

# COP 6726: DataBase System Implementation

## Project 1: Heap File Implementation

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## 1 Introduction:

DBFile class was implemented in this assignment. The DBFile class in the database system is responsible for storing and retrieving records from the disk. We've also used the Google Test Unit Testing Library to write unit test cases for, Every function of the DBFile Class has been implemented. We've also taken notes. Time it took to run each query, as well as the time it took to scan all of the documents records.

## 2 Files Location:

- src/: Contains .cc and .h files.
- bin/ : Contains object(.o) files.
- MakeFile: Make File.
- tpch/: Contains .tbl files which were generated using tpch data generator.
- gtest/: Google Test Unit testing library.
- catalog: Catalog file for the schema of .tbl files

## 3 Assumptions:

- gcc (or clang) must be installed on the machine where the project will be tested, together with "bison" and "flex".
- On the system where the project will be tested, Google Test Unit Testing Library should also be installed and compiled.

## 4 Commands To Run the Program:

- Type **make test.out** to compile the provided test driver.
- Type **./test.out** and then follow the on-screen directions to start the test driver.
- Fill in any CNF from the result section below for the scan and filter operations. After you've finished creating the CNF, press ENTER and then Ctrl+D.
- Type **make gTest** to compile Google Test.
- Type **cd bin./gTestProject1** to run the unit tests.
- The unit tests should run and the test results should be shown.

## 5 Functions:

### 5.1 void Add (Record &addMe);

To add records to the file, use this function. This function simply appends the new record to the end of the file in the case of the unordered heap file used in this assignment.

### 5.2 void MoveFirst ();

This function forces some pointer to point to the file's first record.

### 5.3 int Create (char \*name, fType myType, void \*startup);

The file is generated using this function.

### 5.4 int Open (char \*name);

This function is used to open a file that has already been created.

### 5.5 int Close();

The file is simply closed with this function.

### 5.6 void Load (Schema &mySchema, char \*loadMe);

Using the SuckNextRecord function from Record.h, this code bulk loads the DBFile instance from a text file and appends new data to it.

### 5.7 int GetNext (Record &fetchMe);

This function simply gets the next record from the file and returns it to the user.

### 5.8 int GetNext (Record &fetchMe, CNF &applyMe, Record &literal);

This function takes a selection predicate and returns the file's next record that the selection predicate accepts.

## 6 Results:

Our application was tested on two sets of data generated by the tpch data generator. One set of data is 1 Gb, while the other is 10 Mb.

### 6.1 Query 1:

(r\_name = 'EUROPE')

```
^
Filter with CNF for : region
Enter CNF predicate (when done press ctrl-D):
    (r_name = 'EUROPE')
r_regionkey: [3], r_name: [EUROPE], r_comment: [ly final courts cajole furiously final excuse]
selected 1 recs
```

Figure 1: Query 1-10mb data

```

select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  8. supplier
  2
Filter with CNF for : region
Enter CNF predicate (when done press ctrl-D):
  (r_name = 'EUROPE')
r_regionkey: [3], r_name: [EUROPE], r_comment: [ly final courts cajole furiously final excuse]
selected 1 recs
Closed the file.The total length of the file was 2 pages.

```

Figure 2: Query 1-1gb data

## 6.2 Query 2:

$(r\_name = 'MIDDLE EAST') \text{ AND } (r\_regionkey > 1)$

```

Filter with CNF for : region
Enter CNF predicate (when done press ctrl-D):
  (r_name < 'middle east') AND (r_regionkey > 1)
r_regionkey: [2], r_name: [ASIA], r_comment: [ges. thinly even pinto beans ca]
r_regionkey: [3], r_name: [EUROPE], r_comment: [ly final courts cajole furiously final excuse]
r_regionkey: [4], r_name: [MIDDLE EAST], r_comment: [uickly special accounts cajole carefully blithely close requests. carefully final asymptotes haggle furiously]
selected 3 recs

```

Figure 3: Query 2-10mb data

```

select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  8. supplier
  2
Filter with CNF for : region
Enter CNF predicate (when done press ctrl-D):
  (r_name < 'middle east') AND (r_regionkey > 1)
r_regionkey: [2], r_name: [ASIA], r_comment: [ges. thinly even pinto beans ca]
r_regionkey: [3], r_name: [EUROPE], r_comment: [ly final courts cajole furiously final excuse]
r_regionkey: [4], r_name: [MIDDLE EAST], r_comment: [uickly special accounts cajole carefully blithely close requests. carefully final asymptotes haggle furiously]
selected 3 recs
Closed the file.The total length of the file was 2 pages.

```

Figure 4: Query 2-1gb data

### 6.3 Query 3:

(n\_regionkey = 3) AND (n\_nationkey > 10) AND (n\_name > 'japan')

```
Filter with CNF for : nation
Enter CNF predicate (when done press ctrl-D):
    (n_regionkey = 3) AND (n_nationkey > 10) AND (n_name > 'JAPAN')
n_nationkey: [19], n_name: [ROMANIA], n_regionkey: [3], n_comment: [ular asymptotes are about the furious multipliers. express dependencies nag above the ironically ironic account]
n_nationkey: [22], n_name: [RUSSIA], n_regionkey: [3], n_comment: [ requests against the platelets use never according to the quickly regular pint]
n_nationkey: [23], n_name: [UNITED KINGDOM], n_regionkey: [3], n_comment: [eans boost carefully special requests. accounts are. carefull]
selected 3 recs
```

Figure 5: Query 3-10mb data

```
select test:
    1. load file
    2. scan
    3. scan & filter
    3

select table:
    1. nation
    2. region
    3. customer
    4. part
    5. partsupp
    6. orders
    7. linitem
    8. supplier
    1

Filter with CNF for : nation
Enter CNF predicate (when done press ctrl-D):
    (n_regionkey = 3) AND (n_nationkey > 10) AND (n_name > 'JAPAN')
n_nationkey: [19], n_name: [ROMANIA], n_regionkey: [3], n_comment: [ular asymptotes are about the furious multipliers. express dependencies nag above the ironically ironic account]
n_nationkey: [22], n_name: [RUSSIA], n_regionkey: [3], n_comment: [ requests against the platelets use never according to the quickly regular pint]
n_nationkey: [23], n_name: [UNITED KINGDOM], n_regionkey: [3], n_comment: [eans boost carefully special requests. accounts are. carefull]
selected 3 recs
Closed the file.The total length of the file was 2 pages.
```

Figure 6: Query 3-1gb data

### 6.4 Query 4:

(s\_suppkey < 10)

```
Filter with CNF for : supplier
Enter CNF predicate (when done press ctrl-D):
    (s_suppkey < 10)
s_suppkey: [1], s_name: [Supplier#0000000001], s_address: [ N kD4on9OM Ipw3,gf6JBoQd7grzrddZ], s_nationkey: [17], s_phone: [27-918-338-1736], s_acctbal: [5755.94], s_comment: [each slyly above the carefu
l]
s_suppkey: [2], s_name: [Supplier#0000000002], s_address: [09a5RkxX3ImxJ0Bv0hC], s_nationkey: [6], s_phone: [16-079-863-2259], s_acctbal: [4802.68], s_comment: [ slyly bold instructions. idle dependen
t]
s_suppkey: [3], s_name: [Supplier#0000000003], s_address: [q1,02Pj6QjJuUYfUoH188FTK95aUpbV3], s_nationkey: [1], s_phone: [11-383-516-1199], s_acctbal: [4192.4], s_comment: [blithely silent requests after
the excess dependencies are sll
s_suppkey: [4], s_name: [Supplier#000000004], s_address: [Bk7ah4CK8SYOTepewMkkMw], s_nationkey: [18], s_phone: [25-843-787-7479], s_acctbal: [4641.08], s_comment: [ruiously even requests above the expl
e
s_suppkey: [5], s_name: [Supplier#000000005], s_address: [Gcdm2rJz16g1Tvc], s_nationkey: [11], s_phone: [21-151-098-3643], s_acctbal: [-283.84], s_comment: [ s. slyly regular pinto bee]
s_suppkey: [6], s_name: [Supplier#000000006], s_address: [ttxUvM7s7CnK], s_nationkey: [14], s_phone: [24-695-997-4969], s_acctbal: [1365.79], s_comment: [final accounts. regular dolphins use against the f
ruiously ironic decoy.
s_suppkey: [7], s_name: [Supplier#000000007], s_address: [s,4tchGB4u0PAsGNBuq], s_nationkey: [23], s_phone: [33-998-965-2281], s_acctbal: [6828.35], s_comment: [s unwind silently furiously regular court
s. finds requests are deposits. requests wake quietly blit]
s_suppkey: [8], s_name: [Supplier#000000008], s_address: [95q4BBH2FQEmafOocY45sRfx06yu0], s_nationkey: [17], s_phone: [27-498-742-3868], s_acctbal: [7627.85], s_comment: [al pinto beans. asymptotes hagg
i
s_suppkey: [9], s_name: [Supplier#000000009], s_address: [1KhLgZegwM3u7dsYmeKyVsK], s_nationkey: [18], s_phone: [28-493-398-8662], s_acctbal: [5392.37], s_comment: [s. unusual, even requests along the fu
ruiously regular pac]
selected 9 recs
```

Figure 7: Query 4-10mb data

```

select test:
1. load file
2. scan
3. scan & filter
3

select table:
1. nation
2. region
3. customer
4. part
5. partsupp
6. orders
7. lineitem
8. supplier
8

Filter with CNF for : supplier
Enter CNF predicate (when done press ctrl-D):
(s_suppkey < 10)

s_suppkey: [1], s_name: [Supplier#0000000001], s_address: [N KD4on9OM Ipw3,gf0Jb0Qd7tgrzrdZ], s_nationkey: [17], s_phone: [27-918-335-1736], s_acctbal: [5755.94], s_comment: [each slyly above the carefu
1]
s_suppkey: [2], s_name: [Supplier#0000000002], s_address: [B9e5kx3ImxJBvxObC], s_nationkey: [5], s_phone: [15-679-861-2259], s_acctbal: [4982.68], s_comment: [ slyly bold instructions. idle dependen
s_suppkey: [3], s_name: [Supplier#0000000003], s_address: [q1,03Pj6o]iuuyfuhM188FTKp5uU9DEV3], s_nationkey: [1], s_phone: [11-383-516-1199], s_acctbal: [4192.4], s_comment: [blithely silent requests after
the expeditious
s_suppkey: [4], s_name: [Supplier#0000000004], s_address: [Bk7ahACXSYOTen5ewMkkMew], s_nationkey: [15], s_phone: [25-843-787-7479], s_acctbal: [4441.88], s_comment: [rinsusly even requests above the expl
s_suppkey: [5], s_name: [Supplier#0000000005], s_address: [Gdm2x2RzL61glTvc], s_nationkey: [11], s_phone: [21-151-698-3663], s_acctbal: [-283.84], s_comment: [ i. slyly regular pinto bea
s_suppkey: [6], s_name: [Supplier#0000000006], s_address: [tQuvMn7sCnk], s_nationkey: [14], s_phone: [24-694-597-4969], s_acctbal: [1365.79], s_comment: [final accounts. regular dolphins use against the f
uriously ironclad decays
s_suppkey: [7], s_name: [Supplier#0000000007], s_address: [s_4ticNG84uO6paSeNBuq], s_nationkey: [28], s_phone: [33-990-965-2201], s_acctbal: [6820.35], s_comment: [s unwind silently furiously regular court
final requests for deposits. requests wake quietly blit
s_suppkey: [8], s_name: [Supplier#0000000008], s_address: [0Sq4bbH2FQEmafOocY45sRTx0yu0G], s_nationkey: [17], s_phone: [27-498-742-3868], s_acctbal: [7627.85], s_comment: [al pinto beans. asymptotes heapp
]
s_suppkey: [9], s_name: [Supplier#0000000009], s_address: [1KhUgZegwM3ua7dsMmekYBsk], s_nationkey: [10], s_phone: [20-403-398-8662], s_acctbal: [6302.37], s_comment: [s. unusual, even requests along the fu
riously regular pac
selected 9 recs
Closed the file.The total length of the file was 2 pages.

```

Figure 8: Query 4-1gb data

## 6.5 Query 5:

(s\_nationkey = 18) AND (s\_acctbal > 1000) AND (s\_suppkey < 400)

```

Filter with CNF for : supplier
Enter CNF predicate (when done press ctrl-D):
(s_nationkey = 18) AND (s_acctbal > 1000) AND (s_suppkey < 400)

s_suppkey: [18], s_name: [Supplier#0000000011], s_address: [3fwts,Lzrv, M,9C], s_nationkey: [18], s_phone: [28-613-996-1505], s_acctbal: [3393.08], s_comment: [y ironic packages. slyly ironic accounts affi
x furiously. ironically unusual excuses across the flu]
s_suppkey: [18], s_name: [Supplier#0000000027], s_address: [l1C4CjKwNHUz6L4xIpzOBKAN1HKFTg], s_nationkey: [18], s_phone: [28-788-999-2028], s_acctbal: [1887.62], s_comment: [s according to the quickly regul
ar hockey playe
s_suppkey: [41], s_name: [Supplier#0000000041], s_address: [0_1FKHRA35_wMKfmyt], s_nationkey: [18], s_phone: [28-739-447-2525], s_acctbal: [6942.67], s_comment: [odolites boost across the furiously regular
flu]
s_suppkey: [72], s_name: [Supplier#0000000072], s_address: [mKpAJojtawk2alqV4 ZEBj3PHSwfYq AM8rQq1], s_nationkey: [18], s_phone: [28-113-898-6643], s_acctbal: [7814.6], s_comment: [ theodolites sublate fu
riously about the regularly el]
s_suppkey: [99], s_name: [Supplier#0000000099], s_address: [4SxKTG28nZrtT0,MnVF9H], s_nationkey: [18], s_phone: [28-272-989-1617], s_acctbal: [3671.34], s_comment: [nic dependencies dazzle flu]
selected 5 recs

```

Figure 9: Query 5-10mb data

```

select test:
1. load file
2. scan
3. scan & filter
3

select table:
1. nation
2. region
3. customer
4. part
5. partsupp
6. orders
7. lineitem
8. supplier
8

Filter with CNF for : supplier
Enter CNF predicate (when done press ctrl-D):
(s_nationkey = 18) AND (s_acctbal > 1000) AND (s_suppkey < 400)

s_suppkey: [18], s_name: [Supplier#0000000011], s_address: [3fwts,Lzrv, M,9C], s_nationkey: [18], s_phone: [28-613-996-1505], s_acctbal: [3393.08], s_comment: [y ironic packages. slyly ironic accounts affi
x furiously. ironically unusual excuses across the flu]
s_suppkey: [18], s_name: [Supplier#0000000027], s_address: [l1C4CjKwNHUz6L4xIpzOBKAN1HKFTg], s_nationkey: [18], s_phone: [28-788-999-2028], s_acctbal: [1887.62], s_comment: [s according to the quickly regul
ar hockey playe
s_suppkey: [41], s_name: [Supplier#0000000041], s_address: [0_1FKHRA35_wMKfmyt], s_nationkey: [18], s_phone: [28-739-447-2525], s_acctbal: [6942.67], s_comment: [odolites boost across the furiously regular
flu]
s_suppkey: [72], s_name: [Supplier#0000000072], s_address: [mKpAJojtawk2alqV4 ZEBj3PHSwfYq AM8rQq1], s_nationkey: [18], s_phone: [28-113-898-6643], s_acctbal: [7814.6], s_comment: [ theodolites sublate fu
riously about the regularly el]
s_suppkey: [99], s_name: [Supplier#0000000099], s_address: [4SxKTG28nZrtT0,MnVF9H], s_nationkey: [18], s_phone: [28-272-989-1617], s_acctbal: [3671.34], s_comment: [nic dependencies dazzle flu]
selected 5 recs
Closed the file.The total length of the file was 2 pages.

```

Figure 10: Query 5-1gb data

## 6.6 Query 6:

(c\_nationkey = 23) AND (c\_mktsegment = 'FURNITURE') AND (c\_acctbal > 7023.99) AND (c\_acctbal < 7110.83)

```
Filter with CNF for : customer
Enter CNF predicate (when done press ctrl-D):
  (c_nationkey = 23) AND (c_mktsegment = 'FURNITURE') AND (c_acctbal > 7023.99) AND (c_acctbal < 7110.83)
selected 0 recs
```

Figure 11: Query 6-10mb data

```
select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  3

Filter with CNF for : customer
Enter CNF predicate (when done press ctrl-D):
  (c_nationkey = 23) AND (c_mktsegment = 'FURNITURE') AND (c_acctbal > 7023.99) AND (c_acctbal < 7110.83)
: [7054.59], c_mktsegment: [FURNITURE], c_comment: [sly unusual platelets alongside of the express depots]
: [30970], c_name: [Customer#000030970], c_address: [Q_N4BWYdHosSdg64IXAc6QwXgjn5rlP63swAT], c_nationkey: [23], c_phone: [33-739-174-9054], c_acctbal
: [7027.91], c_mktsegment: [FURNITURE], c_comment: [peculiar ideas, regular, even pinto beans above the slyly pending pinto beans are blithely across]
: [38796], c_name: [Customer#000038796], c_address: [nIGHXDXlaVbOX_BCrIxJUKx], c_nationkey: [23], c_phone: [33-893-935-9650], c_acctbal: [7079.41]
: [61179], c_name: [Customer#000061179], c_address: [dpdbIV6KFYz_x6O784qR9jj], c_nationkey: [23], c_phone: [33-825-707-8461], c_acctbal: [7075.72], c
mktsegment: [FURNITURE], c_comment: [dolites are furiously fluffy final accounts. unusual dugouts, cajole furiously careful]
: [72898], c_name: [Customer#000072898], c_address: [lzx8Pa4oWhhXClJ31v], c_nationkey: [23], c_phone: [33-119-734-3569], c_acctbal: [7096.31], c_m
tsegment: [FURNITURE], c_comment: [unusual accounts haggle carefully final, fluffy excuses, regu]
: [73441], c_name: [Customer#000073441], c_address: [7BHHDG59A_qNn010], c_nationkey: [23], c_phone: [33-868-482-1168], c_acctbal: [7038.25], c_mkts
egment: [FURNITURE], c_comment: [jole carefully silent foxes, asymptotes snooze after the furiously final depende]
: [85818], c_name: [Customer#000085818], c_address: [nahgIhPPadGH5P7Xs4k0gJ0mMw], c_nationkey: [23], c_phone: [33-688-221-5550], c_acctbal: [7073.6
], c_mktsegment: [FURNITURE], c_comment: [s. carefully even pinto beans haggle quickly bold packages, blithely ironic requests]
: [98151], c_name: [Customer#000098151], c_address: [hEKL_FNknb9wrx,1mpqfBPrz26CWIv1kbG], c_nationkey: [23], c_phone: [33-870-939-7560], c_acctbal
: [7045.3], c_mktsegment: [FURNITURE], c_comment: [unusual ideas, unusual, final accounts are carefully packages, furiously ironic excuses sleep never, regu
]
: [125950], c_name: [Customer#000125950], c_address: [q0870ox05ffrrpcB1oEDz51bfZUkH2Y], c_nationkey: [23], c_phone: [33-577-932-3052], c_acctbal: [
7076.18], c_mktsegment: [FURNITURE], c_comment: [g requests about the accounts sleep ]
: [145598], c_name: [Customer#000145598], c_address: [5nXGxG0WlmX117h2MfsoNVBC1J4o3sa], c_nationkey: [23], c_phone: [33-605-336-6690], c_acctbal:
: [7064.61], c_mktsegment: [FURNITURE], c_comment: [ix fluffy special, even deposits, slyly regular reques]
selected 10 Records.
```

Figure 12: Query 6-1gb data

## 6.7 Query 7:

(p\_brand = 'Brand#13') AND (p\_retailprice > 500) AND (p\_retailprice < 930) AND (p\_size > 28) AND (p\_size < 1000000)

```
Filter with CNF for : part
Enter CNF predicate (when done press ctrl-D):
  (p_brand = 'Brand#13') AND (p_retailprice > 500.0) AND (p_retailprice < 930.0) AND (p_size > 28) AND (p_size < 1000000)
p_partkey: [1222], p_name: [slate mint plum drab khaki], p_mfg: [Manufacturer#1], p_brand: [Brand#13], p_type: [SMALL BURNISHED COPPER], p_size: [33], p_container: [WRAP CAN], p_retailprice: [923.02], p_
comment: [sly tickle]
selected 1 recs
```

Figure 13: Query 7-10mb data

```

select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  8. supplier
  4

Filter with CNF for : part
Enter CNF predicate (when done press ctrl-D):
  (ps_partkey > "Brand#13") AND (p_retailprice > 500.0) AND (p_retailprice < 930.0) AND (p_size > 28) AND (p_size < 1000000)
p_partkey: [1023], p_name: [slate mint plum drab khaki], p_mfgr: [Manufacturer#1], p_type: [SMALL DURNISHED COPPER], p_size: [33], p_container: [WRAP CAN], p_retailprice: [923.02], p_
comment: [sly quickly]
selected 1 recs
Closed the file.The total length of the file was 4 pages.

```

Figure 14: Query 7-1gb data

## 6.8 Query 8:

(ps\_supplycost > 999.98)

```

Filter with CNF for : partsupp
Enter CNF predicate (when done press ctrl-D):
  (ps_supplycost > 999.98)
ps_partkey: [1213], ps_suppkey: [51], ps_availability: [5070], ps_supplycost: [999.99], ps_comment: [ ironic, special deposits. carefully final deposits haggle fluffily. furiously final foxes use furiously fu
riously ironic accounts. package]
selected 1 recs

```

Figure 15: Query 8-10mb data

```

select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  8. supplier
  5

Filter with CNF for : partsupp
Enter CNF predicate (when done press ctrl-D):
  (ps_supplycost > 999.98)
ps_partkey: [1213], ps_suppkey: [51], ps_availability: [5070], ps_supplycost: [999.99], ps_comment: [ ironic, special deposits. carefully final deposits haggle fluffily. furiously final foxes use furiously fu
riously ironic accounts. package]
selected 1 recs
Closed the file.The total length of the file was 12 pages.

```

Figure 16: Query 8-1gb data

## 6.9 Query 9:

(ps\_availqty < 10) AND (ps\_supplycost > 100) AND (ps\_suppkey < 300) AND

```
Filter with CNF for : partsupp
Enter CNF predicate (when done press ctrl-D):
  (ps_availqty < 10) AND (ps_supplycost > 100.0) AND (ps_suppkey < 300)
ps_partkey: [744], ps_suppkey: [46], ps_availqty: [4], ps_supplycost: [698.75], ps_comment: [express packages try to use above the even excuses. furiously regular deposits above the silent]
ps_partkey: [744], ps_suppkey: [46], ps_availqty: [8], ps_supplycost: [102.28], ps_comment: [ regular excuses. quickly ironic courts are busily. theodolites haggle carefully slyly final accounts. regular,
special asymptotes haggle along the furious]
ps_partkey: [1427], ps_suppkey: [28], ps_availqty: [3], ps_supplycost: [746.8], ps_comment: [lyly unusual deposits. regular deposits cajole slyly about the blithely special warthogs. furiously regular dol
phins integrate across the bold requests. quickly regular ]
ps_partkey: [1452], ps_suppkey: [31], ps_availqty: [6], ps_supplycost: [969.62], ps_comment: [gle blithely furiously final deposits. carefully ironic packages wake. final asymptotes ar]
selected 4 recs
```

Figure 17: Query 9-10mb data

```
select test:
  1. load file
  2. scan
  3. scan & filter
  3

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  8. supplier
  5

Filter with CNF for : partsupp
Enter CNF predicate (when done press ctrl-D):
  (ps_availqty < 10) AND (ps_supplycost > 100.0) AND (ps_suppkey < 300)
ps_partkey: [744], ps_suppkey: [46], ps_availqty: [4], ps_supplycost: [698.75], ps_comment: [express packages try to use above the even excuses. furiously regular deposits above the silent]
ps_partkey: [977], ps_suppkey: [78], ps_availqty: [8], ps_supplycost: [102.28], ps_comment: [ regular excuses. quickly ironic courts are busily. theodolites haggle carefully slyly final accounts. regular,
special asymptotes haggle along the furious]
ps_partkey: [1427], ps_suppkey: [28], ps_availqty: [3], ps_supplycost: [746.8], ps_comment: [lyly unusual deposits. regular deposits cajole slyly about the blithely special warthogs. furiously regular dol
phins integrate across the bold requests. quickly regular ]
ps_partkey: [1452], ps_suppkey: [31], ps_availqty: [6], ps_supplycost: [969.62], ps_comment: [gle blithely furiously final deposits. carefully ironic packages wake. final asymptotes ar]
selected 4 recs
Closed the file.The total length of the file was 12 pages.
```

Figure 18: Query 9-1gb data

## 6.10 Query 10:

(o\_orderpriority = '1-URGENT') AND (o\_orderstatus = '0') AND (o\_shippriority = 0) AND (o\_totalprice > 1015.68) AND (o\_totalprice < 1051.89)

```
Filter with CNF for : orders
Enter CNF predicate (when done press ctrl-D):
  (o_orderpriority = '1-URGENT') AND (o_orderstatus = '0') AND (o_shippriority = 0) AND (o_totalprice > 1015.68) AND (o_totalprice < 1051.89)
selected 0 recs
```

Figure 19: Query 10-10mb data

```
Filter with CNF for : orders
Enter CNF predicate (when done press ctrl-D):
    (o_orderpriority = '1-URGENT') AND (o_orderstatus = '0') AND (o_shippriority = 0) AND (o_totalprice > 1015.68) AND (o_totalprice < 1051.89)
selected 0 recs
```

Figure 20: Query 10-1gb data

## 6.11 Query 11:

```
(l_shipdate > '1994-01-01') AND (l_shipdate < '1994-01-07') AND (l_discount > 0.05) AND (l_discount < 0.06) AND (l_quantity = 4.0)
```

```
Filter with CNF for : lineitem
Enter CNF predicate (when done press ctrl-D):
    (l_shipdate > '1994-01-01') AND
(l_shipdate < '1994-01-07') AND
(l_discount > 0.05) AND
(l_discount < 0.06) AND
(l_quantity = 4.0)

selected 0 recs
```

Figure 21: Query 11-1gb data

```
[ 7
Filter with CNF for : lineitem
Enter CNF predicate (when done press ctrl-D):
    (l_shipdate > '1994-01-01') AND
(l_shipdate < '1994-01-07') AND
(l_discount > 0.05) AND
(l_discount < 0.06) AND
(l_quantity = 4.0)

selected 0 recs
```

Figure 22: Query 11-1gb data

## 6.12 Query 12:

(l\_orderkey > 100) AND (l\_orderkey < 1000) AND (l\_partkey > 100) AND (l\_partkey < 5000) AND  
 (l\_shipmode = 'AIR') AND (l\_linenumber = 'F') AND (l\_tax < 0.07)

```

filter With CN predicate (for :lineitem)
Enter CN predicate (when done press ctrl-d):
  l_orderkey > 100 AND l_orderkey < 1000 AND l_partkey < 5000 AND l_shipmode = 'AIR' AND l_linestatus = 'F' AND l_tax < 0.07
  l_orderdate between '1992-01-01' and '1992-01-15' AND l_discount < 0.07 AND l_quantity < 2769.69 AND l_discount = 0.12 AND l_tax = 0.02 AND l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-04-16' AND l_commitdate = '1993-06-27' AND l_receiptdate = '1993-06-23' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [rarefully blithely hold acco]
  l_orderkey = [164] l_partkey = [185] l_suppkey = [38] l_linenumber = [2] l_quantity = [24] l_extendedprice = [26844.3] l_discount = 0.05 l_tax = 0.05 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1992-11-22' AND l_commitdate = '1992-11-27' AND l_receiptdate = '1992-11-06' AND l_shipmode = 'AIR' l_comment = [side of the slyly unusual theodolites. f]
  l_orderkey = [164] l_partkey = [185] l_suppkey = [38] l_linenumber = [2] l_quantity = [24] l_extendedprice = [45896.78] l_discount = 0.05 l_tax = 0.05 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-01-15' AND l_commitdate = '1993-01-21' AND l_receiptdate = '1993-01-03' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [cabsle rapturously regular packages. b]
  l_orderkey = [164] l_partkey = [189] l_suppkey = [9] l_linenumber = [6] l_quantity = [21] l_extendedprice = [26732.2] l_discount = 0.1 l_tax = 0.04 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1992-12-23' AND l_commitdate = '1993-01-16' AND l_receiptdate = '1993-01-10' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [lays wear carefully a]
  l_orderkey = [164] l_partkey = [262] l_suppkey = [95] l_linenumber = [4] l_quantity = [45] l_extendedprice = [58833.3] l_discount = 0.01 l_tax = 0.02 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-01-15' AND l_commitdate = '1993-01-21' AND l_receiptdate = '1993-01-10' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [rarefully blithely hold acco]
  l_orderkey = [268] l_partkey = [1465] l_suppkey = [5] l_linenumber = [4] l_quantity = [56] l_extendedprice = [14921.92] l_discount = 0.09 l_tax = 0.04 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1994-01-11' AND l_commitdate = '1994-03-04' AND l_receiptdate = '1994-01-18' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [nic asymptotes. slyly silent r]
  l_orderkey = [261] l_partkey = [1740] l_suppkey = [25] l_linenumber = [3] l_quantity = [28] l_extendedprice = [45968.7] l_discount = 0.08 l_tax = 0.03 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-08-15' AND l_commitdate = '1993-08-21' AND l_receiptdate = '1993-08-08' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [intrinsic packages very carefully find]
  l_orderkey = [261] l_partkey = [1740] l_suppkey = [25] l_linenumber = [3] l_quantity = [28] l_extendedprice = [45968.7] l_discount = 0.08 l_tax = 0.03 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-08-15' AND l_commitdate = '1993-08-21' AND l_receiptdate = '1993-08-08' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [ing to the special. ironic deposit]
  l_orderkey = [294] l_partkey = [597] l_suppkey = [88] l_linenumber = [1] l_quantity = [31] l_extendedprice = [46425.3] l_discount = 0.05 l_tax = 0.01 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-08-06' AND l_commitdate = '1993-08-19' AND l_receiptdate = '1993-08-13' AND l_shipinstruct = 'TAKE BACK RETURN' AND l_shipmode = 'AIR' l_comment = [rarefully along the quick]
  l_orderkey = [294] l_partkey = [597] l_suppkey = [88] l_linenumber = [1] l_quantity = [31] l_extendedprice = [46425.3] l_discount = 0.05 l_tax = 0.01 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-08-06' AND l_commitdate = '1993-08-19' AND l_receiptdate = '1993-08-13' AND l_shipinstruct = 'TAKE BACK RETURN' AND l_shipmode = 'AIR' l_comment = [above the slyly regular requests x-ray q]
  l_orderkey = [322] l_partkey = [1833] l_suppkey = [77] l_linenumber = [4] l_quantity = [16] l_extendedprice = [17340.83] l_discount = 0.06 l_tax = 0.03 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1994-02-14' AND l_commitdate = '1994-03-18' AND l_receiptdate = '1994-02-11' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [322] l_partkey = [1833] l_suppkey = [77] l_linenumber = [4] l_quantity = [16] l_extendedprice = [17340.83] l_discount = 0.06 l_tax = 0.03 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1994-02-14' AND l_commitdate = '1994-03-18' AND l_receiptdate = '1994-02-11' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [deposits grow slyly according to th]
  l_orderkey = [327] l_partkey = [481] l_suppkey = [48] l_linenumber = [2] l_quantity = [1] l_extendedprice = [18165.7] l_discount = 0.09 l_tax = 0.05 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-02-04' AND l_commitdate = '1995-02-18' AND l_receiptdate = '1995-02-07' AND l_shipinstruct = 'NONE!' AND l_shipmode = 'AIR' l_comment = [wading ironic details slouch the hill]
  l_orderkey = [416] l_partkey = [418] l_suppkey = [48] l_linenumber = [2] l_quantity = [1] l_extendedprice = [18165.7] l_discount = 0.09 l_tax = 0.05 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-02-04' AND l_commitdate = '1995-02-11' l_receiptdate = '1995-02-05' AND l_shipinstruct = 'NONE!' AND l_shipmode = 'SHIP' AND l_comment = [asymptote are fu]
  l_orderkey = [483] l_partkey = [1194] l_suppkey = [67] l_linenumber = [1] l_quantity = [44] l_extendedprice = [44992.8] l_discount = 0.01 l_tax = 0.06 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-02-14' AND l_commitdate = '1995-02-21' AND l_receiptdate = '1995-02-14' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [483] l_partkey = [1194] l_suppkey = [67] l_linenumber = [1] l_quantity = [44] l_extendedprice = [44992.8] l_discount = 0.01 l_tax = 0.06 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-02-14' AND l_commitdate = '1995-02-21' AND l_receiptdate = '1995-02-14' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [lss boos after the bold requests.]
  l_orderkey = [486] l_partkey = [781] l_suppkey = [82] l_linenumber = [5] l_quantity = [22] l_extendedprice = [3635.65] l_discount = 0.09 l_tax = 0.03 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-02-14' AND l_commitdate = '1995-02-21' AND l_receiptdate = '1995-02-14' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [486] l_partkey = [781] l_suppkey = [82] l_linenumber = [5] l_quantity = [22] l_extendedprice = [3635.65] l_discount = 0.09 l_tax = 0.03 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1995-02-14' AND l_commitdate = '1995-02-21' AND l_receiptdate = '1995-02-14' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [481] l_partkey = [287] l_suppkey = [8] l_linenumber = [2] l_quantity = [1] l_extendedprice = [21864.8] l_discount = 0.09 l_tax = 0.01 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-01-49' AND l_commitdate = '1993-02-27' AND l_receiptdate = '1993-01-14' AND l_shipinstruct = 'TAKE BACK RETURN' AND l_shipmode = 'AIR' l_comment = [p blithely after t]
  l_orderkey = [481] l_partkey = [1120] l_suppkey = [93] l_linenumber = [5] l_quantity = [31] l_extendedprice = [31654.7] l_discount = 0.05 l_tax = 0.01 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-01-15' AND l_commitdate = '1993-02-21' AND l_receiptdate = '1993-01-21' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [481] l_partkey = [1120] l_suppkey = [93] l_linenumber = [5] l_quantity = [31] l_extendedprice = [31654.7] l_discount = 0.05 l_tax = 0.01 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-01-15' AND l_commitdate = '1993-02-21' AND l_receiptdate = '1993-01-21' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [549] l_partkey = [653] l_suppkey = [54] l_linenumber = [3] l_quantity = [36] l_extendedprice = [55931.4] l_discount = 0.08 l_tax = 0.04 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1992-09-11' AND l_commitdate = '1992-10-11' AND l_receiptdate = '1992-09-12' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [ts against the ironic, even theodolites eng]
  l_orderkey = [549] l_partkey = [653] l_suppkey = [54] l_linenumber = [3] l_quantity = [36] l_extendedprice = [55931.4] l_discount = 0.08 l_tax = 0.04 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1992-09-11' AND l_commitdate = '1992-10-11' AND l_receiptdate = '1992-09-12' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [ts against the ironic, even theodolites eng]
  l_orderkey = [677] l_partkey = [1497] l_suppkey = [15] l_linenumber = [6] l_quantity = [25] l_extendedprice = [34692.2] l_discount = 0.1 l_tax = 0.05 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1994-03-12' AND l_commitdate = '1994-02-02' AND l_receiptdate = '1994-03-28' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [packages integrate blithely]
  l_orderkey = [677] l_partkey = [1497] l_suppkey = [15] l_linenumber = [6] l_quantity = [25] l_extendedprice = [34692.2] l_discount = 0.1 l_tax = 0.05 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1994-03-12' AND l_commitdate = '1994-02-02' AND l_receiptdate = '1994-03-28' AND l_shipinstruct = 'DELIVER IN PERSON' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [678] l_partkey = [787] l_suppkey = [76] l_linenumber = [5] l_quantity = [16] l_extendedprice = [10815.1] l_discount = 0.06 l_tax = 0.04 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1994-03-12' AND l_commitdate = '1994-02-02' AND l_receiptdate = '1994-03-28' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [738] l_partkey = [1781] l_suppkey = [72] l_linenumber = [2] l_quantity = [4] l_extendedprice = [7901.48] l_discount = 0.05 l_tax = 0.03 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-06-20' AND l_commitdate = '1993-04-08' AND l_receiptdate = '1993-07-09' AND l_shipinstruct = 'NONE!' AND l_shipmode = 'AIR' l_comment = [ar packages. fluffy bo]
  l_orderkey = [738] l_partkey = [1781] l_suppkey = [72] l_linenumber = [2] l_quantity = [4] l_extendedprice = [7901.48] l_discount = 0.05 l_tax = 0.03 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-06-20' AND l_commitdate = '1993-04-08' AND l_receiptdate = '1993-07-09' AND l_shipinstruct = 'NONE!' AND l_shipmode = 'AIR' l_comment = [ar packages. fluffy bo]
  l_orderkey = [742] l_partkey = [1999] l_suppkey = [64] l_linenumber = [4] l_quantity = [16] l_extendedprice = [2934.4] l_discount = 0.01 l_tax = 0.05 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1995-01-15' AND l_commitdate = '1995-02-25' AND l_receiptdate = '1995-01-24' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [eodolites haggis carefully regula]
  l_orderkey = [769] l_partkey = [1781] l_suppkey = [94] l_linenumber = [1] l_quantity = [36] l_extendedprice = [55499.1] l_discount = 0.02 l_tax = 0.02 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-08-01' AND l_commitdate = '1993-08-01' AND l_receiptdate = '1993-08-01' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [769] l_partkey = [1781] l_suppkey = [94] l_linenumber = [1] l_quantity = [36] l_extendedprice = [55499.1] l_discount = 0.02 l_tax = 0.02 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1993-08-01' AND l_commitdate = '1993-08-01' AND l_receiptdate = '1993-08-01' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [l comment]
  l_orderkey = [774] l_partkey = [2098] l_suppkey = [24] l_linenumber = [4] l_quantity = [26] l_extendedprice = [1706.8] l_discount = 0.01 l_tax = 0.02 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1993-08-17' AND l_commitdate = '1993-06-29' AND l_receiptdate = '1993-06-29' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [fo the furiously final deposits. fur]
  l_orderkey = [801] l_partkey = [947] l_suppkey = [16] l_linenumber = [2] l_quantity = [21] l_extendedprice = [38886.7] l_discount = 0.05 l_tax = 0.02 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1992-03-14' AND l_commitdate = '1992-04-01' AND l_receiptdate = '1992-04-05' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [wake silently furiously idle deposits.]
  l_orderkey = [808] l_partkey = [1086] l_suppkey = [24] l_linenumber = [2] l_quantity = [21] l_extendedprice = [38886.7] l_discount = 0.05 l_tax = 0.02 l_returnflag = 'R' AND l_linestatus = 'F' AND l_shipdate = '1992-03-14' AND l_commitdate = '1992-04-01' AND l_receiptdate = '1992-04-05' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [wake silently furiously idle deposits.]
  l_orderkey = [808] l_partkey = [1086] l_suppkey = [24] l_linenumber = [2] l_quantity = [21] l_extendedprice = [38886.7] l_discount = 0.05 l_tax = 0.02 l_returnflag = 'A' AND l_linestatus = 'F' AND l_shipdate = '1992-03-14' AND l_commitdate = '1992-04-01' AND l_receiptdate = '1992-04-05' AND l_shipinstruct = 'COLLECT COD' AND l_shipmode = 'AIR' l_comment = [instruction cajole carefully. quiet]

```

Figure 23: Query 12-10mb data

```

1_orderkey: [226], l_partkey: [487], l_suppkey: [98], l_linenumber: [4], l_quantity: [46], l_extendedprice: [58833], l_discount: [0.1], l_tax: [0.02], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-04-17], l_commitdate: [1993-05-27], l_receiptdate: [1993-05-11], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [carefully pending pi]
l_orderkey: [268], l_partkey: [1466], l_suppkey: [5], l_linenumber: [6], l_quantity: [36], l_extendedprice: [49192.6], l_discount: [0.09], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-01-11], l_commitdate: [1994-01-18], l_receiptdate: [1994-01-18], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [nic asymmetr sly silent]
l_orderkey: [241], l_partkey: [1748], l_suppkey: [28], l_linenumber: [3], l_quantity: [28], l_extendedprice: [45948.7], l_discount: [0.08], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-07-24], l_commidate: [1993-08-20], l_recipdate: [1993-08-06], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [ironic packages nag slyly, carefully fin]
l_orderkey: [261], l_partkey: [978], l_suppkey: [6], l_linenumber: [6], l_quantity: [28], l_extendedprice: [37419.4], l_discount: [0.06], l_tax: [0.04], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1993-10-15], l_commitdate: [1993-09-45], l_recipdate: [1993-11-07], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [sing the special ironic deposit]
l_orderkey: [202], l_partkey: [1466], l_suppkey: [4], l_linenumber: [1], l_quantity: [4], l_extendedprice: [44625.1], l_discount: [0.07], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-08-06], l_commitdate: [1993-08-19], l_recipdate: [1993-08-13], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [AIR], l_comment: [le fluffily along the quick]
l_orderkey: [295], l_partkey: [914], l_suppkey: [17], l_linenumber: [2], l_quantity: [26], l_extendedprice: [47187.7], l_discount: [0.04], l_tax: [0.03], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1994-12-13], l_commitdate: [1994-11-30], l_recipdate: [1995-01-06], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [ts above the sly regular requests x-ray q]
l_orderkey: [1722], l_partkey: [1838], l_suppkey: [4], l_linenumber: [4], l_quantity: [24], l_extendedprice: [47348.8], l_discount: [0.07], l_tax: [0.03], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1992-08-14], l_commitdate: [1992-08-14], l_recipdate: [1992-08-14], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [deposits now slyly according th]
l_orderkey: [322], l_partkey: [334], l_suppkey: [91], l_linenumber: [6], l_quantity: [3], l_extendedprice: [3702.97], l_discount: [0.08], l_tax: [0.05], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1992-07-03], l_commitdate: [1992-07-28], l_recipdate: [NONE], l_shipmode: [AIR], l_comment: [ending ironi deposits along the blith]
l_orderkey: [327], l_partkey: [1418], l_suppkey: [48], l_linenumber: [2], l_quantity: [9], l_extendedprice: [11865.7], l_discount: [0.09], l_tax: [0.05], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-08-14], l_commitdate: [1994-08-21], l_recipdate: [1994-08-21], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [sing the special ironic deposit]
l_orderkey: [353], l_partkey: [1194], l_suppkey: [67], l_linenumber: [1], l_quantity: [4], l_extendedprice: [44982.8], l_discount: [0.07], l_tax: [0.04], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-03-25], l_commitdate: [1994-03-31], l_recipdate: [1994-03-30], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [refully final theodoli]
l_orderkey: [416], l_partkey: [1742], l_suppkey: [88], l_linenumber: [3], l_quantity: [25], l_extendedprice: [41093.5], l_discount: [0.07], l_tax: [0.04], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1994-10-16], l_commitdate: [1993-12-03], l_recipdate: [1993-10-29], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [less boost after the gold requests.]
l_orderkey: [458], l_partkey: [1838], l_suppkey: [56], l_linenumber: [6], l_quantity: [24], l_extendedprice: [47348.8], l_discount: [0.07], l_tax: [0.03], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1995-03-11], l_commitdate: [1995-03-16], l_recipdate: [1995-03-16], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [ve even pinto beans; qui]
l_orderkey: [481], l_partkey: [287], l_suppkey: [8], l_linenumber: [2], l_quantity: [19], l_extendedprice: [21036.8], l_discount: [0.08], l_tax: [0.01], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-01-09], l_commitdate: [1992-01-17], l_recipdate: [1992-01-14], l_shipinstruct: [AIR], l_comment: [p blithely after t]
l_orderkey: [518], l_partkey: [1128], l_suppkey: [93], l_linenumber: [3], l_quantity: [3], l_extendedprice: [31654.7], l_discount: [0.08], l_tax: [0.01], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1993-04-15], l_commitdate: [1993-04-23], l_recipdate: [1993-04-23], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [final packages believe. quick]
l_orderkey: [548], l_partkey: [568], l_suppkey: [59], l_linenumber: [4], l_quantity: [21], l_extendedprice: [30881.48], l_discount: [0.08], l_tax: [0.03], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-10-27], l_commitdate: [1994-12-04], l_recipdate: [1994-11-21], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [engage quickly, regular theo]
l_orderkey: [549], l_partkey: [653], l_suppkey: [54], l_linenumber: [3], l_quantity: [36], l_extendedprice: [65931.4], l_discount: [0.08], l_tax: [0.04], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1994-08-26], l_commitdate: [1994-08-25], l_recipdate: [1994-08-25], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [engaged packages eng]
l_orderkey: [577], l_partkey: [269], l_suppkey: [14], l_linenumber: [5], l_quantity: [26], l_extendedprice: [28991.2], l_discount: [0.06], l_tax: [0.01], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1995-04-09], l_commitdate: [1995-04-21], l_recipdate: [1995-04-09], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [AIR], l_comment: [ve slyly of the frets. careful]
l_orderkey: [677], l_partkey: [1497], l_suppkey: [15], l_linenumber: [2], l_quantity: [25], l_extendedprice: [214962.8], l_discount: [0.08], l_tax: [0.05], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-03-12], l_commitdate: [1994-03-28], l_recipdate: [1994-03-28], l_shipinstruct: [AIR], l_comment: [packages integrate blithely]
l_orderkey: [738], l_partkey: [1871], l_suppkey: [72], l_linenumber: [1], l_quantity: [31], l_extendedprice: [70191.48], l_discount: [0.08], l_tax: [0.03], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-03-09], l_commitdate: [1993-04-18], l_recipdate: [1993-04-07], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [about the packages integrate blithely]
l_orderkey: [738], l_partkey: [1871], l_suppkey: [72], l_linenumber: [1], l_quantity: [31], l_extendedprice: [70191.48], l_discount: [0.08], l_tax: [0.03], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1993-06-26], l_commitdate: [1993-06-08], l_recipdate: [1993-07-09], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [ar packages. fluffily bo]
l_orderkey: [738], l_partkey: [1749], l_suppkey: [38], l_linenumber: [5], l_quantity: [38], l_extendedprice: [44932.2], l_discount: [0.08], l_tax: [0.02], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1993-04-26], l_commitdate: [1993-04-25], l_recipdate: [1993-04-25], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [social interactions people blithely regular]
l_orderkey: [742], l_partkey: [1929], l_suppkey: [64], l_linenumber: [4], l_quantity: [14], l_extendedprice: [29134.6], l_discount: [0.01], l_tax: [0.01], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1995-01-18], l_commitdate: [1995-01-24], l_recipdate: [1995-01-24], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [eodolites haggle carefully regul]
l_orderkey: [769], l_partkey: [1761], l_suppkey: [94], l_linenumber: [1], l_quantity: [36], l_extendedprice: [56499.7], l_discount: [0.02], l_tax: [0.02], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-01-14], l_commitdate: [1994-01-21], l_recipdate: [1994-01-18], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [eodolites haggle carefully regul]
l_orderkey: [769], l_partkey: [1761], l_suppkey: [94], l_linenumber: [1], l_quantity: [36], l_extendedprice: [56499.7], l_discount: [0.02], l_tax: [0.02], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-01-14], l_commitdate: [1994-01-21], l_recipdate: [1994-01-18], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [lo the furiously final deposits. fur]
l_orderkey: [801], l_partkey: [947], l_suppkey: [16], l_linenumber: [2], l_quantity: [21], l_extendedprice: [38806.7], l_discount: [0.05], l_tax: [0.02], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1992-03-14], l_commitdate: [1992-04-01], l_recipdate: [1992-04-06], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [wake silently furiously idle deposits.]
l_orderkey: [801], l_partkey: [947], l_suppkey: [16], l_linenumber: [2], l_quantity: [21], l_extendedprice: [38806.7], l_discount: [0.05], l_tax: [0.02], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1996-03-01], l_commitdate: [1996-03-15], l_recipdate: [1996-03-12], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [instructions done carefully quiet]
l_orderkey: [866], l_partkey: [1358], l_suppkey: [59], l_linenumber: [1], l_quantity: [6], l_extendedprice: [42676.75], l_discount: [0.08], l_tax: [0.01], l_returnflag: [R], l_linenstatus: [F], l_shipdate: [1993-01-22], l_commitdate: [1993-01-14], l_recipdate: [1993-02-07], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [AIR], l_comment: [integrate fluffily, carefully fuly]
l_orderkey: [866], l_partkey: [1844], l_suppkey: [31], l_linenumber: [7], l_quantity: [11], l_extendedprice: [11045.1], l_discount: [0.01], l_tax: [0.01], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1995-03-28], l_commitdate: [1995-02-04], l_recipdate: [1995-01-04], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [packages fluffily e]
l_orderkey: [866], l_partkey: [1844], l_suppkey: [27], l_linenumber: [3], l_quantity: [26], l_extendedprice: [49217.7], l_discount: [0.06], l_tax: [0.01], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1995-01-16], l_commitdate: [1995-01-08], l_recipdate: [1995-01-16], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [the deposits affix slyly after t]
l_orderkey: [869], l_partkey: [1879], l_suppkey: [6], l_linenumber: [1], l_quantity: [11], l_extendedprice: [19107.1], l_discount: [0.07], l_tax: [0.01], l_returnflag: [A], l_linenstatus: [F], l_shipdate: [1994-12-24], l_commitdate: [1994-10-26], l_recipdate: [1994-09-20], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [y ironic packages. quickly even ]
selected 35 recs

```

Figure 24: Query 12-1gb data

## 7 Gtests:

### How to run GTests:

- Run Make gtest
- the run `./gtest.out` gives the output

```
[=====] Running 12 tests from 1 test suite.
[-----] Global test environment set-up.
[-----] 12 tests from DBFileTest
[ RUN    ] DBFileTest.CreateTest
[   OK   ] DBFileTest.CreateTest (0 ms)
[ RUN    ] DBFileTest.CreateAfterOpenTest
Cannot recreate file since file already opened!
[   OK   ] DBFileTest.CreateAfterOpenTest (0 ms)
[ RUN    ] DBFileTest.CreateAfterCloseTest
[   OK   ] DBFileTest.CreateAfterCloseTest (0 ms)
[ RUN    ] DBFileTest.CreateAfterCreateTest
Cannot recreate file since file already opened!
[   OK   ] DBFileTest.CreateAfterCreateTest (0 ms)
[ RUN    ] DBFileTest.OpenTest
[   OK   ] DBFileTest.OpenTest (0 ms)
[ RUN    ] DBFileTest.OpenAfterOpenTest
File already opened!
[   OK   ] DBFileTest.OpenAfterOpenTest (0 ms)
[ RUN    ] DBFileTest.OpenAfterCloseTest
[   OK   ] DBFileTest.OpenAfterCloseTest (1 ms)
[ RUN    ] DBFileTest.OpenAfterCreateTest
File already opened!
[   OK   ] DBFileTest.OpenAfterCreateTest (0 ms)
[ RUN    ] DBFileTest.CloseTest
File is not opened!
[   OK   ] DBFileTest.CloseTest (0 ms)
[ RUN    ] DBFileTest.CloseAfterOpenTest
[   OK   ] DBFileTest.CloseAfterOpenTest (0 ms)
[ RUN    ] DBFileTest.CloseAfterCloseTest
File is not opened!
[   OK   ] DBFileTest.CloseAfterCloseTest (0 ms)
[ RUN    ] DBFileTest.CloseAfterCreateTest
[   OK   ] DBFileTest.CloseAfterCreateTest (0 ms)
[-----] 12 tests from DBFileTest (1 ms total)

[-----] Global test environment tear-down
[=====] 12 tests from 1 test suite ran. (1 ms total)
[ PASSED ] 12 tests.
```

Figure 25: Gtests Output data