

# COP 6726 – Database System Implementation

## Project 1: Heap File Implementation Report

### **Group Members:**

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### **Compilation and Execution:**

To compile the code, run the following command:

```
>> make
```

To execute the main.cc code, change the directory to the specific folder (P1) and run the following command:

```
>> ./main.out
```

To execute the test.cc code, change the directory to the specific folder (P1) and run the following command:

```
>> ./test.out
```

*Note: In 'gtest.cc', modify 'tpch\_dir' to the '.tbl' files directory path.*

To compile the gTest (gtest.cc) code, run the following command:

```
>> g++ -o gtest gtest.cc DBFile.cc Schema.cc File.cc Record.cc  
ComparisonEngine.cc -lgtest -lpthread
```

To execute the gTest (gtest.cc) code, run the following command:

```
>> ./gtest
```

### **Code Explanation (modified methods):**

Filename: DBFile.cc

1. *DBFile::Create(f\_path, f\_type, startup) method* –  
Creates a binary(.bin) file for the specific table(.tbl) by calling File::Open() and initializes necessary variables inside the function.
2. *DBFile::Load(f\_schema, load\_path) method* –  
Copies all the record from specific table(.tbl) file to binary(.bin) file. If table file does not exist it loads nothing, otherwise it loads the data.
3. *DBFile::Open(f\_path) method* –  
Opens the binary file with the specified path and sets the pointer to first record.

4. *DBFile::MoveFirst()* method –  
Resets the pointer to first record and copies the pointed record to temporary Page.
5. *DBFile::Close()* method –  
Closes the already opened binary file.
6. *DBFile::Add(addMe)* method –  
Adds record to the current page if current page has enough space otherwise, it flushes current page to the binary file, frees up the current page, and appends the record to it.
7. *DBFile::GetNext(fetchMe)* method –  
This function returns the next record from Page if it exists.
8. *DBFile::GetNext(fetchMe, CNF, Literal)* method –  
This function returns the next record which satisfies the given parameter CNF from Page if it exists.

Filename: File.cc

9. *Page::GetRecordsCnt()* method –  
Returns number of records in the current Page.

Filename: gtest.cc

```
TEST(DBFile_Test_Create, ValidCreate) –  
    Google test for creation of file scenario with valid parameters.  
TEST(DBFile_Test_Create, InvalidCreatePath) –  
    Google test for creation of file scenario with invalid file path.  
TEST(DBFile_Test_Create, InvalidCreateFileType) –  
    Google test for creation of file scenario with invalid file type.  
TEST(DBFile_Test_Open, ValidOpen) –  
    Google test for opening the file scenario with valid parameters.  
TEST(DBFile_Test_Open, InvalidOpen) –  
    Google test for opening the file scenario with invalid/non-  
    existent file path.  
TEST(DBFile_Test_Close, ValidClose) –  
    Google test for closing the file (nation.tbl) scenario with valid  
    parameters.  
TEST(DBFile_Test_Close, InvalidClose) –  
    Google test for closing the file (non-existent) scenario.
```

### Results for test.out:

Load file tests: region.tbl

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:        /home/sanjay/Documents/Database-Implementation/git/tpch-dbgen/
heap files dir:

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

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

DBFile will be created at region.bin
tpch file will be loaded from /home/sanjay/Documents/Database-Implementation/git/tpch-dbgen/region.tbl
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$
```

Load file tests: nation.tbl

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:        /home/sanjay/Documents/Database-Implementation/git/tpch-dbgen/
heap files dir:

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

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

DBFile will be created at nation.bin
tpch file will be loaded from /home/sanjay/Documents/Database-Implementation/git/tpch-dbgen/nation.tbl
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$
```

Load file tests: lineitem.tbl

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ ./test.out

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

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

select table:
  1. nation
  2. region
  3. customer
  4. part
  5. partsupp
  6. orders
  7. lineitem
  7
DBFile will be created at lineitem.bin
tpch file will be loaded from /home/sanjay/Documents/Database-Implementation/git/tpch-dbggen/lineitem.tbl
```

Scan & Filters:

Q1- ( $r\_name = 'EUROPE'$ )

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:        /home/sanjay/Documents/Database-Implementation/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
```

Q2- ( $r\_name < 'MIDDLE\ EAST'$ ) AND ( $r\_regionkey > 1$ )

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:        /home/sanjay/Documents/Database-Implementation/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
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$
```

Q3- ( $n\_regionkey = 3$ ) AND ( $n\_nationkey > 10$ ) AND ( $n\_name > 'JAPAN'$ )

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:        /home/sanjay/Documents/Database-Implementation/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
  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
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$
```

Q11- (l\_shipdate > '1994-01-01') AND (l\_shipdate < '1994-01-04') AND (l\_discount > 0.04) AND (l\_discount < 0.07) AND (l\_quantity = 4.0)

```
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 < '1994-01-04') AND (l_discount > 0.04) AND (l_discount < 0.07) AND (l_quantity = 4.0)
l_orderkey: [629893], l_partkey: [191666], l_supkey: [1667], l_linenum: [4], l_quantity: [4], l_extendedprice: [7839.64], l_discount: [0.06], l_tax: [0.08], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-12-11], l_receiptdate: [1994-01-29], l_shipinstruct: [COLLECT COD], l_shipmode: [SHIP], l_comment: [yly above the fluffy foxes deposit]
l_orderkey: [987651], l_partkey: [191426], l_supkey: [1428], l_linenum: [6], l_quantity: [4], l_extendedprice: [6861.68], l_discount: [0.06], l_tax: [0], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-11-18], l_receiptdate: [1994-01-04], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [RAIL], l_comment: [sual dines]
l_orderkey: [1334916], l_partkey: [162761], l_supkey: [307], l_linenum: [1], l_quantity: [4], l_extendedprice: [7255.04], l_discount: [0.06], l_tax: [0.01], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-03], l_commitdate: [1993-12-27], l_receiptdate: [1994-01-04], l_shipinstruct: [NONE], l_shipmode: [TRUCK], l_comment: [fully fluffy even]
l_orderkey: [177946], l_partkey: [9908], l_supkey: [9981], l_linenum: [2], l_quantity: [4], l_extendedprice: [7559.92], l_discount: [0.08], l_tax: [0.02], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1994-01-15], l_receiptdate: [1994-01-09], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [TRUCK], l_comment: [onic packag]
l_orderkey: [192946], l_partkey: [79239], l_supkey: [9248], l_linenum: [2], l_quantity: [4], l_extendedprice: [4872.92], l_discount: [0.06], l_tax: [0.07], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1994-01-15], l_receiptdate: [1994-01-21], l_shipinstruct: [COLLECT COD], l_shipmode: [TRUCK], l_comment: [accounts about the busily u]
l_orderkey: [1978816], l_partkey: [7288], l_supkey: [4881], l_linenum: [7], l_quantity: [4], l_extendedprice: [8169.52], l_discount: [0.08], l_tax: [0.03], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1994-02-03], l_receiptdate: [1994-01-06], l_shipinstruct: [NONE], l_shipmode: [MAIL], l_comment: [g according to the quickly]
l_orderkey: [298837], l_partkey: [179153], l_supkey: [9154], l_linenum: [1], l_quantity: [4], l_extendedprice: [4928.6], l_discount: [0.06], l_tax: [0], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-12-03], l_receiptdate: [1994-01-29], l_shipinstruct: [NONE], l_shipmode: [TRUCK], l_comment: [ular requests according to t]
l_orderkey: [3629678], l_partkey: [185316], l_supkey: [353], l_linenum: [1], l_quantity: [4], l_extendedprice: [5685.24], l_discount: [0.06], l_tax: [0], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-03], l_commitdate: [1994-02-11], l_receiptdate: [1994-01-28], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [SHIP], l_comment: [ar accounts haggle furiously above the]
l_orderkey: [3681318], l_partkey: [71366], l_supkey: [6381], l_linenum: [4], l_quantity: [4], l_extendedprice: [5349.44], l_discount: [0.06], l_tax: [0.07], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-11-09], l_receiptdate: [1994-01-26], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [FOB], l_comment: [ slyly ironic accounts nag f]
l_orderkey: [3331619], l_partkey: [187681], l_supkey: [128], l_linenum: [2], l_quantity: [4], l_extendedprice: [6754.4], l_discount: [0.06], l_tax: [0.06], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-12-31], l_receiptdate: [1994-01-09], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [FOB], l_comment: [arefully furiously]
l_orderkey: [3932192], l_partkey: [92903], l_supkey: [7922], l_linenum: [3], l_quantity: [4], l_extendedprice: [7583.6], l_discount: [0.06], l_tax: [0], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1994-01-17], l_receiptdate: [1994-01-29], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [TRUCK], l_comment: [l dolphins are fluffy regular, ne]
l_orderkey: [4651438], l_partkey: [87233], l_supkey: [2258], l_linenum: [2], l_quantity: [4], l_extendedprice: [4888.92], l_discount: [0.06], l_tax: [0.07], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1994-03-13], l_receiptdate: [1994-01-28], l_shipinstruct: [DELIVER IN PERSON], l_shipmode: [AIR], l_comment: [latelets a]
l_orderkey: [483688], l_partkey: [178621], l_supkey: [1139], l_linenum: [4], l_quantity: [4], l_extendedprice: [6794.48], l_discount: [0.05], l_tax: [0.03], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1994-01-03], l_commitdate: [1994-01-09], l_receiptdate: [1994-01-29], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [RAIL], l_comment: [ent deposits ab]
l_orderkey: [4961252], l_partkey: [118389], l_supkey: [3412], l_linenum: [3], l_quantity: [4], l_extendedprice: [5629.52], l_discount: [0.06], l_tax: [0.06], l_returnflag: [A], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-12-22], l_receiptdate: [1994-01-17], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [MAIL], l_comment: [ays pending]
l_orderkey: [5818855], l_partkey: [5832], l_supkey: [2533], l_linenum: [6], l_quantity: [4], l_extendedprice: [3748.12], l_discount: [0.06], l_tax: [0.07], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1994-01-02], l_commitdate: [1993-10-28], l_receiptdate: [1994-01-31], l_shipinstruct: [TAKE BACK RETURN], l_shipmode: [MAIL], l_comment: [along the qui]
selected 15 recs
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$
```

Q12- (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)

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$ ./test.out

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location: catalog
tpch files dir: /home/sanjay/Documents/Database-Implementation/git/tpch-dbg/en
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_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: [138], l_partkey: [1739], l_supkey: [4248], l_linenum: [2], l_quantity: [48], 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: [1992-07-20], l_shipinstruct: [NONE], l_shipmode: [AIR], l_comment: [ititely alongside of the regu]
l_orderkey: [194], l_partkey: [2594], l_supkey: [5895], l_linenum: [1], l_quantity: [17], l_extendedprice: [25442], l_discount: [0.06], l_tax: [0.04], l_returnflag: [R], l_linestatus: [F], l_shipdate: [1992-05-24], l_commitdate: [1992-05-22], l_receiptdate: [1992-05-38], l_shipinstruct: [COLLECT COD], l_shipmode: [AIR], l_comment: [ regular deposi]
selected 2 recs
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/PI$
```

### Results for gTests:

```
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ ./gtest

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

[=====] Running 7 tests from 3 test suites.
[-----] Global test environment set-up.
[-----] 3 tests from DBFile_Test_Create
[ RUN     ] DBFile_Test_Create.ValidCreate
[      OK ] DBFile_Test_Create.ValidCreate (0 ms)
[ RUN     ] DBFile_Test_Create.InvalidCreatePath
[      OK ] DBFile_Test_Create.InvalidCreatePath (1 ms)
[ RUN     ] DBFile_Test_Create.InvalidCreateFileType
[      OK ] DBFile_Test_Create.InvalidCreateFileType (1 ms)
[-----] 3 tests from DBFile_Test_Create (3 ms total)

[-----] 2 tests from DBFile_Test_Open
[ RUN     ] DBFile_Test_Open.ValidOpen
[      OK ] DBFile_Test_Open.ValidOpen (0 ms)
[ RUN     ] DBFile_Test_Open.InvalidOpen
[      OK ] DBFile_Test_Open.InvalidOpen (0 ms)
[-----] 2 tests from DBFile_Test_Open (2 ms total)

[-----] 2 tests from DBFile_Test_Close
[ RUN     ] DBFile_Test_Close.ValidClose
[      OK ] DBFile_Test_Close.ValidClose (1 ms)
[ RUN     ] DBFile_Test_Close.InvalidClose
[      OK ] DBFile_Test_Close.InvalidClose (0 ms)
[-----] 2 tests from DBFile_Test_Close (1 ms total)

[-----] Global test environment tear-down
[=====] 7 tests from 3 test suites ran. (7 ms total)
[ PASSED ] 7 tests.
sanjay@sanjay-VirtualBox:~/Documents/Database-Implementation/P1$ |
```