

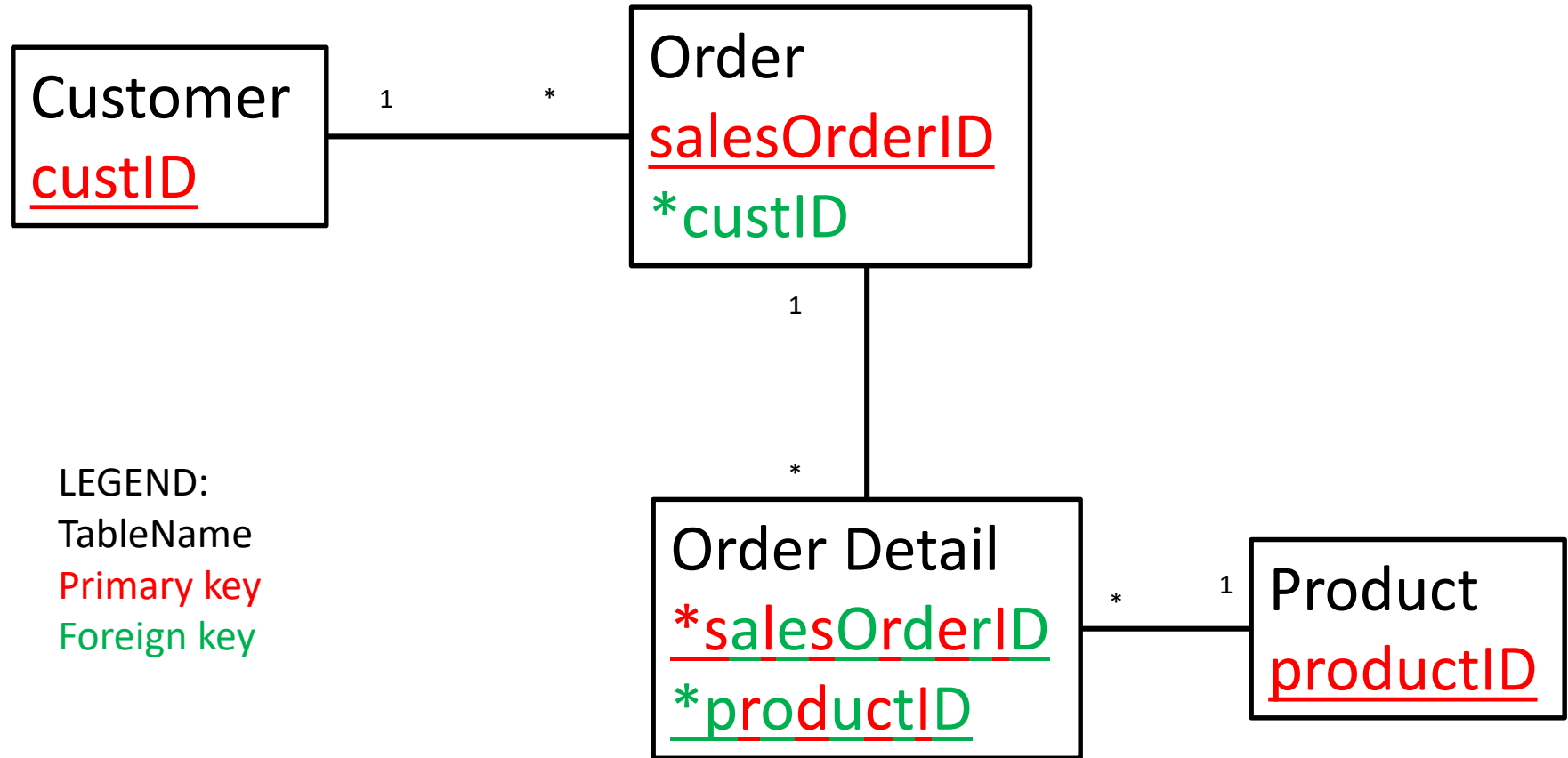
This week:

This lecture will provide an overview of

- Joins – reminder
- how to make new tables
- how to make a field a key (new and existing table)
- fields and datatypes



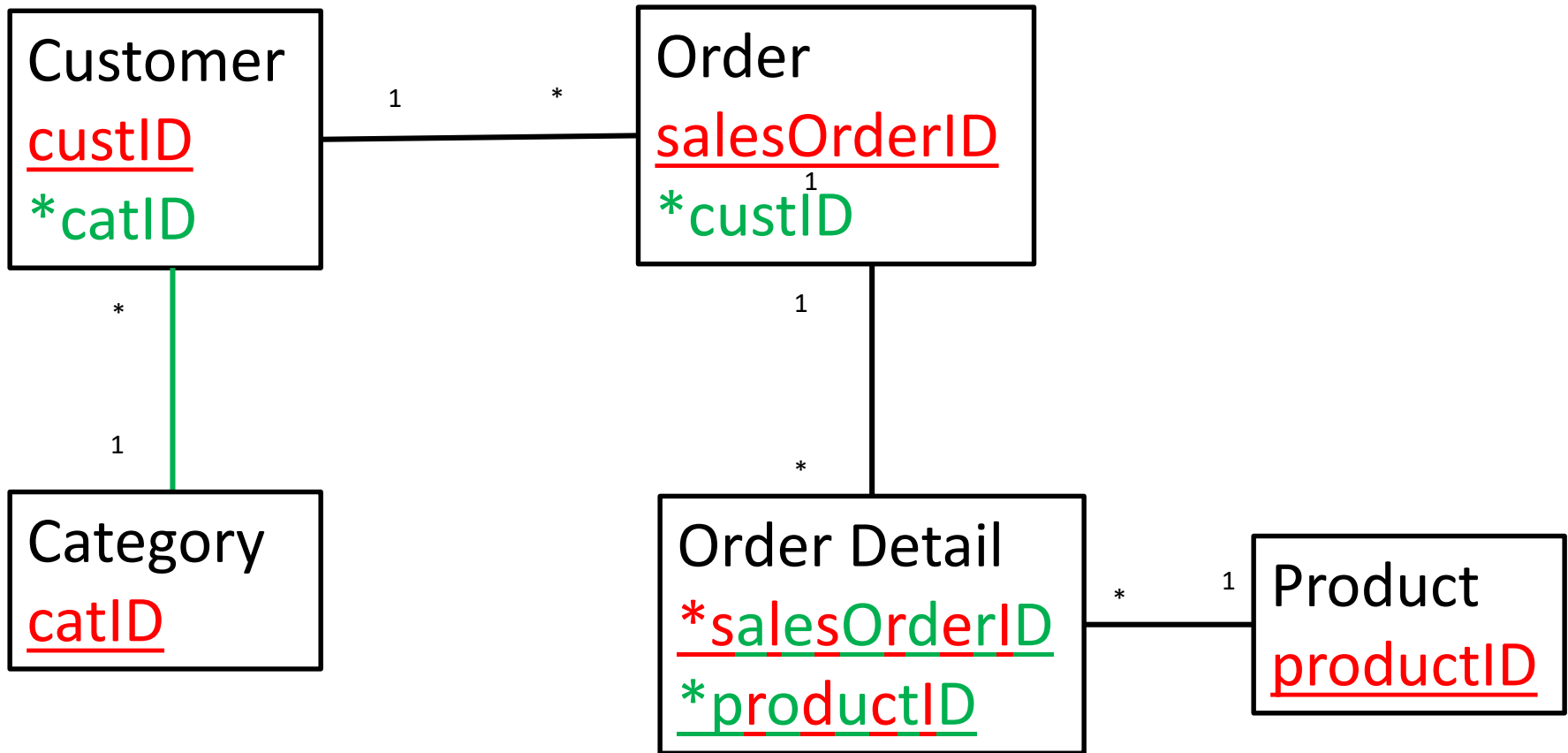
E.R. Diagram (key only) – needed for joins



SELECT * from customer INNER JOIN order on customer.custID = order.custID



E.R. Diagram (key only) – new table



Primary Keys

- tProduct - ProductID
- tCust - CustID
- tOrder - SalesOrderID
- tOrderLine - SalesOrderID,
ProductID
- *Unique* identifier for the record in the table
- Look at tProduct [query1]



Primary Key – Why?

- Each table must have a **unique** primary key
 - productID (*primary key*) for tProduct (*table*)
- Primary keys are used to identify one record for:
 - delete
 - update
 - select
 - join



PK is a Constraint (rule)

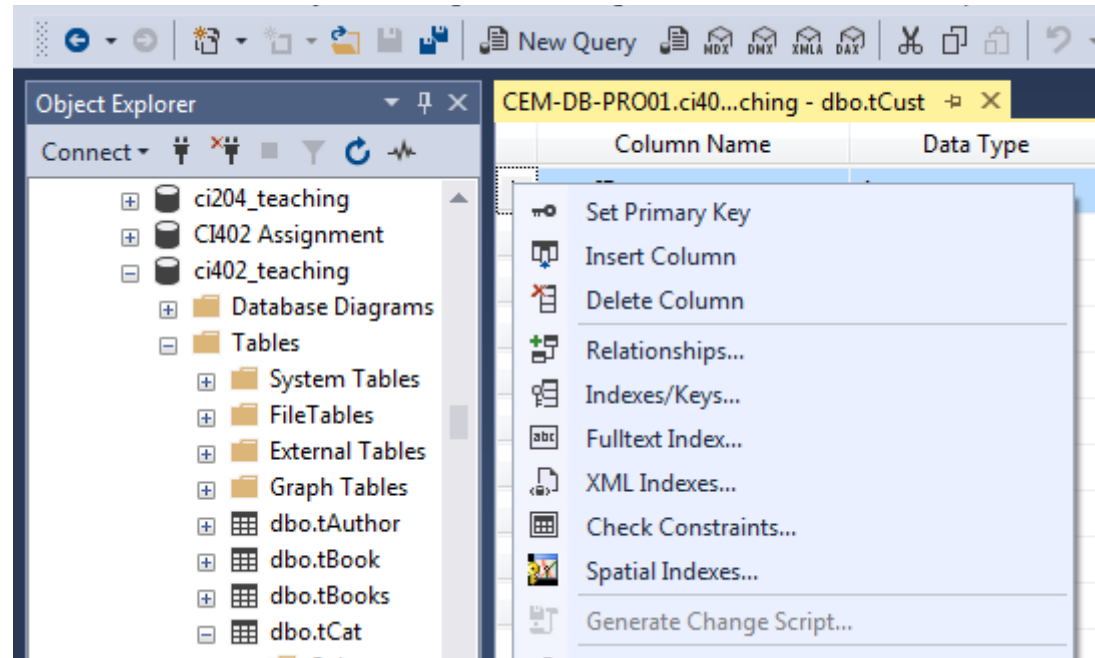
- Primary key must be unique
- DBMS will enforce this constraint



SQL Server

Adding key to existing table

- Right click on the table in *Object Explorer*, select *Design*
- Right click on the correct field and select *Set Primary Key*



MySQL

Adding key to existing table

2. Click on
Structure

Use breadcrumb trail
here to work out where
you are

1. Click on table

3. Click on PK field



The screenshot shows the MySQL Workbench interface. On the left, the 'Schemas' pane shows a tree view with 'jh1033_402' selected, and 'tCust' is highlighted under 'Tables'. A blue callout points to 'tCust' with the text '1. Click on table'. The top toolbar has buttons for 'Browse', 'Structure', 'SQL', 'Search', 'Insert', and 'Export'. A blue callout points to the 'Structure' button with the text '2. Click on Structure'. The main area displays the table structure for 'tCust' with columns: custID, fname, sname, addressLine1, addressLine2, city, country, deleteFlag, and catID. A blue callout points to the 'Primary' key icon in the bottom toolbar with the text '3. Click on Primary (key picture) to add your PK (key will show)'. The breadcrumb trail at the top reads 'Server: localhost:3306 » Database: jh1033_402 » Table: tCust'.

#	Name	Type	Collation	Attributes	Null	Default	Comments
1	custID	int(11)			No	None	
2	fname	varchar(50)	latin1_swedish_ci		Yes	NULL	
3	sname	varchar(50)	latin1_swedish_ci		No	None	
4	addressLine1	varchar(50)	latin1_swedish_ci		Yes	NULL	
5	addressLine2	varchar(50)	latin1_swedish_ci		Yes	NULL	
6	city	varchar(50)	latin1_swedish_ci		Yes	NULL	
7	country	varchar(50)	latin1_swedish_ci		Yes	NULL	
8	deleteFlag	tinyint(1)			No	None	
9	catID	varchar(1)	latin1_swedish_ci		Yes	NULL	

3. Click on Primary (key
picture) to add your PK
(key will show)



If you try to insert data with same PK ... it will fail. Is this good?
Try this [step 5 in this week's tutorial]

SQL Server Error Message for duplicateID

The screenshot shows the Microsoft SQL Server Management Studio interface. On the left is the 'Server Enterprise' tree view with folders for 'chac10', 'chemco', 'ci204_teaching', 'ci402_teaching', 'Database Diagrams', and 'Tables'. The 'Tables' folder is expanded, showing a list of tables including 'dbo.tAuthor', 'dbo.tBook', 'dbo.tBooks', 'dbo.tClass', 'dbo.tCust', 'dbo.tCust2', 'dbo.tDept', 'Columns', 'Keys', 'Constraints', 'Triggers', 'Indexes', 'Statistics', 'dbo.tLoan', 'dbo.tMember', and 'dbo.tOrder'. The 'dbo.tCust2' table is selected. The main window displays a grid of data for this table, with rows numbered 80 to 19. The data includes columns for ID, Name, Surname, Address, City, and Country. Row 19 is highlighted in red, indicating an error. An error message dialog box is open in the center, titled 'Microsoft SQL Server Management Studio'. The message reads: 'No row was updated. The data in row 100 was not committed. Error Source: .Net SqlClient Data Provider. Error Message: Violation of PRIMARY KEY constraint 'PK_tCust2_9725F2E64D605195'. Cannot insert duplicate key in object 'dbo.tCust2'. The duplicate key value is (19). The statement has been terminated. Correct the errors and retry or press ESC to cancel the change(s)'. The dialog has 'OK' and 'Help' buttons.

ID	Name	Surname	Address	City	Country
80	Payton	Benson	One Equinox W...	NULL	Sunrise
81	Max	Benson	2561 Nw 8410th...	NULL	Miami
82	Scot	Bent	5250-505 Burni...	NULL	Vancouver
83	Richard	Bentley	600 Slater Street	NULL	Ottawa
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97	Mary	Bishop	6736 Mowry	NULL	Newark
98	Mae	Black	8525 Nw 17th St.	NULL	Miami
99	Jackie	Blackwell	9876 Fruitville Rd	NULL	Sarasota
19	Jennie	Harding	1 Make Up Stre	NULL	Fakeville



Jennie Harding x School Size an x Dashboard - B x cpanel.brighton x ci402 Teaching x sql - Remove F x

cpnl.brighton.domains/cpsess6626262744/3rdparty/phpMyAdmin/tbl_sql.php?db=jh1033_402&table=tCust

phpMyAdmin

Recent Favorites

information_schema
jh1033_402
Tables
New
tCust
Columns
tOrder
tOrderLine
tProduct
Views
jh1033_504
jh1033_test

Server: localhost:3306 Database: jh1033_402 Table: tCust

Browse Structure SQL Search Insert Export Import Operations Triggers

Run SQL query/queries on table jh1033_402.tCust:

```
1 INSERT INTO `tCust` (`custID`, `fname`, `sname`, `addressLine1`, `addressLine2`, `city`,  
`country`, `deleteFlag`, `catID`) VALUES ('1', 'Jennie', 'Harding', '1 Madeup Street', NULL, NULL,  
NULL, '0', '6');
```

Columns

- custID
- fname
- sname
- addressLine1
- addressLine2
- city
- country
- deleteFlag
- catID

SELECT * SELECT INSERT UPDATE DELETE Clear

Format Get auto-saved query

☐ Bind parameters

[Delimiter ;] ☒ Show this query here again ☐ Retain query box ☐ Rollback when finished ☒ Enable foreign key checks Go

Error

SQL query:

```
INSERT INTO `tCust` (`custID`, `fname`, `sname`, `addressLine1`, `addressLine2`, `city`, `country`, `deleteFlag`, `catID`) VALUES ('1', 'Jennie', 'Harding
```

MySQL said:

#1062 - Duplicate entry '1' for key 'PRIMARY'

Console

SQL to insert new row
custID 1 (already exists)

Error message stating 'duplicateID'

Foreign Keys

- CustomerID in tOrder
- ProductID in tOrderLine
- These keys represent the whole of the record from the master table e.g. tCustomer
- We can join tables based on key fields
- [We don't *have to* actively set the foreign keys]



tOrder

- Attributes *or* Columns *or* Fields:
 - SalesOrderID [Primary key - **unique**]
 - Orderdate
 - CustomerID [Foreign key – ***not unique*** on *tOrder* – unique in customer table]
 - Value
- Look at table data [query2]



tOrder

SalesOrderID	OrderDate	CustomerID	Value
49821	2003-04-01 00:00:00.000	4	10401789.46
49838	2003-04-01 00:00:00.000	41	796279.14
49846	2003-04-01 00:00:00.000	19	34008.15
49861	2003-04-01 00:00:00.000	7	176390.57
49868	2003-04-01 00:00:00.000	11	197347.99
49873	2003-04-01 00:00:00.000	11	167487.47
50189	2003-05-01 00:00:00.000	11	4015764.38
50203	2003-05-01 00:00:00.000	12	5348783.19
50210	2003-05-01 00:00:00.000	4	4906210.44

Foreign key **CustomerID** represents the customer – no need to repeat all the name and address fields – these would be redundant.

Which customer has the most orders here?



tCust

1	Eugene	Huang	2243 W St.	Seaford
2	Ruben	Torres	5844 Linden Land	Hobart
3	Christy	Zhu	1825 Village Pl.	North Ryde
4	Elizabeth	Johnson	7553 Harness Circle	Wollongong
5	Julio	Ruiz	7305 Humphrey Drive	East Brisbane
6	Janet	Alvarez	2612 Berry Dr	Matraville
7	Marco	Mehta	942 Brook Street	Warrnambool
8	Rob	Verhoff	624 Peabody Road	Bendigo
9	Shannon	Carlson	3839 Northgate Road	Hervey Bay
10	Jacquelyn	Suarez	7800 Corrinne Court	East Brisbane
11	Curtis	Lu	1224 Shoenic	East Brisbane



Compound primary key

- tOrderdetail
- Primary key is:
 - OrderID,
 - ProductID
- SQL Server Select both fields (CTRL+CLICK) and then click PK icon when both selected
- MySQL – click checkboxes



Compound Primary Key

OrderID	ProductID	Qty
43659	709	6
43659	711	4
43659	712	2
43659	714	3
43659	716	1
43659	771	1
43660	758	1
43660	762	1
43661	708	5
43661	711	2
43661	712	4
43661	715	4

Duplicate orderID

Duplicate productID

Unique primary key is compound key: OrderID & ProductID

Explain to your neighbour how the orderID 43659 can occur six times



Using these primary keys to join tables...

[NOTE: we have only set the PK – we just need to make the values unique in the table, so that joins can link to one field]



Join tOrder with tCust

SELECT

SalesOrderID,
OrderDate,
fname,
sname,
totalDue

//read data

//which fields

FROM tCust

INNER JOIN tOrder

ON tOrder.CustomerID = tCust.CustID

//which table(s)

//how to join them

Run join [sel_join_torder_tcust.sql]



DBMS provides joins

[All part of the service!]

DBMS will find the customer details for each order

Each order record can then be displayed with customer names and addresses

Show tOrder and tCust



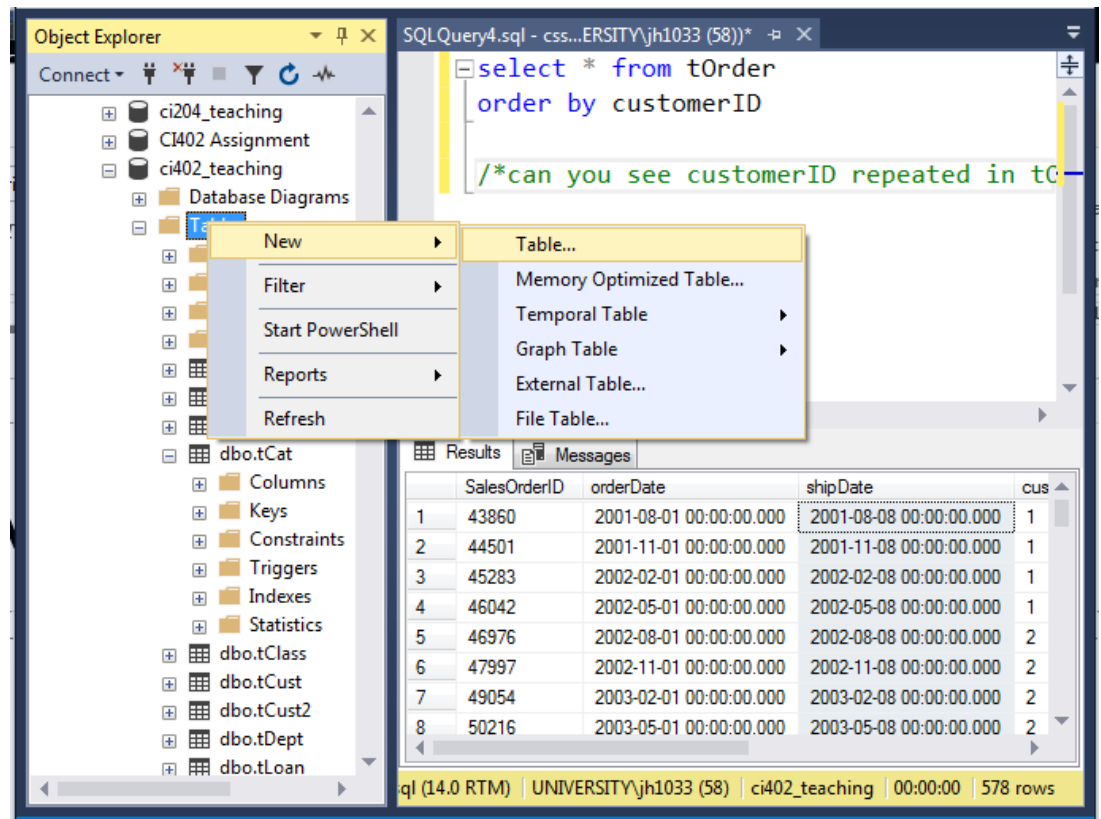
Joins mean:

- We do not have to hold all the customer details on the order table
- We do not have duplicate data
- Customer details – name , address ... held once



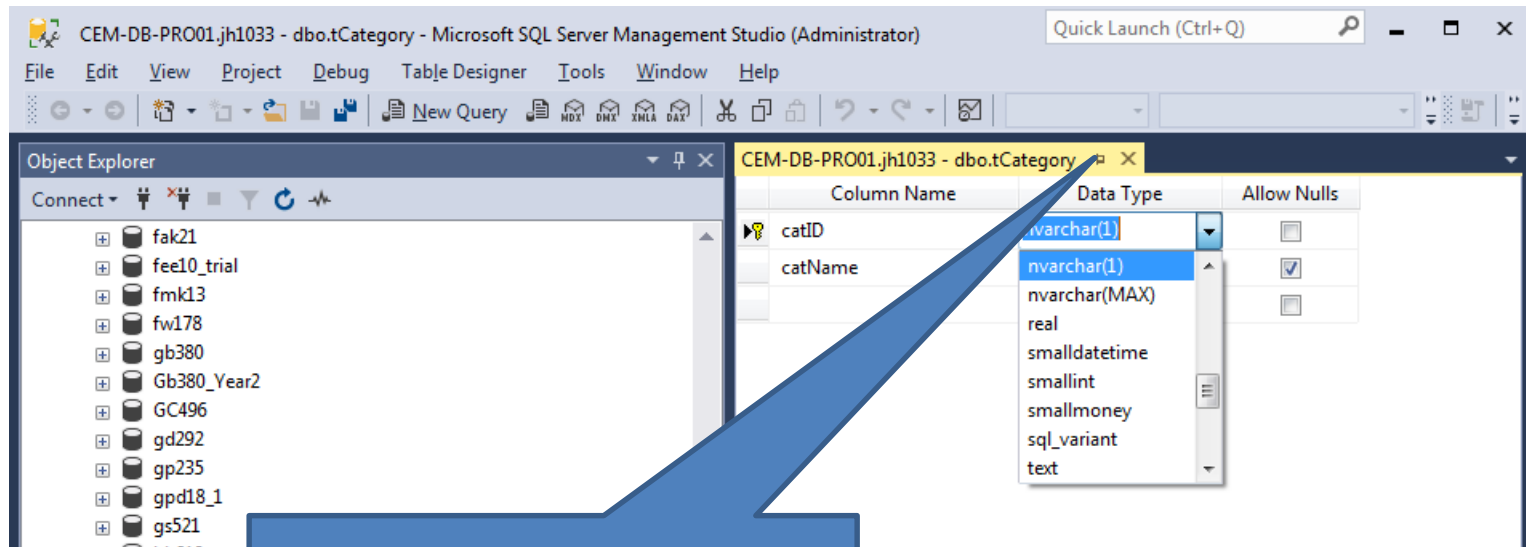
SQLServer – Making New Tables

- Right click on Table, select New > Table



SQLServer – Making New Tables

Name the fields, choose the datatype from drop down list. Select if allowed to be NULL.
Assigning a data type to a field – go to DESIGN view and see possible data types.

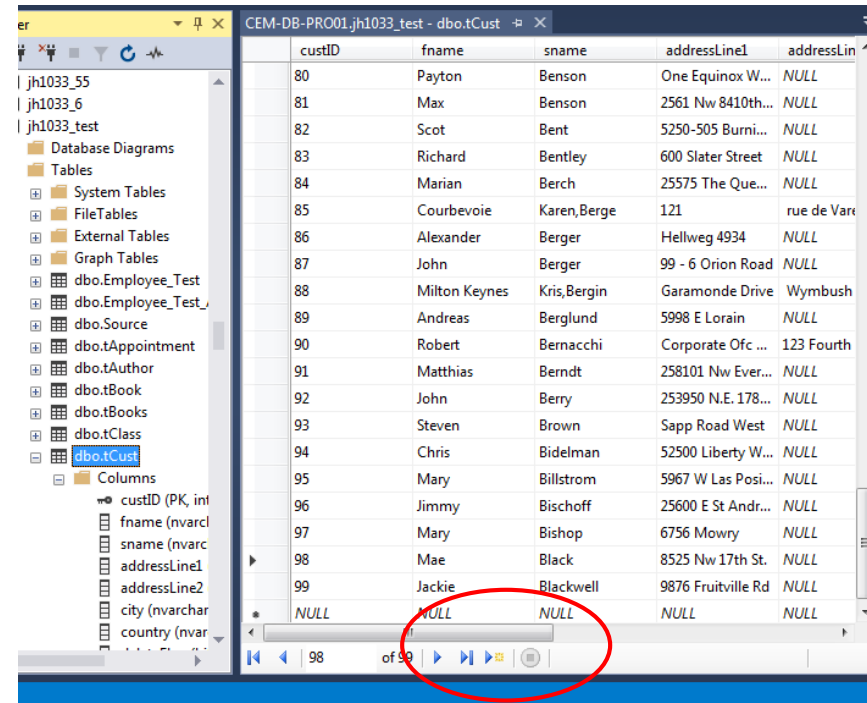


NOTE: table not saved /
created until you CLOSE THIS
WINDOW – then you'll be
asked to name it



SQL Server - Adding Data To A Table

- Right-click on a table e.g. tCust and select *Edit Top 200 Rows*
- Will display table in editable form
- Click on star at bottom to take you to *New Record*
- Type in information
- Won't save record until all info in and validated



custID	fname	sname	addressLine1	addressLine2
80	Payton	Benson	One Equinox W...	NULL
81	Max	Benson	2561 Nw 8410th...	NULL
82	Scot	Bent	5250-505 Burni...	NULL
83	Richard	Bentley	600 Slater Street	NULL
84	Marian	Berch	25575 The Que...	NULL
85	Courbevoie	Karen,Berge	121	rue de Vare
86	Alexander	Berger	Hellweg 4934	NULL
87	John	Berger	99 - 6 Orion Road	NULL
88	Milton Keynes	Kris,Bergin	Garamonde Drive	Wymbush
89	Andreas	Berglund	5998 E Lorain	NULL
90	Robert	Bernacchi	Corporate Ofc ...	123 Fourth
91	Matthias	Berndt	258101 Nw Ever...	NULL
92	John	Berry	253950 N.E. 178...	NULL
93	Steven	Brown	Sapp Road West	NULL
94	Chris	Bidelman	52500 Liberty W...	NULL
95	Mary	Billstrom	5967 W Las Posi...	NULL
96	Jimmy	Bischoff	25600 E St Andr...	NULL
97	Mary	Bishop	6756 Mowry	NULL
98	Mae	Black	8525 Nw 17th St.	NULL
99	Jackie	Blackwell	9876 Fruitville Rd	NULL
NULL	NULL	NULL	NULL	NULL



MySQL– Making New Tables

1. Click on
New

2. Input table
name

3. Choose field
names, types
etc.

4. Press *Save* to
create table

The screenshot shows the phpMyAdmin interface in a web browser. The 'Structure' tab is active, displaying the 'Table name' field and a table structure grid. The grid has columns for Name, Type, Length/Values, Default, Collation, Attributes, Null, and Index. There are four rows in the grid, each with a text input for the name and a dropdown for the type (all set to 'INT'). Below the grid are fields for 'Table comments:', 'Collation:', and 'Storage Engine:' (set to 'MyISAM'). At the bottom right, there are 'Preview SQL' and 'Save' buttons. A 'Console' tab is visible at the very bottom.

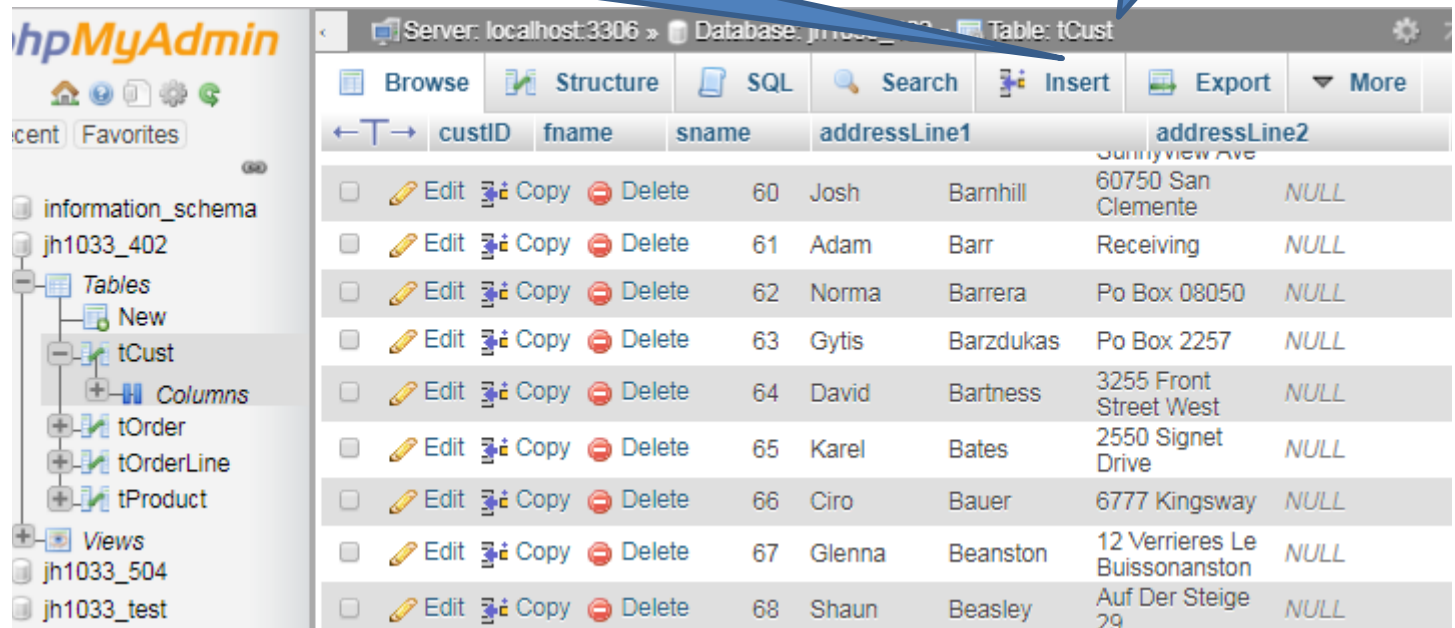
Name	Type	Length/Values	Default	Collation	Attributes	Null	Ind
<input type="text"/>	INT	<input type="text"/>	None	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text"/>	INT	<input type="text"/>	None	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text"/>	INT	<input type="text"/>	None	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text"/>	INT	<input type="text"/>	None	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>



MySQL– Adding New Data

2. Click *Insert* –
will bring up
insert page

1. Make sure that you in
the table that you want to
add data to



Server: localhost:3306 » Database: jh1033_402 » Table: tCust

	custID	fname	sname	addressLine1	addressLine2
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	60	Josh	Barnhill	60750 San Clemente	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	61	Adam	Barr	Receiving	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	62	Norma	Barrera	Po Box 08050	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	63	Gytis	Barzdukas	Po Box 2257	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	64	David	Bartness	3255 Front Street West	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	65	Karel	Bates	2550 Signet Drive	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	66	Ciro	Bauer	6777 Kingsway	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	67	Glenna	Beanston	12 Verrieres Le Buissonanston	NULL
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	68	Shaun	Beasley	Auf Der Steige 29	NULL



Data types: char, varchar, nvarchar

- char(5), char(50)
 - early with simple use of storage
- varchar(50),
 - flexible efficient use of storage (doesn't set aside space if not being used – that's what the VAR means)
- nvarchar(50)
 - more expensive on storage but supports multiple character sets e.g. Mandarin



Numeric Data Types - Standard

Data type	Description	Bytes
Bit	1 or 0	1 bit
Tinyint	Integers 0 to 255	1 byte
Smallint	Integers -32768 to 32767	2 bytes
Int	Integers -2,147,483,648 to 2147483647	4 bytes
Bigint	Huge !!	8 bytes
Decimal	Decimal points – huge	varies

Use DBMS own help to find more info on their own datatypes / extensions

<https://www.journaldev.com/16774/sql-data-types>

Can be exact or approximate

http://devzone.advantagedatabase.com/dz/webhelp/advantage8.1/adssql/exact_numeric_vs_approximate_numeric.htm



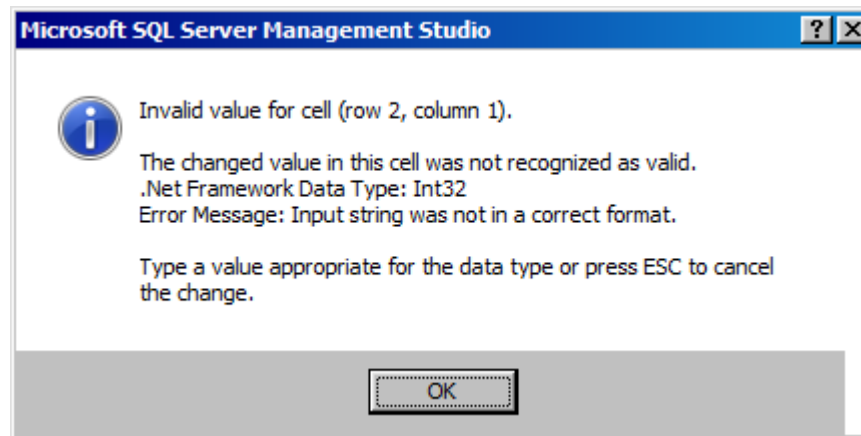
Decimal

- p (precision) The maximum total number of decimal digits that can be stored, both to the left and to the right of the decimal point. The precision must be a value from 1 through the maximum precision of 38. The default precision is 18.
- (18.4)
 - 18 positions altogether
 - 4 after the decimal point
 - so 14 before the decimal point



Data Types as Constraints

- Try to insert “H” into the CUSTID int field:



Numbers in nvarchar field ??

Microsoft SQL Server Management Studio

File Edit View Debug Query Designer Tools Window Community Help

New Query Change Type

CSSL.dcl143 - db102.tCust

CustID	FirstName	LastName	EmailAddress	AddressLine1	City	PostalCode	CountryRegion...
1	Eugene	Huang	eugene10@adv...	2243 W St.	Seaford	3198	Australia
2	56789	Torres	ruben35@adven...	5844 Linden Land	Hobart	7001	Australia
3	Christy	Zhu	christy12@adve...	1825 Village Pl.	North Ryde	2113	Australia
4	Elizabeth	Johnson	elizabeth5@adv...	7553 Harness Ci...	Wollongong	2500	Australia
5	Julio	Ruiz	julio1@adventur...	7305 Humphrey ...	East Brisbane	4169	Australia
6	Janet	Alvarez	janet9@advent...	2612 Berry Dr	Matraville	2036	Australia
7	Marco	Mehta	marco14@adve...	942 Brook Street	Warrnambool	3280	Australia
8	Rob	Verhoff	rob4@adventur...	624 Peabody Road	Bendigo	3550	Australia
9	Shannon	Carlson	shannon38@ad...	3839 Northgate ...	Hervey Bay	4655	Australia
10	Jacquelyn	Suarez	jacquelyn20@ad...	7800 Corrinne C...	East Brisbane	4169	Australia
11	Curtis	Lu	curtis9@advent...	1224 Shoenic	East Brisbane	4169	Australia
12	Lauren	Walker	lauren41@adve...	4785 Scott Street	Bremerton	98312	United States
13	Ian	Jenkins	ian47@adventur...	7902 Hudson Ave.	Lebanon	97355	United States
14	Sydney	Bennett	sydney23@adv...	9011 Tank Drive	Redmond	98052	United States
15	Chloe	Young	chloe23@adven...	244 Willow Pass ...	Burbank	91502	United States
16	Wyatt	Hill	wyatt32@adven...	9666 Northridge...	Imperial Beach	91932	United States
17	Shannon	Wang	shannon1@adv...	7330 Saddlehill L...	Sunbury	3429	Australia
18	Clarence	Rai	clarence32@adv...	244 Riverview	Bendigo	3550	Australia
19	Luke	Lal	luke18@advent...	7832 Landing Dr	Langley	V3A 4R2	Canada
20	Jordan	King	jordan73@adve...	7156 Rose Dr.	Metchosin	V9	Canada
21	Destiny	Wilson	destiny7@adve...	8148 W. Lake Dr.	Beaverton	97005	United States
22	Ethan	Zhang	ethan20@adven...	1769 Nicholas Dr...	Bellingham	98225	United States
23	Seth	Edwards	seth46@advent...	4499 Valley Crest	Bellflower	90706	United States
24	Russell	Xie	russell7@advent...	8734 Oxford Place	Concord	94519	United States
25	Alejandro	Beck	alejandro45@ad...	2596 Franklin Ca...	Hawthorne	4171	Australia
26	Harold	Sai	harold3@advent...	8211 Leeds Ct.	Goulburn	2580	Australia
27	Jessie	Zhao	jessie16@adven...	213 Valencia Place	Warrnambool	3280	Australia
28	Jill	Jimenez	jill13@adventur...	9111 Rose Ann ...	St. Leonards	2065	Australia
29	Jimmy	Moreno	jimmy9@advent...	6385 Mark Twain	Bendigo	3550	Australia
30	Bethany	Yuan	bethany10@adv...	636 Vine Hill Way	Cloverdale	6105	Australia
31	Theresa	Ramos	theresa13@adv...	6465 Detroit Ave.	Matraville	2036	Australia
32	Denise	Stone	denise10@adve...	626 Bentley Street	Melbourne	3000	Australia
33	Jaime	Nath	jaime41@adven...	5927 Rainbow Dr	Milsons Point	2061	Australia
34	Ebony	Gonzalez	ebony19@adve...	5167 Condor Place	North Sydney	2055	Australia
35	Wendy	Dominguez	wendy12@adve...	1873 Mt. Whitne...	Cranbourne	3977	Australia
36	Jennifer	Russell	jennifer93@adv...	3981 Augustine ...	National City	91950	United States
37	Chloe	Garcia	chloe27@adven...	8915 Woodside ...	Cliffside	V8Y 1L1	Canada
38	Diana	Hernandez	diana2@advent...	8357 Sandy Cov...	Lavender Bay	2060	Australia
39	Marc	Martin	marc3@adventu...	9353 Creekside Dr.	Wollongong	2500	Australia
40	Jesse	Murphy	jesse15@adven...	3350 Kingswood...	Tacoma	98403	United States

3 of 200

Ready

Alphanumeric

- nvarchar is an alphanumeric data type
 - accepts numbers
 - will not process them as numbers e.g. add them
- Telephone number:
 - 020-8576-8965
- Postcode:
 - BN8-5TY



VarChar(MAX)

- Replacing old TEXT data type
- Can hold *huge* amount of text.
 - Complete essay, report
- Size is $2^{31}-1$ bytes



Date Data Types

- DateTime 8 bytes
[Jan 1 1553 – Dec 31 9999]
- SmallDateTime 4 bytes
[Jan 1 1900 – Jun 6 2079]
- Date 3 bytes
[Date values Jan 1 0001 – Dec 31 9999]



How is datetime held by databases?

- <https://www.sqlshack.com/sql-server-datetime-data-type-considerations-and-limitations/>



Date Constraints

- Input data must be in a date format:
 - e.g. yyyy/mm/dd ISO 8601 standard
 - 2011/10/25
 - SQL Server displays dates in this format [query2]
- Date formats can become complex !!
- UK format is dd/mm/yyyy
 - 11/09/2001 September 11 2001
- US format mm/dd/yyyy
 - 09/11/2001 hence 9/11 September 11 2001



?

Visitors to a web site from varying locales may be confused by date formats. The format MM/DD/YY is unique to the United States. Most of Europe uses DD/MM/YY. Japan uses YY/MM/DD. The separators may be slashes, dashes or periods. Some locales print leading zeroes, others suppress them. If a native Japanese speaker is reading a US English web page from a web site in Germany that contains the date 03/04/02 how do they interpret it?



Test the DBMS yourself

- Does it accept:
 - YYYY-MM-DD
 - DD-MM-YYYY
 - MM-DD-YYYY
- What about:
 - YY-MM-DD
 - DD-MM-YY
 - MM-DD-YY



11 Sep 2001

- 11 Sep 2001 will work
 - DD MMM YYYY
- However this is locale specific - *Sep* is English



Images

- Latest data type: `varbinary(MAX)`
- Designed to be used by applications which can retrieve image from file system and insert into database



Tracking images

- Alternative is to track images:

```

```

- URL held in a database field – varchar(100)
- Others e.g SQL Server technology is *filestream*
 - Image held on file system
 - Field in database linked to the image
 - Streaming technology to support retrieval



Further data types

- Look at dropdown list in design view
- Use *help* to find explanations
- In reality use:
 - int or decimal or money
 - varchar(n) or nvarchar(n)
 - datetime or date



Summary

- Primary keys – unique identifiers - constraint
- Data defs:
 - int or decimal [money?]
 - varchar(n) or nvarchar(n)
 - datetime or date
 - Varbinary(MAX) - images

