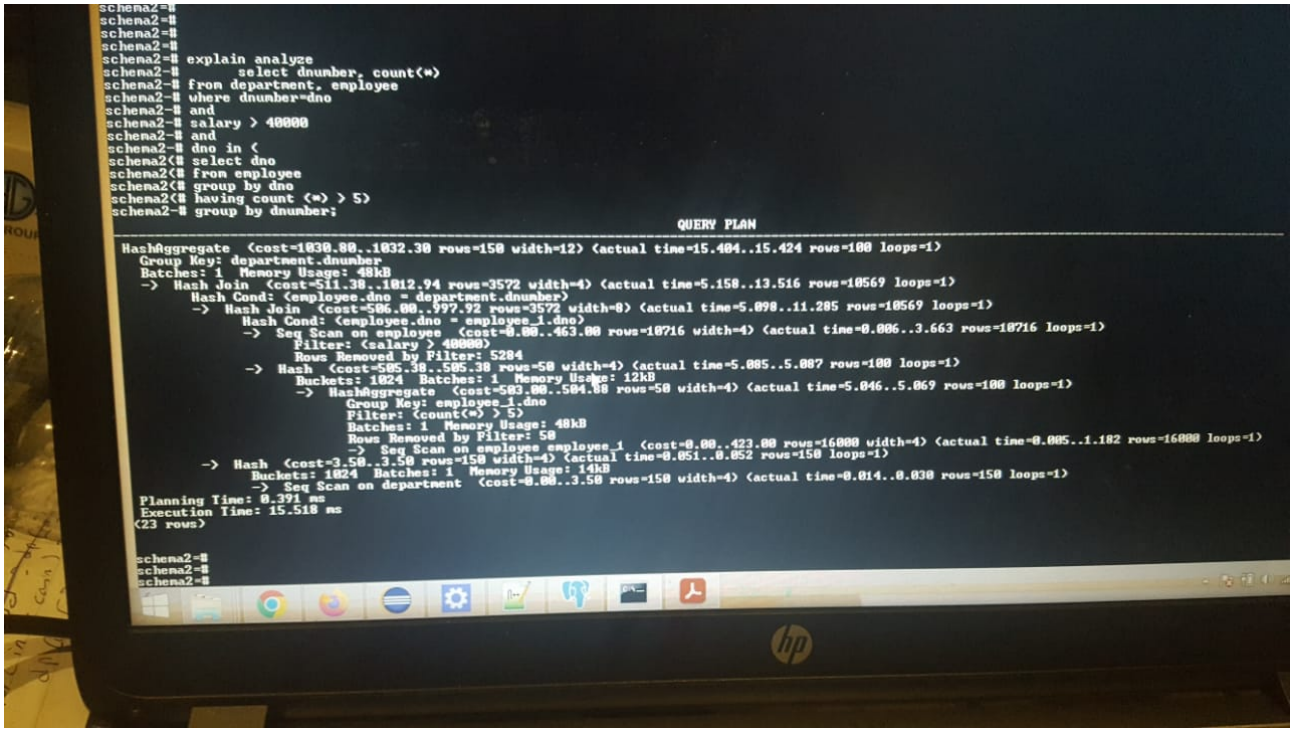
# 1)A)OLD QUERY 6 WITH NO INDEXES:

Flags:1- set enable_seqscan = on;
2- set enable_bitmapscan =off;
3-set enable_indexscan = off;
4- set enable_indexonlyscan = off;



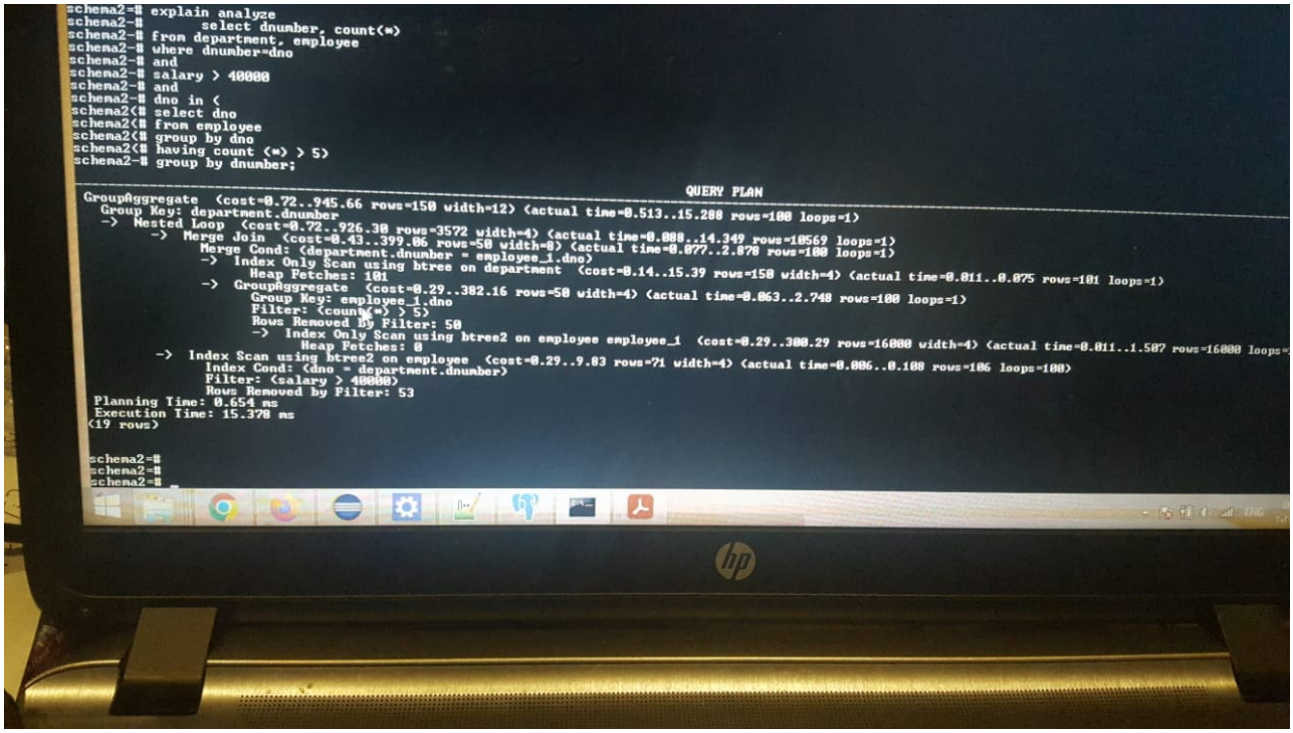

**********CONCLUSION OLD QUERY 6 NO INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 67 NO INDEXES TIME = 15.5 MS

# 1)B)OLD QUERY 6 WITH B+ INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;

B+ Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)



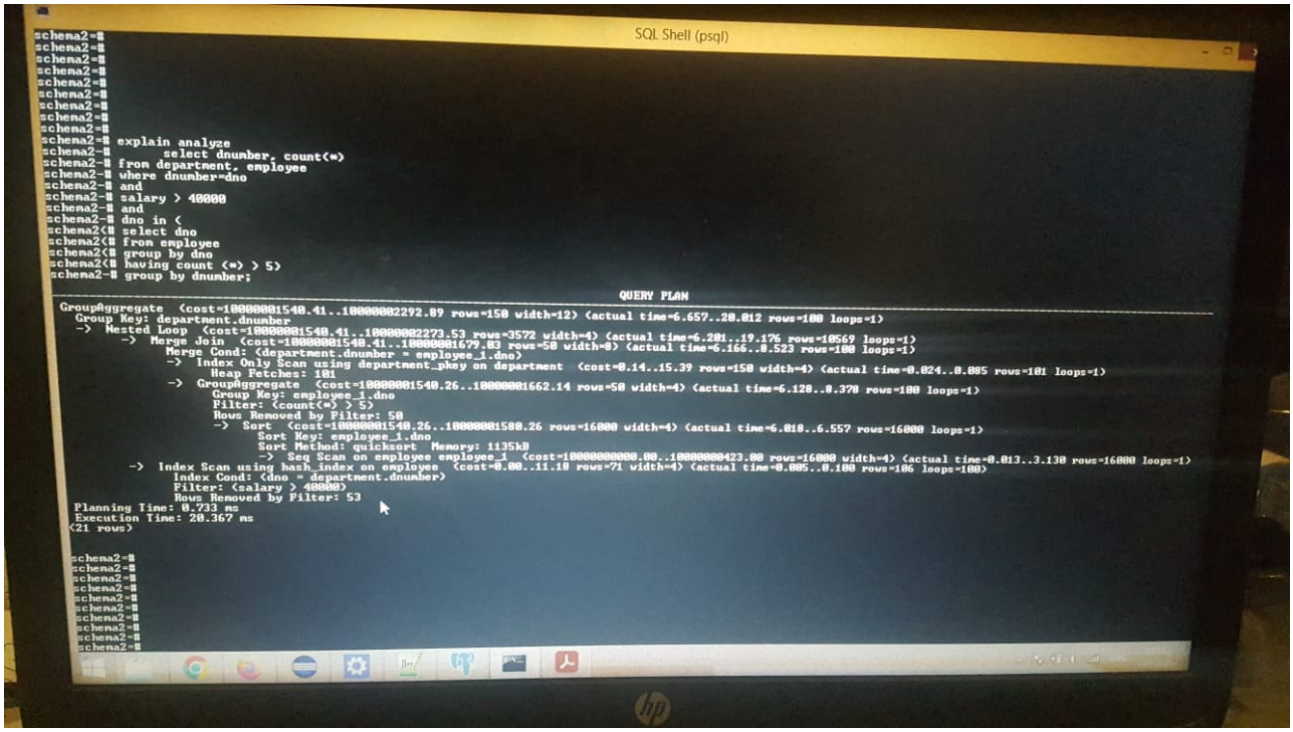

**********CONCLUSION OLD QUERY 6 B+ INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 6 NO INDEXES TIME = 15.5 MS
3-OLD QUERY 6 B+ INDEXES COST = 945
4-OLD QUERY 6 B+ INDEXES TIME = 15.3MS
=> 8.3% more cost efficient & 1.3% more time efficient

# 1)C)OLD QUERY 6 WITH Hash INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;

Hash Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)



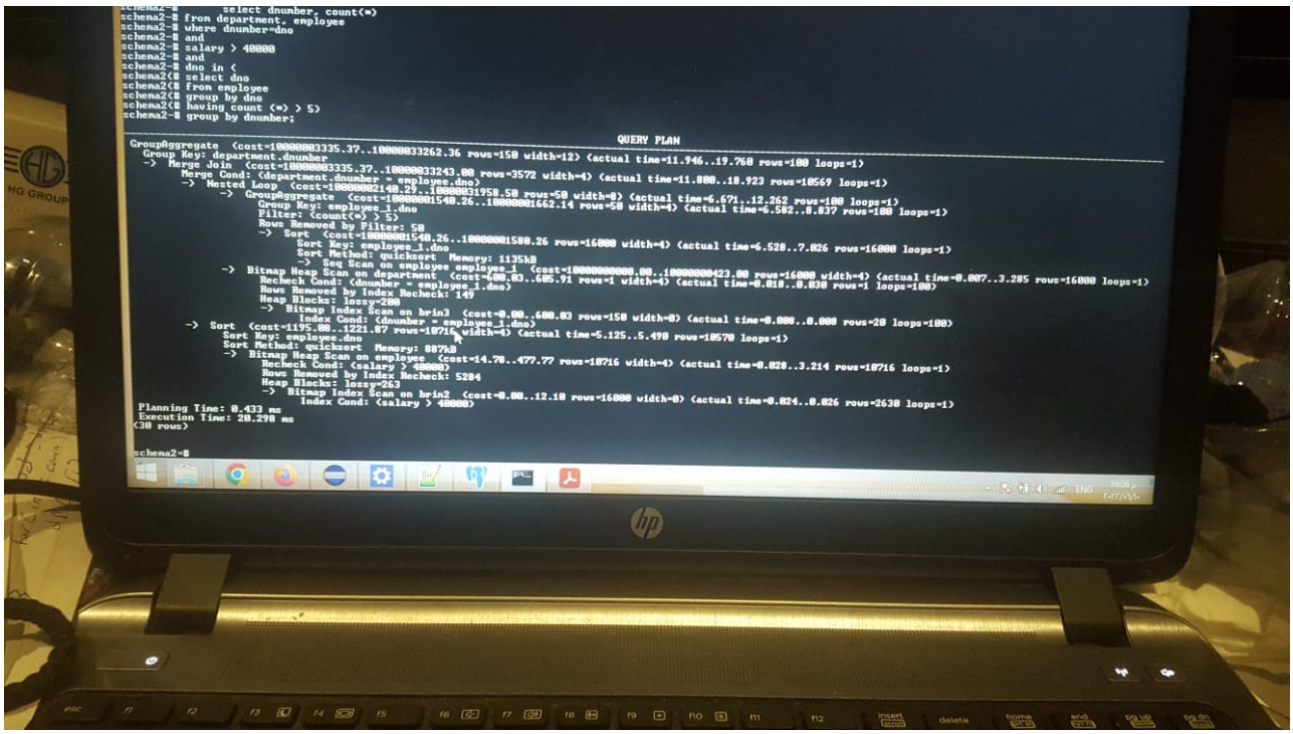

**********CONCLUSION OLD QUERY 6 HASH INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 6 NO INDEXES TIME = 15.5 MS
3-OLD QUERY 6 Hash INDEXES COST = 100000002292
4-OLD QUERY 6 HASH INDEXES TIME = 20

*** As expected much worse as the query needs the seqscan because it contains lots of aggregates and group by and the hash in this case very bad.

# 1)D)OLD QUERY 6 WITH BRIN INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;
5- update pg_index set indisvalid = false where indexrelid = 'DEPARTMENT_pkey'::regclass ;
BRIN Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)



**********CONCLUSION OLD QUERY 6 BRIN INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 6 NO INDEXES TIME = 15.5 MS
3-OLD QUERY 6 BRIN INDEXES COST = 1000000033262
4-OLD QUERY 6 BRIN INDEXES TIME = 20
*** As expected much worse as the query needs the seqscan because it contains lots of aggregates and group by and the BRIN in this case very bad.
**********

# 1)E)OLD QUERY 6 WITH MY CHOICE OF INDEXES:

B+ trees and seqscan strategy(best for aggregates)same as 1)b)

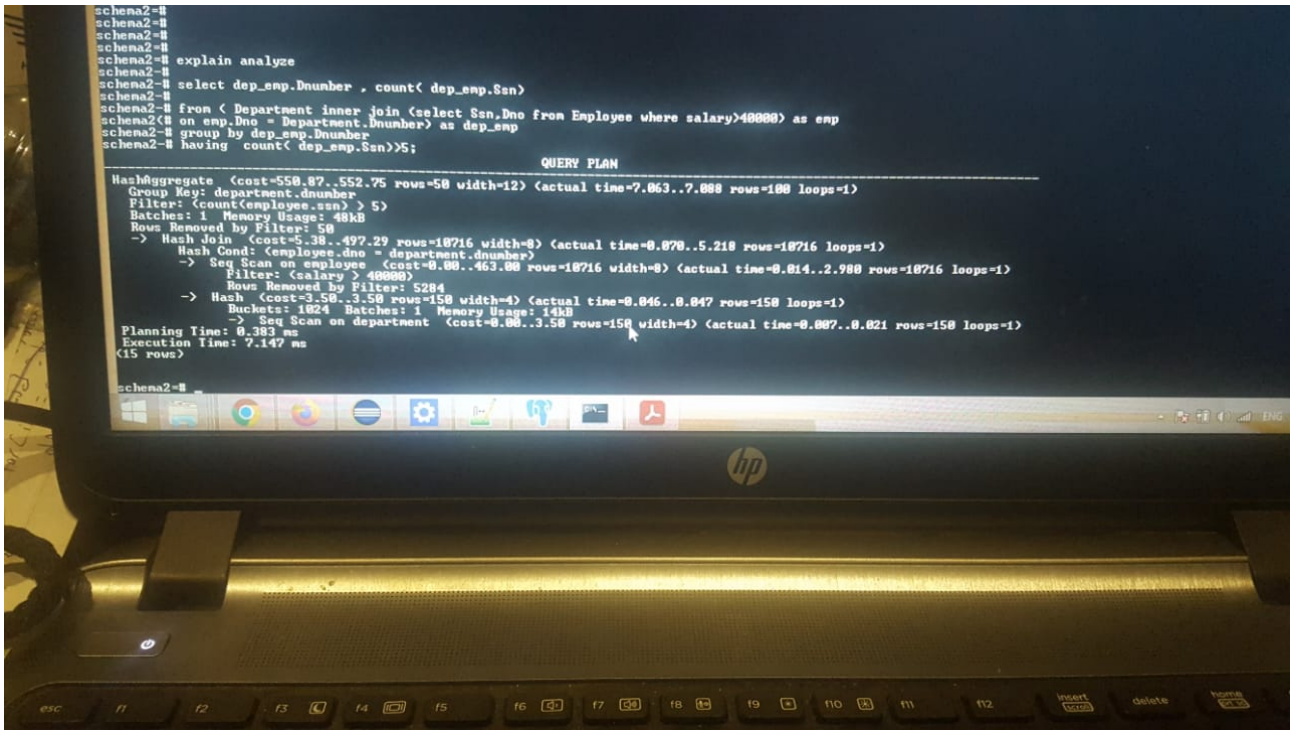
Flags:1- set enable_seqscan = on;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;
B+ Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)

**********CONCLUSION OLD QUERY 6 B+ INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 6 NO INDEXES TIME = 15.5 MS
3-OLD QUERY 6 B+ INDEXES COST = 945
4-OLD QUERY 6 B+ INDEXES TIME = 15.3MS
=> 8.3% more cost efficient & 1.3% more time efficient

# 2)A)OPTIMIZED QUERY 6 WITH NO INDEXES:

Flags:1- set enable_seqscan = on;
2- set enable_bitmapscan =off;
3-set enable_indexscan = off;
4- set enable_indexonlyscan = off;



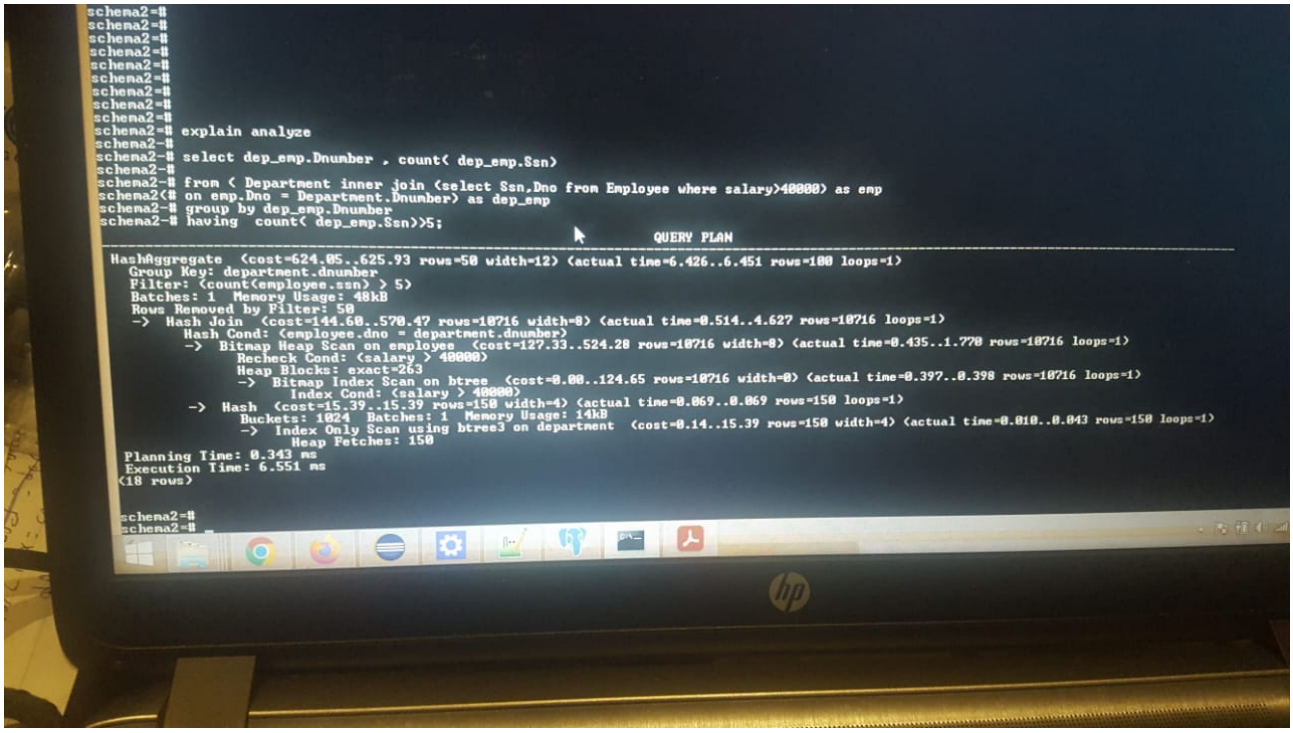

**********CONCLUSION OPTIMIZED QUERY 6 NO INDEXES:**********

1-OLD QUERY 6 NO INDEXES COST = 1032
2-OLD QUERY 67 NO INDEXES TIME = 15.5 MS
3-OPTIMIZED QUERY 6 NO INDEXES COST = 550
4-OPTIMIZED QUERY 67 NO INDEXES TIME = 7.1 MS
=>47% MORE COST EFFICIENT & 55% MORE TIME EFFICIENT

# 2)B)OPTIMIZED QUERY 6 WITH B+ INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;

B+ Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)



**********CONCLUSION OPTIMIZED QUERY 6 B+ INDEXES:**********

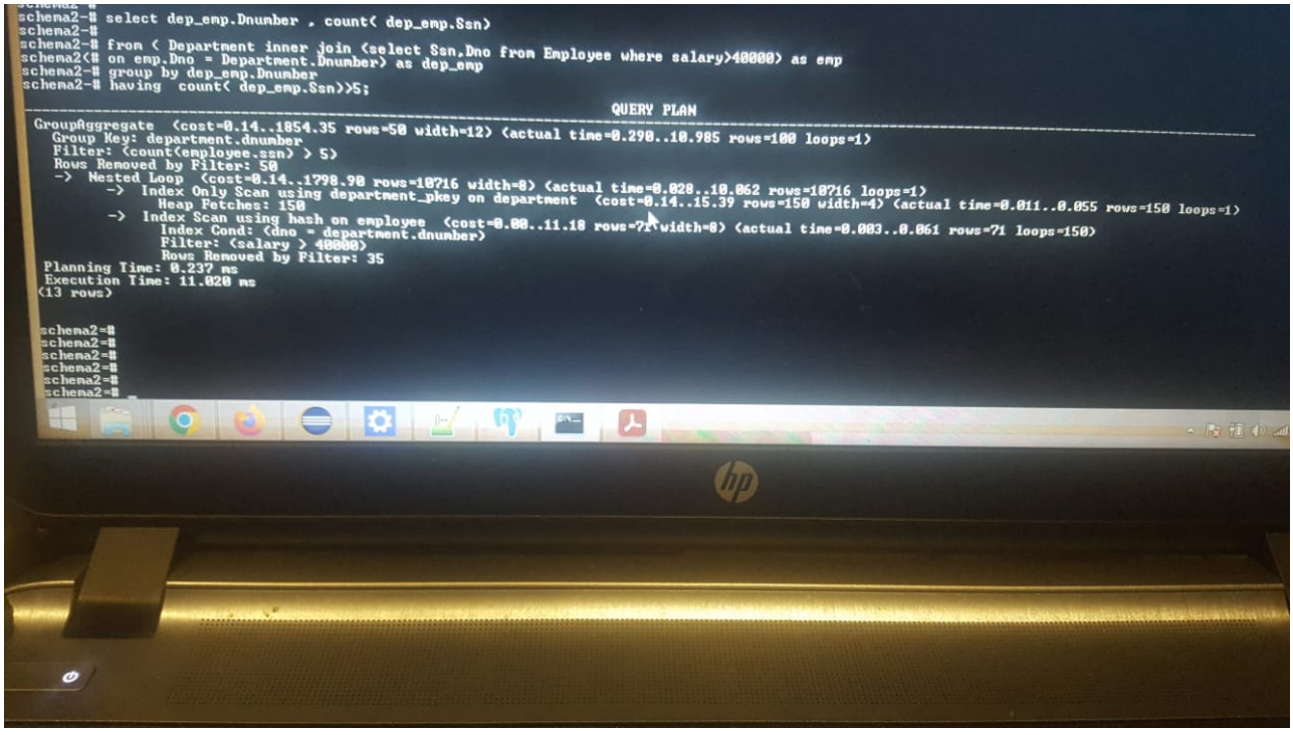
1-OPTIMIZED QUERY 6 NO INDEXES COST = 550
2-OPTIMIZED QUERY 67 NO INDEXES TIME = 7.1 MS
3-OPTIMIZED QUERY 6 B+ INDEXES COST = 624
4-OPTIMIZED QUERY 6 B+ INDEXES TIME = 6.1MS
=> more or less same performance as seqscan but because Of aggregates count () and group by seqscan slightly better.

**********

# 2)C)OPTIMIZED QUERY 6 WITH Hash INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;

Hash Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)

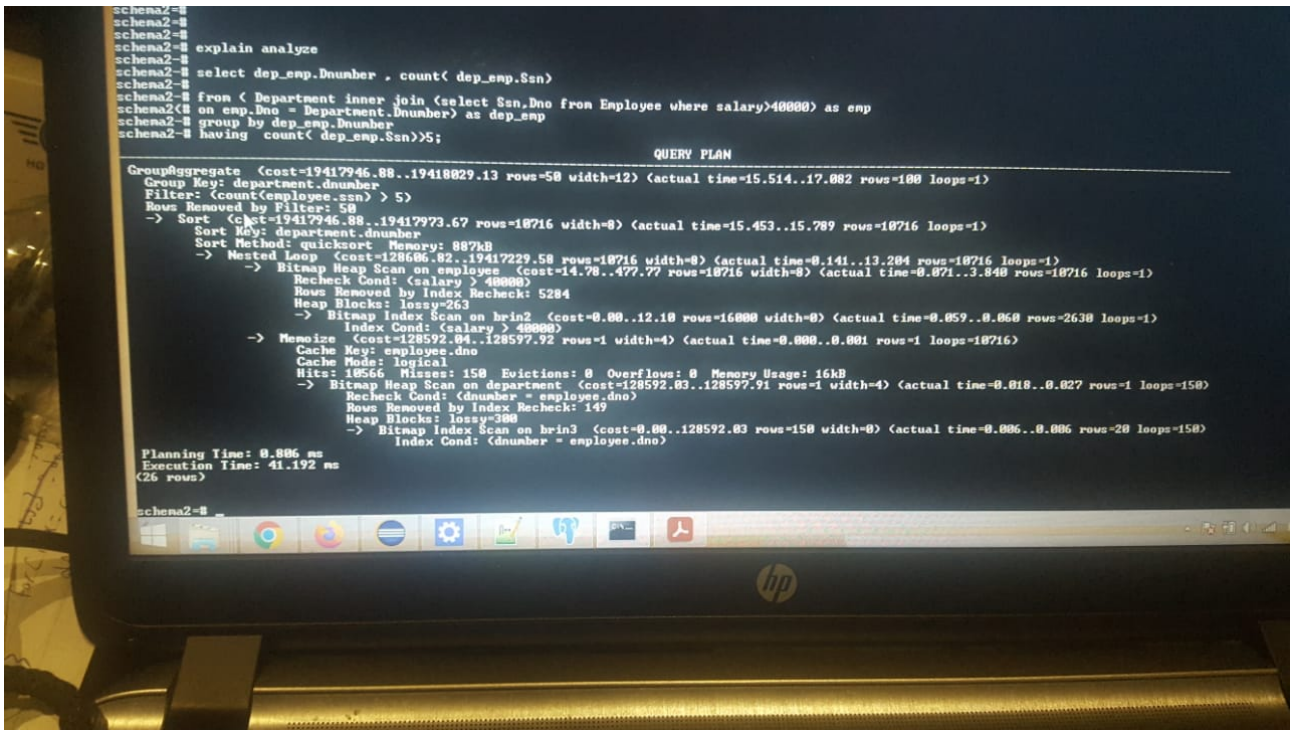


**********CONCLUSION OPTIMIZED QUERY 6 HASH INDEXES:**********

1-OPTIMIZED QUERY 6 NO INDEXES COST = 550
2-OPTIMIZED QUERY 67 NO INDEXES TIME = 7.1 MS
3- OPTIMIZED QUERY 6 Hash INDEXES COST = 1854
4-OPTIMIZED QUERY 6 HASH INDEXES TIME = 11
*** As expected much worse as the query needs the seqscan because it contains lots of aggregates and group by and the hash in this case very bad.
**********

# 2)D)OPTIMIZED QUERY 6 WITH BRIN INDEXES:

Flags:1- set enable_seqscan = off;
2- set enable_bitmapscan =on;
3-set enable_indexscan = on;
4- set enable_indexonlyscan = on;
5- update pg_index set indisvalid = false where indexrelid = 'DEPARTMENT_pkey'::regclass ;
BRIN Indexes: 1- department(Dnumber).
2 - emplyee(Dno).
3 - emplyee(salary)



**********CONCLUSION OPTIMIZED QUERY 6 BRIN INDEXES:**********

1-OPTIMIZED QUERY 6 NO INDEXES COST = 550
2-OPTIMIZED QUERY 67 NO INDEXES TIME = 7.1 MS
3-OPTIMIZED QUERY 6 BRIN INDEXES COST = 19418029
4-OPTIMIZED QUERY 6 BRIN INDEXES TIME = 41

*** As expected much worse as the query needs the seqscan because it contains lots of aggregates and group by and the BRIN in this case very bad.

**********

# 1)E)OPTIMIZED QUERY 6 WITH MY CHOICE OF INDEXES:

For this optimised query I choose no indexes and full seqscans
As it contains aggregates count() and this kills the indexes also it Is nested with multiple dependencies

Flags:1- set enable_seqscan = on;
2- set enable_bitmapscan =off;
3-set enable_indexscan = off;
4- set enable_indexonlyscan = off;

**********CONCLUSION OPTIMIZED QUERY 6 NO INDEXES:**********

1-OPTIMIZED QUERY 6 NO INDEXES COST = 550
2-OPTIMIZED QUERY 67 NO INDEXES TIME = 7.1 MS