1. ER Modeling

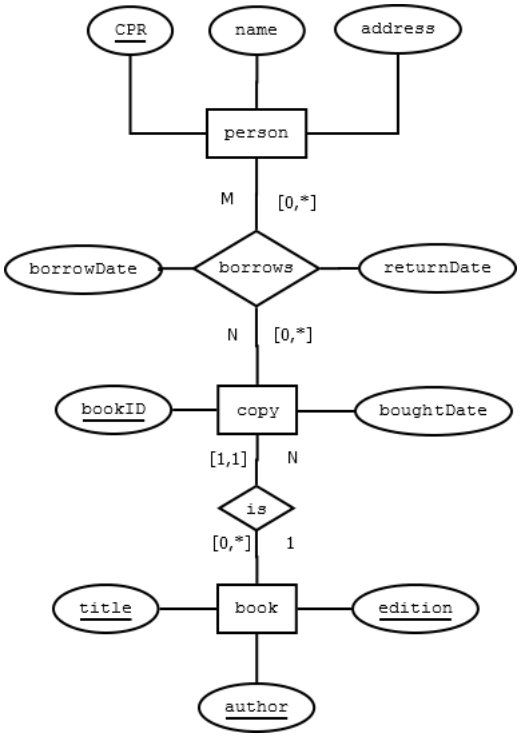

Figure 1: ER Diagram - Exercise 1

2. Banking System

phone

$\{[\underline{number}, provider, contract]\}$

has

$\{[\underline{number \rightarrow phone, SSN \rightarrow customer}]\}$

customer

$\{[\underline{SSN}, name, address]\}$

account

$\{[\underline{accountNumber}, type, balance, owner \rightarrow customer]\}$

statement

$\{[\underline{ID, accountNumber \rightarrow account}, date]\}$

3. Relational Algebra

1.

$\pi_{species,zooID}(animals)$

species	zooID
giraffe	1
giraffe	2
giraffe	3
ape	1
ape	2
owl	2
owl	1

$\sigma_{country='Germany'}(zoos)$

zooID	name	city	country
1	Zoo Frankfurt	Frankfurt	Germany

$\pi_{zooID}(\sigma_{country='Germany'}(zoos))$

zooID
1

$(\pi_{species,zooID}(animals)) \div (\pi_{zooID}(\sigma_{country='Germany'}(zoos)))$

species
giraffe
ape
owl

2.

$(\rho_{T1}(animals)) \bowtie_{T1.zooID=T2.zooID} (\rho_{T2}(animals))$

T1.animalID	T1.nickname	T1.species	T1.gender	T1.zooID	T1.father	T1.mother	T2.animalID
1	Tally	giraffe	female	1	3	2	1
1	Tally	giraffe	female	1	3	2	4
1	Tally	giraffe	female	1	3	2	7
1	Tally	giraffe	female	1	3	2	8
1	Tally	giraffe	female	1	3	2	10
1	Tally	giraffe	female	1	3	2	11
2	Kathy	giraffe	female	2	-	-	5
2	Kathy	giraffe	female	2	-	-	6
...	•	•	•	•	•	•	•

Was too big. Going straight to result:

$\pi_{T1.nickname}(\sigma_{T1.animalID=T2.father \vee T1.animalID=T2.mother}((\rho_{T1}(animals)) \bowtie_{T1.zooID=T2.zooID} (\rho_{T2}(animals))))$

T1.Nickname
Wohoo
Huhuu
Eule

4. Relational Calculus

1.

$$\pi_{sname}((Suppliers) \bowtie ((\sigma_{color='red'}(Parts)) \bowtie (Catalog)))$$

$\{< s.sname > | s \in Suppliers \wedge \exists c(c \in Catalog \wedge c.sid = s.sid \wedge \exists p(p \in Parts \wedge p.pid = c.pid \wedge p.color =' red'))\}$

$\{< sname > | < sid, sname, \_ > \in Suppliers \wedge < sid, pid, \_ > \in Catalog \wedge < pid, \_,' red' > \in Parts\}$

2.

$$\pi_{sid}((\sigma_{color='red' \vee color='green'}(Parts)) \bowtie (Catalog))$$

$\{< c.sid > | c \in Catalog \wedge \exists p(p \in Parts \wedge p.pid = c.pid \wedge (p.color =' red' \vee p.color =' green'))\}$

$\{< sid > | < sid, pid, \_ > \in Catalog \wedge (< pid, \_,' red' > \in Parts \vee < pid, \_,' green' > \in Parts)\}$

3.

$\pi_{sid}((Catalog) \bowtie ((\rho_{T1}(\sigma_{color='red'}(Parts))) \bowtie_{T1.pid=T2.pid} (\rho_{T2}(\sigma_{color='green'}(Parts)))))$

$\{< c.sid > | c \in Catalog \wedge \exists p1(p1 \in Parts \wedge p1.color =' red' \wedge c.pid = p1.pid \wedge \exists c1(c1 \in Catalog \wedge c1.sid = c.sid \wedge \exists p2(p2 \in Parts \wedge p2.pid = c1.pid \wedge p2.color =' green')))\}$

$\{< sid > | < sid, pid, \_ > \in Catalog \wedge (< pid, \_,' red' > \in Parts \wedge < sid, pid', \_ > \in Catalog \wedge < pid', \_,' green' >$

4.

$\pi_{T1.sid,T2.sid}(\sigma_{T1.cost>T2.cost}((\rho_{T1}(Catalog)) \bowtie_{T1.pid=T2.pid} (\rho_{T2}(Catalog))))$

$\{< c1.sid, c2.sid > | c1 \in Catalog \wedge c2 \in Catalog \wedge c1.pid = c2.pid \wedge c1.cost > c2.cost\}$

$\{< sid1, sid2 > | < sid1, pid, cost1 > \in Catalog \wedge < sid2, pid, cost2 > \in Catalog \wedge cost1 > cost2\}$

5.

$$\pi_{T1.pid}((\rho_{T1}(Catalog)) \bowtie_{T1.pid=T2.pid \wedge T1.sid \neq T2.sid} (\rho_{T2}(Catalog)))$$

$$\{< c.pid > | c \in Catalog \wedge \exists c2(c2 \in Catalog \wedge c.pid = c2.pid \wedge c.sid \neq c2.sid)\}$$

$$\{< pid > | < sid1, pid, \_ > \in Catalog \wedge < sid2, pid, \_ > \wedge sid1 \neq sid2\}$$

5. Functional dependencies

FD	OK or violated?
$A \to C$	violated: tuples 3,4
$B \to A$	OK
$C \to A$	violated: tuples 1,3
$A \to B$	violated: tuples 1,2
$B \to C$	violated: tuples 3,4
$BC \to A$	OK
$AC \to B$	OK