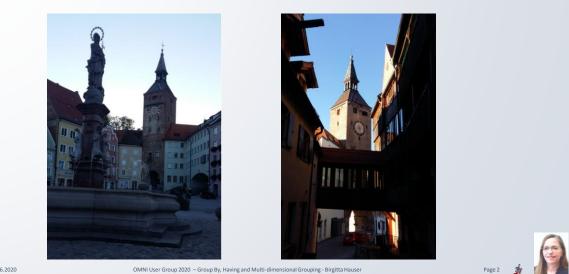
# **Group By, Having** and multi-dimensional Grouping

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## Landsberg am Lech - Schmalzturm (1295)



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#### Agenda

#### SELECT-Statement

#### **GROUP BY Clause**

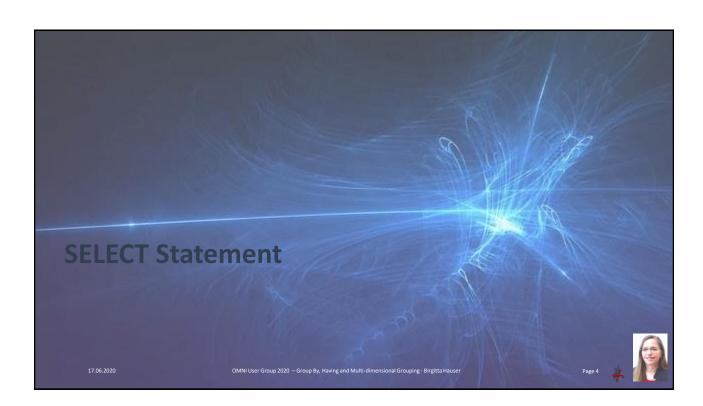
- Aggregate Functions
  - Aggregate Functions handling distinct values
  - Aggregate Functions handling NULL values
  - $_{\circ}~$  Case Clause and Aggregate Functions
- LISTAGG Aggregate Function

#### **HAVING Clause**

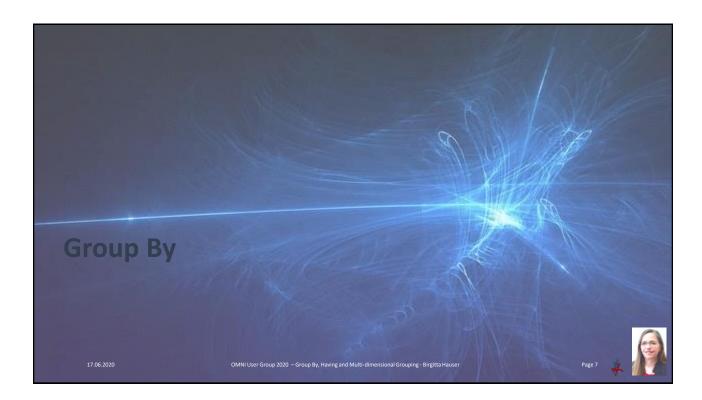
#### **Multi-dimensional Grouping**

- Rollup and Cube Extention
- Grouping Sets
- Grouping Aggregate Function

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- Common Table Expressions	(CTE)	SELECT Statement
Full Select		
SELECT Columns/Fields (incl.scalar/UD fund From Files/Tables/Views/UDTFs incl. Join Where Conditions		
Group By Clause	Sub-Select	
Start With Connect By         (Release)           Order By Clause         (Release)           Fetch First x Rows Only         (Release)		
Merge several Sub-Selects u	sing:	
<ul> <li>UNION / EXCEPT / INTERSECT</li> <li>SELECT Columns/Fields (incl.scalar/UD func From Files/Tables/Views/UDTFs incl. Joir Where Conditions</li> </ul>		
Group By Clause Having Clause	Sub-Select	t
	e 7.1 PTF)	
Order By Clause (Releas Fetch First x Rows Only (Releas		



GROUP BY Claus	e			
Used to arrange ic	lentical data into groups			
For multiple identi	cal data is only a <b>single row</b> returned			
Often used in com	position with <b>aggregate functions</b> for accumulat	ing results		
Positioned in a SE	LECT-Statement			
• After the WHERE Co	ondition			
• After the <b>FROM</b> Cla	use (if there are no WHERE conditions)			
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	Y Clause	Syntax					
SELECT	List Colu	umns/Expressi	on, Aggro	egateFun	tions		
FROM	Schema.Ta	able or View		-			
GROUP	BY List Co	lumns/Expres	sions				
All Colu	mns/Expressio	ons without Agg	Rows regate Func	tion (Grou	oing Expressio	on)	
have to	be repeated a	-	regate Func			-	lect
have to Generat Select Va From S Group	be repeated a ed Names for mar(SalesDate) Sa m(Amount) Total,	ons without Agg after Group BY columns/Expr. ir lesYear, <u>CustNo</u> , Count (*) p	regate Func	List are <b>not</b> • Group		ame Sub-Sel	ect

# **Aggregate Functions Before Release 7.3**

Function Name	Description
AVG()	Average of a set of numbers
Count()	Number of rows/values in a set of rows/values
	Number of rows/values in a set of rows/values
Count_Big()	Similar to COUNT but the result can be greater than the maximum value of integer
Max()	Maximum value in a set of values in a group
Min()	Minimum value in a set of values in a group
Sum()	Sum of a set of numbers
StdDev()	biased standard deviation (/n) of a set of numbers
<pre>StdDev_Samp()</pre>	sample standard deviation (/n-1) of a set of numbers
Variance()	biased variance (/n) of a set of numbers
Variance_Samp()	sample variance (/n-1) of a set of numbers
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# **Aggregate Functions New Release 7.3**

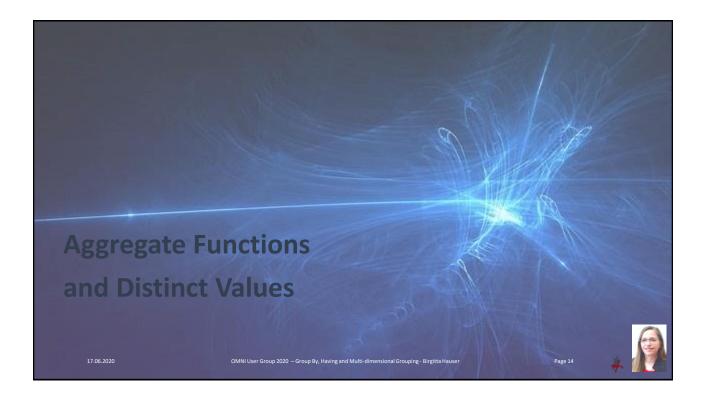
Aggregate Functions	Description					
Correlation()	Coefficient of correlation of a set of number pairs					
Covariance()	(Population) Covariance of a set of number pairs					
Covariance_Samp() Unbiased Sample Covariance (n-1) of a set of number pairs						
Median()	Median of a set of numbers					
Percentile_Cont()	Value that corresponds to the specified percentile given a sort specification by using a continuous distribution model					
Percentile_Disc()	Value that corresponds to the specified percentile given a sort specification by using using a discrete distribution model.					
Regression_Functions						
Regr_Count()	number of non-null number pairs used to fit the regression line					
Regr_Intercept()	y-intercept of the regression line ("b" in the equation $y = a * x + b$ )					
Regr_R2()	coefficient of determination ("R-squared" or "goodness-of-fit") for the regression					
Regr_Slope()	Slope of the line ("a" in the equation y = a * x + b)					
Regr_AVGX()						
Regr_AVGY()						
Regr_SXX()	can be used to compute various diagnostic statistics needed for the evaluation of the quality and statistical validity of the regression model					
Regr_SXY()	regression moder					
Regr_SYY()						
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Enhanced 7.3

From Sales Group By C Order By C	Min(Amount) S CustNo		Dec(11, 2 n", <i>Max</i> (An					
CUSTNO	NbrRows	Total	Average	Minimum	Maximum			
10001	19	3031,14	159,53	20,00	450,85			
10002	8	2986,25	373,28	20,00	1350,00			
10003	18	6680,61	371,14	35,00	1555,75			
10004	14	3143,95	224,56	45,00	539,75	• Accur	mulatin	g Sales per Customer
10005	6	4051,95	675,32	225,00	1587,50	• CC	OUNT(*)	Counts the number of Rows per Customer
10006	22	19425,70	882,98	122,23	3368,75	<ul> <li>SU</li> </ul>	JM()	Summarizes the AMOUNT of all Customer rows
						<ul> <li>A\</li> </ul>	/G()	Calculates the Average of all Customer rows

# **GROUP BY Clause - Examples**

Cast	t(*) "NbrRows ( <i>Avg</i> (Amount) as A Amount) "Minimum es	Dec(11, 2)	) "Av	erage",			•	Grouping Expression GROUP BY and ORDER BY different sequence
Group By	emNo Between '51 Year(SalesDate) CustNO, SalesYe	, CustNo	300'				•	WHERE Condition – Column not included in the Grouping Expression
(								
SALESYEAR	CUSTNO	NbrRows	Total	Average	Minimum	Maximum		
2008	10001	2	115,00	57,50	55,00	60,00		
2009	10001	15	2634,20	175,61	20,00	450,85		
2010	10001	2	281,94					
2008	10002	1	-	1350,00	-	1350,00		
	10002	3	489,90					
	10003	1	,					
	10003	3	853,10			· · · ·		
	10004	8				-		
2008	10005	1	310,00	· · · · ·				/
0.000	10005 10006	3		301,48				6
				561 82	495,00	628,65		

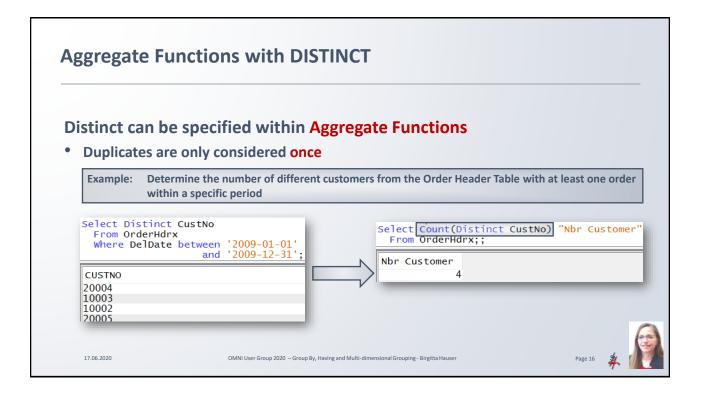


## Distinct

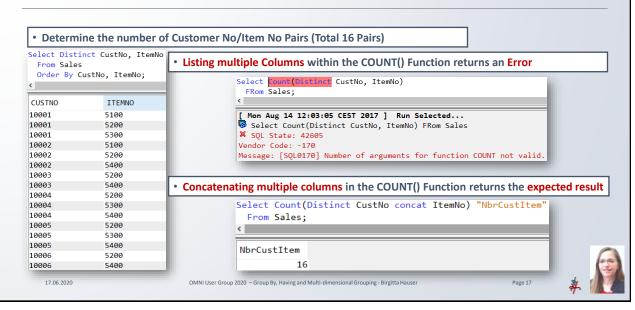
#### Eliminates duplicate rows of the final result table

• **DISTINCT** must be specified **immediately after SELECT** 

Select Distinct CustNo From OrderHdrx where DelDate between '2009-01-01' and '2009-12-31'; CUSTNO 20004 10003 10002 20005	CUSTNO 20004 20004	• Without DISTINCT → Duplicate Customer No
---	--------------------------	---



# Aggregate Functions with DISTINCT over multiple Columns - Example



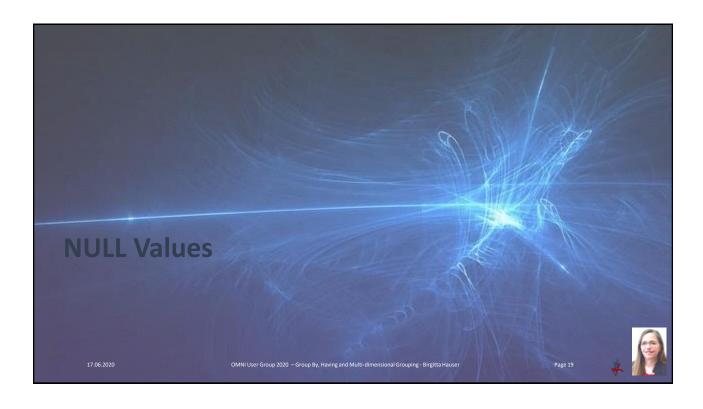
# Aggregate Functions with DISTINCT - Examples

Cour Cour	nt(*) nt(Distinct Cu nt(Distinct It nt(Distinct Cu es	emNo)	)	emNo	"Nbr "Nbr	Cust Iter		15"
Group By	Year(SalesDat	e)						
	•	· ·						
	SalesYear							
	SalesYear	·						
Order By	SalesYear Nbr Positions	Nbr	Customer	Nbr	Items	Nbr	Customer/	/Items
Order By	Nbr Positions	Nbr	Customer 5	Nbr	Items 3	Nbr	Customer/	Items
Order By SALESYEAR	Nbr Positions	9				Nbr	Customer/	

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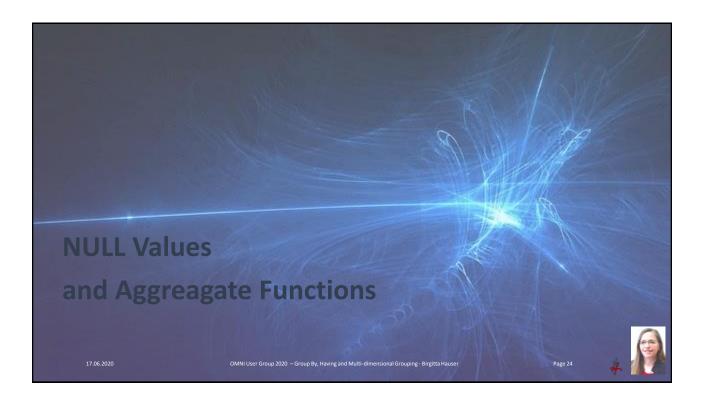
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				_
What are NULI	. Values?			
	nor Zero nor x'00'	ue -> will NOT return NULL values		
NULL Value in <sup>•</sup> • Separate flag s	the Database set to $*On/*Off \rightarrow Must be$	checked separately		
∘ SQL:	using the NULL predicate	IS NULL / IS NOT NULL		
<ul> <li>RPG:</li> <li>Embedded SQI</li> </ul>	Built-In-Function: .: Indicator Variable	%NullInd()		
Select * From OrderHdr	x			

COALESCE(Column, Default1, Default2, DefaultN) or IFNULL(Column, Default)         Converts a NULL Value into a Default Value         Can be used for all data types         COALESCE is more powerful than IFNULL → Multiple Default Values can be specified         Select h.Company, h.OrderNo, h.DelDate,         Coalesce(ItemNo, 'No Order Position') Item, Coalesce(OrderQty, 0) OrderPostX d         on h.Company = d.Company and h.OrderNo = d.OrderNo         COMPANY       ORDERNO         DELDATE       ITEM         ID BINR2009-10-15/1       2009-08-20         COMPANY       ORDERNO         ID BINR2009-10-15/1       2009-08-20         ID BINR2009-10-15/1       2009-08-20         ID BINR2009-10-15/1       2009-08-20         ID BINR2009-10-33/5       2009-08-20         ID BINR2009-10-33/5       2009-08-20         ID BINR2009-10-33/5       2009-08-20         ID BINR2009-10-33/5       2009-08-20	Conv	vert Defau	ult Val	ues into NU	LL Value	25
Can be used for all data types COALESCE is more powerful than IFNULL → Multiple Default Values can be specified Select h.Company, h.OrderNo, h.DelDate, Coalesce(ItemNo, 'No Order Position') Item, Coalesce(OrderQty, 0) OrderQty from OrderHdrX h left outer join OrderDetX d on h.Company = d.Company and h.OrderNo = d.OrderNo COMPANY ORDERNO DELDATE ITEM ORDERQTY 10 BNR2009-10-15/1 2009-08-20 CF001 10 10 BNR2009-10-15/1 2009-08-20 CF003 15 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 BS002 20 10 BNR2009-10-23/5 2009-08-28 No Order Position 0		•	-		2, Defa	aultN) or
COMPANY ORDERNO DELDATE ITEM ORDERQTY 10 BNR2009-10-15/1 2009-08-20 CF001 10 10 BNR2009-10-15/1 2009-08-20 CF003 15 10 BNR2009-10-15/1 2009-08-20 BS002 20 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 SS002 20 10 BNR2009-10-23/5 2009-08-28 No Order Position 0	Conv	erts a NULL	Value ir	ito a Default V	alue	
COMPANY ORDERNO DELDATE ITEM ORDERQTY 10 BNR2009-10-15/1 2009-08-20 CF001 10 10 BNR2009-10-15/1 2009-08-20 CF003 15 10 BNR2009-10-15/1 2009-08-20 BS002 20 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 SS002 20 10 BNR2009-10-23/5 2009-08-28 No Order Position 0	• Car	be used for a	all data ty	bes		
Select h.Company, h.OrderNo, h.DelDate, Coalesce(ItemNo, 'No Order Position') Item, Coalesce(OrderQty, 0) OrderQty from OrderHdrX h left outer join OrderDetX d on h.Company = d.Company and h.OrderNo = d.OrderNo COMPANY ORDERNO DELDATE ITEM ORDERQTY 10 BNR2009-10-15/1 2009-08-20 CF001 10 10 BNR2009-10-15/1 2009-08-20 CF003 15 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 BS002 20 10 BNR2009-10-23/5 2009-08-28 No Order Position 0					$\rightarrow$ Multiple	P Default Values can be specified
10 BNR2009-10-15/1       2009-08-20       CF001       10         10 BNR2009-10-15/1       2009-08-20       CF003       15         10 BNR2009-10-15/1       2009-08-20       HG001       3         10 BNR2009-10-15/1       2009-08-20       BS002       20         10 BNR2009-10-23/5       2009-08-28       No Order Position       0	from	<i>Coalesce</i> (ItemNo, <i>Coalesce</i> (OrderQty OrderHdrX h left	'No Order F , 0) OrderQt outer join C	osition') Item, y rderDetX d		
10 BNR2009-10-15/1 2009-08-20 CF001 10 10 BNR2009-10-15/1 2009-08-20 CF003 15 10 BNR2009-10-15/1 2009-08-20 HG001 3 10 BNR2009-10-15/1 2009-08-20 B5002 20 10 BNR2009-10-23/5 2009-08-28 No Order Position 0	COMPANY	ORDERNO	DELDATE	ITEM	ORDEROTY	
10 BNR2009-10-15/1       2009-08-20       HG001       3         10 BNR2009-10-15/1       2009-08-20       BS002       20         10 BNR2009-10-23/5       2009-08-28       No Order Position       0	1	0 BNR2009-10-15/1	2009-08-20	CF001		
10 BNR2009-10-15/1         2009-08-20         BS002         20           10 BNR2009-10-23/5         2009-08-28         No Order Position         0	1	0 BNR2009-10-15/1	2009-08-20	CF003	15	Convert a Default value into a NULL value
10 BNR2009-10-23/5 2009-08-28 No Order Position 0	1	0 BNR2009-10-15/1	2009-08-20	HG001	3	
						(
10 BNR2009-10-30/2 2009-09-09 BS001 50					-	le l
17.06.2020 OMNU User Group 2020 – Group By, Having and Multi-dimensional Grouping - Birgitta Hauser Page 22			2009-09-09	85001	50	

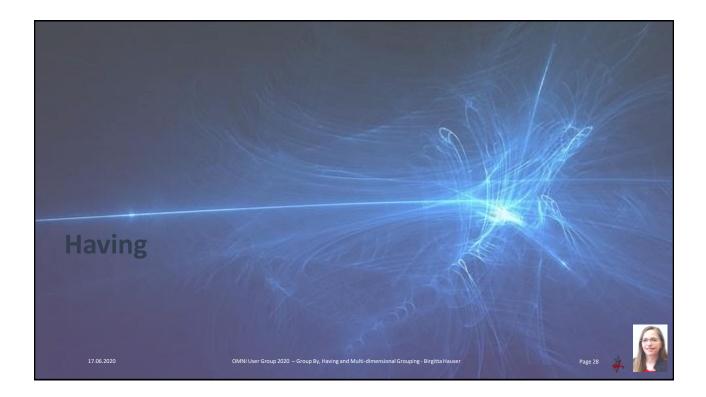
NULLIF(Column, ToRe					
Converts a specified		ito a NULL	value		
<ul> <li>Can be used for all data</li> </ul>	ata types				
Select Company, OrderNo, Count(*) "Tota Avg(DelQty) "AvgD	lPos", Cou				
From OrderDetX			• Co	nvert a specified	value into a NULL value
Group By Company, Orde	rNo				
COMPANY ORDERNO	TotalPos	PosWithDelQty	AvgDelQty	AvgDelQty > 0	
	6	5	6	7	
10 BNR2009-12-20/2			-		
10 BNR2009-12-20/2 10 BNR2009-12-23/7	3	0	0	-	
	3	0	0 36	- 36	



NULL Values and	Aggregat Functions	
NULL values are ig	nored by aggregat functions	
Important for COUN	(), AVG(), MIN(), MAX()	
• Example: 6 rows v	with 2 NULL values $\rightarrow$ Count(Column) = 4	
• COUNT (*) Counts	LL rows even if there is a row with only NULL	S .
Select Company, OrderNo, Count(*) "Totla Avg(DelQty) "AvgDe From OrderDetx Group By Company, Order	<pre>lqty", Avg(NULLIF(Delqty, 0)) "AvgDelqty &gt; 0"</pre>	
COMPANY ORDERNO 10 BNR2009-12-20/2 10 BNR2009-12-23/7	TotlaPos PoswithDelQty AvgDelQty AvgDelQty > 0 6 5 6 7 3 0 0 0 7	<ul> <li>Positions without delivery quantity are considered</li> </ul>
10 BNR2009-12-15/2 10 BNR2009-10-15/2 10 BNR2009-10-15/1 10 BNR2009-12-15/1	5 5 36 36 4 3 10 14 4 3 21 28	<ul> <li>Positions without delivery quantity are ignored</li> </ul>
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# NULL Values in Aggregate Functions are ignored - Example

YINT MYCHA	R MYDEC MYDATE	MYGRAPH2									
1 -		-									
2 AAA		-		Select	Count(*)	"All",					
1 BBB		BBB	1		Count(MyInt)		MvInt".	Count(M	/Dec)	"Count	MyDec",
1 -	123,00-	-			Count(MyChar)						
2 -	456,00-	-	$\mathbf{>}$		NULLFile;						
2 AAA	777,00-	-	1	<							
3 CCC	444,00 -	CCC	11	A11	Count MyInt	Cour	nt MyDec	Coun	t MyChar	Count	: MyGraph2
1 -	- 2007-02-21	L -			.6	16	it hybet	9	-	1	nydrapiiz
1 XXX	- 2007-01-31	XXX		1	.0	10		9	1	1	
2 -	1000,00 2007-05-15	BBB									
2 AAA	- 2007-05-15										
3 AAA	- 2007-01-07										
2 AAA	2000,00 2007-01-07										
2 XXX	900,00 2007-01-07	BBB									
2 AAA	700,00 -	-									



#### **Having Clause**

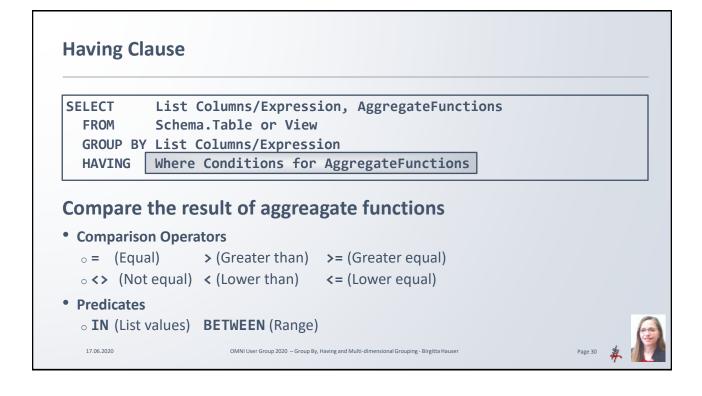
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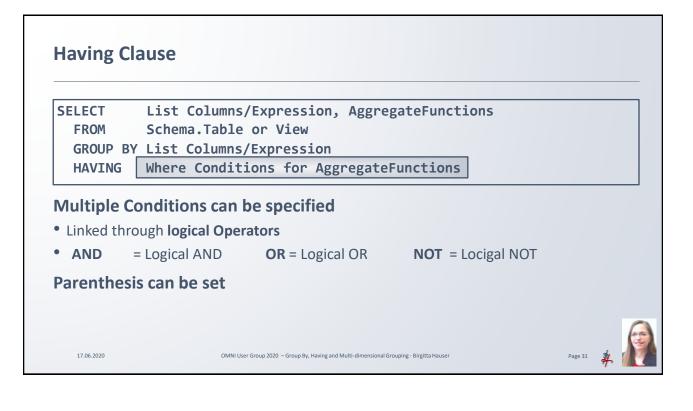
SELECTList Columns/Expression, AggregateFunctionsFROMSchema.Table or ViewGROUP BYList Columns/ExpressionHAVINGWhere Conditions for AggregateFunctions

#### Having = WHERE Conditions for Aggregate Functions

- WHERE conditions only allowed for Column Values but NOT for aggregated Values
- Examples: Select customers with a total amount > x Euro Select all orders with more than y positions

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from ( Group	Company, OrderNo, DrderDetx By Company, Order g Count(*) > 4;		Positions	Determine all	orders with more than 4 positions
10	ORDERNO DBNR2009-12-20/2 DBNR2009-10-15/2 DBNR2009-12-15/2 DBNR2009-10-20/2		POSITIONS 6 5 5 6		
From Sa Group B	ear(SalesDate) Sal ales By Year(SalesDate) Sum(Amount) > and Count(*) >	, CustNo 3000	ıstNo, <i>Sum</i> (ı	Amount) Total	Determine all Customer with an annual amount > 3000 and
	R CUSTNO 00910003 01010006	TOTAL 4589,8 19425,7			more than 10 Positions



	ons for the Group By			
• Cube(Grou	ping Columns/Field	ds)		
• RollUp(Gr	ouping Colums/Fie	Lds)		
• Grouping	Sets(Grouping Col	umns/Fields)		
Cube and Ro	lup can be specified	l within the Grou	ping Sets()	

# Multi-dimensional Grouping - RollUp() Extention

#### RollUp() Extention

• Generate Sub-Totals based on the colums specified with RollUP()

#### Example: Group By RollUp (Year, Month, Day)

- Generates the following Sub-Totals:
  - $_{\circ}\,$  Sub-Total per Year, Month, Day
  - $_{\circ}\,$  Sub-Total per Year, Month,
  - $_{\circ}\,$  Sub-Total per Year
  - $_{\circ}\,$  Grand Total
- Sequence of the result set depends on the ORDER BY Clause

Select Year(SalesDat From Sales	e) SalesYear, CustNo, <i>Sum</i> (Amount) Total	Sales per Year and Customer
	(ear(SalesDate), CustNo)	Sales per rear and customer
	,	
SALESYEAR CUSTNO	TOTAL	
2008 10001	115,00	
2008 10002	1350,00	
2008 10003	535,00	
2008 10004	470,00	Sub-Totals:
2008 10005	310,00	
2008 -	2780,00	Year/Customer
200910001	2634,20	• Year
2009 10002	1636,25	
2009 10003	4589,86	
2009 10004	2673,95	
2009 10005	3741,95	
2009 -	15276,21	
201010001	281,94	
2010 10003	1555,75	
2010 10006	19425.70	
2010 -	21263.39	
	39319,60	Grand Total

# Mulit-dimensional Grouping Cube Extention

#### **Extention Cube**

Generates Sub-Totals for each possible composition of columns specified in Group By Clause
 → All Sub-Totals created by RollUp() + "cross tabulation")

Example: Group By Cube(Year, Customer, ltem) • Generates the following Sub-Totals: • Sub-Total per Year, Customer, Item • Sub-Total per Year, Customer • Sub-Total per Year, Item • Sub-Total per Customer, Item • Sub-Total per Year Sub-Total per Customer Sub-Total per Item • Grand-Total Sequence of the Result Set depends on the ORDER BY Clause 17.06.2020 Page 37 OMNI User Group 2020 - Group By, Having and Multi-dimensional Grouping - Birgitta Hauser

#### Multi-dimensional Grouping Cube() versus RollUp() - Examples

	ate) SalesYear, CustNo,	[temNo,			Date) SalesYear, CustNo,	Item,	
<i>Sum</i> (Amount)	Total		Sum(	Amount)	Total		
From Sales			From Sales				
where SalesDate	e between '2008-10-01'		where S	alesDat	e between '2008-10-01'		
	and '2009-03-31'				and '2009-03-31'		
and CustNa in	n ('10001', '10002')						
		2			n ('10001', '10002')		
	(SalesDate), CustNo, Iter	<u>n)</u>			ear(SalesDate), CustNo, 1	[tem)	
Order By SalesYear	, CustNo, Item		Order By Sa	lesYear	, CustNo, Item		
<			<				
SALESYEAR CUSTNO	ITEMNO	TOTAL	SALESYEAR	CUSTNO	ITEM	TOTAL	
2008 10001	King,Stephen - Es	115,00	2008	10001	King,Stephen - Es	115,00	
	-	115,00	2008	10001	-	115,00	
	King,Stephen - Es	1350,00	2008	10002	King,Stephen - Es	1350,00	
2008 10002		1350,00	2008	10002	-	1350,00	
2008 -	King,Stephen - Es	1465,00	2008	-	-	1465,00	
2008 -	-	1465,00	2009	10001	Grisham, John - Die Akte	180,00	
	Grisham,John - Die Akte	180,00	2009	10001	King,Stephen - Drei	160,00	
	King,Stephen - Drei	160,00	2009	10001	-	340,00	
2009 10001	-	340,00	2009		-	340,00	
2009 -	Grisham, John - Die Akte	180,00	-	-	-	1805,00	
2009 - 2009 -	King,Stephen - Drei	160,00					
	- Grisham,John - Die Akte	180,00					
- 10001	King,Stephen - Drei	160,00					
	King,Stephen - Es	115,00					
- 10001	- King,Stephen - Es	455,00					
	Es	1350,00		• Cro	oss Tablulation		
- 10002	- Grisham,John - Die Akte	1350,00 180,00					
	King, Stephen - Drei	160,00					
	King,Stephen - Es	1465,00					
	King, Scephen - Es	1805,00					
	-	1805,00					

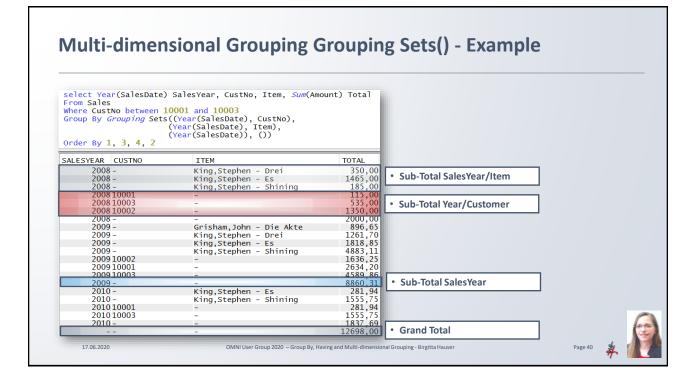
#### Multi-dimensional Grouping – Grouping Sets () Extention

#### Grouping Sets() Extention

• Define any grouping level/sub-totals you want

#### Example: Grouping Sets((A, B, C), (B, C), ())

- Generates the following sub-totals:
  - ∘ Sub-Total per A, B, C
  - ∘ Sub-Total per B, C
  - $_{\circ}\,$  Grand Total
- Sequence of the Result Set depends on the ORDER BY Clause



#### **Multi-Dimensional Grouping - Aggregat-Function Grouping**

Grouping(ColumnName)

#### Aggregate-Function: Grouping(Column)

• Can only be used in composition with multi-dimensional Grouping

#### **Identifies NULL Values in Sub-Total Rows**

- 1 = NULL value in the specified column in the sub-total row
- 0 = No NULL value in the specified column

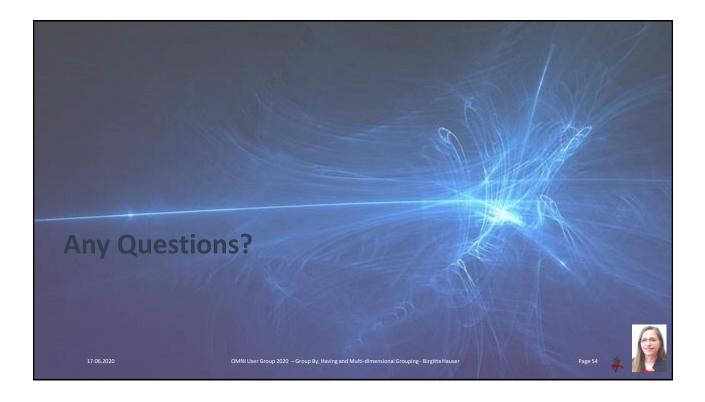
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#### Multi-dimensional Grouping - Aggregate Function Grouping -Example

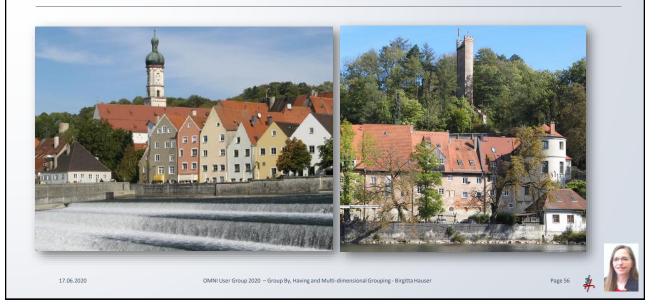
When Gro Then 'To Else ''	and Total' uping(CustNo) tal Year ' conc End, tNo, <i>Sum</i> (Amount alesYear, CustN	= 1 at <i>Varchar</i> (S ) as Total	SalesYear)	• Generate Summary Textes based on the <b>GROUPING</b> Aggregate Function	
00001	SALESYEAR 2008	CUSTNO 10001	TOTAL 115,00		
		10002 10003	1350,00		
		10003	535,00 470,00		
		10005	310,00		
Total Year 2008	2008		2780,00		
		10001 10002	2634,20 1636,25		
		10003	4589.86		
		10004	2673,95		
		10005	3741,95		
Total Year 2009	2009		15276,21		
		10001 10003	281,94 1555,75		
		10005	19425 70		-
Total Year 2010	2010	-	21263.39		6
Grand Total	-	-	39319,60		17

#### Multi-dimensional Grouping - Aggregate Function Grouping -Example

ith x as (Select	Year(SalesDat Sales)	e) SalesYear,	CustNo, Amount	
Gelect Case When G		Year) = 1		
	'Grand Total'			
	<i>Grouping</i> (CustN	o) = 1 concat <i>Varchar</i>	(SalesVear)	
	'' End,	concac varchar	(Salesteal)	
		ount) <mark>as</mark> Total		
from x				
Group By Rollur Having <i>Grouping</i>				Based on a Having Condition
Order By Sales	Year, CustNo	-		in composition with the Grouping Aggregate Function
00001 5	SALESYEAR	CUSTNO	TOTAL	
Total Year 2008	200	)8 -	2780,00	
Fotal Year 2009		)9 -	15276,21	
Fotal Year 2010	201	L0 -	21263,39 39319,60	(



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#### **Speaker's Biography**

#### Birgitta Hauser Diplom-Betriebswirt (BA) Database and Software Architect

**Birgitta Hauser** worked on the IBM i and its predecessors since 1992. She graduated with a business economics diploma, and started programming on the AS/400 in 1992. She worked and works as traditional RPG Programmer but also as Database and Software Engineer, focusing on IBM i application and database modernization.

Currently she is self-employed and works in Consulting and Application and Database Modernization on IBM i and Db2 for i. Since July, 2019 she is occasionally working for Fresche Solutions Inc. (Montréal) as a contractor.

She also works in education as a trainer for RPG and SQL developers.

Since 2002 she has frequently spoken at the COMMON User Groups and other IBM i and Power Conferences in Germany, other European Countries, USA and Canada.

In addition, she is co-author of two IBM Redbooks and also the author of several articles and papers focusing on RPG and SQL for the ITP Verlag (a German publisher), IT Jungle Guru and IBM DeveloperWorks.

In 2015 she received the John Earl Speaker Scholarship Award. In 2018 she received the Al Barsa Memorial Scholarship Award.

IBM Champion 2020

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# Group By, Having and multi-dimensional Grouping? Yes I can!

If you are interested in more detailed individual Workshops on-site or remote, Please contact me directly

> Birgitta Hauser Diplom-Betriebswirt (BA) Database and Software Architect