Relational Model

Modifications in ER Model

1. The relationship type ‘committed’ has the correct cardinality as 1:N but is marked as M:N in the ER diagram submitted to us.

2. The relationship type ‘visited by’ has the correct cardinality as 1:N but is marked as M:N in the ER diagram submitted to us.

3. The relationship type ‘Belongs to’ has the cardinality as 1:N but it was not marked in the ER diagram submitted to us.

Relational Model Stepwise:

Step 1:Mapping of regular entity types

All the strong entity types are defined in relation where all simple attributes are taken under consideration and composite attributes’ simple attributes are added to the relation(eg. In prisoner composite attribute PName is added as PFirstName and PLastName).All the multivalued attributes are excluded from inclusion in the relation.(eg. In PoliceOfficer entity type POContactNo. Attribute is excluded)

Prisoner(PName attribute is added as PFirstName and PLastName)

PId	PFirstName	PLastName	PJailId	PDName	PAdd	PConfinementPeriod	PDOB	PDateOfImprisonment

Jail

JId	JName	JAddress	JCapacity

PoliceOfficer(POEmail and POContactNo. is excluded)

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting

Step 2:Mapping of Weak entity types

All the weak entity types are defined in relation where all simple attributes are taken under consideration and composite attributes' simple attributes are added to the relation(eg. In Visitor composite attribute VName is added as VFName and VLName).All the multivalued attributes are excluded from inclusion in the relation.(eg. In Visitor entity type VContactNo. Attribute is excluded)

Crime

CPId	CType	CDate	CLocation

Visitor(VName is added as VFName and VLName, and VContactNO. is excluded)

VPId	VFName	VLName	VAddress	VDOB

Department

DJailId	DName	DHeadId	DWage	DWorkHours

Step 3: Mapping of binary 1:1 relation types

a)'Headed-by' relationship type

The primary key of PoliceOfficer(DHeadId) was already included as foreign key in the department and as department is in complete participation so DHeadId is NOT NULL

Department

DJailId	DName	DHeadId	DWage	DWorkHours

Step 4: Mapping of binary 1:N relation types

a)'Committed' relationship type

The primary key of Prisoner(PId) was already included as foreign key in the Crime as CPId and as Crime is in complete participation so CPId is NOT NULL

Crime

CPId	CType	CDate	CLocation

b) 'Visited by' relationship type

The primary key of Prisoner(PId) was already included as foreign key in the Visitor as VPId and as Visitor is in complete participation so VPId is NOT NULL

Visitor

VPId	VFName	VLName	VAddress	VDOB

c)'Works in' relationship type

The primary key of Department(DJailId + DName) was already included as foreign key (PJailId + PDName) in the Prisoner.

Prisoner

PId	PFirstName	PLastName	PJailId	PDName	PAdd	PConfinementPeriod	PDOB	PDateOfImprisonment

d)'is captivated' relationship type

The primary key of Jail(JId) was already included as foreign key (PJailId) in the Prisoner.

Prisoner

PId	PFirstName	PLastName	PJailId	PDName	PAdd	PConfinementPeriod	PDOB	PDateOfImprisonment

e)'belongs to' relationship type

The primary key of Jail(JId) was already included as foreign key (DJailId) in the Department.

Department

DJailId	DName	DHeadId	DWage	DWorkHours

f)'posted in' relationship type

The primary key of Jail(JId) was already included as foreign key (POJailId) in the PoliceOfficer.

PoliceOfficer

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting

Step 5: Mapping of binary M:N relation types

NO such relationship type exists

Step 6: Mapping of multivalued attributes

a) ‘VContactNo’ is a multivalued attribute of relation ‘visitor’ so a new relation is defined as VisitorContactNo:

Visitor

VPId	VFName	VLName	VAddress	VDOB

VisitorContactNo

VPId	VFName	VContactNo

b) ‘POContactNo’ is a multivalued attribute of relation ‘PoliceOfficer’ so a new relation is defined as PoliceOfficerContactNo:

PoliceOfficer

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting

PoliceOfficerContactNo

POId	POContactNo

c) ‘POEmail’ is a multivalued attribute of relation ‘PoliceOfficer’ so a new relation is defined as PoliceOfficerEmail:

PoliceOfficer

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting

PoliceOfficerEmail

POId	POEmail

Step 7: Mapping of N-ary relationship types

In mapping of N-ary relationship type, primary keys of all the N entity types involved in the N-ary relationship type are added as an attribute to the relation defining the N-ary relationship.
Here,
Primary key of Prisoner is PId
Primary key of Jails is JId
Primary key of Department is { DJailId,DName }
Primary key of PoliceOfficer is POId

The primary key of department contains DJailId + DName and primary key of jail contains JId since JId and DJailId are same so the attribute was only added once in the relation as JId

Works for

PId	JId	DName	POId

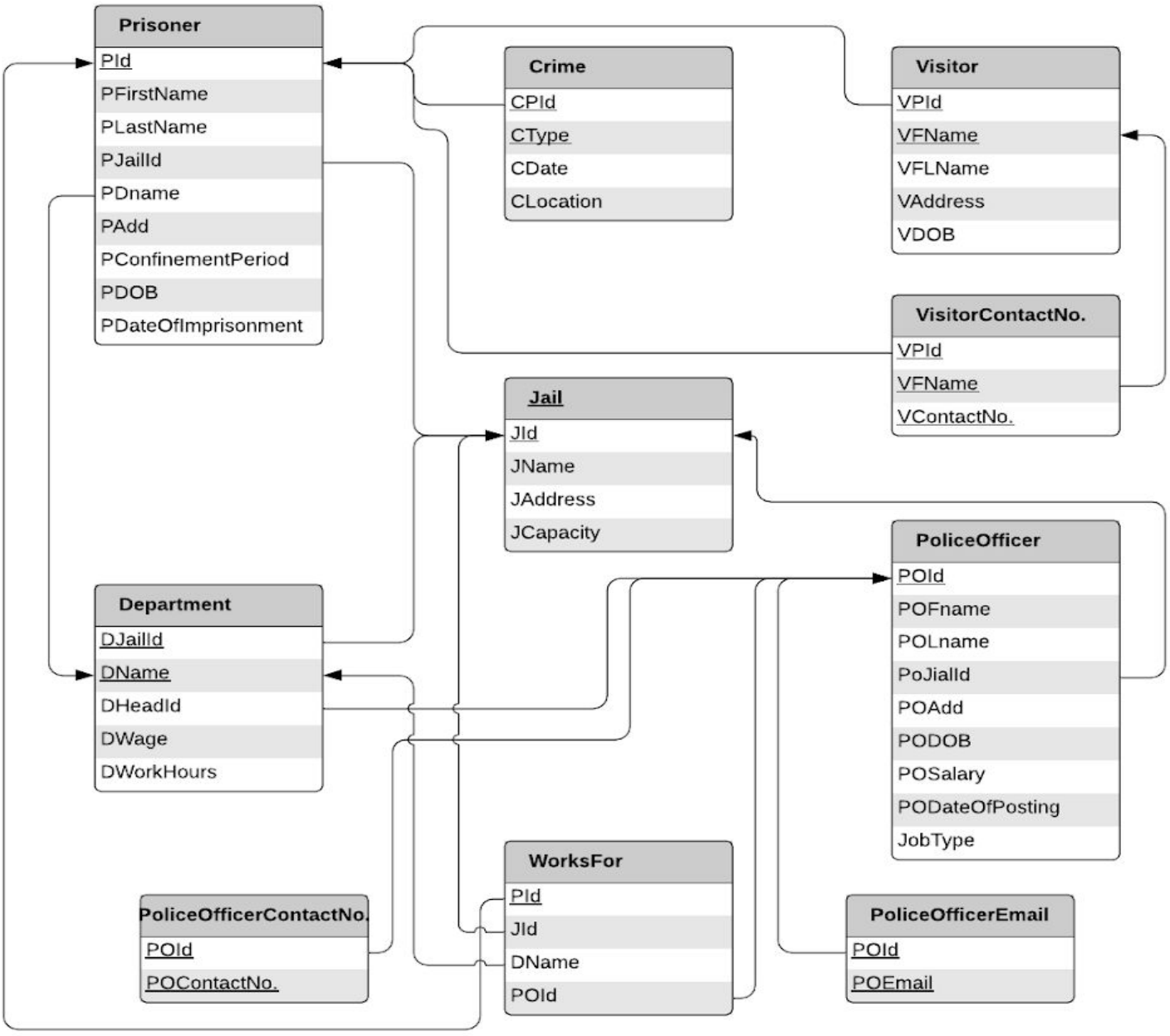
Step 8: Mapping of specialization

'JobType' attribute is added to PoliceOfficer relation to include subclasses 'jailer' and 'guard'.JobType attribute can have only one of the two values from {'jailer','guard'}

PoliceOfficer

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting	JobType

Final Relational Model:



1NF form:

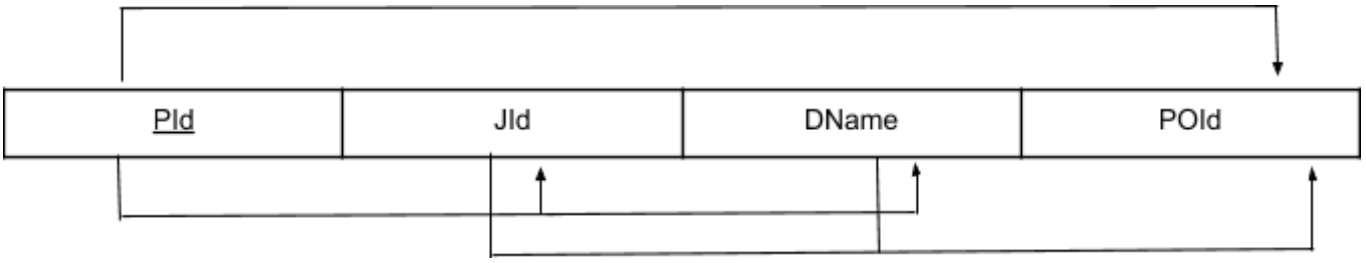
The Relational Model was already in 1NF form.

2NF form:

The Relational Model was already in 2NF form.

3NF form:

In relation WorksFor:



X={ PId }
Y={ JId,DName }
Z={ POId }

As X → Y and X → Z and Z → Y . X is a prime attribute, Y is a non-prime attribute and Z is neither a candidate key nor a subset of key.
This implies the following 'WorksFor' relation is not in 3NF form.

The relation WorksFor would be divided into two relations as follows:

PWorksFor

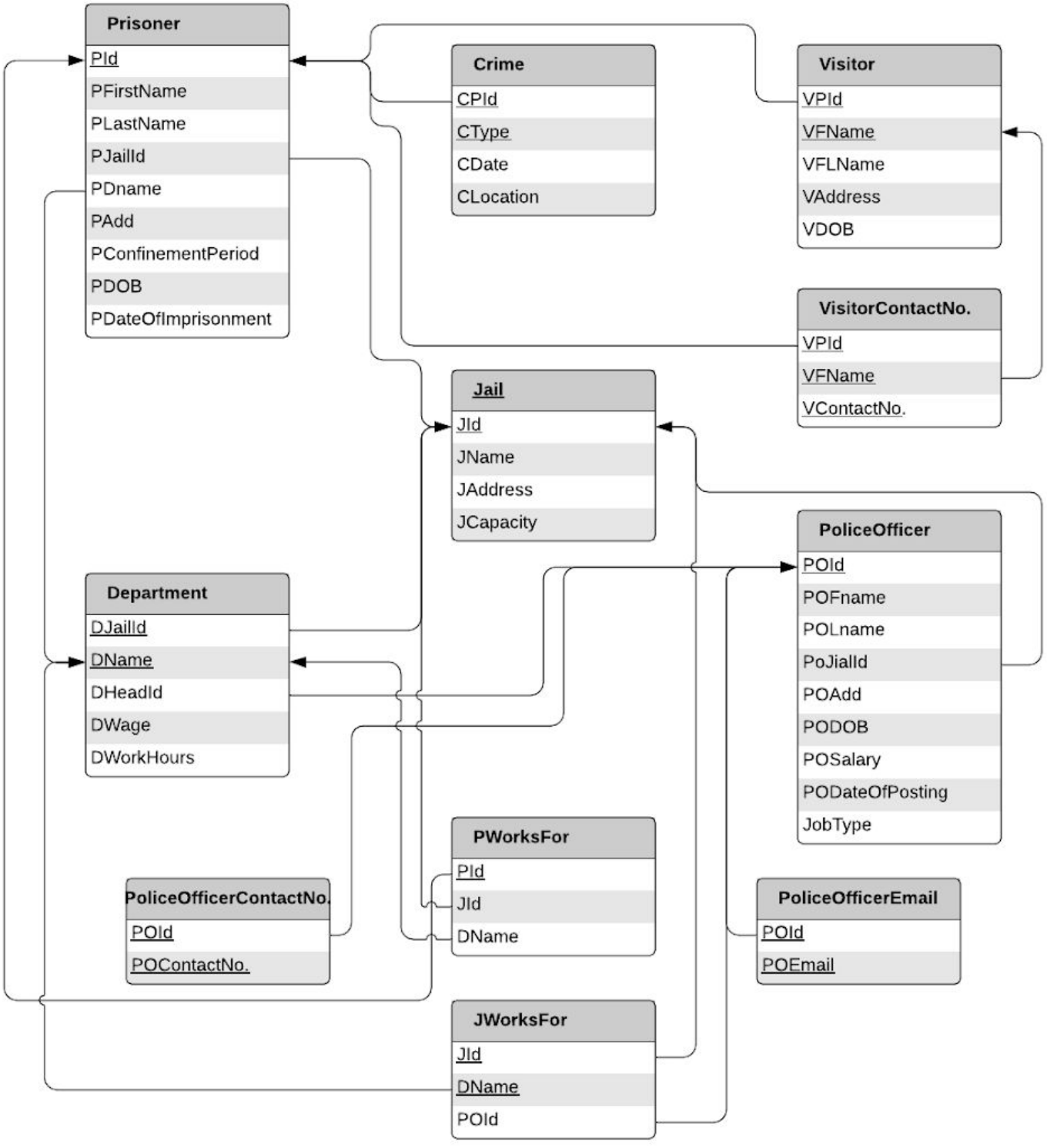
PId	JId	DName

JWorksFor

JId	DName	POId

All other relations are already in 3NF form.

Relational Model in 3NF form:



Examples of Tuples for all the relations

Prisoner

PId	PFirstName	PLastName	PJailId	PDName	PAdd	PConfinementPeriod	PDOB	PDateOfImprisonment
125	Nikunj	Nawal	1	Toilet cleaning	Katra no. 5 , Indore	14	14/03/2000	15/03/2018
128	Sajal	Khandelwal	2	Kitchen	Raj Mahal no. 3,Alwar	5	25/05/2001	4/02/2018

Jail

JId	JName	JAddress	JCapacity
1	Tihar Jail	Delhi	1500
2	KalaPani	Andaman and nicobar	250

PoliceOfficer

POId	POFName	POLName	POJailId	POAdd	PODOB	POSalary	PODateOfPosting	JobType
1	Tanish	Lad	1	Yawtmal ,Mahrastra	07/12/1992	10000	05/11/2015	Jailer
2	Manish	Lad	2	Rohtak, Haryana	15/08/1954	25000	04/09/1985	Jailer
3	Kushagra	Aggarwal	1	Kolkata	14/02/1914	5000	14/02/1948	Guard
4	Shantanu	Aggarwal	2	Madhya Pradesh	15/08/1947	7000	18/05/1975	Guard
5	Manas	kabre	1	Bengaluru	31/10/1987	5000	14/08/2005	Guard

Crime

CPId	CType	CDate	CLocation
125	rape	10/02/2018	Hyderabad
125	murder	14/02/2018	Flat no. 3 , Mahow,Indore
128	Robbery	17/01/2018	Mahal no. 4 , Alwar

Visitor

VPId	VFName	VLName	VAddress	VDOB
125	Rohit	Sharma	Mumbai	15/05/1954
128	Amogh	Tiwari	Delhi	18/05/1924
125	Anubhav	Sharma	Jaipur	05/05/1967

Department

DJailId	DName	DHeadId	DWage	DWorkHours
1	Toilet Cleaning	3	200	14
2	Kitchen	4	100	20

VisitorContactNo

VPId	VFName	VContactNo
125	Rohit	9861655245
125	Rohit	5281688785
125	Anubhav	3562875249
128	Amogh	9865472158

PoliceOfficerContactNo

POId	POContactNo
1	9865321245
2	7845129826
3	6589421578
4	2563985641
4	2514869574

PoliceOfficerEmail

POId	POEmail
5	manas1@gmai.com
5	manas2@gmail.com

PWorksFor

PId	JId	DName
125	1	Toilet Cleaning
128	2	Kitchen

JWorksFor

JId	DName	POId
1	Toilet Cleaning	3
2	kitchen	4