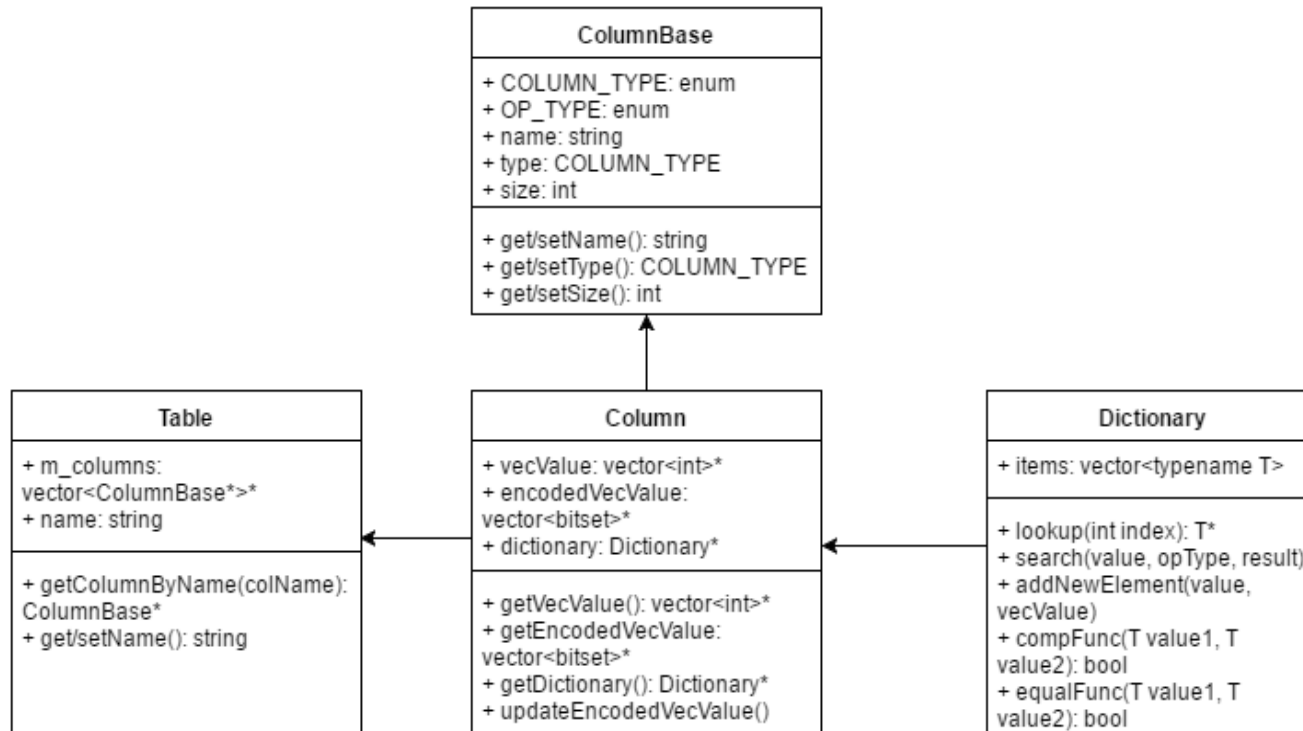


Database Management

Column-Store Demo

Le Van Duc – 2016/12

Architecture



C++ compiler configuration

- g++: version 4.8
- CXXFLAGS = -O2 -g -Wall -fmessage-length=0 -std=c++11 -lstdc++ -lsqlparser -L/usr/local/lib/ -L/home/duclv/work/sql-parser/src/ -L/usr/local/boost_1_61_0
- Use boost library at: <http://www.boost.org/>
- Use open source SQL parser at: <https://github.com/hyrise/sql-parser>
- Use open source bit packing PackedArray (<https://github.com/gpakosz/PackedArray>)

Homework 2

- **Requirement:** design and implement Column-Store, experiment with Select query.
- **Table:** Orders (1,500,000 rows, 4 columns)
- **Query:**
 - (1): `SELECT * FROM Orders WHERE o_totalprice > 56789.`
 - (2): `SELECT * FROM Orders WHERE o_totalprice > 5678 AND o_totalprice < 56789.`

Homework 2 - Demo

Query 1

```
Enter a query (enter 'quit' to quit): select * from orders where o_totalprice > 56789
Parsed successfully!
Table name: orders
select fields[0] = o_orderkey
select fields[1] = o_orderstatus
select fields[2] = o_totalprice
select fields[3] = o_comment
where fields[0] = o_totalprice
where operators[0] = >
value values[0] = 56789
*** Query result ***
o_orderkey, o_orderstatus, o_totalprice, o_comment,
1383879, "O", 181229, "al accounts haggle bli",
1384544, "O", 276518, "riously. close\, even requests across the blithely r",
1391554, "O", 103741, "ously even platelets. furiou",
1393795, "O", 196458, "ing foxes after the even\, ironic foxes sleep s",
1408642, "O", 155349, "never furiously even ideas. ex",
1410916, "O", 80917, "e among the carefully bold orbits. courts among the",
1415524, "O", 183795, "y ironic grouches. slyly express pinto beans are carefully",
4009671, "F", 368188, "counts. boldly ironic packages slee",
2411843, "F", 268097, "terns about the fluffily express ideas sleep carefully unusual deposits. spe",
1424359, "O", 66797, "arefully pending accounts cajole slyly around the instructions. slyly even a",
Showing 10/1249095 results !
Table Selection time: 0.027647 seconds
```

Query 2

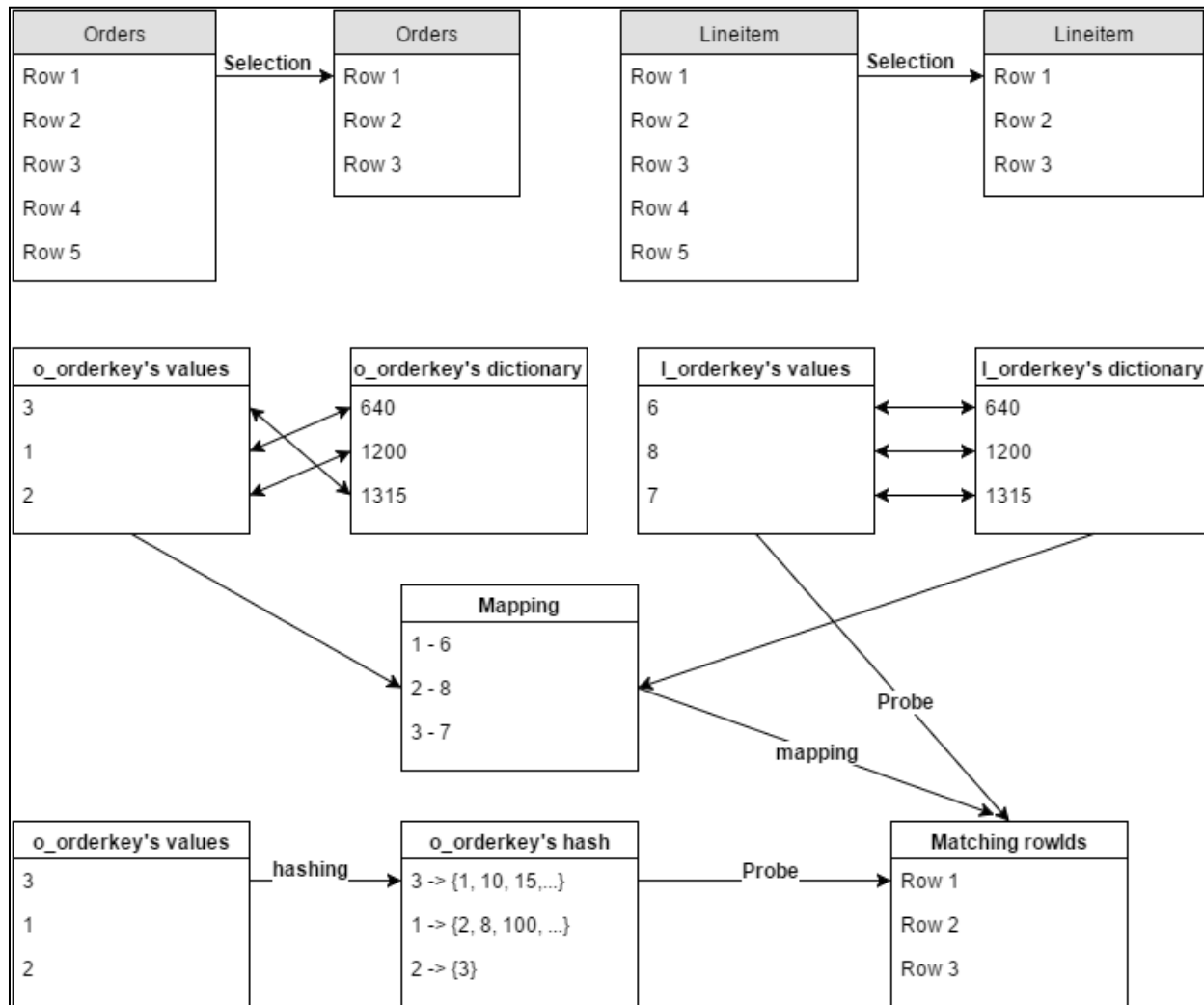
```
Enter a query (enter 'quit' to quit): select * from orders where o_totalprice > 5678 and o_totalprice < 56789
Parsed successfully!
Table name: orders
select fields[0] = o_orderkey
select fields[1] = o_orderstatus
select fields[2] = o_totalprice
select fields[3] = o_comment
where fields[0] = o_totalprice
where fields[1] = o_totalprice
where operators[0] = >
where operators[1] = <
value values[0] = 5678
value values[1] = 56789
*** Query result ***
o_orderkey, o_orderstatus, o_totalprice, o_comment,
2410080, "F", 28792, "bold escapades according to the blithely even accounts are carefull",
5219, "O", 34965, "aggle always. foxes above the ironic deposits",
3405412, "F", 30779, "to beans. pinto beans could cajole furiously. flu",
2835463, "F", 19129, "ar theodolites. deposits haggle furiously regular accounts. final courts after",
3797830, "O", 17161, "ffix quickly pending foxes. foxes nag: final\, express requests nag. slyly",
12647, "O", 33822, ". regular theodolites sleep after the care",
1472960, "O", 17528, "furiously after the packages. quickly even id",
3800352, "O", 39159, "uickly above the quickly ironic instructions; even requests about t",
1483047, "O", 37704, "ts use slyly across the idly regular f",
43300, "O", 52391, "s. express requests are. ironic requests are carefully after th",
Showing 10/235398 results !
Table Selection time: 0.045552 seconds
```

Homework 3

- **Requirement:** design and implement Join & Inverted Index on Column-Store.
- **Tables:** Orders (1,500,000 rows) and Lineitem (6,001,215 rows).
- **3 join queries:**
 - Select * from orders o join lineitem l where o.o_orderkey = l.l_orderkey.
 - Select * from orders o join lineitem l where o.o_orderkey = l.l_orderkey and o_totalprice < 56789 AND l_quantity > 40.
 - Select * from orders o join lineitem l where o.o_orderkey = l.l_orderkey and o_comment contain “gift”.

Homework 3

Join design



Homework 3 - Demo

Join query 1

```
Enter a query (enter 'quit' to quit) or select join query example (join1/join2/join3): join1
***** Print join result *****
      SELECT * from orders JOIN lineitem ON orders.o_orderkey = lineitem.l_orderkey
l_orderkey, l_quantity, l_returnflag, o_orderkey, o_orderstatus, o_totalprice, o_comment,
2897891, 21, "A", 2897891, "F", 170747, "accounts play. fluffy\, ironic requests cajo",
1576099, 41, "R", 1576099, "F", 121054, "vly pending packages use after the packages. furiou",
3643552, 37, "A", 3643552, "F", 320378, "ts hang quickly ironic orbits. sly",
5340295, 14, "A", 5340295, "F", 201644, "y among the furiously special account",
2002982, 31, "R", 2002982, "F", 181573, " the unusual\, pending deposits impress quickly furiou",
3273220, 38, "A", 3273220, "F", 291480, "s. blithely idle requests haggle. regular accounts affix quickly
166145, 24, "N", 166145, "O", 234987, "o the special\, even requests cajole slyly unusual theo",
2161094, 33, "A", 2161094, "F", 150239, " the carefully regular ",
3461926, 34, "R", 3461926, "F", 233217, ". furiously express accounts unw",
1852933, 13, "N", 1852933, "O", 182709, "ze slyly blithely final foxes. slyly bold requests wak",
Showing 10/6001215 results !
Query time: 15.7641 seconds
```

Join query 2

```
Enter a query (enter 'quit' to quit) or select join query example (join1/join2/join3): join2
Orders rowIds count = 250898
Lineitem rowIds count = 1200257
***** Print join result *****
      SELECT * from orders JOIN lineitem ON orders.o_orderkey = lineitem.l_orderkey WHERE
orders.o_totalprice < 56789 AND l_quantity > 40
l_orderkey, l_quantity, l_returnflag, o_orderkey, o_orderstatus, o_totalprice, o_comment,
5275043, 43, "A", 5275043, "F", 44393, "nal epitaphs haggle blithely accounts. carefully regular platele
5612706, 41, "N", 5612706, "O", 54564, "egular pinto beans hang slyly. packages detect slyly among the i
3736035, 45, "N", 3736035, "O", 49118, "he requests nag even requests. deposits doubt according to the c
5053185, 48, "N", 5053185, "O", 56030, "ts cajole carefully. u",
3785411, 47, "N", 3785411, "F", 50788, "asymptotes. furiously eve",
5805921, 44, "N", 5805921, "O", 41251, " accounts. carefully blithe foxes cajole. even dependencies main
387141, 48, "N", 387141, "O", 50079, "eposits are along the quickly bold requests. blithely express ide
4304807, 50, "N", 4304807, "O", 47397, "r warhorses. furiously stealthy dolphins among the q",
5440610, 42, "N", 5440610, "O", 47502, ". platelets was furio",
3203717, 50, "N", 3203717, "O", 55342, "s theodolites. ironic\, ironic orbits cajole quickly regular mul
Showing 10/13883 results !
Query time: 3.98078 seconds
```

Join query 3

```
Enter a query (enter 'quit' to quit) or select join query example (join1/join2/join3): join3
Orders rowIds count = 6505
***** Print join result *****
      SELECT * from orders JOIN lineitem ON orders.o_orderkey = lineitem.l_orderkey WHERE
orders.o_comment contains 'gift'
l_orderkey, l_quantity, l_returnflag, o_orderkey, o_orderstatus, o_totalprice, o_comment,
3315334, 34, "N", 3315334, "O", 151322, " gifts sleep quickly aga",
792935, 44, "N", 792935, "O", 57561, "ronic accounts haggle quickly. carefully close gifts integ",
2505858, 13, "R", 2505858, "F", 235111, "inal instructions sleep furiously silent gifts. slyly pending pi
5612995, 36, "N", 5612995, "O", 187558, "ly bold packages. final gifts along the blithely silent platelet
2264679, 46, "N", 2264679, "O", 278416, "ely express gifts. slyly ",
5327911, 11, "A", 5327911, "F", 100923, "d gifts. even\, even frets among the fur",
579360, 28, "N", 579360, "O", 86948, "nal deposits. gifts x-ray: ideas was slyly! blithely ",
410820, 8, "N", 410820, "O", 140868, "nic gifts cajole final\, ironic orbits. sl",
4012805, 48, "R", 4012805, "F", 170677, "he quickly special gifts are slyly unusual ideas. final\, regula
1481254, 4, "N", 1481254, "O", 53107, "ress gifts. blithely final not",
Showing 10/25882 results !
Query time: 12.7857 seconds
```


Homework 4

- **Requirement:** design and implement MVCC on Column-Store. Implement as client-server.
- **Table:** Orders
- **Operation implementation with MVCC:**
 - INSERT
 - UPDATE
 - Garbage Collection
 - Write conflict
 - Scan performance

Homework 4 - Demo

```
Test command options:
1. INSERT
2. UPDATE
3. Garbage Collection
4. Write conflict
5. SCAN
Your choice: 2

Test command options:
1. INSERT
2. UPDATE
3. Garbage Collection
4. Write conflict
5. SCAN
Your choice:
Client command: SCAN|1383879|o_orderkey|=
[Sending]      SCAN|1383879|o_orderkey|=
[Response]
o_orderkey, o_orderstatus, o_totalprice, o_comment,
1383879, "0", 181229, "al accounts haggle bli",
Showing 1/1 results !
Query time: 0.039681 seconds

Client command: UPDATE|1|1383879|D|56789|Le Van Duc
[Sending]      UPDATE|1|1383879|D|56789|Le Van Duc
[Response]
Updated 1 row with rid = 1

Client command: SCAN|1383879|o_orderkey|=
[Sending]      SCAN|1383879|o_orderkey|=
[Response]
o_orderkey, o_orderstatus, o_totalprice, o_comment,
1383879, "D", 56789, "Le Van Duc",
Showing 1/1 results !
Query time: 0.039615 seconds
```

Homework 5

- **Requirement:** design and implement Redo log, Log manager for Column-Store.
- **Table:** Orders.
- **Implementation scenario: ACID**
 - *Atomic*: Undo an incomplete Transaction.
 - *Consistence*: The database can go back to consistent status in case of failure.
 - *Durable*: Restore database to state before crash.

Homework 5 - Demo

```
Client command: RESTORE
[Sending]      RESTORE
[Response]
Restore database successfully !
Client command: SCAN|8888|o_orderkey|=
[Sending]      SCAN|8888|o_orderkey|=
[Response]
o_orderkey, o_orderstatus, o_totalprice, o_comment,
8888,      "O",      181229,      "al accounts haggle bli",
8888,      "A",      3456,      "duclv",
Showing 2/2 results !
Query time: 0.000391 seconds

Client command: UPDATE_WITH_ABORT|2|8888
[Sending]      UPDATE_WITH_ABORT|2|8888
[Response]
Transaction Id = 1
Client command: SCAN|8888|o_orderkey|=
[Sending]      SCAN|8888|o_orderkey|=
[Response]
o_orderkey, o_orderstatus, o_totalprice, o_comment,
8888,      "O",      181229,      "al accounts haggle bli",
8888,      "A",      3456,      "duclv",
Showing 2/2 results !
Query time: 0.000392 seconds

Client command: ABORT|1
[Sending]      ABORT|1
[Response]
Abort transaction 1 successfully !
Client command: █
```

Client

```
***** Simple Column-Store Database start *****
>>>> Server is listening at port: 30000
[Received]     RESTORE
>> Restore database
Start redo log restore !
Restored from checkpoint file: log/checkpoint_16446708
Restored from log file: log/redo_log_16477044
End redo log restore !
o_orderkey #distinct values = 14967/14968
o_orderstatus #distinct values = 3/14968
o_totalprice #distinct values = 14621/14968
o_comment #distinct values = 14963/14968
Garbage Collector running ! with #rids = 5
Garbage Collector run finished !
[Received]     SCAN|8888|o_orderkey|=
>> Scan command
[Received]     UPDATE_WITH_ABORT|2|8888
>> Update with abort command
[Received]     SCAN|8888|o_orderkey|=
>> Scan command
[Received]     ABORT|1
>> Abort ...
█
```

Server

Thank you !

Le Van Duc