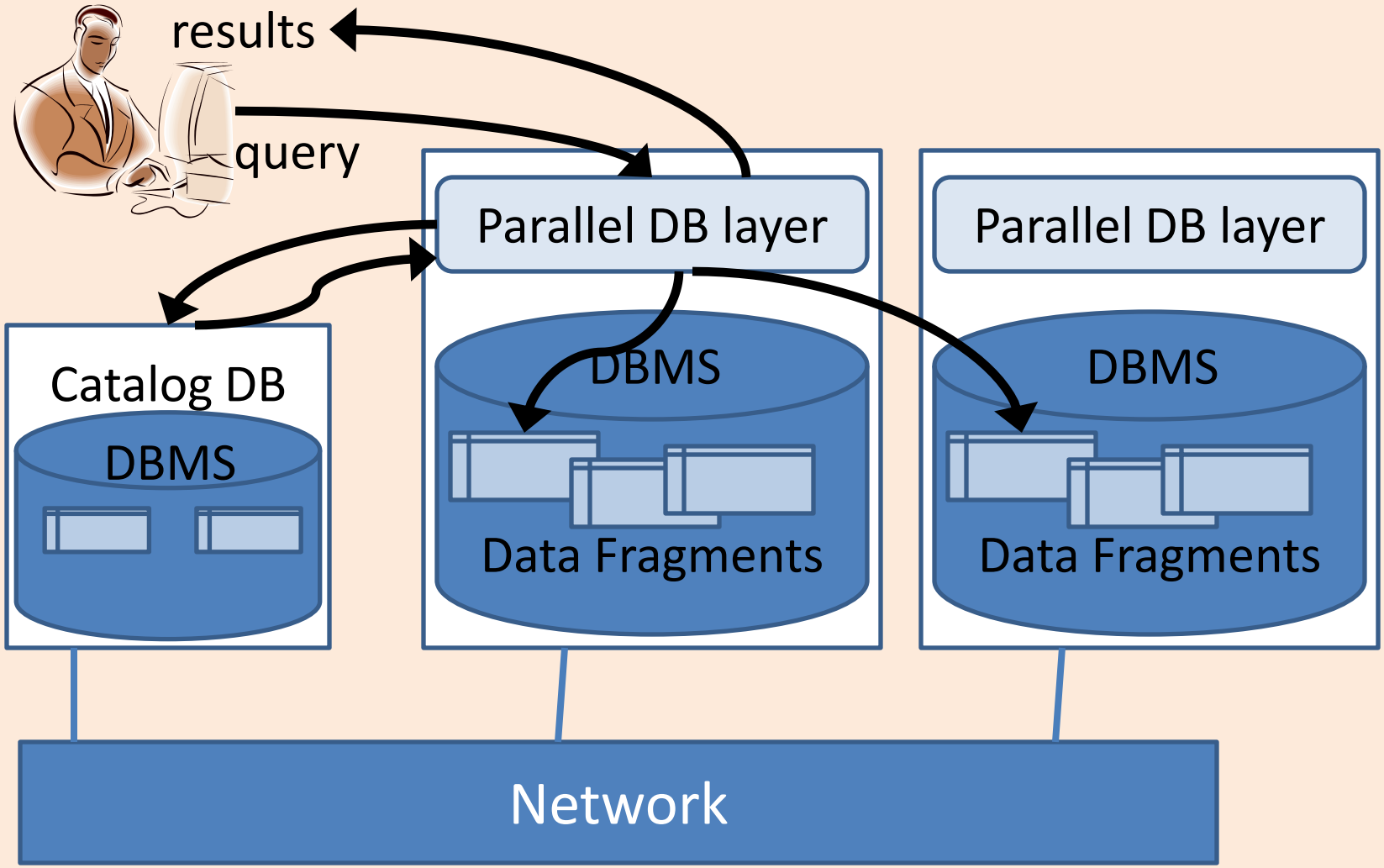
Shared-Nothing Architecture

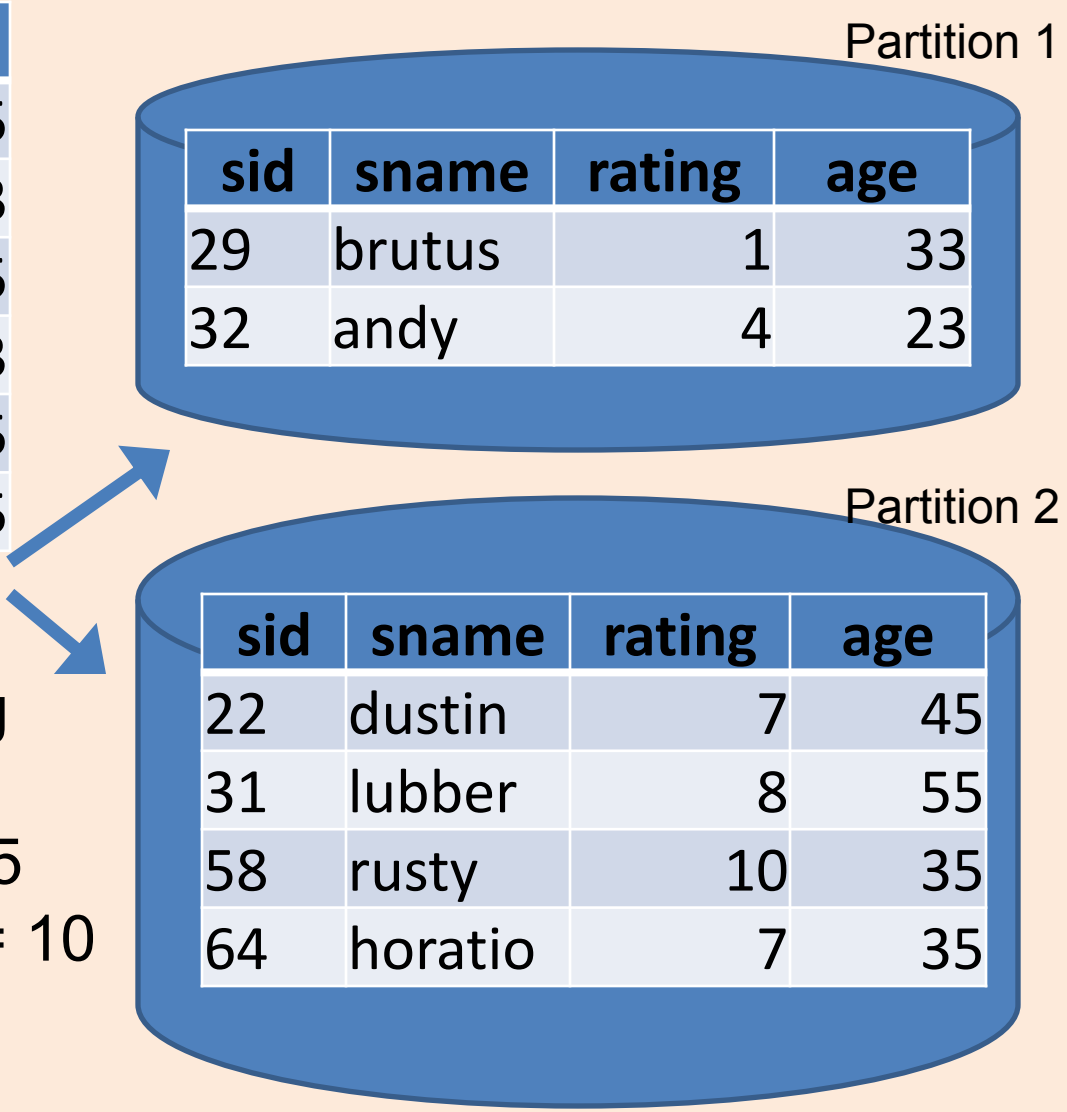


Logical Parallel DBMS Architecture



Horizontal Fragmentation: Range Partition

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
31	lubber	8	55
32	andy	4	23
58	rusty	10	35
64	horatio	7	35



Range Partition on rating column

- Partition 1: 0 <= rating < 5
- Partition 2: 5 <= rating <= 10

Range Partition: Query Processing

- Which partitions?
- Better than non-parallel ?

```
SELECT *
FROM Sailors S
```

```
SELECT *
FROM Sailors S
WHERE rating = 2
```

```
SELECT *
FROM Sailors S
WHERE age  > 30
```

```
SELECT *
FROM Sailors S
WHERE rating < 2 and age < 30
```

Partition 1

sid	sname	rating	age
29	brutus	1	33
32	andy	4	23

Partition 2

sid	sname	rating	age
22	dustin	7	45
31	lubber	8	55
58	rusty	10	35
64	horatio	7	35

Horizontal Fragmentation: Hash Partition

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
31	lubber	8	55
32	andy	4	23
58	rusty	10	35
64	horatio	7	35

- Hash partitioning using hash function
  - Partition = rating mod 2

Partition 1

sid	sname	rating	age
31	lubber	8	55
32	andy	4	23
58	rusty	10	35

Partition 2

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
64	horatio	7	35

Hash Partition: Query Processing

- Which partitions?
- Better than non-parallel ?

```
SELECT *
FROM Sailors S
```

```
SELECT *
FROM Sailors S
WHERE rating = 2
```

```
SELECT *
FROM Sailors S
WHERE age  > 30
```

```
SELECT *
FROM Sailors S
WHERE rating < 2 and age < 30
```

Partition 1

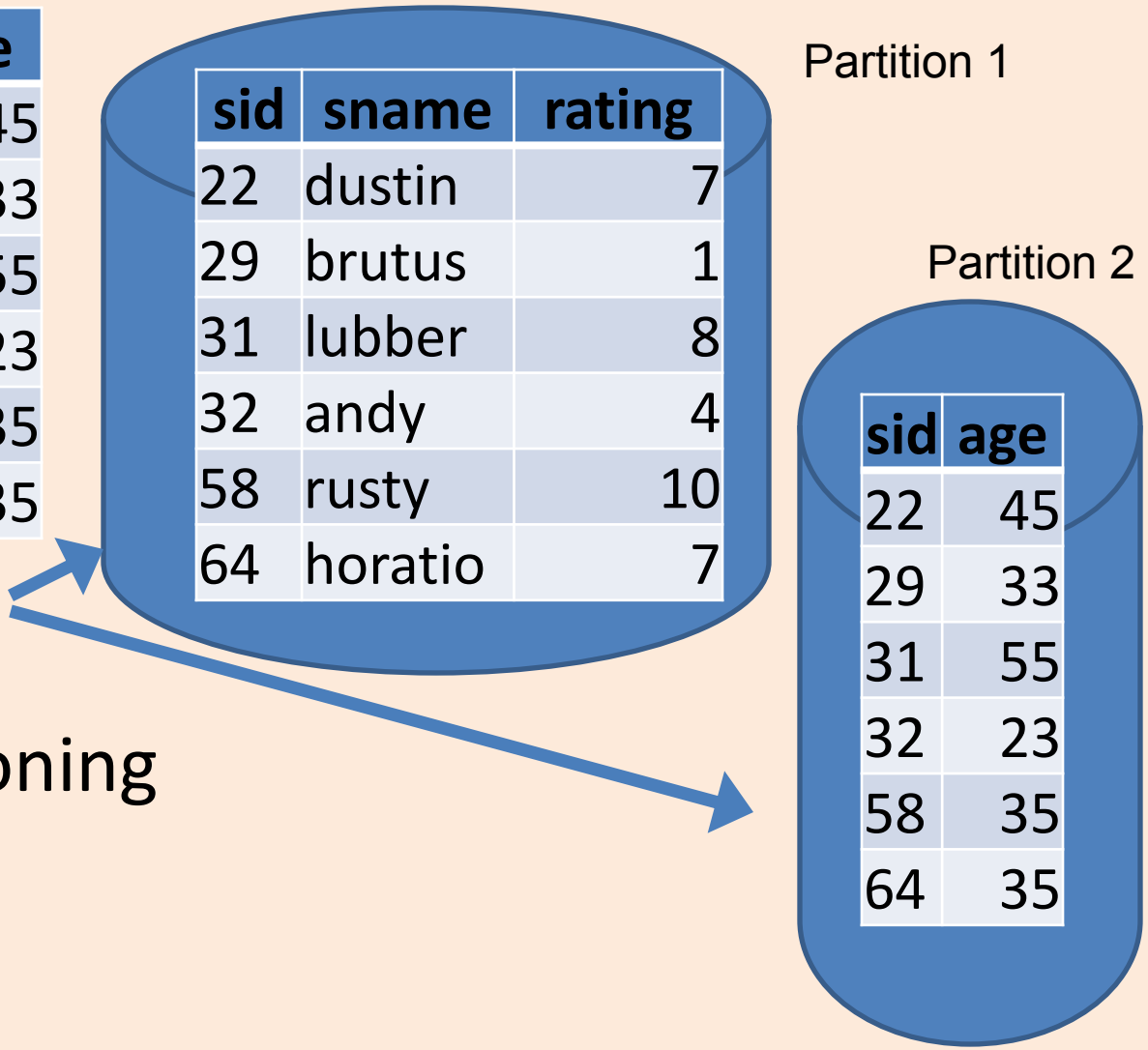
sid	sname	rating	age
31	lubber	8	55
32	andy	4	23
58	rusty	10	35

Partition 2

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
64	horatio	7	35

Vertical Fragmentation/Partition

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
31	lubber	8	55
32	andy	4	23
58	rusty	10	35
64	horatio	7	35



sid	sname	rating
22	dustin	7
29	brutus	1
31	lubber	8
32	andy	4
58	rusty	10
64	horatio	7

sid	age
22	45
29	33
31	55
32	23
58	35
64	35

- Vertical partitioning
  - Use sid as row identifier

Vertical Partition: Query Processing

- Which partitions?
- Better than non-parallel ?

```
SELECT *
FROM Sailors S
```

```
SELECT sname
FROM Sailors S
```

```
SELECT *
FROM Sailors S
WHERE rating = 2
```

```
SELECT sid
FROM Sailors S
WHERE age  > 30
```

```
SELECT sid
FROM Sailors S
WHERE rating < 2 and age < 30
```

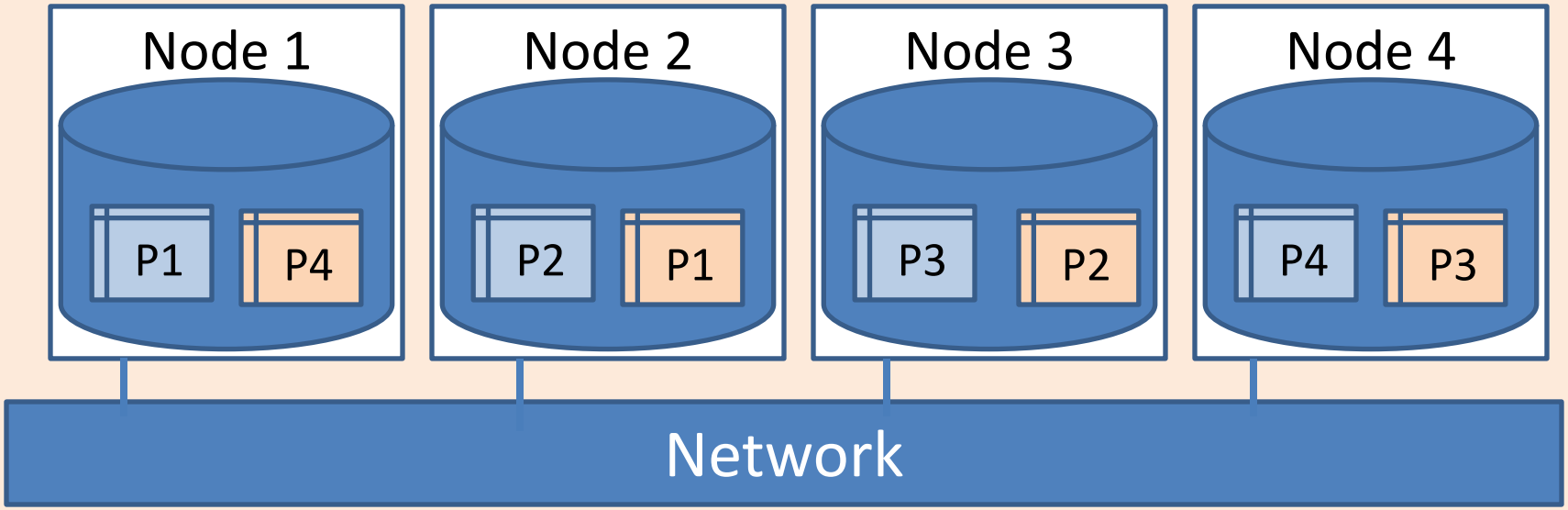
Partition 1

sid	sname	rating
22	dustin	7
29	brutus	1
31	lubber	8
32	andy	4
58	rusty	10
64	horatio	7

Partition 2

sid	age
22	45
29	33
31	55
32	23
58	35
64	35

Fragmentation & Replication



- Suppose table is fragmented into 4 partitions on 4 nodes
- Replication stores another partition on each node
  - What happens when 1 node fails ? 2 nodes ?
  - What happens when a row needs to be updated ?

What about joins ?

```
SELECT R.sid, R.bid
FROM Sailors S,
Reserves R
WHERE S.sid=R.sid AND
rating > 8
```

- Sailors: hash
  - part = rating mod 2
- Reserves: hash
  - part = sid mod 2
- Where to perform join ?
- What data to ship ?

Partition 1

Sailors

sid	sname	rating	age
31	lubber	8	55
32	andy	4	23
58	rusty	10	35

Reserves

sid	bid	day
31	101	…
29	103	…

Partition 2

Sailors

sid	sname	rating	age
22	dustin	7	45
29	brutus	1	33
64	horatio	7	35

Reserves

sid	bid	day
64	105	…
58	103	…