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Methodology

Data Preparation

There are 3 files responsible for data preparation: prepare_data.sh, prepare_data.py and prepare_index_data.py

prepare_data.sh transfers a.parquet from local to hdfs, starts prepare_data.py, copies newly made data folder to hdfs and starts prepare_index_data.py

prepare_data.py is unchanged from initial file

prepare_index_data.py reads files from hdfs data folder and creates a new partition using rdd

Indexer tasks

index.sh – Pipeline Runner Script that orchestrates the full indexing pipeline.

Actions:

- Accepts input path (local or HDFS) and uploads local files if needed
- Runs first MapReduce job to compute raw term frequencies
- Runs second MapReduce job to generate document stats and build the inverted index
- Triggers the Python script (app.py) to load results into Cassandra

MapReduce Stage 1

mapper1.py – Tokenizes document text, emits one entry per word occurrence.
Takes tab-separated lines with doc_id, title, text as input.
Returns lines with doc_id, term, and title.

reducer1.py – Sums word counts per document to get term frequency.

Takes sorted output from mapper1.py.

Returns aggregated doc_id, term, tf, title.

MapReduce Stage 2

mapper2.py – Computes total document length and prepares structured input for indexing.

Takes output from reducer1 and returns:

DOCLEN lines with total doc length and title.

TERM lines with individual term frequencies per document.

reducer2.py – Groups all documents per term, computes document frequency (df) per term and finalizes all index entries.

Takes output from mapper2.

Output:

VOCAB entries: term → document frequency (df).

INDEX entries: term → document ID, term frequency (tf).

DOCLEN entries: document ID → length, title.

app.py – Loads structured index output into Cassandra tables

Functions:

fetch_hdfs_output(): Reads reducer2 output from HDFS.

connect_cassandra(): Connects to Cassandra and ensures keyspace exists.

create_tables(): Creates tables for vocabulary, inverted_index, and documents.

parse_and_insert(): Parses output and performs batch inserts into Cassandra.

Stored Tables:

vocabulary(term, df) is used to calculate BM25 IDF component

inverted_index(term, doc_id, tf) is used to calculate BM25 TF component

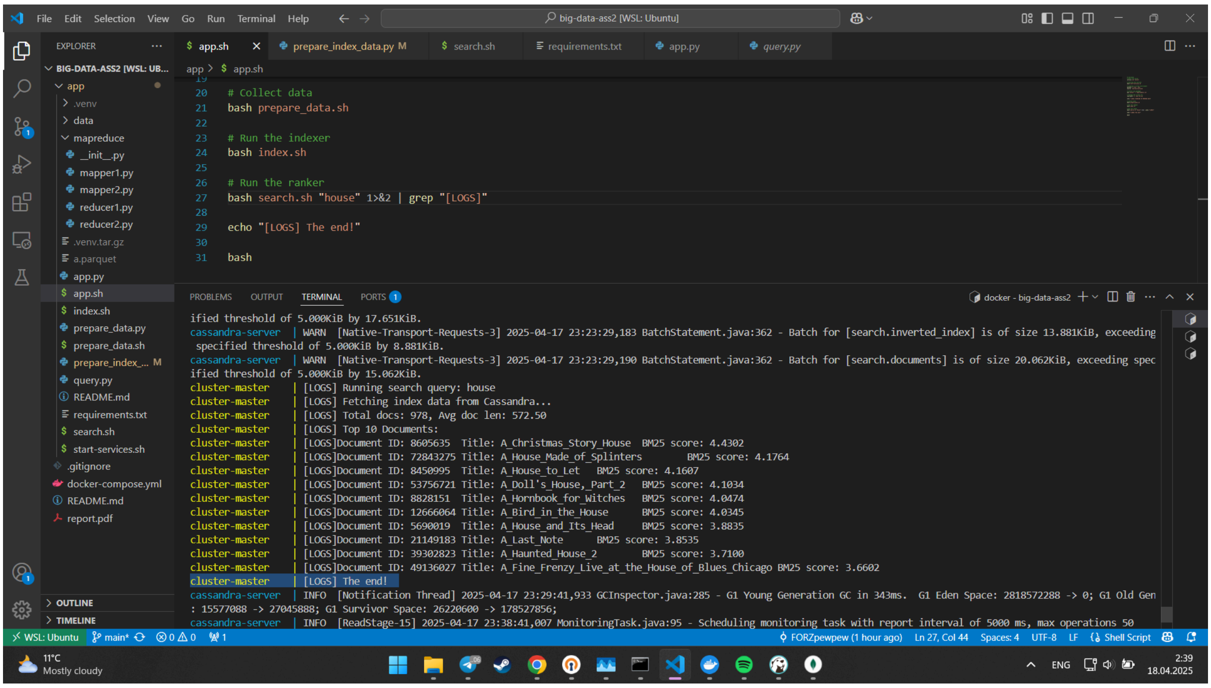
documents(doc_id, length, title): length is needed for normalization, **title** and **doc_id** are used as an output for search

Search tasks

1. Parsing: taking input string from search.sh and splitting it to lowercase standalone words.
2. Preparing RDD from inverted index: index_rdd = sc.parallelize(index)
3. Filtering: filtered = index_rdd.filter(lambda x: x[0] in query_terms)
4. Calculating BM25 Score for each matching document using function score()
5. Aggregating scores by document: doc_scores = scored.reduceByKey(lambda a, b: a + b)
6. Getting top 10 results: top10 = doc_scores.takeOrdered(10, key=lambda x: -x[1])

Demonstration

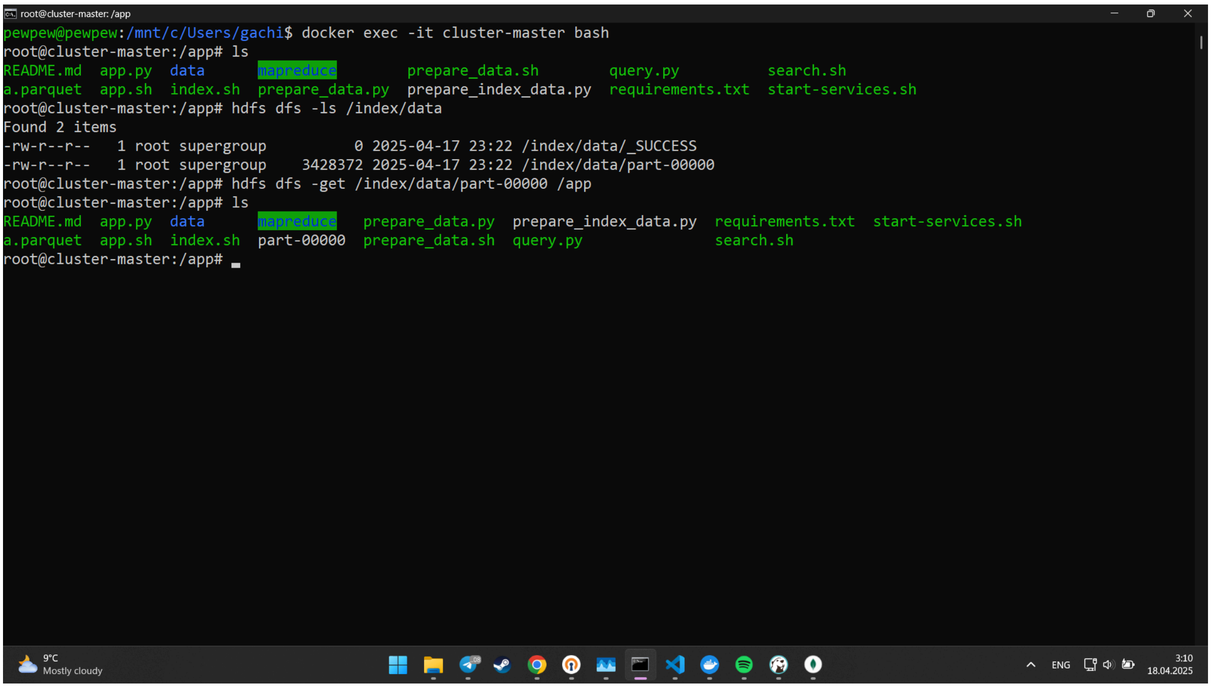
All you need to do for the full demo of the assignment is run docker compose up, which will build 3 containers (cluster-master, cluster-slave, and cassandra). After app.sh is finished running (demonstrated by top 10 documents for query "house" and message [LOGS] The end! on screenshot), in a separate terminal you can write "***docker exec -it cluster-master bash***" to connect to cluster-master's bash console for search queries using command "***bash search.sh "your query"***" or accessing hdfs using ***"hdfs df"***.
Alternatively "***docker exec -it cassandra-server cqlsh***" can be used to connect to cqlsh of cassandra (it uses "search" keyspace, which has 3 tables: documents, vocabulary and inverted index).



```
# Collect data
bash prepare_data.sh

# Run the indexer
bash index.sh

# Run the ranker
bash search.sh "house" 1>&2 | grep "[LOGS]"

echo "[LOGS] The end!"

bash
```

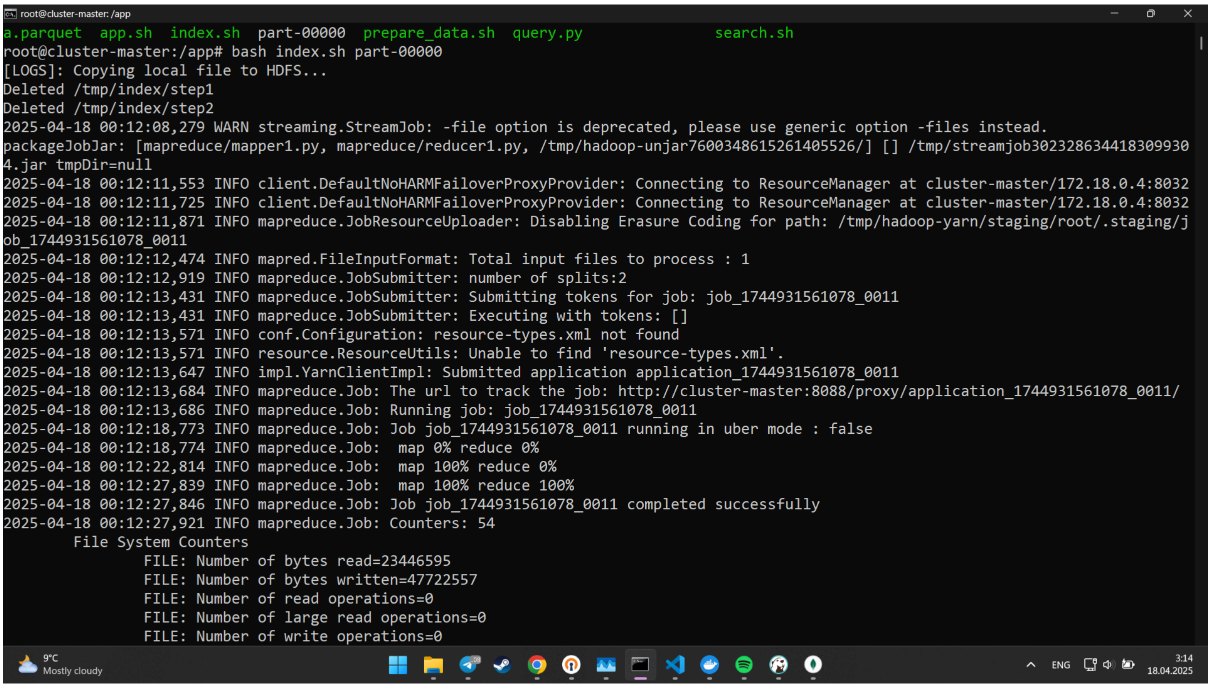
```
ified threshold of 5.000KiB by 17.651KiB.
cassandra-server  | WARN  [Native-Transport-Requests-3] 2025-04-17 23:23:29,183 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 13.881KiB, exceeding
 specified threshold of 5.000KiB by 8.881KiB.
cassandra-server  | WARN  [Native-Transport-Requests-3] 2025-04-17 23:23:29,190 BatchStatement.java:362 - Batch for [search.documents] is of size 20.062KiB, exceeding spec
ified threshold of 5.000KiB by 15.062KiB.
cluster-master    | [LOGS] Running search query: house
cluster-master    | [LOGS] Fetching index data from Cassandra...
cluster-master    | [LOGS] Total docs: 978, Avg doc len: 572.50
cluster-master    | [LOGS] Top 10 Documents:
cluster-master    | [LOGS]Document ID: 8605635  Title: A_Christmas_Story_House  BM25 score: 4.4302
cluster-master    | [LOGS]Document ID: 72843275 Title: A_House_Made_of_Splinters        BM25 score: 4.1764
cluster-master    | [LOGS]Document ID: 8450995  Title: A_House_to_Let   BM25 score: 4.1607
cluster-master    | [LOGS]Document ID: 53756721 Title: A_Doll's_House,_Part_2   BM25 score: 4.1034
cluster-master    | [LOGS]Document ID: 8828151  Title: A_Hornbook_for_Witches   BM25 score: 4.0474
cluster-master    | [LOGS]Document ID: 12666064 Title: A_Bird_in_the_House      BM25 score: 4.0345
cluster-master    | [LOGS]Document ID: 5690019  Title: A_House_and_Its_Head     BM25 score: 3.8835
cluster-master    | [LOGS]Document ID: 21149183 Title: A_Last_Note      BM25 score: 3.8535
cluster-master    | [LOGS]Document ID: 39302823 Title: A_Haunted_House_2        BM25 score: 3.7100
cluster-master    | [LOGS]Document ID: 49136027 Title: A_Fine_Frenzy_Live_at_the_House_of_Blues_Chicago BM25 score: 3.6602
cluster-master    | [LOGS] The end!
cassandra-server  | INFO  [Notification Thread] 2025-04-17 23:29:41,933 GCInspector.java:285 - G1 Young Generation GC in 343ms.  G1 Eden Space: 2818572288 -> 0; G1 Old Gen
: 15577088 -> 27045888; G1 Survivor Space: 26220600 -> 178527856;
cassandra-server  | INFO  [ReadStage-15] 2025-04-17 23:38:41,007 MonitoringTask.java:95 - Scheduling monitoring task with report interval of 5000 ms, max operations 50
```

Here is a demonstration of how to copy part-00000 from hdfs to local container storage to use as a file for local indexing:

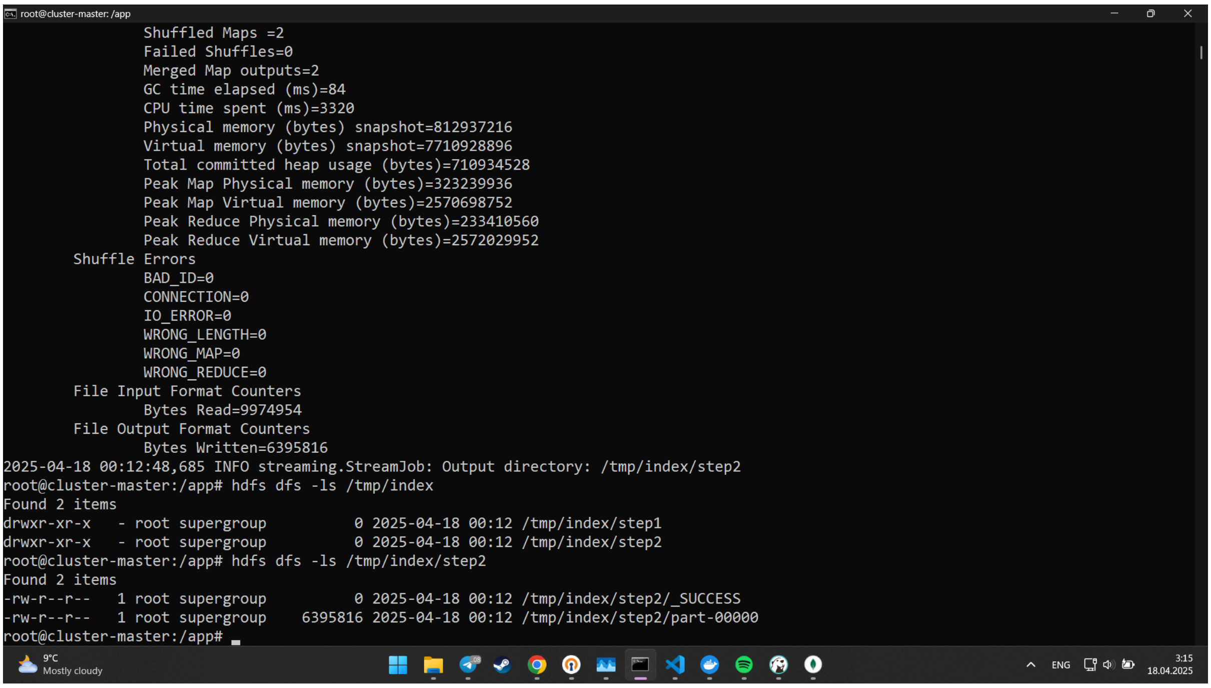


```
pewpew@pewpew:/mnt/c/Users/gachi$ docker exec -it cluster-master bash
root@cluster-master:/app# ls
README.md  app.py  data      mapreduce       prepare_data.sh        query.py          search.sh
a.parquet  app.sh  index.sh  prepare_data.py  prepare_index_data.py  requirements.txt  start-services.sh
root@cluster-master:/app# hdfs dfs -ls /index/data
Found 2 items
-rw-r--r--   1 root supergroup          0 2025-04-17 23:22 /index/data/_SUCCESS
-rw-r--r--   1 root supergroup    3428372 2025-04-17 23:22 /index/data/part-00000
root@cluster-master:/app# hdfs dfs -get /index/data/part-00000 /app
root@cluster-master:/app# ls
README.md  app.py  data      mapreduce  prepare_data.py  prepare_index_data.py  requirements.txt  start-services.sh
a.parquet  app.sh  index.sh  part-00000  prepare_data.sh  query.py               search.sh
root@cluster-master:/app# _
```

And by running ***"bash index.sh part-00000",*** you can index the local file, but the file should be a result of prepare_data.sh. A script that processes a.parquet (you can change the name of the processed file in bash script yourself if needed and run it, resulting part-00000 file will always be at hdfs' *index/data* folder).

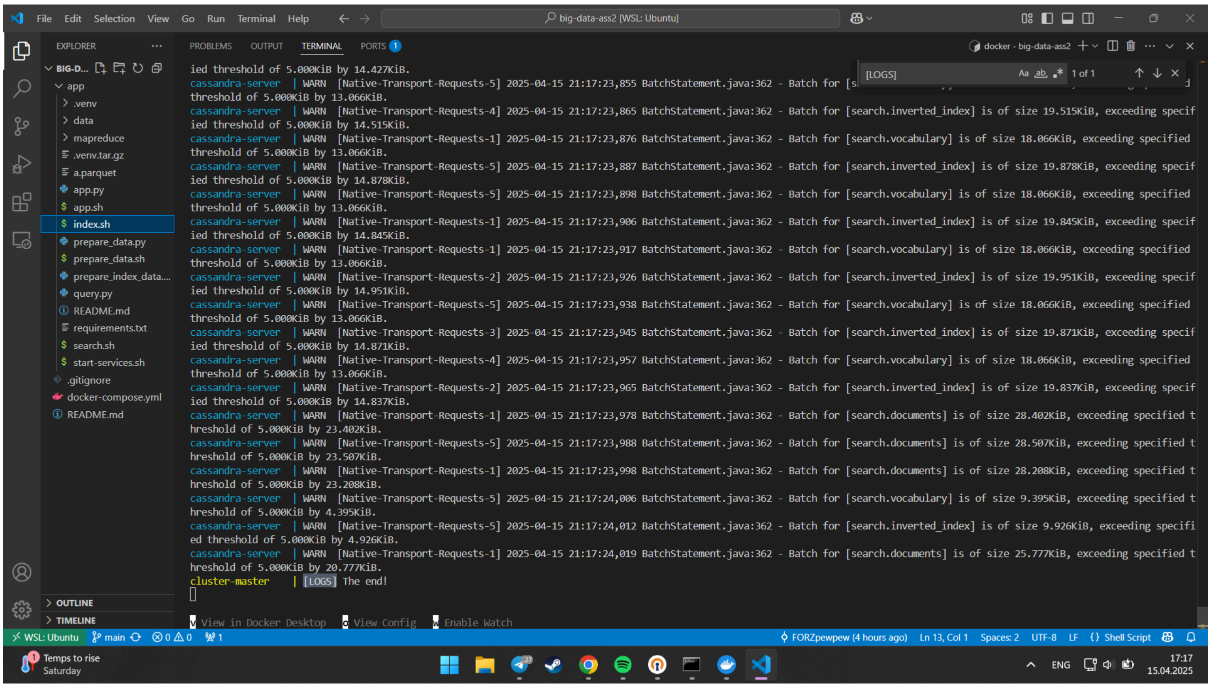


```
a.parquet  app.sh  index.sh  part-00000  prepare_data.sh  query.py               search.sh
root@cluster-master:/app# bash index.sh part-00000
[LOGS]: Copying local file to HDFS...
Deleted /tmp/index/step1
Deleted /tmp/index/step2
2025-04-18 00:12:08,279 WARN streaming.StreamJob: -file option is deprecated, please use generic option -files instead.
packageJobJar: [mapreduce/mapper1.py, mapreduce/reducer1.py, /tmp/hadoop-unjar7600348615261405526/] [] /tmp/streamjob302328634418309930
4.jar tmpDir=null
2025-04-18 00:12:11,553 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at cluster-master/172.18.0.4:8032
2025-04-18 00:12:11,725 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at cluster-master/172.18.0.4:8032
2025-04-18 00:12:11,871 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/root/.staging/j
ob_1744931561078_0011
2025-04-18 00:12:12,474 INFO mapred.FileInputFormat: Total input files to process : 1
2025-04-18 00:12:12,919 INFO mapreduce.JobSubmitter: number of splits:2
2025-04-18 00:12:13,431 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1744931561078_0011
2025-04-18 00:12:13,431 INFO mapreduce.JobSubmitter: Executing with tokens: []
2025-04-18 00:12:13,571 INFO conf.Configuration: resource-types.xml not found
2025-04-18 00:12:13,571 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2025-04-18 00:12:13,647 INFO impl.YarnClientImpl: Submitted application application_1744931561078_0011
2025-04-18 00:12:13,684 INFO mapreduce.Job: The url to track the job: http://cluster-master:8088/proxy/application_1744931561078_0011/
2025-04-18 00:12:13,686 INFO mapreduce.Job: Running job: job_1744931561078_0011
2025-04-18 00:12:18,773 INFO mapreduce.Job: Job job_1744931561078_0011 running in uber mode : false
2025-04-18 00:12:18,774 INFO mapreduce.Job:  map 0% reduce 0%
2025-04-18 00:12:22,814 INFO mapreduce.Job:  map 100% reduce 0%
2025-04-18 00:12:27,839 INFO mapreduce.Job:  map 100% reduce 100%
2025-04-18 00:12:27,846 INFO mapreduce.Job: Job job_1744931561078_0011 completed successfully
2025-04-18 00:12:27,921 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=23446595
                FILE: Number of bytes written=47722557
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
```



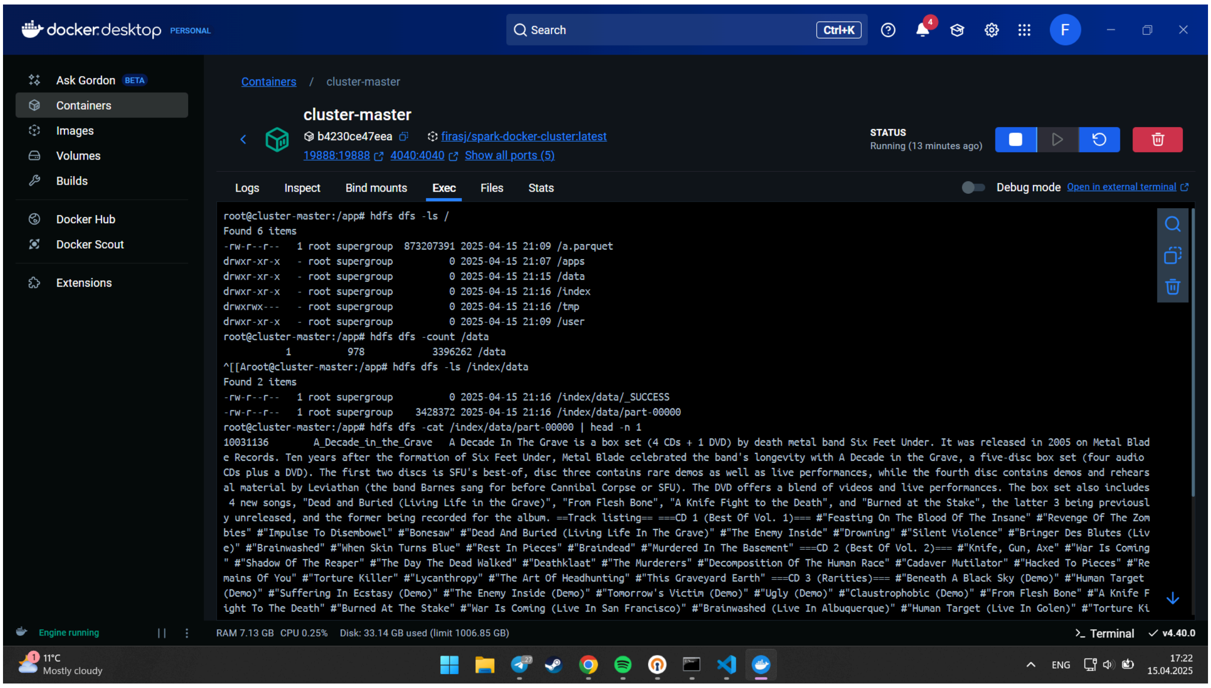
```
                Shuffled Maps =2
                Failed Shuffles=0
                Merged Map outputs=2
                GC time elapsed (ms)=84
                CPU time spent (ms)=3320
                Physical memory (bytes) snapshot=812937216
                Virtual memory (bytes) snapshot=7710928896
                Total committed heap usage (bytes)=710934528
                Peak Map Physical memory (bytes)=323239936
                Peak Map Virtual memory (bytes)=2570698752
                Peak Reduce Physical memory (bytes)=233410560
                Peak Reduce Virtual memory (bytes)=2572029952
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=9974954
        File Output Format Counters
                Bytes Written=6395816
2025-04-18 00:12:48,685 INFO streaming.StreamJob: Output directory: /tmp/index/step2
root@cluster-master:/app# hdfs dfs -ls /tmp/index
Found 2 items
drwxr-xr-x   - root supergroup          0 2025-04-18 00:12 /tmp/index/step1
drwxr-xr-x   - root supergroup          0 2025-04-18 00:12 /tmp/index/step2
root@cluster-master:/app# hdfs dfs -ls /tmp/index/step2
Found 2 items
-rw-r--r--   1 root supergroup          0 2025-04-18 00:12 /tmp/index/step2/_SUCCESS
-rw-r--r--   1 root supergroup    6395816 2025-04-18 00:12 /tmp/index/step2/part-00000
root@cluster-master:/app# _
```

Warn messages from cassandra due to batch size is higher than threshold by a couple of KiB(but files are still added to cassandra)



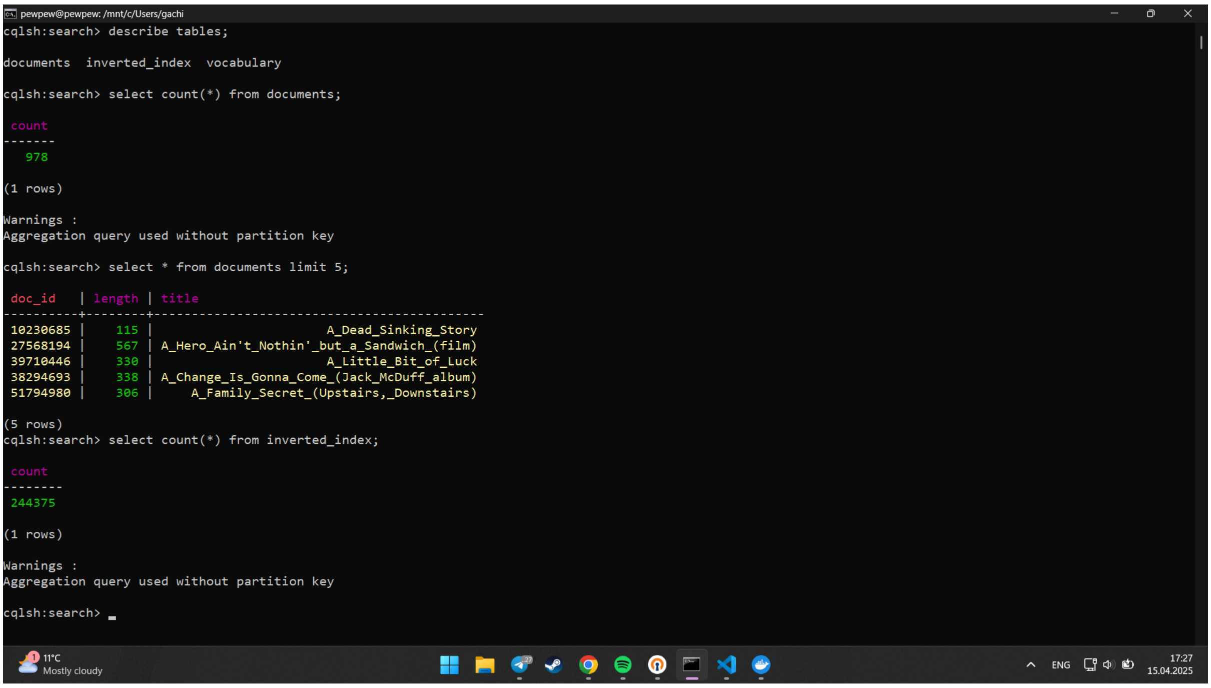
```
ied threshold of 5.000KiB by 14.427KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:23,855 BatchStatement.java:362 - Batch for [s
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-4] 2025-04-15 21:17:23,865 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.515KiB, exceeding specif
ied threshold of 5.000KiB by 14.515KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:23,876 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 18.066KiB, exceeding specified
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:23,887 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.878KiB, exceeding specif
ied threshold of 5.000KiB by 14.878KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:23,898 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 18.066KiB, exceeding specified
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:23,906 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.845KiB, exceeding specif
ied threshold of 5.000KiB by 14.845KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:23,917 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 18.066KiB, exceeding specified
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-2] 2025-04-15 21:17:23,926 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.951KiB, exceeding specif
ied threshold of 5.000KiB by 14.951KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:23,938 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 18.066KiB, exceeding specified
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-3] 2025-04-15 21:17:23,945 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.871KiB, exceeding specif
ied threshold of 5.000KiB by 14.871KiB.
cassandra-server  | WARN  [Native-Transport-Requests-4] 2025-04-15 21:17:23,957 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 18.066KiB, exceeding specified
threshold of 5.000KiB by 13.066KiB.
cassandra-server  | WARN  [Native-Transport-Requests-2] 2025-04-15 21:17:23,965 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 19.837KiB, exceeding specif
ied threshold of 5.000KiB by 14.837KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:23,978 BatchStatement.java:362 - Batch for [search.documents] is of size 28.402KiB, exceeding specified t
hreshold of 5.000KiB by 23.402KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:23,988 BatchStatement.java:362 - Batch for [search.documents] is of size 28.507KiB, exceeding specified t
hreshold of 5.000KiB by 23.507KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:23,998 BatchStatement.java:362 - Batch for [search.documents] is of size 28.208KiB, exceeding specified t
hreshold of 5.000KiB by 23.208KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:24,006 BatchStatement.java:362 - Batch for [search.vocabulary] is of size 9.395KiB, exceeding specified t
hreshold of 5.000KiB by 4.395KiB.
cassandra-server  | WARN  [Native-Transport-Requests-5] 2025-04-15 21:17:24,012 BatchStatement.java:362 - Batch for [search.inverted_index] is of size 9.926KiB, exceeding specifi
ed threshold of 5.000KiB by 4.926KiB.
cassandra-server  | WARN  [Native-Transport-Requests-1] 2025-04-15 21:17:24,019 BatchStatement.java:362 - Batch for [search.documents] is of size 25.777KiB, exceeding specified t
hreshold of 5.000KiB by 20.777KiB.
cluster-master    | [LOGS] The end!

v View in Docker Desktop   o View Config   w Enable Watch
```

This screenshot shows contents of hdfs / folder, number of documents in /data folder which is 978, contents of /index/data folder and the first line of /index/data/part-00000

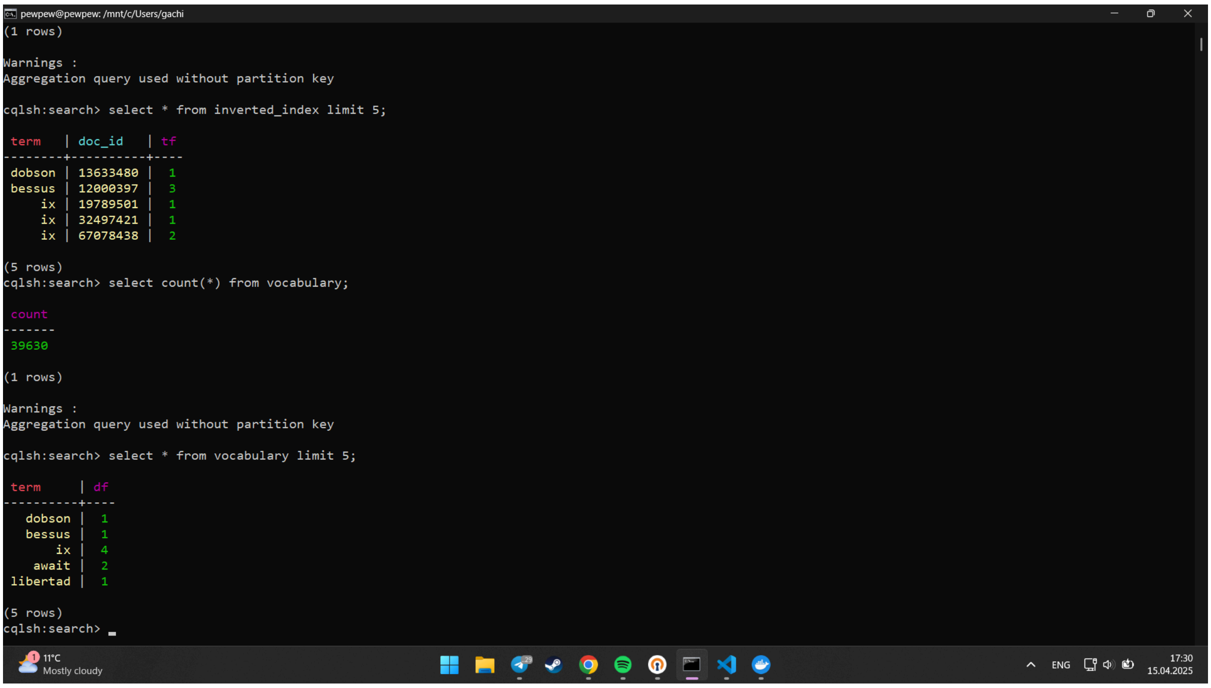


```
root@cluster-master:/app# hdfs dfs -ls /
Found 6 items
-rw-r--r--   1 root supergroup  873207391 2025-04-15 21:09 /a.parquet
drwxr-xr-x   - root supergroup          0 2025-04-15 21:07 /apps
drwxr-xr-x   - root supergroup          0 2025-04-15 21:15 /data
drwxr-xr-x   - root supergroup          0 2025-04-15 21:16 /index
drwxrwx---   - root supergroup          0 2025-04-15 21:16 /tmp
drwxr-xr-x   - root supergroup          0 2025-04-15 21:09 /user
root@cluster-master:/app# hdfs dfs -count /data
           1          978            3396262 /data
^[[Aroot@cluster-master:/app# hdfs dfs -ls /index/data
Found 2 items
-rw-r--r--   1 root supergroup          0 2025-04-15 21:16 /index/data/_SUCCESS
-rw-r--r--   1 root supergroup    3428372 2025-04-15 21:16 /index/data/part-00000
root@cluster-master:/app# hdfs dfs -cat /index/data/part-00000 | head -n 1
10031136        A_Decade_in_the_Grave   A Decade In The Grave is a box set (4 CDs + 1 DVD) by death metal band Six Feet Under. It was released in 2005 on Metal Blad
e Records. Ten years after the formation of Six Feet Under, Metal Blade celebrated the band's longevity with A Decade in the Grave, a five-disc box set (four audio
CDs plus a DVD). The first two discs is SFU's best-of, disc three contains rare demos as well as live performances, while the fourth disc contains demos and rehears
al material by Leviathan (the band Barnes sang for before Cannibal Corpse or SFU). The DVD offers a blend of videos and live performances. The box set also includes
 4 new songs, "Dead and Buried (Living Life in the Grave)", "From Flesh Bone", "A Knife Fight to the Death", and "Burned at the Stake", the latter 3 being previousl
y unreleased, and the former being recorded for the album. ==Track listing== ===CD 1 (Best Of Vol. 1)=== #"Feasting On The Blood Of The Insane" #"Revenge Of The Zom
bies" #"Impulse To Disembowel" #"Bonesaw" #"Dead And Buried (Living Life In The Grave)" #"The Enemy Inside" #"Drowning" #"Silent Violence" #"Bringer Des Blutes (Liv
e)" #"Brainwashed" #"When Skin Turns Blue" #"Rest In Pieces" #"Braindead" #"Murdered In The Basement" ===CD 2 (Best Of Vol. 2)=== #"Knife, Gun, Axe" #"War Is Coming
" #"Shadow Of The Reaper" #"The Day The Dead Walked" #"Deathklaat" #"The Murderers" #"Decomposition Of The Human Race" #"Cadaver Mutilator" #"Hacked To Pieces" #"Re
mains Of You" #"Torture Killer" #"Lycanthropy" #"The Art Of Headhunting" #"This Graveyard Earth" ===CD 3 (Rarities)=== #"Beneath A Black Sky (Demo)" #"Human Target
(Demo)" #"Suffering In Ecstasy (Demo)" #"The Enemy Inside (Demo)" #"Tomorrow's Victim (Demo)" #"Ugly (Demo)" #"Claustrophobic (Demo)" #"From Flesh Bone" #"A Knife F
ight To The Death" #"Burned At The Stake" #"War Is Coming (Live In San Francisco)" #"Brainwashed (Live In Albuquerque)" #"Human Target (Live In Golen)" #"Torture Ki
```

Next screenshots show cassandra db tables, their contents and count of rows (global count is expensive without partitions, but there’s no workaround :c)
Note the number of documents in documents table: 978, which is well over 100 specified in assignment.



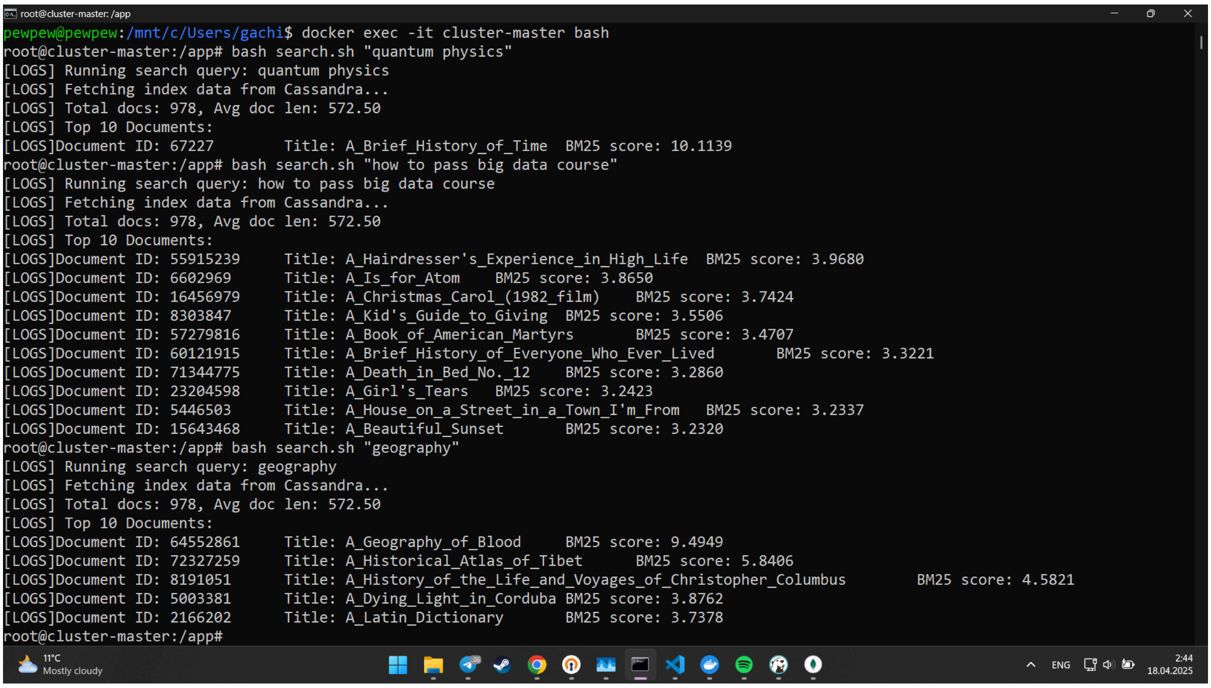
```
cqlsh:search> describe tables;

documents  inverted_index  vocabulary

cqlsh:search> select count(*) from documents;

 count
-------
   978

(1 rows)

Warnings :
Aggregation query used without partition key

cqlsh:search> select * from documents limit 5;

 doc_id   | length | title
----------+--------+-------------------------------------------
 10230685 |    115 |                       A_Dead_Sinking_Story
 27568194 |    567 | A_Hero_Ain't_Nothin'_but_a_Sandwich_(film)
 39710446 |    330 |                       A_Little_Bit_of_Luck
 38294693 |    338 | A_Change_Is_Gonna_Come_(Jack_McDuff_album)
 51794980 |    306 |     A_Family_Secret_(Upstairs,_Downstairs)

(5 rows)
cqlsh:search> select count(*) from inverted_index;

 count
--------
 244375

(1 rows)

Warnings :
Aggregation query used without partition key

cqlsh:search> _
```



```
(1 rows)

Warnings :
Aggregation query used without partition key

cqlsh:search> select * from inverted_index limit 5;

 term   | doc_id   | tf
--------+----------+----
 dobson | 13633480 |  1
 bessus | 12000397 |  3
     ix | 19789501 |  1
     ix | 32497421 |  1
     ix | 67078438 |  2

(5 rows)
cqlsh:search> select count(*) from vocabulary;

 count
-------
 39630

(1 rows)

Warnings :
Aggregation query used without partition key

cqlsh:search> select * from vocabulary limit 5;

 term     | df
----------+----
   dobson |  1
   bessus |  1
       ix |  4
    await |  2
 libertad |  1

(5 rows)
cqlsh:search> _
```

Now it is time for 3 back-to-back search query demonstration:
Not all queries return 10 documents since it is possible that there are less than 10 relevant documents. A really good example of this is the first query “quantum physics” which returned only 1 book, but the book (A Brief History Of Time by Stephen Hawking) exactly matches the given query. Second query “how to pass big data course” has 6 words, but most of them likely don’t contribute much for BM25 score ([how, to, big] are definitely on a much more popular side of a vocabulary), and other terms didn’t find that many exact matches, so there are numerous documents returned, but their score is low. Lastly, the

query “geography” found only 5 relevant documents, but most of them had great scores, and the top one even featured the query in the title.



```
pewpew@pewpew:/mnt/c/Users/gachi$ docker exec -it cluster-master bash
root@cluster-master:/app# bash search.sh "quantum physics"
[LOGS] Running search query: quantum physics
[LOGS] Fetching index data from Cassandra...
[LOGS] Total docs: 978, Avg doc len: 572.50
[LOGS] Top 10 Documents:
[LOGS]Document ID: 67227        Title: A_Brief_History_of_Time  BM25 score: 10.1139
root@cluster-master:/app# bash search.sh "how to pass big data course"
[LOGS] Running search query: how to pass big data course
[LOGS] Fetching index data from Cassandra...
[LOGS] Total docs: 978, Avg doc len: 572.50
[LOGS] Top 10 Documents:
[LOGS]Document ID: 55915239     Title: A_Hairdresser's_Experience_in_High_Life  BM25 score: 3.9680
[LOGS]Document ID: 6602969      Title: A_Is_for_Atom    BM25 score: 3.8650
[LOGS]Document ID: 16456979     Title: A_Christmas_Carol_(1982_film)    BM25 score: 3.7424
[LOGS]Document ID: 8303847      Title: A_Kid's_Guide_to_Giving  BM25 score: 3.5506
[LOGS]Document ID: 57279816     Title: A_Book_of_American_Martyrs       BM25 score: 3.4707
[LOGS]Document ID: 60121915     Title: A_Brief_History_of_Everyone_Who_Ever_Lived       BM25 score: 3.3221
[LOGS]Document ID: 71344775     Title: A_Death_in_Bed_No._12    BM25 score: 3.2860
[LOGS]Document ID: 23204598     Title: A_Girl's_Tears   BM25 score: 3.2423
[LOGS]Document ID: 5446503      Title: A_House_on_a_Street_in_a_Town_I'm_From   BM25 score: 3.2337
[LOGS]Document ID: 15643468     Title: A_Beautiful_Sunset       BM25 score: 3.2320
root@cluster-master:/app# bash search.sh "geography"
[LOGS] Running search query: geography
[LOGS] Fetching index data from Cassandra...
[LOGS] Total docs: 978, Avg doc len: 572.50
[LOGS] Top 10 Documents:
[LOGS]Document ID: 64552861     Title: A_Geography_of_Blood     BM25 score: 9.4949
[LOGS]Document ID: 72327259     Title: A_Historical_Atlas_of_Tibet      BM25 score: 5.8406
[LOGS]Document ID: 8191051      Title: A_History_of_the_Life_and_Voyages_of_Christopher_Columbus        BM25 score: 4.5821
[LOGS]Document ID: 5003381      Title: A_Dying_Light_in_Corduba BM25 score: 3.8762
[LOGS]Document ID: 2166202      Title: A_Latin_Dictionary       BM25 score: 3.7378
root@cluster-master:/app#
```