URBAN EDGE 15/2/19

MODULE 2

ER Model to Relational Model Conversion

(i) EMPLOYEE (Salary, Address, Sex, ssn, Birthdate, Fname, Mname, Lname)

(ii) DEPARTMENT (Name, No)

(iii) PROJECT (Name, Number, Location)

(iv) DEPENDENT (Name, Sex, BirthDate, Relatnship, Essn)

(v) DEPARTMENTLOCATION (DNo, Location)

Rules

- Strong entities are written as tables 1st
- The simple attributes are listed 1st
- Composite attributes are split & become separate columns
- Multivalued attributes become separate entity with primary key of containing entity
- Weak entity has primary key of containing strong entity as its primary key

Mapping 1:1 Relatn Types

(i) Foreign key approach

(ii) Merged relatn optn

(iii) Cross reference / relatnship relatn optn

Foreign Key Approach

(i) DEPARTMENT (Name, No, Mgrssn, MgrStartDate)

- Used when there is total participatn on 1 side & partial participatn on other side

1:N Mapping

Move 1°. key. of 1 side to N side.

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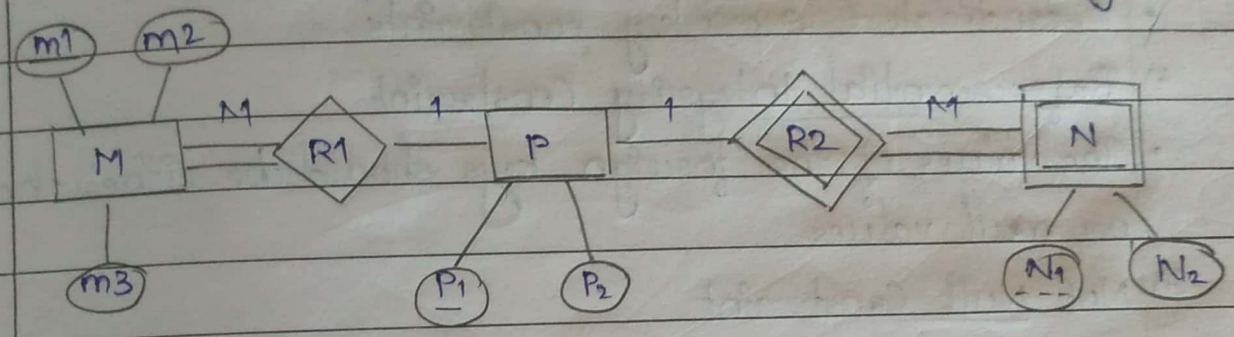
(ii) EMPLOYEE (Salary, Address, Sex, Ssn, BirthDate, Fname, Minit, Lname, Dno, Superssn)

(iii) PROJECT (Name, No, Loctn, Dno)

- If the foreign key references the same relatn, then the foreign key is self-referencing foreign key.

(iv) WORKSON (Essn, Pno, Hours) → M:N Mapping

(1) Find min. no. of tables required for the ER diagram



ans. No. of tables = 3

M(M1, M2, M3, P1)

P(P1, P2

N(N1, N2, P1)

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Relational Model

- Properties

(i) Ordering of tuples in a relation is not important

No. of columns = arity/degree

" " tuples = cardinality

(ii) Ordering of attributes in a relation is not important but ordering of values within a tuple is important

(iii) Null values are allowed

(iv) Multivalued/Composite attributes are not allowed in a relation.

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- Constraints

(i) Model based constraints

(ii) Schema " "

(iii) Integrity constraint

(a) Entity Integrity Constraint

- Primary key value should not be null.

(b) Key Constraint

- 1°, candidate & super key constraints.

(c) Referencential Integrity Constraint

- The values of the foreign keys should be either the 1° key or null values.

(d) Not Null Constraint

- Attribute cannot have null value

Relational Algebra

(i) select (σ)

(ii) project (π)

(iii) Rename ($\leftarrow$/ρ)

(iv) Set Union ($\cup$)

(v) " Intersect^n ($\cap$)

(vi) " Difference ($-$)

(vii) Cartesian Product ($\times$)

(viii) Join ($\bowtie$)

(ix) Natural join ($*$)

(x) Division ($\div$)

(xi) Equi join ($\bowtie_=$)

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(xii) Thetajoin ($\bowtie_\theta$)

(xiii) Outerjoin → Left outer join ($⟕$)
→ Right " " ($⟖$)
→ Full " " ($⟗$)

(xiv) Aggregate function (F)

Select (σ)

- σ_{cond} (table name)
- Used for selecting a particular tuple in a relatn.

eg: Retrieve the details of students whose mark is greater than 40

$\sigma_{mark>40}$ (Student)

Student

name	roll no	mark
Hari	12	37
Silpa	36	42

Project (π)

- Used for selecting a particular attribute in a relatn

eg: Retrieve the names of students.

π_{name} (Student)

- $\pi_{A_1, A_2 \cdots A_n}$ (R)

① Retrieve the names of all students whose mark is greater than 39

ans π_{name} ($\sigma_{mark>39}$ (Student))

Users

(uid, email, ph no.ξ, ageξ, uname)

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Post
(pid, body, uid, mid)
Media
(mid, uid, link, access)
Group
(gid, uid, privilege)
Country
(cid, ip-range, uid)
Advert
(aid, topic, proof)
Pages
(pgid, links, pid)

① Retrieve names of all users between 18 & 50.

ans. $\Pi_{uname}(\sigma_{age>18}(\sigma_{age<50}(Users)))$

$\Pi_{uname}(\sigma_{age<50}(\sigma_{age>18}(Users)))$

$\Pi_{uname}(\sigma_{(age>18)\wedge(age<50)}(Users))$

$\Pi_{uname}(\sigma_{(age>18)\text{ and }(age<50)}(Users))$

② Retrieve the country ID of the users who post in the ip-range 192.168.0.2 – 192.168.0.55

ans $\Pi_{cid}(\sigma_{ip\text{-}range = class\ c}(Country))$

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③ Retrieve the email IDs of all users

ans. Π_{email} (Users)

④ Retrieve the ~~post~~ user IDs of all ~~users~~ posts whose body contains cricket

ans. $\Pi_{uid}(\sigma_{body = cricket}(Post))$

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Stud-2010

Name	Dept
Haritha	CS
Aiby	EC
Krishna	CS

Stud-2012

Name	Dept
Kaumudi	CS
Aneesh	EC
Krishna	CS

Set Union

① Retrieve the names of students who are studying either in the year 2010 or 2012

ans. $\Pi_{name}(Stud\text{-}2010) \cup \Pi_{name}(Stud\text{-}2012)$

- Degrees of the 2 tables must be same
- Attributes of 2 tables must be type compatible

} Condition for binary set operat'ns

② Retrieve the student names who are studying in the year 2010 but not 2012

ans. $\Pi_{name}(Stud\text{-}2010) - \Pi_{name}(Stud\text{-}2012)$ → set difference

③ Retrive the names of students who are studying in 2010 & 2012

ans. $\Pi_{name}(Stud\text{-}2010) \cap \Pi_{name}(Stud\text{-}2012)$

Cartesian Product

④ Retrieve the names of all students in CS dept.

ans. * Dept

Dname	Dno
Computer Science	CS
Electronics	EC

Student

Name	RegNo	Dept
Haritha	123	CS
Aiby	456	EC
Krishna	729	CS

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Student × Department

S.Name	S.Reg No.	S.Dept	D.Dname	D.Dno
Harittha	123	CS	Computer Science	CS
Harittha	123	EC	Electronics	EC
Aiby	456	CS	Computer Science	CS
Aiby	456	EC	Electronics	EC
Krishna	729	CS	Computer Science	CS
Krishna	729	EC	Electronics	EC

~~$\Pi_{name}(\sigma_{S.Dept = D.Dno = CS}(Student \times Department))$~~

$\sigma_{S.Dept = D.Dno}$ (Student × Department)

S.Name	S.Reg No.	S.Dept	D.Dname	D.Dno
Harittha	123	CS	Computer Science	CS
Aiby	456	EC	Electronics	EC
Krishna	729	CS	Computer Science	CS

$\sigma_{D.Dname = \text{"Computer Science"}}$ ($\sigma_{S.Dept = D.Dno}$ (Student × Department))

S.Name	S.Reg No	S.Dept	D.Dname	D.Dno
Harittha	123	CS	Computer Science	CS
Krishna	729	CS	Computer Science	CS

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$\Pi_{name}(\sigma_{(S.Dept = D.Dno) \text{ and } (D.Dname = \text{"Computer Science"})}(\text{student} \times \text{Department}))$

Based on Employee Table

① To retrieve the tuples for all employees who work in dept 4 & make over $25000 / year or work in dept: 5 & make over $30,000/year

ans- Employee (Fname, Miname, lname, ssn, Bdate, Address, sex, Dno, salary, superssn)

Department (Dname, Dno, mgrssn, mgrstrtdate)

$\sigma_{((Dno=4) \text{ and } (Salary > 25,000)) \text{ or } ((Dno=5) \text{ and } (Salary > 30,000))}(\text{Employee})$

Dept_loc (Dno, Dloc)

Project (Pname, Pno, Ploc, Dno)

Workon (Essn, Pno, hrs)

Dependent (Essn, Dependentname, sex, Bdate, Relationship)

$\sigma_{(Dno=4) \text{ and } (Salary > 25000)}(\text{Employee}) \cup \sigma_{(Dno=5) \text{ and } (Salary > 30000)}(\text{Employee})$

② Retrieve employee's first name, last name & salary

ans $\Pi_{fname, lname, salary}(\text{Employee})$

③ Retrieve the name & salary of employees who work in dept no: 5

ans $\Pi_{name, salary}(\sigma_{Dno=5}(\text{Employee}))$

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$Dno5emp \leftarrow \sigma_{Dno=5}(Employee)$

$Result \leftarrow \pi_{Fname, salary}(Dno5emp)$

④ Retrieve the name of all employees who are working in the purchase dept.

ans Employee × Department

$\pi_{name}(\sigma_{(D.Dno = E.Dno) and (D.Dname = "purchase")}(Employee \times Department))$

⑤ Retrieve the project nos in the dept purchase

ans Project × Department

$\pi_{Pno}(\sigma_{(P.Dno = D.Dno) and (Dname = "purchase")}(Project \times Department))$

25/2/19 Join

⑥ Retrieve the name of the manager of each dept.

ans $\pi_{name}(\sigma_{mgrssn = ssn}(Employee \times Department))$

or

$\pi_{Fname, Lname}(Employee \bowtie_{mgrssn = ssn} Department)$

- Join → Select + Cartesian product

~~π_{name} (Student~~

$\pi_{name}(\sigma_{Dname = "Computer\ Science"}(Department \bowtie_{S.Dept = D.Dno} Student))$

⑦ To retrieve the ssn of all employees who either work in dept no 5 or directly supervises an employee working in dept no 5.

ans $\pi_{ssn}(\sigma_{Dno=5}(Employee)) \cup \pi_{superssn}(\sigma_{Dno=5}(Employee))$

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⑧ To retrieve for each female employee, a list of the names of their dependent

ans $\Pi_{\text{Dependentname, Fname, Lname}} (\sigma_{sex=F} (\text{Employee} \bowtie_{Essn=ssn} \text{Dependent}))$

⑨ Retrieve the name & address of all employees who work for Research dept.

ans $\Pi_{\text{Fname, Lname, Address}} (\sigma_{\text{Dname="Research"}} (\text{Employee} \bowtie_{E.Dno=D.Dno} \text{Department}))$

⑩ Retrieve names of employees who have no dependents.

ans ~~$\Pi_{\text{Fname, Lname}}$ (Employ~~ $\text{Result1} \leftarrow \Pi_{\text{Fname, Lname}} (\sigma_{Essn=ssn} (\text{Employee} \times \text{Dependent}))$

~~$\Pi_{\text{Fname, Lname}}$~~ $\text{Result2} \leftarrow \Pi_{\text{Fname, Lname}} (\text{Employee})$

$\text{Result} \leftarrow \text{Result2} - \text{Result1}$

$\Pi_{\text{Fname, Lname}} (\text{Result})$

Division

⑦ Retrieve the employee names who work all the projects in which John Smith works.

ans $\text{Project1} \leftarrow \Pi_{Pno} (\sigma_{Essn=ssn} (\sigma_{(\text{Fname="John"}) \text{ and } (\text{Lname="Smith"})} (\text{Employee})) \times \text{Workon})$

$\text{Project2} \leftarrow \Pi_{\text{~~Ssn~~ ~~Fname, Lname,~~ Pno, Fname, Lname,}} (\text{Employee} \bowtie_{Essn=ssn} \text{Workon})$

$\text{Project} \leftarrow \text{Project2} \div \text{Project1}$

$\Pi_{\text{Fname, Lname}} (\text{Project})$

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$T1 \leftarrow \pi_{Pno, Essn}(Workon)$

$JohnPno \leftarrow \pi_{Pno}(\sigma_{(Fname = "John") \text{ and } (Lname = "smith")}(Employee \bowtie_{Essn = Ssn} Workon))$

$SSN \leftarrow T1 \div JohnPno$

$Result \leftarrow \pi_{Fname, Lname}(SSN \bowtie Employee)$

Q

② How to implement division without using division operator.

③ Supplier (sid, sname, saddr)

Parts (pid, Pname, color)

Catalog (sid, Pid, cost)

(i) Find name of all suppliers who supply yellow parts

ans. $\cancel{Res1 \leftarrow \pi}\ \pi_{Sname}(\sigma_{P.color = "yellow"}(Supplier \bowtie_{S.sid = C.sid} (Catalog \bowtie_{C.Pid = P.Pid} Parts)))$

(ii) Find name of supplier who supply both blue & back parts.

Solutn without using intersectn operator

ans. $\cancel{\pi_{Sname}(\sigma_{(P.color = "blue") \text{ or } (P.color = "black")}(Supplier \bowtie_{S.sid = C.sid} (Catalog \bowtie_{C.Pid = P.Pid} Parts)))}$

~~or~~

$\pi_{Sname, Color}(Supplier \bowtie Catalog \bowtie Parts) \div \pi_{color}(\sigma_{color = "Blue" \text{ or } color = "Black"}(Parts))$

(iii) Retrieve the name of the supplier who supply all the parts.

ans. $\pi_{Sname, Pid}(Supplier \bowtie Catalog \bowtie Parts) \div \pi_{Pid}(Parts)$

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ans. ② Let R(A,B) & S(B) be 2 relatns. Division should find all values of A in R that are connected with all values of B in S.

$AB \div B = A$

$R \div S = \Pi_A(R) - \Pi_A(\Pi_A(R) \times S - R)$

$\Pi_A(R) \times S \rightarrow$ This contains all possible AB pairs

$R \rightarrow$ This contains actual AB pairs.

For values of A that are connected to all values of B, after we do the difference, those will be gone. In the difference $\Pi_A(R) \times S - R$ there are only values of A that are not connected to all B.

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④ Find the ~~max. mark~~ name of student who got max. mark.

~~Ans~~

Name	Mark
Harisankar	35
Silpa	45
Appu	40
Priyanka	41

Student

ans. $S \leftarrow$ Student

$\Pi \leftarrow S \bowtie_{S.Mark < Student.Mark}$ Student

S

Name	Mark
Hari	35
Silpa	45
Appu	40
Priyanka	41

~~Ex~~

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S.name	S.mark	Student name	Student mark
Hari	35	Silpa	45
Hari	35	Appu	40
Hari	35	Priyanka	41
Appu	40	Silpa	45
Appu	40	Priyanka	41
Priyanka	41	Silpa	45

~~π_{Mark}~~ $Result \leftarrow \pi_{Mark}(Student) - T1$

~~$\pi_{Name}(Result)$~~ $Name \leftarrow \pi_{Name}(S) - T1$

⑤ Retrieve the min. age of employee in company

ans: $E \leftarrow Employee$

$T1 \leftarrow E \bowtie_{E.Bdate \leq Employee.Bdate} Employee$

$Result \leftarrow \pi_{Bdate}(Employee) - T1$

Outer Join (⟕, ⟖, ⟗)

Employee

Name	Eid	Dept
Ravi	123	Research
Amala	456	Purchase
Deepthi	256	Marketing

Manager

Name	Mid
Soumya	176
Ravi	123
Amala	456

$Employee \bowtie_{Eid = Mid} Manager$

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E.Name	Eid	Dept	M.Name	Mid
Ravi	123	Research	Ravi	123
Amala	456	Purchase	Amala	456
Deepthi	256	Marketing	Null	Null

$$\text{Employee} \bowtie_{Eid=Mid} \text{Manager}$$

E.Name	Eid	Dept	M.Name	Mid
Ravi	123	Research	Ravi	123
Amala	456	Purchase	Amala	456
Null	Null	Null	Soumya	176

$$\text{Employee} \bowtie_{Eid=Mid} \text{Manager}$$

E.Name	Eid	Dept	M.Name	Mid
Ravi	123	Research	Ravi	123
Amala	456	Purchase	Amala	456
Deepthi	256	Marketing	Null	Null
Null	Null	Null	Soumya	176

① For every project located in Stanford, list the project no, controlling dept no, dept manager's last name, address & date of birth

ans. $\text{Stanford} \leftarrow \pi_{Pno, Dno}(\sigma_{Ploc=\text{"Stanford"}}(\text{Project}))$

$\text{Manager} \leftarrow \pi_{D.Mgrssn, D.Dno}(\text{Department} * \text{Stanford})$

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$$Details \leftarrow \pi_{Lname, Address, Bdate, M.Dno}(Manager \bowtie_{Mgrssn = ssn} Employee)$$

$$Result \leftarrow Stanford \bowtie_{M.Dno = P.Dno} Details$$

or

$$\pi_{Pno, Dnb, Lname, Address, Bdate}(\sigma_{Plc = "Stanford"}(Project \bowtie_{D.Dno = P.Dno} Department \bowtie_{Mgrssn = ssn} Employee))$$

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Complete Set of Relatnal Algebra Operations

$(\sigma, \cup, -, \pi, \rho, \times)$

Using these 6 basic operators any operator can be realized.

$$R \bowtie_{cond} S = \sigma_{cond}(R \times S)$$

$$R \cap S = (R \cup S) - ((R-S) \cup (S-R))$$

$$\underset{(X,Y)}{R} \div \underset{(X)}{S} = \pi_Y R - \pi_Y(\pi_Y(R) \times S - R)$$

$$\pi_{name}(\sigma_{marks>20}(Student)) = \pi_{name}(Student) - \pi_{name}(\sigma_{marks\leq 20}(Student))$$

Aggregate Functions

Main functions: min, max, count, avg

(i) $f_{average\ salary}(employee)$

(ii) $_{Dno}f_{average\ salary}(employee)$

Dno	Avg
5	3300
4	10000

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(iii) $f_{R(Dno,\ No.\ of\ emp,\ Avg\text{-}sal)}$ $_{Dno}f_{count\ ssn,\ average\ salary}$ (employee)

① Find min. age of an employee

ans $f_{minimum\ salary}$ (employee)

② Find avg salary of each dept

ans $_{Dno}f_{average\ salary}$ (employee)

③ List names of all employees with 2 or more dependents

ans. $T1 \leftarrow (Ssn,\ No.\ of\ dependent) \leftarrow Essn\ f_{count\ dependent\ name}$ (Dependent)

$T2 \leftarrow \sigma_{No.\ of\ dependent > 2}$ (T1)

$Result \leftarrow \pi_{Lname,\ Fname}$ (T2 * employee)

④ Assume the companies may be located in several cities. Find all companies located in every city in which "small bank corporation" is located.

ans. Employee, Works, Company, Manages

Employee (Name, Street, City)

Works (Name, Comp-Name, Sal)

Company (Comp-name, City)

Manages (Name, Manager-name)

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$\Pi_{comp\text{-}name}(Company) \div \Pi_{city}(\sigma_{comp\text{-}name="SBC"}(Company))$

⑤ Give all employees of FBC a 10% salary hike

ans: $Works \leftarrow \Pi_{person\text{-}name,\ employee\text{-}name,\ 1.1 * salary}$

$\sigma_{comp\text{-}name="FBC"}((Works) \cup (Works - \sigma_{comp\text{-}name="FBC"}(Works)))$

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