



ORM

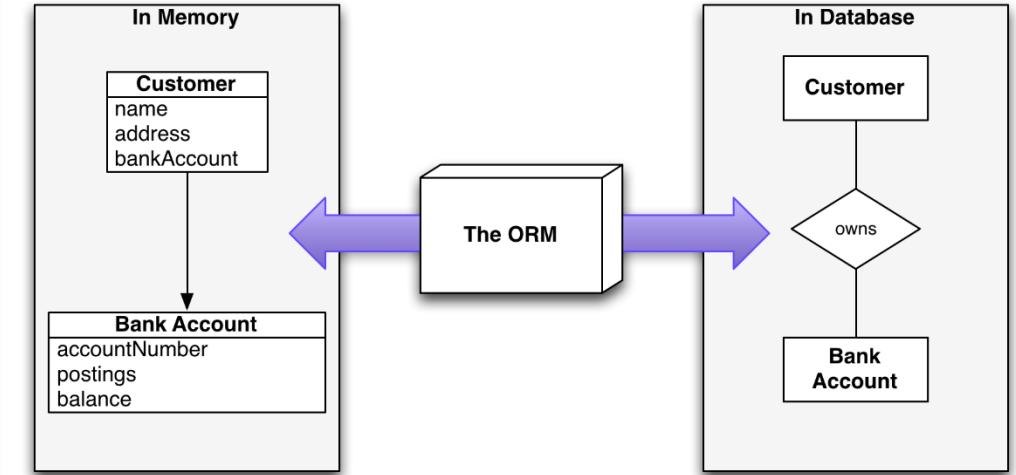
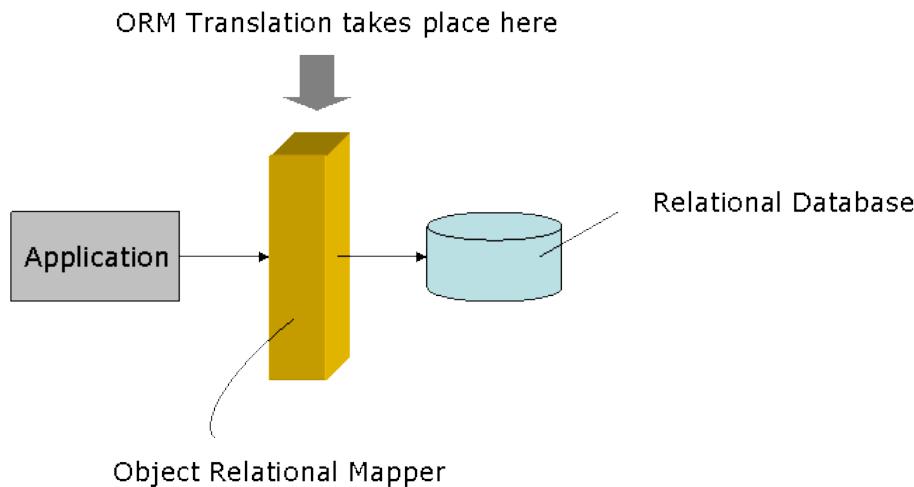
Object Relational Mapping

Omar El-Essiely



Omar Hassan
Senior Software Engineer
Management Information System (MIS)
Alexandria University
ITI Intake 37

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Object Relational Mapping

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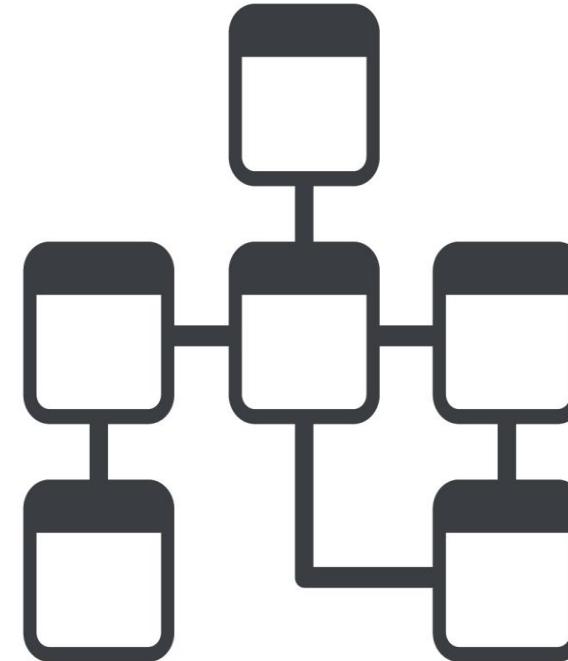
- Database Concepts and Standards.
- Object Oriented Concepts and Standards.
- Object Relational Mapping.
- Object Oriented Database Management Systems.



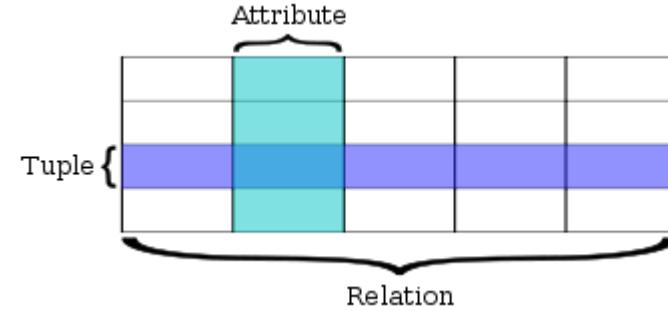
Database Concepts and Standards

Database Concepts and Standards

- Relational Database
- ACID Properties
- SQL Server stores data
- Locking
 - Levels of Locking.
 - Types of Locking.
 - Optimistic Vs. Pessimistic.



Relational Database



SQL term	Relational database term	Description
Row	Tuple or record	A data set representing a single item
Column	Attribute or field	A labeled element of a tuple, e.g. "Address" or "Date of birth"
Table	Relation or Base relvar	A set of tuples sharing the same attributes
View or Result set	Derived relvar	Any set of tuples; a data report from the RDBMS in response to a query

ACID Properties

Atomicity

- guarantee A group of operations (transaction) either succeed or fail.

Consistency

- guarantee that your data will be consistent; none of the constraints you have on related data will ever be violated.

Isolation

- guarantee one transaction cannot read data from another transaction that is not yet completed.

Durability

- guarantee that all of the changes have been recorded to a durable medium (such as a hard disk).

ACID Properties



Atomicity



- Transaction Management Component

Consistency



- Application / Programmer

Isolation



- Concurrency Control Manager

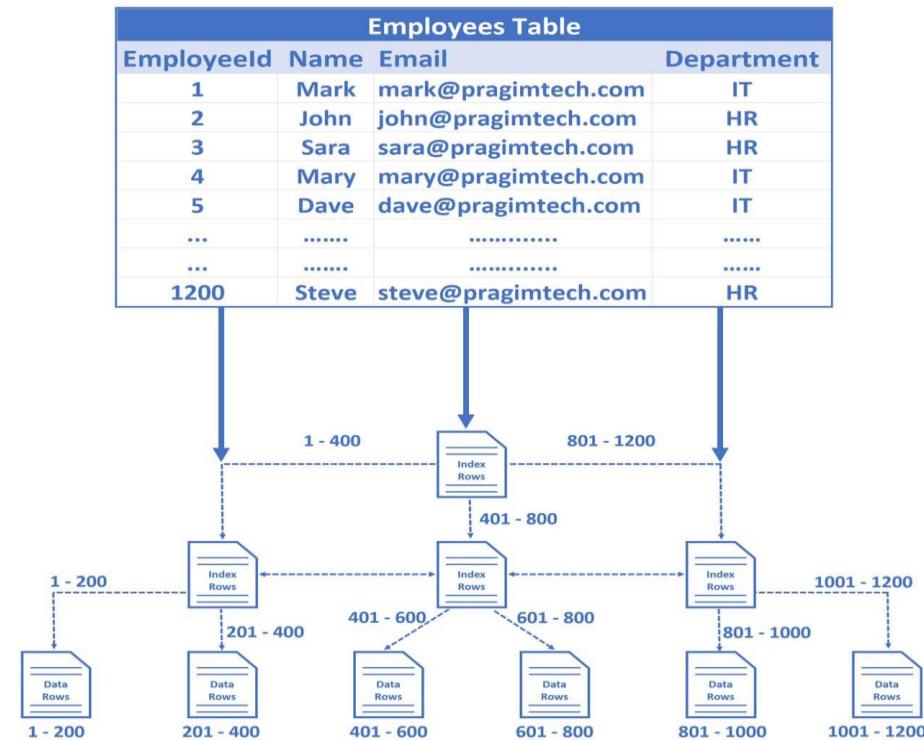
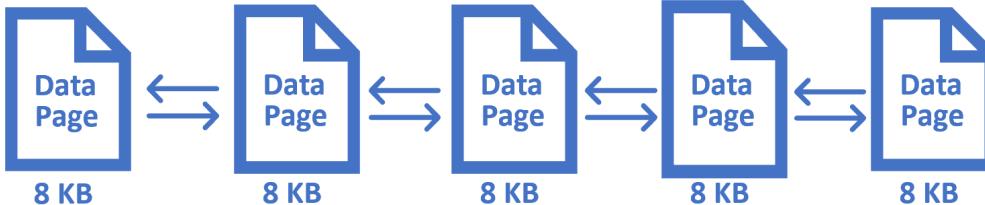
Durability



- Recovery Manager

How is data stored in SQL database ?

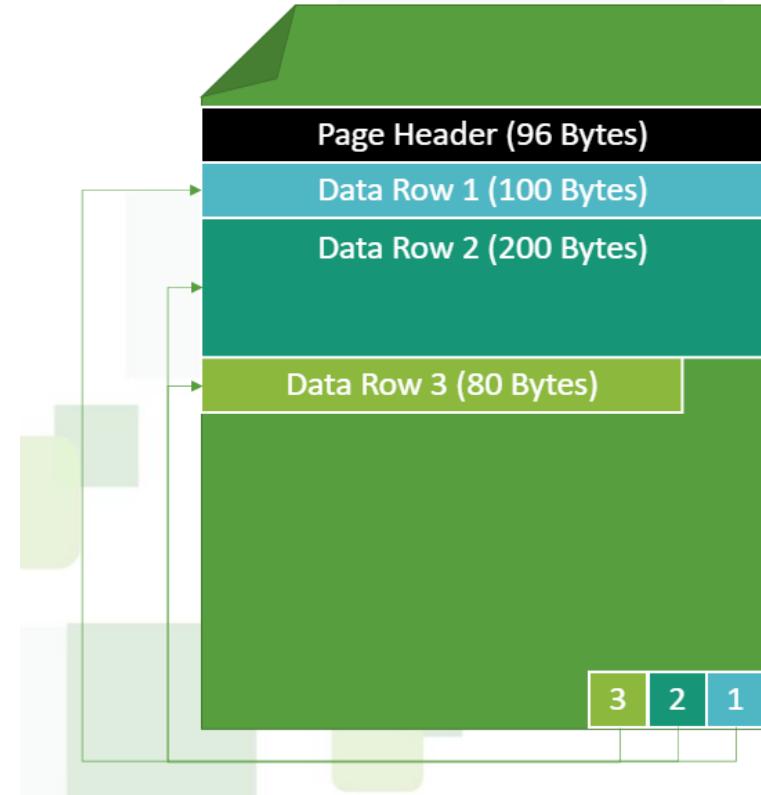
- data in tables is stored in row and column format at the **logical level**
- **physically** it stores data in something called data pages. A data page is the fundamental unit of data storage in SQL Server and it is 8KB in size.



How is data stored in SQL database ?

1- Page

- 8KB in Size or 8192 Bytes
- Header is 96 Bytes
- Contains:
 - Page ID
 - Pointers to Previous and Next Pages
 - Free space
 - Total # of rows on the page
- 128 Pages = 1 Megabyte | $128,000 = 1 \text{ Gigabyte}$
- Smallest Unit of allocation; there are no half pages



For this example:
Row Offset 1 would have the value 96
Row Offset 2 would have the value 196
Row Offset 3 would have the value 396

Row offset: Distance from the first byte
in the row to the start of the page

How is data stored in SQL database ?

2- Extent

- A set of 8 Pages
- 1 Page = 8KB | 8 Pages = 64 KB

- Two Types

- **Mixed**: contains pages owned by multiple objects (up to 8)
- **Uniform**: all pages contained within come from one object and the entire extent can only be used by that object.

Note :

Usually all new tables or indexes are allocated pages from mixed extents. SQL Server extent switches from mixed to uniform type only when a table or index has at least eight or more pages.

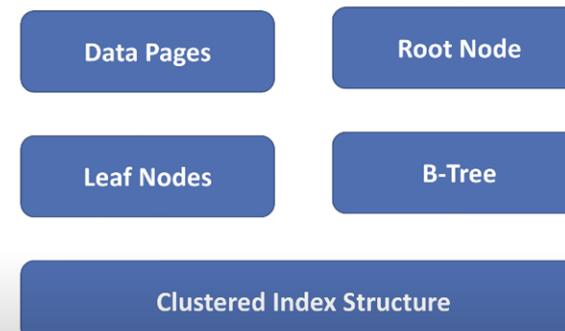
- **MIXED_PAGE_ALLOCATION** = {OFF|ON} (New for SQL 2016)



How is data stored in SQL database ?

- EmployeeId is the primary key column
So by default, a clustered index on this.
EmployeeId column is created
This means the data that is physically
stored in the database is sorted by
EmployeeId column

Technical Jargon



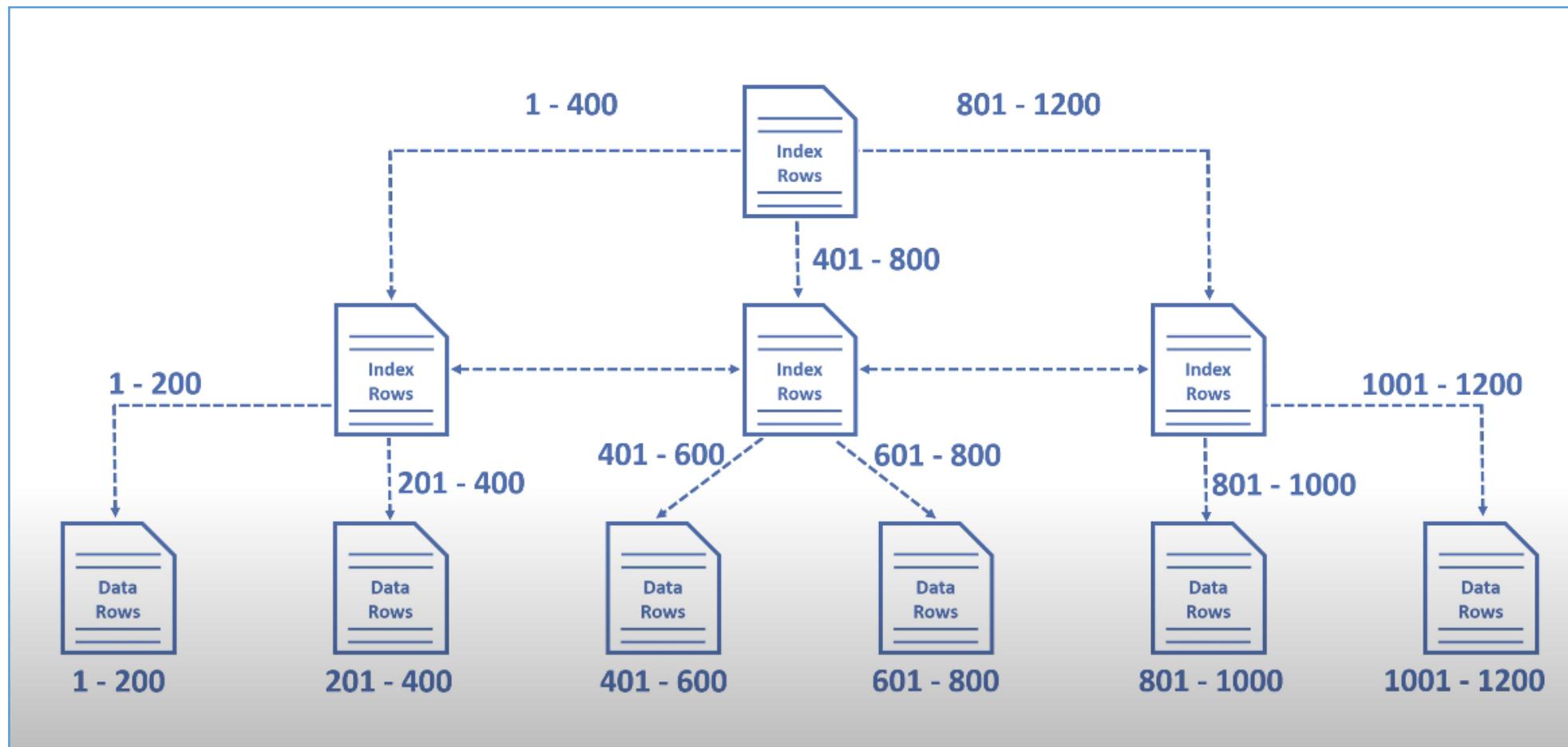
Primary Key

Employees Table

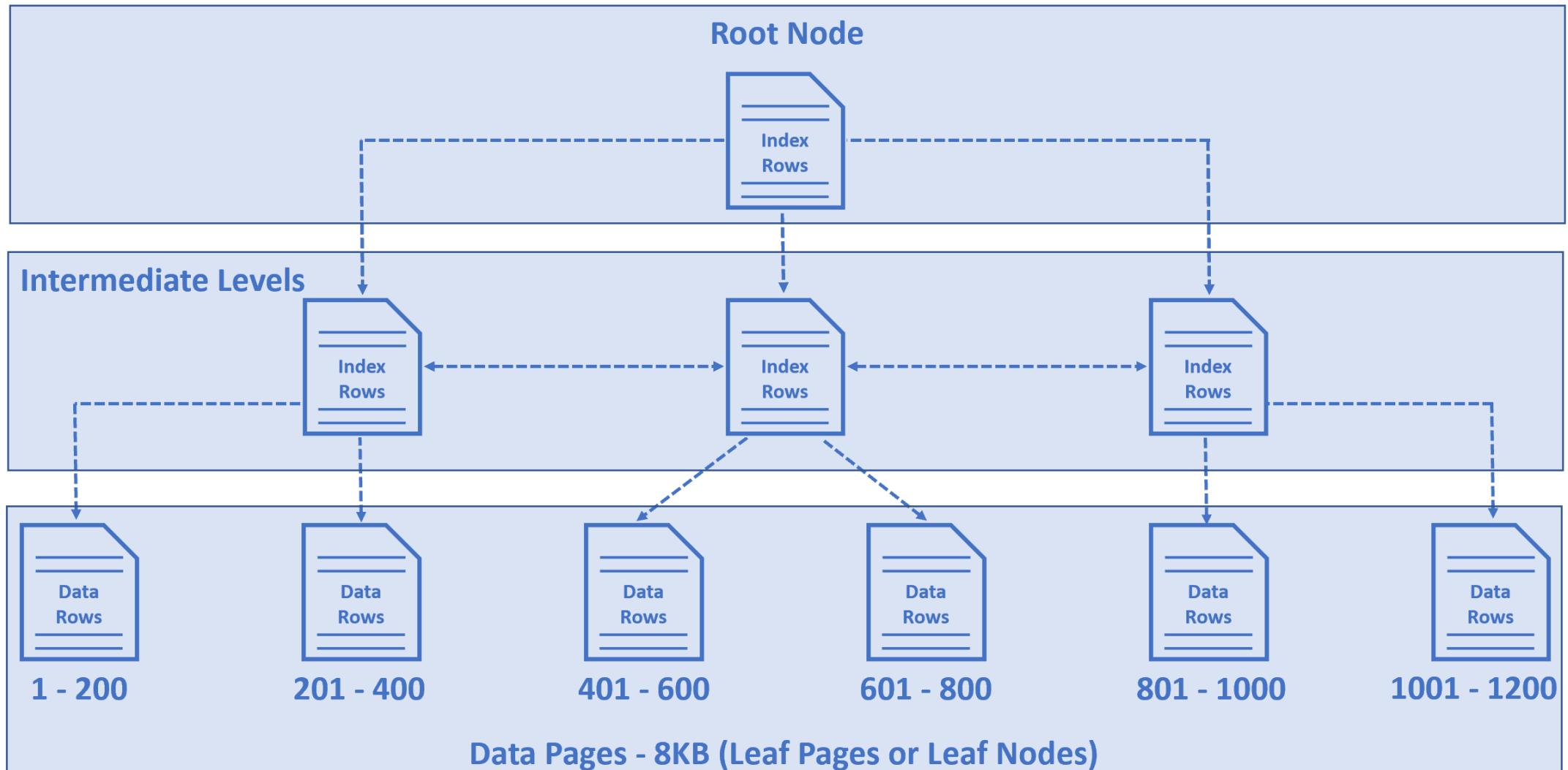
EmployeeId	Name	Email	Department
1	Mark	mark@pragimtech.com	IT
2	John	john@pragimtech.com	HR
3	Sara	sara@pragimtech.com	HR
4	Mary	mary@pragimtech.com	IT
5	Dave	dave@pragimtech.com	IT
...
...
1200	Steve	steve@pragimtech.com	HR

1200 rows in table

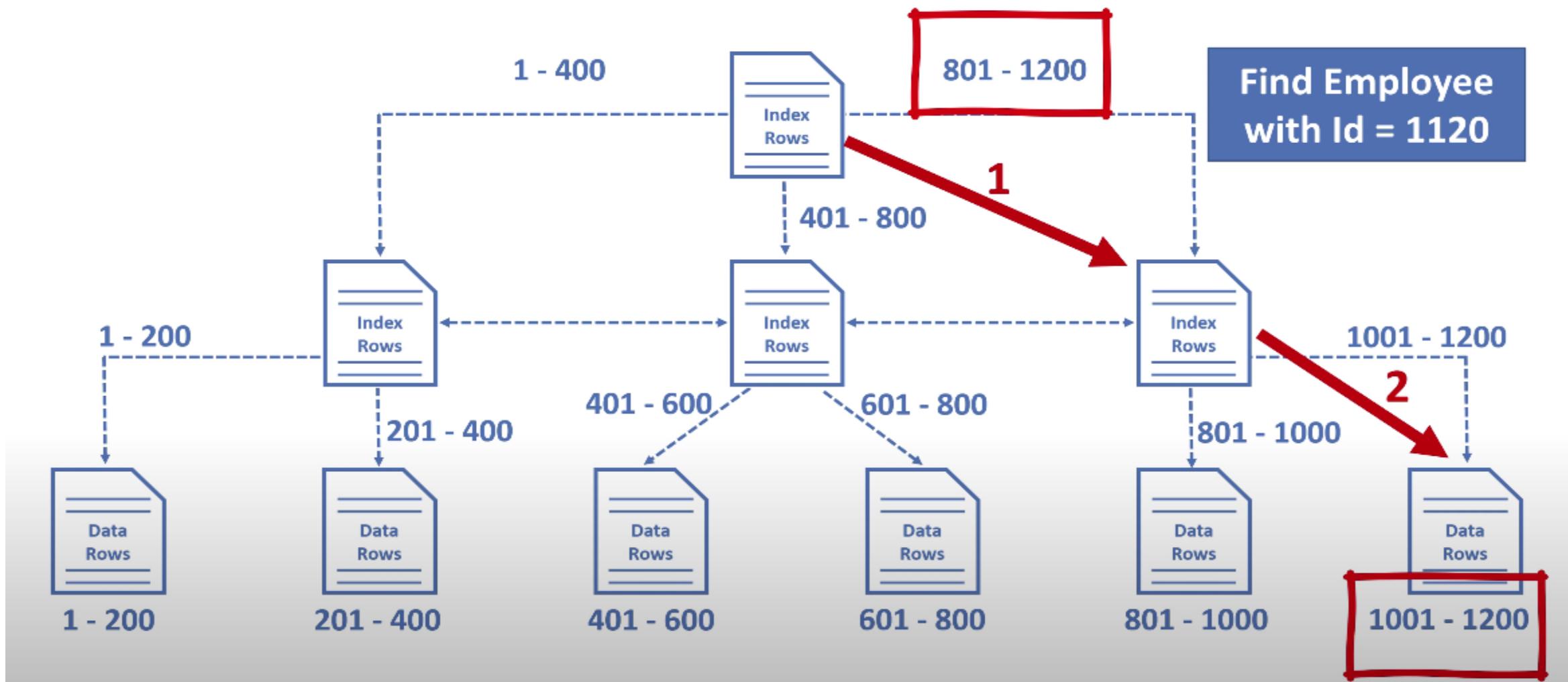
How is data stored in SQL database ?



How is data stored in SQL database ?



How is data stored in SQL database ?



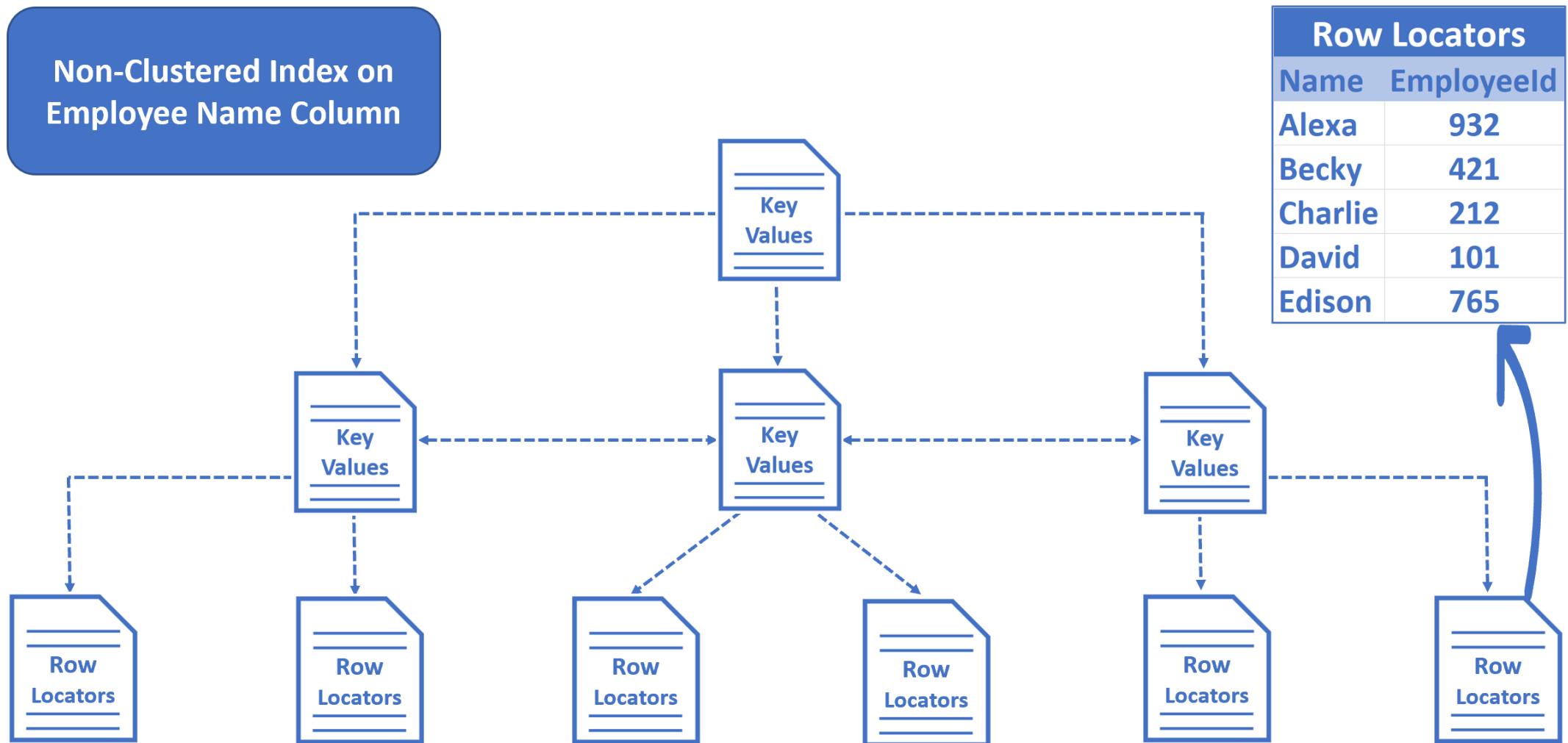
How is data stored in SQL database ?

Index Seek

Index Scan

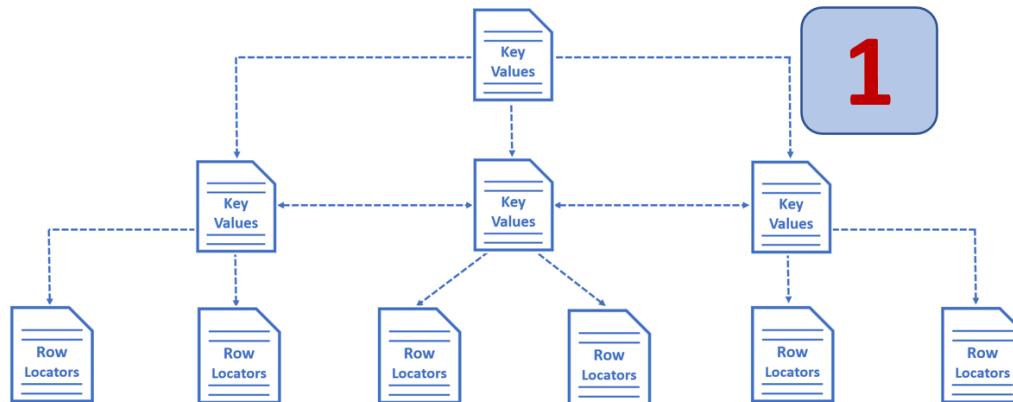


How is data stored in SQL database ?

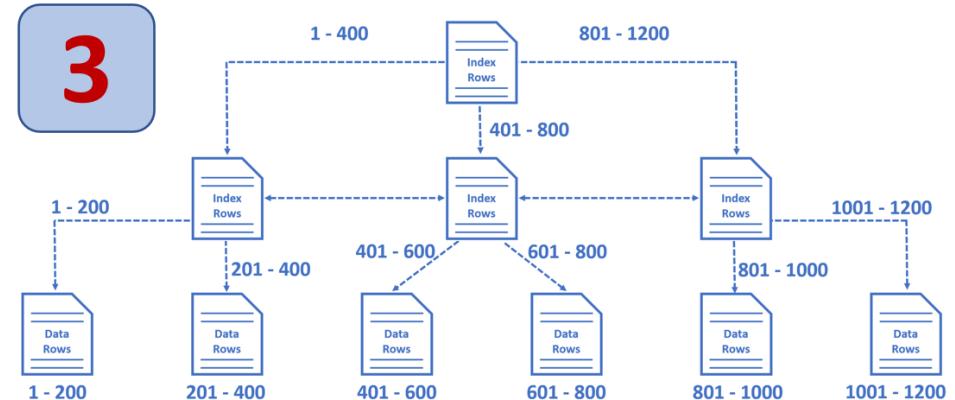


How is data stored in SQL database ?

Non-Clustered Index on Employee Name Column



Clustered Index on Employee ID Column



Row locators contain employee Name & Employee Id

Row Locators	
Name	EmployeeId
Alexa	932
Becky	421
Charlie	212
David	101
Edison	765

2

Data rows in the leaf node are sorted by Employee ID

Employees Table			
EmployeeId	Name	Email	Department
1	Mark	mark@pragimtech.com	IT
2	John	john@pragimtech.com	HR
3	Sara	sara@pragimtech.com	HR
4	Mary	mary@pragimtech.com	IT
5	Dave	dave@pragimtech.com	IT
...
...
1200	Steve	steve@pragimtech.com	HR

4

How is data stored in SQL database ?

Without index on Name column		With index on Name column	
SELECT		SELECT	
Cached plan size	16 KB	Cached plan size	24 KB
Estimated Operator Cost	0 (0%)	Estimated Operator Cost	0 (0%)
Degree of Parallelism	0	Degree of Parallelism	0
Estimated Subtree Cost	11.0685	Estimated Subtree Cost	0.0065704
Estimated Number of Rows Per Execution	1.00118	Estimated Number of Rows Per Execution	1
Statement		Statement	
SELECT * FROM [Employees] WHERE [Name]=@1		SELECT * FROM [Employees] WHERE [Name]=@1	

How is data stored in SQL database ?



RID	Id	Name	Email	Dept
xxx7	19	Charlie	ch@a.com	IT
xxx3	32	David	da@a.com	HR
xxx5	57	Edison	ed@a.com	IT
xxx1	74	Alexa	al@a.com	HR
xxx8	41	Becky	bk@a.com	IT

**What is a
Heap Table
In SQL Server**

How is data stored in SQL database ?

No Clustered Index

EmployeeId	Name	Email	Department
3	Sara	sara@pragimtech.com	HR
1	Mark	mark@pragimtech.com	IT
2	John	john@pragimtech.com	HR
5	Dave	dave@pragimtech.com	IT
4	Mary	mary@pragimtech.com	IT

May have one or more non-clustered index

The order of data rows is not guaranteed

A table without a clustered index is called heap

How is data stored in SQL database ?

To create a heap

Create a table without a clustered index

Already has a clustered index, drop it

To remove a heap

Create a clustered index on the heap



Operation ?



Index Seek



Index Scan



Table Scan

How is data stored in SQL database ?

Table Scan

Id	Gender
1	Male
3	Not Specified
2	Female



Table scan is used to select data from a heap if there are no indexes to help the query

Table scan is not always bad from performance standpoint

Even if there is an index on a small table, SQL server might still end up using table scan

How is data stored in SQL database ?

Table Scan	
SELECT	
Cached plan size	16 KB
Estimated Operator Cost	0 (0%)
Degree of Parallelism	0
Estimated Subtree Cost	0.0032853
Estimated Number of Rows Per Execution	1
Statement	
SELECT * FROM [Gender] WHERE [GenderName]=@1	
Index Seek	
SELECT	
Cached plan size	24 KB
Estimated Operator Cost	0 (0%)
Degree of Parallelism	0
Estimated Subtree Cost	0.0065704
Estimated Number of Rows Per Execution	1
Statement	
Select * from Gender with (Index (IX_Gender_GenderName)) where GenderName = 'Male'	

Red arrows point from the Estimated Subtree Cost values in the Table Scan and Index Seek sections to the corresponding numbers in the respective tables.

How is data stored in SQL database ?

When to use

RID	Id	Name	Email	Dept
xxx7	19	Charlie	ch@a.com	IT
xxx3	32	David	da@a.com	HR
xxx5	57	Edison	ed@a.com	IT
xxx1	74	Alexa	al@a.com	HR
xxx8	41	Becky	bk@a.com	IT

Staging table for large and unordered insert operations

Table is small with just a few rows

Data always accessed through nonclustered indexes

How is data stored in SQL database ?

Row Locators	
Name	RID
Alexa	xxx1
Becky	xxx8
Charlie	xxx7
David	xxx3
Edison	xxx5

Row Locators	
Name	EmployeeId
Alexa	74
Becky	41
Charlie	19
John	2
Mark	1

**RID & Key Lookup
in Execution Plan**

RID Lookup

Key Lookup

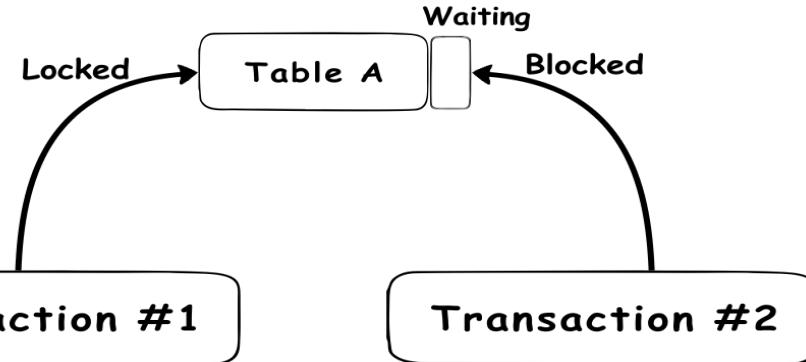
RID	EmployeeId	Name	Email	Dept
xxx7	19	Charlie	IT
xxx3	32	David	HR
xxx1	74	Alexa	HR
xxx8	41	Becky	IT
xxx5	57	Edison	IT

Employees Table

EmployeeId	Name	Email	Dept
1	Mark	m@m.com	IT
2	John	j@j.com	HR
3	Sara	s@s.com	HR
4	Mary	m@a.com	IT
...
200	Ash	ash@a.com	IT

Employees Table

Locking (Levels)



Page Level

- A page lock in SQL Server will lock 8K worth of data even when your query only needs 10 bytes from the page. So your query will lock additional data which you do not request in your query.

Hobt Level

- When a table is partitioned it is possible a Single partition will be locked.

Table Level

- lock the complete table.

Row level

- one or more specific rows will be locked, and the adjacent rows are still available for locking by concurrent queries.

Locking (Types)

Binary Locks

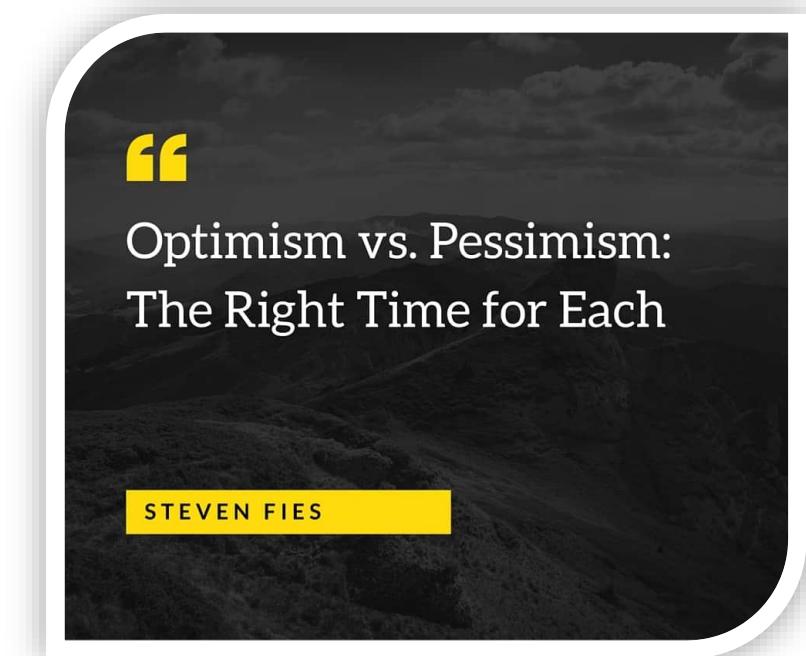
- Too restrictive for data items because at most one transaction can hold on a given item whether the transaction is reading or writing.

Shared/Exclusive Locks

- Shared(or Read) Locks : allow multiple users to read data, but do not allow any users to change that data.
- Exclusive(or Write) Locks : allows only one user/connection to update a particular piece of data (insert, update, and delete).

Optimistic Vs. Pessimistic

Optimistic	Pessimistic
<ul style="list-style-type: none">✓ means that multiple users can open a record for editing at the same time.✓ You'd use this when the chance of a conflict between users is low.	<ul style="list-style-type: none">✓ means that a user can't open a record for editing if another user has already opened it.✓ You'd use this when the chance of a conflict between users is high.





OOP Concepts and Standards

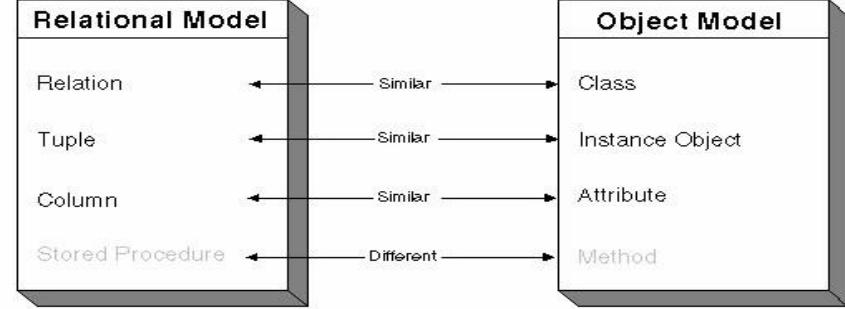
Object Oriented Concepts

Objects	Objects represent an entity that actually exists
Class	Class is the blue print of an object
Abstraction	Abstraction represents the behavior of a real world entity without details
Encapsulation	Encapsulation is the mechanism of binding the data together and hiding them from outside world
Inheritance	Inheritance is the mechanism of making new classes from existing one
Polymorphism	It defines the mechanism to allow objects to exist in different form



Object Relational Mapping

The Best of Both Worlds



Data Persistence world

- Data persistence doesn't mean a DB its means the ability to save some kind of information and retrieve it later.
- A most common approach is a Relational Database.
- The Relational Database key terms are Table, Column, record and Relations.
- Database uses a declarative language "SQL" slightly differs from one implementation to another.

Programming World

- Procedural, Object oriented , ...
- In an object oriented model the key terms are class ,attribute, object and Relations.
- All programming language are imperative.

The problem here is that every world has its own language, structure, ways and techniques.

From the start of both these worlds, visionaries try to mix these worlds together.

Impendence Mismatch: Cultural Mismatch

Declarative vs. Imperative programming

The object-oriented paradigm is based on practical software engineering principles. The relational paradigm, however, is based on proven mathematical principles.

Instance vs. Record

- Object Life Cycle

Mismatched Concepts

- No Encapsulation, Inheritance, Polymorphism
- No concepts of Interface

Impediment Mismatch: Technical Differences

Structural differences

Validation vs. Integrity Constraints

Association vs. Foreign Keys

Type Differences

- String vs. NVAR CHAR

Functions vs Stored Procedures

Transactional Differences

Performance

ORM WAIT BUT WHY

Remove the need of learning another languages (SQL).

ORMs abstract the developers from the complexity of The DB.

ORM Tools provide Data source ignorant API's that allow developers to switch the Data Source without affecting the application.

How ORM works ?

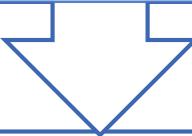
Most ORM tools rely heavily on **metadata** about both the **data source** and **objects**, so that the objects need to know nothing about the data source and the data source doesn't need to know anything about how the data is structured in the application.

ORM provides data **repositories** or other data sources and sinks, while simultaneously hiding the often changing details of related interfaces from developers and the code they create.

Mapping Tables to objects (DB First)

Mapping relational data types into object types.

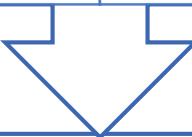
Mapping NVARCHAR to String



Mapping relational table definitions to object classes.

Employee Table to Class

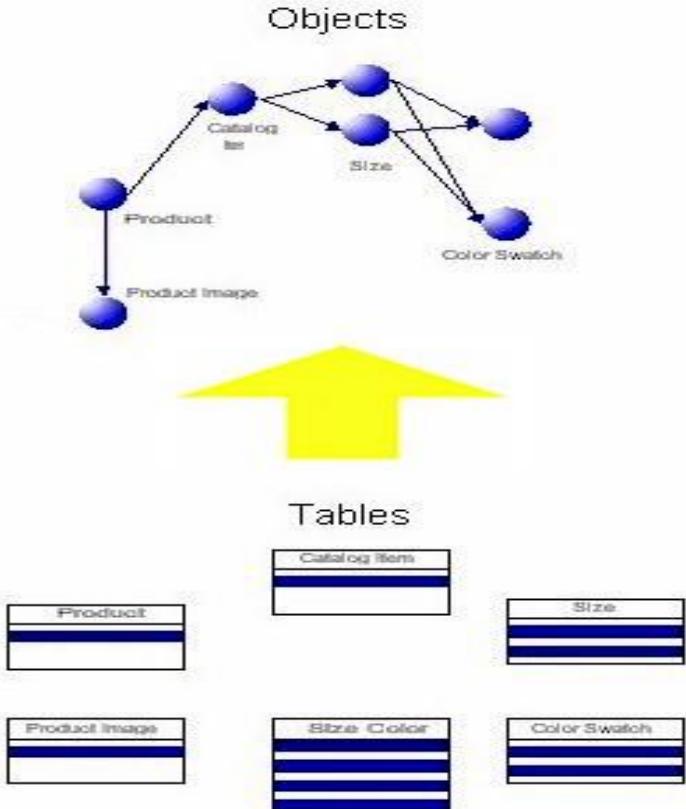
Mapping inheritance based on a table or multiple tables



The table definitions map directly except for foreign keys. Those are replaced by relationships.

Mapping foreign key to navigational properties

Mapping Many to Many tables to association



Mapping Objects to Tables (Model First)

- **Mapping objects to tables involves creating or updating data stored in a relational database. Mapping involves:**

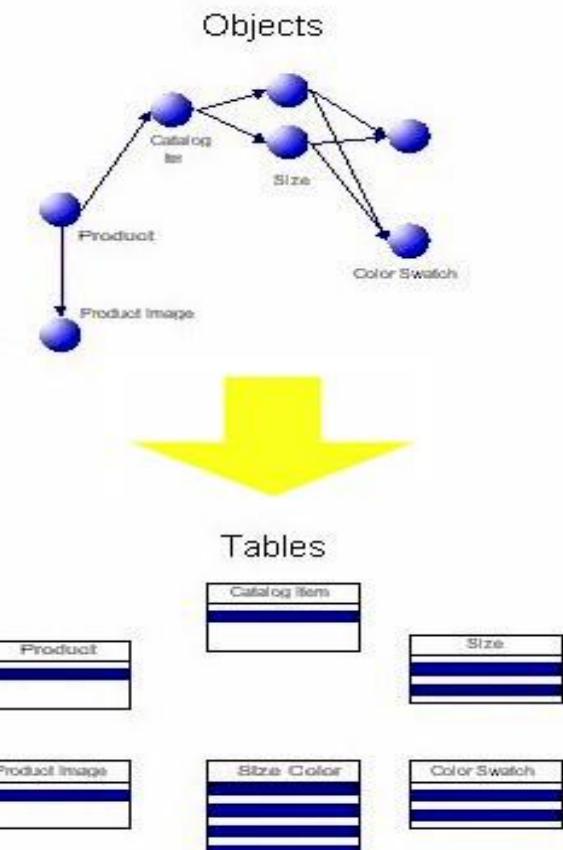
Mapping object types to database data types.

Mapping objects to one or many tables. There are usually multiple ways to map objects to tables. The issues include:

- Mapping Inheritance
- Class to Table Mapping count
- Control Redundancy
- Update precedence

Mapping Navigational collection classes into tables.

Mapping Many to Many relations.





Object Oriented Database Management Systems (ODBMS)

Object Oriented Database

When you integrate database capabilities with object programming language capabilities, the result is an object-oriented database management system (ODBMS).

An ODBMS makes database objects appear as programming language objects in one or more existing programming languages.

Object database management systems extend the object programming language with transparently persistent data, concurrency control, data recovery, associative queries, and other database capabilities.

Why ODBMS? One Model

With ODBMS there is no need to:

- Develop two data models.
- Maintain two data models.
- Develop mapping between the relational and object models.
- Maintain the mapping between the relational and object models.
- Have this course ☺

Any
questions?



References

- https://en.wikipedia.org/wiki/List_of_object-relational_mapping_software#.NET
- <http://www.service-architecture.com/>
- <http://www.agiledata.org/essays/mappingObjects.html>
- <https://www.tutorialspoint.com/dbms/>
- [https://technet.microsoft.com/en-us/library/jj856598\(v=sql.110\).aspx](https://technet.microsoft.com/en-us/library/jj856598(v=sql.110).aspx)