

# **COP-6726 DATABASE SYSTEM IMPLEMENTATION**

## **Project-2.1 Report**

### **GROUP MEMBER NAMES:**

K Jaswanth Reddy - (UFID: 22719671)

M Dheeraj Kumar - (UFID: 82690922)

### **RUNNING THE CODE:**

-> Source code is in the folder "a2test". It contains all the tbl and respective bin files for 7 tables.

-> Unit Testing is done and are presented in gTest.cc

-> To run main.cc, from project root execute command "make main" and then execute "./main" and follow the on-screen instructions.

-> Google test framework has been added in the directory "googletest". This framework is needed to run gtest unit test cases.

-> To run test.cc, from project root execute command "make test.out" and then execute "./test.out" and choose the desired options.

-> Test Driver gives a menu on the console for performing testing to the code as:

1. sort – performs the sorting operation and outputs the records to output pipe.
2. sort + Display – performs the operations: sorting -> Dumping -> Displaying
3. sort + write – Performs an additional operation to the above as writing to .bigq file.

### **Steps to run the Tests(test.cc):**

make test.out

./test.out

### **Steps to run gTests(gTest.cc):**

make gTest.out

./gTest.out

## **Function Description:**

1. TwoPassMultiwayMergeSort()
  - Pthread function called by the constructor of BigQ class.
  - It performs the basic operations like 'input pipe', 'output pipe', 'order maker'
  - The process is basically performed using two phases: split phase and merge phase.
2. OpenFile(): Opens/ Creates a temporary file to manage records for the class. It returns the integer value as output 1 for success and 0 for failure.
3. CloseFile(): Closes the temporary file, returns 1 on success and 0 on failure.
4. Create(): This function first checks the type of the file and starts creating the file.
5. noMorePages(): Return a boolean variable to return True/ False if there are no more pages
6. isFull(): Return a boolean variable to check if the block is full
7. isEmpty(): Return a boolean variable to check if the block is empty
8. loadPage(): Load the block with the respective page
9. getFrontRecord(): Obtain the front record from the Block
10. popFrontRecord(): Remove the front record from the Block
11. compare4Sort(): compare4Sort
12. sortRecords(): Perform the sorts using the sort function.
13. readFromPipe(): Function call to read the records from the Input File
14. safeHeapPush(): Perform the record push into the Heap Structure
15. nextPopBlock(): Perform the record pop from the block
16. mergeBlocks(): Function call to merge the blocks with the conditions to check if there is enough space for merging
17. writeToPipe(): Function to write the contents of the input file to the pipe

## RESULTS:

TPCH Data Size = 1GB

Creation of the bin files from the respective tables chosen.

## Output1.txt

```
Output1.txt
1 n_nationkey: [6], n_name: [FRANCE], n_regionkey: [3], n_comment: [refully final requests. regular, ironi]
2 n_nationkey: [19], n_name: [ROMANIA], n_regionkey: [3], n_comment: [ular asymptotes are about the furious multipliers. express dependencies nag above the
3 n_nationkey: [22], n_name: [RUSSIA], n_regionkey: [3], n_comment: [ requests against the platelets use never according to the quickly regular pint]
4 n_nationkey: [23], n_name: [UNITED KINGDOM], n_regionkey: [3], n_comment: [eans boost carefully special requests. accounts are. carefull]
5 n_nationkey: [13], n_name: [JORDAN], n_regionkey: [4], n_comment: [ic deposits are blithely about the carefully regular pa]
6 n_nationkey: [4], n_name: [EGYPT], n_regionkey: [4], n_comment: [y above the carefully unusual theodolites. final dugouts are quickly across the furiously
7 n_nationkey: [11], n_name: [IRAQ], n_regionkey: [4], n_comment: [nic deposits boost atop the quickly final requests? quickly regula]
8 n_nationkey: [20], n_name: [SAUDI ARABIA], n_regionkey: [4], n_comment: [ts. silent requests haggle. closely express packages sleep across the blithely]
9 n_nationkey: [10], n_name: [IRAN], n_regionkey: [4], n_comment: [efully alongside of the slyly final dependencies. ]
10 consumer: removed 25 recs from the pipe
11 *****
12 Moved to first Page in Database File
13 producer: inserted 1500 recs into the pipe
14 consumer: removed 1500 recs from the pipe
15 *****
16 o_orderkey: [39620], o_custkey: [1279], o_orderstatus: [F], o_totalprice: [406938], o_orderdate: [1994-10-05], o_orderpriority: [2-HIGH], o_clerk: [Clerk#
17 o_orderkey: [17571], o_custkey: [358], o_orderstatus: [F], o_totalprice: [408346], o_orderdate: [1992-03-16], o_orderpriority: [4-NOT SPECIFIED], o_clerk:
18 o_orderkey: [39456], o_custkey: [1016], o_orderstatus: [0], o_totalprice: [409771], o_orderdate: [1998-02-16], o_orderpriority: [2-HIGH], o_clerk: [Clerk#
19 o_orderkey: [57376], o_custkey: [676], o_orderstatus: [0], o_totalprice: [411255], o_orderdate: [1995-06-20], o_orderpriority: [1-URGENT], o_clerk: [Clerk#
20 o_orderkey: [6882], o_custkey: [178], o_orderstatus: [0], o_totalprice: [422360], o_orderdate: [1997-04-09], o_orderpriority: [1-URGENT], o_clerk: [Clerk#
21 o_orderkey: [59106], o_custkey: [953], o_orderstatus: [0], o_totalprice: [430626], o_orderdate: [1996-10-24], o_orderpriority: [4-NOT SPECIFIED], o_clerk:
22 o_orderkey: [44707], o_custkey: [1013], o_orderstatus: [0], o_totalprice: [431772], o_orderdate: [1997-08-14], o_orderpriority: [1-URGENT], o_clerk: [Clerk#
23 o_orderkey: [29158], o_custkey: [667], o_orderstatus: [0], o_totalprice: [439687], o_orderdate: [1995-10-21], o_orderpriority: [2-HIGH], o_clerk: [Clerk#
24 o_orderkey: [52965], o_custkey: [676], o_orderstatus: [0], o_totalprice: [466001], o_orderdate: [1996-09-22], o_orderpriority: [3-MEDIUM], o_clerk: [Clerk#
25 consumer: removed 15000 recs from the pipe
26 *****
27 n_nationkey: [7], n_name: [GERMANY], n_regionkey: [3], n_comment: [l platelets. regular accounts x-ray: unusual. regular acco]
28 n_nationkey: [19], n_name: [ROMANIA], n_regionkey: [3], n_comment: [ular asymptotes are about the furious multipliers. express dependencies nag above the
29 n_nationkey: [22], n_name: [RUSSIA], n_regionkey: [3], n_comment: [ requests against the platelets use never according to the quickly regular pint]
30 n_nationkey: [23], n_name: [UNITED KINGDOM], n_regionkey: [3], n_comment: [eans boost carefully special requests. accounts are. carefull]
31 n_nationkey: [4], n_name: [EGYPT], n_regionkey: [4], n_comment: [y above the carefully unusual theodolites. final dugouts are quickly across the furiously
32 n_nationkey: [10], n_name: [IRAN], n_regionkey: [4], n_comment: [efully alongside of the slyly final dependencies. ]
33 n_nationkey: [11], n_name: [IRAQ], n_regionkey: [4], n_comment: [nic deposits boost atop the quickly final requests? quickly regula]
34 n_nationkey: [13], n_name: [JORDAN], n_regionkey: [4], n_comment: [ic deposits are blithely about the carefully regular pa]
35 n_nationkey: [20], n_name: [SAUDI ARABIA], n_regionkey: [4], n_comment: [ts. silent requests haggle. closely express packages sleep across the blithely]
36 consumer: removed 25 recs from the pipe
37
```

## GTEST RESULTS:

Unit Test cases are performed against the Bigq process, and all the test cases are passed. Code to the test cases is present in 'gtest.cc' file.

```
dheeraj@dheeraj-Virtual-Machine:~/Downloads/testa2-1/p2/a2-2test$ ./gtest.out
[=====] Running 3 tests from 1 test suite.
[-----] Global test environment set-up.
[-----] 3 tests from DBFileTest
[ RUN ] DBFileTest.CreateTest
[ OK ] DBFileTest.CreateTest (0 ms)
[ RUN ] DBFileTest.CloseTest
[ OK ] DBFileTest.CloseTest (2 ms)
[ RUN ] DBFileTest.OpenTest
[ OK ] DBFileTest.OpenTest (14 ms)
[-----] 3 tests from DBFileTest (16 ms total)

[-----] Global test environment tear-down
[=====] 3 tests from 1 test suite ran. (16 ms total)
[ PASSED ] 3 tests.
```

## Bash Shell:

The bash shell script is used to perform the automated test cases from tc1.txt, tc2.txt, tc3.txt and tc4.txt. Below are the outputs tested out manually to depict that the unit tests are working fine.

```
select test option:
1. sort
2. sort + display
3. sort + write
2

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

specify runlength:
16

specify sort ordering (when done press ctrl-D):
(n_regionkey)

producer: opened DBFile nation.bin
producer: inserted 25 recs into the pipe
n_nationkey: [0], n_name: [ALGERIA], n_regionkey: [0], n_comment: [ haggle. carefully final deposits detect slyly agai]
n_nationkey: [5], n_name: [ETHIOPIA], n_regionkey: [0], n_comment: [ven packages wake quickly. regul]
n_nationkey: [14], n_name: [KENYA], n_regionkey: [0], n_comment: [ pending excuses haggle furiously deposits. pending, express pinto beans wake fluffily past t]
n_nationkey: [15], n_name: [MOROCCO], n_regionkey: [0], n_comment: [rms. blithely bold courts among the closely regular packages use furiously bold platelets?]
n_nationkey: [16], n_name: [MOZAMBIQUE], n_regionkey: [0], n_comment: [s. ironic, unusual asymptotes wake blithely r]
n_nationkey: [17], n_name: [ARGENTINA], n_regionkey: [1], n_comment: [al foxes promise slyly according to the regular accounts. bold requests alon]
n_nationkey: [2], n_name: [BRAZIL], n_regionkey: [1], n_comment: [y alongside of the pending deposits, carefully special packages are about the ironic forges, slyly special ]
n_nationkey: [3], n_name: [CANADA], n_regionkey: [1], n_comment: [eas hang ironic, silent packages, slyly regular packages are furiously over the tithes, fluffily bold]
n_nationkey: [17], n_name: [PERU], n_regionkey: [1], n_comment: [platelets. blithely pending dependencies use fluffily across the even pinto beans. carefully silent account]
n_nationkey: [24], n_name: [UNITED STATES], n_regionkey: [1], n_comment: [y final packages. slow foxes cajole quickly. quickly silent platelets breach ironic accounts. unusual pinto be]
n_nationkey: [21], n_name: [VIETNAM], n_regionkey: [2], n_comment: [hely enticingly express accounts. even, final ]
n_nationkey: [9], n_name: [INDONESIA], n_regionkey: [2], n_comment: [ slyly express asymptotes. regular deposits haggle slyly. carefully ironic hockey players sleep blithely. careful]
n_nationkey: [12], n_name: [JAPAN], n_regionkey: [2], n_comment: [ously. final, express gifts cajole a]
n_nationkey: [18], n_name: [CHINA], n_regionkey: [2], n_comment: [c dependencies. furiously express notornis sleep slyly regular accounts. ideas sleep. depos]
n_nationkey: [8], n_name: [INDIA], n_regionkey: [2], n_comment: [ss excuses cajole slyly across the packages, deposits print aroun]
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: [7], n_name: [GERMANY], n_regionkey: [3], n_comment: [l platelets. regular accounts x-ray: unusual, regular acco]
n_nationkey: [6], n_name: [FRANCE], n_regionkey: [3], n_comment: [refully final requests. regular, iron]
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]
n_nationkey: [11], n_name: [IRAQ], n_regionkey: [4], n_comment: [nic deposits boost atop the quickly final requests? quickly regula]
n_nationkey: [10], n_name: [IRAN], n_regionkey: [4], n_comment: [efully alongside of the slyly final dependencies. ]
n_nationkey: [13], n_name: [JORDAN], n_regionkey: [4], n_comment: [ic deposits are blithely about the carefully regular pa]
n_nationkey: [20], n_name: [SAUDI ARABIA], n_regionkey: [4], n_comment: [ts. silent requests haggle, closely express packages sleep across the blithely]
n_nationkey: [4], n_name: [EGYPT], n_regionkey: [4], n_comment: [y above the carefully unusual theodolites. final dugouts are quickly across the furiously regular d]
consumer: removed 25 recs from the pipe
consumer: 25 recs out of 25 recs in sorted order
dheeraj@dheeraj-Virtual-Machine:~/Downloads/p2/p2/a2tests
```

```
dheeraj@dheeraj-Virtual-Machine:~/Downloads/p2/p2/a2test$ ./test.out
```

```
** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
catalog location:      catalog
tpch files dir:
heap files dir:

select test option:
1. sort
2. sort + display
3. sort + write
3

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

specify runlength:
16

specify sort ordering (when done press ctrl-D):
(c_phone) AND (c_custkey)

producer: opened DBFile customer.bin
producer: inserted 1500 recs into the pipe
consumer: removed 1500 recs from the pipe
consumer: recs removed written out as heap DBFile at customer.bin.bigq
consumer: 1500 recs out of 1500 recs in sorted order
```

```

** IMPORTANT: MAKE SURE THE INFORMATION BELOW IS CORRECT **
db catalog location:      catalog
dbph files dir:
heap files dir:

select test option:
1. sort
2. sort + display
3. sort + write
2

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

specify runlength:
8

specify sort ordering (when done press ctrl-D):
(n_regionkey) AND (n_name)

producer: opened DBfile nation.bin
producer: inserted 25 recs into the pipe
n.nationkey: [0], n.name: [ALGERIA], n.regionkey: [0], n.comment: [ haggle, carefully final deposits detect slyly agai]
n.nationkey: [5], n.name: [ETHIOPIA], n.regionkey: [0], n.comment: [ven packages wake quickly, regu]
n.nationkey: [14], n.name: [KENYA], n.regionkey: [0], n.comment: [ pending excuses haggle furiously deposits, pending, express pinto beans wake fluffily past t]
n.nationkey: [15], n.name: [MOROCCO], n.regionkey: [0], n.comment: [rms, blithely bold courts among the closely regular packages use furiously bold platelets?]
n.nationkey: [16], n.name: [MOZAMBIQUE], n.regionkey: [0], n.comment: [s, ironic, unusual asymptotes wake blithely r]
n.nationkey: [11], n.name: [ARGENTINA], n.regionkey: [1], n.comment: [al foxes promise slyly according to the regular accounts, bold requests alon]
n.nationkey: [2], n.name: [BRAZIL], n.regionkey: [1], n.comment: [y alongside of the pending deposits, carefully special packages are about the ironic forges, slyly special ]
n.nationkey: [3], n.name: [CANADA], n.regionkey: [1], n.comment: [eas hang ironic, silent packages, slyly regular packages are furiously over the tithes, fluffily bold]
n.nationkey: [17], n.name: [PERU], n.regionkey: [1], n.comment: [platelets, blithely pending dependencies use fluffily across the even pinto beans, carefully silent accoun]
n.nationkey: [24], n.name: [UNITED STATES], n.regionkey: [1], n.comment: [y final packages, slow foxes cajole quickly, quickly silent platelets breach ironic accounts, unusual pinto be]
n.nationkey: [18], n.name: [CHINA], n.regionkey: [2], n.comment: [c dependencies, furiously express notornis sleep slyly regular accounts, ideas sleep, depos]
n.nationkey: [8], n.name: [INDIA], n.regionkey: [2], n.comment: [ss excuses cajole slyly across the packages, deposits print aroun]
n.nationkey: [9], n.name: [INDONESIA], n.regionkey: [2], n.comment: [ slyly express asymptotes, regular deposits haggle slyly, carefully ironic hockey players sleep blithely, carefull]
n.nationkey: [12], n.name: [JAPAN], n.regionkey: [2], n.comment: [ously, final, express gifts cajole a]
n.nationkey: [21], n.name: [VIETNAM], n.regionkey: [2], n.comment: [hely enticingly express accounts, even, final ]
n.nationkey: [6], n.name: [FRANCE], n.regionkey: [3], n.comment: [refully final requests, regular, ironi]
n.nationkey: [7], n.name: [GERMANY], n.regionkey: [3], n.comment: [l platelets, regular accounts x-ray: unusual, regular acco]
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]
n.nationkey: [4], n.name: [EGYPT], n.regionkey: [4], n.comment: [y above the carefully unusual theodolites, final dugouts are quickly across the furiously regular d]
n.nationkey: [10], n.name: [IRAN], n.regionkey: [4], n.comment: [efully alongside of the slyly final dependencies, ]
n.nationkey: [11], n.name: [IRAQ], n.regionkey: [4], n.comment: [nic deposits boost atop the quickly final requests? quickly regula]
n.nationkey: [13], n.name: [JORDAN], n.regionkey: [4], n.comment: [ic deposits are blithely about the carefully regular pa]
n.nationkey: [20], n.name: [SAUDI ARABIA], n.regionkey: [4], n.comment: [ts, silent requests haggle, closely express packages sleep across the blithely]
consumer: removed 25 recs from the pipe
consumer: 25 recs out of 25 recs in sorted order
dheeraj@dheeraj-Virtual-Machine:~/Downloads/p2/p2/a2tests$

```

## CONCLUSION:

We have successfully implemented sorting of a file.