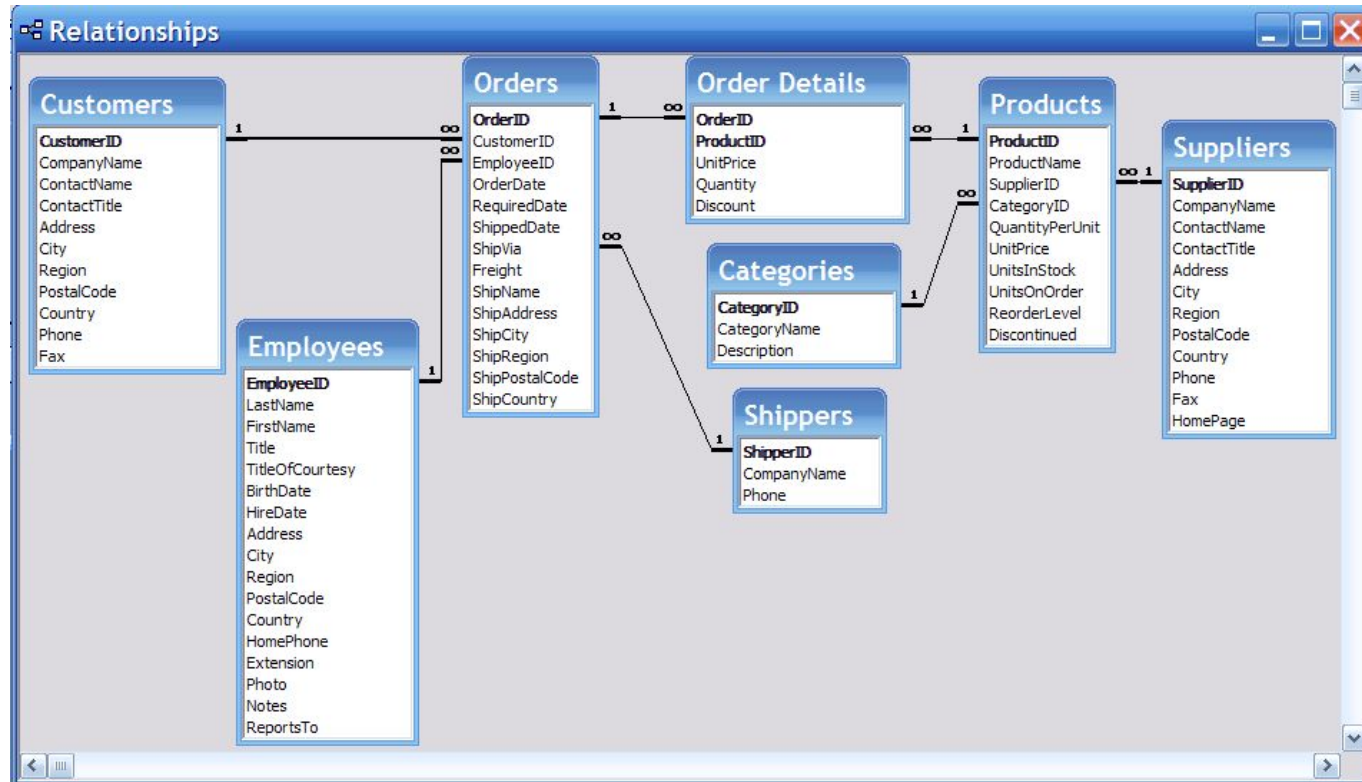


ORIE 3120

Lecture 7: Foreign Keys

From first lecture: A database schema is a collection of tables related by keys



Primary Key

A primary key is a field (or collection of fields) in a table.

It must satisfy these properties:

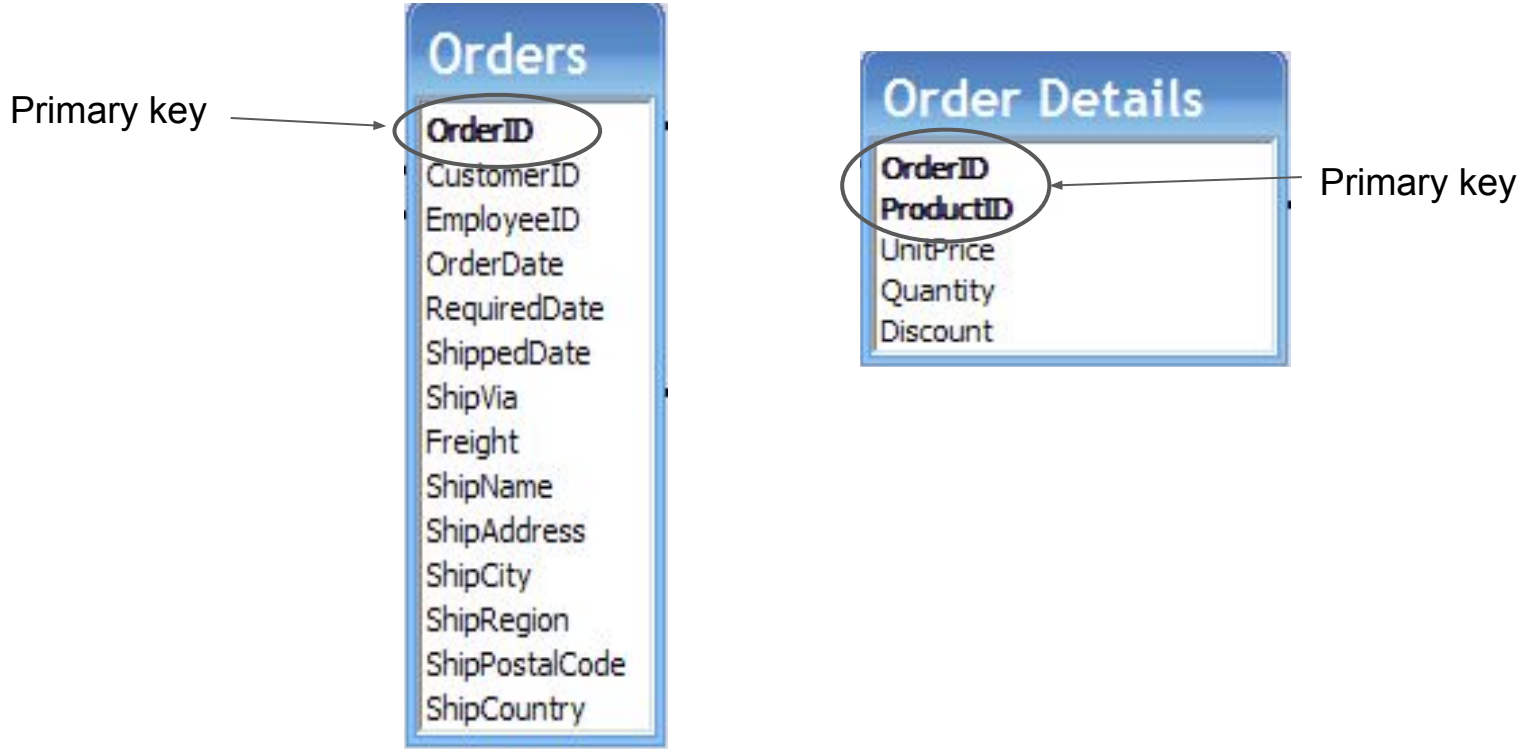
1. Each record has a unique value
2. No record has a NULL value

It helps the database identify a record uniquely.

If you try to add two records with the same value for a primary key, the database will give you an error.

If we just say “key”, we usually mean “primary key”

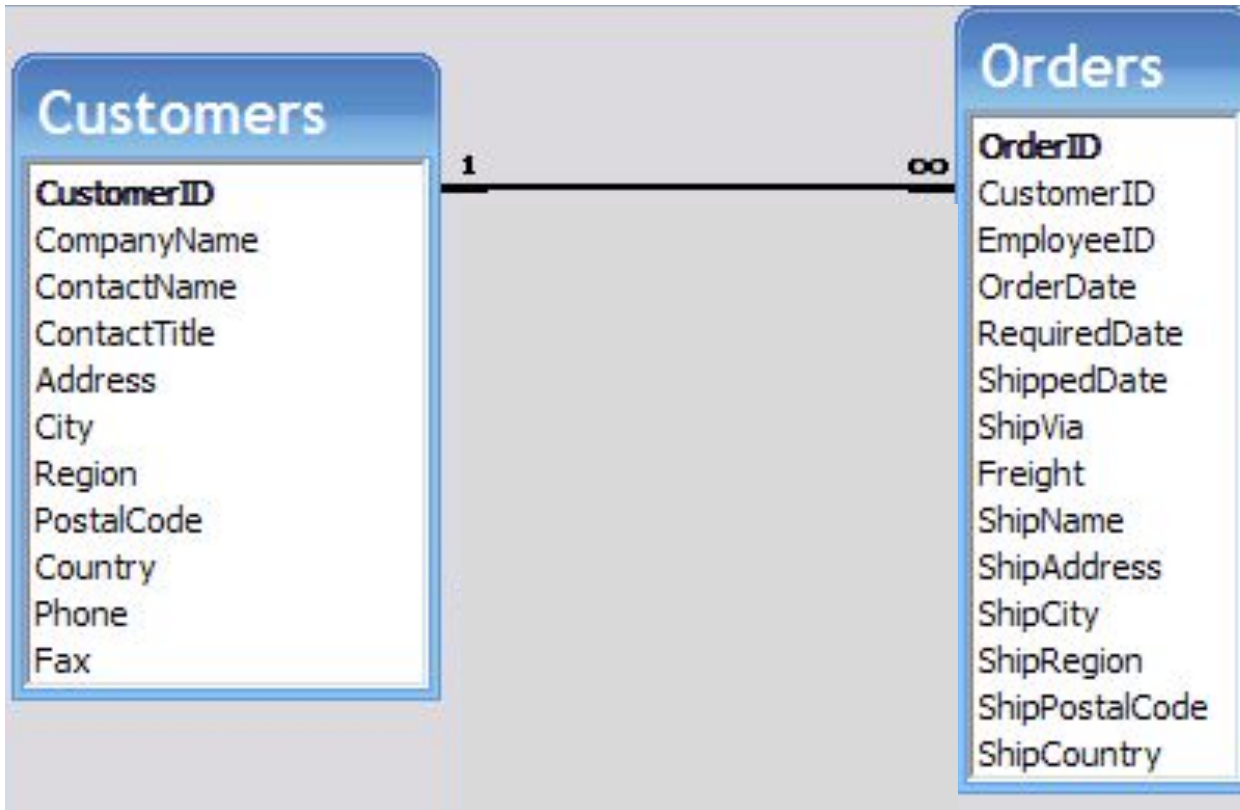
In our diagrams, we indicate primary keys with **boldface**



Definition: Foreign Key

- A foreign key is a field (or collection of fields) in one table that references another field (or collection of fields).
- Values in the referenced field(s) must be unique.
- The referenced field(s) is/are usually in a different table, but can be in the same table.

Foreign Key Example

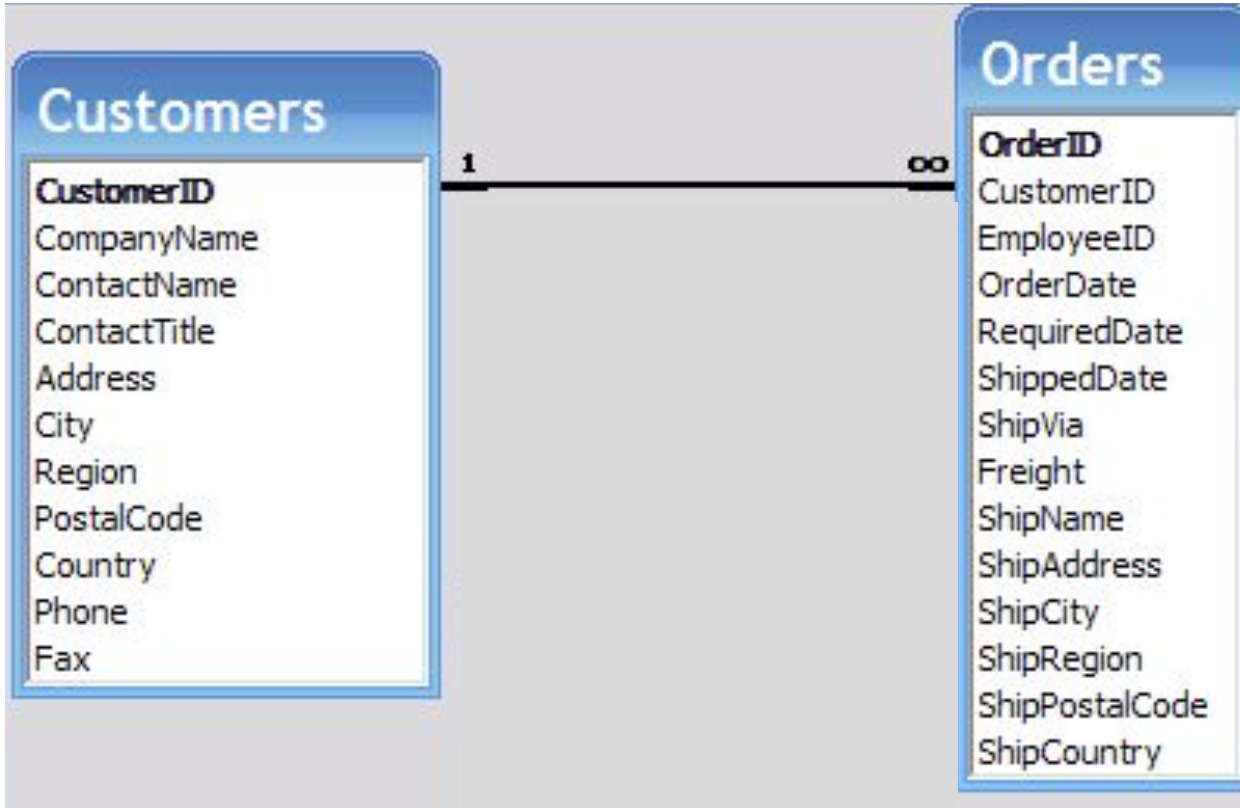


- Orders.CustomerID “references” Customers.CustomerID
- It tells us which customer made the order
- The record in Customers with that CustomerID must be unique
- The information in the other fields in that record tell us about the customer who made the order

Foreign Key

- The table referencing is called the “child”
- The table being referenced is called the “parent”
- A foreign key indicates a many-to-one relationship:
 - A record in the parent table may be referenced by many records in the child table
 - A record in the child table references at most one parent

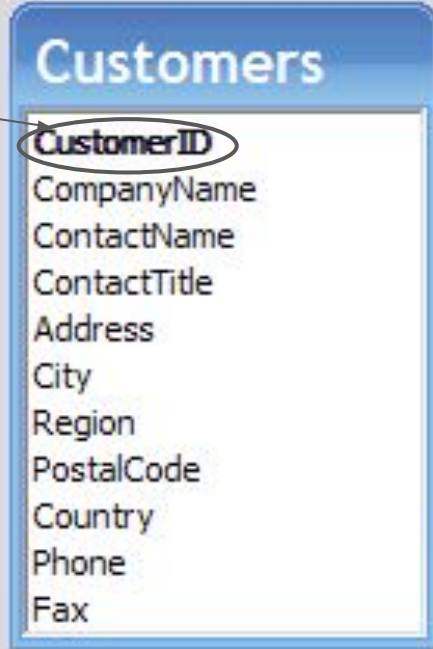
Foreign Key Example



- CustomerID in the child table (Orders) references CustomerID in the parent table (Customers)
- Orders.CustomerID is a foreign key
- This foreign key ensures that for every CustomerID in the Orders table, there is a corresponding CustomerID in the Customers table.

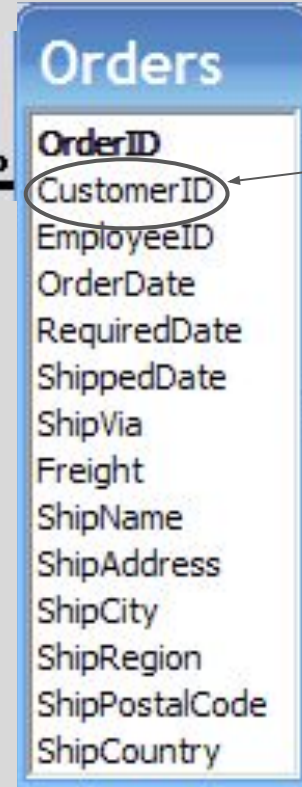
In our diagrams, we indicate foreign keys with a line labeled by ∞

Referenced
field in
parent table



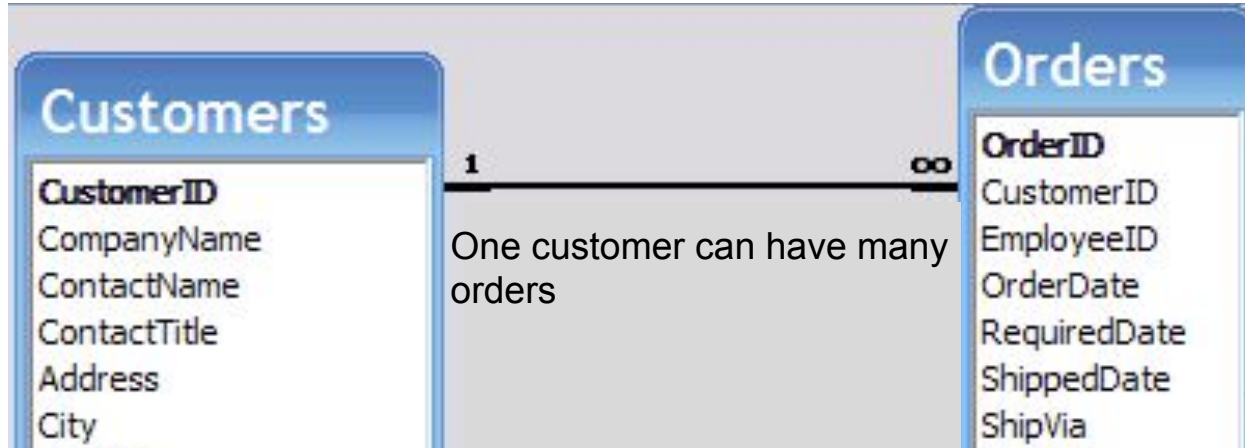
1

∞



Referencing field in
child table. This is
the foreign key.

Many-to-One Relationship



CustomerID	CompanyName	...
1	Cactus Comidas para llevar	...
2	Du Monde entier	...
3	Bottom Dollar Markets	...

OrderID	Customer ID	...	ShippedDate	ShipVia	...
1001	3		1/24/2020	4	
1002	2		1/24/2020	1	
1003	3		1/25/2020	2	

Referential Integrity

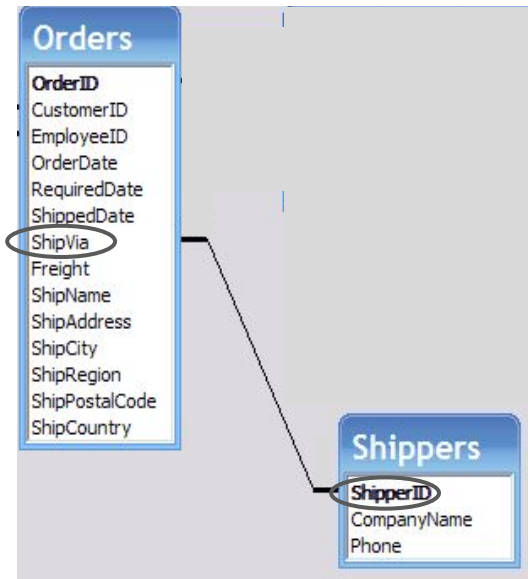
- For a value to be inserted for CustomerID in the child table (Orders), a value for CustomerID in the parent table (Customers) must exist.
- For a value to be removed for CustomerID in the parent table (Customers), all corresponding values for CustomerID must be removed from the child table (Orders).
- This is called “referential integrity”

- You can also have NULL values for a foreign key.
- This means that record in the child table does not refer to the parent table.

Q1: Foreign Key Example

OrderID	...	ShippedDate	ShipVia	...
1		1/24/2019	4	
2		1/24/2019	1	
3		1/25/2019	2	
4		1/26/2019	4	
...

ShipperID	CompanyName	Phone
1	UPS	888-123-4567
2	FedEx	888-314-1592
3	USPS	888-271-8281
4	DHL	888-141-4213



Question 1:

- (a) ShipVia 1, child
ShipperID ∞, parent
- (b) ShipVia ∞, child
ShipperID 1, parent
- (c) ShipVia 1, parent
ShipperID ∞, child
- (d) ShipVia ∞, parent
ShipperID 1, child

Q2: Another Foreign Key Example

Employee

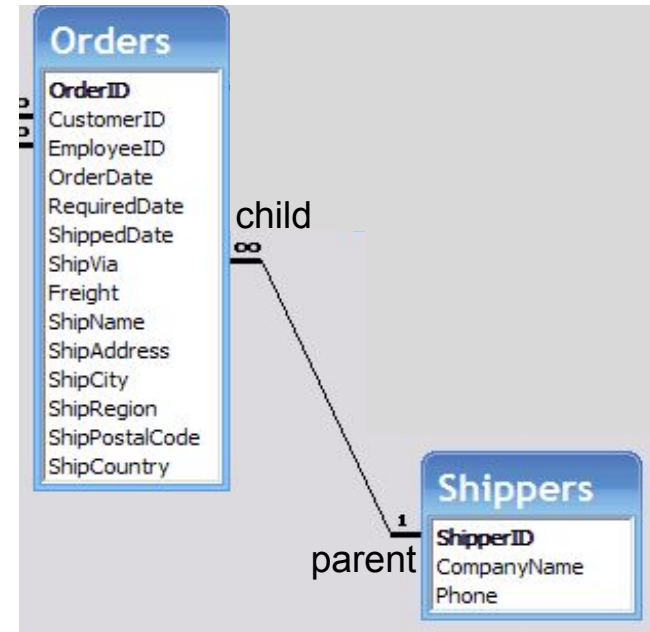
EmplID	LastName
100	Tan
101	Frazier
102	Zhou

Testing Data

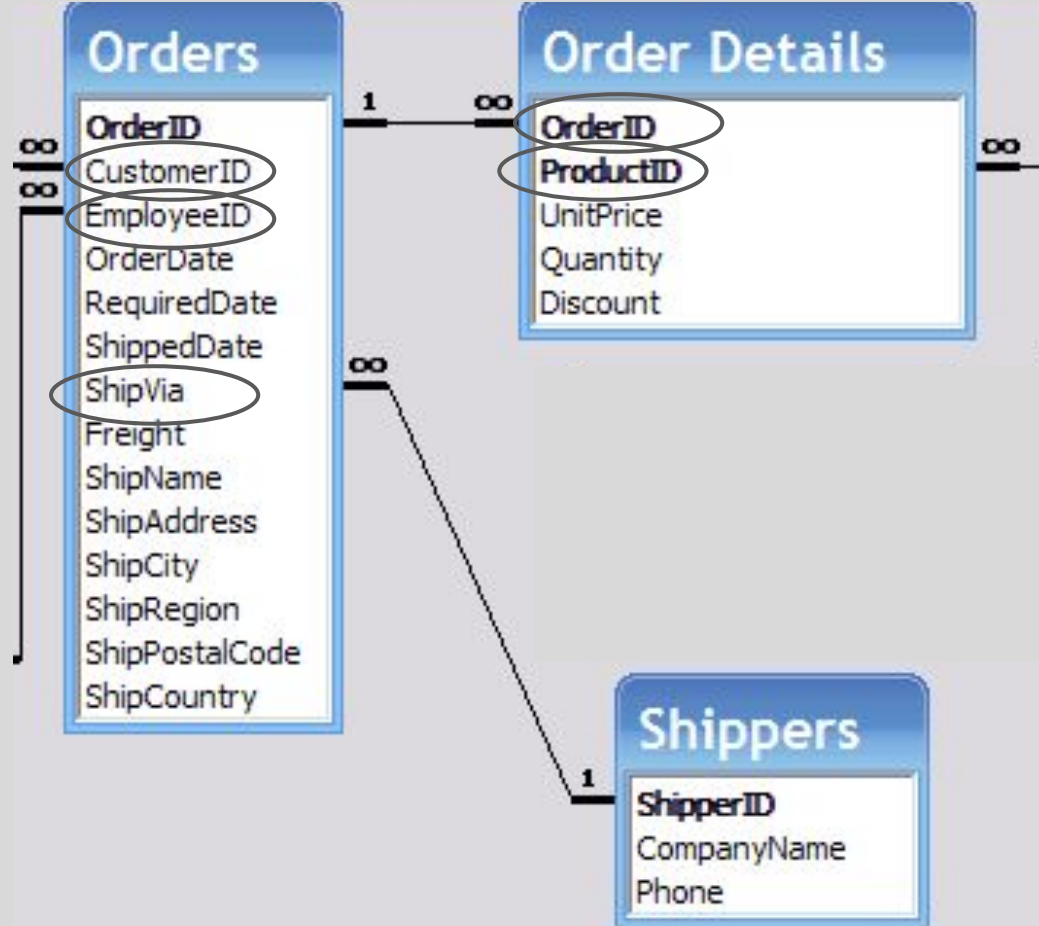
date	EmplID	Result
Feb 2	101	NOT DETECTED
Feb 3	102	NOT DETECTED
...
Feb 10	101	POSITIVE

- (a) TestingData.EmplID 1, child
EmployeeID.Emplid ∞ , parent
- (b) TestingData.EmplID ∞ , child
EmployeeID.Emplid 1, parent
- (c) TestingData.EmplID 1, parent
EmployeeID.Emplid ∞ , child
- (d) TestingData.EmplID ∞ , parent
EmployeeID.Emplid 1, child

- The ShipVia field is a foreign key for the Orders table.
- This foreign key references the ShipperID field in the Shippers table.
- The foreign key ensures that for every ShipVia in the Orders table, there is a corresponding ShipperID in the Shippers table.



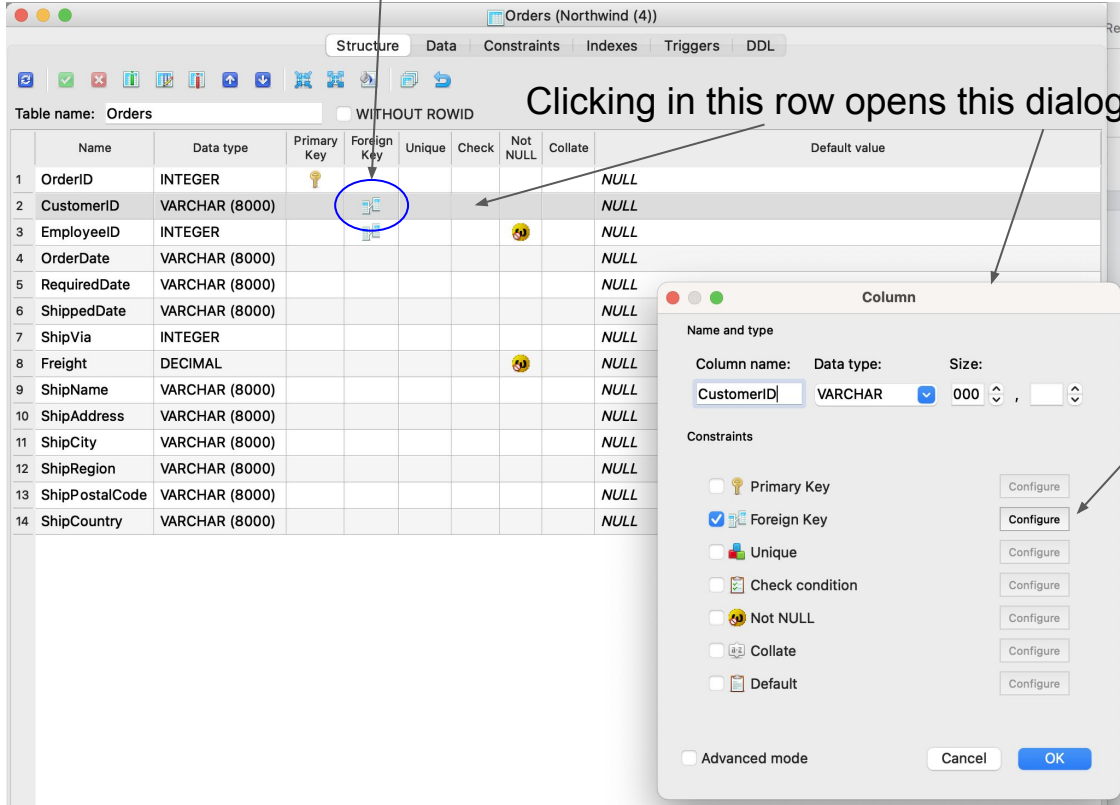
Here are some more foreign keys



Creating foreign keys in SQLite Studio

This icon means that CustomerID is a foreign key

Clicking in this row opens this dialog



	Name	Data type	Primary Key	Foreign Key	Unique	Check	Not NULL	Collate	Default value
1	OrderID	INTEGER							NULL
2	CustomerID	VARCHAR (8000)							NULL
3	EmployeeID	INTEGER							NULL
4	OrderDate	VARCHAR (8000)							NULL
5	RequiredDate	VARCHAR (8000)							NULL
6	ShippedDate	VARCHAR (8000)							NULL
7	ShipVia	INTEGER							NULL
8	Freight	DECIMAL							NULL
9	ShipName	VARCHAR (8000)							NULL
10	ShipAddress	VARCHAR (8000)							NULL
11	ShipCity	VARCHAR (8000)							NULL
12	ShipRegion	VARCHAR (8000)							NULL
13	ShipPostalCode	VARCHAR (8000)							NULL
14	ShipCountry	VARCHAR (8000)							NULL

Table name: Orders WITHOUT ROWID

Clicking this button opens this dialog

Column

Name and type

Column name: Data type: Size:

CustomerID VARCHAR 000

Constraints

- ☐ Primary Key
- ☒ Foreign Key
- ☐ Unique
- ☐ Check condition
- ☐ Not NULL
- ☐ Collate
- ☐ Default

Advanced mode

Cancel OK

Edit constraint

Foreign key

Foreign table: Customers

Foreign column: CustomerID

Reactions

- ☐ ON UPDATE NO ACTION
- ☐ ON DELETE NO ACTION
- ☐ MATCH SIMPLE

Deferred foreign key

Named constraint Constraint name

Cancel Apply

Q3: Which of these are legal
(foreign key, referenced field) pairs?

T1		
	A	B
1	1	A
2	1	C
3	1	B
4	2	D
5	3	E

T2		
	C	D
1	5	A
2	4	B
3	3	C
4	2	D
5	1	E

- (a) T1.A references T2.C
- (b) T1.A references T2.D
- (c) T2.C references T1.A
- (d) T2.D references T1.A
- (e) None of the above

Q4: Which of these are legal
(foreign key, referenced field) pairs?

T1

	A	B
1	1	A
2	1	C
3	1	B
4	2	D
5	3	E

T2

	C	D
1	5	A
2	4	B
3	3	C
4	2	D
5	1	E

- (a) T1.B references T2.C
- (b) T1.B references T2.D
- (c) T2.C references T1.B
- (d) T2.D references T1.B
- (e) None of the above

(there are multiple correct answers)

Q5: How many legal
(foreign key, referenced field) pairs
can you identify in these two tables*?

T1

	A	B
1	1	A
2	1	C
3	1	B
4	2	D
5	3	E

T2

	C	D
1	5	A
2	4	B
3	3	C
4	2	D
5	1	E

(a) 0

(b) 1

(c) 2

(d) 3

(e) 4

*do not include keys that reference themselves;
only include keys that are a single field