Baze de date

Curs 4 – Diagrame ER și transformare în RM, Indecși

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Cuprins

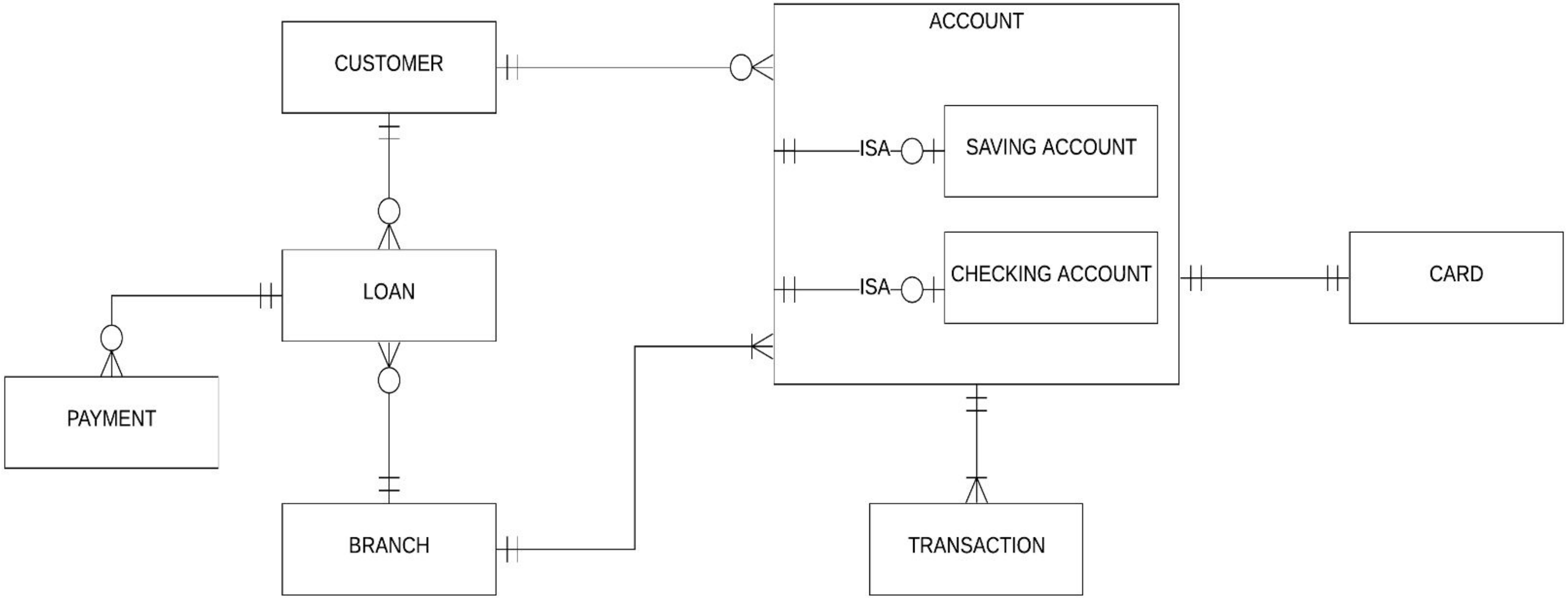
1. Exemple scheme conceptuale (⟵ diagrame entitate-relaţie sau ERD)
2. Transformare ERD în RM
3. Indecși

1. Exemple scheme conceptuale

Banking entities

- A customer opens a saving account or a checking account, at a bank branch. He may also access loans. For each checking account he has a card. Periodically he may withdraw money from his account or partially pay his loans. He may also transfer money from one account to another.

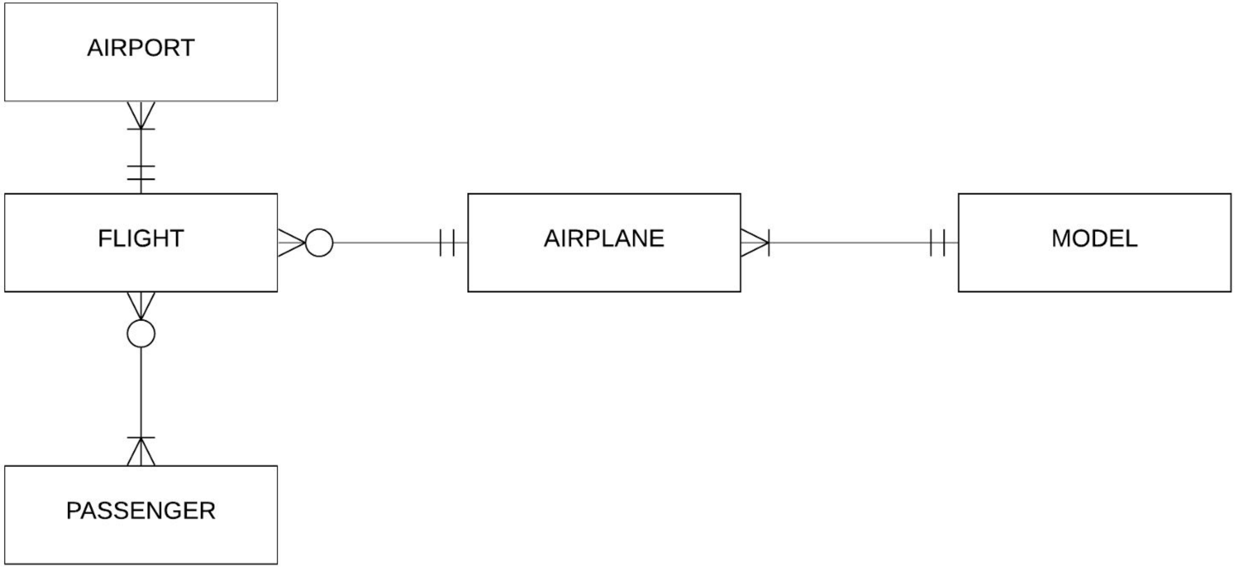
Banking relationships



Airline relationships

- The airline has one or more airplanes. An airplane has a model number, and capacity. Each flight is carried out by airplanes. An airplane is uniquely identified by its Registration_No and a flight is identified by its Flight_No. A passenger can book a ticket for a flight.

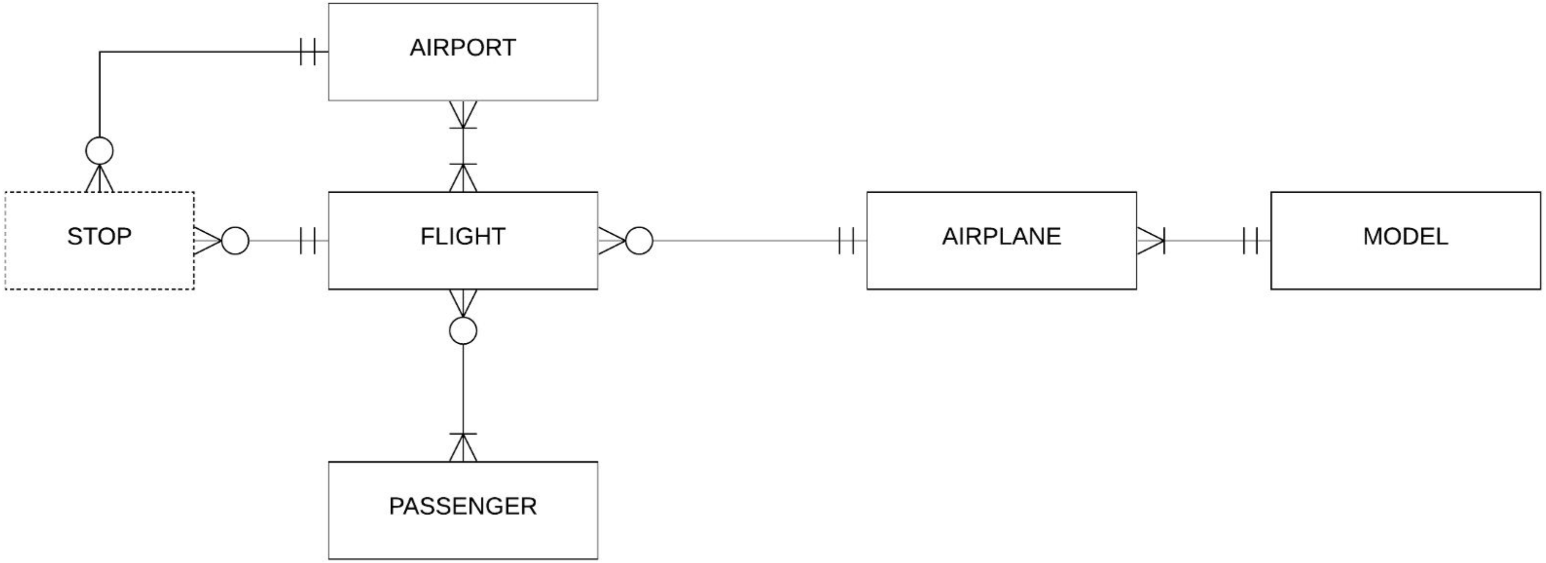
Airline relationships



Airline relationships

- The airline has one or more airplanes. An airplane has a model number, and capacity. Each flight is carried out by airplanes. An airplane is uniquely identified by its Registration_No and a flight is identified by its Flight_No. A passenger can book a ticket for a flight. **A flight may have one or more stops.**

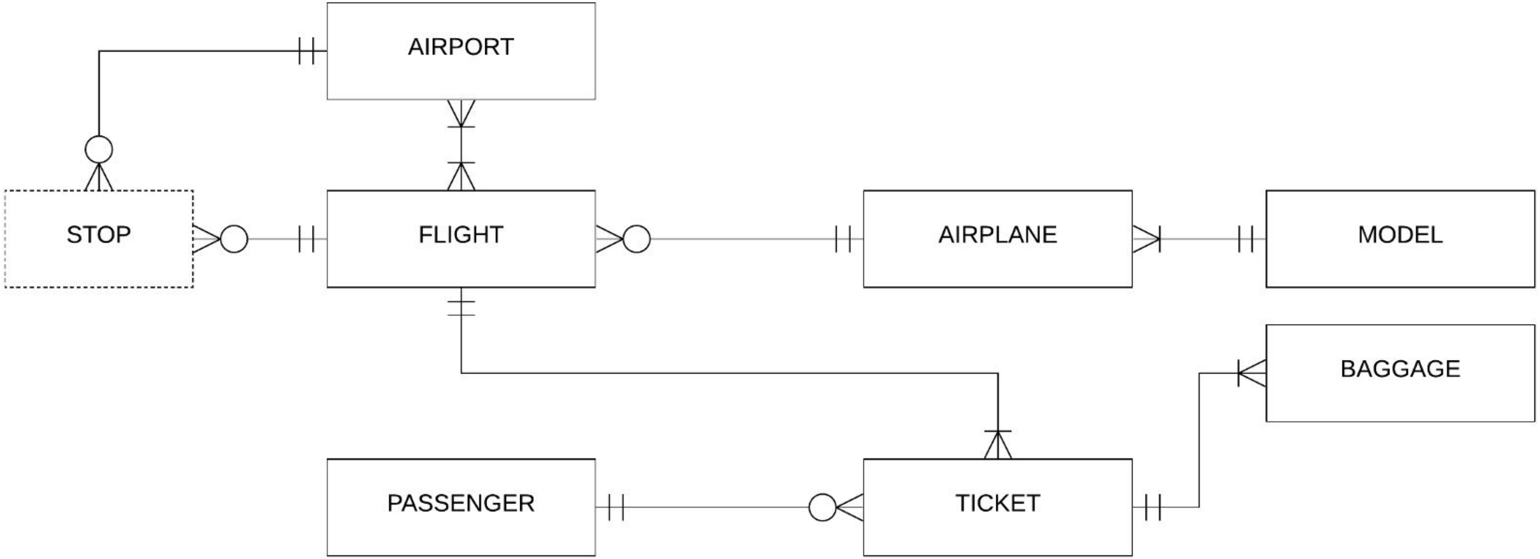
Airline relationships



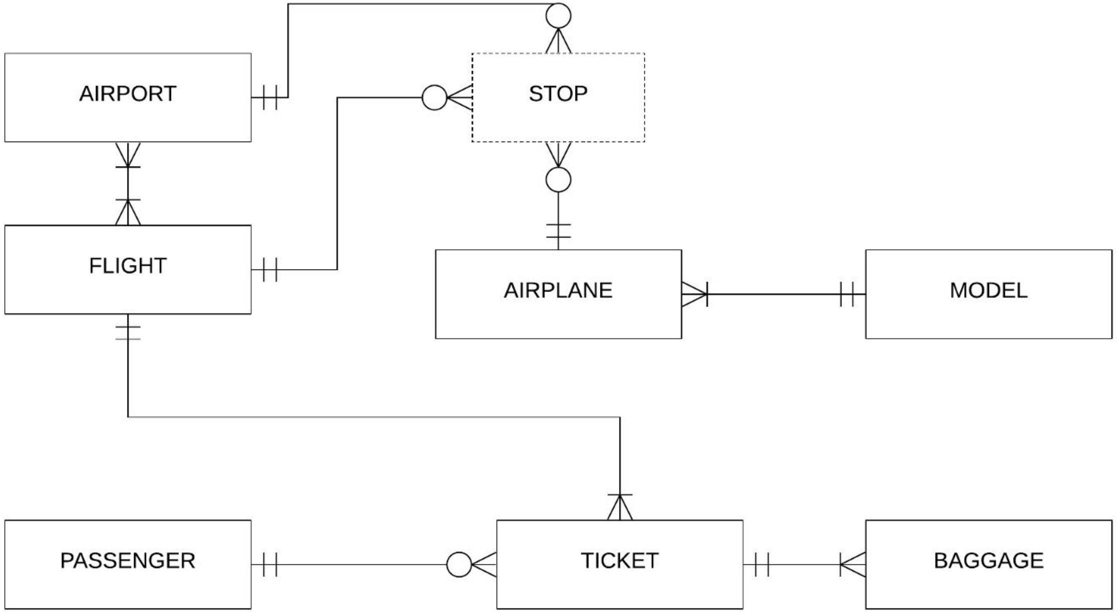
Airline relationships

- The airline has one or more airplanes. An airplane has a model number, and capacity. Each flight is carried out by airplanes. An airplane is uniquely identified by its Registration_No and a flight is identified by its Flight_No. A passenger can book a ticket for a flight. A flight may have one or more stops. **The passenger will pay for extra baggage.**

Airline relationships



Airline relationships



1. Exemple scheme conceptuale

➢ din fișierul diagrameER.pdf

2. Converting conceptual schema (ER) into RM

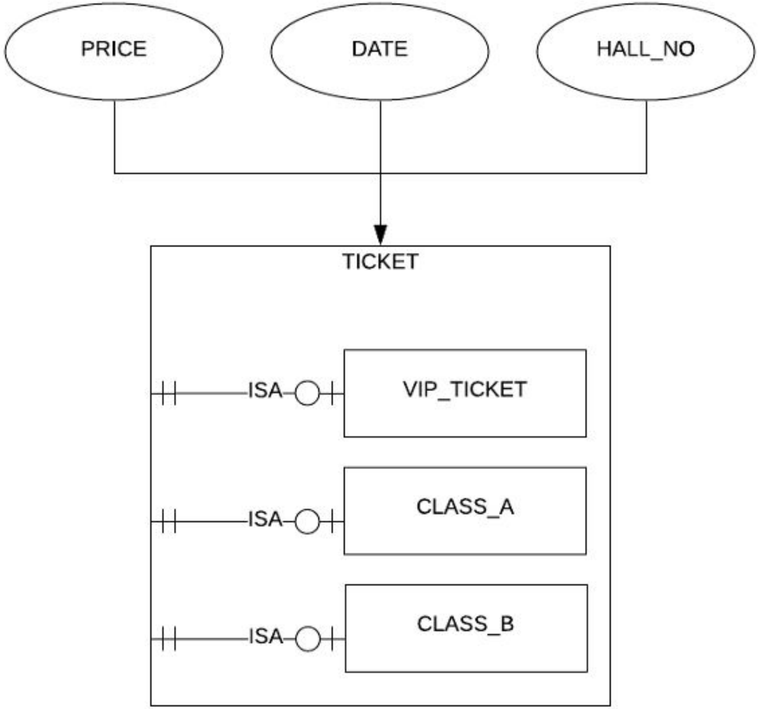
Rules for entities

- Strong entities ⟶ independent tables
  - PK doesn’t contain foreign keys.

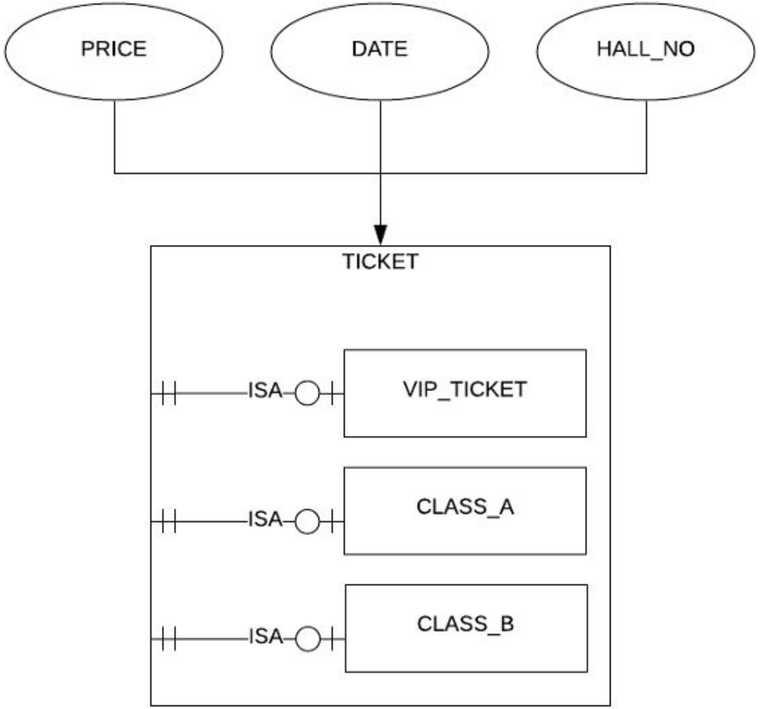
- Weak entities ⟶ table
  - PK contains the key of the related strong entity and or more key attributes.

- Sub-entities ⟶ one ore more tables, Boolean attribute, type_attribute
  - PK may also represent a FK.

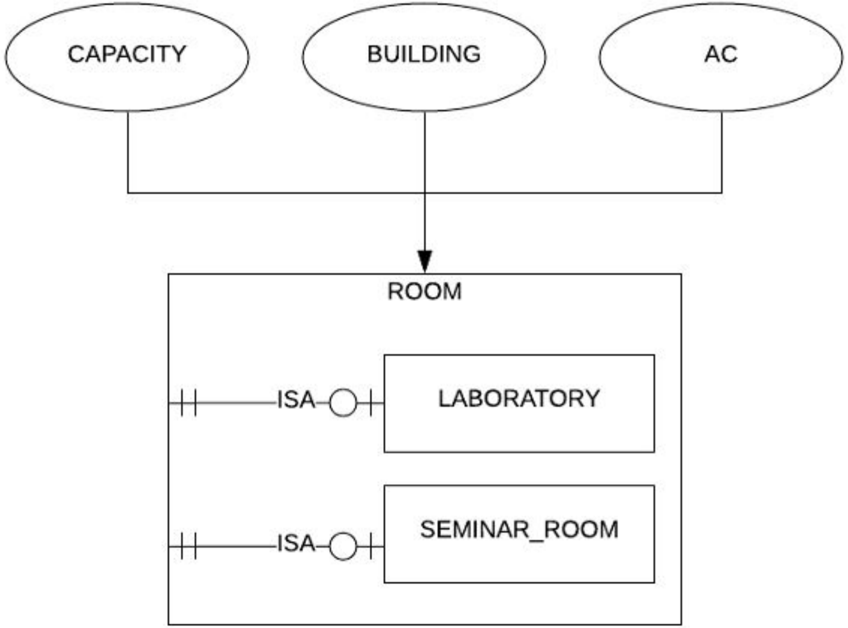
Rules for entities ISA



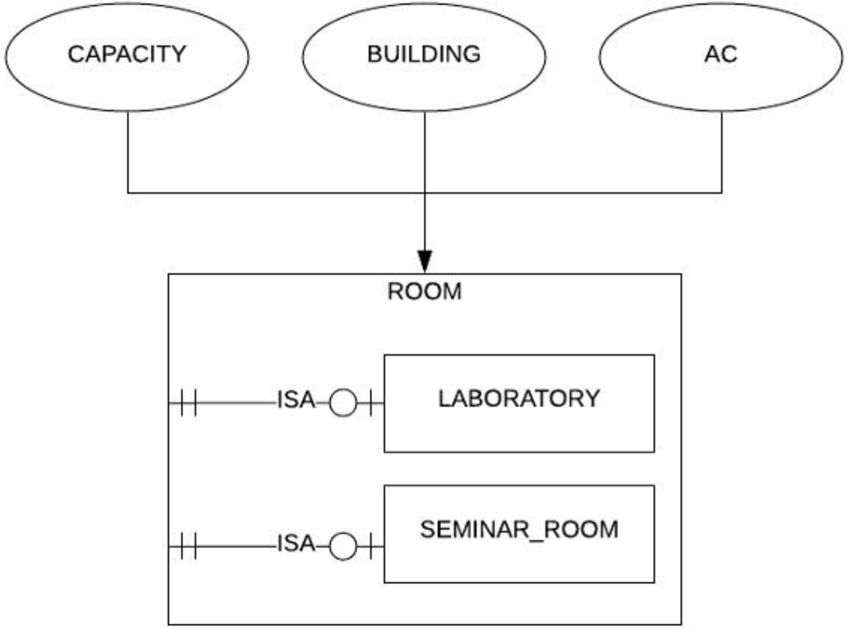
TICKET_ID	PRICE	HALL_NO	DATE	TYPE
1	200	Coliseum	08/03/20	VIP
2	150	Lyttelton	14/04/20	A
3	140	Olivier	01/05/20	A
4	90	Coliseum	04/06/20	B
5	220	Lyttelton	08/03/20	VIP
6	95	Olivier	14/04/20	B
7	210	Coliseum	20/03/20	VIP



Rules for entities ISA



ROOM_ID	CAPACITY	BUILDING	LAB	SEM
1	40	FMI	1	0
2	45	Magurele	1	0
3	30	Geografie	0	0
4	90	FMI	1	0
5	80	FMI	1	0
6	95	Drept	0	1
7	20	FMI	0	1

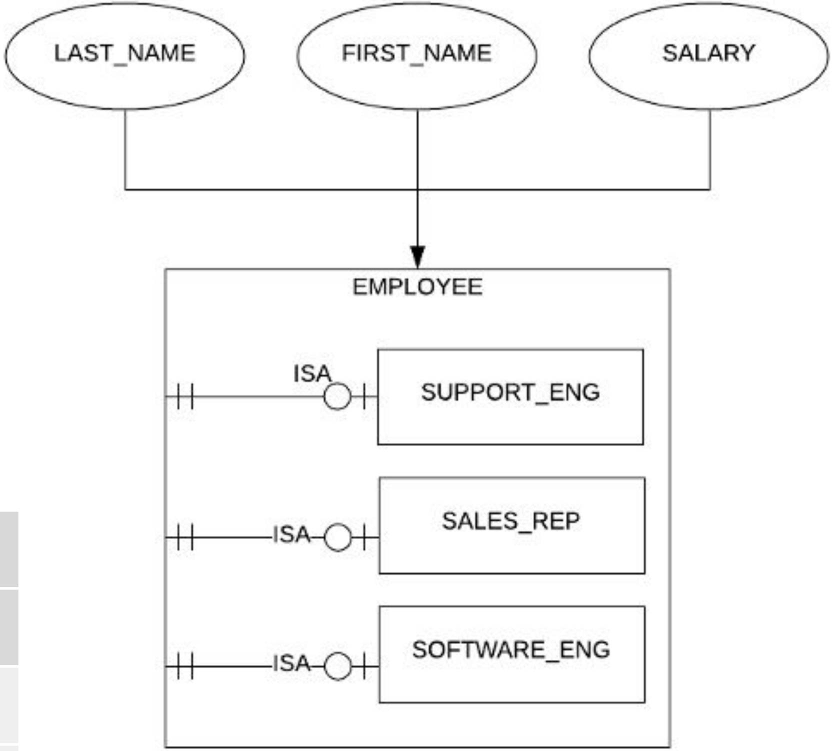


EMPLOYEES			
EMP_ID	LAST_NAME	FIRST_NAME	SALARY
1	Smith	John	2500
2	Grant	Anne	2700
3	Brown	Gregory	2300
…			

SUPPORT_ENG	
EMP_ID	LEVEL
1	3
…	…

SALES_REP	
EMP_ID	TARGET
2	25
…	…

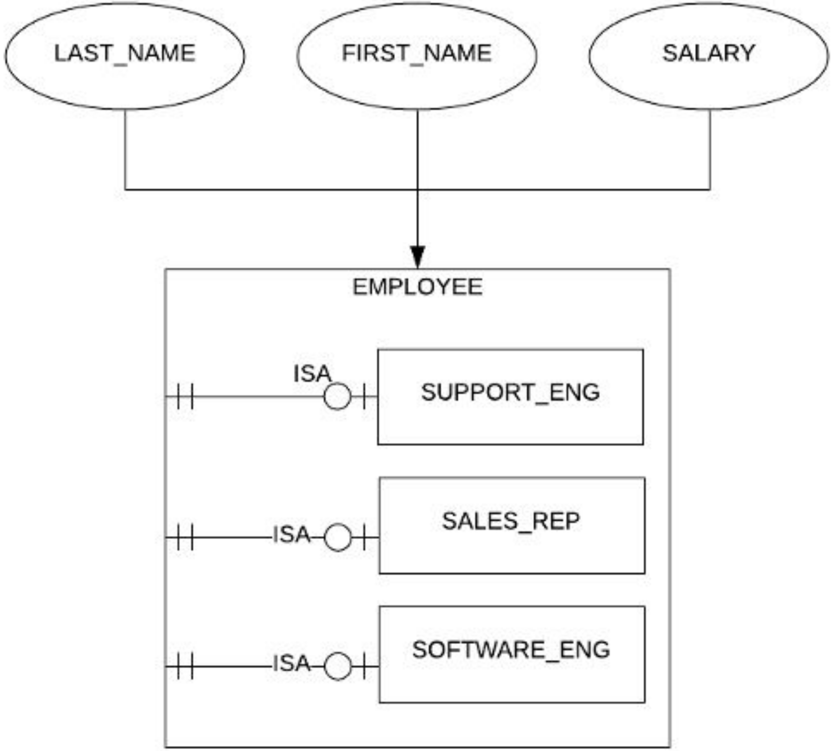
SOFTWARE_ENG	
EMP_ID	TEAM
3	3
…	…



SUPPORT_ENG				
EMP_ID	LAST_NAME	FIRST_NAME	SALARY	LEVEL
1	Smith	John	2500	3
…				

SALES_REP				
EMP_ID	LAST_NAME	FIRST_NAME	SALARY	TARGET
2	Grant	Anne	2700	25
…				

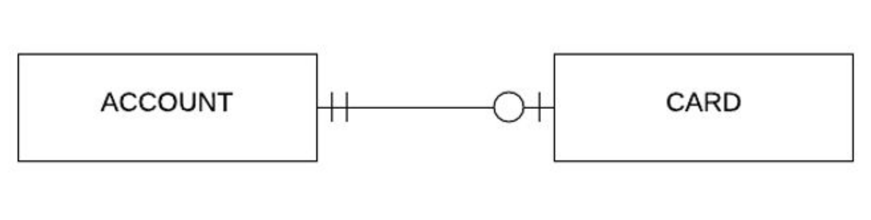
SOFTWARE_ENG				
EMP_ID	LAST_NAME	FIRST_NAME	SALARY	TEAM
3	Brown	Gregory	2300	3
…				



Rules for relationships

- 1 to 1 & 1 to M ⟶ foreign keys.
  - 1 (PK) to M (FK)
  - Usually in 1 to 1 relationships the FK is placed in the tables with fewer rows.
- M to M ⟶ associative table.
  - PK contains FKs and additional column.
- Ternary relationships ⟶ associative table.
  - PK contains FKs and additional column.

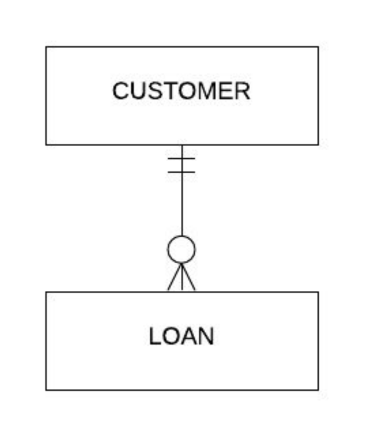
One to one



ACCOUNT			
ACCOUNT_ID	LAST_NAME	FIRST_NAME	DATE
10	Snow	John	08/03/20
22	Grant	Anee	14/04/20
300	Brown	Gregory	01/05/20
…	…	…	…

CARD			
CARD_ID	ACCOUNT_ID	CVN	DATE
16897	10	125	18/04/21
24789	22	987	14/04/22
34597	300	875	03/05/21
…	…	…	…

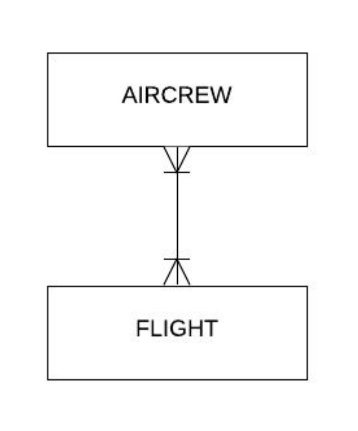
One to many



CUSTOMER			
CUSTOMER_ID	LAST_NAME	FIRST_NAME	....
10	Snow	John	....
22	Grant	Anee	....
300	Brown	Gregory	....
...	...	...	...

LOAN			
LOAN_ID	CUSTOMER_ID	VALUES	DATE
16897	10	125000	18/04/21
24789	22	987000	14/04/22
34597	300	87500	03/05/21
...	...	...	...

Many to many

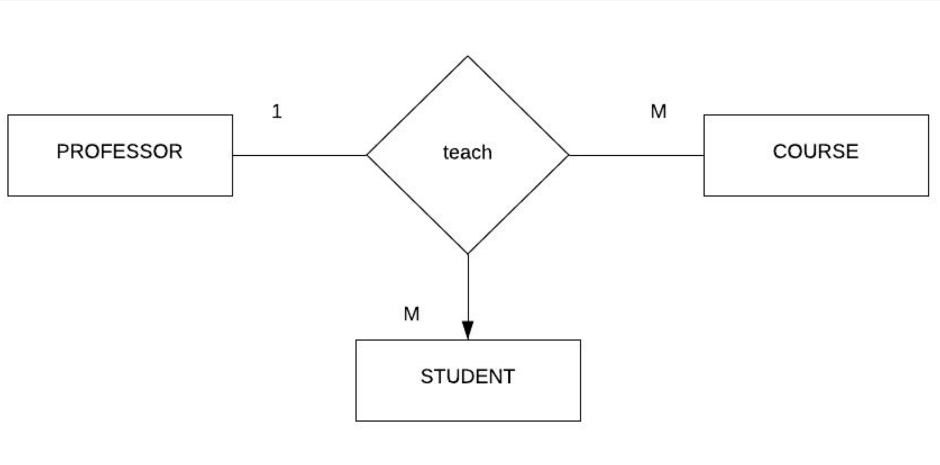


FLIGHT			
FLIGHT_ID	DEP_AIRPORT	DATE	….
1	Gatwick Airport	20/04/21	….
2	Grant	14/05/20	….
…	…	…	…

FLIGHT_CREW		
CREW_ID	FLIGHT_ID	OBSERVATIONS
10	1	…
22	1	…
10	2	…

AIRCREW			
CREW_ID	LAST_NAME	FIRST_NAME	JOB_ID
10	Snow	John	captain
22	Grant	Anee	first_officer
…	…	…	…

Ternary Relationships

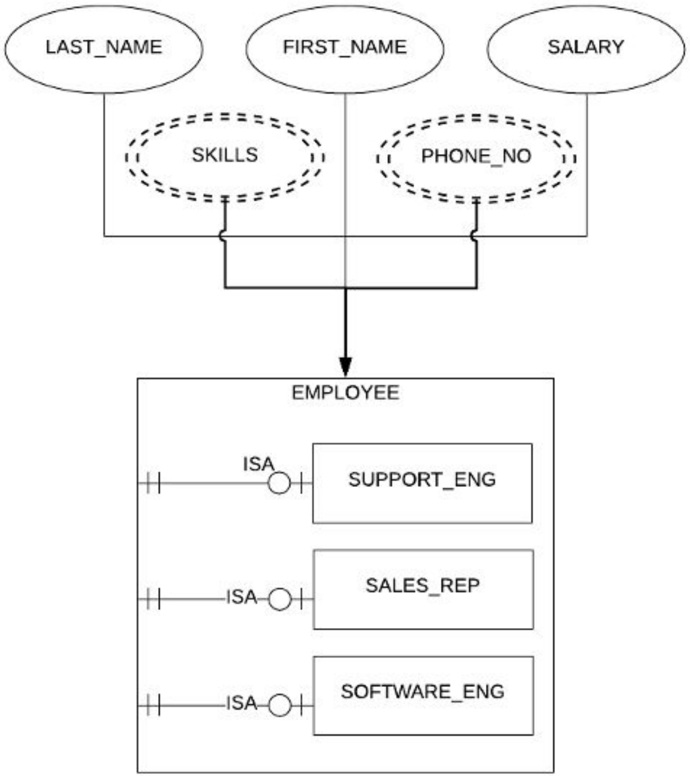


TEACH			
PROFESSOR_ID	COURSE_ID	STUDENT_ID	GRADE
1	BD	1001	9
1	SGBD	1002	10
1	BD	1002	8
2	TAP	1001	8
2	TAP	1002	10
2	AG	1001	5
….	….	….	….

Rules for attributes

- Simple attribut ⟶ column
- Multivalued attributes ⟶ weak entity ⟶ table
  ⟶ set of columns

Rules for entities
ISA



EMPLOYEES					
EMP_ID	**LAST_NAME**	**FIRST_NAME**	**SALARY**	**PHONE1**	**PHONE2**
1	Smith	John	2500	0745…	0720…
2	Grant	Anne	2700	07497…	NULL
3	Brown	Gregory	2300	NULL	07458..
…	…	…	…	…	…

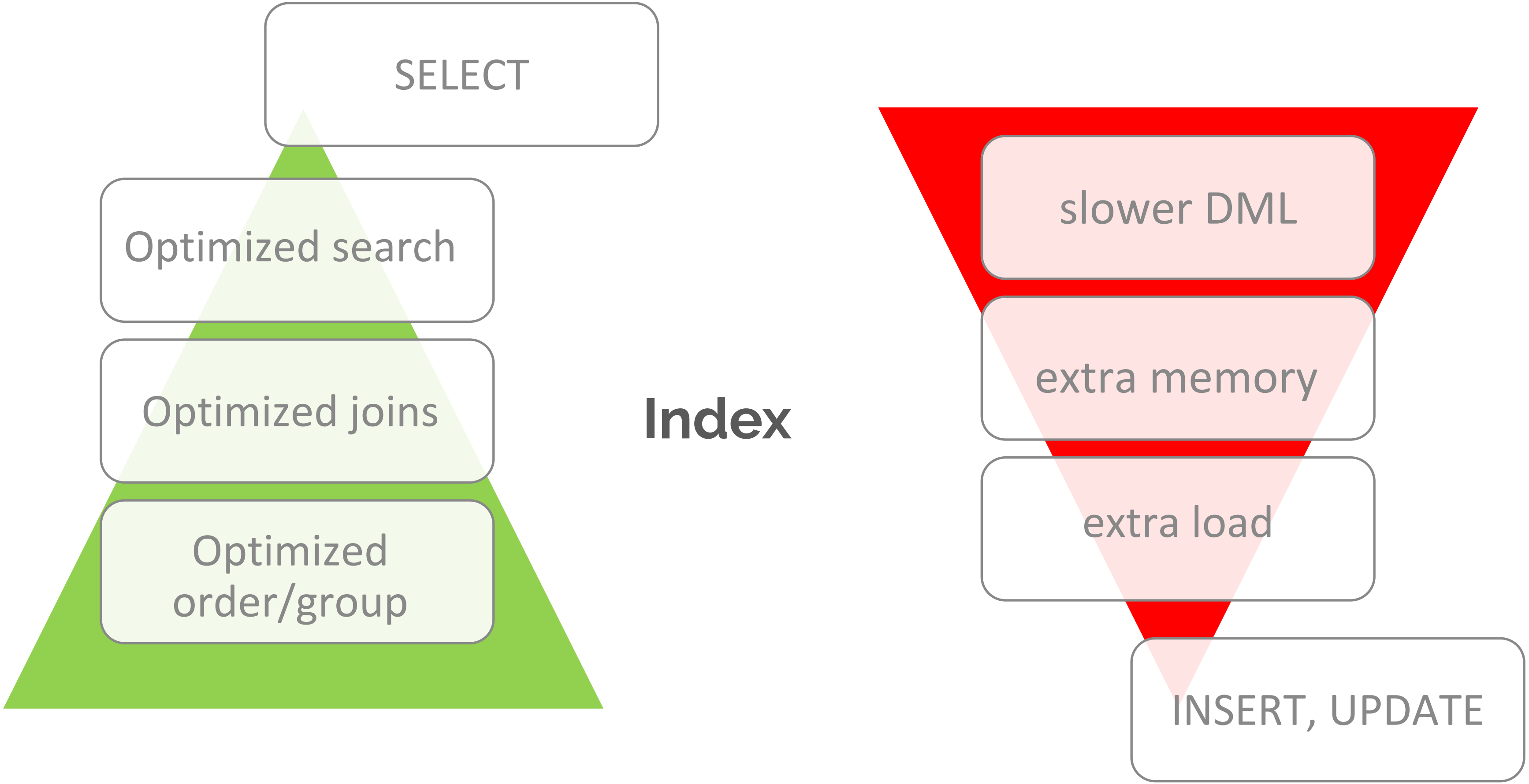
EMP_SKILL		
EMP_ID	**SKILL**	**LEVEL**
1	Python	3
1	C++	2
1	NoSql	3
2	SQL	1

3. Indexes

- Maps search key to data using specific data structures.

- Optimized search.
- Optimized joins (lookup in more than one table).
- Optimized order/group.

- Slower DML (insert and update operations).
- Extra memory.



SELECT

Optimized search

Optimized joins

Optimized order/group

Index

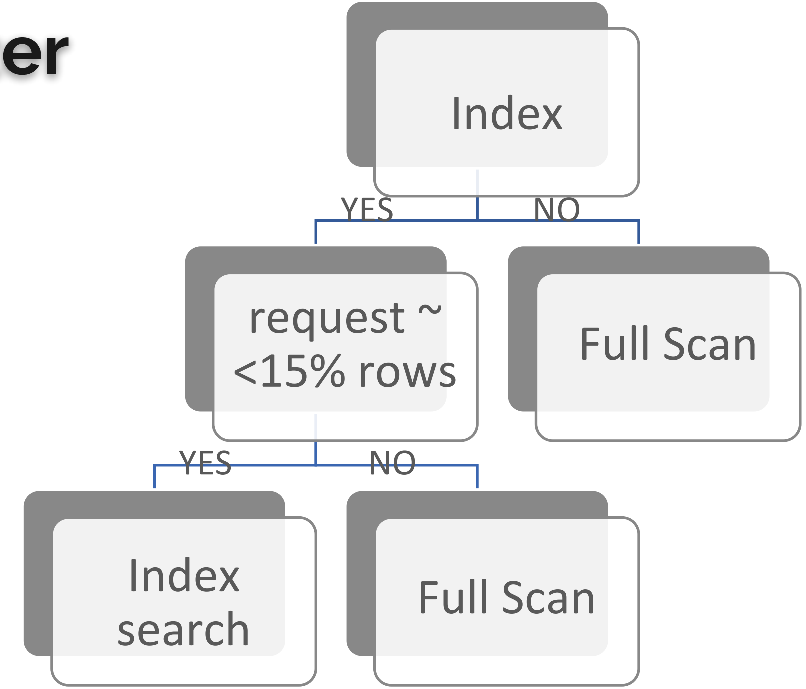
slower DML

extra memory

extra load

INSERT, UPDATE

Sql Optimizer



Index

YES

NO

request ~ <15% rows

Full Scan

YES

NO

Index search

Full Scan

Autogenerated columns

- MySQL auto-generated index (key):
  - DB_ROW_ID increases monotonically as new rows are inserted.
  - DB_ROLL_PTR roll pointer, points to log record.
  - DB_TRX_ID last transaction that updated or inserted the row.

- Oracle ROWID:
  - Pseudo column 18 characters = 10 + 4 + 4 (block, row, file).
  - Store and return row address in hexadecimal format (string).
  - Unique identifier for each row.
  - Immutable.

Autogenerated columns

- Oracle ROWID:
  - Used in where clause to select/update/delete a row.

- Oracle ROWNUM:
  - Sequential number in which Oracle has fetched the row, before ordering the result.
  - Temporary generated along with a select statement.

- Mongo
  - ObjectID (timestamp 4Bytes + random 5Bytes + Count 3Bytes.

Index

- ➢ Data structure that optimize search.
- ➢ Automatically created when a primary key is defined.

MySQL

```
SHOW EXTENDED INDEX FROM index_test;
```

Oracle

```
select * from user_indexes
where table_name = 'INDEX_TEST';
```

Primay key

- ➢ Constraint imposed on insert/update behavior.
- ➢ NotNull & Unique.

MySQL

```
select * from  information_schema.statistics
where table_name = 'index_test1’
      and index_name = 'primary';
```

Oracle

```
select * from user_constraints
where table_name = 'INDEX_TEST';
```

Index types

Clustered index (SqlServer, MySql)

- Defines the order in which data is physically stored in a table (index on column semester).
- Only one clustered index on a table (data can be stored in only one order)
- A cluster index is created automatically when a primary key is defined.
- No second data structure for the table.

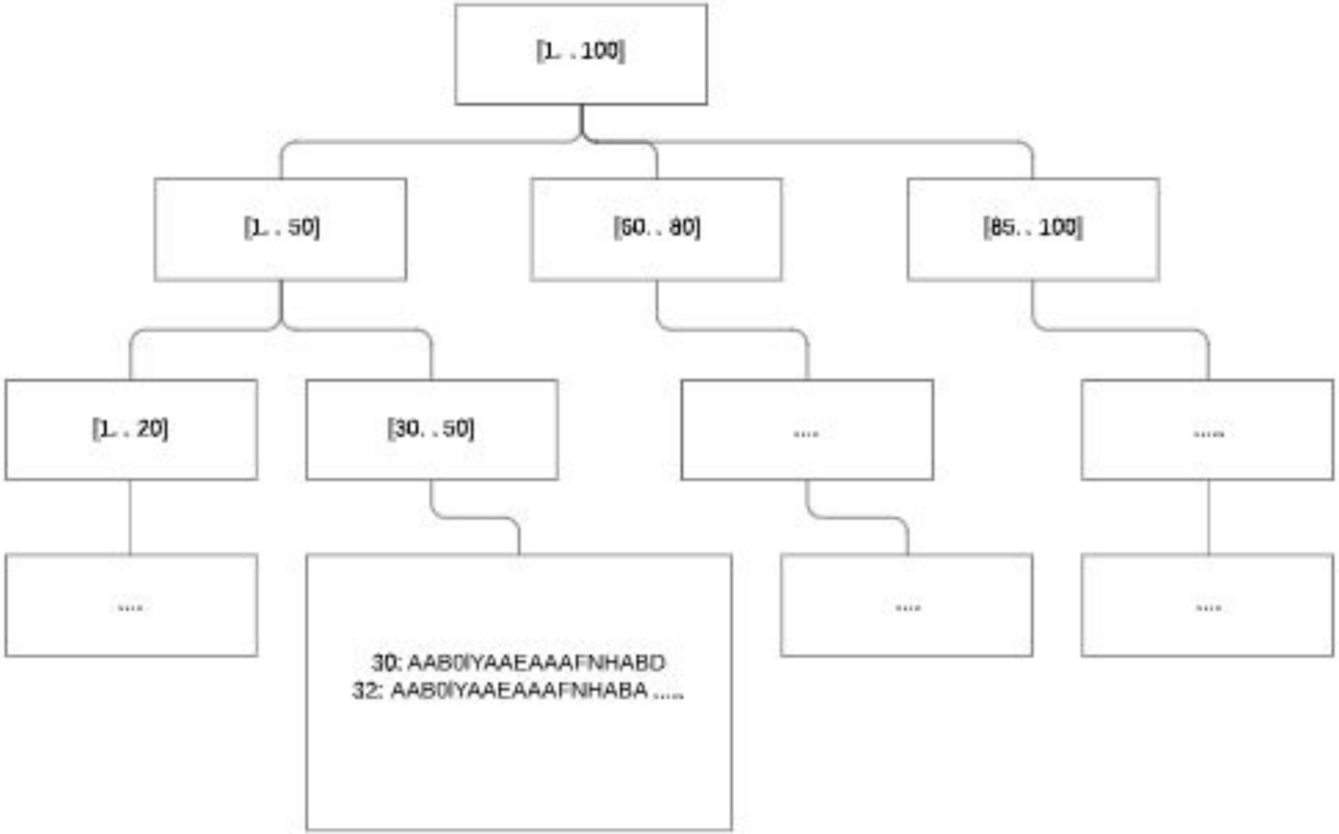
- Oracle: IOT index organized tables.
  Table is stored in a B-tree structure (key and non-keys column are stored in leafs).

B – Tree

- B => Balanced tree.
- Default index type in Oracle.
- Two types of nodes: branch blocks and leaf blocks.
- Branch blocks pointers to lower levels.
- Leaf blocks contain rowids/physical address.
- The number of blocks traversed in order to reach a leaf block is the same for each leaf block.

B – Tree

- CREATE INDEX idx_emp_id ON employees(employee_id).
  - Devide employee_id values in sorted ranges.
  - Leafs nodes store rowid.



[1. . 100]

[1. . 50]

[60. . 80]

[85. . 100]

[1. . 20]

[30. . 50]

.....

.....

.....

30: AAB0IYAAEAAAFNHABD
32: AAB0IYAAEAAAFNHABA .....

.....

.....

Reverse index

- B – tree where keys are in reverse order.
  Key 4573 is stored 3754.
- Optimized insert operations.
- Key 4573 will be stored in the same block with key 9573 while 4574 will be stored in a different block.

Bitmap index

- ➢ Used for columns with limited number of distinct values.
- ➢ Example: language proficiency levels (en)

emp_id	en	fr
1	A1	B1
2	A2	B2
3	C1	A1
4	A1	B1
5	A1	

row_id	A1	A2	B1	B2	C1	C2
AAB0lYAAEAAAFNHABD	1	0	0	0	0	0
AAB0lYAAEAAAFNHABV	0	1	0	0	0	0
AAB0lYAAEAAAFNHABX	0	0	0	0	1	0
AAB0lYAAEAAAFNHAAv	1	0	0	0	0	0
AAB0lYAAEAAAFNHAAV	1	0	0	0	0	0