SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

QUERY_1

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_1
GROUP BY Date;
```

QUERY_2

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_2
GROUP BY Date;
```

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76

IDENTICAL QUERIES ON IDENTICAL DATA

QUERY_1

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_1
GROUP BY Date;
```

QUERY_2

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_2
GROUP BY Date;
```

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76

IDENTICAL QUERIES ON IDENTICAL DATA

QUERY_1

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_1
GROUP BY Date;
```

QUERY_2

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_2
GROUP BY Date;
```

BUT QUERY 1 RUNS 10X TO 100X FASTER THAN QUERY 2

IDENTICAL QUERIES ON
IDENTICAL DATA

BUT QUERY 1 RUNS 10X TO
100X FASTER THAN QUERY 2

THE DIFFERENCE IS
BECAUSE OF AN INDEX

THE DIFFERENCE IS BECAUSE OF AN INDEX

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

THE DIFFERENCE IS BECAUSE OF AN INDEX

THESE TABLES HOLD THE SAME DATA, BUT BEHIND THE SCENES (ON DISK) THEY ARE LAID OUT VERY DIFFERENTLY

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

THESE TABLES HOLD THE SAME DATA, BUT BEHIND THE SCENES (ON DISK) THEY ARE LAID OUT VERY DIFFERENTLY

THE DBA INDEXED `SALES_DATA_1` BY DATE

THE DBA FORGOT TO INDEX `SALES_DATA_2` OR CREATE A PRIMARY KEY

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

THE DBA INDEXED SALES_DATA_1 BY DATE

CONTIGUOUS LOCATIONS ON DISK

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Bellandur	Bananas	January 17,2016	2342.33

CONTIGUOUS LOCATIONS ON DISK

Date
January 17,2016
January 18,2016

ACTUAL DISK LAYOUT OF INDEX ON COLUMN DATE

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
	Butter	January 17,2016	5673.01
		January 17,2016	4543.98
	as	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

CONTIGUOUS LOCATIONS ON DISK

SALES_DATA_1

StoreLocation	Product	Date	Revenue

CONCEPTUAL LAYOUT

THE DBA INDEXED SALES_DATA_1 BY DATE

CONTIGUOUS LOCATIONS ON DISK

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
			1,621.58
			2342.33

CONTIGUOUS LOCATIONS ON DISK

Date

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_1
GROUP BY Date;
```

			Revenue
			2342.33
			6345.10
		Butter	January 17,2016	5673.01
			January 17,2016	4543.98
		nas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

CONTIGUOUS LOCATIONS ON DISK

SALES_DATA_1

StoreLocation	Product	Date	Revenue

CONCEPTUAL LAYOUT

NOW A QUERY LIKE THIS IS EASY-PEASY!

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_1
GROUP BY Date;
```

THESE TABLES HOLD THE SAME DATA, BUT BEHIND THE SCENES (ON DISK) THEY ARE LAID OUT VERY DIFFERENTLY

THE DBA INDEXED `SALES_DATA_1` BY DATE

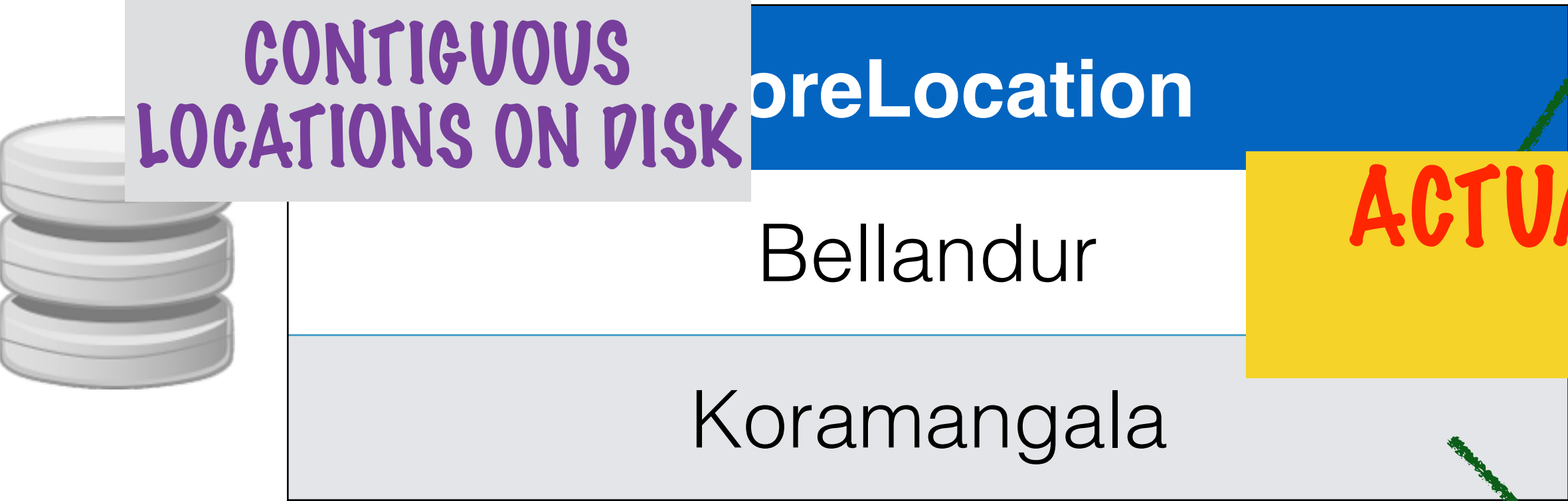## THE DBA FORGOT TO INDEX `SALES_DATA_2` OR CREATE A PRIMARY KEY

SALES_DATA_1

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

SALES_DATA_2

StoreLocation	Product	Date	Revenue
Bellandur	Bananas	January 18,2016	8,236.33
Bellandur	Nutella	January 18,2016	7,455.67

THE DBA FORGOT TO INDEX `SALES_DATA_2` OR CREATE A PRIMARY KEY

CONTIGUOUS LOCATIONS ON DISK

	Product	Date	Revenue
	Bananas	January 18,2016	8,236.33
	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98

CONTIGUOUS LOCATIONS ON DISK

StoreLocation
Bellandur
Koramangala

ACTUAL DISK LAYOUT, PICKED BY THE DBMS "AT RANDOM"

StoreLocation	Product	Date	Revenue
Koramangala	Bananas	January 18,2016	9,456.01
Koramangala	Nutella	January 18,2016	3,644.33
Koramangala	Peanut Butter	January 18,2016	8,988.64
Koramangala	Milk	January 18,2016	1,621.58
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

CONTIGUOUS LOCATIONS ON DISK

SALES_DATA_2

StoreLocation	Product	Date	Revenue

CONCEPTUAL LAYOUT

THE DBA FORGOT TO INDEX `SALES_DATA_2` OR CREATE A PRIMARY KEY

CONTIGUOUS LOCATIONS ON DISK

	Product	Date	Revenue
	Bananas	January 18,2016	8,236.33
	Nutella	January 18,2016	7,455.67
Bellandur	Peanut Butter	January 18,2016	5,316.89
Bellandur	Milk	January 18,2016	2,433.76
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Bananas	January 17,2016	2342.33
Bellandur	Nutella	January 17,2016	6345.10
Bellandur	Peanut Butter	January 17,2016	5673.01
Bellandur	Milk	January 17,2016	4543.98

CONTIGUOUS LOCATIONS ON DISK

StoreLocation

```
SELECT Date,Sum(Revenue)
FROM Sales_Data_2
GROUP BY Date;
```

ACCESS DBMS AT RANDOM

CONTIGUOUS LOCATIONS ON DISK

		Revenue
	2016	9,456.01
	2016	3,644.33
	Peanut Butter	January 18,2016	8,988.64
	Milk	January 18,2016	1,621.58
Koramangala	Bananas	January 17,2016	8902.65
Koramangala	Nutella	January 17,2016	9114.67
Koramangala	Peanut Butter	January 17,2016	5102.05
Koramangala	Milk	January 17,2016	1299.45

SALES_DATA_2

StoreLocation	Product	Date	Revenue
CONCEPTUAL LAYOUT			

OI OI OI..THIS QUERY NEEDS A TON OF DISK IO!

```sql
SELECT Date,Sum(Revenue)
FROM Sales_Data_2
GROUP BY Date;
```

MORAL OF THE STORY:

SETTING UP INDICES CORRECTLY CAN SAVE HOURS AND HOURS OF TIME

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Date ON Sales_Data_1(Date);
```

THE SQL IS SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Date ON Sales_Data_1(Date);
```

THE SQL IS SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Date ON Sales_Data_1(Date);
```

(INDEX NAME)

THE SQL IS SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Date ON Sales_Data_1(Date);
```

(TABLE NAME)

THE SQL IS
SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Date ON Sales_Data_1(Date);
```

(COLUMNS)

THE SQL IS
SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I SET UP INDICES CORRECTLY?

```
CREATE INDEX IX_Store_Product ON
Sales_Data_1(StoreLocation,ProductName);
```

(MULTIPLE COLUMNS ARE FINE TOO)

THE SQL IS SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I
SET UP INDICES CORRECTLY?

YOU CAN USE **ALTER** TO CHANGE
AN EXISTING INDEX, AND **DROP**
TO GET RID OF AN INDEX

THE SQL IS
SIMPLE ENOUGH

OKEY-DOKEY, SO HOW DO I
SET UP INDICES CORRECTLY?

INDICES MAKE QUERIES MUCH
FASTER, BUT UPDATES MUCH SLOWER

A CLASSIC DATABASES
TRADE-OFF

INDICES MAKE QUERIES MUCH FASTER, BUT UPDATES MUCH SLOWER

MOST DBMS WILL - BY DEFAULT- CREATE INDICES ON PRIMARY KEYS

INDICES MAKE QUERIES MUCH FASTER, BUT UPDATES MUCH SLOWER

MOST DBMS WILL - BY DEFAULT- CREATE INDICES ON PRIMARY KEYS INDICES ON COMMONLY QUERIED COLUMNS ARE A LIFE-SAVER

INDICES MAKE LESS SENSE ON COLUMNS THAT

ARE IN VERY SMALL TABLES

HOLD A LOT OF NULLS

ARE WRITTEN MORE THAN READ