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Queries and Quantifiers

- QT-Expressions
  - QT-Selectors
  - QT-Predicates
  - QT-Counters

Queries and Quantifiers

Loc(*Dept*	*Floor*)
Rug	1
Rug	2
Shoe	2
Toy	1

Class(*Item*	*Type*)
Yarn	A
String	A
Ball	B
Sandal	C

Supply(*Comp*	*Dept*	*Item*	*Vol*)
Domtex	Rug	Yarn	10
Playsew	Rug	Yarn	17
Playsew	Toy	Yarn	20
Oddball	Toy	Yarn	13
Domtex	Rug	String	5
Domtex	Toy	String	2
Playsew	Toy	String	10
Playsew	Shoe	String	5
Shoeco	Shoe	String	15
Playsew	Toy	Ball	2
Oddball	Toy	Ball	2

QT-Selectors

Find items supplied to more than two departments

[*Item*] **where** $\{(\# > 2)$ *Dept*$\}$ **in** *Supply*

[*Item, Dept*] **in** *Supply*

(*Item*	*Dept*)	#*Dept*	>2?	*Item*
Yarn	Rug			
Yarn	Toy	2	f	
String	Rug			
String	Toy			
String	Shoe	3	t	String
Ball	Toy	1	f	

Find items supplied to two or three departments

[*Item*] **where** $\{$(#=2 **or** #=3) *Dept*$\}$ **in** *Supply*
or

[*Item*] **where** $\{$(1 <# **or** #< 4) *Dept*$\}$ **in** *Supply*
or..

[*Item, Dept*] **in** *Supply*

(*Item*	*Dept*)	#*Dept*	=2 or 3?	*Item*
Yarn	Rug			
Yarn	Toy	2	t	Yarn
String	Rug			
String	Toy			
String	Shoe	3	t	String
Ball	Toy	1	f	

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Find items supplied to an odd number of departments

[*Item*] **where** $\{(\# \textbf{ mod } 2 = 0)\ \textit{Dept}\}$ **in** *Supply*

[*Item, Dept*] **in** *Supply*

(*Item*	*Dept*)	#*Dept*	odd?	*Item*
Yarn	Rug			
Yarn	Toy	2	f	
String	Rug			
String	Toy			
String	Shoe	3	t	String
Ball	Toy	1	t	Ball

Find all items except those supplied in volumes of less than 10

$[\mathit{Item}]$ **where** $\{(\# = 0)\ \mathit{Vol}\}\ \mathit{Vol} < 10$ **in** *Supply*

$[\mathit{Item}, \mathit{Vol}]$ **in** *Supply*

(*Item*	*Vol*)	*Vol*< 10?	#*Vol*	=0?	*Item*
Yarn	10	f			
Yarn	13	f			
Yarn	17	f			
Yarn	20	f	0	t	Yarn
String	2	t			
String	5	t			
String	5	t			
String	10	f			
String	15	f	2	f	
Ball	2	t			
Ball	2	t	1	f	

Find items supplied by at least two companies to more than one department

[*Item*] **where** $\{(\# \geq 2)$ *Comp*, $(\# > 1)$ *Dept*$\}$ **in** *Supply*

[*Item, Comp, Dept*] **in** *Supply*

(*Item*	*Comp*	*Dept*)	#*Dept*	>1?	#*Comp*	≥2?	*Item*
`Yarn`	`Domtex`	`Rug`	1	`f`			
`Yarn`	`Playsew`	`Rug`					
`Yarn`	`Playsew`	`Toy`	2	`t`			
`Yarn`	`Oddball`	`Toy`	1	`f`	1	`f`	
`String`	`Domtex`	`Rug`					
`String`	`Domtex`	`Toy`	2	`t`			
`String`	`Playsew`	`Toy`					
`String`	`Playsew`	`Shoe`	2	`t`	2	`t`	`String`
`Ball`	`Playsew`	`Toy`					
`Ball`	`Oddball`	`Toy`	1	`f`			

Find items supplied to more than one department by at least two companies

[*Item*] **where** {(# > 1) *Dept*, (# ≥ 2) *Comp*} **in** *Supply*

[*Item, Dept, Comp*] **in** *Supply*

(*Item*	*Dept*	*Comp*)	#*Comp*	≥2?	#*Dept*	>1?	*Item*
Yarn	Rug	Domtex					
Yarn	Rug	Playsew	2	t			
Yarn	Toy	Oddball					
Yarn	Toy	Playsew	2	t	2	t	Yarn
String	Rug	Domtex	1	f			
String	Shoe	Playsew					
String	Shoe	Shoeco	2	t			
String	Toy	Domtex					
String	Toy	Playsew	2	t	2	t	String
Ball	Toy	Oddball					
Ball	Toy	Playsew	2	t	1	f	

cf. $\forall x \exists y \; y > x \neq \exists y \forall x \; y > x$

Find items supplied by all companies to the Toy department

[*Item*] **where** $\{(\bullet = 1)$ *Comp*$\}$ *Dept* = "Toy" **in** *Supply*
i.e.

[*Item*] **where** $\{(\#/4 = 1)$ *Comp*$\}$ *Dept* = "Toy" **in** *Supply*

[*Item, Comp*] **where** *Dept* = "Toy" **in** *Supply*

(*Item*	*Comp*)	$\bullet$*Dept*	=1?	*Item*
Yarn	Oddball			
Yarn	Playsew	.5	f	
String	Domtex			
String	Playsew	.5	f	
Yarn	Oddball			
Yarn	Playsew	.5	f	

Find items supplied by most companies to the Toy department

[*Item*] **where** $\{(\bullet \geq .5)$ *Comp*$\}$ *Dept* = "Toy" **in** *Supply*

QT-Selectors with Relational and Domain Algebras

Find departments that sell no items of type B

[*Dept*] **where** {(# = 0) *Item*} *Type* = "B" **in** (*Sales* **ijoin** *Class*)

(where *Sales* <− [*Dept*, *Item*] **in** *Supply*)

Sales **ijoin** *Class*

(*Dept*	*Item*	*Type*)	*Type*="B"?	#*Item*	=0?	*Dept*
Rug	Yarn	A	f			
Rug	String	A	f	0	t	Rug
Toy	Ball	B	t			
Toy	Yarn	A	f			
Toy	String	A	f	1	f	
Shoe	String	A	f	0	t	Shoe

NB. If remove {(Shoe, String)} from *Sales*, *Shoe* will disappear from result, even though *Shoe* sells no items (of type B).

Find departments that sell at least two thirds of the items supplied to the departments on the same floor

let *Count* **be equiv max of** (**par** + **of** 1 **order** *Item* **by** *Floor*) **by** *Floor*

([*Dept*] **where** ($\# \geq 2 \times Count/3$)*Item* **in** (*Sales* **ijoin** *Loc*))
ijoin
([*Floor, Item, Count*] **in** (*Supply* **ijoin** *Loc*))

Sales **ijoin** *Loc*			*Supply* **ijoin** *Loc*			
(*Dept*	*Item*	*Floor*)	(*Floor*	*Item*	*Dept*)	*Count*
Rug	Yarn	1	1	Yarn	Rug	3
Rug	Yarn	2	1	Yarn	Toy	3
Toy	Yarn	1	1	String	Toy	3
Toy	String	1	1	Ball	Toy	3
Toy	Ball	1	2	Yarn	Rug	2
			2	String	Shoe	2

(...) **ijoin** [*Floor, Item, Count*] **in** (...)

(*Dept*	*Count*	*Item*	*Floor*)	*#Item*	$\geq 2Count/3$?	*Dept*
Rug	3	Yarn	1	1	f	
Rug	2	Yarn	2	1	f	
Toy	3	Yarn	1			
Toy	3	String	1			
Toy	3	Ball	1	3	t	Toy

Find departments that sell all of the items supplied to the departments on the same floor
let *Floor'* **be** *Floor*;

[*Dept*] **where** *Floor* = *Floor'* **in**

((*Sales* **ijoin** *Loc*) ⊇ ([*Item, Floor'*] **in** (*Supply* **ijoin** *Loc*)))

QT-Predicates

All companies supply volumes in excess of 10

$\{(\bullet = 1)\ \mathit{Comp}\}\ \mathit{Vol} > 10$ **in** *Supply*

$[\mathit{Comp}, \mathit{Vol}]$ **in** *Supply*

(*Comp*	*Vol*)	$\mathit{Vol} > 10$?	$\bullet\mathit{Comp}$	> 1?
Domtex	10	f		
Domtex	5	f		
Domtex	2	f		
Playsew	17	t		
Playsew	20	t		
Playsew	10	f	0.75	f
Playsew	5	f		
Playsew	2	f		
Oddball	13	t		
Oddball	2	f		
Shoeco	15	t		

QT-Counters

Find the number of departments to which string is supplied

$\#[Dept]$ **where** *Item* $=$ `"String"` **in** *Supply*

[*Dept* **where** *Item* = `"String"` **in** *Supply*	
(*Dept*)	#*Dept*
`Rug`	
`Toy`	
`Shoe`	`3`

Find the proportion of departments to which string is supplied

$\bullet[Dept]$ **where** *Item* $=$ `"String"` **in** *Supply*

[*Dept* **where** *Item* = `"String"` **in** *Supply*	
(*Dept*)	#*Dept*/3
`Rug`	
`Toy`	
`Shoe`	`1.0`