Database Assignment Phase 3

Jai Bardhan, Vikrant Dewangan, Bhavyajeet Singh

November 2, 2019

Contents

Chapter 1

Conversion from ER-Model to Relational Model

The following shows the conversion of our ER Model to a Relational Model.

1.1 Step 1: Mapping of Regular Entity Types

For each regular strong entity type E in the schema, we created a relation that includes all the simple attributes of E:

- Added Investor entity type as a relation.
  - Investor ID
  - First Name
  - Last Name
  - Sex
  - Date of Birth

  The primary key of this relation is Investor ID. Since Education is multi-valued attribute, we do not include it in this step.

- Added Employee entity type as a relation.
  - Employee ID
  - Employee Name

  - Employee Dept.
  - Employee Salary
  - Sex

  The primary key of this relation is Employee ID.

- Added Startup entity type as a relation.
  - Startup ID
  - Startup Name
  - No. of Employees
  - Networth

  The primary key of this relation is Startup ID.

- Added Resource entity type as a relation.
  - Resource ID
  - Resource value
  - Resource Type

  The primary key of this relation is Resource ID.

- Added Location entity type as a relation.
  - PIN Code
  - City
  - Country

  The primary key of this relation is PIN Code.

- Added Industry entity type as a relation.
  - Industry ID
  - Industry Name
  - Industry Type

  The primary key of this relation is Industry ID.

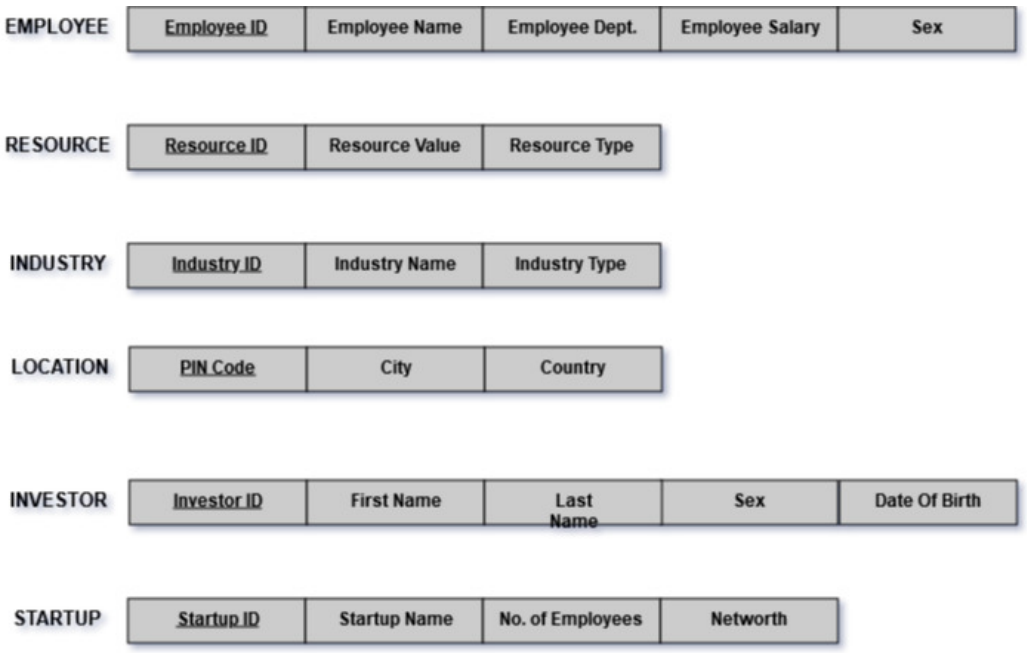

Figure 1.1: Strong Entity Types as Relations

1.2 Step 2: Mapping of Weak Entity Types

For each weak entity type W in the ER schema with owner entity type E, we created a relation and included all simple attributes (or simple components of composite attributes) as attributes of relation. We also included as foreign key of relation, the primary key of the owner entity type E.The primary key of W's relation is the combination of E's primary key and partial key of W.

- Added Director weak entity type as a relation.
  - Startup ID
  - Name
  - Sex
  - Experience

  The primary key of this relation is combination of Startup ID and Name. Also we have assumed Director's Education as multi-valued attribute and thus is not included in this step.

- Added Project weak entity type as a relation.
  - Startup ID
  - Project Name
  - Start Date
  - No. of Employees

  The primary key of this relation is combination of Startup ID and Project Name.

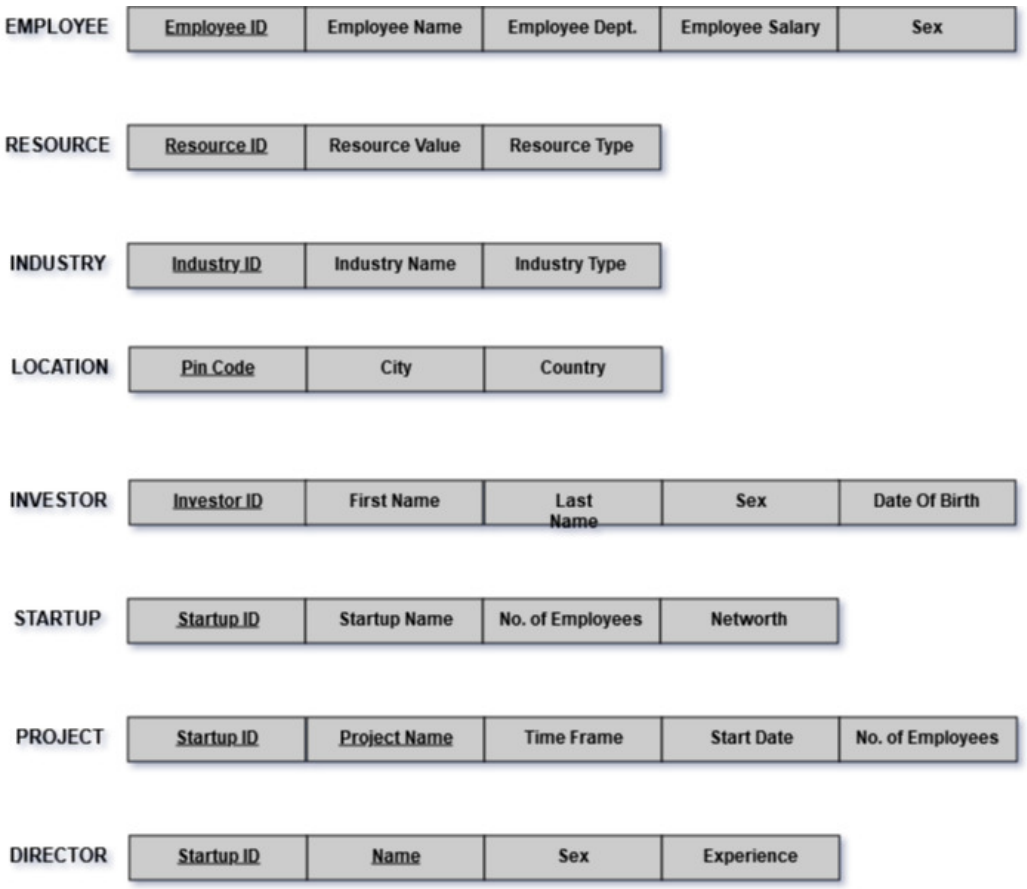

Figure 1.2: Weak Entity Types as Relations

1.3 Step 3: Mapping of Binary 1:1 Relationship Types

Since we don't have any 1:1 relationship types, we don't need to map them.

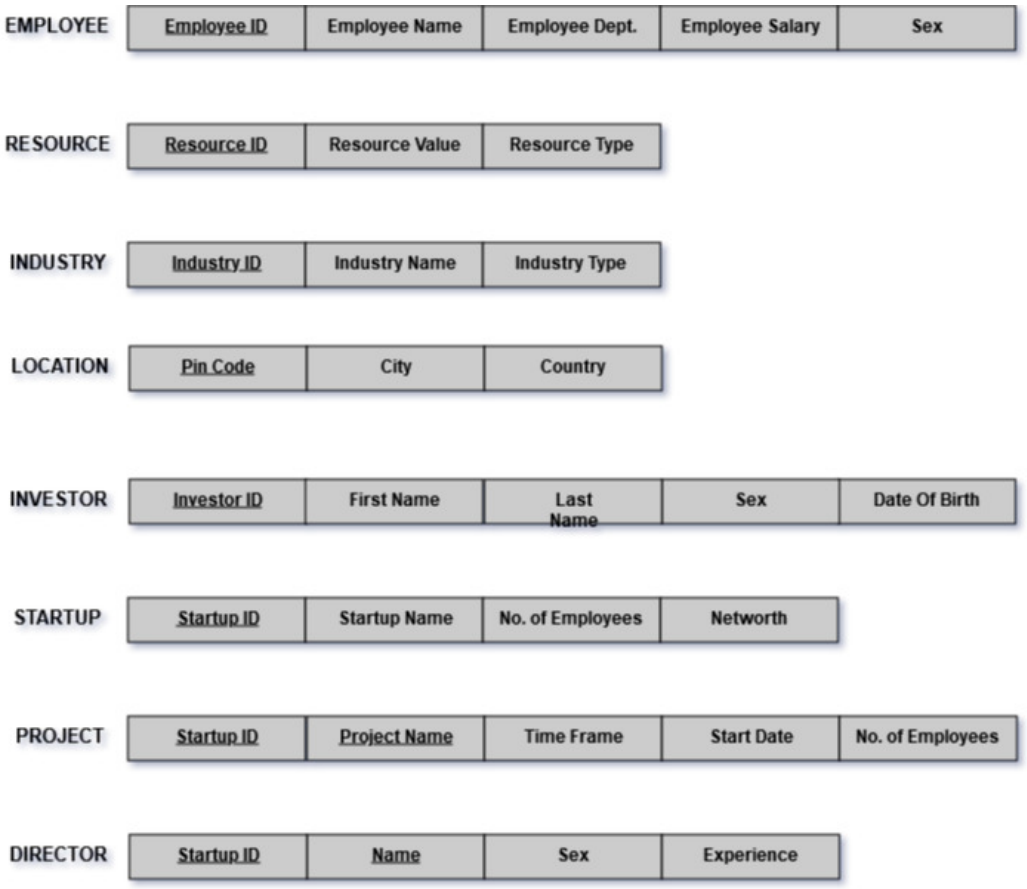

Figure 1.3: Mapped all 1:1 relationship types

1.4 Step 4: Mapping of Binary 1:N Relationship Types

The following 1:N relationship types are mapped

- LIVES_IN : This relationship type between Investor and Location is mapped via keeping a Location ID on the Investor entity type's relation (*N-side*). This is a foreign key referencing PIN Code in the Location entity type's relation.

- WORKS_ON : This relationship type between Startup and Project is mapped via keeping a Startup ID on the Project entity type's relation (*N-side*). This is a foreign key referencing Startup ID in the Startup entity type's relation.

- DIRECTS : This is an identifying relationship between Startup strong entity type and Directors weak entity type. The relationship type is mapped via keeping a foreign key Startup ID in the Director entity type's relation. Note that as mentioned earlier, Director entity type's relation has primary key composed of Startup ID and Name.

- WORKS_FOR : This relationship type was added by the the other team and does not comply with our entire model. It seems there was a misunderstanding since the Employees are employed by Incubator and not by any Startup.

- CONSUMES : This is done by adding Resource ID as a foreign key to the Startup entity relation (N - *side*).

- PROVIDES : This was not added in the their ER Model but since it is a functional requirement of our SRS, we have included it . This is done by adding Resource ID as a foreign key to the Employe+e entity relation (N - *side*).

1.5 Step 5: Mapping of Binary M:N Relationship Types

For each binary relationship type R, we are creating a new *relationship relation* S which includes as foreign keys, the primary keys of participating entity types.

- BASED_IN : This relationship type between Startup and Location is mapped via introducing a new relation BASED_IN which contains as

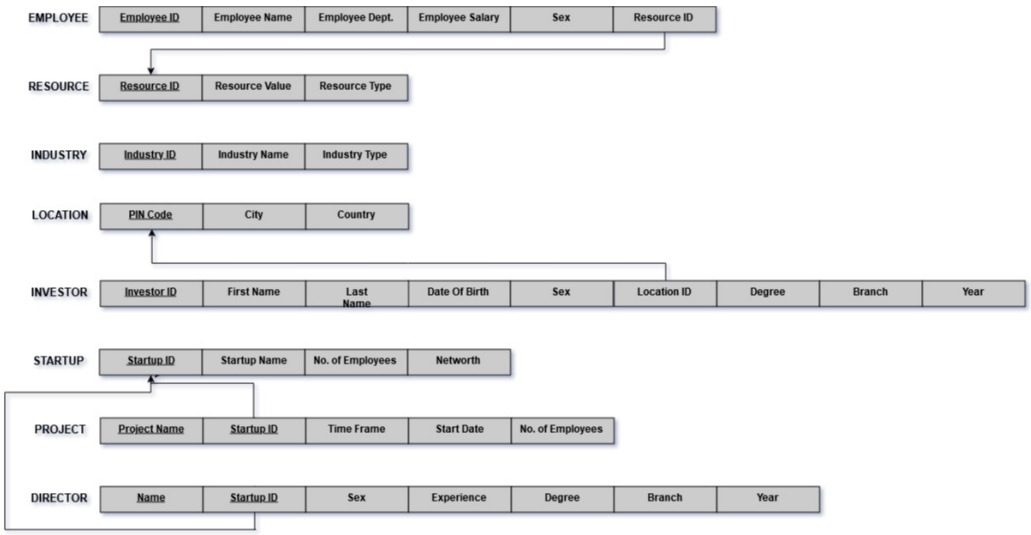

Figure 1.4: Mapping 1:N relationship types

attributes , Startup ID and Location ID which references Startup entity type's primary key and Location entity type's primary key respectively. The primary key of this new relation is composition of attributes Startup ID and Location ID.

- WORKS_IN : Since it does not comply with our model , we are not adding it to out model.

1.6 Step 6: Mapping of Multi-valued Attributes

For each multivalued attribute A, create a new relation R that will include attribute corresponding to A, plus the primary key attribute K as foreign key in R.The primary key of R is a combination of A and K.

- Founders : We have created a new relation "Startup Founders" which shall include founder and Startup ID as foreign key referencing Startup entity type's relation.The primary key of this new relation is composition of attributes Startup ID.

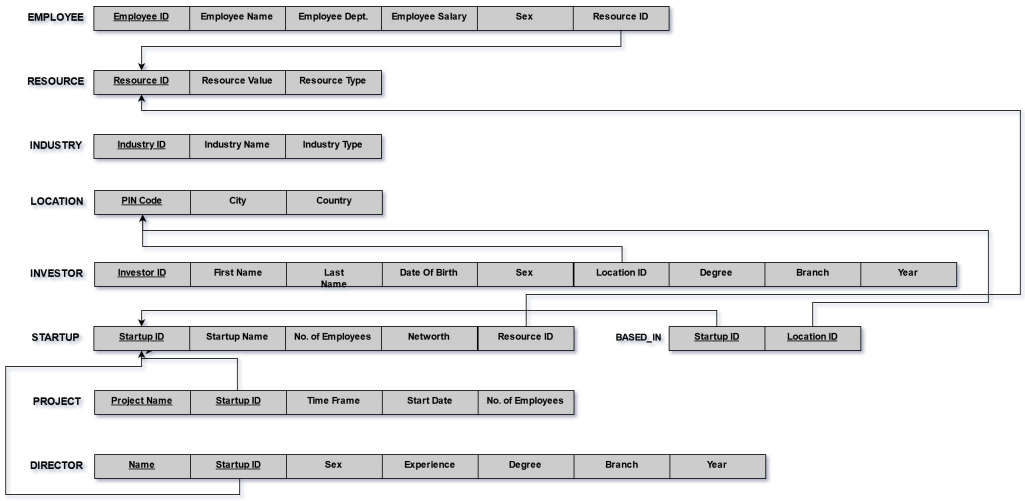

Figure 1.5: Mapping N:M relationship types

- Investor's Education : We have created a new relation "Investor's Education" which shall include the attributes of Investor's Education that is Degree, Branch and Year and Investor ID as foreign key referencing Investor entity type's relation.The primary key of this new relation is composition of attributes Investor ID and Degree,Branch and Year.

- Director's Education : We have created a new relation "Director's Education" which shall include the attributes of Director's Education that is Degree, Branch and Year and Name and Startup ID as foreign key referencing Director weak entity type's relation.The primary key of this new relation is composition of attributes Name,Startup ID and Degree,Branch and Year.

1.7 Step 7: Mappping of N-ary Relationship Types

- INVESTS : We have added a new relation "INVESTS" which includes as foreign keys, primary keys of all participating entities. It has Investor ID, Industry ID, Startup ID, Resource ID as foreign keys referencing to Investor,Industry,Startup and Resource entity type's relations.

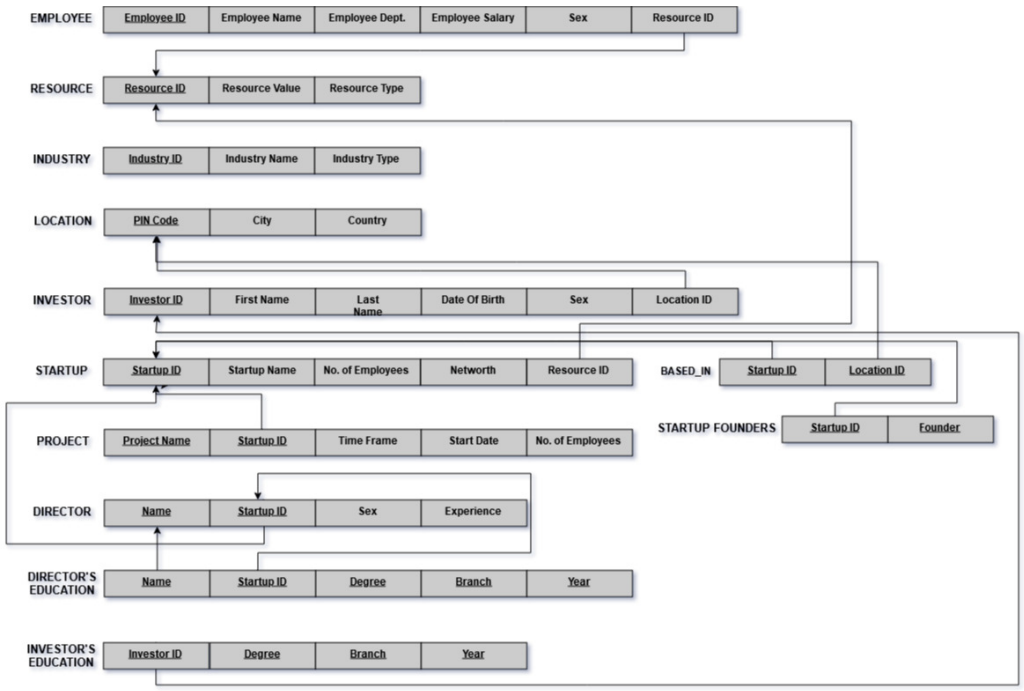

Figure 1.6: Mapping multivalued attributes

1.8 Step 8,9:Mapping Speacializations or Generalisations

Since our Industry subclass doesn't have any attribute of it's own and the division is disjoint, the Speacialization can just be represented by keeping it as an attribute.

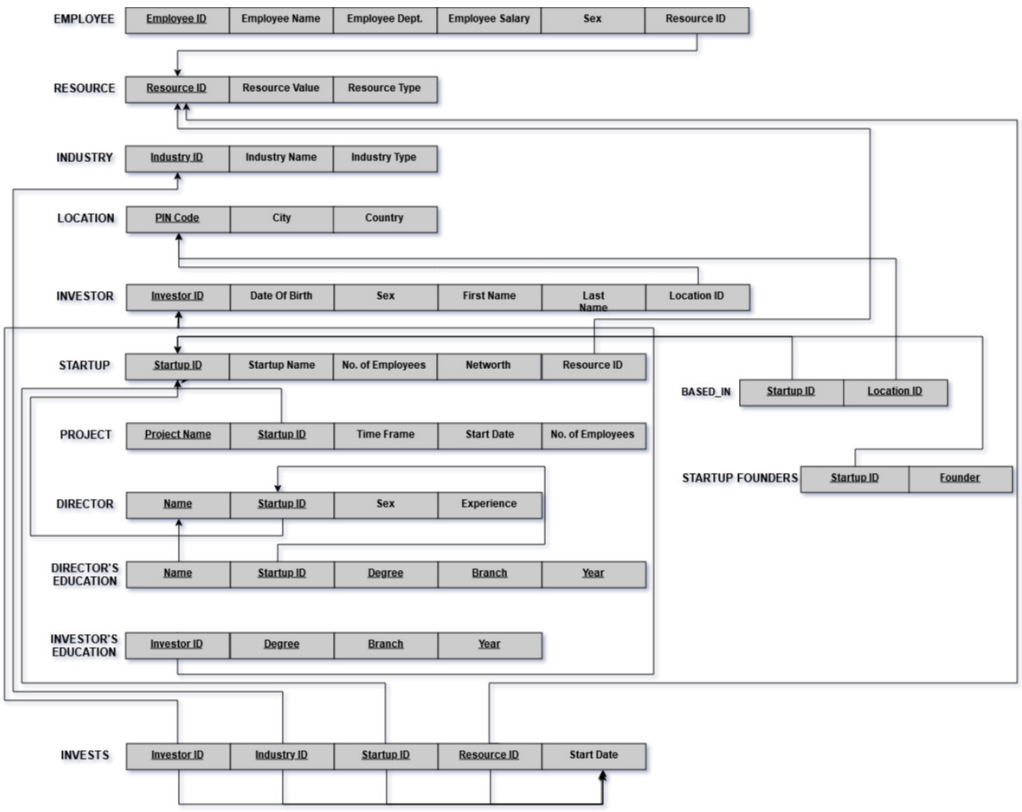

Figure 1.7: Mapping n-ary relationships

Chapter 2

Normalizing the Relational Model

2.1 Conversion to 1NF Form

Since we don't have any nested relations in our model and we have already taken care of composite and multivalued attributes, our model is already in 1NF Form.

2.2 Conversion to 2NF Form

We have to ensure the relation containing composite primary keys don't have partial dependencies those having simple primary keys are already fully functionally dependent.The following relations contain composite primary keys -

1. Project : As project is a weak entity type and each project has a Name and Startup ID, each of the non-prime attributes are dependent on composition of the same and thus can't be dependent on a smaller subset of them.

2. Director's Education : Each attribute here is prime and thus it is fully functionally dependent.

3. Investor's Education : Each attribute here is prime and thus it is fully functionally dependent.

4. Invests : Since it is not possible to tell Start Date by any smaller subset of primary key, we say it is fully functionally dependent.

Thus our model is already in 2NF.

2.3 Conversion to 3NF Form

Apart from Location entity type's relation, all other entity type's relation have no transitive dependency as all non-prime attributes fully depend on primary keys only. However, given a city, one may argue that country is functionally dependent on city as given a city you can obtain the country name, if that assumption were to be true , then we could have converted to 3NF Form by seperating into 2 relations, R_1 with PIN Code and City in one relation and R_2 with City and Country having City as primary key.
But however in real world we have examples where cities from 2 different countries share the same name. Example - Hyderabad is both in Pakistan and India (as given in example).

Chapter 3

Example Database State

Table 3.1: Employee

EmployeeID	**EmployeeName**	**EmployeeDept**	**Salary**	**Sex**	**ResourceID**
57	Rajesh	HR	50,000	Male	101
91	Ramesh	Sales	20,000	Male	102
123	Rita	Finance	1,00,000	Female	103

Table 3.2: Resource

ResourceID	**Resource Value**	**Resource Type**
101	10,00,000	Capital
102	50,000	Workspaces
103	5,00,000	Computers
104	10,000	Manufacturing Space

Table 3.3: Industry

IndustryID	**IndustryName**	**Industry Type**
1	Transportation	Tertiary
2	Textile	Secondary
3	Agriculture	Primary
4	Horticulture	Primary
5	IT	Tertiary

Table 3.4: Location

Pincode	**City**	**Country**
250001	Meerut	India
500032	Hyderabad	India
710000	Hyderabad	Pakistan
400094	Mumbai	India

Table 3.5: Investor

InvestorID	**DOB**	**Sex**	**FirstName**	**LastName**	**LocationID**
1	10-7-1990	Male	Shyam	Gopal	250001
2	2-5-1991	Female	Rama	Dewan	400094
3	29-3-1992	Male	Anubhav	Trump	710000

Table 3.6: Startup

StartupID	**StartupName**	**No.ofEmployees**	**Networth**	**LocationID**
1	DreamView	100	10,00,000	500032
2	Ober Cab Services	200	2,00,000	250001

Table 3.7: Project

ProjectName	StartupID	TimeFrame(days)	Start Date	No.ofEmployees
AlphaQ	1	200	10-10-2010	32
BetaG	2	100	20-10-2000	25

Table 3.8: Director

Name	StartupID	Sex	Experience(years)
Kamal	1	Male	10
Nonidh	2	100	2

Table 3.9: Director's Education

Name	StartupID	Degree	Branch	Year
Kamal	1	PhD	Computer Science	2000
Kamal	1	B.Tech	Computer Science	1990
Nonidh	2	B.Tech	Computer Science	2010
Nonidh	1	M.Sc	Natural Sciences	2015

Table 3.10: Investor's Education

InvestorID	Degree	Branch	Year
1	PhD	Computer Science	2000
1	B.Tech	Computer Science	1990
2	B.Tech	Computer Science	2010
3	M.Sc	Natural Sciences	2015

Table 3.11: Invests

InvestorID	IndustryID	StartupID	ResourceID	StartDate
2	1	1	101	9-1-2008
3	2	2	102	10-10-2009

Table 3.12: BASED_IN

StartupID	**LocationID**
1	500032
1	400094
2	250001

Table 3.13: Startup Founders

StartupID	**Founder**
1	Ahish Deshpande
1	Utkarsh Mishra
2	Yoogottam
2	Trunapushpa