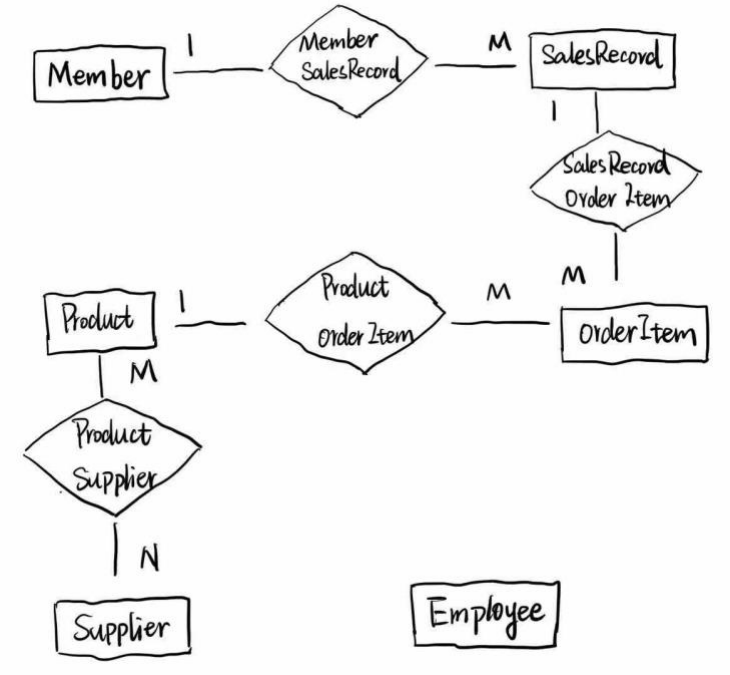
Conceptual database design:

Final ER diagram:



Constraints:

Id in Member is the PK of Member, it also FK in SalesRecord

Id in SalesRecord is the PK of SalesRecord, it also FK in OrderItem

SalesRecordId is the PK of OrderItem, it also the FK in OrderItem

ProductId is the PK of OrderItem, it also the FK in OrderItem

Id in Product is the PK of Product, it also the FK in OrderItem

Id in Supplier is the PK of Supplier, it also the FK in Product

Logical database design:

Converting ER to Relational schema:

Member

id	FirstName	LastName	DateOfBirth	Address	Phone	RewardPoint	MembershipPaid
1	Chaoneng	Quan	12/6/2020	UA	123	100	Yes
2	Jian	Fang	12/6/2020	UA	456	100	Yes

SalesRecord

id	OrderDate	PaymentMethod	TotalAmount	MemberId
5200013864	20201206	VISA	599.99	1
5200013865	20201206	MASTER	299.99	2

OrderItem

SalesRecordId	ProductId	PaidPrice	Quantity
5200013864	3052	599.99	1
5200013865	4033	299.99	1

Product

id	Name	RetailPrice	Category	MemberDiscount	StockInfo	Supplier
3033	Wireless Mouse	199.99	Input Device	0	3	9880
3052	FHD Monitor	599.99	Display	0	2	5236
4033	Wireless Keyboard	299.99	Input Device	0	6	9880

Supplier

Id	Name	RestockDate	SupplyPrice	Amount
9880	Logitech	12/6/2020	199.99	3
5236	DELL	12/6/2020	599.99	2
9880	Logitech	12/6/2020	299.99	6

Employee

Id	FirstName	LastName	Gender	Address	Phone	EmployeeGroup	Salary
001	Mortiest	Morty	Male	UA	123123	Sales	3000
002	Rickiest	Rick	Male	UA	456456	Sales Manager	5000
003	Bossiest	Boss	Male	UA	789789	General Manager	8000

Normalization analysis:

1st normal form defines that A relation is in 1st normal form if its attributes are not set-valued. In the 6 relations listed above, none of their attributes are set-valued, so our relations fit 1st normal form.

Table Member: X -> Y, X only contains PK. If remove PK from X, it destroys this dependency.

Non-prime attributes in Member relations are all the attributes except the PK.

The PK in Member relation is the only CK and the only prime attribute

In Member relation, all non-prime attribute of Member is FFD upon every CK of Member

Table SalesRecord: X -> Y, X contains PK and FK. Because in SalesRecord, we need both SalesRecordId and MemberId to identify the record. There is possibility that one member can have multiple sales records. If remove either PK or FK, it destroys this dependency.

Non-prime attributes in SalesRecord relations are all the attributes except the PK and FK.

In SalesRecord relation, all non-prime attribute of SalesRecord is FFD upon every CK of SalesRecord

Table OrderItem: X -> Y, X only contains PK. If remove any PK from X, it destroys this dependency. Because each orderItem Id corresponds to one record. So, we need the PK to identify each OrderItem Record.

Non-prime attributes in OrderItem relation are all the attributes except the PK.

In OrderItem relation, all non-prime attribute of OrderItem is FFD upon every CK of OrderItem.

Table Product: X -> Y, X contains PK and FK. If remove PK or FK from X, it destroys this dependency. Because same product can be supplied by different supplier, which may cause the price difference

Non-prime attributes in Product relation are all the attributes except the PK and FK.

In Product relation, all non-prime attribute of Product is FFD upon every CK of OrderItem.

Table Supplier: X -> Y, X contains PK. If remove any PK from X, it destroys this dependency. Because one supplier may provide many different products.

Non-prime attributes in Supplier relation are all the attributes except the PK and FK.

In Supplier relation, all non-prime attribute of Product is FFD upon every CK of Supplier.

Table Employee: X -> Y, X contains PK. If remove PK from X, it destroys this dependency.

Non-prime attributes in Employee are all the attributes except the PK.

In Employee, all non-prime attribute of Employee is FFD upon every CK of Employee

According to the analysis listed above, all the tables are in 2nd normal form.

3rd normal form defines that A relation R is in 3rd normal form if R is in 2nd normal form and every non-prime attribute of R is non-transitively dependent on every CK of R.

For table Member, it is in 2nd normal form, and every non-attribute is directly dependent on CK of Member

For table SalesRecord, it is in 2nd normal form, and every non-attribute is directly dependent on CK of SalesRecord

For table OrderItem, it is in 2nd normal form, and every non-attribute is directly dependent on CK of OrderItem

For table Product, it is in 2nd normal form, and every non-attribute is directly dependent on CK of Product

For table Supplier, it is in 2nd normal form, and every non-attribute is directly dependent on CK of Supplier

For table Employee, it is in 2nd normal form, and every non-attribute is directly dependent on CK of Employee

Query description:

In our design, we included a query which returns top 10 customers who have spent most money at our mall.

For business like a mall, we probably will have some events each season. Getting the top 10 customers who have spent most money at our mall, it helps us to giving back rewards or bonus points to stimulate the customers continuing to do business with us.