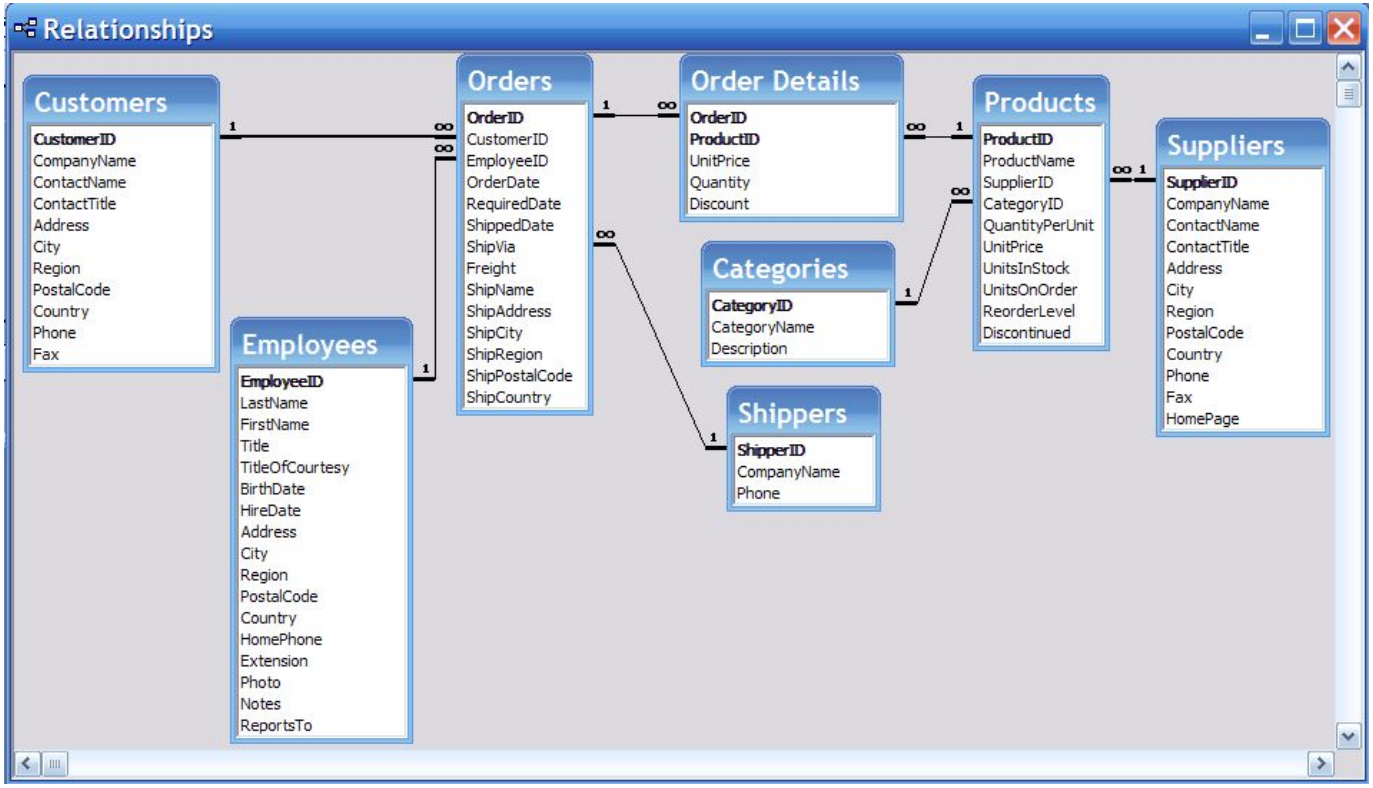
ORIE 3120

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:

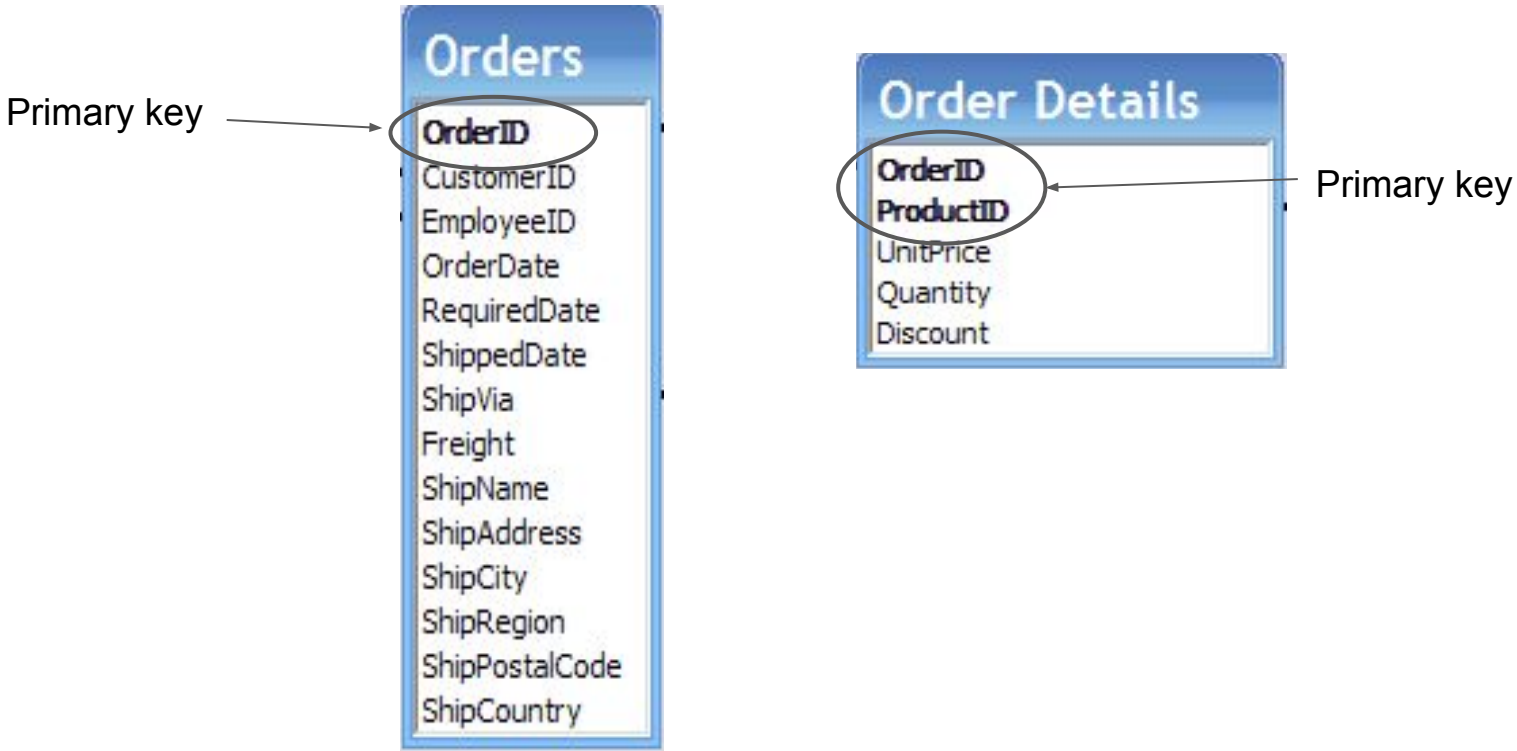
1. Each record has a unique value
2. No record has a NULL value

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”

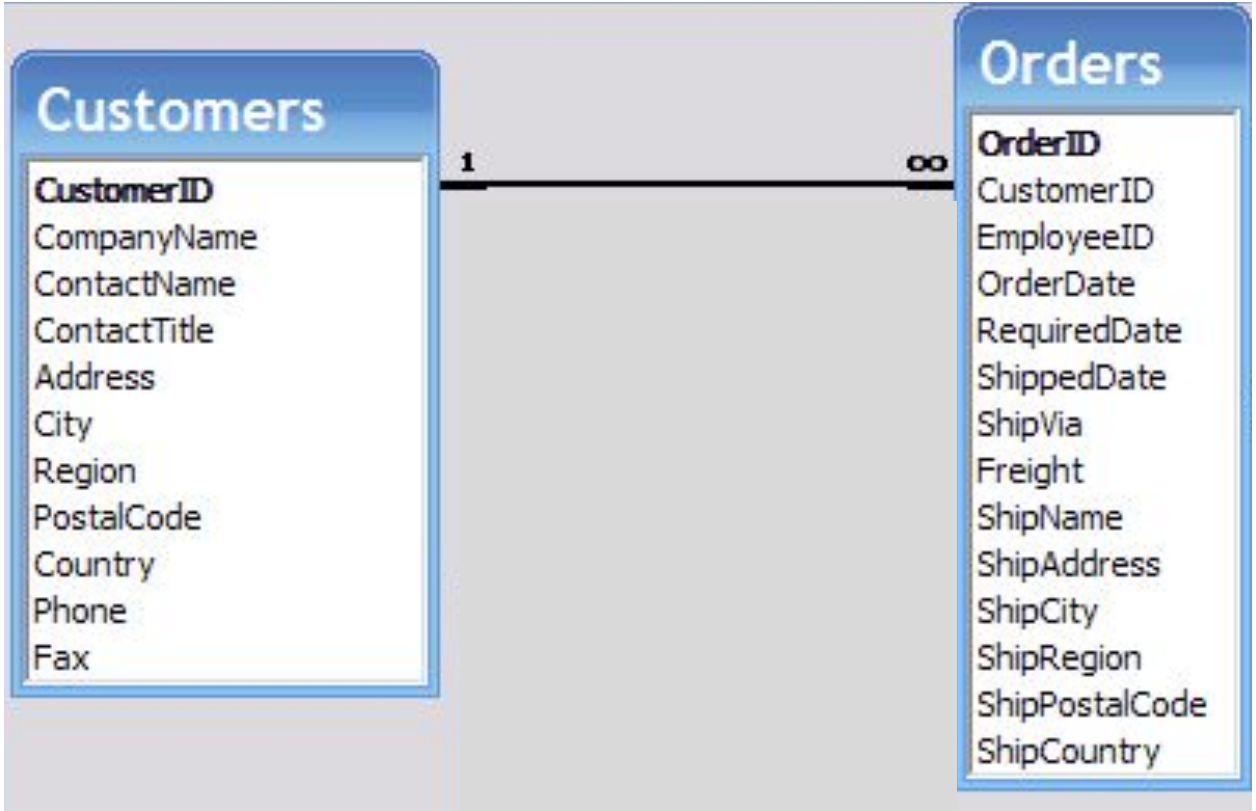
In our diagrams, we indicate primary keys with **boldface**



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

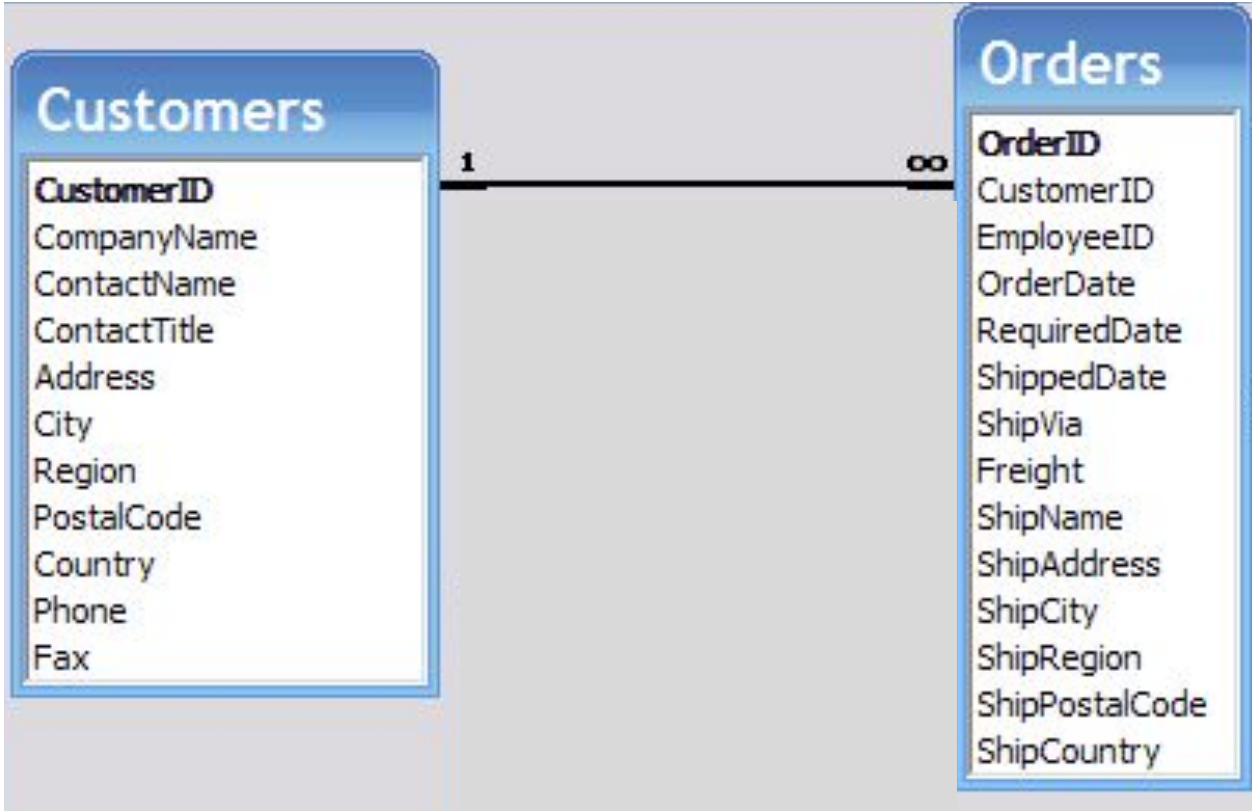


- Orders.CustomerID “references” Customers.CustomerID
- It tells us which customer made the order
- The record in Customers with that CustomerID must be unique
- The information in the other fields in that record tell us about the customer who made the order

Foreign Key

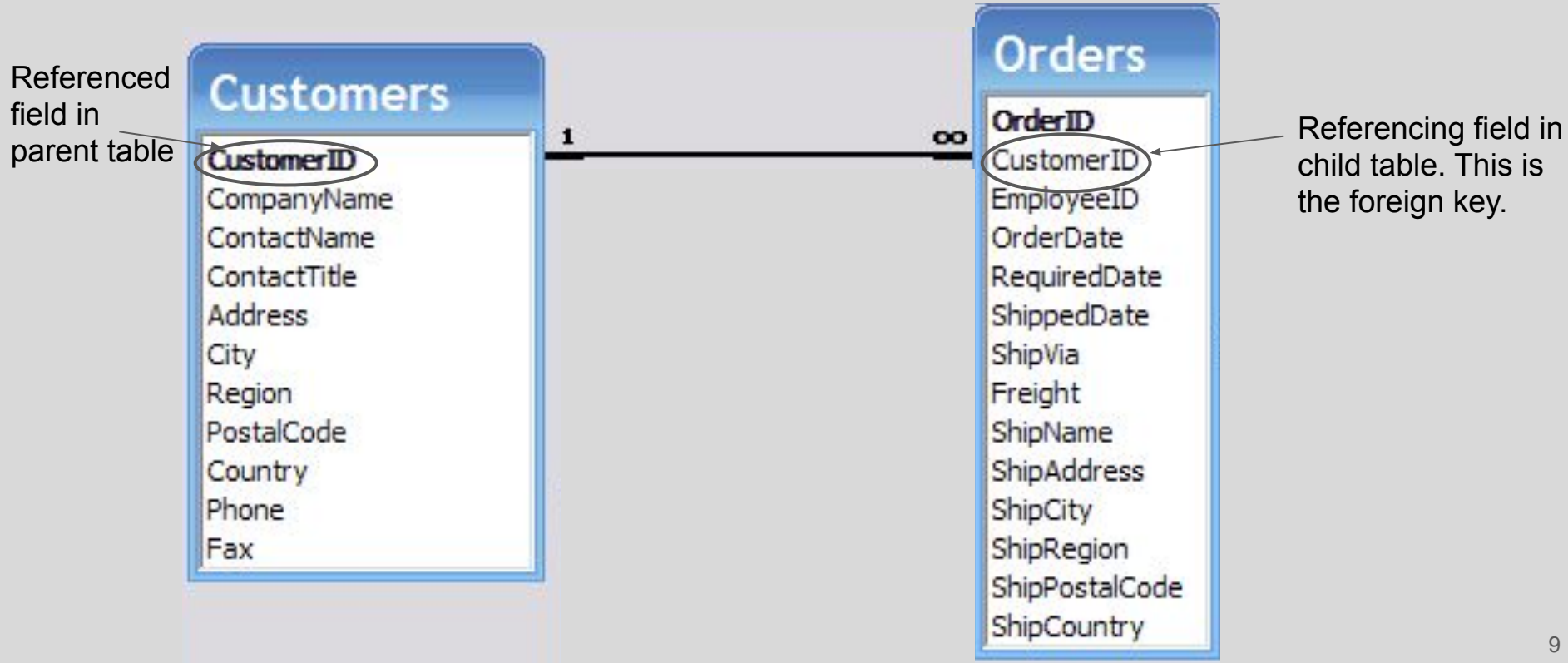
- The table referencing is called the “child”
- The table being referenced is called the “parent”
- A foreign key indicates a many-to-one relationship:
  - A record in the parent table may be referenced by many records in the child table
  - A record in the child table references at most one parent

Foreign Key Example

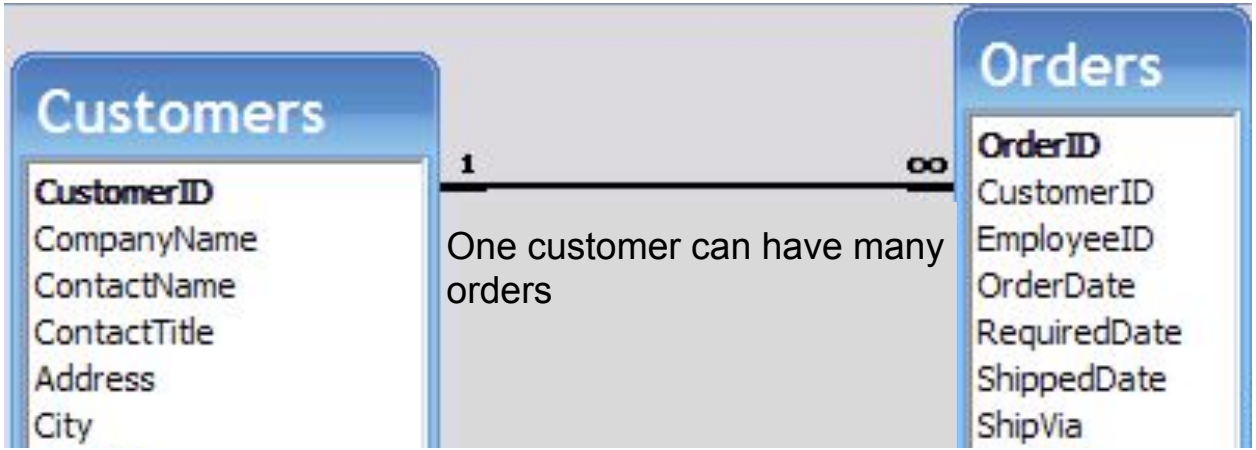


- CustomerID in the child table (Orders) references CustomerID in the parent table (Customers)
- Orders.CustomerID is a foreign key
- This foreign key ensures that for every CustomerID in the Orders table, there is a corresponding CustomerID in the Customers table.

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



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

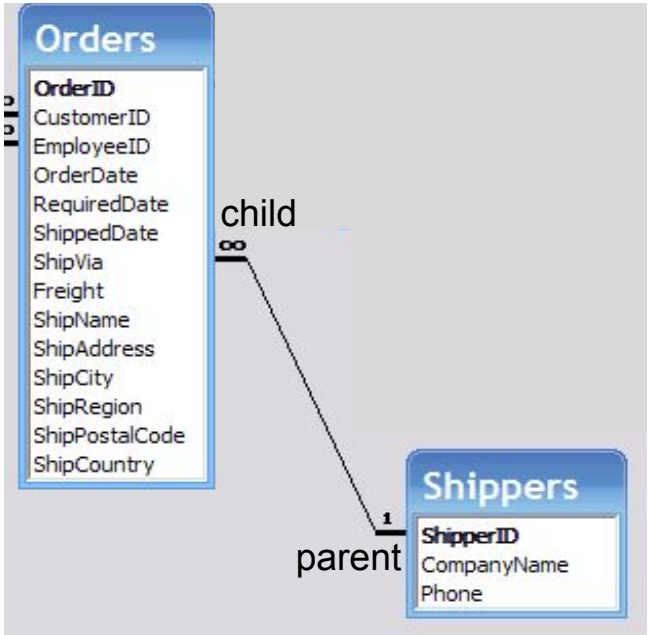
(a) TestingData.EmplID 1, child
EmployeeID.Emplid ∞, parent

(b) TestingData.EmplID ∞, child
EmployeeID.Emplid 1, parent

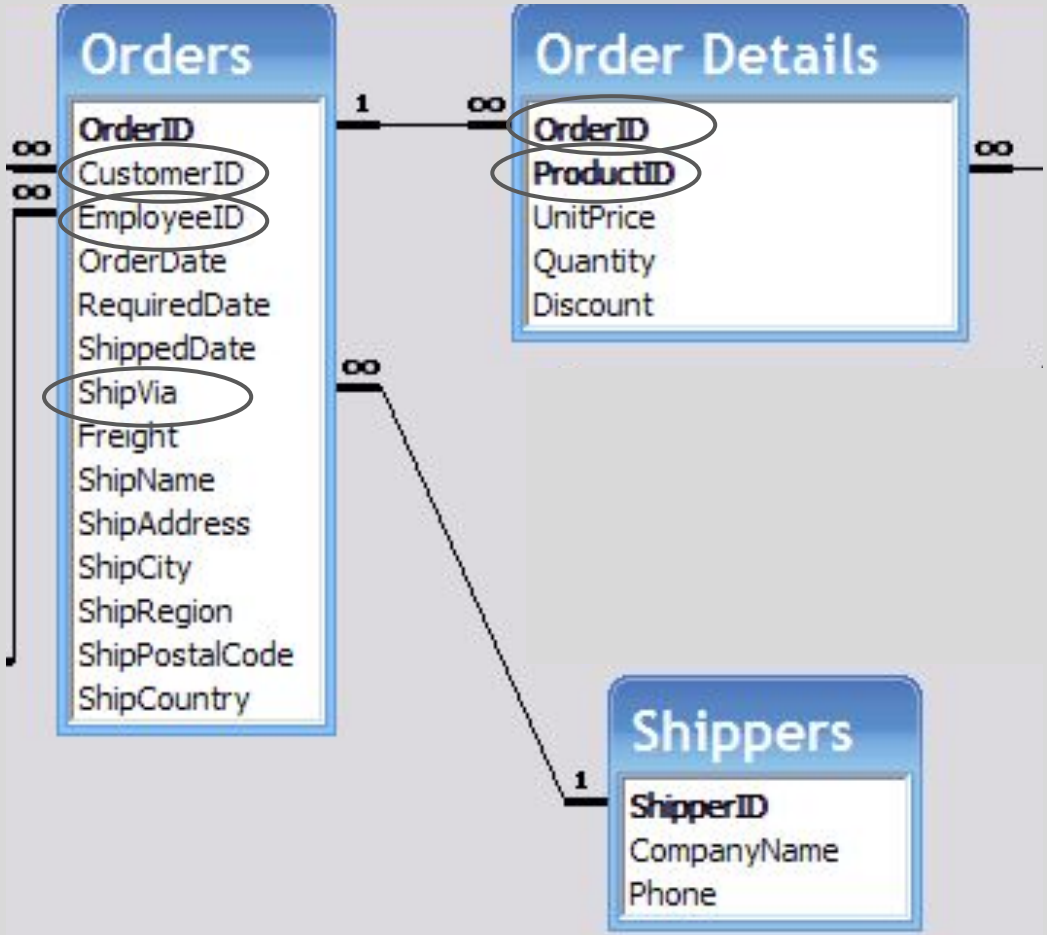
(c) TestingData.EmplID 1, parent
EmployeeID.Emplid ∞, child

(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

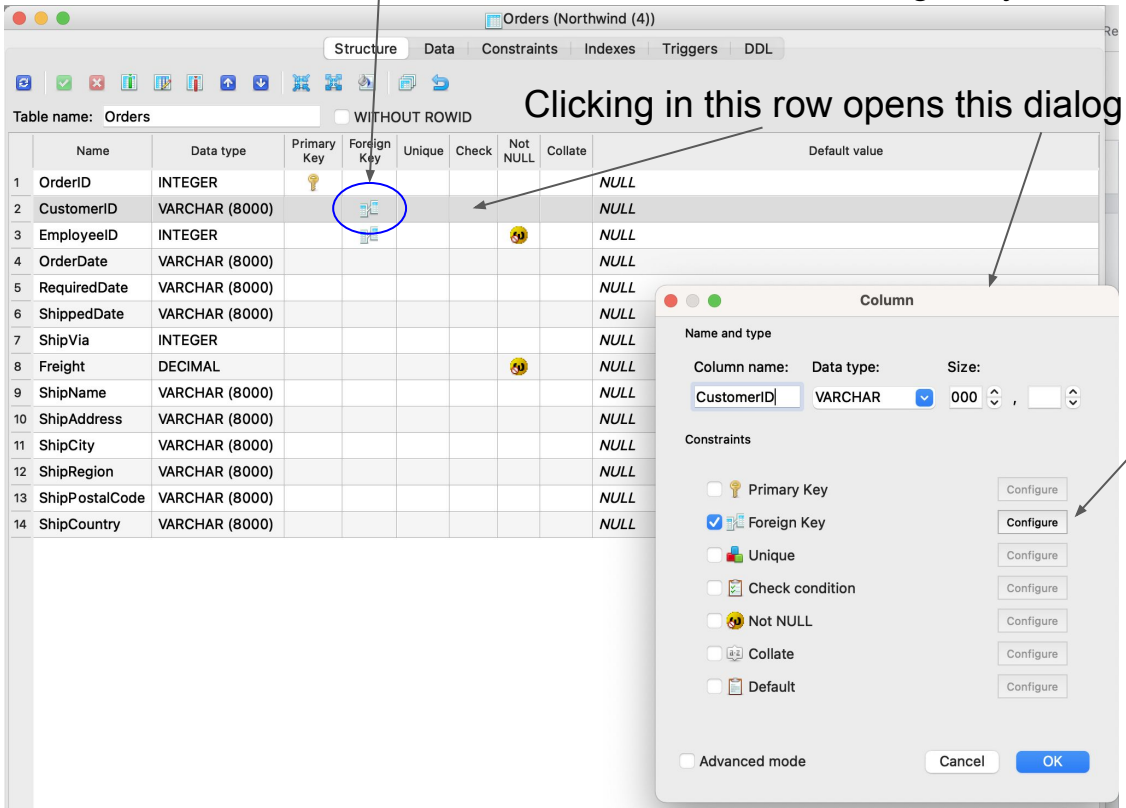


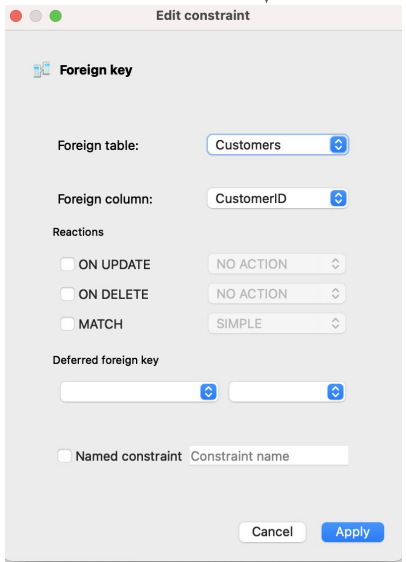
Creating foreign keys in SQLite Studio

This icon means that CustomerID is a foreign key

Clicking in this row opens this dialog

Clicking this button opens this dialog





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