Database Systems Project Report

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1 Company Business explanation

E-commerce is an online platform for purchasing goods. The platform connects the customers and the shop owners. These kinds of platforms could be one of three: business-to-business, business-to-customer, or customer-to-customer. In this project, a business-to-customer e-commerce database system is implemented. In our system, many existing businesses have a lot of products to offer to the customers. A customer could purchase any number of a chosen product as long as it exists in the stock. Through the platform, a customer may add products to the basket. And a business deals with a shipping company that will ship the product to the customer.

2 Database design

2.1 Design Explanation

In this e-commerce database, there are five entities: the business (company), the customer, the product, the basket, and the shipping company (cargo). Each business must have a license ID, a business name, category of products, telephone, and location. Every product must have an ID, a category name, a price, and a specification. The database must keep tracks of the number of products in stock. Every customer must have a first and a last name (composite attribute), an address (street, city) (P.S.: It is a local e commerce platform therefore country is not it needed), a telephone, an email, credit card info (name, number, CVC, date), and auto-generated ID. Every basket has its own automatically generated ID and a total price. Every shipping company must have a name, and an ID. It must also store the shipment ID, a courier information consisting of name and telephone (composite attribute), and delivery date.

All companies in the database must offer at least one product, and all products must be related to one company. Moreover, all customers have their own unique baskets. However, not all customers add products to their baskets; therefore, some baskets remain empty. And there exits some unpopular products in the database which are not added to any basket. Also, the database stores information about inactive cargo companies. Furthermore, because some baskets can be empty, not all baskets are shipped by the cargo. Also, due to some inactive customers, not all customers receive a shipped basked.

2.2 Tables

This database consists of 5 tables: company, product, customer, basket, and cargo. These are the entities; they represent the real-life physical elements that engage in the platform.

2.3 Relations

This database contains six relations that connect the five entities together: offers, adds, is added, ships, is shipped, and has.

3 ER Diagram and Snapshots

3.1 ER Diagram

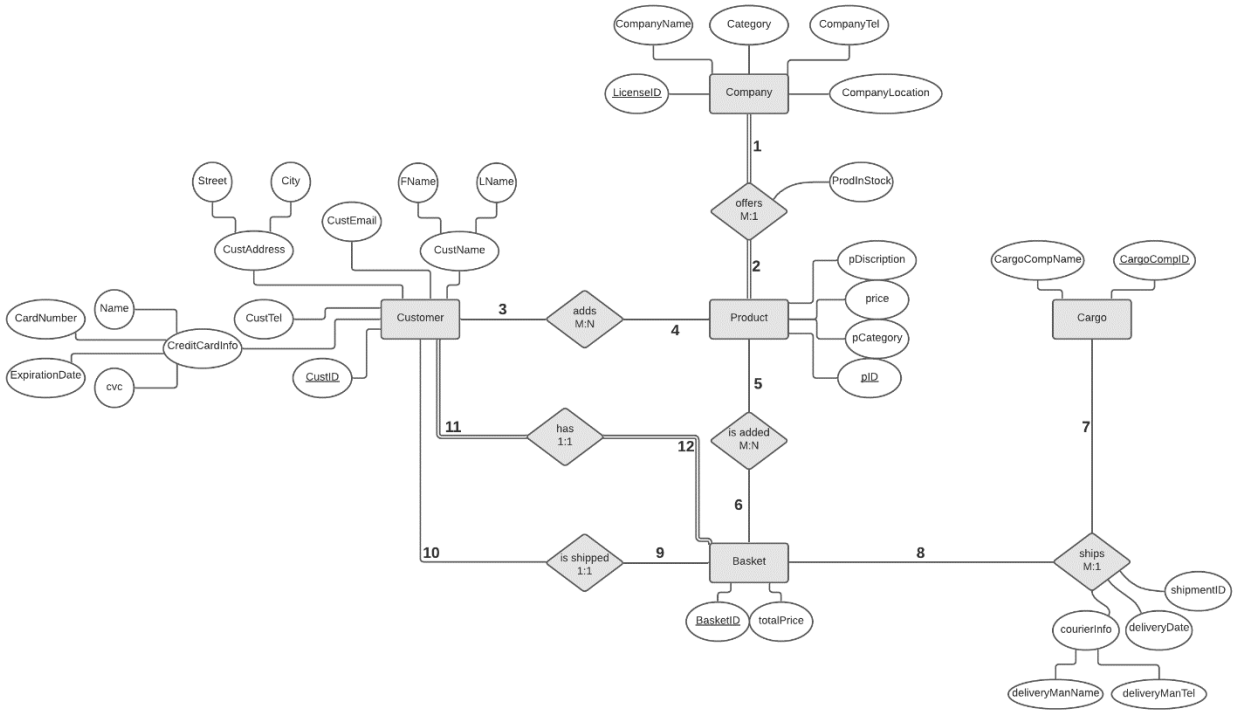

Figure1: E-commerce platform database ER diagram representation

3.2 Snapshots

Company

LicenseID	CompanyName	Category	CompanyTel	CompanyLocation
123123	Sunshine	Cosmetics	2124567	Metrokent, basaksehir, Istanbul
122122	Organics	Food	2127809	Metrokent, basaksehir, Istanbul
189189	Fashion House	Clothing	2128986	Metrokent, basaksehir, Istanbul
154154	Moonlight	Cosmetics	2135601	Xxx sokak, ortakoy, Istanbul
167167	Yummy Yummy	Food	2138906	Xxx sokak, ortakoy, Istanbul
190190	Cool Fits	Clothing	3127779	Xxx sokak, ortakoy, Istanbul

Products

pID	pCategory	pDiscription	price
111	Cosmetics	ABC Sunblock	30
112	Cosmetics	DEF Sunblock	40

113	Cosmetics	Moisturizing cream	30
114	Cosmetics	Moisturizing cream	40
115	Food	Apples	10
116	Food	Eggs	20
117	Food	Milk	15
118	Food	Candy	12
119	Clothing	Sweatshirt	100
120	Clothing	Pants	120
121	Clothing	Scarf	70
122	Clothing	Dress	200

Customer

CustID	CustName	CustEmail	CustTel	CustAddress	CreditCardInfo
1111	Hajar Faiyad	hajar@gmail.com	5357862190	Basaksehir, Istanbul	Hajar Faiyad, 4541111188902345, 11/26, 674
1112	Mariam Faiyad	mariam@gmail.com	5357862190	Basaksehir, Istanbul	Hajar Faiyad, 4541111188902345, 11/26, 674
1113	Yomna Faiyad	yomna@gmail.com	5357862196	Basaksehir, Istanbul	Hajar Faiyad, 4541111188902345, 11/26, 674
1114	Joudi Ahmed	joudi@gmail.com	5357862194	Basaksehir, Istanbul	Hajar Faiyad, 4541111188902345, 11/26, 674
1115	Dalia Omar	dalis@gmail.com	5357862193	Basaksehir, Istanbul	Omar Youssef, 2170000088902345, 09/29, 904
1116	Mohmammed Omar	mohammed@gmail.com	5357862192	Basaksehir, Istanbul	Omar Youssef, 2170000088902345, 09/29, 904
1117	Omar Youssef	omar@gmail.com	5357862191	Basaksehir, Istanbul	Omar Youssef, 2170000088902345, 09/29, 904

Basket

BasketID	totalPrice
B1	45
B2	15
B3	200
B4	70
B5	130
B6	0
B7	0

Cargo

CargoCompID	CargoCompName
511	Sea Shipment
512	Sky Shipment
513	Land Shipment

Offers (1:M) notice 1 and 2 are both total participation.

LisenceID	pID	pInStock
123123	111	5
123123	112	5
122122	115	8
122122	116	2
189189	119	5
189189	120	4
154154	113	5
154154	114	5
167167	117	7
167167	118	8
190190	121	9
190190	122	2

Adds (M:N) notice 3 and 4 are both partial participation.

custID	pID
1111	111
1111	117
1112	117
1113	122
1114	121
1115	120
1115	115

Is added (M:N) notice 5 and 6 are partial participation.

pID	BasketID
111	B1
117	B1
117	B2
122	B3
121	B4
120	B5
115	B5

Ships (1:M) notice 7 and 8 are partial participation.

CargoCompID	BasketID	shipmentID	deliveryDate	CourierInfo
511	B1	01	1/13/2022	Ahmet, 5158982377
511	B2	02	1/13/2022	Ahmet, 5158982377
511	B3	03	1/13/2022	Ahmet, 5158982377
512	B4	04	1/13/2022	Ahmet, 5158982377
512	B5	05	1/13/2022	Ahmet, 5158982377

Is Shipped (1:1) notice 9 and 10 are partial participation.

BasketID	custID
B1	1111
B2	1112
B3	1113
B4	1114
B5	1115

Has (1:1) notice 11 and 12 are total participation.

CustID	BasketID
1111	B1
1112	B2
1113	B3
1114	B4
1115	B5
1116	B6
1117	B7

4 Keys and Cardinalities

4.1 Keys

The database's unary/atomic primary keys are: LicenseID, pID, CustID, BasketID, and CargoCompID. For the relations, the primary key is not minimal anymore; it becomes a compound primary key, for it consists of a combination of two keys of the ones listed previously.

As for the foreign keys: they are used in the relations as a way of referring to the primary keys of the tables.

4.2 Cardinality

- "Offers" is M:1 because one company offers more than one product, but one product is offered by only one company.
- "Adds" is M:N because more than one customer could add the same product, and more than one product could be added by one customer.

- “Is added” is M:N because more than one product could be added to a basket, and a basket could contain more than one product.
- “Ships” is M:1 because a cargo company could ship more than one basket, but a basket is shipped by only one cargo company.
- “Is shipped” is 1:1 because every basked is shipped to only one customer, and a customer receives only one basket at a time.
- “Has” is 1:1 because very customer has only one basket, and every basket is related to only one customer.

4.3 Participation constraints

Notice the numbering of the connection lines in the ER diagram.

1: total because all companies must offer a product.

2: total because all products must be offered by a company.

3: partial because at least one inactive customer exits.

4: partial because at least one product is unpopular and not added.

5: partial because at least one product is not added to a basket.

6: partial because at least one basket is empty.

7: partial because at least one cargo company is inactive or has no shipments.

8: partial because at least one basket is not shipped by any cargo company.

9: partial because at least one basked is not shipped to any customer.

10: partial because at least one customer doesn’t have any basket shipments.

11: total because all customers have a basket.

12: total because all baskets have a customer.

5 4NF Normalization

To apply 4NF normalization to the database, I go step by step starting from the 1NF till I reach the 4NF.

Step1: check if the all the tables are in 1NF. Recall that the 1st normal form is related to the values of the tables. All tables’ values must be atomic, semantically correct, and uniquely identified. The tables cannot have a compositive nor a multivalued attribute.

Step2: modify tables customer, and ship to mate the courierInfo and the CreditCardInfo attributes atomic. To normalize the tables, we split the attributes. Note that we did not need to modify the address and the location of the customer and the company because an address all its fields are of the same type.

Customer

CustID	CustName	CustEmail	CustTel	CustAddress	CardHolder	CardNumber	Expirationdate	CVC
1111	Hajar Faiyad	hajar@gmail.com	5357862190	Basaksehir, Istanbul	Hajar Faiyad	4541111188902345	11/26	674
1112	Mariam Faiyad	mariam@gmail.com	5357862190	Basaksehir, Istanbul	Hajar Faiyad	4541111188902345	11/26	674
1113	Yomna Faiyad	yomna@gmail.com	5357862196	Basaksehir, Istanbul	Hajar Faiyad	4541111188902345	11/26	674
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1117	Omar Youssef	omar@gmail.com	5357862191	Basaksehir, Istanbul	Omar Youssef	2170000088902345	09/29	904

Ship

CargoCompID	BasketID	shipmentID	deliveryDate	CourierInfo	CourierTel
511	B1	01	1/13/2022	Ahmet	5158982377
511	B2	02	1/13/2022	Ahmet	5158982377
511	B3	03	1/13/2022	Ahmet	5158982377
512	B4	04	1/13/2022	Ahmet	5158982377
512	B5	05	1/13/2022	Ahmet	5158982377

Step3: check if the all the tables are in 2NF. Recall that the 2nd normal form is related to the partial dependencies. All nonprime attributes must be fully dependent from the prime key, which is true for the current database.

Step4: check if the all the tables are in 3NF. Recall that the 3rd normal form is related to the transitive dependencies.

Step5: modify the Offers functions. Notice that the pInStock attribute depend on the product, or on the pID, not on the licenseID nor the company.

Offers

LisenceID	pID
123123	111
123123	112
122122	115
122122	116
189189	119
189189	120
154154	113

154154	114
167167	117
167167	118
190190	121
190190	122

Stock

pID	pInStock
111	5
112	5
115	8
116	2
119	5
120	4
113	5
114	5
117	7
118	8
121	9
122	2

Step6: check if the all the tables are in 4NF. Recall that the 4th normal form is related to the functional dependencies. All tables must not have any multi-valued dependencies. Notice that the current database is in 4NF because it doesn't not contain any functional dependencies, moreover it doesn't have any duplicates.

Therefore, this database design is in 4NF.