Advanced Database

- Cours : 16 h
- TD : 16 h
- TP : 16 h

Plan

- Introduction
- Structure of DBMS
- Data storage and indexing
  - Physical storage
  - Logical storage
  - Index
- Transaction
  - Lock
- Query processing and optimizing
  - Parsing
  - optimizing
- Trigger
- PL/SQL

Advanced Database

Introduction

Plan

- Introduction to database
- Introduction to database management system
- Database design process
- Entity relationship model
- Relational model
- Query language

Introduction to Database

- DB is a collection of persistent data that is used by information system/applications in a company (C. J. Date).
- DB is a collection of information (data) which is arranged in individual records and is searchable

Introduction to Database

- Why database?
  - Easy to define
  - Easy to manipulate data
  - Reliable
  - Security

Ex: Suppose that you want to build an university database. It must store the following information:

Entities: Students, Professors, Classes, Classrooms

Relationships: Who teaches what? Who teaches where? Who teaches whom?

Introduction to DBMS

- A software which is used to manage database
- Responsible for objectives of database
  - Data storing
  - Data archiving and restoring
  - Concurrent access
  - Data replication
  - Correct and affective data access
- Example: MySQL, Oracle, SQL server, DB2, ...

Introduction to DBMS

What can DBMS does?

- Store huge amount of data (e.g., 1000 TB+) over a long period of time
- Allow apps to query and update data
  - Query: what is Mary's grade in the "Operating System" course?
  - Update: enroll Mary in the "Database" course
- Protect from unauthorized access.
  - Students cannot change their course grades.
- Protect data from system crashes
  - When some system components fail (hard drive, network, etc.), database can be restored to a good state.

Database Design Process

Step 1: Requirements Analysis

What data to store in the database?

What application (e.g., queries...) needs from the database?

Step 2: Conceptual Database Design

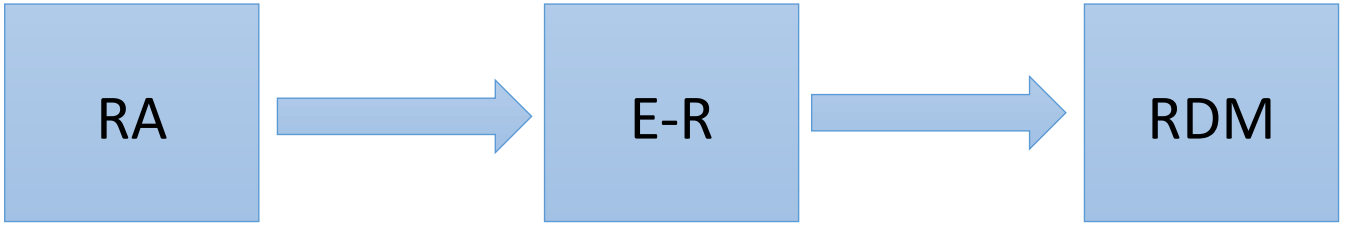
Come up with the design: Entity-Relation (ER) model

Sketch the design using pictures called entity-relationship diagrams.

Step 3: Logical Database Design

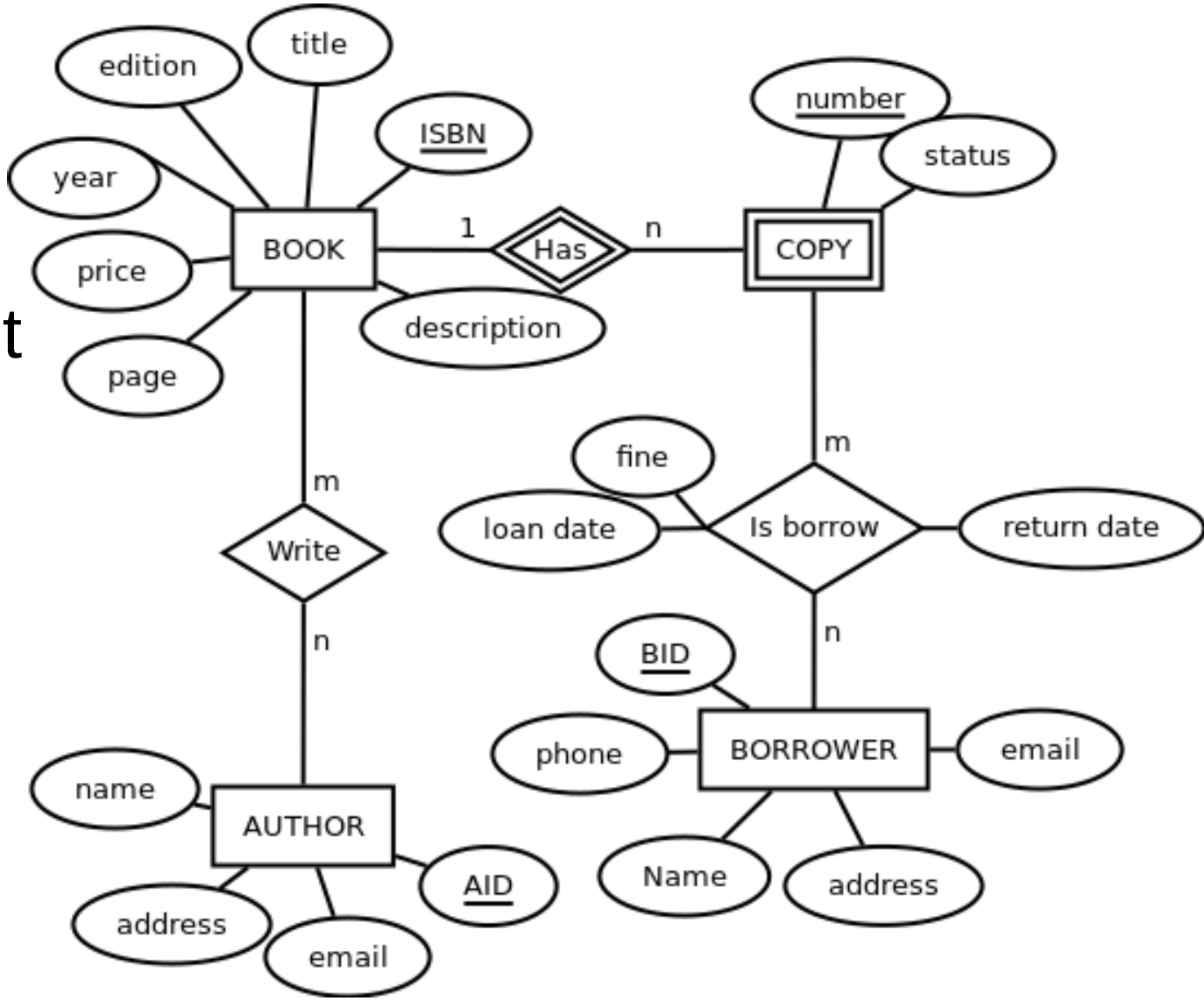
Implement the design: relational data model

Easy to map ER diagrams into the relational data model.



Entity relationship model

- Entity set
  - Attribute
  - Key entity set
- Relationship set
  - Attribute
  - Cardinality
    - (1:1)
    - (1:n)
    - (n:n)



Relational Model

- Data is structured into 2 dimension table called relation (related attributes)
  - Relation/ table
  - Schema
  - Tuple
  - Field

Relation Teacher

TID	Tname	DoB	Degree	Field	Dname
1	Sok Dara	01/01/85	Master	Math	Math
2	Sam Sambath	01/02/80	PhD	Mechanic of fluid	Mechanic
3	Sao Piseth	05/08/70	PhD	Biology	Environment
4	Tao Pisey	14/07/65	Engineer	Electronic	Electronic
5	Van Dany	08/12/87	Engineer	hydropower	Environment

Relational Model

- Integrity constraint (Primary key)

type	procducer	model	fabrication year	color	fuel	serial number	identification number
LIMOUSINE	BMV	740	2008	BLACK	GAS	WBADL9105 GW65796	SB24MEA
VAN	VW	TRANS PORTE R	2007	RED	DIESEL	QASMD8209 NF37590	AB08DGF
LIMOUSINE	MERCED ES	320	2008	WHITE	GAS	XEFAR2096 WM19875	SB06GHX
LIMOUSINE	AUDI	ALLROA D	2009	BLUE	DIESEL	AKLMD8064 MW79580	SB52MAG
LIMOSIONE	BMW	525	2007	GREY	DIESEL	QMXAS4390 WQ21998	AB02AMR

Relation Car

Relation Owner

id	first name	last name	city	street	number	phone	identification number
1	JOHN	SMITH	NewYork	MORILOR	29	223778	SB24MEA
2	MARY	FORD	DC	TEILOR	14	431034	AB08DGF
3	ANNE	SHEPARD	NewYork	SEBASIAN	22	231024	SB06GHX
4	WILLIAM	HILL	NewYork	OCNA	55	213866	NULL
5	JOE	PESCI	DC	MOLDOVA	59	493257	AB02AMR

Relational Model

- Referential constraint (Foreign key)

type	procducer	model	fabrication year	color	fuel	serial number	identification number
LIMOUSINE	BMV	740	2008	BLACK	GAS	WBADL9105 GW65796	SB24MEA
VAN	VW	TRANS PORTE R	2007	RED	DIESEL	QASMD8209 NF37590	AB08DGF
LIMOUSINE	MERCED ES	320	2008	WHITE	GAS	XEFAR2096 WM19875	SB06GHX
LIMOUSINE	AUDI	ALLROA D	2009	BLUE	DIESEL	AKLMD8064 MW79580	SB52MAG
LIMOSIONE	BMW	525	2007	GREY	DIESEL	QMXAS4390 WQ21998	AB02AMR

Relation Car

Relation Owner

id	first name	last name	city	street	number	phone	identification number
1	JOHN	SMITH	NewYork	MORILOR	29	223778	SB24MEA
2	MARY	FORD	DC	TEILOR	14	431034	AB08DGF
3	ANNE	SHEPARD	NewYork	SEBASIAN	22	231024	SB06GHX
4	WILLIAM	HILL	NewYork	OCNA	55	213866	NULL
5	JOE	PESCI	DC	MOLDOVA	59	493257	AB02AMR

Relational Model

- Referential constraint (Foreign key)

sid	sname	rating	age
22	Dustin	7	45
29	Brustus	1	33
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35
64	Horatio	7	35
71	Zorba	10	16
74	Horatio	9	35
85	Art	3	25.5
95	Bob	3	63.5

Relation Sailor

sid	bid	day
22	101	1998-10-10
22	102	1998-10-10
22	103	1998-08-10
22	104	1998-07-10
31	102	1998-10-11
31	103	1998-06-11
31	104	1998-12-11
64	101	1998-05-09
64	102	1998-08-09
74	103	1998-08-09

Relation Reserves

bid	bname	color
101	interlake	blue
102	interlake	red
103	Clipper	green
104	Marine	red

Relation Boat

Relational Model

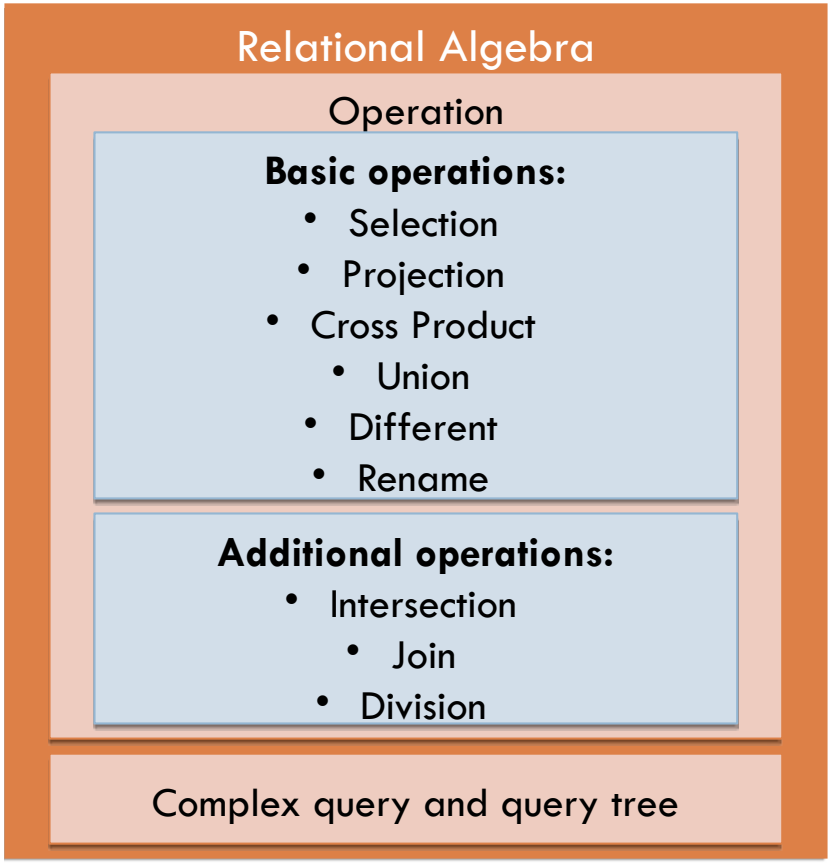
- Referential constraint (Foreign key)

employeeNumber	lastName	reportsTo	jobTitle
1002	Murphy	null	President
1056	Patterson	1002	VP Sales
1076	Firrelli	1002	VP Marketing
1088	Patterson	1056	Sales Manager (APAC)
1102	Bondur	1056	Sale Manager (EMEA)
1143	Bow	1056	Sales Manager (NA)
1165	Jennings	1143	Sales Rep
1166	Thompson	1143	Sales Rep
1188	Firrelli	1143	Sales Rep

Relation Employee

Query Language

- Relational Algebra
  - Operation based query language



Query Language

- Consider the following Sailor database

Relation Sailor

sid	sname	rating	age
22	Dustin	7	45
29	Brustus	1	33
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35
64	Horatio	7	35
71	Zorba	10	16
74	Horatio	9	35
85	Art	3	25.5
95	Bob	3	63.5

sid	bid	day
22	101	1998-10-10
22	102	1998-10-10
22	103	1998-08-10
22	104	1998-07-10
31	102	1998-10-11
31	103	1998-06-11
31	104	1998-12-11
64	101	1998-05-09
64	102	1998-08-09
74	103	1998-08-09

Relation Reserves

bid	bname	color
101	interlake	blue
102	interlake	red
103	Clipper	green
104	Marine	red

Relation Boat

$\pi_{sid,sname}(Sailor)$

$\pi_{sname,age}(\sigma_{rating>8}(Sailor))$

$\sigma_{rating>8}(Sailor)$

$Sailor \bowtie_{Sailor.sid=Reserves.sid} Reserves$

Query Language

- Structured Query Language
  - Based on Relational Algebra
  - Used for manipulating relational data by RDBMS.
- Common SQL Commands
  - Data Definition Language (DDL): Create, Alter, Drop
  - Data Manipulation Language (DML): Select, Insert, Update, Delete
  - Data Control Language (DCL): Grant, Revoke

Query Language

- Consider the following Sailor database

Relation Sailor

sid	sname	rating	age
22	Dustin	7	45
29	Brustus	1	33
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35
64	Horatio	7	35
71	Zorba	10	16
74	Horatio	9	35
85	Art	3	25.5
95	Bob	3	63.5

sid	bid	day
22	101	1998-10-10
22	102	1998-10-10
22	103	1998-08-10
22	104	1998-07-10
31	102	1998-10-11
31	103	1998-06-11
31	104	1998-12-11
64	101	1998-05-09
64	102	1998-08-09
74	103	1998-08-09

Relation Reserves

bid	bname	color
101	interlake	blue
102	interlake	red
103	Clipper	green
104	Marine	red

Relation Boat

```
SELECT sname, age
FROM sailor JOIN reserves ON sailor.sid = reserves.sid
WHERE rating > 8;
```