

# Σχεδιασμός Βάσεων Δεδομένων

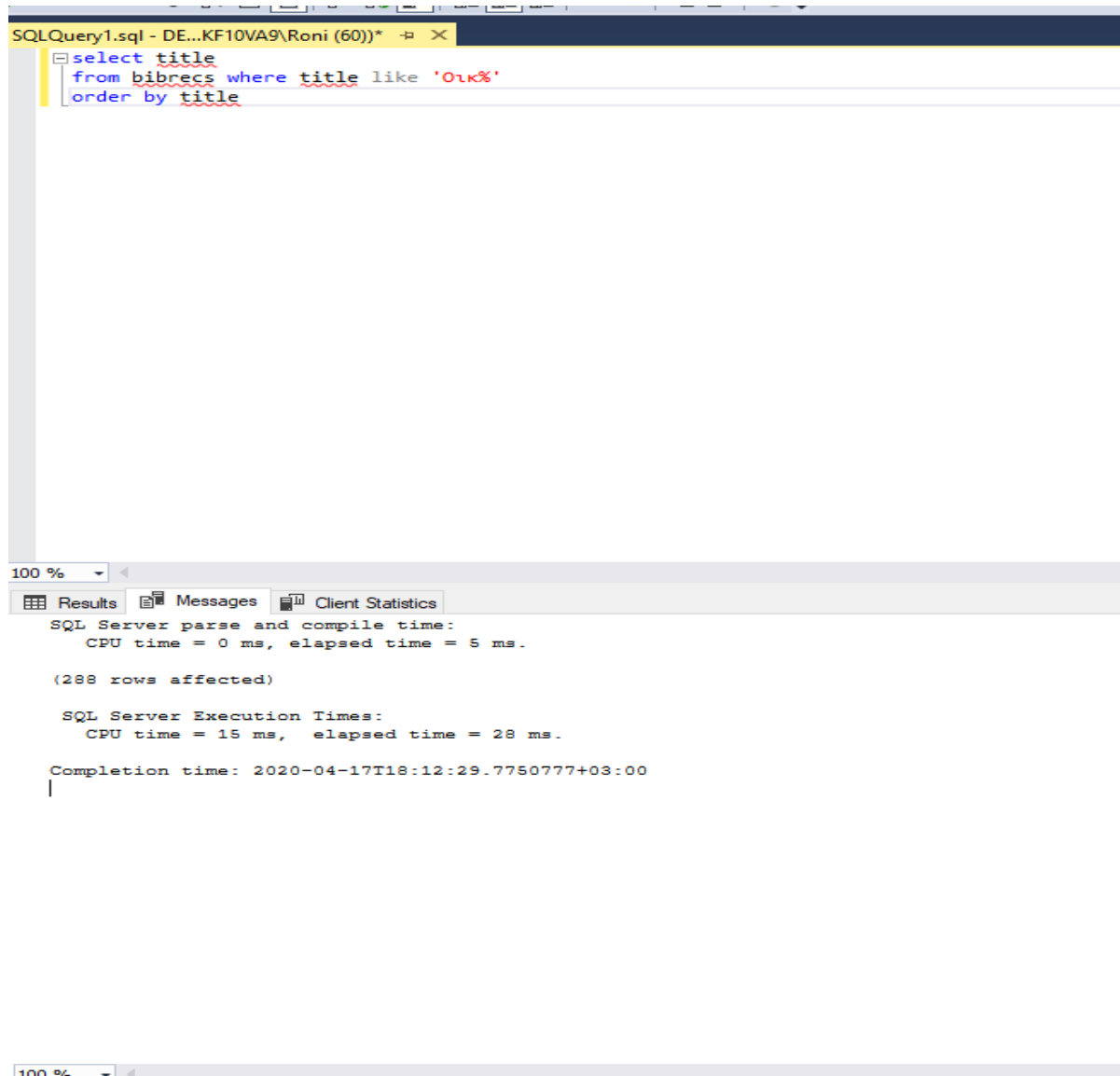
## Project Part A

### Τοσκολάρι Ρόναλντ

3160244

#### Ζήτημα Πρώτο

1) Ο χρόνος του Query για το πρώτο ζήτημα (Το ευρετήριο δεν έχει δημιουργηθεί ακόμη)



The screenshot shows the SQL Server Enterprise Manager interface. The top pane displays the following SQL query:

```
select title
from bibrecs where title like 'Οικ%'
order by title
```

The bottom pane shows the execution results, including the following text:

```
SQL Server parse and compile time:
  CPU time = 0 ms, elapsed time = 5 ms.

(288 rows affected)

SQL Server Execution Times:
  CPU time = 15 ms,  elapsed time = 28 ms.

Completion time: 2020-04-17T18:12:29.7750777+03:00
```

SQLQuery1.sql - DE...KF10VA9\Roni (60))\* X

```
select title
from bibrecs where title like 'Oık%'
order by title
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%  
select title from bibrecs where title like 'Oık%' order by title  
Missing Index (Impact 63.618): CREATE NONCLUSTERED INDEX [<Name of Missing Inde...

SELECT  
Cost: 0 %

Sort  
Cost: 0 %

Clustered Index Scan (Clustered)  
Cost: 0 %

Sort

Sort the input.

Physical Operation	Sort
Logical Operation	Sort
Estimated Execution Mode	Row
Estimated Operator Cost	0.073601 (9%)
Estimated I/O Cost	0.0112613
Estimated Subtree Cost	0.786564
Estimated CPU Cost	0.0036331
Estimated Number of Executions	1
Estimated Number of Rows	278.801
Estimated Row Size	111 B
Node ID	0

Output List  
[LIBRARY].[dbo].[bibrecs].title

Order By  
[LIBRARY].[dbo].[bibrecs].title Ascending

Query executed successfully

Col 15 Ch 15

KA9\Roni (60) | LIBRARY | 00:00:00 | 0 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))

```

select title
from bibrecs where title like 'Ouk%'
order by title

```

00 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select title from bibrecs where title like 'Ouk%'

Missing Index (Impact 63.618): CREATE NONCLUSTERED INDEX [IX\_bibrecs\_title] ON [bibrecs].[PK\_bibrecs\_5C7FC9B7E8B9769F] ([title])

Clustered Index Scan (Clustered)

Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.639421
Estimated Operator Cost	0.712963 (91%)
Estimated CPU Cost	0.0735413
Estimated Subtree Cost	0.712963
Estimated Number of Executions	1
Estimated Number of Rows	278.801
Estimated Number of Rows to be Read	66713
Estimated Row Size	111 B
Ordered	False
Node ID	1

Predicate

[LIBRARY].[dbo].[bibrecs].[title] like 'Ouk%'

Object

[LIBRARY].[dbo].[bibrecs].[PK\_bibrecs\_5C7FC9B7E8B9769F]

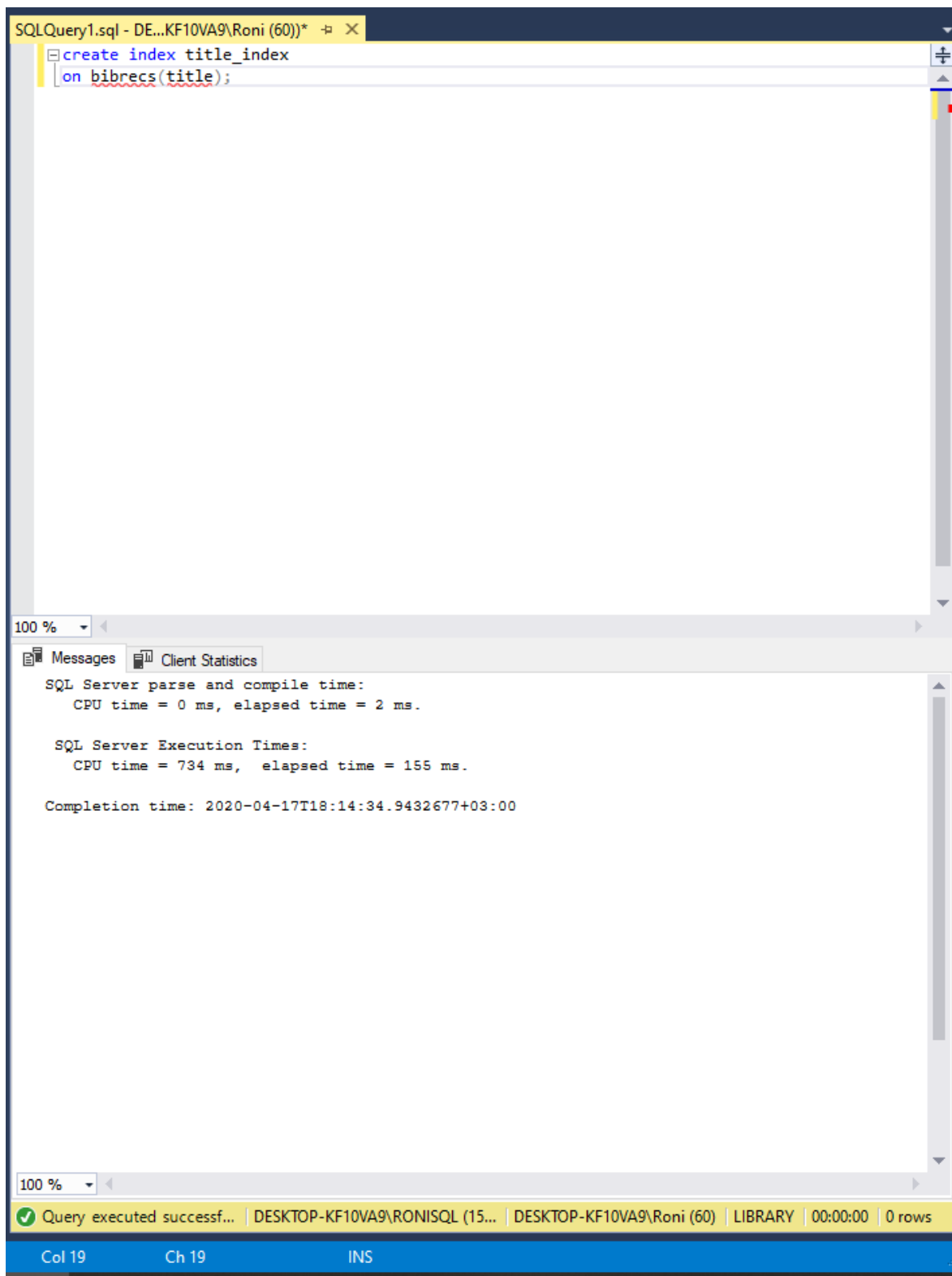
Output List

[LIBRARY].[dbo].[bibrecs].title

Query executed successf... | DESKTOP-KF10VA9\RONISQL (15...)

Col 15 Ch 15 INS

Η εντολή για την δημιουργία του index είναι στην εικόνα απο κάτω.



Στις εικόνες παρακάτω είναι ο νέος χρόνος υπολογισμού του Query.

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select title
from bibrecs where title like 'Ouk%'
order by title
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 1 ms, elapsed time = 1 ms.

(288 rows affected)

SQL Server Execution Times:  
CPU time = 0 ms, elapsed time = 0 ms.

Completion time: 2020-04-17T18:15:12.3121332+03:00

100 %

Query executed succe... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 288 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```

select title
from bibrecs where title like 'Ouk%'
order by title

```

100 %

Messages Execution plan

Query 1: Query cost (rel  
select title from bibrecs

SELECT  
Cost: 0 %

Index Seek (NonClustered)

Scan a particular range of rows from a nonclustered index.

Physical Operation	Index Seek
Logical Operation	Index Seek
Estimated Execution Mode	Row
Storage	RowStore
Estimated Operator Cost	0.0043294 (100%)
Estimated I/O Cost	0.0038657
Estimated Subtree Cost	0.0043294
Estimated CPU Cost	0.0004637
Estimated Number of Executions	1
Estimated Number of Rows	278.801
Estimated Number of Rows to be Read	278.801
Estimated Row Size	111 B
Ordered	True
Node ID	0

**Predicate**  
[LIBRARY].[dbo].[bibrecs].[title] like 'Ouk%'

**Object**  
[LIBRARY].[dbo].[bibrecs].[title\_index]

**Output List**  
[LIBRARY].[dbo].[bibrecs].bibno, [LIBRARY].[dbo].[bibrecs].title

**Seek Predicates**  
Seek Keys[1]: Start: [LIBRARY].[dbo].[bibrecs].title >= Scalar Operator('Ouk'), End: [LIBRARY].[dbo].[bibrecs].title < Scalar Operator('Ouk')

Query executed successf... | DES

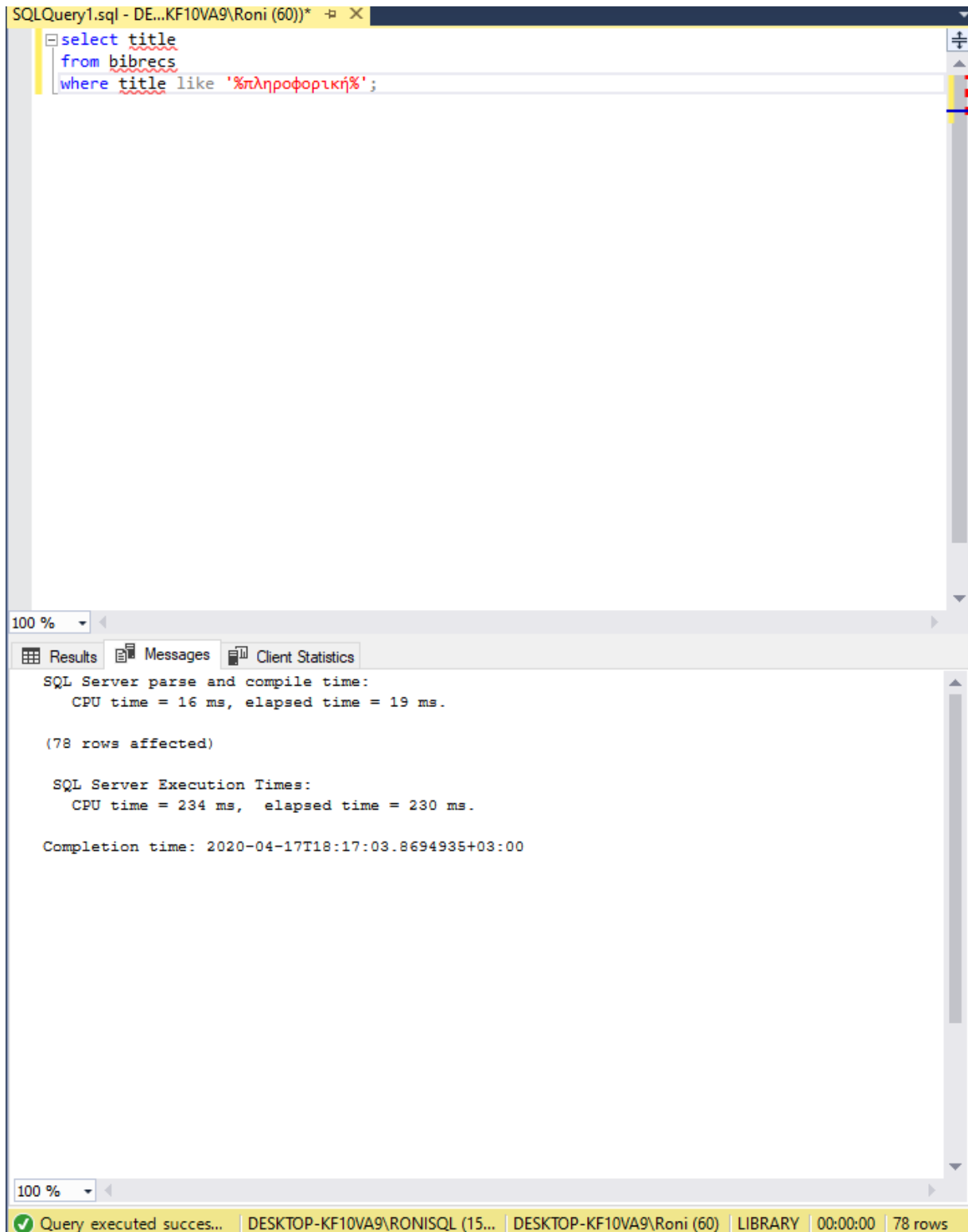
Col 15 Ch 15

ARY | 00:00:00 | 0 rows

2)

A)

Εμφάνισε τον τίτλο των τεκμηρίων που περιέχουν στον τίτλο την λέξη πληροφορική.



The screenshot shows the SQL Server Enterprise Manager interface. The top pane displays a query in the 'SQLQuery1.sql' file:

```
select title
from bibrecs
where title like '%πληροφορική%';
```

The bottom pane shows the 'Results' tab with the following execution statistics:

```
SQL Server parse and compile time:
  CPU time = 16 ms, elapsed time = 19 ms.

(78 rows affected)

SQL Server Execution Times:
  CPU time = 234 ms,  elapsed time = 230 ms.

Completion time: 2020-04-17T18:17:03.8694935+03:00
```

The status bar at the bottom indicates: 'Query executed succes...' (with a green checkmark icon), 'DESKTOP-KF10VA9\RONISQL (15...', 'DESKTOP-KF10VA9\Roni (60)', 'LIBRARY', '00:00:00', and '78 rows'.

SQLQuery1.sql - DE...KF10VA9\Roni (60)) \* -p X

```
select title
from bibrecs
where title like '%πληροφορική%';
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select title from bibrecs

SELECT  
Cost: 0 %

Index Scan (NonClustered)  
[bibrecs].[title\_index]  
Cost: 1.00

#### Index Scan (NonClustered)

Scan a nonclustered index, entirely or only a range.

Physical Operation	Index Scan
Logical Operation	Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated Operator Cost	0.429259 (100%)
Estimated I/O Cost	0.355718
Estimated Subtree Cost	0.429259
Estimated CPU Cost	0.0735413
Estimated Number of Executions	1
Estimated Number of Rows	59.743
Estimated Number of Rows to be Read	66713
Estimated Row Size	111 B
Ordered	False
Node ID	0

#### Predicate

[LIBRARY].[dbo].[bibrecs].[title] like '%πληροφορική%'

#### Object

[LIBRARY].[dbo].[bibrecs].[title\_index]

#### Output List

[LIBRARY].[dbo].[bibrecs].title

Query executed successfully. DESKTOP

00:00:00 0 rows

Col 34

Ch 34



Όπως βλέπουμε και απο τις εικόνες πάνω το index μας ήταν αρκετά χρήσιμο, έτσι και αλλιώς το βλέπουμε και στην συνθήκη where στην οποία χρησιμοποιούμε το tittle.

B)

Εμφάνισε τον τίτλο, και το είδος των τεκμηρίων με τίτλο "Economics".

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select title, material  
from bibrecs  
where title = 'Economics';
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:

CPU time = 0 ms, elapsed time = 2 ms.

SQL Server parse and compile time:

CPU time = 0 ms, elapsed time = 0 ms.

(63 rows affected)

SQL Server Execution Times:

CPU time = 0 ms, elapsed time = 0 ms.

Completion time: 2020-04-17T18:19:28.5288463+03:00

100 %

Query executed succes... | DESKTOP-KF10VA9\RONISOL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 63 rows

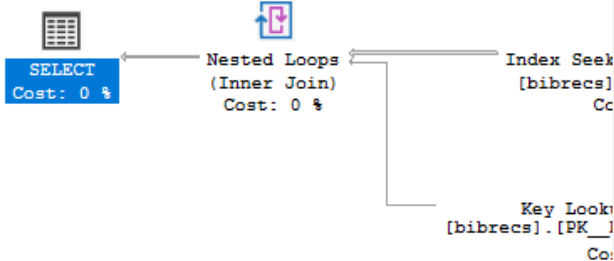
SQLQuery1.sql - DE...KF10VA9\Roni (60))

```
select title, material
from bibrecs
where title = 'Economics';
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch):  
select title, material from bibrecs where ti



#### Key Lookup (Clustered)

Uses a supplied clustering key to lookup on a table that has a clustered index.

Physical Operation	Key Lookup
Logical Operation	Key Lookup
Estimated Execution Mode	Row
Storage	RowStore
Estimated Operator Cost	0.196996 (98%)
Estimated I/O Cost	0.003125
Estimated Subtree Cost	0.196996
Estimated CPU Cost	0.0001581
Estimated Number of Executions	63
Estimated Number of Rows	1
Estimated Row Size	26 B
Ordered	True
Node ID	4

#### Object

[LIBRARY].[dbo].[bibrecs].  
[PK\_\_bibrecs\_\_5C7FC9B7E8B9769F]

#### Output List

[LIBRARY].[dbo].[bibrecs].material

#### Seek Predicates

Seek Keys[1]: Prefix: [LIBRARY].[dbo].[bibrecs].bibno =  
Scalar Operator([LIBRARY].[dbo].[bibrecs].bibno)

Query executed successfully. DESKTOP-KF10VA9\RONISQL (15...

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select title, material
from bibrecs
where title = 'Economics';
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch):  
select title, material from bibrecs where ti

```
graph LR
    SELECT[SELECT  
Cost: 0 %] --> NL[Nested Loops  
(Inner Join)  
Cost: 0 %]
    NL --> IS[Index Seek  
[bibrecs].  
Cost: 0.0033513]
    IS --> KL[Key Lookup  
[bibrecs].[PK__b  
Cost: 0.0002263]
```

Index Seek (NonClustered)

Scan a particular range of rows from a nonclustered index.

Physical Operation	Index Seek
Logical Operation	Index Seek
Estimated Execution Mode	Row
Storage	RowStore
Estimated Operator Cost	0.0033513 (2%)
Estimated I/O Cost	0.003125
Estimated Subtree Cost	0.0033513
Estimated CPU Cost	0.0002263
Estimated Number of Executions	1
Estimated Number of Rows	63
Estimated Number of Rows to be Read	63
Estimated Row Size	58 B
Ordered	True
Node ID	2

Object

[LIBRARY].[dbo].[bibrecs].[title\_index]

Output List

[LIBRARY].[dbo].[bibrecs].bibno, [LIBRARY].[dbo].[bibrecs].title

Seek Predicates

Seek Keys[1]: Prefix: [LIBRARY].[dbo].[bibrecs].title = Scalar Operator('Economics')

Query executed successf... | DESKTOP-KF10VA9\RONISQL (15...

Col 27 Ch 27 INS

Ομοίως και εδώ βλέπουμε ότι το index μας βοηθάει έστω και ελάχιστα για την ευρεση των πλειάδων που θέλουμε.

C)

Εμφάνισε τον τίτλο και το είδος των τεκμηρίων των οποίων ο τίτλος ξεκινάει με την λέξη "Economics".

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select title, material
from bibrecs
where title like 'Economics%';
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 1 ms, elapsed time = 1 ms.

(513 rows affected)

SQL Server Execution Times:  
CPU time = 0 ms, elapsed time = 90 ms.

Completion time: 2020-04-17T18:21:26.5513945+03:00

100 %

✓ Query executed succe... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 513 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select title, material
from bibrecs
where title like 'Economics%';
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select title, material from  
Missing Index (Impact 59.56)

SELECT  
Cost: 0 %

Clustered Index  
[bibrecs].[PK\_...]  
Cost

**Clustered Index Scan (Clustered)**  
Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.639421
Estimated Operator Cost	0.712963 (100%)
Estimated CPU Cost	0.0735413
Estimated Subtree Cost	0.712963
Estimated Number of Executions	1
Estimated Number of Rows	517.773
Estimated Number of Rows to be Read	66713
Estimated Row Size	128 B
Ordered	False
Node ID	0

**Predicate**

[LIBRARY].[dbo].[bibrecs].[title] like 'Economics%'

**Object**

[LIBRARY].[dbo].[bibrecs].[PK\_bibrecs\_\_5C7FC9B7E8B9769F]

**Output List**

[LIBRARY].[dbo].[bibrecs].title, [LIBRARY].[dbo].[bibrecs].material

Query executed successf... DESKTOP

Col 29

Ch 29

Εδώ βλέπουμε ότι το ευρετήριο δεν ήταν αρκετά αποδοτικό όπως το A αλλά πάλι μας δίνει μια ελάχιστη βελτίωση.

## **Ζήτημα Δεύτερο**

1)

A) Εμφανίστε τον τίτλο και την γλώσσα των τεκμηρίων που έχει εκδώσει ο 'Κλειδάριθμος'.



```
select b.title, b.lang
from bibtexes as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'κλειδάριθμος';
```

100 %

Results Messages Client Statistics

	title	lang
1	Γραφικά	gre
2	γλώσσα προγραμματισμού C	gre
3	Οργάνωση συστημάτων ενός χρήστη	gre
4	περιβάλλον προγραμματισμού UNIX	gre
5	λεξικό της πληροφορικής	gre
6	Excel 4 for Windows	gre
7	Μάθετε το 1-2-3	gre
8	Εισαγωγή στην πληροφορική	gre
9	Turbo prolog	gre
10	Βασικές αρχές γλωσσών προγραμματισμού	gre
11	οδηγός της Microsoft για τα Windows 3.1	gre
12	οδηγός της microsoft για το word for windows	gre
13	Excel 5	gre
14	Word for windows 6.0	gre
15	Windows 3.1	gre
16	υπολογιστές	gre
17	Πως δουλεύουν οι υπολογιστές	gre
18	οδηγός της Microsoft για το Word for Windows 95	gre
19	οδηγός της Microsoft για τα Windows 95	gre

✓ Query executed succes... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 97 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select b.title, b.lang
from bibrecs as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'Κλειδάριθμος';
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 91 ms, elapsed time = 91 ms.

(97 rows affected)

SQL Server Execution Times:  
CPU time = 16 ms, elapsed time = 10 ms.

Completion time: 2020-04-17T18:30:27.0229731+03:00

100 %

Query executed succes... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 97 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```

select b.title, b.lang
from bibrecs as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'Κλειδάριθμος';

```

100 %
Messages
Execution plan
Client Statistics

Query 1: Query cost

select b.title, b.lang

Missing Index (Impact

Hash Match	
Use each row from the top input to build a hash table, and each row from the bottom input to probe into the hash table, outputting all matching rows.	
Physical Operation	Hash Match
Logical Operation	Inner Join
Estimated Execution Mode	Row
Estimated Operator Cost	0.4554618 (38%)
Estimated I/O Cost	0
Estimated Subtree Cost	1.18587
Estimated CPU Cost	0.453803
Estimated Number of Executions	1
Estimated Number of Rows	19.691
Estimated Row Size	114 B
Node ID	0

**Output List**

[LIBRARY].[dbo].[bibrecs].title, [LIBRARY].[dbo].[bibrecs].lang

**Hash Keys Probe**

[LIBRARY].[dbo].[bibrecs].pubid

**Probe Residual**

[LIBRARY].[dbo].[publishers].[pubid] as [p].[pubid]=  
[LIBRARY].[dbo].[bibrecs].[pubid] as [b].[pubid]

SELECT

Cost: 0 %

Hash Me

(Inner C

Cost: 3

Query executed successf...

Col 34

Ch 34

hi (60) | LIBRARY | 00:00:00 | 0 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select b.title, b.lang
from bibrecs as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'Κλειδάριθμος';
```

100 %

MessagesExecution planClient Statistics

Query 1: Query cost (relative to the batch): 100%

select b.title, b.lang from bibrecs as b join publishers as p on b.pubid = p.pu...

Missing Index (Impact 98.0634): CREATE NONCL...

SELECT  
Cost: 0 %

Hash Match  
(Inner Join)  
Cost: 38 %

Clustered Inde  
[publishers].[PK\_...]  
Cos

Clustered Inde  
[bibrecs].[PK\_b...]  
Cos

**Clustered Index Scan (Clustered)**  
Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.639421
Estimated Operator Cost	0.712963 (60%)
Estimated CPU Cost	0.0735413
Estimated Subtree Cost	0.712963
Estimated Number of Executions	1
Estimated Number of Rows	66713
Estimated Number of Rows to be Read	66713
Estimated Row Size	118 B
Ordered	False
Node ID	2

**Object**  
[LIBRARY].[dbo].[bibrecs].[PK\_bibrecs\_5C7FC9B7E8B9769F] [b]

**Output List**  
[LIBRARY].[dbo].[bibrecs].title, [LIBRARY].[dbo].[bibrecs].lang,  
[LIBRARY].[dbo].[bibrecs].pubid

Query executed successf... | DESKTOP-KF10VA9\RONISQL (15...

Col 34Ch 34INS

27 x

SQLQuery1.sql - DE...KF10VA9\Roni (60))

```

select b.title, b.lang
from bibrecs as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'Κλειδάριθμος';

```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100.00  
 select b.title, b.lang from bibrecs as b join publishers as p  
 Missing Index (Impact 98.0634): CREATE NONCLUSTERED INDEX ON publishers (pubname)

Hash Match (Inner Join) Cost: 38 %

Clustered Index Scan (publishers). [PK\_publications] Cost: 1.00

Clustered Index Scan (bibrecs). [PK\_bibrecs] Cost: 1.00

**Clustered Index Scan (Clustered)**  
 Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.0134954
Estimated Operator Cost	0.0174452 (1%)
Estimated CPU Cost	0.0039498
Estimated Subtree Cost	0.0174452
Estimated Number of Executions	1
Estimated Number of Rows	1
Estimated Number of Rows to be Read	3448
Estimated Row Size	32 B
Ordered	False
Node ID	1

**Predicate**  
 [LIBRARY].[dbo].[publishers].[pubname] as [p].[pubname] = 'Κλειδάριθμος'

**Object**  
 [LIBRARY].[dbo].[publishers].[PK\_publications]

**Output List**  
 [LIBRARY].[dbo].[publishers].[pubid]

Query executed successfully. DESKTOP-KF10VA9\RONISQL (15...) DESKTOP-KF10VA9\RONISQL (15...)

Col 34 Ch 34 INS

B)

Εμφανίστε έναν κατάλογο με το όνομα κάθε τμήματος και τον συνολικό αριθμό των δανεισμών που έγιναν από τα μέλη του το έτος 2000.

SQLQuery1.sql - DE...KF10VA9\Roni (60))

```
select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;
```

100 %

Results Messages Client Statistics

	depname	total_loans
1	Διοίκησης επιχειρήσεων	974
2	Φυσικής	866
3	Νομικής	1305
4	Μαθηματικών	2079
5	Βιολογίας	106
6	Οικονομικών	1070
7	Στατιστικής	55
8	Ιατρικής	149
9	Πληροφορικής	754
10	Ψυχολογίας	104

Query executed succes... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 10 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 0 ms, elapsed time = 7 ms.

(10 rows affected)

SQL Server Execution Times:  
CPU time = 31 ms, elapsed time = 25 ms.

Completion time: 2020-04-17T18:49:03.7275712+03:00

100 %

Query executed succes... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 10 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))

```

select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;

```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select d.depname, count(l.bid) as total\_loans from departments as d join borrow...

SELECT  
Cost: 0 %

Compute Scalar  
Cost: 0 %

Hash Ma  
(Aggreg  
Cost: 0 %

**Hash Match**  
Use each row from the top input to build a hash table, and each row from the bottom input to probe into the hash table, outputting all matching rows.

Physical Operation	Hash Match
Logical Operation	Aggregate
Estimated Execution Mode	Row
Estimated Operator Cost	0.068563 (9%)
Estimated I/O Cost	0
Estimated Subtree Cost	0.796248
Estimated CPU Cost	0.0685623
Estimated Number of Executions	1
Estimated Number of Rows	10
Estimated Row Size	25 B
Node ID	1

**Output List**  
[LIBRARY].[dbo].[departments].depname, Expr1007

**Build Residual**  
[LIBRARY].[dbo].[departments].[depname] as [d].  
[depname] = [LIBRARY].[dbo].[departments].  
[depname] as [d].[depname]

Index Scan  
[LIBRARY].[dbo].[departments].[PK\_depname]  
Cost: 0 %

Hash Match  
(Inner Join)  
Cost: 32 %

00 | 0 rows

Query executed successfully... | DESKTOP-KF10VA9\RONIS...

Col 20 Ch 20 INS



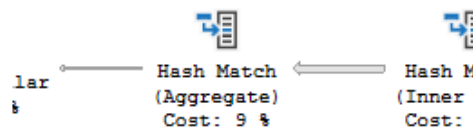
SQLQuery1.sql - DE...KF10VA9\Roni (60))

```
select d.depname, count(1.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(1.loandate) = 2000
group by d.depname;
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to query plan) 1.0000  
select d.depname, count(1.bid)



#### Hash Match

Use each row from the top input to build a hash table, and each row from the bottom input to probe into the hash table, outputting all matching rows.

Physical Operation	Hash Match
Logical Operation	Inner Join
Estimated Execution Mode	Row
Estimated Operator Cost	0.075787 (10%)
Estimated I/O Cost	0
Estimated Subtree Cost	0.727685
Estimated CPU Cost	0.075784
Estimated Number of Executions	1
Estimated Number of Rows	7573.7
Estimated Row Size	21 B
Node ID	2

#### Output List

[LIBRARY].[dbo].[departments].depname

#### Hash Keys Probe

[LIBRARY].[dbo].[borrowers].depcode

#### Probe Residual

[LIBRARY].[dbo].[borrowers].[depcode] as [b].  
[depcode]=[LIBRARY].[dbo].[departments].[depcode]  
as [d].[depcode]

Query executed successfully | DESKTOP-KF10VA9

Col 20

Ch 20

IN

RY | 00:00:00 | 0 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select d.depname, count(l.bid)



Hash Match  
(Inner Join)  
Cost: 10 %

Clustered Index Scan  
[departments].[PK\_\_d...]  
Cost: 3

Hash Match  
(Inner Join)  
Cost: 3

**Hash Match**  
Use each row from the top input to build a hash table, and each row from the bottom input to probe into the hash table, outputting all matching rows.

Physical Operation	Hash Match
Logical Operation	Inner Join
Estimated Execution Mode	Row
Estimated Operator Cost	0.2584507 (32%)
Estimated I/O Cost	0
Estimated Subtree Cost	0.648605
Estimated CPU Cost	0.205297
Estimated Number of Executions	1
Estimated Number of Rows	7573.7
Estimated Row Size	11 B
Node ID	4

#### Output List

[LIBRARY].[dbo].[borrowers].depcode

#### Hash Keys Probe

[LIBRARY].[dbo].[borrowers].bid

#### Probe Residual

[LIBRARY].[dbo].[loanstats].[bid] as [l].[bid]=[LIBRARY].[dbo].[borrowers].[bid] as [b].[bid]

Query executed successfully | DESKTOP-KF10VA9

Col 20

Ch 20

Y | 00:00:00 | 0 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))

```
select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;
```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%  
select d.depname, count(l.bid) as total\_loans from departments as d j

Hash Match  
(Inner Join)  
Cost: 10 %

Clustered Index Scan (Clustered)  
[departments].[PK\_department\_288D89...]  
Cost: 0 %

Hash Match  
(Inner Join)  
Cost: 32 %

Clustered Index Scan (Clustered)  
[loanstats].[PK\_loan...]  
Cost: 45 %

Clustered Index Scan (Clustered)  
[borrowers].[PK\_borr...]  
Cost: 6 %

**Clustered Index Scan (Clustered)**  
Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.0386806
Estimated Operator Cost	0.0512533 (6%)
Estimated CPU Cost	0.0125727
Estimated Subtree Cost	0.0512533
Estimated Number of Executions	1
Estimated Number of Rows	11287
Estimated Number of Rows to be Read	11287
Estimated Row Size	15.8
Ordered	False
Node ID	7

Object

[LIBRARY].[dbo].[borrowers].[PK\_borrower\_DE90ADE7A06B8690]  
[b]

Output List

[LIBRARY].[dbo].[borrowers].bid, [LIBRARY].[dbo].  
[borrowers].depcode

Query executed successf... DESKTOP-KF10VA9\RONISQL (15... DESKTOP-KF10VA9\Roni (60) LIBRAR

Col 20 Ch 20 INS

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```

select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;

```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select d.depname, count(l.bid) as total\_loans from departments as d j

Clustered Index Scan (Clustered)  
[departments].[PK\_department\_288D89...]  
Cost: 0 %

Hash Match (Inner Join)  
Cost: 32 %

Clustered Index Scan (Clustered)  
[loanstats].[PK\_loanstats\_...]  
Cost: 43 %

Clustered Index Scan (Clustered)  
[borrowers].[PK\_borrower\_...]  
Cost: 6 %

**Clustered Index Scan (Clustered)**  
Scanning a clustered index, entirely or only a range.

Physical Operation	Clustered Index Scan
Logical Operation	Clustered Index Scan
Estimated Execution Mode	Row
Storage	RowStore
Estimated I/O Cost	0.0386806
Estimated Operator Cost	0.0512533 (6%)
Estimated CPU Cost	0.0125727
Estimated Subtree Cost	0.0512533
Estimated Number of Executions	1
Estimated Number of Rows	11287
Estimated Number of Rows to be Read	11287
Estimated Row Size	15 B
Ordered	False
Node ID	7

**Object**  
[LIBRARY].[dbo].[borrowers].[PK\_borrower\_DE90ADE7A06B8690]  
[b]

**Output List**  
[LIBRARY].[dbo].[borrowers].bid, [LIBRARY].[dbo].[borrowers].depcode

Query executed successf... DESKTOP-KF10VA9\RONISQL (15... DESKTOP-KF10VA9\Roni (60) LIBRAR

Col 20 Ch 20 INS

C)

Εμφανίστε έναν κατάλογο με τον τίτλο, την γλώσσα και το όνομα του συγγραφέα (ή των συγγραφέων) των τεκμηρίων στα οποία έχει αποδοθεί ο θεματικός όρος "Databases".

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select b.title, b.lang, a.author
from bibrecs as b join bibauthors as ba
on b.bibno = ba.bibno
join bibterms as bt
on b.bibno = bt.bibno
join authors as a
on a.aid = ba.aid
join sterm as s
on s.tid = bt.tid
where s.term = 'Databases';
```

100 %

Results Messages Client Statistics

	title	lang	author
1	architectural logic of database systems	eng	Γιαννακουδάκης, Εμμανουήλ Ι.
2	Using quatro	eng	Cobb, Stephen
3	1/2/2003	eng	Campbell, Mary
4	NBER patent citations data file	eng	Hall, Bronwyn H.
5	Building an object-oriented database system	eng	Bancilhon, Francois
6	Data on the Web	eng	Buneman, Peter
7	Principles of database and knowledge - base syste...	eng	Ullman, Jeffrey D.
8	LISP	eng	Hom, Berthold Klaus Paul
9	Introduction to algorithms	eng	Comen, Thomas H.
10	Introduction to algorithms	eng	Leiserson, Charles E.
11	Introduction to algorithms	eng	Rivest, Ronald L.
12	Software engineering	eng	Pressman, Roger S.
13	Intelligent software systems development	eng	Hamon, Paul
14	Object-oriented databases	eng	Nahouraii, Ez
15	Object-oriented databases	eng	Petry, Fred
16	Computing	eng	Lenstra, J. K.
17	Computing	eng	Rinnooy Kan, A. H. G.
18	development of databases on education and traini...	eng	Vignaud, Dominique
19	Computer algorithms	eng	Horowitz, Ellis

Query executed succ... DESKTOP-KF10VA9\RONISQL (15... DESKTOP-KF10VA9\Roni (60) LIBRARY 00:00:00 1,263 rows

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select b.title, b.lang, a.author
from bibrecs as b join bibauthors as ba
on b.bibno = ba.bibno
join bibterms as bt
on b.bibno = bt.bibno
join authors as a
on a.aid = ba.aid
join sterms as s
on s.tid = bt.tid
where s.term = 'Databases';
```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 751 ms, elapsed time = 751 ms.

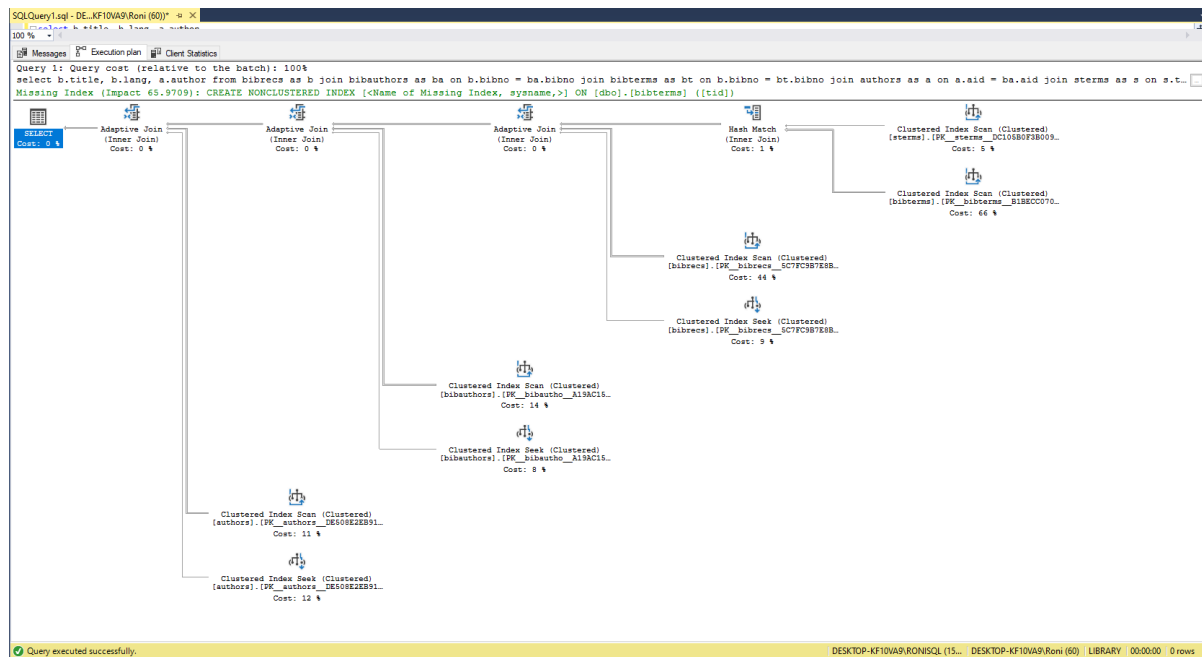
(1263 rows affected)

SQL Server Execution Times:  
CPU time = 47 ms, elapsed time = 132 ms.

Completion time: 2020-04-17T19:32:34.3908711+03:00

100 %

Query executed succ... | DESKTOP-KF10VA9\RONISQL (15... | DESKTOP-KF10VA9\Roni (60) | LIBRARY | 00:00:00 | 1,263 rows



2)

Για το **πρώτο** query το πρώτο ευρετήριο είναι το παρακάτω.

**create index publisher\_id\_index**

**on bibrecs(pubid);**

Βλέπουμε οτι ο χρόνος εκτέλεσης έγινε καλύτερος απο οτι στις πάνω εικόνες

```
SQLQuery2.sql - DE...KF10VA9\Roni (55))* SQLQuery1.sql - DE...KF10VA9\Roni (57))*
select b.title, b.lang
from bibrecs as b join publishers as p
on b.pubid = p.pubid
where p.pubname = 'κλειδάριθμος';
```

100 %

Results Messages

SQL Server parse and compile time:  
CPU time = 0 ms, elapsed time = 207 ms.

(97 rows affected)

SQL Server Execution Times:  
CPU time = 0 ms, elapsed time = 22 ms.

Completion time: 2020-04-23T02:12:32.4824699+03:00

Για το **δεύτερο** ερώτημα το ευρετήριο είναι:

**create index bid\_index**

**on loanstats(bid);**



```
SQLQuery2.sql - DE...KF10VA9\Roni (55))*  SQLQuery1.sql - DE...KF
select d.depname, count(l.bid) as total_loans
from departments as d join borrowers as b
on d.depcode = b.depcode
join loanstats as l
on b.bid = l.bid
where year(l.loandate) = 2000
group by d.depname;
```

100 %

Results Messages

SQL Server parse and compile time:  
CPU time = 7 ms, elapsed time = 7 ms.

(10 rows affected)

SQL Server Execution Times:  
CPU time = 16 ms, elapsed time = 25 ms.

Completion time: 2020-04-23T02:36:48.3720170+03:00

Για το **τρίτο** ερώτημα έχω το ευρετήριο:

**create index tid\_index**

**on bibterms(tid);**

QLQuery2.sql - DE...KF10VA9\Roni (55))\* SQLQuery1.sql - DE...KF10VA

```
select b.title, b.lang, a.author
from bibrecs as b join bibauthors as ba
on b.bibno = ba.bibno
join bibterms as bt
on b.bibno = bt.bibno
join authors as a
on a.aid = ba.aid
join sterms as s
on s.tid = bt.tid
where s.term = 'Databases';
```

00 %

Results Messages

SQL Server parse and compile time:  
CPU time = 0 ms, elapsed time = 11 ms.

(1263 rows affected)

SQL Server Execution Times:  
CPU time = 0 ms, elapsed time = 114 ms.

Completion time: 2020-04-23T02:42:58.1046462+03:00

## Ζήτημα 3ο

1)

Το πρώτο query είναι αυτό που βλέπουμε στην εικόνα απο κάτω.

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select distinct b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'OPA' and b.bibno in (select b.bibno
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'ANA');
```

100 %

Results Messages Client Statistics

	bibno	title
1	22735	2004 η ελληνική οικονομία στο κατώφλι του 21ου ...
2	8172	A course in probability theory
3	2666	A dictionary for accountants
4	32000	A dictionary of econometrics
5	9380	A dictionary of economic quotations
6	25060	A first course in the numerical analysis of differential e...
7	31445	A primer in european macroeconomics
8	35945	A user's guide to principal components
9	59006	Accounting
10	60183	Accounting
11	60886	Accounting for the environment
12	58959	Accounting theory
13	60218	Advanced financial accounting
14	24654	Advanced macroeconomics
15	52029	Advanced macroeconomics
16	38033	Advanced management accounting
17	58671	Advanced modelling in finance using Excel and VBA
18	54602	Advanced models for project management
19	44621	Algebraic riccati equations
20	44472	algorithm design manual
21	44636	Algorithms in C++

Query executed successfully.

SQLQuery1.sql - DE\_KF10VA9/Roni(60)\* = X

```

select distinct b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'OPA' and b.bibno in (select b.bibno
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'AMA');

```

100 %

Results Messages Client Statistics

SQL Server parse and compile time:  
CPU time = 27 ms, elapsed time = 27 ms.

(702 rows affected)

SQL Server Execution Times:  
CPU time = 62 ms, elapsed time = 136 ms.

Completion time: 2020-04-17T21:09:52.9020846+03:00

Query executed successfully. DESKTOP-KF10VA9/RONISQL (15... DESKTOP-KF10VA9/Roni (60) LIBRARY 00:00:00 / 702 rows

SQLQuery1.sql - DE\_KF10VA9/Roni(60)\* = X

```

select distinct b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'OPA' and b.bibno in (select b.bibno
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'AMA');

```

100 %

Messages Execution plan Client Statistics

Query 1: Query cost (relative to the batch): 100%

select distinct b.bibno, b.title from bibrecs as b join copies as c on b.bibno = c.bibno where copyloc = 'OPA' and b.bibno in (select b.bibno from bibrecs as b join copies as c on b.bibno = c.bibno where copyloc = 'AMA');

Missing Index (Impact 9.56366): CREATE NONCLUSTERED INDEX [<Name of Missing Index, sysname,>] ON [dbo].[copies] ([copyloc]) INCLUDE ([bibno])

SELECT Cost: 0 %

Hash Match (Right Semi Join) Cost: 13 %

Hash Match (Inner Join) Cost: 16 %

Hash Match (Aggregate) Cost: 6 %

Hash Match (Inner Join) Cost: 21 %

Clustered Index Scan (Clustered) (copies).[PK\_copies\_F31F97CFE2C29\_ Cost: 9 %

Index Scan (NonClustered) (bibrecs).[title\_index] (b) Cost: 13 %

Clustered Index Scan (Clustered) (copies).[PK\_copies\_F31F97CFE2C29\_ Cost: 9 %

Index Scan (NonClustered) (bibrecs).[title\_index] (b) Cost: 13 %

Query executed successfully. DESKTOP-KF10VA9/RONISQL (15... DESKTOP-KF10VA9/Roni (60) LIBRARY 00:00:00 / 0 rows

Το δεύτερο query είναι αυτό που φαίνεται στην εικόνα παρακάτω.

SQLQuery1.sql - DE...KF10VA9\Roni (60))\*

```
select b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'OPA'
intersect
select b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'ANA';
```

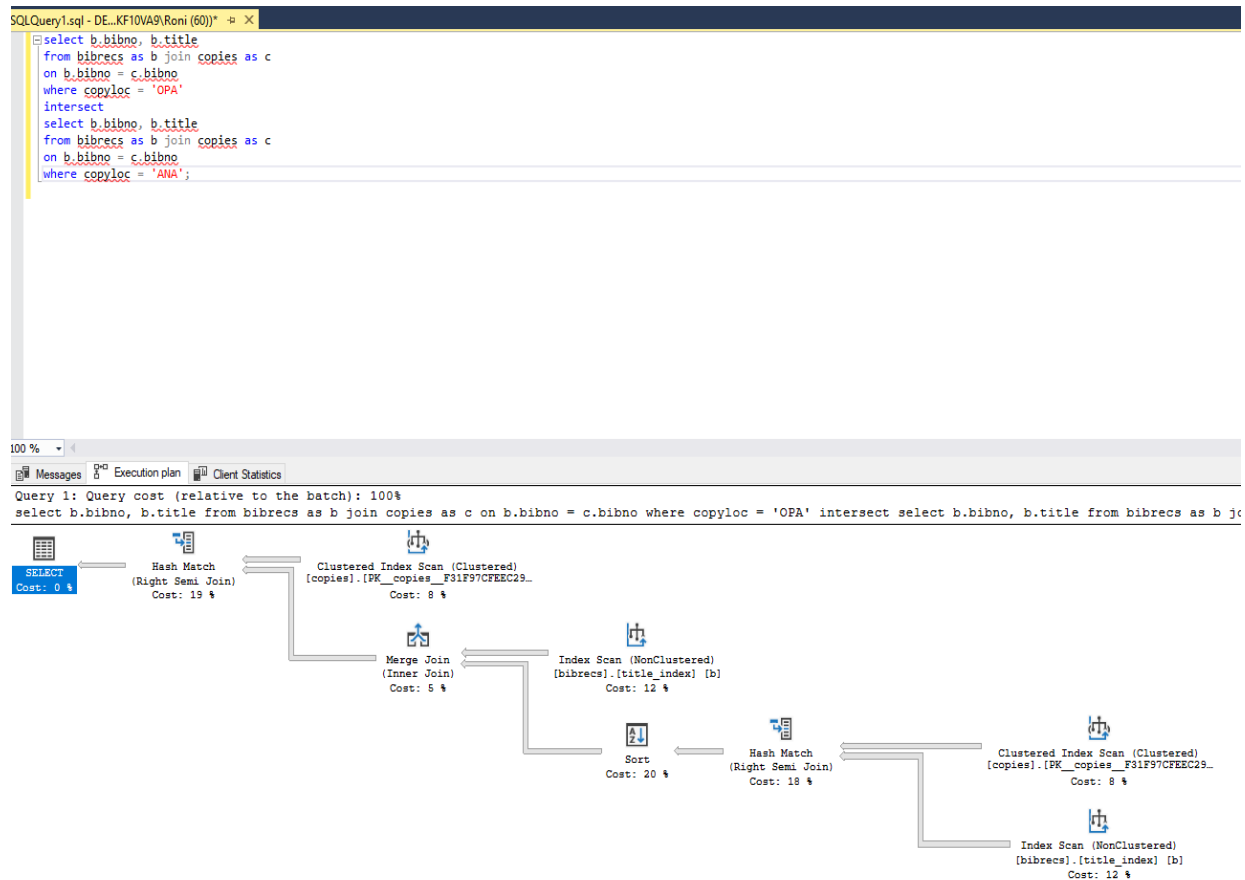
100 %

Results Messages Client Statistics

	bibno	title
1	22735	2004 η ελληνική οικονομία στο κατώφλι του 21ου ...
2	8172	A course in probability theory
3	2666	A dictionary for accountants
4	32000	A dictionary of econometrics
5	9380	A dictionary of economic quotations
6	25060	A first course in the numerical analysis of differential e...
7	31445	A primer in european macroeconomics
8	35945	A user's guide to principal components
9	59006	Accounting
10	60183	Accounting
11	60886	Accounting for the environment
12	58959	Accounting theory
13	60218	Advanced financial accounting
14	24654	Advanced macroeconomics
15	52029	Advanced macroeconomics
16	38033	Advanced management accounting
17	58671	Advanced modelling in finance using Excel and VBA
18	54602	Advanced models for project management
19	44621	Algebraic riccati equations
20	44472	algorithm design manual
21	44636	Algorithms in C++

✓ Query executed successfully.





Το Query που θα έπαιρνα είναι το πρώτο διότι βλέπουμε ότι έχει πιο γρήγορο χρόνο εκτέλεσης, καθώς και ένα καλύτερο query plan, στο οποίο βλέπουμε ότι με την χρήση σωστού ευτερητηρίου θα κάνει την εκτέλεση του ακόμη πιο γρήγορη καθώς βοηθάει και το sub-query στην εκτέλεση του.

2) Το ευρετήριο που επέλεξα είναι το παρακάτω, διότι το συγκεκριμένο θα βοηθήσει και τα δύο query και sub-query στην γρήγορη εκτέλεση του και αυτό φαίνεται από τον χρόνο στην εικόνα παρακάτω.

**create index copy\_index**

**on copies(copyloc, bibno);**

```
select distinct b.bibno, b.title
from bibrecs as b join copies as c
on b.bibno = c.bibno
where copyloc = 'OPA' and b.bibno in (select b.bibno
                                     from bibrecs as b join copies as c
                                     on b.bibno = c.bibno
                                     where copyloc = 'ANA');
```

10 %

Results Messages

SQL Server parse and compile time:

CPU time = 15 ms, elapsed time = 33 ms.

(702 rows affected)

SQL Server Execution Times:

CPU time = 31 ms, elapsed time = 93 ms.

Completion time: 2020-04-23T03:03:42.4776423+03:00

## Ζήτημα 4

Το query για την δημιουργία του πίνακα words είναι το ακόλουθο:

**create table words(**



```
wid int,  
word varchar(100),  
primary key(wid)  
);
```

Για το 2ο πίνακα έχουμε το ακόλουθο query:

```
create table bibwords(  
    wid int,  
    bibno int,  
    primary key(wid, bibno),  
    foreign key (wid) references words(wid),  
    foreign key (bibno) references bibrecs(bibno)  
);  
2)
```

Ένα χρήσιμο ευρετήριο χρήσιμο ευρετήριο θα ήταν ακόλουθο:

```
create index word_index  
on words(word);
```

Η λογική είναι ότι γίνονται πολλές αναζητήσεις για να βρούμε την συγκεκριμένη λέξη, κυρίως στην συνθήκη του where.

Ένα άλλο χρήσιμο ευρετήριο θα ήταν επίσης και το ακόλουθο:

```
create index wid_bibwords_index  
on bibwords(wid);
```

Ο λόγος που είναι χρήσιμο το συγκεκριμένο index είναι διότι το wid του πίνακα bibwords θα χρησιμοποιηθεί για να γίνει join με τον πίνακα

words, καθώς μπορεί να έχουμε χιλιάδες εγγραφές για ένα record θα ήταν χρήσιμο να γίνει γρήγορα το join.

Ομοίως και για το όρισμα bibno του πίνακα bibwords που θα κάνει join με το bibrecs.

```
create index bibrecs_bibwords_index  
on bibrecs(bibno);
```