CMPE 272 – Enterprise SW Platforms
Mini Project
Information in Cloud

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SQLite

Purchase Order Management

Schema Diagram:

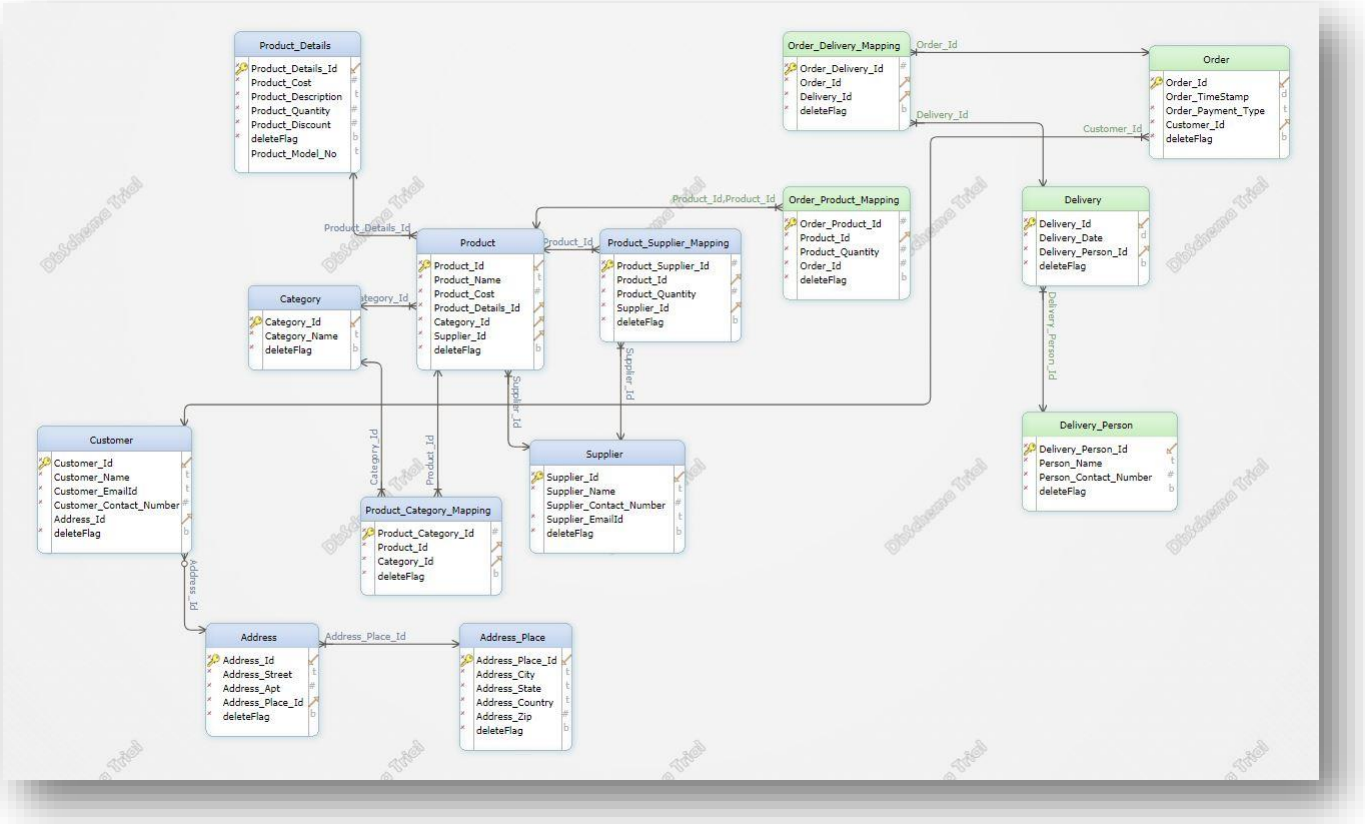

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Table Specification:

Table: Address

Indexes	Field Name	Data Type	Description
*	Address_Id	integer	
*	Address_Street	varchar(2000000000)	
*	Address_Apt	integer	
*	Address_Place_Id	varchar(2000000000)	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Address	ON Address_Id	
Foreign Keys			
	Fk_Address	(Address_Place_Id) ref Address_Place (Address_Place_Id)	

Table: Address_Place

Indexes	Field Name	Data Type	Description
*	Address_Place_Id	integer	
*	Address_City	varchar(2000000000)	
*	Address_State	varchar(2000000000)	
*	Address_Country	varchar(2000000000)	
*	Address_Zip	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Address_Place	ON Address_Place_Id	

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Table: Category

Indexes	Field Name	Data Type	Description
*	Category_Id	integer	
*	Category_Name	varchar(2000000000)	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Category	ON Category_Id	

Table: Customer

Indexes	Field Name	Data Type	Description
*	Customer_Id	integer	
*	Customer_Name	varchar(2000000000)	
*	Customer_EmailId	varchar(2000000000)	
*	Customer_Contact_Number	integer	
	Address_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Customer	ON Customer_Id	
Foreign Keys			
	Fk_Customer	(Address_Id) ref Address (Address_Id)	

Table: Delivery

Indexes	Field Name	Data Type	Description
*	Delivery_Id	integer	
*	Delivery_Date	date	
*	Delivery_Person_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Delivery	ON Delivery_Id	
Foreign Keys			
	Fk_Delivery	(Delivery_Person_Id) ref Delivery_Person (Delivery_Person_Id)	

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Table: Delivery_Person

Indexes	Field Name	Data Type	Description
*	Delivery_Person_Id	integer	
*	Person_Name	varchar(2000000000)	
*	Person_Contact_Number	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Delivery_Person	ON Delivery_Person_Id	

Table: Order

Indexes	Field Name	Data Type	Description
*	Order_Id	integer	
	Order_TimeStamp	datetime DEFAULT CURRENT_TIMESTAMP	
*	Order_Payment_Type	varchar(2000000000)	
*	Customer_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Order	ON Order_Id	
Foreign Keys			
	Fk_Order	(Customer_Id) ref Customer (Customer_Id)	

Table: Order_Delivery_Mapping

Indexes	Field Name	Data Type	Description
*	Order_Delivery_Id	integer	
*	Order_Id	integer	
*	Delivery_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Order_Delivery_Mapping	ON Order_Delivery_Id	
Foreign Keys			
	Fk_Order_Delivery_Mapping	(Delivery_Id) ref Delivery (Delivery_Id)	
	Fk_Order_Delivery_Mapping	(Order_Id) ref Order (Order_Id)	

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Table: Order_Product_Mapping

Indexes	Field Name	Data Type	Description
*	Order_Product_Id	integer	
*	Product_Id	integer	
*	Product_Quantity	integer	
*	Order_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Order_Product_Mapping	ON Order_Product_Id	
Foreign Keys			
	Fk_Order_Product_Mapping	(Product_Id, Product_Id) ref Product (Product_Id, Product_Id)	

Table: Product

Indexes	Field Name	Data Type	Description
*	Product_Id	integer	
*	Product_Name	varchar(2000000000)	
*	Product_Cost	float(2000000000, 10)	
*	Product_Details_Id	integer	
*	Category_Id	integer	
*	Supplier_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Product	ON Product_Id	
Foreign Keys			
	Fk_Product	(Category_Id) ref Category (Category_Id)	
	Fk_Product	(Product_Details_Id) ref Product_Details (Product_Details_Id)	
	Fk_Product	(Supplier_Id) ref Supplier (Supplier_Id)	

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Table: Product_Category_Mapping

Indexes	Field Name	Data Type	Description
*	Product_Category_Id	integer	
*	Product_Id	integer	
*	Category_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Product_Category_Mapping	ON Product_Category_Id	
Foreign Keys			
	Fk_Product_Category_Mapping	(Category_Id) ref Category (Category_Id)	
	Fk_Product_Category_Mapping	(Product_Id) ref Product (Product_Id)	

Table: Product_Details

Indexes	Field Name	Data Type	Description
*	Product_Details_Id	integer	
*	Product_Cost	integer	
*	Product_Description	text	
*	Product_Quantity	integer	
*	Product_Discount	float(2000000000, 10)	
*	deleteFlag	boolean	
	Product_Model_No	varchar(2000000000)	
Indexes			
	pk_Product_Details	ON Product_Details_Id	

Table: Product_Supplier_Mapping

Indexes	Field Name	Data Type	Description
*	Product_Supplier_Id	integer	
*	Product_Id	integer	
*	Product_Quantity	integer	
*	Supplier_Id	integer	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Product_Supplier_Mapping	ON Product_Supplier_Id	
Foreign Keys			

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Indexes	Field Name	Data Type	Description
	Fk_Product_Supplier_Mapping	(Product_Id) ref Product (Product_Id)	
	Fk_Product_Supplier_Mapping	(Supplier_Id) ref Supplier (Supplier_Id)	

Table: Supplier

Indexes	Field Name	Data Type	Description
*	Supplier_Id	integer	
*	Supplier_Name	varchar(2000000000)	
	Supplier_Contact_Number	integer	
*	Supplier_EmailId	varchar(2000000000)	
*	deleteFlag	boolean DEFAULT 0	
Indexes			
	pk_Supplier	ON Supplier_Id	

Queries and Results:

1. Create Operation:

   Create Address table:
   CREATE TABLE "Address" ("Address_Id" INTEGER PRIMARY KEY NOT NULL ,
   "Address_Street" VARCHAR NOT NULL , "Address_Apt" INTEGER NOT NULL,
   "Address_Place_Id" VARCHAR NOT NULL, "deleteFlag" BOOL NOT NULL DEFAULT 0,
   FOREIGN KEY ("Address_Place_Id") REFERENCES Address_Place("Address_Place_Id"))

   Create Address_Place table:
   CREATE TABLE "Address_Place" ("Address_Place_Id" INTEGER PRIMARY KEY NOT NULL ,
   "Address_City" VARCHAR NOT NULL , "Address_State" VARCHAR NOT NULL ,
   "Address_Country" VARCHAR NOT NULL , "Address_Zip" INTEGER NOT NULL ,
   "deleteFlag" BOOL NOT NULL DEFAULT 0)

   Create Category table:
   CREATE TABLE "Category" ("Category_Id" INTEGER PRIMARY KEY NOT NULL ,
   "Category_Name" VARCHAR NOT NULL , "deleteFlag" BOOL NOT NULL DEFAULT 0)

   Create Customer table:
   CREATE TABLE "Customer" ("Customer_Id" INTEGER PRIMARY KEY NOT NULL
   ,"Customer_Name" VARCHAR NOT NULL ,"Customer_EmailId" VARCHAR NOT NULL

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,"Customer_Contact_Number" INTEGER NOT NULL , "Address_Id" INTEGER, "deleteFlag" BOOL NOT NULL DEFAULT 0, FOREIGN KEY (Address_Id) REFERENCES Address(Address_Id))

Create Delivery table:
CREATE TABLE "Delivery" ("Delivery_Id" INTEGER PRIMARY KEY NOT NULL DEFAULT (null) ,"Delivery_Date" DATE NOT NULL DEFAULT (null) ,"Delivery_Person_Id" INTEGER NOT NULL ,"deleteFlag" BOOL NOT NULL DEFAULT (0) , FOREIGN KEY (Delivery_Person_Id) REFERENCES Delivery_Person(Delivery_Person_Id))

Create Delivery_Person table:
CREATE TABLE "Delivery_Person" ("Delivery_Person_Id" INTEGER PRIMARY KEY NOT NULL ,"Person_Name" VARCHAR NOT NULL ,"Person_Contact_Number" INTEGER NOT NULL ,"deleteFlag" BOOL NOT NULL DEFAULT (0))

Create Order table:
CREATE TABLE "Order" ("Order_Id" INTEGER PRIMARY KEY NOT NULL ,"Order_TimeStamp" DATETIME DEFAULT (CURRENT_TIMESTAMP) ,"Order_Payment_Type" VARCHAR NOT NULL ,"Customer_Id" INTEGER NOT NULL , "deleteFlag" BOOL NOT NULL DEFAULT 0, FOREIGN KEY (Customer_Id) REFERENCES Customer(Customer_Id))

Create Order_Delivery_Mapping table:
CREATE TABLE Order_Delivery_Mapping ("Order_Delivery_Id" INTEGER PRIMARY KEY NOT NULL , "Order_Id" INTEGER NOT NULL , "Delivery_Id" INTEGER NOT NULL, "deleteFlag" BOOL NOT NULL DEFAULT 0, FOREIGN KEY ("Order_Id") REFERENCES "Order"("Order_Id"), FOREIGN KEY ("Delivery_Id") REFERENCES Delivery("Delivery_Id"))

Create Order_Product_Mapping table:
CREATE TABLE "Order_Product_Mapping" ("Order_Product_Id" INTEGER PRIMARY KEY NOT NULL , "Product_Id" INTEGER NOT NULL, "Product_Quantity" INTEGER NOT NULL , "Order_Id" INTEGER NOT NULL, "deleteFlag" BOOL NOT NULL DEFAULT 0 , FOREIGN KEY (Product_Id) REFERENCES Product(Product_Id), FOREIGN KEY (Product_Id) REFERENCES Product(Product_Id))

Create Product table:

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CREATE TABLE "Product" ("Product_Id" INTEGER PRIMARY KEY NOT NULL , "Product_Name" VARCHAR NOT NULL , "Product_Cost" FLOAT NOT NULL , "Product_Details_Id" INTEGER NOT NULL , "Category_Id" INTEGER NOT NULL , "Supplier_Id" INTEGER NOT NULL , "deleteFlag" BOOL NOT NULL DEFAULT 0, FOREIGN KEY (Product_Details_Id) REFERENCES Product_Details(Product_Details_Id), FOREIGN KEY (Category_Id) REFERENCES Category(Category_Id) , FOREIGN KEY (Supplier_Id) REFERENCES Supplier(Supplier_Id))

Create Product_Category_Mapping table:
CREATE TABLE "Product_Category_Mapping" ("Product_Category_Id" INTEGER PRIMARY KEY NOT NULL , "Product_Id" INTEGER NOT NULL , "Category_Id" INTEGER NOT NULL, "deleteFlag" BOOL NOT NULL DEFAULT 0, FOREIGN KEY (Category_Id) REFERENCES Category(Category_Id) , FOREIGN KEY (Product_Id) REFERENCES Product(Product_Id))

Create Product_Details table:
CREATE TABLE "Product_Details" ("Product_Details_Id" INTEGER PRIMARY KEY NOT NULL , "Product_Cost" INTEGER NOT NULL , "Product_Description" TEXT NOT NULL , "Product_Quantity" INTEGER NOT NULL , "Product_Discount" FLOAT NOT NULL , "deleteFlag" BOOL NOT NULL , "Product_Model_No" VARCHAR)

Create Product_Supplier_Mapping table:
CREATE TABLE "Product_Supplier_Mapping" ("Product_Supplier_Id" INTEGER PRIMARY KEY NOT NULL , "Product_Id" INTEGER NOT NULL, "Product_Quantity" INTEGER NOT NULL , "Supplier_Id" INTEGER NOT NULL, "deleteFlag" BOOL NOT NULL DEFAULT 0 , FOREIGN KEY (Product_Id) REFERENCES Product(Product_Id), FOREIGN KEY (Supplier_Id) REFERENCES Supplier(Supplier_Id))

Create Supplier table:
CREATE TABLE "Supplier" ("Supplier_Id" INTEGER PRIMARY KEY NOT NULL , "Supplier_Name" VARCHAR NOT NULL , "Supplier_Contact_Number" INTEGER, "Supplier_EmailId" VARCHAR NOT NULL , "deleteFlag" BOOL NOT NULL DEFAULT 0)

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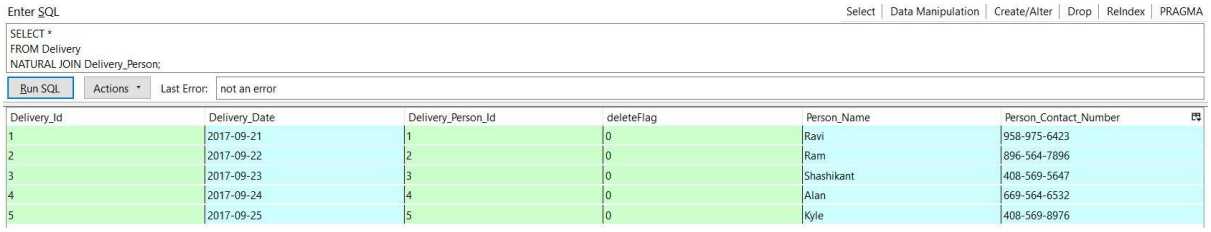
2. Select Operation:

NATURAL Join of Delivery and Delivery_Person Tables:



Enter SQL

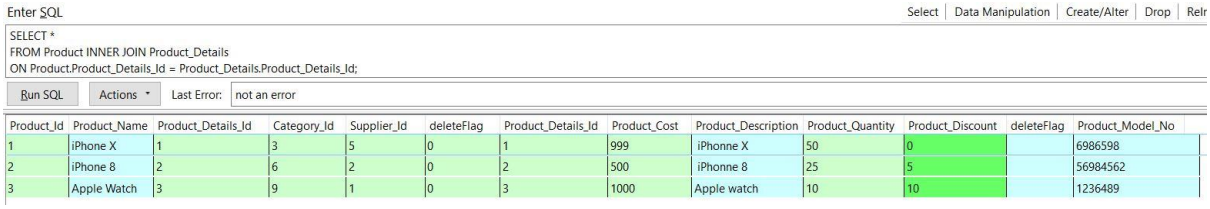
Select | Data Manipulation | Create/Alter | Drop | ReIndex | PRAGMA

```
SELECT *
FROM Delivery
NATURAL JOIN Delivery_Person;
```

Run SQL | Actions | Last Error: not an error

Delivery_Id	Delivery_Date	Delivery_Person_Id	deleteFlag	Person_Name	Person_Contact_Number
1	2017-09-21	1	0	Ravi	958-975-6423
2	2017-09-22	2	0	Ram	896-564-7896
3	2017-09-23	3	0	Shashikant	408-569-5647
4	2017-09-24	4	0	Alan	669-564-6532
5	2017-09-25	5	0	Kyle	408-569-8976

INNER Join of Product and Product_Delivery Tables:



Enter SQL

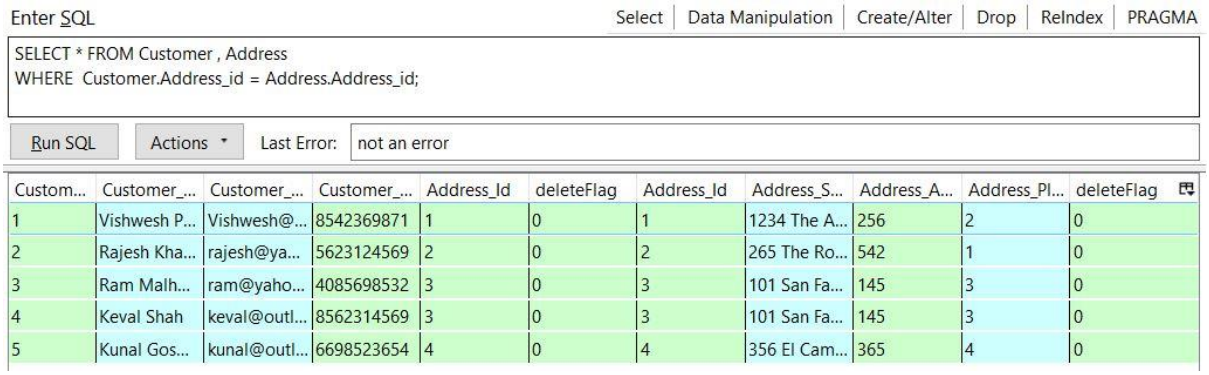
Select | Data Manipulation | Create/Alter | Drop | Relr

```
SELECT *
FROM Product INNER JOIN Product_Details
ON Product.Product_Details_Id = Product_Details.Product_Details_Id;
```

Run SQL | Actions | Last Error: not an error

Product_Id	Product_Name	Product_Details_Id	Category_Id	Supplier_Id	deleteFlag	Product_Details_Id	Product_Cost	Product_Description	Product_Quantity	Product_Discount	deleteFlag	Product_Model_No
1	iPhone X	1	3	5	0	1	999	iPhonne X	50	0		6986598
2	iPhone 8	2	6	2	0	2	500	iPhonne 8	25	5		56984562
3	Apple Watch	3	9	1	0	3	1000	Apple watch	10	10		1236489

OUTER Join of Customer and Address Tables:



Enter SQL

Select | Data Manipulation | Create/Alter | Drop | ReIndex | PRAGMA

```
SELECT * FROM Customer , Address
WHERE  Customer.Address_id = Address.Address_id;
```

Run SQL | Actions | Last Error: not an error

Custom...	Customer_...	Customer_...	Customer_...	Address_Id	deleteFlag	Address_Id	Address_S...	Address_A...	Address_Pl...	deleteFlag
1	Vishwesh P...	Vishwesh@...	8542369871	1	0	1	1234 The A...	256	2	0
2	Rajesh Kha...	rajesh@ya...	5623124569	2	0	2	265 The Ro...	542	1	0
3	Ram Malh...	ram@yaho...	4085698532	3	0	3	101 San Fa...	145	3	0
4	Keval Shah	keval@outl...	8562314569	3	0	3	101 San Fa...	145	3	0
5	Kunal Gos...	kunal@outl...	6698523654	4	0	4	356 El Cam...	365	4	0

CROSS Join of Product and Category Tables:

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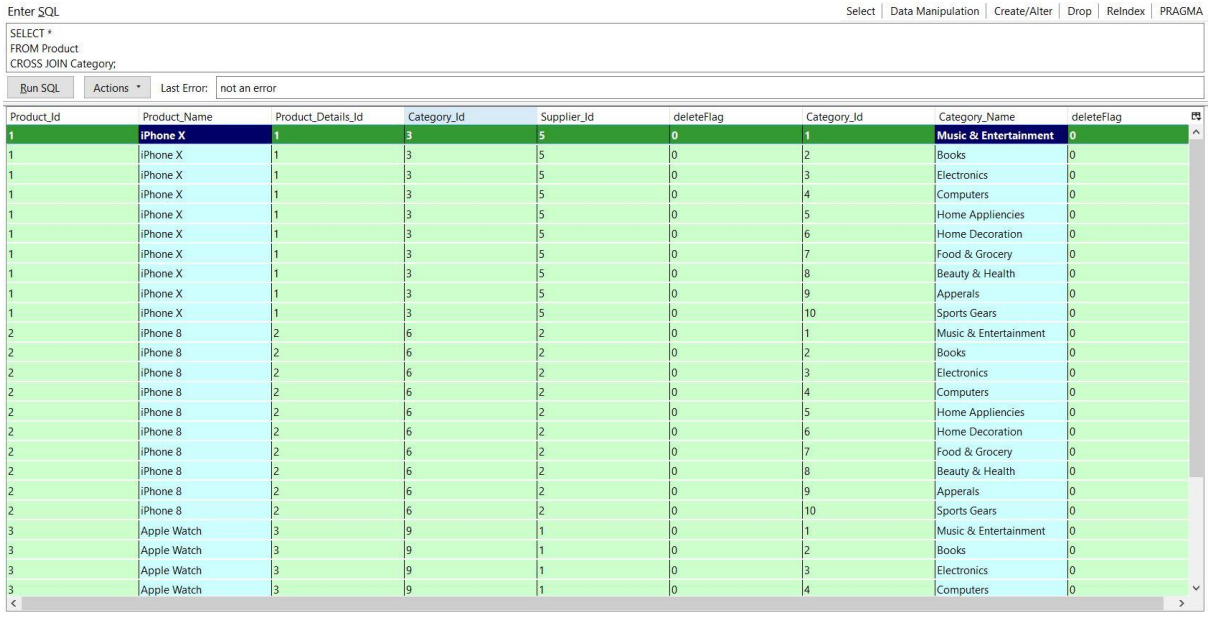


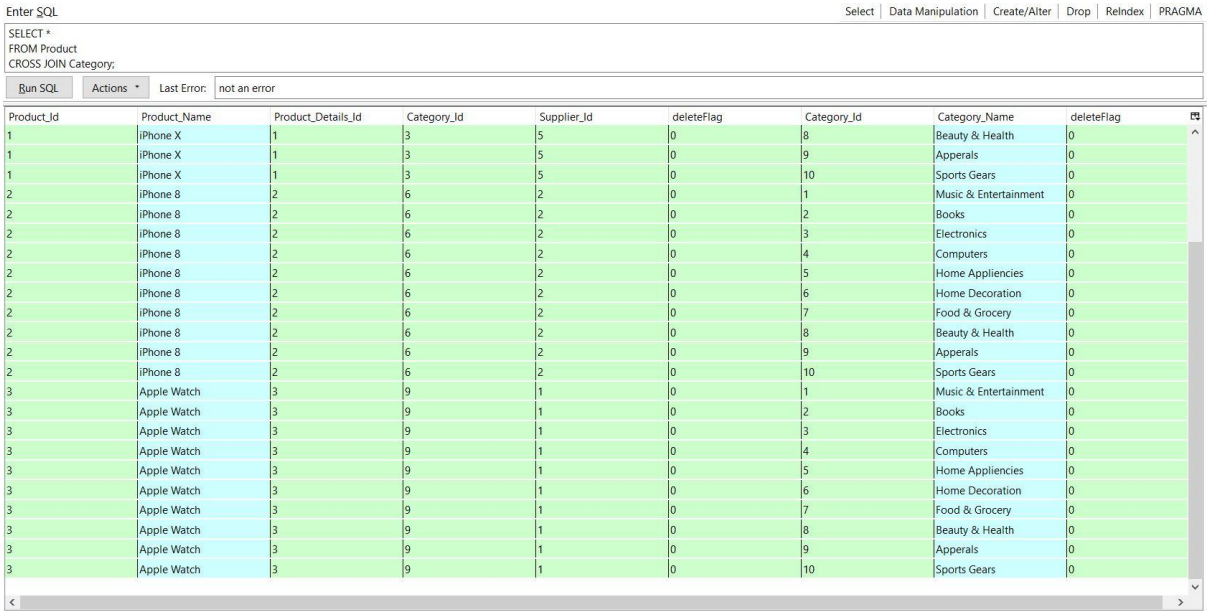
Enter SQL

Select | Data Manipulation | Create/Alter | Drop | ReIndex | PRAGMA

```
SELECT *
FROM Product
CROSS JOIN Category;
```

Run SQL | Actions | Last Error: not an error

Product_Id	Product_Name	Product_Details_Id	Category_Id	Supplier_Id	deleteFlag	Category_Id	Category_Name	deleteFlag
1	iPhone X	1	3	5	0	1	Music & Entertainment	0
1	iPhone X	1	3	5	0	2	Books	0
1	iPhone X	1	3	5	0	3	Electronics	0
1	iPhone X	1	3	5	0	4	Computers	0
1	iPhone X	1	3	5	0	5	Home Appliencies	0
1	iPhone X	1	3	5	0	6	Home Decoration	0
1	iPhone X	1	3	5	0	7	Food & Grocery	0
1	iPhone X	1	3	5	0	8	Beauty & Health	0
1	iPhone X	1	3	5	0	9	Apperals	0
1	iPhone X	1	3	5	0	10	Sports Gears	0
2	iPhone 8	2	6	2	0	1	Music & Entertainment	0
2	iPhone 8	2	6	2	0	2	Books	0
2	iPhone 8	2	6	2	0	3	Electronics	0
2	iPhone 8	2	6	2	0	4	Computers	0
2	iPhone 8	2	6	2	0	5	Home Appliencies	0
2	iPhone 8	2	6	2	0	6	Home Decoration	0
2	iPhone 8	2	6	2	0	7	Food & Grocery	0
2	iPhone 8	2	6	2	0	8	Beauty & Health	0
2	iPhone 8	2	6	2	0	9	Apperals	0
2	iPhone 8	2	6	2	0	10	Sports Gears	0
3	Apple Watch	3	9	1	0	1	Music & Entertainment	0
3	Apple Watch	3	9	1	0	2	Books	0
3	Apple Watch	3	9	1	0	3	Electronics	0
3	Apple Watch	3	9	1	0	4	Computers	0



Enter SQL

Select | Data Manipulation | Create/Alter | Drop | ReIndex | PRAGMA

```
SELECT *
FROM Product
CROSS JOIN Category;
```

Run SQL | Actions | Last Error: not an error

Product_Id	Product_Name	Product_Details_Id	Category_Id	Supplier_Id	deleteFlag	Category_Id	Category_Name	deleteFlag
1	iPhone X	1	3	5	0	8	Beauty & Health	0
1	iPhone X	1	3	5	0	9	Apperals	0
1	iPhone X	1	3	5	0	10	Sports Gears	0
2	iPhone 8	2	6	2	0	1	Music & Entertainment	0
2	iPhone 8	2	6	2	0	2	Books	0
2	iPhone 8	2	6	2	0	3	Electronics	0
2	iPhone 8	2	6	2	0	4	Computers	0
2	iPhone 8	2	6	2	0	5	Home Appliencies	0
2	iPhone 8	2	6	2	0	6	Home Decoration	0
2	iPhone 8	2	6	2	0	7	Food & Grocery	0
2	iPhone 8	2	6	2	0	8	Beauty & Health	0
2	iPhone 8	2	6	2	0	9	Apperals	0
2	iPhone 8	2	6	2	0	10	Sports Gears	0
3	Apple Watch	3	9	1	0	1	Music & Entertainment	0
3	Apple Watch	3	9	1	0	2	Books	0
3	Apple Watch	3	9	1	0	3	Electronics	0
3	Apple Watch	3	9	1	0	4	Computers	0
3	Apple Watch	3	9	1	0	5	Home Appliencies	0
3	Apple Watch	3	9	1	0	6	Home Decoration	0
3	Apple Watch	3	9	1	0	7	Food & Grocery	0
3	Apple Watch	3	9	1	0	8	Beauty & Health	0
3	Apple Watch	3	9	1	0	9	Apperals	0
3	Apple Watch	3	9	1	0	10	Sports Gears	0

3. Update Operation:

Update Customer name to ‘Vishweshkumar Patel’ from ‘Vishwesh Patel’ :

```
UPDATE Customer SET Customer_Name = "Vishweshkumar Patel" WHERE
Customer_Name = "Vishwesh Patel";
```

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4. Delete Operation:

   Delete Category having Category_Id ‘9’:

   DELETE * FROM Category WHERE Category_Id = 9;

5. Insert Operation:

   Insert Product_Details of Apple Mac Book:

   INSERT INTO "main"."Product_Details"
   ("Product_Cost","Product_Description","Product_Quantity","Product_Discount","deleteFl
   ag","Product_Model_No") VALUES (?1,?2,?3,?4,?5,?6)
   Parameters:
   param 1 (integer): 250
   param 2 (text): Apple Mac Book
   param 3 (integer): 100
   param 4 (integer): 25
   param 5 (integer): 0
   param 6 (text): Mac-5689

   Insert Product Apple Mac Book:

   INSERT INTO "main"."Product"
   ("Product_Name","Product_Details_Id","Category_Id","Supplier_Id") VALUES
   (?1,?2,?3,?4)
   Parameters:
   param 1 (text): Apple Mac Book
   param 2 (integer): 4
   param 3 (integer): 4
   param 4 (integer): 3

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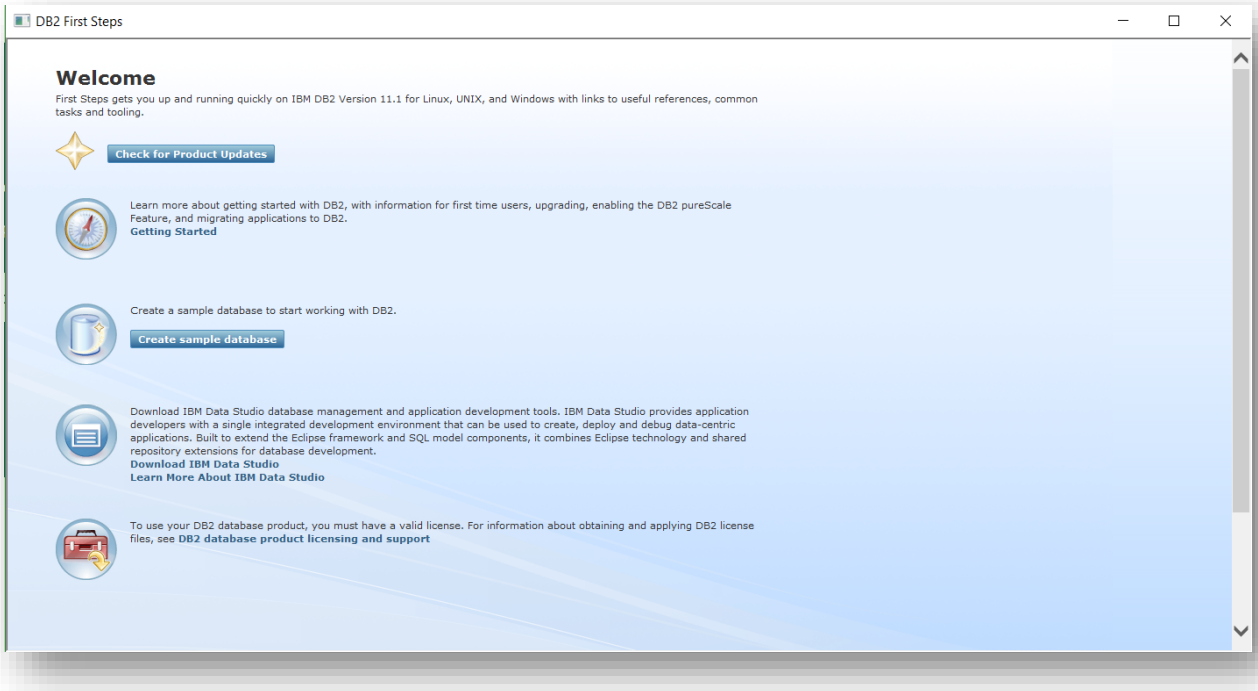
Db2 Express C

Installation

- Installing Db2 Express C is an easy process.
- Go to https://www.ibm.com/us-en/marketplace/db2-express-c
- Sign In using an existing account or Sign Up using your .edu email id.
- A zip file will be downloaded which will take around 5-10 minutes.
- The installation process is self-explanatory.
- You also get an option to setup database user and password.
- First Screen:



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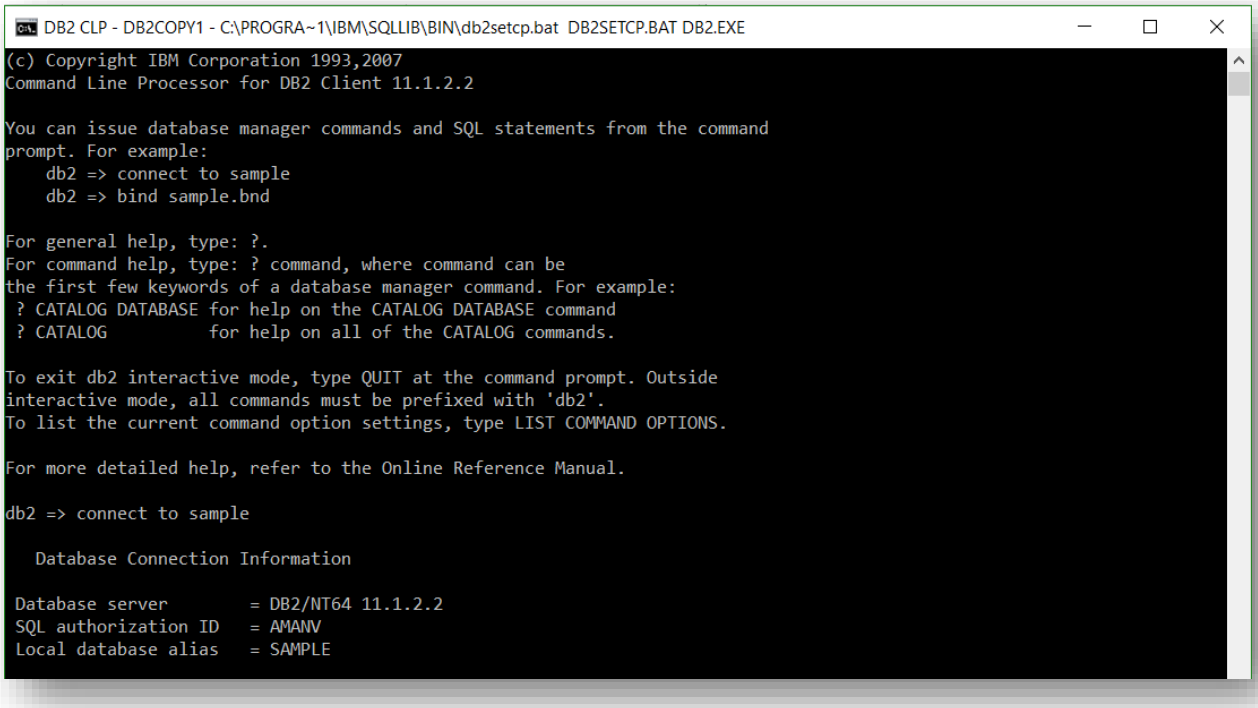
Sample Database Creation

- A sample database is created while installing the software.
- Also, we can create our own sample data base using the db2sampl command.
- To access the Sample database, we have to do the following steps:
  - ✓ Go to Start >> IBM Command Line Processor Plus
  - ✓ Type 'connect to sample'



- Running queries is quite similar to other databases.
- A sample query is written and the following output is generated.

  Select * from staff;

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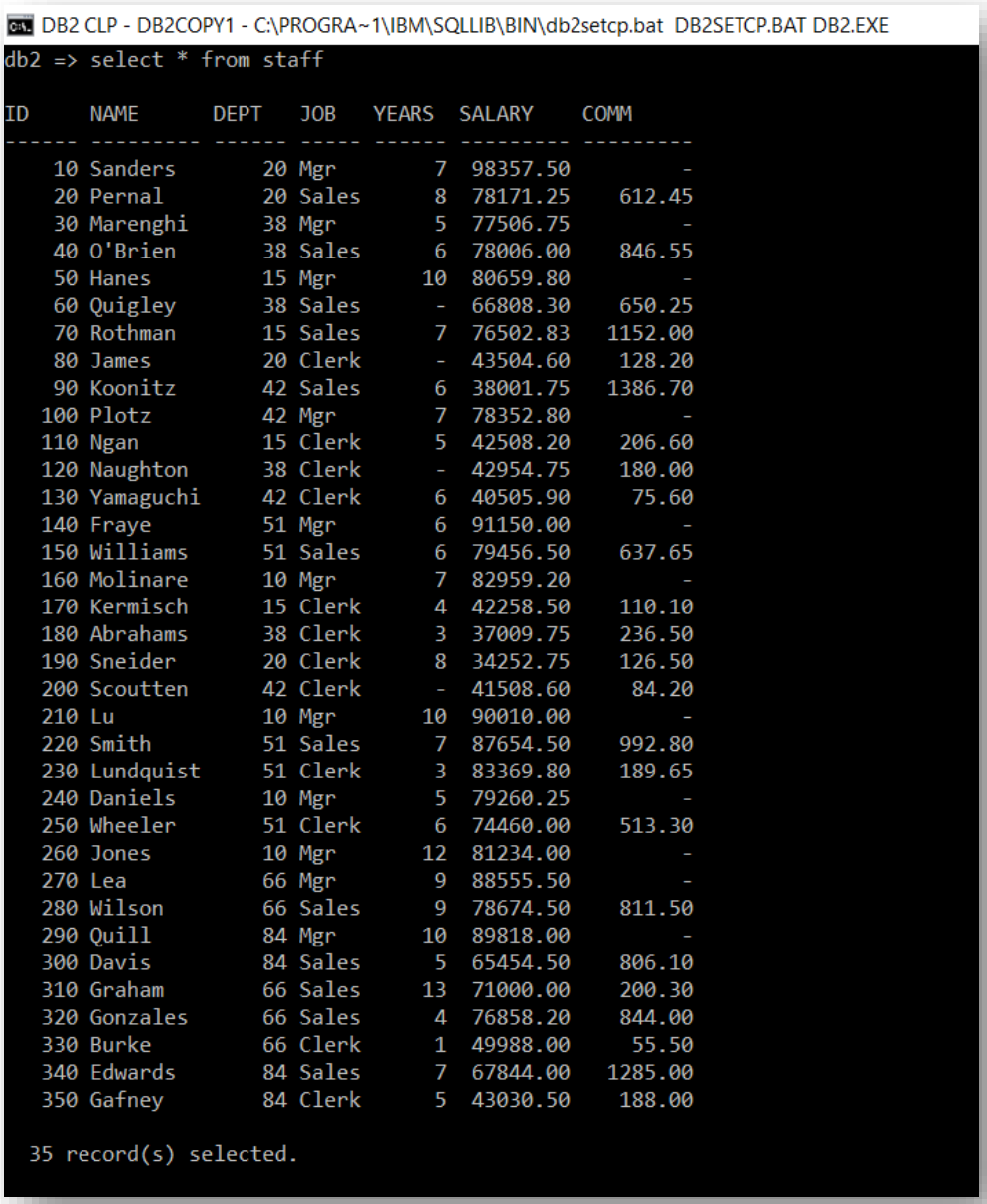

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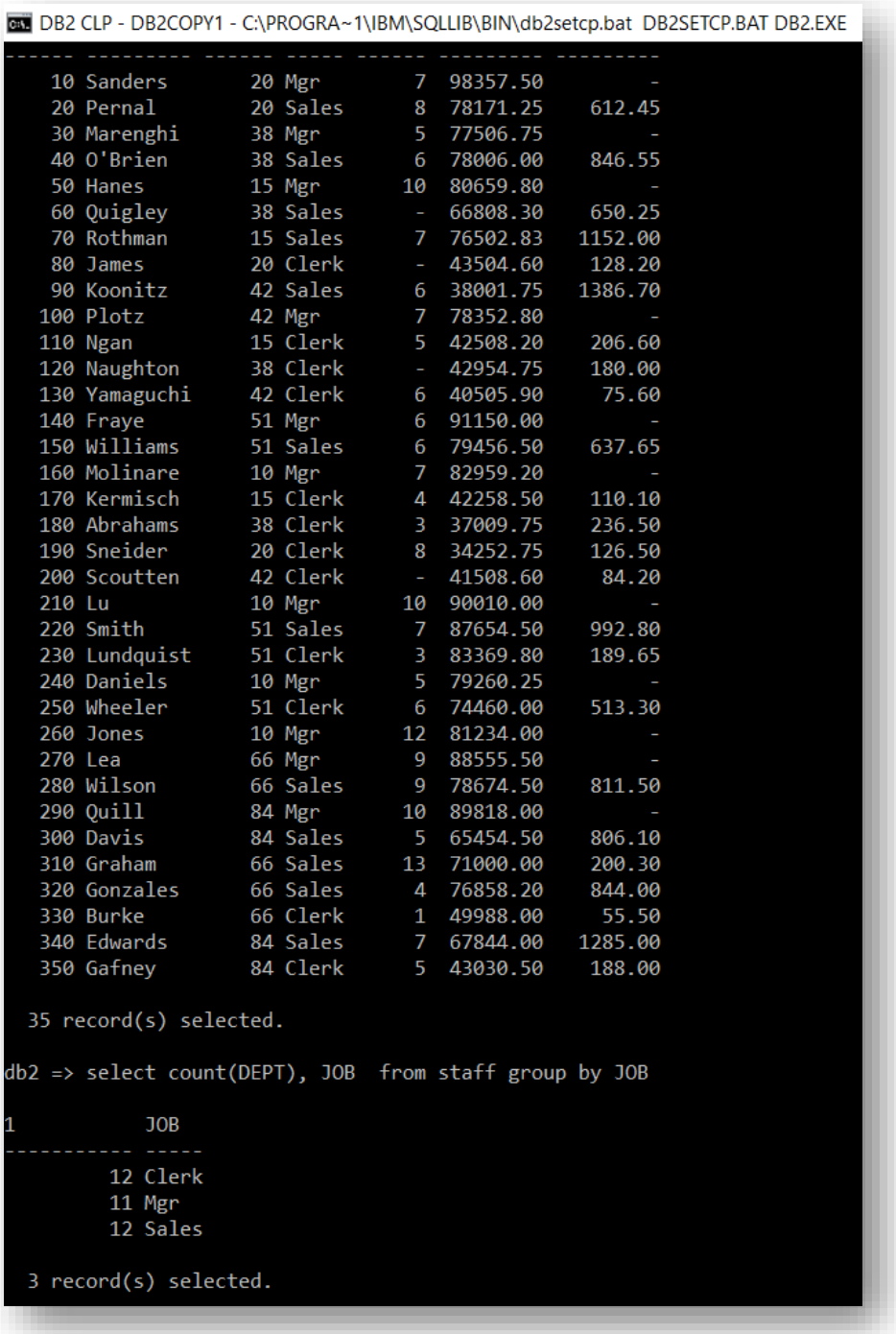
Sample Query

- As mentioned before, writing queries is very simple in Db2.
- The outputs are quick and takes very little processing time.
- A simple query was run and output is shown below.



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Query explain Plan

- To generate the query explain plan, we have to run the 'EXPLAIN.DDL' from the misc directory.

```
C:\Program Files\IBM\SQLLIB\MISC>db2 -tf EXPLAIN.DDL

******* IMPORTANT **********

USAGE: db2 -tf EXPLAIN.DDL

******* IMPORTANT **********
```

- Next, we have to set the current explain mode flag and current explain snapshot flag to 'yes' by using the following commands:

  db2 set current explain mode yes
  db2 set current explain snapshot yes

- Next, we need to execute a query for which we need the Query explain plan.
- Finally, we can run the db2exfmt command to generate the plan in an output file.

```
C:\Program Files\IBM\SQLLIB\BIN>db2exfmt
DB2 Universal Database Version 11.1, 5622-044 (c) Copyright IBM Corp. 1991, 2015
Licensed Material - Program Property of IBM
IBM DATABASE 2 Explain Table Format Tool

Enter Database Name ==> SAMPLE
Connecting to the Database.
Connect to Database Successful.
Binding package - Bind was Successful
Enter up to 26 character Explain timestamp (Default -1) ==>
Enter up to 128 character source name (SOURCE_NAME, Default %%) ==>
Enter source schema (SOURCE_SCHEMA, Default %%) ==>
Enter section number (0 for all, Default 0) ==>
Enter outfile name. Default is to terminal ==> output.txt
Output is in output.txt.
Executing Connect Reset -- Connect Reset was Successful.

C:\Program Files\IBM\SQLLIB\BIN>
```

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IBM Bluemix

The restaurant graph database application service is designed to show relation between entities like Person, Restaurant and Location.

Diagram shows different entities and their attributes.

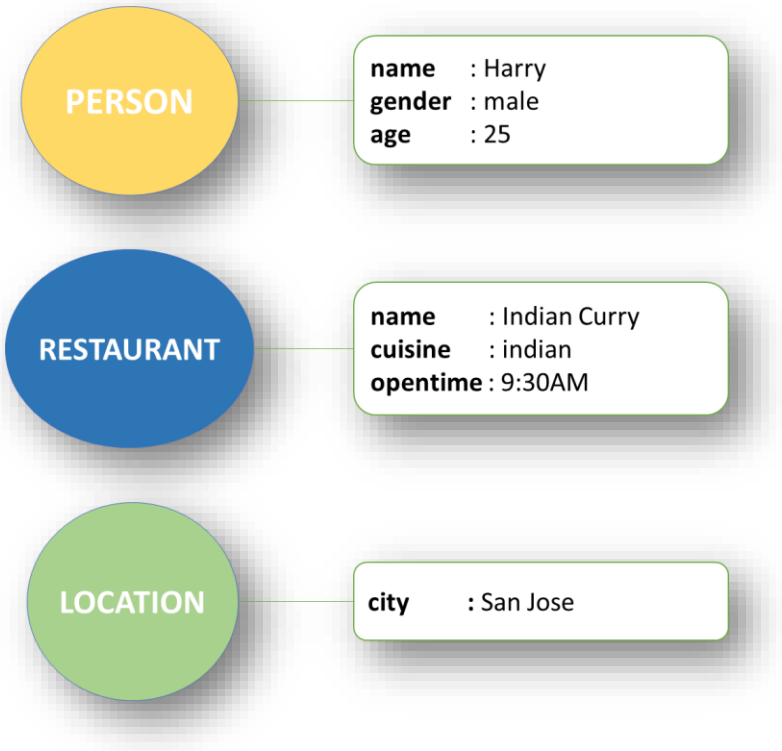

Figure 1: Entities and respective attributes

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The dataset model below represents the relationships between different entities.

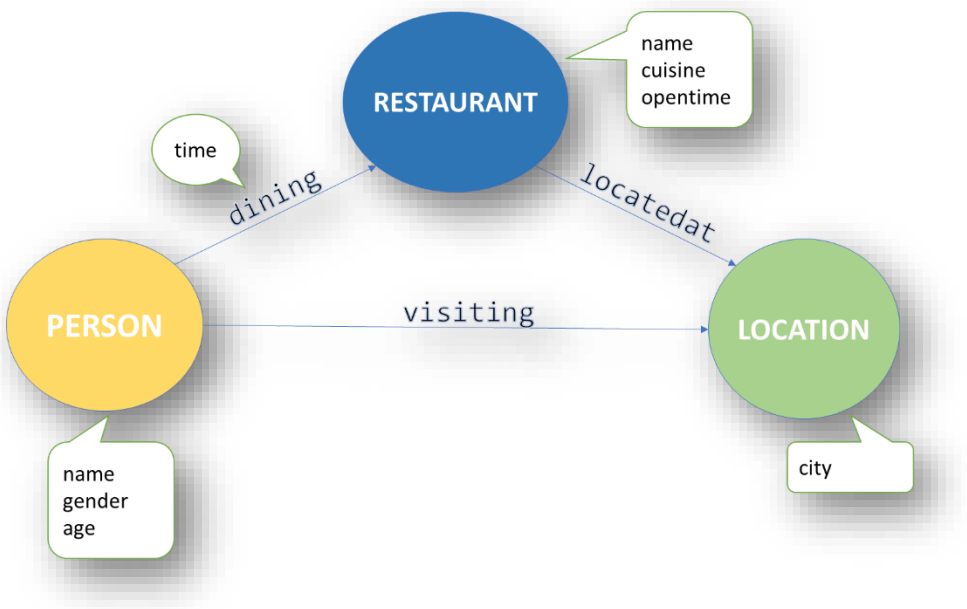

Figure 2: Dataset model

SCHEMA:

```
SCHEMA='
{
 "propertyKeys": [
  {"name": "name", "dataType": "String", "cardinality": "SINGLE"},
  {"name": "cuisine", "dataType": "String", "cardinality": "SINGLE"},
  {"name": "opentime", "dataType": "String", "cardinality": "SINGLE"},
  {"name": "city", "dataType": "String", "cardinality": "SINGLE"},
  {"name": "gender", "dataType": "String", "cardinality": "SINGLE"},
  {"name": "age", "dataType": "Integer", "cardinality": "SINGLE"},
  {"name": "time", "dataType": "String", "cardinality": "SINGLE"}
 ],
 "vertexLabels": [
  {"name": "person"},
  {"name": "restaurant"},
  {"name": "location"}
 ],
 "edgeLabels": [
  {"name": "locatedat", "multiplicity": "MULTI"},
  {"name": "visiting", "multiplicity": "MULTI"},
  {"name": "dinning", "multiplicity": "MULTI"}
```

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```
 ],
 "vertexIndexes": [
  {"name": "vByName", "propertyKeys": ["name"], "composite": true, "unique": true},
  {"name": "vByCuisine", "propertyKeys": ["cuisine"], "composite": true, "unique": false},
  {"name": "vByOpentime", "propertyKeys": ["opentime"], "composite": true, "unique": false},
  {"name": "vByCity", "propertyKeys": ["city"], "composite": true, "unique": false},
  {"name": "vBygender", "propertyKeys": ["gender"], "composite": true, "unique": false},
  {"name": "vByAge", "propertyKeys": ["age"], "composite": true, "unique": false}
 ],
 "edgeIndexes" :[
  {"name": "eByTime", "propertyKeys": ["time"], "composite": true, "unique": false}
 ]
}'
```

- We must setup a schema before creating the data which defines the datatypes and indexes for the properties used while data acquisition. Every property, let it be a vertex or an edge property, requires an index. Schemas once created neither be updated or be appended in any case.

- The above schema represents the dataset we have used in our application. Our schema describes a dataset consisting information of some American restaurants with multiple cuisines to offer, their visitors and the city it's located in. Some of the restaurants can have visitors in common, even though situated in two different cities. Using a gremlin query over the IBM Graph, we can easily track frequent visitors and their information. Moreover, restaurants can be classified based on cuisine they had to offer in that locality.

- The entities mentioned above constitutes restaurant, person and location respectively. A typical restaurant entity stores the restaurant's name, it's cuisine and opening time, whereas a person entity stores the individual's name, its gender and age. The location entity is nothing but the city name where the restaurant is located. An edge from person to restaurant signifies the person dinning at a mentioned time, whereas that from a person to location states him/her visiting that city. A link between a restaurant and location can be interpreted as restaurant's address.

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So, let us define the vertices and edges of our database graph.

```
at << ENDGREMLIN >gremlin.json # write everything until ENDGREMLIN into gremlin.json
{
"gremlin": "
def harry = graph.addVertex('name','Harry',label,'person','gender','male','age',25);
def michael = graph.addVertex('name','Michael',label,'person','gender','male','age',30);
def ron = graph.addVertex('name','Ron',label,'person','gender','male','age',28);
def kate = graph.addVertex('name','Kate',label,'person','gender','male','age',20);

def indiancurry = graph.addVertex('name','Indian Curry', label, 'restaurant', 'cuisine', 'indian',
'opentime', '9:30');
def tandoori = graph.addVertex('name','Tandoori Hut', label, 'restaurant', 'cuisine', 'indian',
'opentime', '10:30');
def punjab = graph.addVertex('name','Punjab Cafe', label, 'restaurant', 'cuisine', 'indian', 'opentime',
'8:30');
def panda = graph.addVertex('name','Panda Express', label, 'restaurant',  'cuisine', 'chinese',
'opentime', '10:30');
def chipotle = graph.addVertex('name', 'Chipotle', label, 'restaurant', 'cuisine', 'mexican', 'opentime',
'11:30');

def sanjose = graph.addVertex('city','San Jose',label,'location');
def sf = graph.addVertex('city','San Francisco',label,'location');
def sc = graph.addVertex('city','Santa Clara',label,'location');
indiancurry.addEdge('locatedat',sanjose);

punjab.addEdge('locatedat',sanjose);
tandoori.addEdge('locatedat',sf);
panda.addEdge('locatedat',sanjose);
chipotle.addEdge('locatedat',sc);

harry.addEdge('visiting',sanjose);
harry.addEdge('visiting',sf);
harry.addEdge('visiting',sc);
michael.addEdge('visiting',sf);
kate.addEdge('visiting',sc);
ron.addEdge('visiting',sanjose);
ron.addEdge('visiting',sf);
ron.addEdge('visiting',sc);

harry.addEdge('dinning',indiancurry,'time', '8:30PM');
harry.addEdge('dinning',tandoori, 'time', '9:30PM');
harry.addEdge('dinning',punjab, 'time', '9:00PM');
harry.addEdge('dinning',panda, 'time', '10:00PM');
harry.addEdge('dinning',chipotle, 'time', '08:00PM');
michael.addEdge('dinning',tandoori, 'time', '08:30PM');
ron.addEdge('dinning',punjab, 'time', '9:30PM');
```

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```
ron.addEdge('dinning',panda, 'time', '9:30PM');
ron.addEdge('dinning',chipotle, 'time', '08:30PM');
kate.addEdge('dinning',chipotle, 'time', '08:30PM');
 "
}
ENDGREMLIN
```

Below graph gives you a basic idea of what the structure would be like, upon successful loading of data.

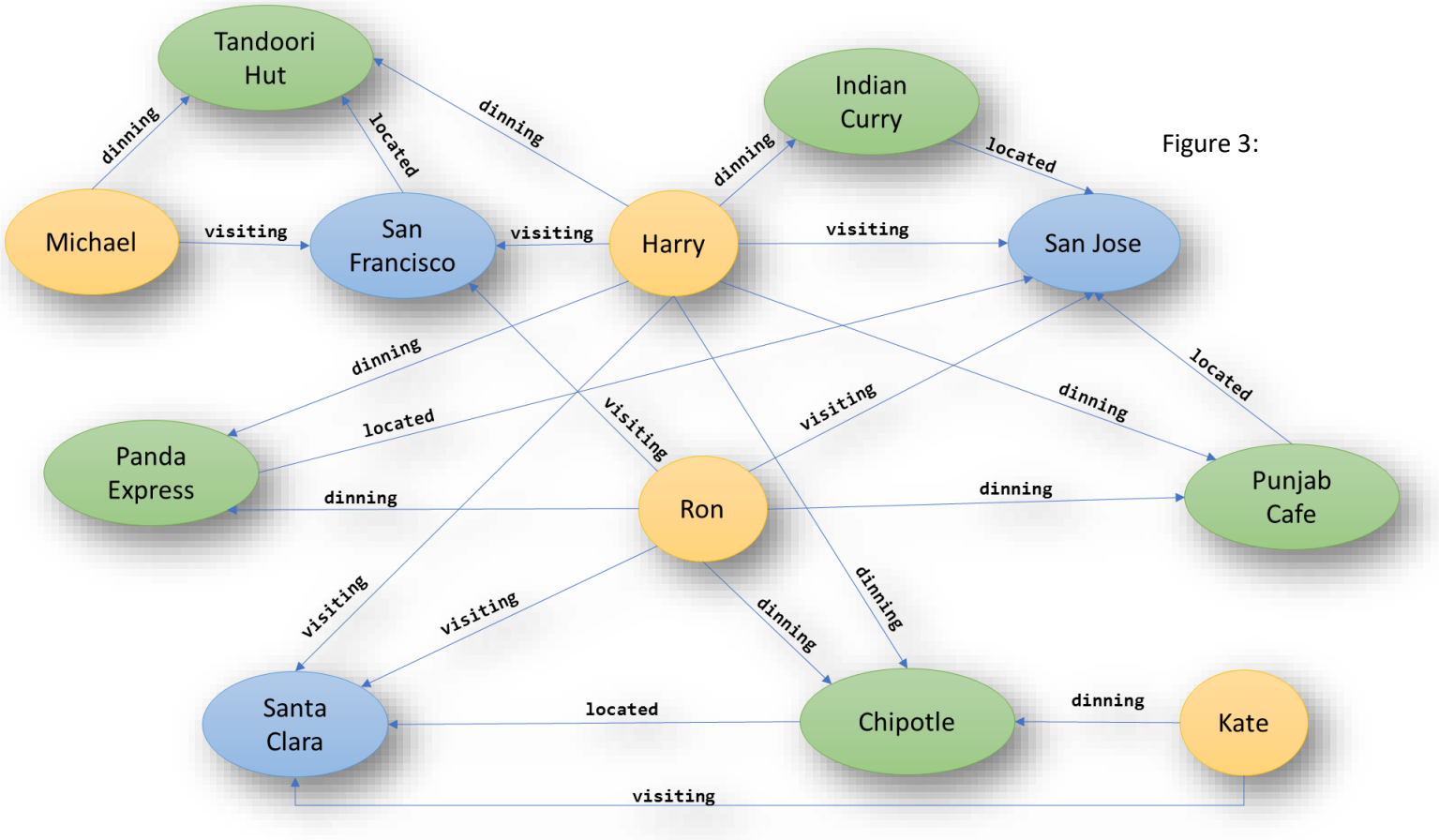

Figure 3:

Database graph - Interaction diagram

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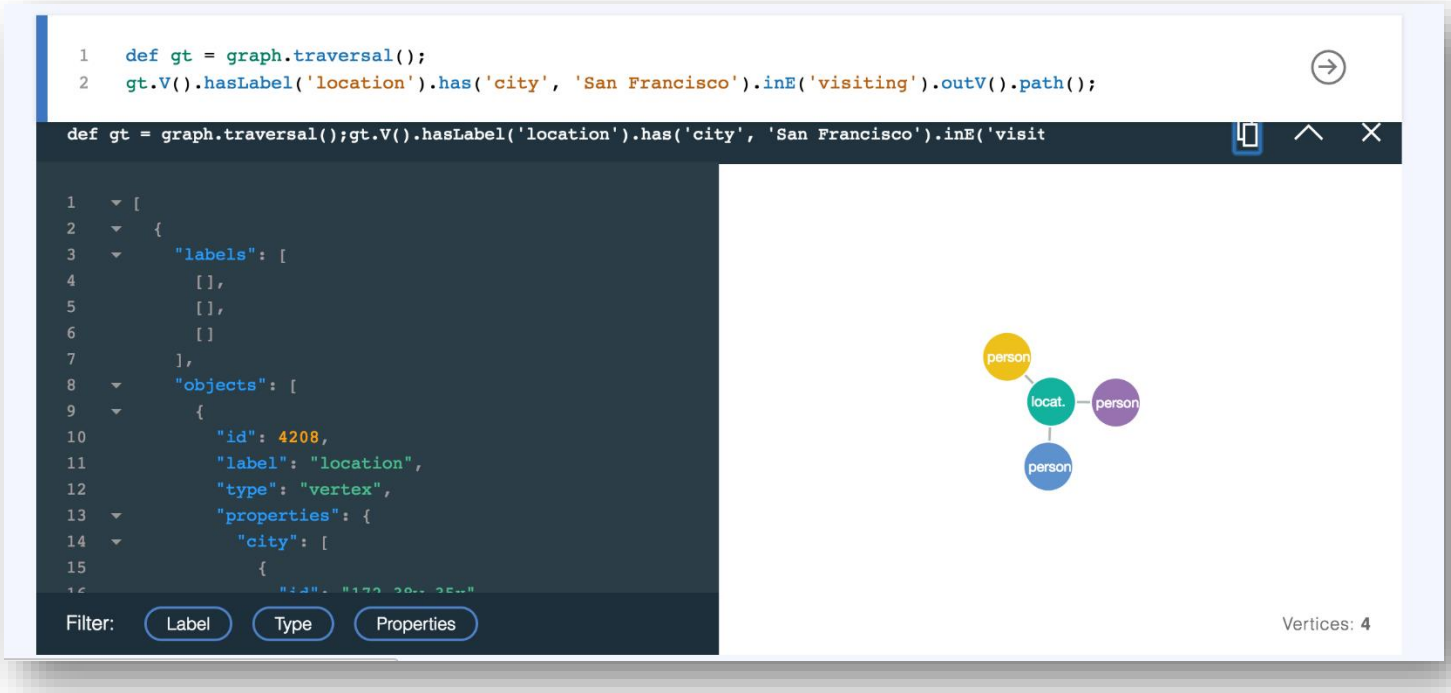
The sample query set performed on the graph database are as follows:

1. All the people who visited San Francisco
def gt = graph.traversal(); gt.V().hasLabel('location').has('city', 'San Francisco').inE('visiting').outV().path();



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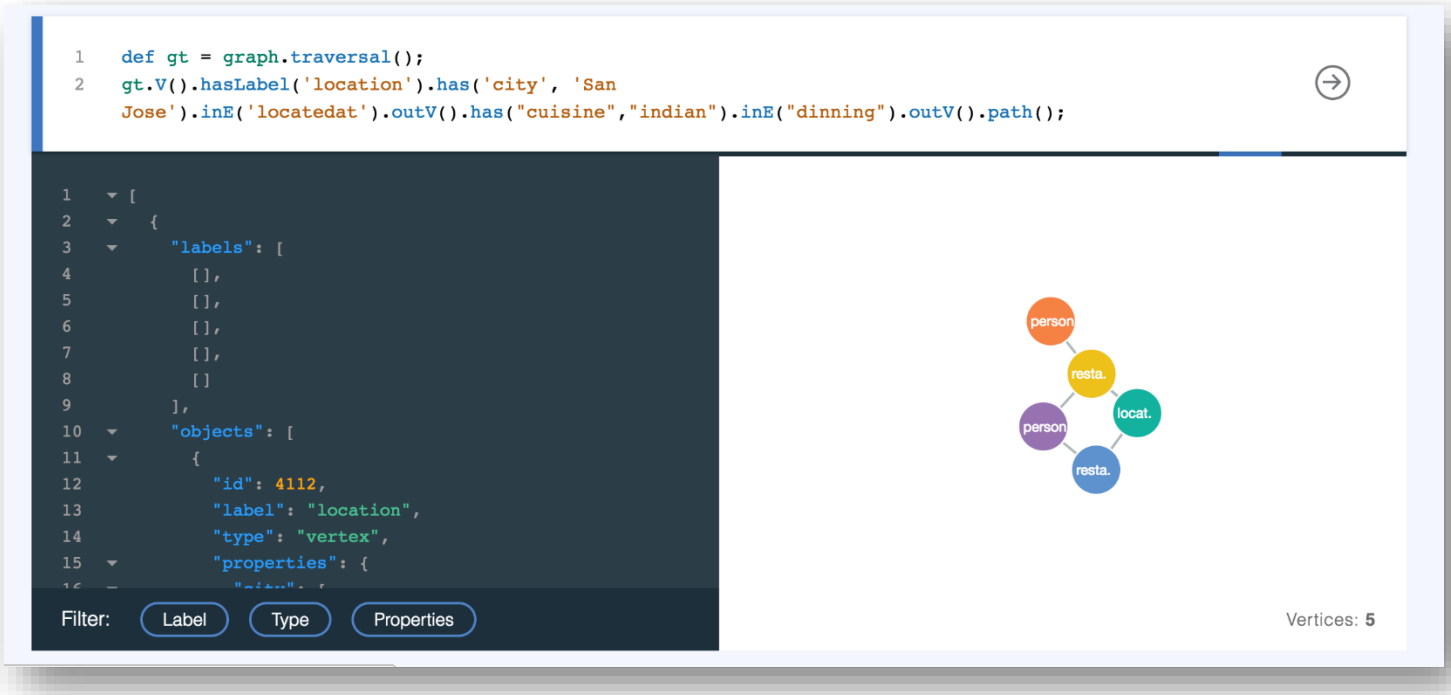
2. All the people who had an Indian Cuisine at the restaurants in San Jose
def gt = graph.traversal(); gt.V().hasLabel('location').has('city', 'San Jose').inE('locatedat').outV().has("cuisine","indian").inE("dinning").outV().path();



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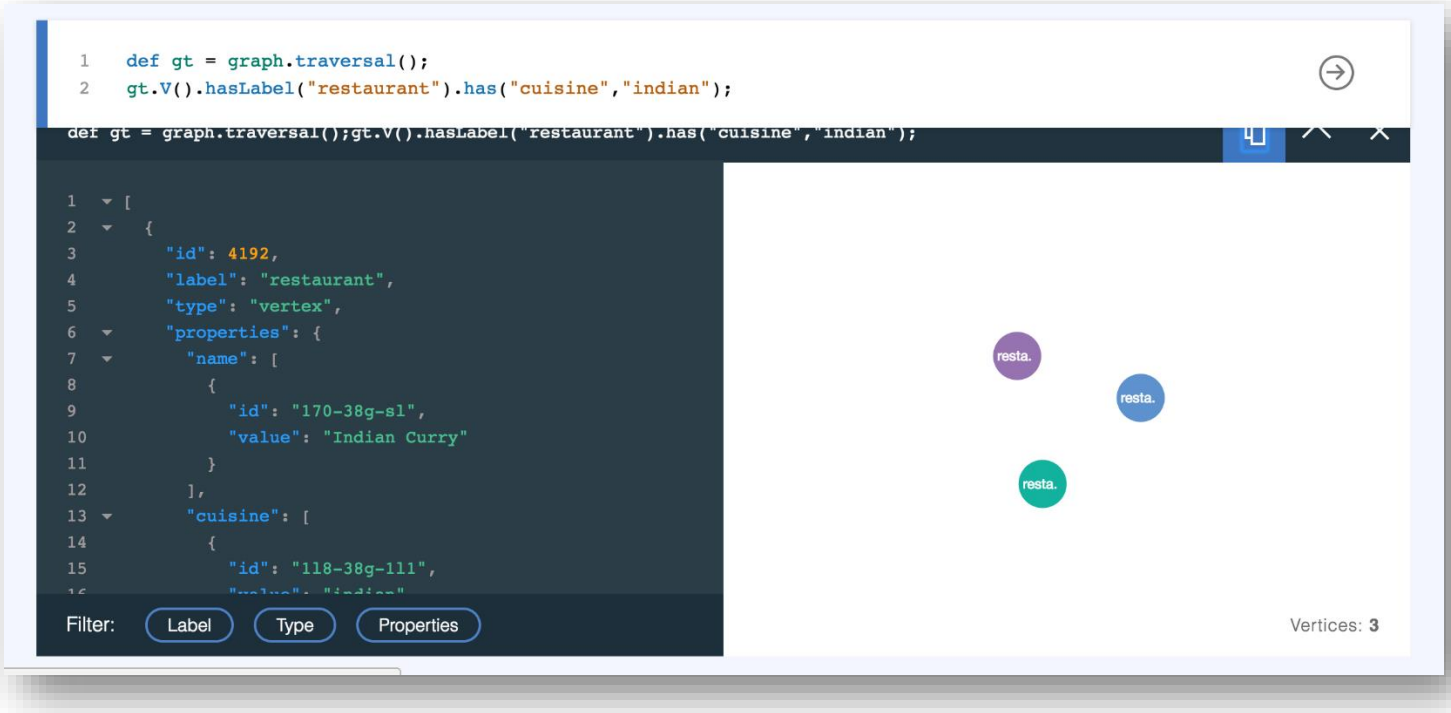
3. List all the restaurants where Indian cuisine is provided
def gt = graph.traversal(); gt.V().hasLabel("restaurant").has("cuisine","indian");



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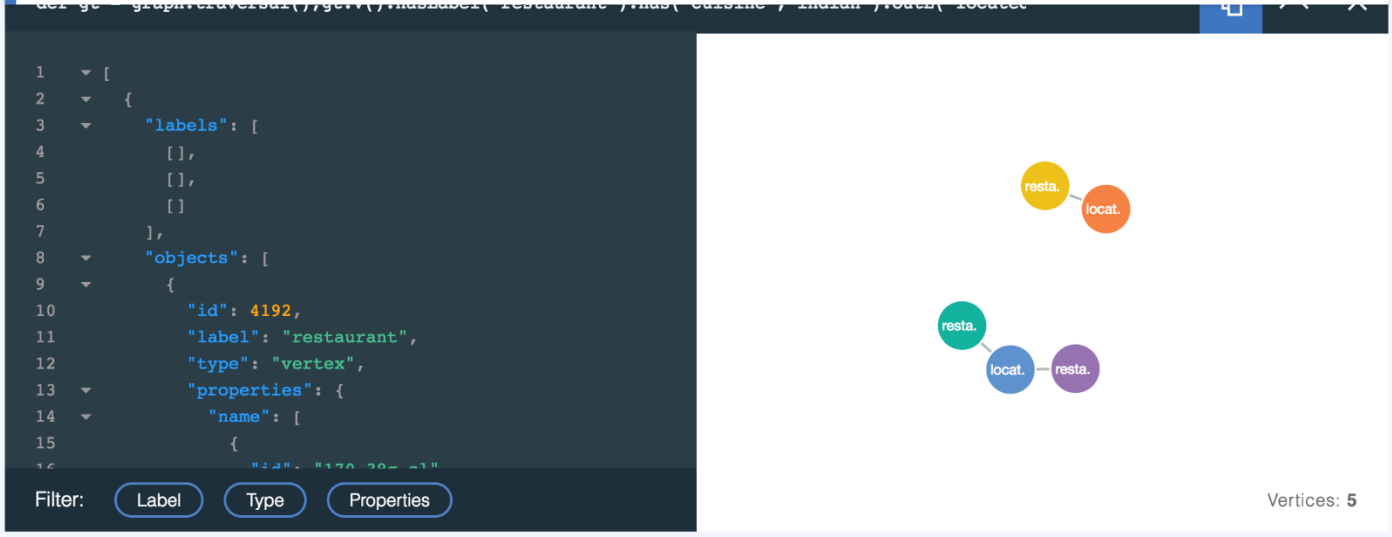
4. List all the restaurants where Indian cuisine is provided - path
def gt = graph.traversal(); gt.V().hasLabel("restaurant").has("cuisine","indian").outE('locatedat').inV().path();

```
def gt = graph.traversal();
gt.V().hasLabel("restaurant").has("cuisine","indian").outE('locatedat').inV().path();
```



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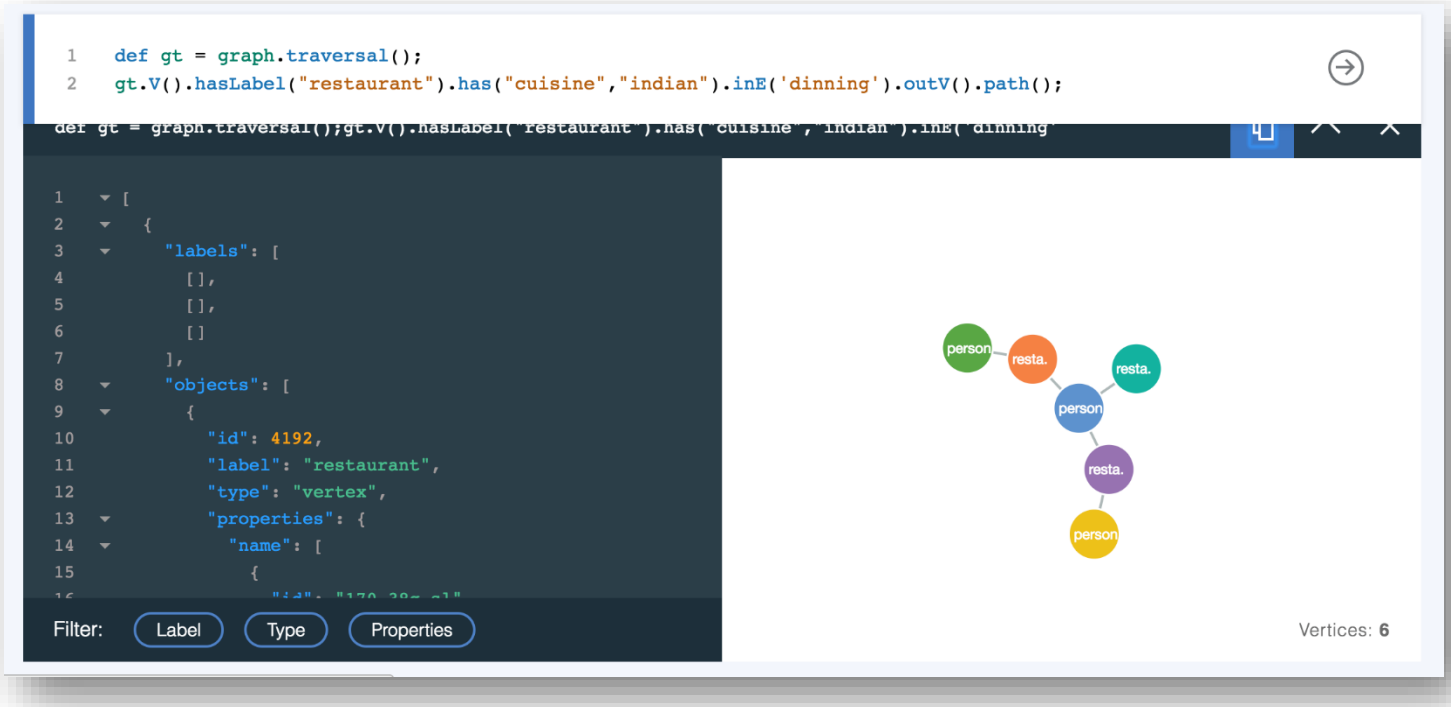
5. People dining at restaurants offering Indian cuisine
def gt = graph.traversal(); gt.V().hasLabel("restaurant").has("cuisine","indian").inE('dinning').outV().path();



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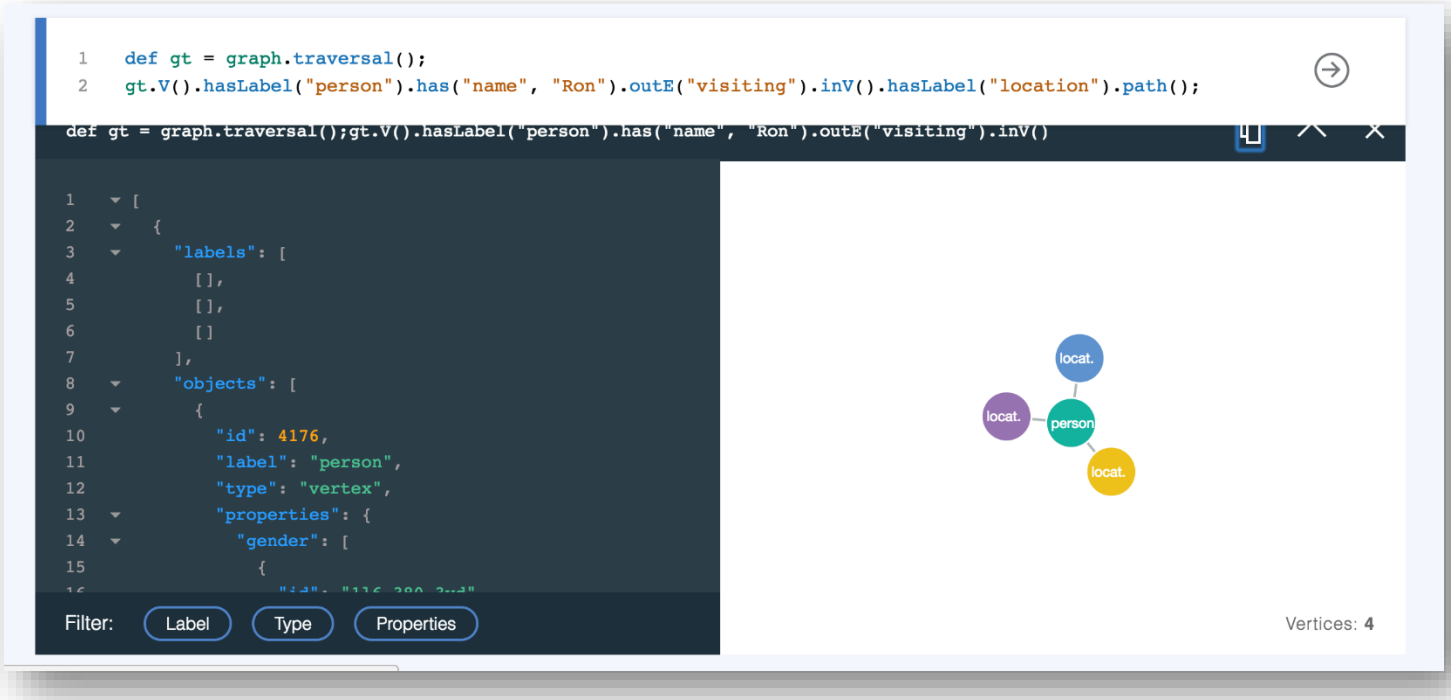
6. Get all places where Ron has visited – vertices
def gt = graph.traversal(); gt.V().hasLabel("person").has("name", "Ron").outE("visiting").inV().hasLabel("location").path();



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7. Get all places where Ron has visited - values
def gt = graph.traversal(); gt.V().hasLabel("person").has("name", "Ron").out("visiting").values('city');