CS245: Databases SQL

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Reading Data From Tables

• Set/Bag operations

- Union of two tables
- Intersection between two tables
- Difference of two tables
- Cross product of two tables
- Joining two tables

Join

- Natural join
- Inner join (theta join)
- Left outer join
- Right outer join
- Full outer join

Intersection & Difference - limitations using IN

- Duplicate rows cause problems when used IN predicate
- We will provide two to three alternate ways of implementing Intersect, Difference
- The implementation will be discussed after we go through (1) join operator (2) nested queries and (3) querying on the go method

Reading Data From Tables

• Set/Bag operations

- Union of two tables
- Intersection between two tables
- Difference of two tables
- Cross product of two tablesJoining two tables

Join

- Natural join
- Inner join (theta join)
- Left outer join
- Right outer join
- Full outer join
- Full outer joir
 Re-naming
- Creating tables using queries
- Having clause
- Using all clauses of SELECT
- Nested queries
- Querying tables on go
- Correlated nested queries
- Examples

Cartesian (Cross) product

Definition

 $A \times B = \{ (a, b) \mid a \in A \text{ AND } b \in B \}$

Example

Tab	ole R_1
Α	В
1	2
3	4

Т	able S	S ₁
В	C	D
2	5	6
4	7	8
9	10	11

	Table $R_1 \times S_1$					
$R_1.A$	$R_1.B$	$S_1.B$	$S_1.C$	$S_1.D$		
1	2	2	5	6		
1	2	4	7	8		
1	2	9	10	11		
3	4	2	5	6		
3	4	4	7	8		
3	4	9	10	11		

Example Database

	Sailors				
$_{ m sid}$	$_{ m sname}$	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	\mathbf{Art}	3	25.5		
95	Bob	3	63.5		

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	Boats	
bid	bname	color
101	Interlake	blue
102	Interlanke	$_{\rm red}$
103	Clipper	green
104	Marine	red

	Sailors				
sid	sname	rating	age		
22	Dustin	7	45.0		
29	$_{ m Brutus}$	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	$_{\mathrm{Bob}}$	3	63.5		

	Reserves				
$_{ m sid}$	bid	day			
22	101	10-Oct-2019			
22	102	10-Oct-2019			
22	103	08-Oct-2019			
22	104	07-Oct-2019			
31	102	10-Nov-2019			
31	103	06-Nov-2019			
31	104	12-Nov-2019			
64	101	05-Sep-2019			
64	102	08-Sep-2019			
74	103	08-Sep-2019			

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019

	Sailors				
sid	sname	rating	age		
22	Dustin	7	45.0		
29	$_{ m Brutus}$	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	Bob	3	63.5		

	Reserves				
sid	bid	day			
22	101	10-Oct-2019			
22	102	10-Oct-2019			
22	103	08-Oct-2019			
22	104	07-Oct-2019			
31	102	10-Nov-2019			
31	103	06-Nov-2019			
31	104	12-Nov-2019			
64	101	05-Sep-2019			
64	102	08-Sep-2019			
74	103	08-Sep-2019			

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019

Sailors					
sid	sname	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
22	Dustin	7	45.0	31	102	10-Nov-2019

	0.11	,				
	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT '	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	$05 ext{-Sep-}2019$
64	102	08-Sep-2019
74	103	08-Sep-2019

-		SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
Г	$_{ m sid}$	sname	rating	age	sid	bid	day
ı	22	Dustin	7	45.0	22	101	10-Oct-2019
	22	Dustin	7	45.0	22	102	10-Oct-2019
	22	Dustin	7	45.0	22	103	08-Oct-2019
	22	Dustin	7	45.0	22	104	07-Oct-2019
	22	Dustin	7	45.0	31	102	10-Nov-2019
	22	Dustin	7	45.0	31	103	06-Nov-2019
	22	Dustin	7	45.0	31	104	12-Nov-2019
	22	Dustin	7	45.0	64	101	$05 ext{-Sep-}2019$

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
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64	Horatio	7	35.0			
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sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	05-Sep-2019
22	Dustin	7	45.0	64	102	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
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64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	05-Sep-2019
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
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74	Horatio	9	35.0			
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves	
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$	
29	Brutus	1	33.0	22	101	10-Oct-20	19

	Sai	lors	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
29	$_{ m Brutus}$	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019

	Sai	lors	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
29	$_{ m Brutus}$	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

	Re	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019

	Sai	lors	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
29	$_{ m Brutus}$	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
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85	Art	3	25.5
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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	$_{ m Brutus}$	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019
29	Brutus	1	33.0	31	102	10-Nov-2019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
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71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019

	Sailors					
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
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sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

_		SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
	$_{ m sid}$	sname	rating	age	sid	bid	day
П	29	Brutus	1	33.0	22	101	10-Oct-2019
	29	Brutus	1	33.0	22	102	10-Oct-2019
	29	Brutus	1	33.0	22	103	08-Oct-2019
	29	Brutus	1	33.0	22	104	07-Oct-2019
	29	Brutus	1	33.0	31	102	10-Nov-2019
	29	Brutus	1	33.0	31	103	06-Nov-2019
	29	Brutus	1	33.0	31	104	12-Nov-2019
	29	Brutus	1	33.0	64	101	$05 ext{-Sep-}2019$

Sailors					
$_{ m sid}$	sname	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	Bob	3	63.5		

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT '	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	Brutus	1	33.0	64	102	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Res	serves
$_{ m sid}$	bid	$_{ m day}$
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
29	Brutus	1	33.0	22	101	10-Oct-2019
29	Brutus	1	33.0	22	102	10-Oct-2019
29	Brutus	1	33.0	22	103	08-Oct-2019
29	Brutus	1	33.0	22	104	07-Oct-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	$_{ m Brutus}$	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	$_{ m Brutus}$	1	33.0	64	102	08-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			



	Re	serves
$_{ m sid}$	bid	$_{ m day}$
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019

	Sai	Sailors					
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	$_{ m Andy}$	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

	Res	serves
$_{ m sid}$	bid	$_{ m day}$
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019

Sailors					
sid	sname	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	Bob	3	63.5		

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT *	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT *	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019

	Sailors				
sid	sname	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	$_{\mathrm{Bob}}$	3	63.5		

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	$05 ext{-Sep-}2019$
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
31	Lubber	8	55.5	64	101	$05 ext{-Sep-}2019$

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT '	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT *	FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
31	Lubber	8	55.5	22	101	10-Oct-2019
31	Lubber	8	55.5	22	102	10-Oct-2019
31	Lubber	8	55.5	22	103	08-Oct-2019
31	Lubber	8	55.5	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

×

	D						
	Reserves						
$_{ m sid}$	bid	$_{ m day}$					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	Bob	3	63.5	22	102	10-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT '	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	104	07-Oct-2019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	Bob	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	104	07-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	102	10-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

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	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	sid	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{ m Bob}$	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019
95	$_{ m Bob}$	3	63.5	22	104	07-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	102	10-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	103	06-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	Bob	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019
95	Bob	3	63.5	22	104	07-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	102	10-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	103	06-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	104	12-Nov-2019

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	102	10-Oct-2019
95	Bob	3	63.5	22	103	08-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	104	07-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	102	10-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	103	06-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	104	12-Nov-2019
95	$_{ m Bob}$	3	63.5	64	101	$05 ext{-Sep-}2019$

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
sid	sname	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	102	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	103	08-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	104	07-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	102	10-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	103	06-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	104	12-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	64	101	05-Sep-2019
95	Bob	3	63.5	64	102	08-Sep-2019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	ant nam	* 55011	G 11	GD O GG	TOTAL	D
	SELECT	* FROM	Sailors	CROSS	JOIN	Reserves
$_{ m sid}$	$_{ m sname}$	rating	age	$_{ m sid}$	bid	day
95	Bob	3	63.5	22	101	10-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	102	10-Oct-2019
95	Bob	3	63.5	22	103	08-Oct-2019
95	$_{\mathrm{Bob}}$	3	63.5	22	104	07-Oct-2019
95	Bob	3	63.5	31	102	10-Nov-2019
95	$_{\mathrm{Bob}}$	3	63.5	31	103	06-Nov-2019
95	Bob	3	63.5	31	104	12-Nov-2019
95	$_{ m Bob}$	3	63.5	64	101	05-Sep-2019
95	Bob	3	63.5	64	102	08-Sep-2019
95	$_{\mathrm{Bob}}$	3	63.5	74	103	08-Sep-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

NATURAL JOIN

Reserves						
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

۲	SELECT *	FROM Sa	ailors N	ATURA	L JOIN	Reserves
$_{ m sid}$	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

NATURAL JOIN

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

		SELECT *	FROM S	ailors N	ATURA	AL JOIN	l Reserves
I	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$
Ī	22	Dustin	7	45.0	22	101	10-Oct-2019
ı	22	Dustin	7	45.0	22	102	10-Oct-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

NATURAL JOIN

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELECT * FROM Sailors NATURAL JOIN Reserves							
	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
	22	Dustin	7	45.0	22	101	10-Oct-2019	
	22	Dustin	7	45.0	22	102	10-Oct-2019	
:	22	Dustin	7	45.0	22	103	08-Oct-2019	

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

NATURAL JOIN

	Reserves							
$_{ m sid}$	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

 $\label{eq:condition: Sailors.sid} Join \ condition: \ Sailors.sid = Reserves.sid \ (join \ identical \ column \ names \ from \ both \ tables)$

SELECT * FROM Sailors NATURAL JOIN Reserves								
$_{ m sid}$	sname	rating	age	sid	bid	day		
22	Dustin	7	45.0	22	101	10-Oct-2019		
22	Dustin	7	45.0	22	102	10-Oct-2019		
22	Dustin	7	45.0	22	103	08-Oct-2019		
22	Dustin	7	45.0	22	104	07-Oct-2019		

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

NATURAL JOIN

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELECT * FROM Sailors NATURAL JOIN Reserves							
sid	sname	rating	age	$_{ m sid}$	bid	day		
22	Dustin	7	45.0	22	101	10-Oct-2019		
22	Dustin	7	45.0	22	102	10-Oct-2019		
22	Dustin	7	45.0	22	103	08-Oct-2019		
22	Dustin	7	45.0	22	104	07-Oct-2019		
31	Lubber	8	55.5	31	102	10-Nov-2019		

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	$_{ m Andy}$	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

NATURAL JOIN

Reserves							
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

SELECT * FROM Sailors NATURAL JOIN Reserves							
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	22	101	10-Oct-2019	
22	Dustin	7	45.0	22	102	10-Oct-2019	
22	Dustin	7	45.0	22	103	08-Oct-2019	
22	Dustin	7	45.0	22	104	07-Oct-2019	
31	Lubber	8	55.5	31	102	10-Nov-2019	
31	Lubber	8	55.5	31	103	06-Nov-2019	

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

NATURAL JOIN

Reserves						
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

 $\label{eq:condition: Sailors.sid} Join \ condition: \ Sailors.sid = Reserves.sid \ (join \ identical \ column \ names \ from \ both \ tables)$

	SELECT * FROM Sailors NATURAL JOIN Reserves						
sid	l sname	rating	age	sid	bid	day	
22	Dustin	7	45.0	22	101	10-Oct-2019	
22	Dustin	7	45.0	22	102	10-Oct-2019	
22	Dustin	7	45.0	22	103	08-Oct-2019	
22	Dustin	7	45.0	22	104	07-Oct-2019	
31	Lubber	8	55.5	31	102	10-Nov-2019	
31	Lubber	8	55.5	31	103	06-Nov-2019	
31	Lubber	8	55.5	31	104	12-Nov-2019	

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

NATURAL JOIN

	Reserves						
S	id	bid	day				
2	2	101	10-Oct-2019				
2	2	102	10-Oct-2019				
2	2	103	08-Oct-2019				
2	2	104	07-Oct-2019				
3	1	102	10-Nov-2019				
3	1	103	06-Nov-2019				
3	1	104	12-Nov-2019				
6	4	101	05-Sep-2019				
6	4	102	08-Sep-2019				
7	4	103	08-Sep-2019				

	SELECT *	FROM Sa	ilors NA	ATURA	L JOIN	l Reserves
si	d sname	rating	age	sid	bid	day
22	2 Dustin	7	45.0	22	101	10-Oct-2019
22	2 Dustin	7	45.0	22	102	10-Oct-2019
22	2 Dustin	7	45.0	22	103	08-Oct-2019
22	2 Dustin	7	45.0	22	104	07-Oct-2019
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
64	4 Horatio	7	35.0	64	101	$05 ext{-Sep-}2019$

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

NATURAL JOIN

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

	SELECT * FROM Sailors NATURAL JOIN Reserves						
s	$_{\rm id}$	sname	rating	age	sid	bid	day
2	22	Dustin	7	45.0	22	101	10-Oct-2019
2	22	$_{ m Dustin}$	7	45.0	22	102	10-Oct-2019
2	22	Dustin	7	45.0	22	103	08-Oct-2019
2	22	Dustin	7	45.0	22	104	07-Oct-2019
- 3	31	Lubber	8	55.5	31	102	10-Nov-2019
- 3	31	Lubber	8	55.5	31	103	06-Nov-2019
3	31	Lubber	8	55.5	31	104	12-Nov-2019
ϵ	34	Horatio	7	35.0	64	101	05-Sep-2019
ϵ	64	Horatio	7	35.0	64	102	08-Sep-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

NATURAL JOIN

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition: Sailors.sid} Join \ condition: Sailors.sid = Reserves.sid \ (join identical column names from both tables)$

	SELECT * FROM Sailors NATURAL JOIN Reserves							
sid	sname	rating	age	sid	bid	day		
22	Dustin	7	45.0	22	101	10-Oct-2019		
22	Dustin	7	45.0	22	102	10-Oct-2019		
22	Dustin	7	45.0	22	103	08-Oct-2019		
22	Dustin	7	45.0	22	104	07-Oct-2019		
31	Lubber	8	55.5	31	102	10-Nov-2019		
31	Lubber	8	55.5	31	103	06-Nov-2019		
31	Lubber	8	55.5	31	104	12-Nov-2019		
64	Horatio	7	35.0	64	101	05-Sep-2019		
64	Horatio	7	35.0	64	102	08-Sep-2019		
74	Horatio	9	35.0	74	103	08-Sep-2019		

Theta Join

Natural Join

- Join condition is implicit
- Join condition is on attributes whose name is identical
- Attributes are always joined by equality condition

Theta Join

- Specify the condition on which on row from each table to be joined by using ON clause
- Specify filtering condition by using WHERE clause

	Sailors							
sid	sname	rating	age					
22	Dustin	7	45.0					
29	Brutus	1	33.0					
31	Lubber	8	55.5					
32	Andy	8	25.5					
58	Rusty	10	35.0					
64	Horatio	7	35.0					
71	Zorba	10	16.0					
74	Horatio	9	35.0					
85	Art	3	25.5					
95	Bob	3	63.5					

JOIN ON Sailors.sid < Reserves.sid

	-							
	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	SELE	CT * FRO	M Sailors	JOIN	Reserves	s ON	Sailors.sid	<	Reserves
Ī	sid	sname	rating	age	$_{ m sid}$	bid	day		
Ī	22	Dustin	7	45.0	31	102	10-Nov-2	01	9

Sailors							
sid	sname	rating	age				
22	Dustin	7	45.0				
29	$_{ m Brutus}$	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	$_{ m SEL}$	ECT * FR	OM Sailor	s JOIN	Reserv	ves ON	Sailors.sid	< Reserve
ı	sid	sname	rating	age	$_{ m sid}$	bid	day	
ı	22	Dustin	7	45.0	31	102	10-Nov-2	2019
ı	22	Dustin	7	45.0	31	103	06-Nov-2	2019

Sailors							
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

SELI	ECT * FR	OM Sailor	s JOIN	Reserv	res ON	Sailors.sid	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	31	102	10-Nov-2	019
22	Dustin	7	45.0	31	103	06-Nov-2	019
22	Dustin	7	45.0	31	104	12-Nov-2	019

Sailors							
$_{ m sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition:Sailors.sid} \mbox{ Join condition: } \frac{\mbox{Sailors.sid}}{\mbox{condition}} < \frac{\mbox{Reserves.sid}}{\mbox{Reserves.sid}} \mbox{ (join on specified condition)}$

	SELI	ECT * FR	OM Sailor	s JOIN	Reserv	es ON	Sailors.sid	< Reserve
ı	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
ı	22	Dustin	7	45.0	31	102	10-Nov-2	019
ı	22	Dustin	7	45.0	31	103	06-Nov-2	019
ı	22	Dustin	7	45.0	31	104	12-Nov-2	019
ı	22	Dustin	7	45.0	64	101	05-Sep-2	019

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

SEL	ECT * FR	OM Sailo	rs JOIN	Reserv	es ON	Sailors.sid	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	31	102	10-Nov-2	019
22	Dustin	7	45.0	31	103	06-Nov-2	019
22	Dustin	7	45.0	31	104	12-Nov-2	019
22	Dustin	7	45.0	64	101	05-Sep- 2	019
22	Dustin	7	45.0	64	102	08-Sep-2	019

Sailors							
sid	sname	rating	age				
22	Dustin	7	45.0				
29	$_{ m Brutus}$	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	$_{\mathrm{Bob}}$	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

 $\label{eq:condition:Sailors.sid} \mbox{ Join condition: } \frac{\mbox{Sailors.sid}}{\mbox{condition}} < \frac{\mbox{Reserves.sid}}{\mbox{Reserves.sid}} \mbox{ (join on specified condition)}$

SEL	ECT * FR	OM Sailoi	s JOIN	Reserv	es ON	Sailors.sid	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-20	019
22	Dustin	7	45.0	31	103	06-Nov-20	019
22	Dustin	7	45.0	31	104	12-Nov-20	019
22	Dustin	7	45.0	64	101	05-Sep-20	19
22	Dustin	7	45.0	64	102	08-Sep-20	19
22	Dustin	7	45.0	74	103	08-Sep-20	19

Sailors							
$_{ m sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

 $\label{eq:condition:Sailors.sid} \mbox{ Join condition: } \frac{\mbox{Sailors.sid}}{\mbox{condition}} < \frac{\mbox{Reserves.sid}}{\mbox{Reserves.sid}} \mbox{ (join on specified condition)}$

SELE	CT * FR	OM Sailor	s JOIN	Reserv	$^{\rm res}$ ON	Sailors.sid <	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	31	102	10-Nov-20	19
22	Dustin	7	45.0	31	103	06-Nov-20	19
22	Dustin	7	45.0	31	104	12-Nov-20	19
22	Dustin	7	45.0	64	101	05-Sep-20	19
22	Dustin	7	45.0	64	102	08-Sep-20	19
22	Dustin	7	45.0	74	103	08-Sep-20	19
29	Brutus	1	33.0	31	102	10-Nov-20	19

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

SELE	CT * FR	OM Sailor	s JOIN	Reserv	es ON	Sailors.sid	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	31	102	10-Nov-2	2019
22	Dustin	7	45.0	31	103	06-Nov-2	2019
22	Dustin	7	45.0	31	104	12-Nov-2	2019
22	Dustin	7	45.0	64	101	05-Sep-2	019
22	Dustin	7	45.0	64	102	08-Sep-2	019
22	Dustin	7	45.0	74	103	08-Sep-2	019
29	Brutus	1	33.0	31	102	10-Nov-2	019
29	Brutus	1	33.0	31	103	06-Nov-2	2019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	$_{\mathrm{Bob}}$	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

SELE	CT * FRC	M Sailors	JOIN	Reserve	es ON	Sailors.sid	< Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	31	102	10-Nov-2	019
22	Dustin	7	45.0	31	103	06-Nov-2	019
22	Dustin	7	45.0	31	104	12-Nov-2	019
22	Dustin	7	45.0	64	101	05-Sep-20	019
22	Dustin	7	45.0	64	102	08-Sep-20	019
22	Dustin	7	45.0	74	103	08-Sep-20	019
29	Brutus	1	33.0	31	102	10-Nov-2	019
29	Brutus	1	33.0	31	103	06-Nov-2	019
29	Brutus	1	33.0	31	104	12-Nov-2	019

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

SELI	ECT * FRO	OM Sailor	s JOIN	Reserv	es ON	Sailors.sid	< Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-2	019
22	Dustin	7	45.0	31	103	06-Nov-2	019
22	Dustin	7	45.0	31	104	12-Nov-2	019
22	Dustin	7	45.0	64	101	05-Sep- 2	019
22	Dustin	7	45.0	64	102	08-Sep-2	019
22	Dustin	7	45.0	74	103	08-Sep-2	019
29	Brutus	1	33.0	31	102	10-Nov-2	019
29	Brutus	1	33.0	31	103	06-Nov-2	019
29	Brutus	1	33.0	31	104	12-Nov-2	019
29	Brutus	1	33.0	64	101	05-Sep-2	019

	Sailors						
sid	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

< Reserve
2019
2019
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019
019

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

SELE	ECT * FI	ROM Sailo	rs JOIN	Reserv	zes ON	Sailors.sid <	< Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-20	19
22	Dustin	7	45.0	31	103	06-Nov-20	19
22	Dustin	7	45.0	31	104	12-Nov-20	19
22	Dustin	7	45.0	64	101	05-Sep-20	19
22	Dustin	7	45.0	64	102	08-Sep-20	19
22	Dustin	7	45.0	74	103	08-Sep-20	19
29	Brutus	1	33.0	31	102	10-Nov-20	19
29	Brutus	1	33.0	31	103	06-Nov-20	19
29	Brutus	1	33.0	31	104	12-Nov-20	19
29	Brutus	1	33.0	64	101	05-Sep-20	19
29	Brutus	1	33.0	64	102	09-Sep-20	19
29	Brutus	1	33.0	74	103	08-Sep-20	19

Sailors					
$_{ m sid}$	sname	rating	age		
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	Bob	3	63.5		

JOIN ON Sailors.sid < Reserves.sid

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

SEL	ECT * FRO	OM Sailor	rs JOIN	Reserv	es ON	Sailors.sid <	Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-20	19
22	Dustin	7	45.0	31	103	06-Nov-20	19
22	Dustin	7	45.0	31	104	12-Nov-20	19
22	Dustin	7	45.0	64	101	05-Sep-20	19
22	Dustin	7	45.0	64	102	08-Sep-20	19
22	Dustin	7	45.0	74	103	08-Sep-20	19
29	Brutus	1	33.0	31	102	10-Nov-20	19
29	Brutus	1	33.0	31	103	06-Nov-20	19
29	Brutus	1	33.0	31	104	12-Nov-20	19
29	Brutus	1	33.0	64	101	05-Sep-20	19
29	Brutus	1	33.0	64	102	09-Sep-20	19
29	Brutus	1	33.0	74	103	08-Sep-20	19
31	Lubber	8	55.5	64	101	05-Sep-20	19

	Sailors					
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	$_{ m Andy}$	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

SEL	ECT * FRO		s JOIN	Reserv	es ON	Sailors.sid <	Reserve
$_{ m sid}$	$_{ m sname}$	rating	age	$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-201	19
22	Dustin	7	45.0	31	103	06-Nov-201	L9
22	Dustin	7	45.0	31	104	12-Nov-201	L9
22	Dustin	7	45.0	64	101	05-Sep-201	9
22	Dustin	7	45.0	64	102	08-Sep-201	.9
22	Dustin	7	45.0	74	103	08-Sep-201	9
29	Brutus	1	33.0	31	102	10-Nov-201	19
29	Brutus	1	33.0	31	103	06-Nov-201	19
29	Brutus	1	33.0	31	104	12-Nov-201	19
29	Brutus	1	33.0	64	101	05-Sep-201	9
29	Brutus	1	33.0	64	102	09-Sep-201	9
29	Brutus	1	33.0	74	103	08-Sep-201	9
31	Lubber	8	55.5	64	101	05-Sep-201	9
31	Lubber	8	55.5	64	102	08-Sep-201	9

	Sailors						
	$_{ m sid}$	sname	rating	age			
	22	Dustin	7	45.0			
	29	Brutus	1	33.0			
П	31	Lubber	8	55.5			
	32	Andy	8	25.5			
	58	Rusty	10	35.0			
	64	Horatio	7	35.0			
	71	Zorba	10	16.0			
	74	Horatio	9	35.0			
	85	Art	3	25.5			
	95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	ECT * FRO		s JOIN	Reserv	es ON S	Sailors.sid $<$ Reserves
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	05-Sep-2019
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	Brutus	1	33.0	64	102	09-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019

	Sailors							
$_{ m sid}$	sname	rating	age					
22	Dustin	7	45.0					
29	Brutus	1	33.0					
31	Lubber	8	55.5					
32	Andy	8	25.5					
58	Rusty	10	35.0					
64	Horatio	7	35.0					
71	Zorba	10	16.0					
74	Horatio	9	35.0					
85	Art	3	25.5					
95	$_{\mathrm{Bob}}$	3	63.5					

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
$_{ m sid}$	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

	CT * FRO	M Sailors	JOIN	Reserves	ON	Sailors.sid < Reserve
$_{ m sid}$	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	$05 ext{-Sep-}2019$
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	Brutus	1	33.0	64	102	09-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019
32	Andy	8	25.5	64	101	05-Sep-2019

	Sail	lors	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	$_{\mathrm{Bob}}$	3	63.5

JOIN ON Sailors.sid < Reserves.sid

	D							
	Reserves							
$_{ m sid}$	bid	$_{ m day}$						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

SELE	CT * FRO	OM Sailors	JOIN	Reserves		Sailors.sid < Reserves
$_{ m sid}$	sname	rating	$_{ m age}$	$_{ m sid}$	bid	day
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	05-Sep-2019
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	Brutus	1	33.0	64	102	09-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019
32	Andy	8	25.5	64	101	05-Sep-2019
32	Andy	8	25.5	64	102	08-Sep-2019

Sailors							
$_{ m sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

SELE	CT * FRO		JOIN	Reserves	ON	Sailors.sid < Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	05-Sep-2019
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	05-Sep-2019
29	Brutus	1	33.0	64	102	09-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019
32	Andy	8	25.5	64	101	05-Sep-2019
32	Andy	8	25.5	64	102	08-Sep-2019
32	Andy	8	25.5	74	103	08-Sep-2019

	Sailors							
sid	sname	rating	age					
22	Dustin	7	45.0					
29	Brutus	1	33.0					
31	Lubber	8	55.5					
32	Andy	8	25.5					
58	Rusty	10	35.0					
64	Horatio	7	35.0					
71	Zorba	10	16.0					
74	Horatio	9	35.0					
85	Art	3	25.5					
95	Bob	3	63.5					

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

Join condition: Sailors.sid < Reserves.sid (join on specified condition)

SEL	ECT * FR	OM Saile	ors JOIN	Reserv	es ON	Sailors.sid <	Reserve
$_{ m sid}$	$_{ m sname}$	rating		$_{ m sid}$	bid	$_{ m day}$	
22	Dustin	7	45.0	31	102	10-Nov-20	
22	Dustin	7	45.0	31	103	06-Nov-20	L9
22	Dustin	7	45.0	31	104	12-Nov-20	19
22	Dustin	7	45.0	64	101	05-Sep-201	.9
22	Dustin	7	45.0	64	102	08-Sep-201	.9
22	Dustin	7	45.0	74	103	08-Sep-201	9
29	Brutus	1	33.0	31	102	10-Nov-20	L9
29	Brutus	1	33.0	31	103	06-Nov-20	19
29	Brutus	1	33.0	31	104	12-Nov-20	19
29	Brutus	1	33.0	64	101	05-Sep-201	9
29	Brutus	1	33.0	64	102	09-Sep-201	9
29	Brutus	1	33.0	74	103	08-Sep-201	9
31	Lubber	8	55.5	64	101	05-Sep-201	9
31	Lubber	8	55.5	64	102	08-Sep-201	9
31	Lubber	8	55.5	74	103	08-Sep-201	.9
32	Andy	8	25.5	64	101	05-Sep-201	9
32	Andy	8	25.5	64	102	08-Sep-201	.9
32	Andy	8	25.5	74	103	08-Sep-201	9
58	Rusty	10	35.0	64	101	05-Sep-201	9

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Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

Join condition: Sailors.sid < Reserves.sid (join on specified condition)

-	SELE	CT * FRO	M Sailors	JOIN	Reserves	ON	Sailors.sid < Reserve
	sid	sname	rating	age	sid	bid	day
	22	Dustin	7	45.0	31	102	10-Nov-2019
	22	Dustin	7	45.0	31	103	06-Nov-2019
	22	Dustin	7	45.0	31	104	12-Nov-2019
	22	Dustin	7	45.0	64	101	05-Sep-2019
	22	Dustin	7	45.0	64	102	08-Sep-2019
ı	22	Dustin	7	45.0	74	103	08-Sep-2019
	29	Brutus	1	33.0	31	102	10-Nov-2019
	29	Brutus	1	33.0	31	103	06-Nov-2019
	29	Brutus	1	33.0	31	104	12-Nov-2019
	29	Brutus	1	33.0	64	101	05-Sep-2019
	29	Brutus	1	33.0	64	102	09-Sep-2019
	29	Brutus	1	33.0	74	103	08-Sep-2019
	31	Lubber	8	55.5	64	101	05-Sep-2019
	31	Lubber	8	55.5	64	102	08-Sep-2019
	31	Lubber	8	55.5	74	103	08-Sep-2019
	32	Andy	8	25.5	64	101	05-Sep-2019
	32	Andy	8	25.5	64	102	08-Sep-2019
	32	Andy	8	25.5	74	103	08-Sep-2019
	58	Rusty	10	35.0	64	101	05-Sep-2019
	58	Rusty	10	35.0	64	102	08-Sep-2019

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Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition:Sailors.sid} \mbox{Sailors.sid} < \mbox{Reserves.sid} \mbox{ (join on specified condition)}$

22 Dustin 7 45.0 31 102 10-Nov-2019 22 Dustin 7 45.0 31 103 06-Nov-2019 22 Dustin 7 45.0 31 104 12-Nov-2019 22 Dustin 7 45.0 64 101 05-Sep-2019 22 Dustin 7 45.0 64 102 08-Sep-2019 22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 31 104 12-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 101<		CT * FRO		JOIN			Sailors.sid < Reserve
22 Dustin 7 45.0 31 103 06-Nov-2019 22 Dustin 7 45.0 31 104 12-Nov-2019 22 Dustin 7 45.0 64 101 05-Sep-2019 22 Dustin 7 45.0 64 102 08-Sep-2019 22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 104 12-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102<	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22 Dustin 7 45.0 31 104 12-Nov-2019 22 Dustin 7 45.0 64 101 05-Sep-2019 22 Dustin 7 45.0 64 102 08-Sep-2019 22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102<	22	Dustin	7	45.0	31	102	10-Nov-2019
22 Dustin 7 45.0 64 101 05-Sep-2019 22 Dustin 7 45.0 64 102 08-Sep-2019 22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 64 101<	22	Dustin	7	45.0	31	103	06-Nov-2019
22 Dustin 7 45.0 64 102 08-Sep-2019 22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102	22	Dustin	7	45.0	31	104	12-Nov-2019
22 Dustin 7 45.0 74 103 08-Sep-2019 29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 64 102	22	Dustin	7	45.0	64	101	$05 ext{-Sep-}2019$
29 Brutus 1 33.0 31 102 10-Nov-2019 29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 31 104 12-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103	22	Dustin	7	45.0	64	102	
29 Brutus 1 33.0 31 103 06-Nov-2019 29 Brutus 1 33.0 31 104 12-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 99-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	22	Dustin	7	45.0	74	103	
29 Brutus 1 33.0 31 104 12-Nov-2019 29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	29	Brutus	1	33.0	31	102	10-Nov-2019
29 Brutus 1 33.0 64 101 05-Sep-2019 29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	29	Brutus	1	33.0	31	103	
29 Brutus 1 33.0 64 102 09-Sep-2019 29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	29	Brutus	1	33.0	31	104	12-Nov-2019
29 Brutus 1 33.0 74 103 08-Sep-2019 31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019		Brutus					
31 Lubber 8 55.5 64 101 05-Sep-2019 31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	29	Brutus	1	33.0	64	102	
31 Lubber 8 55.5 64 102 08-Sep-2019 31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019	29	Brutus	1	33.0	74	103	
31 Lubber 8 55.5 74 103 08-Sep-2019 32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019			-	55.5	64		
32 Andy 8 25.5 64 101 05-Sep-2019 32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019			8				
32 Andy 8 25.5 64 102 08-Sep-2019 32 Andy 8 25.5 74 103 08-Sep-2019		Lubber	8		74		
32 Andy 8 25.5 74 103 08-Sep-2019					64		
		Andy	-			102	
59 Pusty 10 25.0 64 101 05 Sep 2010		Andy	8	25.5	74	103	
	58	Rusty	10	35.0	64	101	05-Sep-2019
58 Rusty 10 35.0 64 102 08-Sep-2019							
58 Rusty 10 35.0 74 103 08-Sep-2019	58	Rusty	10	35.0	$7\overline{4}$	103	08-Sep-2019

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	Sailors							
sid	sname	rating	age					
22	Dustin	7	45.0					
29	Brutus	1	33.0					
31	Lubber	8	55.5					
32	Andy	8	25.5					
58	Rusty	10	35.0					
64	Horatio	7	35.0					
71	$_{ m Zorba}$	10	16.0					
74	Horatio	9	35.0					
85	Art	3	25.5					
95	Bob	3	63.5					

JOIN ON Sailors.sid < Reserves.sid

	Reserves							
$_{ m sid}$	bid	$_{ m day}$						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

						Sailors.sid < Reserve
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$
22	Dustin	7	45.0	31	102	10-Nov-2019
22	Dustin	7	45.0	31	103	06-Nov-2019
22	Dustin	7	45.0	31	104	12-Nov-2019
22	Dustin	7	45.0	64	101	$05 ext{-Sep-}2019$
22	Dustin	7	45.0	64	102	08-Sep-2019
22	Dustin	7	45.0	74	103	08-Sep-2019
29	Brutus	1	33.0	31	102	10-Nov-2019
29	Brutus	1	33.0	31	103	06-Nov-2019
29	Brutus	1	33.0	31	104	12-Nov-2019
29	Brutus	1	33.0	64	101	$05 ext{-Sep-}2019$
29	Brutus	1	33.0	64	102	09-Sep-2019
29	Brutus	1	33.0	74	103	08-Sep-2019
31	Lubber	8	55.5	64	101	05-Sep-2019
31	Lubber	8	55.5	64	102	08-Sep-2019
31	Lubber	8	55.5	74	103	08-Sep-2019
32	Andy	8	25.5	64	101	05-Sep-2019
32	Andy	8	25.5	64	102	08-Sep-2019
32	Andy	8	25.5	74	103	08-Sep-2019
58	Rusty	10	35.0	64	101	05-Sep-2019
58	Rusty	10	35.0	64	102	08-Sep-2019
58	Rusty	10	35.0	74	103	08-Sep-2019
64	Horatio	7	35.0	74	103	08-Sep-2019 = *7 (* 79/161

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74	$_{ m Horatio}$	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

JOIN ON Sailors.sid < Reserves.sid

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition:Sailors.sid} \mbox{Sailors.sid} < \mbox{Reserves.sid} \mbox{ (join on specified condition)}$

-	SELE	CT * FROI	M Sailors	JOIN	Reserves	ON	Sailors.sid < Reserves
	sid	sname	rating	age	sid	bid	day
	22	Dustin	7	45.0	31	102	10-Nov-2019
	22	Dustin	7	45.0	31	103	06-Nov-2019
	22	Dustin	7	45.0	31	104	12-Nov-2019
	22	Dustin	7	45.0	64	101	05-Sep-2019
	22	Dustin	7	45.0	64	102	08-Sep-2019
	22	Dustin	7	45.0	74	103	08-Sep-2019
	29	Brutus	1	33.0	31	102	10-Nov-2019
	29	Brutus	1	33.0	31	103	06-Nov-2019
	29	Brutus	1	33.0	31	104	12-Nov-2019
	29	Brutus	1	33.0	64	101	05-Sep-2019
	29	Brutus	1	33.0	64	102	09-Sep-2019
	29	Brutus	1	33.0	74	103	08-Sep-2019
	31	Lubber	8	55.5	64	101	05-Sep-2019
	31	Lubber	8	55.5	64	102	08-Sep-2019
	31	Lubber	8	55.5	74	103	08-Sep-2019
	32	Andy	8	25.5	64	101	05-Sep-2019
	32	Andy	8	25.5	64	102	08-Sep-2019
	32	Andy	8	25.5	74	103	08-Sep-2019
	58	Rusty	10	35.0	64	101	05-Sep-2019
	58	Rusty	10	35.0	64	102	08-Sep-2019
	58	Rusty	10	35.0	74	103	08-Sep-2019
	64	Horatio	7	35.0	74	103	08-Sep-2019
	71	Zobra	10	16.0	74	103	08-Sep-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85 Art		3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid
 Reserves.sid where Sailros.rating \geq 9

Reserves							
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SEL	ECT * FR	OM Sailo	rs JOIN	Reser	ves ON	Sailors.sid	. <	Reserves
ı	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day		
ı	58	Rusty	10	35.0	64	101	05-Sep- 2	019	
_									

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85 Art		3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid
 Reserves.sid where Sailros.rating \geq 9

Reserves							
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

	SEL	ECT * FR	OM Sailo	rs JOIN	Reser	ves ON	Sailors.sid	<	Reserve
ı	$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day		
ı	58	Rusty	10	35.0	64	101	05-Sep- 2	019)
ı	58	Rusty	10	35.0	64	103	08-Sep-2	019)

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	$_{ m Horatio}$	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

JOIN ON Sailors.sid < Reserves.sid where Sailros.rating ≥ 9

	Reserves					
sid	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

SELECT * FROM Sailors JOIN Reserves ON Sailors.sid < Reserve								
where Sailors.rating ≥ 9								
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	$_{ m day}$		
58	Rusty	10	35.0	64	101	05-Sep-2019		
58	Rusty	10	35.0	64	103	08-Sep-2019		
58	Rusty	10	35.0	74	103	08-Sep-2019	Ī	

Sailors						
sid	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74 Horatio		9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

JOIN ON Sailors.sid
 Reserves.sid where Sailros.rating \geq 9

	Reserves					
$_{ m sid}$	bid	day				
22	101	10-Oct-2019				
22	102	10-Oct-2019				
22	103	08-Oct-2019				
22	104	07-Oct-2019				
31	102	10-Nov-2019				
31	103	06-Nov-2019				
31	104	12-Nov-2019				
64	101	05-Sep-2019				
64	102	08-Sep-2019				
74	103	08-Sep-2019				

SELECT * FROM Sailors JOIN Reserves ON Sailors.sid < Reserves

			where 5	anors.r	ating 2	9
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
58	Rusty	10	35.0	64	101	05-Sep-2019
58	Rusty	10	35.0	64	103	08-Sep-2019
58	Rusty	10	35.0	74	103	08-Sep-2019
71	$_{ m Zobra}$	10	16.0	74	103	08-Sep-2019

(Left/Right) Outer Join

Outer join

Definition: In addition to the Natural join, add any dangling tuples from R or S.

Dangling tuples: The tuples that did not meet the Natural join criteria

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

	Reserves				
sid	bid	day			
22	101	10-Oct-2019			
22	102	10-Oct-2019			
22	103	08-Oct-2019			
22	104	07-Oct-2019			
31	102	10-Nov-2019			
31	103	06-Nov-2019			
31	104	12-Nov-2019			
64	101	05-Sep-2019			
64	102	08-Sep-2019			
74	103	08-Sep-2019			

ON Sailors LEFT OUTER JOIN Reserves ON Sailors.sid = Reserves.sid						
$_{ m sid}$	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	$_{ m Brutus}$	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

LEFT OUTER JOIN

	D	serves
$_{ m sid}$	bid	$_{ m day}$
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

 $\label{eq:condition: Sailors.sid} Join \ condition: Sailors.sid = Reserves.sid \ (join identical column names from both tables)$

SELECT	*	FROM	Sailors	LEFT	OUTER	JOIN	Reserves

		ON Sailor	rs.sid =	Reserv	res.sid	
$_{ m sid}$	sname	rating	age	sid	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019

Natural Join Execution - 03/01

Sailors					
sid	sname	rating	age		
22	Dustin	7	45.0		
29	$_{\rm Brutus}$	1	33.0		
31	Lubber	8	55.5		
32	Andy	8	25.5		
58	Rusty	10	35.0		
64	Horatio	7	35.0		
71	Zorba	10	16.0		
74	Horatio	9	35.0		
85	Art	3	25.5		
95	Bob	3	63.5		

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

 $\label{eq:condition: Sailors.sid} Join \ condition: \ Sailors.sid = Reserves.sid \ (join \ identical \ column \ names \ from \ both \ tables)$

SELECT * FROM Sailors LEFT OUTER JOIN Reserves

		ON Sailor	rs.sid =	Reserv	$_{ m ves.sid}$	
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019

Natural Join Execution - 04/01

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

_			
		Res	serves
	$_{ m sid}$	bid	$_{ m day}$
	22	101	10-Oct-2019
	22	102	10-Oct-2019
	22	103	08-Oct-2019
	22	104	07-Oct-2019
	31	102	10-Nov-2019
	31	103	06-Nov-2019
	31	104	12-Nov-2019
	64	101	05-Sep-2019
	64	102	08-Sep-2019
	74	103	08-Sep-2019

 $\label{eq:condition: Sailors.sid} Join \ condition: Sailors.sid = Reserves.sid \ (join \ identical \ column \ names \ from \ both \ tables)$

SELECT * FROM Sailors LEFT OUTER JOIN Reserves
ON Sailors sid = Reserves sid

sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019

Left Outer Join Execution - 01 (Left-outer-join)/04

Sailors							
$_{\rm sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

LEFT OUTER JOIN

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition: Sailors.sid} Join \ condition: \ Sailors.sid = Reserves.sid \ (join identical \ column \ names \ from \ both \ tables)$

SELECT * FROM Sailors LEFT OUTER JOIN Reserves
ON Sailors sid = Reserves sid

sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0			

Sailors							
$_{\rm sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	$_{ m Andy}$	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	$_{\mathrm{Bob}}$	3	63.5				

LEFT OUTER JOIN

	Reserves						
sid	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

 $\label{eq:condition: Sailors.sid} Join \ condition: \ Sailors.sid = Reserves.sid \ (join identical \ column \ names \ from \ both \ tables)$

SELECT * FROM Sailors LEFT OUTER JOIN Reserves							
ON Sailors.sid = Reserves.sid							
sid	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	22	101	10-Oct-2019	
22	Dustin	7	45.0	22	102	10-Oct-2019	
22	Dustin	7	45.0	22	103	08-Oct-2019	
22	Dustin	7	45.0	22	104	07-Oct-2019	
29	Brutus	1	33.0			_	
31	Lubber	8	55.5	31	102	10-Nov-2019	

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

LEFT OUTER JOIN

	Reserves						
$_{ m sid}$	bid	day					
22	101	10-Oct-2019					
22	102	10-Oct-2019					
22	103	08-Oct-2019					
22	104	07-Oct-2019					
31	102	10-Nov-2019					
31	103	06-Nov-2019					
31	104	12-Nov-2019					
64	101	05-Sep-2019					
64	102	08-Sep-2019					
74	103	08-Sep-2019					

SELECT	*	FROM	Sailors	LEFT	OUTER	JOIN	Reserves
		ON S	lailore e	id - B	ecervec ci	d	

		Or Dano	. D.DIG —	recour .	Conside	
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0			_
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019

Sailors							
$_{ m sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

SELECT * FROM Sailors LEFT OUTER JOIN Reserves
ON Sailors.sid = Reserves.sid

si	d sname	rating	age	$_{ m sid}$	bid	day
2:	2 Dustin	7	45.0	22	101	10-Oct-2019
2	2 Dustin	7	45.0	22	102	10-Oct-2019
2:	2 Dustin	7	45.0	22	103	08-Oct-2019
2:	2 Dustin	7	45.0	22	104	07-Oct-2019
2	9 Brutus	1	33.0		Τ.	T
3	l Lubber	8	55.5	31	102	10-Nov-2019
3	l Lubber	8	55.5	31	103	06-Nov-2019
3	l Lubber	8	55.5	31	104	12-Nov-2019

Left Outer Join Execution - 01(Left-outer-join)/08

Sailors						
$_{\rm sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

 $\label{eq:condition: Sailors.sid} Join \ condition: Sailors.sid = Reserves.sid \ (join identical column names from both tables)$

SELECT *	FROM	Sailors	LEFT	OUTER	JOIN	Reserves
	ON S	ailors.s	id = R	eserves.si	d	

sid	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0			_
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
32	\mathbf{Andy}	8	25.5			_

Left Outer Join Execution - 01(Left-outer-join)/09

Sailors						
$_{\rm sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

S	SELECT * FROM Sailors LEFT OUTER JOIN Reserves						
ON Sailors.sid = Reserves.sid							
sid	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	22	101	10-Oct-2019	
22	Dustin	7	45.0	22	102	10-Oct-2019	
22	Dustin	7	45.0	22	103	08-Oct-2019	
22	Dustin	7	45.0	22	104	07-Oct-2019	
29	Brutus	1	33.0			_	
31	Lubber	8	55.5	31	102	10-Nov-2019	
31	Lubber	8	55.5	31	103	06-Nov-2019	
31	Lubber	8	55.5	31	104	12-Nov-2019	
32	Andy	8	25.5		Τ.	_	
58	Rusty	10	35.0		Τ.	T	

Sailors						
$_{ m sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

_	SELECT *	FROM	Sailors	LEFT	OUTER	JOIN	Reserves	
ON Sailors sid = Reserves sid								

sid	sname	rating	age	sid	bid	dav
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	· ·	$45.0 \\ 45.0$	22	$\frac{101}{102}$	10-Oct-2019 10-Oct-2019
		<u> </u>				
22	Dustin	$\frac{\gamma}{2}$	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0	\perp	\perp	
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
32	Andy	8	25.5	\perp		_
58	Rusty	10	35.0			
64	Horatio	7	35.0	64	101	$05 ext{-Sep-}2019$

Sailors						
$_{\rm sid}$	sname	rating	age			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	$_{ m Zorba}$	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

SELECT *	ROM Sailors LEFT OUTER JOIN Reserves	
	ON Sailors.sid = Reserves.sid	

sid sname					
	rating	$_{ m age}$	$_{ m sid}$	bid	$_{ m day}$
22 Dustin	7	45.0	22	101	10-Oct-2019
22 Dustin	7	45.0	22	102	10-Oct-2019
22 Dustin	7	45.0	22	103	08-Oct-2019
22 Dustin	7	45.0	22	104	07-Oct-2019
29 Brutus	1	33.0			_
31 Lubber	8	55.5	31	102	10-Nov-2019
31 Lubber	8	55.5	31	103	06-Nov-2019
31 Lubber	8	55.5	31	104	12-Nov-2019
32 Andy	8	25.5		Τ.	T
58 Rusty	10	35.0	\perp		_
64 Horatio	7	35.0	64	101	$05 ext{-Sep-}2019$
64 Horatio	7	35.0	64	102	08-Sep-2019

Left Outer Join Execution - 01 (Left-outer-join)/12

Sailors							
$_{\rm sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

LEFT OUTER JOIN

	Reserves							
$_{ m sid}$	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

Join condition: Sailors.sid = Reserves.sid (join identical column names from both tables)

	ON Sailors.sid = Reserves.sid							
sid	sname	rating	age	$_{ m sid}$	bid	day		
22	Dustin	7	45.0	22	101	10-Oct-2019		
22	Dustin	7	45.0	22	102	10-Oct-2019		
22	Dustin	7	45.0	22	103	08-Oct-2019		
22	Dustin	7	45.0	22	104	07-Oct-2019		
29	Brutus	1	33.0			T		
31	Lubber	8	55.5	31	102	10-Nov-2019		
31	Lubber	8	55.5	31	103	06-Nov-2019		
31	Lubber	8	55.5	31	104	12-Nov-2019		
32	Andy	8	25.5			_		
58	Rusty	10	35.0			T		
64	Horatio	7	35.0	64	101	05-Sep-2019		
64	Horatio	7	35.0	64	102	08-Sep-2019		

16.0

SELECT * FROM Sailors LEFT OUTER JOIN Reserves

Zorba

10

Sailors						
$_{ m sid}$	sname	rating	$_{ m age}$			
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	Bob	3	63.5			

LEFT OUTER JOIN

	Reserves							
sid	bid	day						
22	101	10-Oct-2019						
22	102	10-Oct-2019						
22	103	08-Oct-2019						
22	104	07-Oct-2019						
31	102	10-Nov-2019						
31	103	06-Nov-2019						
31	104	12-Nov-2019						
64	101	05-Sep-2019						
64	102	08-Sep-2019						
74	103	08-Sep-2019						

Join condition: Sailors.sid = Reserves.sid (join identical column names from both tables)

ON Sailors.sid = Reserves.sid						
		ON Sailor	s.sid =	Reserv	es.sid	
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0			1
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
32	Andy	8	25.5			上
58	Rusty	10	35.0			上
64	Horatio	7	35.0	64	101	05-Sep-2019
64	Horatio	7	35.0	64	102	08-Sep-2019
71	Zorba	10	16.0			
74	Horatio	9	35.0	74	103	08-Sep-2019

CELECE * EDOM C. 1. LEDE OLIEED TOIN D.

Left Outer Join Execution - 01 (Left-outer-join) /14

Sailors						
$_{ m sid}$	sid sname rating					
22	Dustin	7	45.0			
29	Brutus	1	33.0			
31	Lubber	8	55.5			
32	Andy	8	25.5			
58	Rusty	10	35.0			
64	Horatio	7	35.0			
71	Zorba	10	16.0			
74	Horatio	9	35.0			
85	Art	3	25.5			
95	$_{\mathrm{Bob}}$	3	63.5			

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

$_{ m SE}$	SELECT * FROM Sailors LEFT OUTER JOIN Reserves						
	ON Sailors.sid = Reserves.sid						
sid	sname	rating	age	$_{ m sid}$	bid	day	
22	Dustin	7	45.0	22	101	10-Oct-2019	
22	Dustin	7	45.0	22	102	10-Oct-2019	
22	Dustin	7	45.0	22	103	08-Oct-2019	
22	Dustin	7	45.0	22	104	07-Oct-2019	
29	Brutus	1	33.0			T	
31	Lubber	8	55.5	31	102	10-Nov-2019	
31	Lubber	8	55.5	31	103	06-Nov-2019	
31	Lubber	8	55.5	31	104	12-Nov-2019	
32	Andy	8	25.5			_	
58	Rusty	10	35.0			T	
64	Horatio	7	35.0	64	101	05-Sep-2019	
64	Horatio	7	35.0	64	102	08-Sep-2019	
71	$_{ m Zorba}$	10	16.0			T	
74	Horatio	9	35.0	74	103	08-Sep-2019	
85	Art	3	25.5		Τ.		

Left Outer Join Execution - 01 (Left-outer-join) /15

	Sailors						
$_{ m sid}$	sname	rating	age				
22	Dustin	7	45.0				
29	Brutus	1	33.0				
31	Lubber	8	55.5				
32	Andy	8	25.5				
58	Rusty	10	35.0				
64	Horatio	7	35.0				
71	Zorba	10	16.0				
74	Horatio	9	35.0				
85	Art	3	25.5				
95	Bob	3	63.5				

LEFT OUTER JOIN

	Res	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

SELECT * FROM Sailors LEFT OUTER JOIN Reserves						IN Reserves
ON Sailors.sid = Reserves.sid						
$_{ m sid}$	sname	rating	age	$_{ m sid}$	bid	day
22	Dustin	7	45.0	22	101	10-Oct-2019
22	Dustin	7	45.0	22	102	10-Oct-2019
22	Dustin	7	45.0	22	103	08-Oct-2019
22	Dustin	7	45.0	22	104	07-Oct-2019
29	Brutus	1	33.0			T
31	Lubber	8	55.5	31	102	10-Nov-2019
31	Lubber	8	55.5	31	103	06-Nov-2019
31	Lubber	8	55.5	31	104	12-Nov-2019
32	Andy	8	25.5			_
58	Rusty	10	35.0			_
64	Horatio	7	35.0	64	101	05-Sep-2019
64	Horatio	7	35.0	64	102	08-Sep-2019
71	$_{ m Zorba}$	10	16.0			
74	Horatio	9	35.0	74	103	08-Sep-2019
85	Art	3	25.5		1	
95	$_{\mathrm{Bob}}$	3	63.5			_

Left Outer Join - Example

	U	
Α	В	C
1	2	3
4	5	6
7	8	9

LEFT OUTER JOIN

	V	
В	C	D
2	3	10
2	3	11
6	7	12

SELECT * FROM U LEFT OUTER JOIN V A B C B C D

Left Outer Join - Example

	U	
Α	В	С
1	2	3
4	5	6 9
7	8	9

LEFT OUTER JOIN

	V	
В	С	D
2	3	10
2	3	11
6	7	12

SELECT * FROM U LEFT OUTER JOIN V

SE.	LECI		tOM	O LE	FI OUIER JOIN V
A	В	C	В	C	D
1	2	3	2	3	10
- 1	2	3	2	3	11

Left Outer Join - Example

	U	
A	В	С
1	2	3
4	5	6
7	8	9

LEFT OUTER JOIN

	V	
В	C	D
2	3	10
2	3	11
6	7	12

SEI	LECT	* FF	ROM U	J LEI	FT OUTER JOIN V
A	В	С	В	C	D
1	2	3	2	3	10
1	2	3	2	3	11
4	5	6			_

Left Outer Join - Example

	U	
A	В	C
1	2	3
4	5	6
7	8	9

LEFT OUTER JOIN

	V	
В	С	D
2	3	10
2	3	11
6	7	12

SELECT * FROM U LEFT OUTER JOIN V

SEI	LECI	F I	TOM	O LEI	1 00	TER JOIN	V
A	В	С	В	C	D		
1	2	3	2	3	10		
1	2	3	2	3	11		
4	5	6			\perp		
7	8	9					

Right Outer Join

Right Outer Join - Example

	U	
A	В	С
1	2	3
4	5	6
7	8	9

RIGHT OUTER JOIN

	V	
В	C	D
2	3	10
2	3	11
6	7	12

SEI	LECT	* FI	ROM	U	RIGHT	OUTER	JOIN V
A	В	С	В	(C D		
1	2	3	2		3 10		

Right Outer Join

Right Outer Join - Example

	U	
Α	В	С
1	2	3
4	5	6 9
7	8	9

RIGHT OUTER JOIN

_			
		V	
	В	С	D
	2	3	10
	2	3	11
	6	7	12

SELECT * FROM U RIGHT OUTER JOIN V

SEI	TEC I	. r r	COM	O RIC	3111	OUTER JOIN	v
A	В	C	В	C	D		
1	2	3	2	3	10		
1	2	3	2	3	11		

Right Outer Join

Right Outer Join - Example

	U	
A	В	С
1	2	3
4	5	6
7	8	9

RIGHT OUTER JOIN

	V	
В	С	D
2	3	10
2	3	11
6	7	12

SELECT * FROM U RIGHT OUTER JOIN V						
Α	В	С	В	C	D	
1	2	3	2	3	10	
1	2	3	2	3	11	
			6	7	12	

Full Outer Join

Full outer join

TableA left outer join TableB

U

TableA right outer join TableB

FULL Outer Join

FULL Outer Join - Example (Not in MySQL)

	U	
A	В	С
1	2	3
4	5	6
7	8	9

FULL OUTER JOIN

	V	
В	C	D
2	3	10
2	3	11
6	7	12

SELECT * FROM U LEFT OUTER JOIN V A B C B C D 1 2 3 2 3 10 1 2 3 2 3 11 4 5 6 \perp L \perp L 7 8 9 1 1

Re-naming

Example - 01

table		tak	ole 2
A	В	В	D
1	2	2	3
1	2	4	5
		4	5

	New	Table	;
A1	B1	B2	D1
1	2	2	3
1	2	2	3

SELECT A AS A1, table 1.B AS B1,

table 2.B AS B2, D AS D1

FROM table1
JOIN table2

ON table1.B = table2.B WHERE table1.A < table2.D;

Create Table

Create a table out of select query

table table2		le2	
A	В	В	D
1	2	2	3
1	2	4	5
		4	5

Result				
A1	В1	B2	D1	
1	2	2	3	
1	2	2	3	

```
CREATE TABLE Result (
```

SELECT A AS A1, table 1 .B AS B1, table 2 .B AS B2, D AS D1

FROM table 1
JOIN table 2

ON table1.B = table2.B

WHERE table 1.A < table 2.D);

Select continued - 01

Group by rating such that each group has at least two sailors

SELECT *

FROM Sailors

GROUP BY rating

HAVING COUNT(rating) > 1;

Output

	Sail	lors	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
64	Horatio	7	35.0
29	$_{ m Brutus}$	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

	$\gamma_{rating}($	Sailors)	
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
31	Lubber	8	55.5
58	Rusty	10	35.0
85	Art	3	25.5

Select continued - 02

Group by rating such that each group has at least two sailors where sailor age ≥ 30

SELECT

FROM Sailors
WHERE age >= 30

GROUP BY rating

HAVING COUNT(rating) > 1;

Output

	Sail	lors	
sid	sname	rating	age
22	Dustin	7	45.0
64	Horatio	7	35.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
71	$_{ m Zorba}$	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

$\gamma_{rating}(Sailors)$			
$_{ m sid}$	sname	rating	age
22	Dustin	7	45.0
31	Lubber	8	55.5
58	Rusty	10	35.0

All six clauses of SELECT

Group by rating such that each group has at least two sailors where sailor age > 20 sort by sailor names

SELECT FROM

Sailors

age >= 20

WHERE GROUP BY rating

HAVING COUNT(rating) > 1

ORDER BY sname;

Output

	Sail	lors	
sid	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

$\gamma_{rating}(Sailors)$			
$_{ m sid}$	sname	rating	age
85	Art	3	25.5
22	Dustin	7	45.0
31	Lubber	8	55.5
58	Rusty	10	35.0

Nested Query

Query containing a sub-query

Correlated Nested Query

A sub-query which refers to columns of the tables of its containing query

Q1: Find the names of the Sailors who have reserved Boat 103

S sname

SELECT

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE S. sname

Sailors **AS** S **E** S.sid **IN**

WHERE

(SELECT R. sid FROM Reser

Reserves AS R R. bid = 103);

	Sailo	rs			
22	Dustin	7	45.0		
29	Brutus	1	33.0		
31	Lubber	8			
32	Andy	8	25.5		
58	Rusty	10			
64	Horatio	7			
71	Zorba	10	16.0		
74	Horatio	9			
85	Art	3	25.5		
95	Bob	3	63.5		

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE S.sname Sailors AS S S.sid IN

(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 22 in $\{22, 31, 74\}$ then retrieve

sname

	Sailo	rs		
22	Dustin	7	45.0	
29	Brutus	1	33.0	
31	Lubber	8		
	Andy	8	25.5	
58	Rusty			
64	Horatio	7		
71	Zorba		16.0	
74	Horatio	9		
85	Art	3	25.5	
	Bob	3	63.5	



	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE S.sname Sailors AS S S.sid IN

(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 29 in $\{22, 31, 74\}$ then retrieve

sname

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
	Bob	3	63.5



	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

FROM WHERE

SELECT S. sname Sailors AS S S. sid IN

> (SELECT R. sid

FROM Reserves AS R. WHERE R. bid = 103);

test condition

Is 31 in {22, 31, 74} then retrieve

sname

Dustin, Lubber

6. 11			
	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba		16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

FROM WHERE

SELECT S. sname Sailors AS S S. sid IN

> (SELECT R. sid

FROM Reserves AS R. WHERE R. bid = 103);

test condition

Is 32 in {22, 31, 74} then retrieve

sname

Dustin, Lubber

	Sailors			
22	Dustin	7	45.0	
29	Brutus	1		
31	Lubber	8		
32	Andy	8	25.5	
58	Rusty	10	35.0	
64	Horatio	7		
71	Zorba		16.0	
74	Horatio	9		
85	Art	3	25.5	
95	Bob	3	63.5	



	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT S. sname FROM WHERE

Sailors AS S S. sid IN

(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 58 in {22, 31, 74} then retrieve

sname Dustin, Lubber

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba		16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5



	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

FROM WHERE

SELECT S. sname Sailors AS S S. sid IN

> (SELECT R. sid

FROM Reserves AS R. WHERE R. bid = 103);

test condition

Is 64 in {22, 31, 74} then retrieve

sname

Dustin, Lubber

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

FROM WHERE

SELECT S. sname Sailors AS S S. sid IN

> (SELECT R. sid

FROM Reserves AS R. WHERE R. bid = 103);

test condition

Is 71 in {22, 31, 74} then retrieve

sname

Dustin, Lubber

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5



	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE

S.sname Sailors **AS** S

S. sid IN
(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 74 in $\{22, 31, 74\}$ then retrieve

sname

Dustin, Lubber, Horatio

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE S. sname Sailors AS S S. sid IN

(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 85 in $\{22, 31, 74\}$ then retrieve

sname

Dustin, Lubber, Horatio

	Sailo	rs		
22	Dustin	7	45.0	
29	Brutus	1		
31	Lubber	8		
32	Andy	8	25.5	
58	Rusty	10		
64	Horatio	7		
71	Zorba	10	16.0	
74	Horatio	9		
85	Art	3	25.5	
95	Bob	3	63.5	

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT FROM WHERE S.sname Sailors AS S S.sid IN

(SELECT R. sid

FROM Reserves AS R WHERE R. bid = 103);

test condition

Is 95 in $\{22,\,31,\,74\}$ then retrieve

sname

Dustin, Lubber, Horatio

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba		16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Nested Queries - Example 02

Find the names of sailors who have NOT reserved boat 103

 SELECT
 \$1.\$ sname

 FROM
 \$Sailors AS \$1\$

 WHERE
 \$1.\$ sid NOT IN

 (SELECT R1.\$ sid

 $\begin{array}{lll} \textbf{FROM} & \text{Reserves} & \textbf{AS} & \text{R1} \\ \textbf{WHERE} & \text{R1.bid} & = 103) \end{array}$

Nested Queries - Example 03

Find the names of Sailors who have reserved a red boat

```
| SELECT | S1.sname | Sailors AS S1 | Sailors AS S1 | S1.sid IN | (SELECT R1.sid | FROM | Reserves | AS R1 | WHERE | R1.bid | IN | (SELECT | B1.bid | FROM | Boats | AS B1 | WHERE | B1.color = 'red') |
```

Correlated nested queries

- The inner sub-query has been completely independent of the outer query
- In general, the inner sub-query could dependent on the row currently being examined in the outer query
- Such queries are known as Correlated nested queries

Find the names of sailors who have reserved boat number 103

EXISTS test whether a set is nonempty

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Find the names of sailors who have reserved boat number 103

	Sailors			
22	Dustin	7	45.0	
29	Brutus	1	33.0	
31	Lubber	8	55.5	
32	Andy	8	25.5	
58	Rusty	10		
64	Horatio	7		
71	Zorba	10	16.0	
74	Horatio	9		
85	Art	3	25.5	
95	Bob	3	63.5	

	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves		
$_{ m sid}$	$_{ m bid}$	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95		3	63.5

	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
	Bob	3	63.5

	Reserves			
sid	bid	day		
22	101	10-Oct-2019		
22	102	10-Oct-2019		
22	103	08-Oct-2019		
22	104	07-Oct-2019		
31	102	10-Nov-2019		
31	103	06-Nov-2019		
31	104	12-Nov-2019		
64	101	05-Sep-2019		
64	102	08-Sep-2019		
74	103	08-Sep-2019		

Find the names of sailors who have reserved boat number 103

	Sailo	rs	
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

	Re	serves
sid	bid	day
22	101	10-Oct-2019
22	102	10-Oct-2019
22	103	08-Oct-2019
22	104	07-Oct-2019
31	102	10-Nov-2019
31	103	06-Nov-2019
31	104	12-Nov-2019
64	101	05-Sep-2019
64	102	08-Sep-2019
74	103	08-Sep-2019

Find the names of sailors who have reserved boat number 103

	Sailors			
22	Dustin	7	45.0	
29	Brutus	1		
31	Lubber	8		
32	Andy	8	25.5	
58	Rusty			
64	Horatio	7		
71	Zorba	10	16.0	
74	Horatio	9	35.0	
85	Art	3	25.5	
		3	63.5	

	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Find the names of sailors who have reserved boat number 103

.5

	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Find the names of sailors who have reserved boat number 103

Sailors			
22	Dustin	7	45.0
29	Brutus	1	
31	Lubber	8	
32	Andy	8	25.5
58	Rusty	10	
64	Horatio	7	
71	Zorba	10	16.0
74	Horatio	9	
85	Art	3	25.5
95	Bob	3	63.5

	Reserves		
sid	bid	day	
22	101	10-Oct-2019	
22	102	10-Oct-2019	
22	103	08-Oct-2019	
22	104	07-Oct-2019	
31	102	10-Nov-2019	
31	103	06-Nov-2019	
31	104	12-Nov-2019	
64	101	05-Sep-2019	
64	102	08-Sep-2019	
74	103	08-Sep-2019	

Example 19 - Complex Correlated Nested Queries

Find the names of sailors who have reserved both red and green boat

```
SELECT Sl. sname
FROM
       Sailors AS S1
WHERE
       S1. sid IN
        (SELECT
                  R1. sid
         FROM
                  Reserves AS R1
         JOIN
                  Boats AS B1
         ON
                  B1.bid = B1.bid
                  B1.color = 'red'
         WHERE
         AND
                  R1. bid IN
         (SELECT
                   R1.sid
          FROM
                   Reserves AS R1
                   Boats AS B1
          JOIN
          ON
                   B1 bid = B1 bid
          WHERE
                   B1.color = 'green'
```

Example 20(a) - Complex Correlated Nested Queries

Find the names of sailors who have reserved all boats

Example 20(b) - Complex Correlated Nested Queries

Find the names of sailors who have reserved all boats

```
SELECT Sl. sname
FROM
       Sailors AS S1
WHERE
       NOT EXISTS
       (SELECT B1. bid
        FROM
                Boats AS B1
        WHERE NOT EXISTS
                (SELECT
                        R1. bid
                FROM
                         Reserves AS R1
                         R1.sid = S1.sid
                WHERE
                AND
                         B1 bid = B1 bid
```

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT S. sname

FROM Sailors ASS, Reserves ASR

WHERE (S. sid = R. sid AND R. bid = 103)

```
Q1: Find the names of the Sailors who have reserved Boat 103
```

```
SELECT sname
FROM Sailors
JOIN Reserves
```

Keserves

ON Sailors.sid = Reserves.sid

WHERE (Reserves.bid = 103)

Q1: Find the names of the Sailors who have reserved Boat 103

SELECT S. sname

FROM Sailors AS S

JOIN Reserves **AS** R

ON S. sid = R. sid

WHERE (R. bid = 103)

```
Q1: Find the names of the Sailors who have reserved Boat 103

SELECT S. sname
FROM Sailors AS S

WHERE S. sid IN

(SELECT R. sid
FROM Reserves AS R
WHERE R. bid = 103)
```

```
Q2: Find the names of the Sailors who reserved a red boat
```

```
SELECT S.sname
FROM Sailors AS S, Reserves AS R, Boats AS B
WHERE (S.sid = R.sid AND R.bid = B.bid
AND B.color = 'red')
```

```
Q2: Find the names of the Sailors who reserved a red boat

SELECT S. sname
FROM Sailors AS S

JOIN Reserves AS R

JOIN Boats AS B

ON (S. sid = R. sid AND R. bid = B. bid)

WHERE B. color = 'red';
```

```
Q3: Find the colors of boats reserved by Lubber
```

```
SELECT S. sname
```

FROM Sailors AS S, Reserves AS R, Boats AS B

WHERE (S.sid = R.sid AND R.bid = B.bid AND)

S. sname = 'Lubber')

```
Q3: Find the colors of boats reserved by Lubber

SELECT S. sname

FROM Sailors AS S

JOIN Reserves AS R

JOIN Boats AS B

ON (S. sid = R. sid AND R. bid = B. bid)

WHERE S. sname = 'Lubber';
```

Q4: Find the names of Sailors who have reserved at least one boat

SELECT S. sname

FROM Sailors ASS, Reserves ASR

WHERE (S.sid = R.sid);

```
Q4: Find the names of Sailors who have reserved at least one boat
```

```
SELECT S. sname
```

FROM Sailors AS S JOIN Reserves AS R

ON (S. sid = R. sid);

```
Q5: Find the names of Sailors who have reserved a red or a green Boat
SELECT S. sname
FROM
        Sailors AS S, Reserves AS R, Boats AS B
       (S. sid = R. sid AND R. bid = B. bid AND B. color = 'red');
                        UNION
SELECT S sname
        Sailors AS S. Reserves AS R. Boats AS B
FROM
       (S. sid = R. sid AND R. bid = B. bid AND B. color = 'green');
```

Boats AS B

JOIN

Q5: Find the names of Sailors who have reserved a red or a green $\overline{\text{Boat}}$

```
(SELECT S. sname
FROM Sailors AS S
JOIN Reserves AS R
JOIN Boats AS B
       (S. sid = R. sid AND R. bid = B. bid)
ON
       B. color = 'red');
WHERE
    UNION
(SELECT S. sname
FROM
        Sailors AS S
JOIN
    Reserves AS R
```

 $\mathbf{ON} \qquad \qquad (S.\,\mathrm{sid}\,=R.\,\mathrm{sid}\,\,\mathbf{AND}\,R.\,\mathrm{bid}\,=B.\,\mathrm{bid}\,)$

WHERE

Q6: Find the names of Sailors who have reserved a red AND a green Boat (**SELECT** R. sid FROM Reserves **AS** R JOIN Boats AS B **ON** (R. bid = B. bid)WHERE B. color = 'red' AND B. sid IN(**SELECT** R. sid FROM Reserves **AS** R **JOIN** Boats **AS** B ON(R. bid = B. bid)

B. color = 'green');

Q6: Find the names of Sailors who have reserved a red AND a green Boat

```
SELECT Sl. sname
FROM Sailors AS S1
JOIN (SELECT R. sid
        FROM Reserves AS R.
        JOIN Boats AS B
        ON (R. bid = B. bid)
        WHERE B. color = 'red' AND R. sid
                IN
        (SELECT R. sid
        FROM Reserves AS R.
        JOIN Boats AS B
        ON (R. bid = B. bid)
        WHERE B. color = 'green')) AS S2
        S1. sid = S2. sid:
```

Q7: Find the names of Sailors who have reserved at least two boats

```
CREATE TABLE Temp1 AS
        (SELECT S. sid, S. sname, R. bid
        FROM Sailors AS S, Reserves AS R
        WHERE S.sid = R.sid);
SELECT T1. sname
FROM
       Temp1 AS T1
JOIN
       Temp1 AS T2
ON T1. sid = T2. sid
WHERE (T1. bid \Leftrightarrow T2. bid)
```

```
Q7: Find the names of Sailors who have reserved at least two boats
SELECT T1 sname
FROM
       (SELECT S. sid, S. sname, R. bid
        FROM
                 Sailors AS S. Reserves AS R
        WHERE
                S. sid = R. sid) AS T1
        JOIN
                 (SELECT S. sid , S. sname, R. bid
                            Sailors AS S, Reserves AS R
                  WHERE S. sid = R. sid ) AS T2
ON
        T1. sid = T2. sid
WHERE
           (T1. bid \Leftrightarrow T2. bid):
```

Q8: Find the sids of Sailors with age over 20 who have not reserved a red boat

```
SELECT S1. sid
FROM Sailors AS S1
WHERE S1.age \Rightarrow 20 AND S1.sid
         NOT IN
 SELECT S2. sid
 FROM Sailors AS S2
 JOIN Reserves AS R2
 JOIN Boats As B2
         (S2. sid = R2. sid AND R2. bid = B2. bid)
 \mathbf{O}\mathbf{N}
 WHERE
         (B. color = 'red'))
```