

# **Database System Implementation**

## **Project 1 - Implementation of Heap File**

**Developed by –**

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Aim of this project is to implement a Heap file.

We have completed the DBFile class by writing the required functions. The job of the DBFile within the system is to store and retrieve records from the disk.

### **Implementation Details:**

We have created the following private fields in the DBFile.h

**File \*fileBuffer;** // a file instance

**Page \*writeBuffer;** // a page buffer to write records

**Page \*readBuffer;** // a page buffer to read records

**bool isEmptyWriteBuffer;** // to check if the writeBuffer is empty

**bool endoffile;** // to check if end of file has been reached

**int pageIndex;** // to track page index in File

### **Method Definitions:**

- **DBFile::DBFile ()**

Constructor used to create instances of the File and page buffers. End of file flag is off and isEmptyWriteBuffer is true

- **int DBFile::Create (const char \*f\_path, fType f\_type, void \*startup)**

This method takes input f\_path, f\_type and creates a bin file. It also creates a metadata file which stores the required the file type.

- **void DBFile::Load (Schema &f\_schema, const char \*loadpath)**

This method takes schema, loadpath as input and loads the records from the dataset into the bin file

- **int DBFile::Open (const char \*f\_path)**

This method takes the f\_path as input and points to the bin file

- **void DBFile::MoveFirst ()**

This method points to the first record in the Heap File using readBuffer

- **void DBFile::Add (Record &rec)**

This method is used to add the records to the DBFile. The records are first added to the writeBuffer and whenever the writeBuffer is full we are adding the Page to the File. This writeBuffer is emptied and used again for storing records

- **int DBFile::GetNext (Record &fetchme)**

This method returns the record from the DBFile instance using readBuffer

- **int DBFile::GetNext (Record &fetchme, CNF &cnf, Record &literal)**

This method returns the record from the DBFile if it matches the filter CNF using readBuffer

- **int DBFile::Close ()**

It checks whether writeBuffer is empty to add the last page to file and then deletes all the file and page instances

File **gtest.cc** written to unit test the Create, Open and Close functions of the DBFile

### **Instructions to run code:**

#### **1) Compile and run code main.cc:**

1. make main

2. ./main

Enter the CNF on the console

E.g. (I\_orderkey > 27) AND (I\_orderkey < 45)

Press Enter and then Ctrl + D

Output is printed on the Console (**Screenshot of ./main is on the next page**)

```
Activities Terminal Sun 23:15
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1

File Edit View Search Terminal Help

aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ make main
g++ -O2 -Wno-deprecated -o main Record.o ComparisonEngine.o Schema.o File.o y.tab.o lex.yy.o main.o -lfl
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./main
Enter in your CNF: (l_orderkey > 27) AND (l_orderkey < 45)
( Att 0 from left record > Att 0 from literal record (Int)) AND
( Att 0 from left record < Att 1 from literal record (Int))
l_orderkey: [32], l_partkey: [828], l_suppkey: [95], l_linenum: [1], l_quantity: [28], l_extendedprice: [48407], l_discount: [0.05], l_tax: [0.08], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-10-23], l_commitdate: [1995-08-27], l_receiptdate: [1995-10-26], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [TRUCK], l_comment: [sleep quickly. req]
l_orderkey: [32], l_partkey: [1980], l_suppkey: [25], l_linenum: [2], l_quantity: [32], l_extendedprice: [68223.4], l_discount: [0.02], l_tax: [0], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-08-14], l_commitdate: [1995-10-07], l_receiptdate: [1995-08-27], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [lithely regular deposits. fluffily ]
l_orderkey: [32], l_partkey: [442], l_suppkey: [72], l_linenum: [3], l_quantity: [2], l_extendedprice: [2684.88], l_discount: [0.09], l_tax: [0.02], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-08-07], l_commitdate: [1995-10-07], l_receiptdate: [1995-08-23], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [ express accounts wake according to the]
l_orderkey: [32], l_partkey: [28], l_suppkey: [79], l_linenum: [4], l_quantity: [4], l_extendedprice: [3712.08], l_discount: [0.09], l_tax: [0.03], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-08-04], l_commitdate: [1995-10-01], l_receiptdate: [1995-09-03], l_shipinstruct: [NONE], l_shipmode: [REG AIR], l_comment: [e slyly final pac]
l_orderkey: [32], l_partkey: [859], l_suppkey: [93], l_linenum: [5], l_quantity: [44], l_extendedprice: [77433.4], l_discount: [0.05], l_tax: [0.06], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-08-28], l_commitdate: [1995-08-20], l_receiptdate: [1995-09-14], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [symptotes nag according to the ironic depo]
l_orderkey: [32], l_partkey: [117], l_suppkey: [44], l_linenum: [6], l_quantity: [6], l_extendedprice: [6102.66], l_discount: [0.04], l_tax: [0.03], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-07-21], l_commitdate: [1995-09-23], l_receiptdate: [1995-07-25], l_shipinstruct: [COLLECT COD], l_shipmode: [RAIL], l_comment: [ gifts cajole carefully.]
l_orderkey: [33], l_partkey: [614], l_suppkey: [8], l_linenum: [1], l_quantity: [31], l_extendedprice: [46952.9], l_discount: [0.09], l_tax: [0.04], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1993-10-29], l_commitdate: [1993-12-19], l_receiptdate: [1993-11-08], l_shipinstruct: [COLLECT COD], l_shipmode: [TRUCK], l_comment: [ng to the furiously ironic package]
l_orderkey: [33], l_partkey: [606], l_suppkey: [69], l_linenum: [2], l_quantity: [32], l_extendedprice: [48211.2], l_discount: [0.02], l_tax: [0.05], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1993-12-09], l_commitdate: [1994-01-04], l_receiptdate: [1993-12-28], l_shipinstruct: [COLLECT COD], l_shipmode: [MAIL], l_comment: [gular theodolites]
l_orderkey: [33], l_partkey: [1375], l_suppkey: [14], l_linenum: [3], l_quantity: [5], l_extendedprice: [6381.85], l_discount: [0.05], l_tax: [0.03], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1993-12-09], l_commitdate: [1993-12-25], l_receiptdate: [1993-12-23], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [AIR], l_comment: [ stealthily bold exc]
l_orderkey: [33], l_partkey: [348], l_suppkey: [41], l_linenum: [4], l_quantity: [41], l_extendedprice: [50853.9], l_discount: [0.09], l_tax: [0], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1993-11-09], l_commitdate: [1994-01-24], l_receiptdate: [1993-11-11], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [MAIL], l_comment: [unusual packages doubt caref]
l_orderkey: [34], l_partkey: [884], l_suppkey: [18], l_linenum: [1], l_quantity: [13], l_extendedprice: [23203.4], l_discount: [0], l_tax: [0.07], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1998-10-23], l_commitdate: [1998-09-14], l_receiptdate: [1998-11-06], l_shipinstruct: [NONE], l_shipmode: [REG AIR], l_comment: [nle accounts. deposits are alon]
l_orderkey: [34], l_partkey: [895], l_suppkey: [29], l_linenum: [2], l_quantity: [22], l_extendedprice: [39509.6], l_discount: [0.08], l_tax: [0.06], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1998-10-09], l_commitdate: [1998-10-16], l_receiptdate: [1998-10-12], l_shipinstruct: [NONE], l_shipmode: [FOB], l_comment: [they slyly p]
l_orderkey: [34], l_partkey: [1696], l_suppkey: [79], l_linenum: [3], l_quantity: [6], l_extendedprice: [9586.14], l_discount: [0.02], l_tax: [0.06], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1998-10-30], l_commitdate: [1998-09-20], l_receiptdate: [1998-11-05], l_shipinstruct: [NONE], l_shipmode: [FOB], l_comment: [ar foxes sleep ]
l_orderkey: [35], l_partkey: [5], l_suppkey: [31], l_linenum: [1], l_quantity: [24], l_extendedprice: [21720], l_discount: [0.02], l_tax: [0], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1996-02-21], l_commitdate: [1996-01-03], l_receiptdate: [1996-03-18], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [FOB], l_comment: [, regular tilthe]
l_orderkey: [35], l_partkey: [1620], l_suppkey: [62], l_linenum: [2], l_quantity: [34], l_extendedprice: [51735.1], l_discount: [0.06], l_tax: [0.08], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1996-01-22], l_commitdate: [1996-01-06], l_receiptdate: [1996-01-27], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [RAIL], l_comment: [s are carefully against the f]
l_orderkey: [35], l_partkey: [1289], l_suppkey: [21], l_linenum: [3], l_quantity: [7], l_extendedprice: [7771.4], l_discount: [0.06], l_tax: [0.04], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1996-01-19], l_commitdate: [1996-12-22], l_receiptdate: [1996-01-29], l_shipinstruct: [NONE], l_shipmode: [MAIL], l_comment: [ the carefully regular ]
l_orderkey: [35], l_partkey: [852], l_suppkey: [86], l_linenum: [4], l_quantity: [25], l_extendedprice: [43821.2], l_discount: [0.06], l_tax: [0.05], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-11-26], l_commitdate: [1995-12-25], l_receiptdate: [1995-12-21], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [SHIP], l_comment: [ quickly until]
l_orderkey: [35], l_partkey: [1200], l_suppkey: [73], l_linenum: [5], l_quantity: [34], l_extendedprice: [37448.8], l_discount: [0.08], l_tax: [0.06], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1995-11-08], l_commitdate: [1996-01-15], l_receiptdate: [1995-11-26], l_shipinstruct: [COLLECT COD], l_shipmode: [MAIL], l_comment: [, silent, unusual deposits boost]
l_orderkey: [35], l_partkey: [308], l_suppkey: [37], l_linenum: [6], l_quantity: [28], l_extendedprice: [33832.4], l_discount: [0.03], l_tax: [0.02], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1996-02-01], l_commitdate: [1995-12-24], l_receiptdate: [1996-02-28], l_shipinstruct: [COLLECT COD], l_shipmode: [RAIL], l_comment: [ly alongside of ]
l_orderkey: [36], l_partkey: [1198], l_suppkey: [99], l_linenum: [1], l_quantity: [42], l_extendedprice: [46166], l_discount: [0.09], l_tax: [0], l_returnflag: [N], l_linestatus: [0], l_shipdate: [1996-02-03], l_commitdate: [1996-01-21], l_receiptdate: [1996-02-23], l_shipinstruct: [COLLECT COD], l_shipmode: [SHIP], l_comment: [ careful courts. special ]
l_orderkey: [37], l_partkey: [227], l_suppkey: [55], l_linenum: [1], l_quantity: [40], l_extendedprice: [45088.8], l_discount: [0.09], l_tax: [0.03], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1992-07-21], l_commitdate: [1992-08-01], l_receiptdate: [1992-08-15], l_shipinstruct: [NONE], l_shipmode: [REG AIR], l_comment: [luffly regular requests. slyly final acco]
```

## 2) Compile and run code test.cc:

Ensure that the tpch\_dir has the correct path to data generated by the tpch-dbggen so that project has access to datasets.

Ensure there is Catalog file in the root folder as well

1. make
2. ./test.out

Queries used for testing on 1GB tpch-dbggen files are below:

**(q1)** select \* from region where r\_name='EUROPE';

**(q2)** select \* from region where r\_name < 'middle east' and r\_regionkey > 1;

**(q3)** select \* from nation where n\_regionkey = 3 and n\_nationkey > 10 and n\_name > 'japan';

**(q11)** select \* from lineitem where l\_shipdate > '1994-01-01' and l\_shipdate < '1994-01-04' and l\_discount > 0.05 and l\_discount < 0.06 and l\_quantity = 4.0;

**(q12)** select \* from lineitem where l\_orderkey > 100 and l\_orderkey < 1000 and l\_partkey > 100 and l\_partkey < 5000 and l\_shipmode='AIR' and l\_linestatus='F' and l\_tax < '0.07';

## Output screenshots of the above mentioned queries:

**(q1)** select \* from region where r\_name='EUROPE';

```
Activities Terminal Sun 23:18
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1

File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ make
g++ -O2 -Wno-deprecated -g -c DBFile.cc
g++ -O2 -Wno-deprecated -g -c test.cc
g++ -O2 -Wno-deprecated -o test.out Record.o Comparison.o ComparisonEngine.o Schema.o File.o DBFile.o y.tab.o lex.yy.o test.o -lfl
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/aseesh/git/tpch-dbggen/
heap files dir:

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
  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
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```

*There is only one record matching the above-mentioned query in the database.*

**(q2)** select \* from region where r\_name < 'middle east' and r\_regionkey > 1;

```
Activities Terminal Sun 23:20
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1

File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/aseesh/git/tpch-dbggen/
heap files dir:

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
  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]
selected 2 recs
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```

There are two records matching the above-mentioned query in the database.

**(q3)** select \* from nation where n\_regionkey = 3 and n\_nationkey > 10 and n\_name > 'japan';

```
Activities Terminal
Sun 23/21
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1$

File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/aseesh/glt/tpch-dbgcn/
heap files dir:

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
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. careful]
selected 3 recs
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```

There are 3 records matching the above-mentioned query in the database.

**(q11)** select \* from lineitem where l\_shipdate > '1994-01-01' and l\_shipdate < '1994-01-04' and l\_discount > 0.05 and l\_discount < 0.06 and l\_quantity = 4.0;

```
Activities Terminal
Sun 23/24
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1$

File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/aseesh/glt/tpch-dbgcn/
heap files dir:

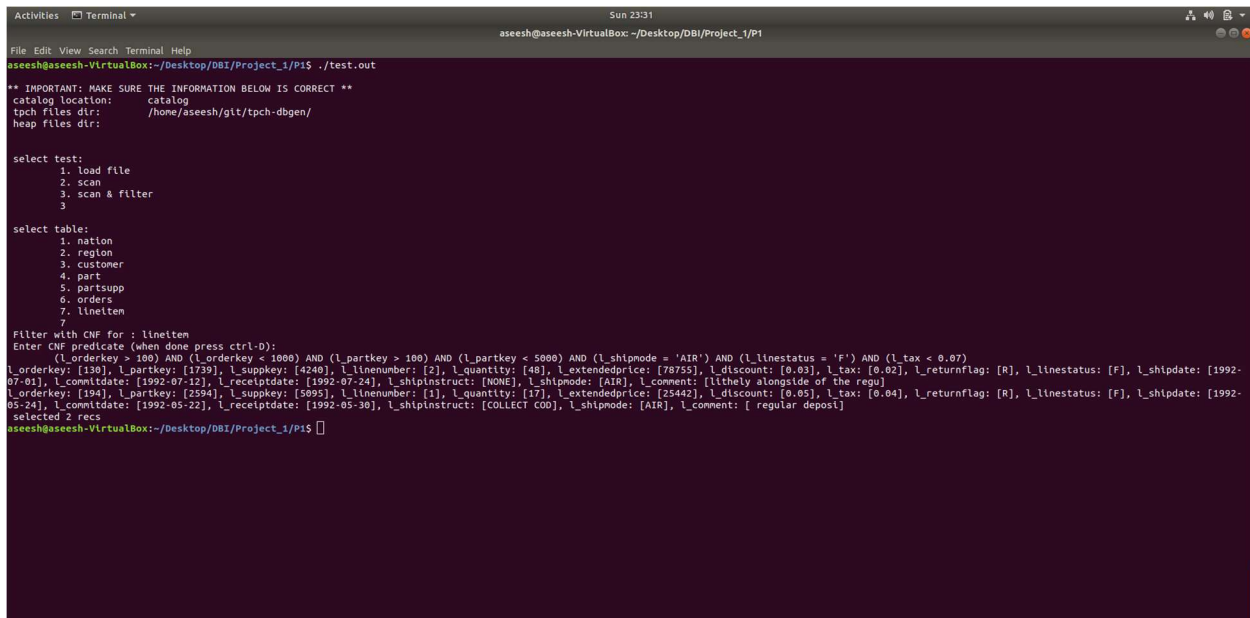
select test:
1. load file
2. scan
3. scan & filter
3

select table:
1. nation
2. region
3. customer
4. part
5. partsupp
6. orders
7. lineitem
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
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```

*There are zero records that corresponds to the above-mentioned query in the database.*

**(q12)** select \* from lineitem where l\_orderkey > 100 and l\_orderkey < 1000 and l\_partkey > 100 and l\_partkey < 5000 and l\_shipmode='AIR' and l\_linestatus='F' and l\_tax < '0.07';



```
Activities Terminal
Sun 23/3/1
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1$ ./test.out
File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./test.out
** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/aseesh/glt/tpch-dbgem/
heap files dir:

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
7
Filter with CNF for : llineltem
Enter CNF predicate (when done press ctrl-D):
(l_orderkey > 100) AND (l_orderkey < 1000) AND (l_partkey > 100) AND (l_partkey < 5000) AND (l_shipmode = 'AIR') AND (l_linestatus = 'F') AND (l_tax < 0.07)
l_orderkey: [130], l_partkey: [1739], l_suppkey: [4240], l_linenum: [2], l_quantity: [40], l_extendedprice: [78755], l_discount: [0.03], l_tax: [0.02], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1992-07-01], l_commitdate: [1992-07-12], l_receiptdate: [1992-07-24], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [lithely alongside of the regu]
l_orderkey: [194], l_partkey: [2594], l_suppkey: [5095], l_linenum: [1], l_quantity: [17], l_extendedprice: [25442], l_discount: [0.05], l_tax: [0.04], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1992-05-24], l_commitdate: [1992-05-22], l_receiptdate: [1992-05-30], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [ regular deposit]
selected 2 recs
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```

*There are two records that match the above-mentioned query in the database.*

### 3) Instructions to run gtests:

File gtest.cc contains the test cases for the Open, Create and Close methods of DBFile.

There are a total of 9 test cases testing the functionality of the above mentioned methods on 3 tables lineitem, orders, customer. Therefore, each table has 3 methods (Create, Open, Close) that are tested.

### Compile and run code gtest.cc:

1. make gtest
2. ./gtest

The screenshot of ./gtest is present on the next page

```
Activities Terminal
Sun 23:36
aseesh@aseesh-VirtualBox: ~/Desktop/DBI/Project_1/P1

File Edit View Search Terminal Help
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ make gtest
g++ -c -o gtest.o gtest.cc
g++ -O2 -Wno-deprecated -o gtest Record.o Comparison.o ComparisonEngine.o Schema.o File.o DBFile.o y.tab.o lex.yy.o gtest.o -lfl -lpthread -lgtest
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$ ./gtest
===== Running 9 tests from 3 test cases.
[-----] Global test environment set-up.
[-----] 3 tests from DBFileCreation
[ RUN      ] DBFileCreation.CreateFile_LineItem
Creating lineitem.bin
[ OK      ] DBFileCreation.CreateFile_LineItem (33 ms)
[ RUN      ] DBFileCreation.CreateFile_Orders
Creating orders.bin
[ OK      ] DBFileCreation.CreateFile_Orders (2 ms)
[ RUN      ] DBFileCreation.CreateFile_Customer
Creating customer.bin
[ OK      ] DBFileCreation.CreateFile_Customer (1 ms)
[-----] 3 tests from DBFileCreation (44 ms total)

[-----] 3 tests from DBFileOpen
[ RUN      ] DBFileOpen.OpenFile_LineItem
Opening lineitem.bin
[ OK      ] DBFileOpen.OpenFile_LineItem (0 ms)
[ RUN      ] DBFileOpen.OpenFile_Orders
Opening orders.bin
[ OK      ] DBFileOpen.OpenFile_Orders (0 ms)
[ RUN      ] DBFileOpen.OpenFile_Customer
Opening customer.bin
[ OK      ] DBFileOpen.OpenFile_Customer (0 ms)
[-----] 3 tests from DBFileOpen (0 ms total)

[-----] 3 tests from DBFileClose
[ RUN      ] DBFileClose.CloseFile_LineItem
Closing lineitem.bin
[ OK      ] DBFileClose.CloseFile_LineItem (0 ms)
[ RUN      ] DBFileClose.CloseFile_Orders
Closing orders.bin
[ OK      ] DBFileClose.CloseFile_Orders (0 ms)
[ RUN      ] DBFileClose.CloseFile_Customer
Closing customer.bin
[ OK      ] DBFileClose.CloseFile_Customer (0 ms)
[-----] 3 tests from DBFileClose (1 ms total)

[-----] Global test environment tear-down
===== 9 tests from 3 test cases ran. (45 ms total)
[ PASSED ] 9 tests.
aseesh@aseesh-VirtualBox:~/Desktop/DBI/Project_1/P1$
```