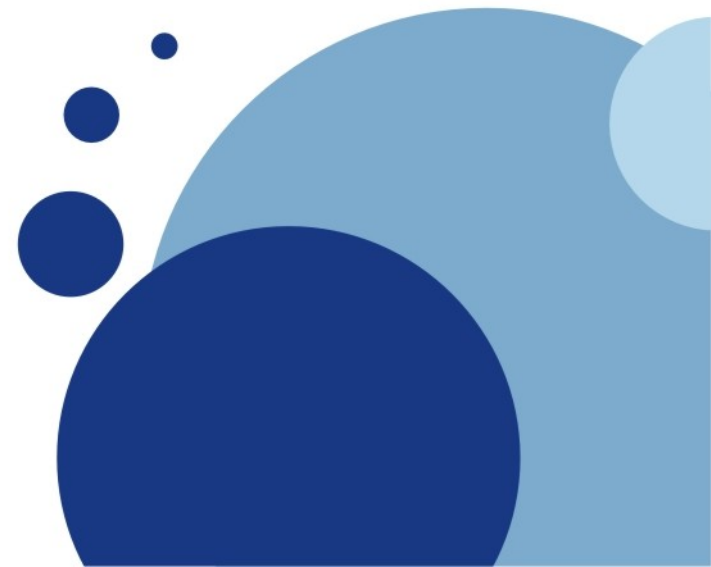


# Columnar RDBMS

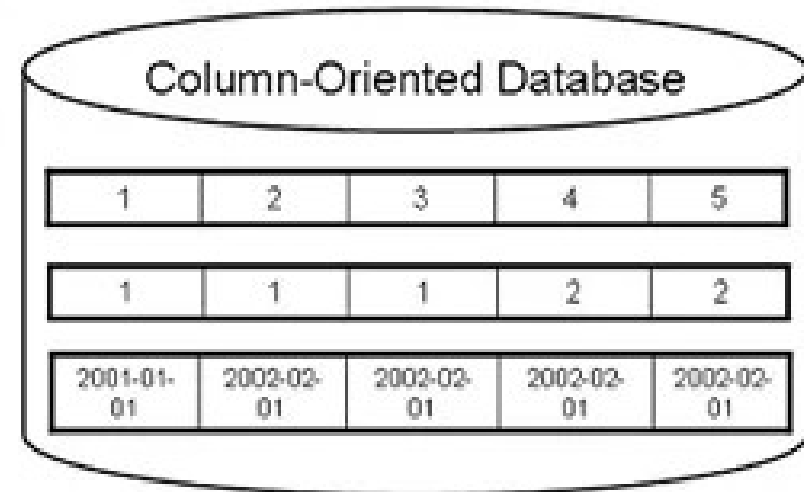
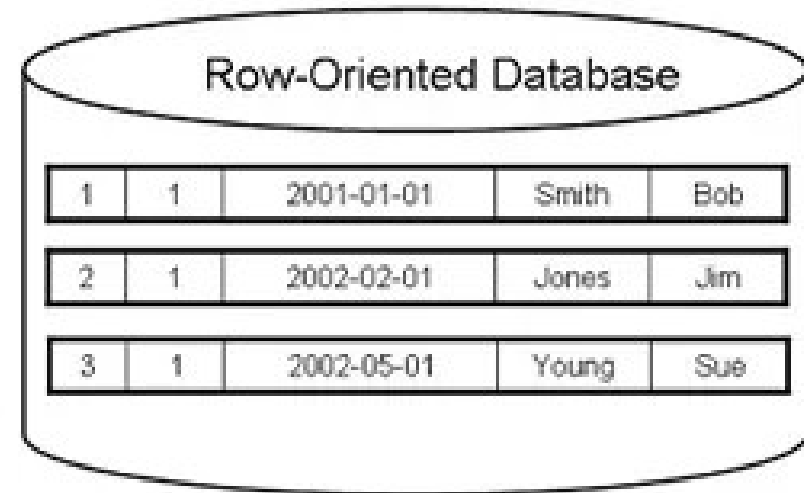
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`rim.moussa@gmail.com`



# Column-oriented storage systems versus row-oriented storage systems

Emp_no	Dept_id	Hire_date	Emp_ln	Emp_fn
1	1	2001-01-01	Smith	Bob
2	1	2002-02-01	Jones	Jim
3	1	2002-05-01	Young	Sue
4	2	2003-02-01	Stemle	Bill
5	2	1999-06-15	Aurora	Jack
6	3	2000-08-15	Jung	Laura



# *Benchmarking Data Servers: Column-oriented vs row-oriented storage systems*

- Columnar Storage Systems
  - High IO performance: less data moving from hard drives to memory
  - Efficient Memory Management: load only required data into memory
  - Reduced Storage: columns with low cardinality are compressed
  - Efficient Schema Modifying Techniques: adding new columns will not induce a file storage re-organization
- Types
  - Binary Association Tables
    - Each column is stored in a separate (surrogate key, value) table, e.g. RDBMS: MonetDB, C-Store, ...
  - Family of columns
    - Vertical partitioning for DB design

# Perf. Results (TPC-H\*d, sf=10) with *MonetDB*

## COMAD'2013, BICOD'2017

MySQL DBMS (row-oriented)			MonetDB DBMS (column-oriented)		
SQL Workload	MDX Workload (sec)		SQL Workload	MDX Workload (sec)	
	Query	Cube-then-Query		Query	Cube-then-Query

	MySQL	MonetDB
C1	2,778 sec	30 sec
C10	Java heap space Error	758 sec
C11	2,558 sec	2,536 sec
C3	Mondrian Error: Size of cross join exceeded limit	

Q11	4.00	2,558.21	3,020.27	1,604.10	0.17	2,536.28	2,834.2	1,313.5
Q12	144.36	456.81	735.67	123.43	2.91	42.78	54.64	23.36
Q13	38.68	$n/a^{*2}$	$n/a^{*2}$	-	3.53	$n/a^{*2}$	$n/a^{*2}$	-
Q14	122.11	391.06	946.16	0.06	0.19	4.6	18.01	0.09
Q15	90.97	13,005.27	32,064.90	12,413.74	2.9	18.4	532.35	5.4
Q16	47.92	414.82	461.90	4.62	1.36	18.08	64.94	0.99
Q17	4.22	1,131.37	5,711.14	2.03	2.06	8.76	47.48	0.82
Q18	905.16	$n/a^{*2}$	$n/a^{*1}$	-	1.68	$n/a^{*2}$	$n/a^{*1}$	-
Q19	1.56	598.9	727.72	37.57	0.8	57.22	79.31	0.12
Q20	1.55	14,662.53	$n/a^{*3}$	-	0.58	423.9	$n/a^{*3}$	-
Q21	511.54	578.09	855.46	0.15	2.43	5.8	36.74	0.11
Q22	2.40	68.74	402.16	39.33	2.16	100.92	435.8	1.5