

**Συστήματα Διαχείρισης Βάσεων Δεδομένων – 5<sup>ο</sup> Εξάμηνο**

**Ιανουάριος 2024**

Μέλη ομάδας:

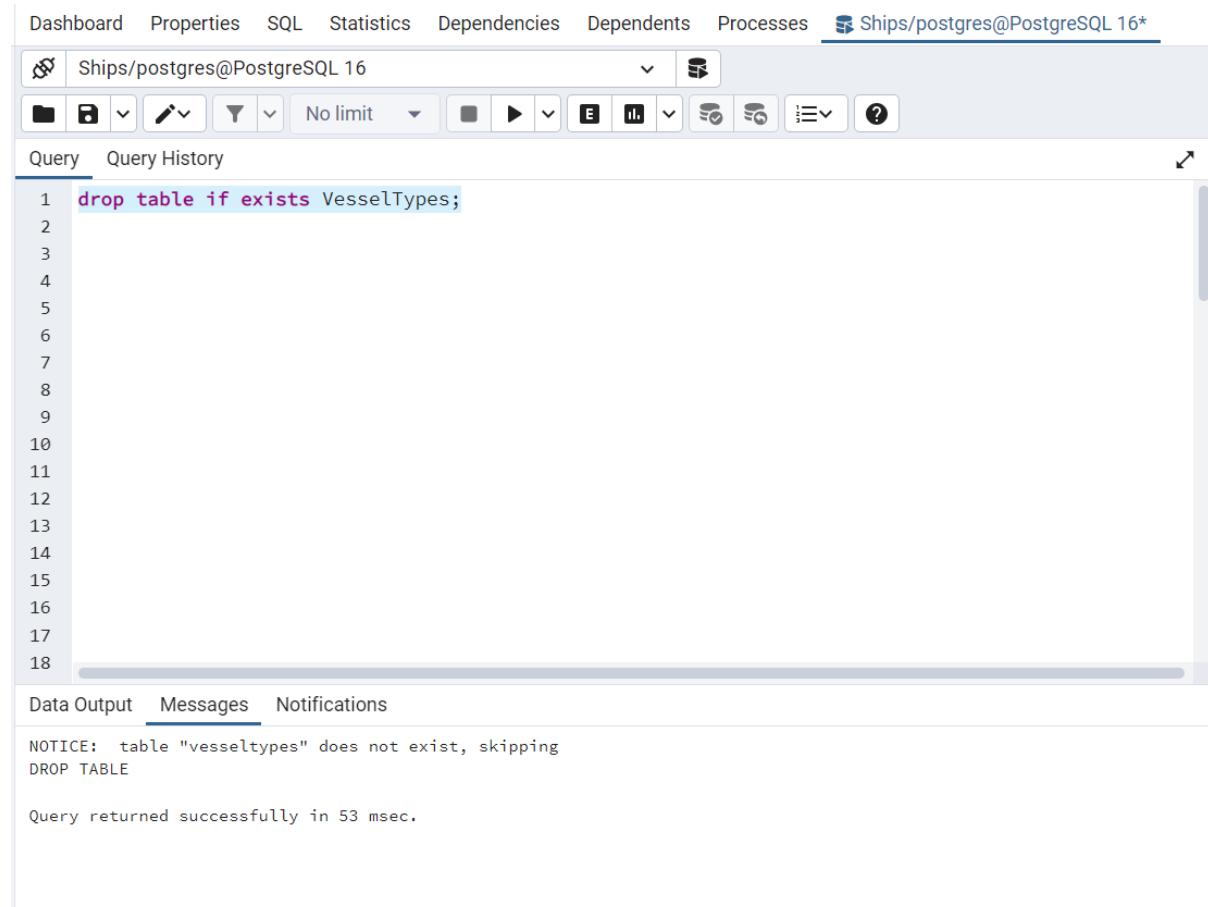
Π20048 – ΖΗΝΑ ΓΚΟΥΜΑ

Π20035 – ΝΑΤΑΛΙΑ ΒΟΡΙΖΑΝΑΚΗ

Π21227 – ΙΩΑΝΝΗΣ ΓΚΟΤΣΟΠΟΥΛΟΣ

## Ερώτημα 1 (30 %)

Αρχικά φορτώνουμε τα δεδομένα μας στην PostgreSQL. Πρώτα ελέγχουμε εάν υπάρχει ο πίνακας Vesseltypes .



The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with tabs: Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and one for the current connection: Ships/postgres@PostgreSQL 16\*. Below the navigation bar is a toolbar with various icons for database management. The main area is divided into two sections: 'Query' and 'Query History'. The 'Query' section contains the following SQL code:

```
1 drop table if exists VesselTypes;
```

The 'Messages' tab is selected at the bottom, showing the following output:

```
NOTICE:  table "vesseltypes" does not exist, skipping
DROP TABLE
```

Below the messages, it says: "Query returned successfully in 53 msec."

Εφόσον δεν υπάρχει ο συγκεκριμένος πίνακας, δημιουργούμε έναν

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The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with links: Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab labeled "Ships/postgres@PostgreSQL 16\*". Below the navigation bar is a toolbar with various icons for database management tasks. The main area is divided into two panes: "Query" (active) and "Query History". The "Query" pane contains the following SQL code:

```
1 drop table if exists VesselTypes;
2
3 CREATE TABLE VesselTypes (
4     code integer,
5     description text,
6     PRIMARY KEY (code)
7 );
8
9
10
11
12
13
14
15
16
17
18
```

Below the code, the "Messages" tab is selected, showing the execution results:

CREATE TABLE

Query returned successfully in 31 msec.

Έχοντας ολοκληρωθεί η δημιουργία της πίνακας VesselTypes, στη συνέχεια φορτώνουμε τα δεδομένα του CSV αρχείου VesselTypes στον πίνακα VesselTypes.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
1 drop table if exists VesselTypes;
2
3 CREATE TABLE VesselTypes (
4     code integer,
5     description text,
6     PRIMARY KEY (code)
7 );
8
9 copy VesselTypes from 'C:\University\VesselTypes.csv' with csv header delimiter ',';
10
11
12
13
14
15
16
17
18
```

Data Output Messages Notifications

COPY 106

Query returned successfully in 32 msec.

Τώρα ακολουθούμε τα ίδια βήματα για τον πίνακα Vessels.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
1 drop table if exists VesselTypes;
2
3 CREATE TABLE VesselTypes (
4     code integer,
5     description text,
6     PRIMARY KEY (code)
7 );
8
9 copy VesselTypes from 'C:\University\VesselTypes.csv' with csv header delimiter ',';
10
11 drop table if exists Vessels;
12
13
14
15
16
17
18
```

Data Output Messages Notifications

NOTICE: table "vessels" does not exist, skipping  
DROP TABLE

Query returned successfully in 52 msec.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
11 drop table if exists Vessels;
12
13 CREATE TABLE Vessels (
14     id varchar(64),
15     type integer,
16     flag varchar(30),
17     PRIMARY KEY (id),
18     FOREIGN KEY (type) REFERENCES vesseltypes(code)
19 );
20
21
22
23
24
25
26
27
28
```

Data Output Messages Notifications

CREATE TABLE

Query returned successfully in 51 msec.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit E

Query History

```
11 drop table if exists Vessels;
12
13 CREATE TABLE Vessels (
14     id varchar(64),
15     type integer,
16     flag varchar(30),
17     PRIMARY KEY (id),
18     FOREIGN KEY (type) REFERENCES vesseltypes(code)
19 );
20
21 copy Vessels from 'C:\University\Vessels.csv' with csv header delimiter ',';
22
23
24
25
26
27
28
```

Data Output Messages Notifications

COPY 489

Query returned successfully in 45 msec.

Τώρα πραγματοποιούμε την ίδια διαδικασία για τον πίνακα

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
11 drop table if exists Vessels;
12
13 CREATE TABLE Vessels (
14     id varchar(64),
15     type integer,
16     flag varchar(30),
17     PRIMARY KEY (id),
18     FOREIGN KEY (type) REFERENCES vesseltypes(code)
19 );
20
21 copy Vessels from 'C:\University\Vessels.csv' with csv header delimiter ',';
22
23 drop table if exists Positions;
24
25
26
27
28
```

Data Output Messages Notifications

NOTICE: table "positions" does not exist, skipping

DROP TABLE

Query returned successfully in 45 msec.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
23 drop table if exists Positions;
24
25 CREATE TABLE Positions (
26     id bigint NOT NULL,
27     vessel_id varchar(64),
28     t timestamp,
29     lon double precision,
30     lat double precision,
31     heading double precision,
32     course double precision,
33     speed double precision,
34     PRIMARY KEY (id),
35     FOREIGN KEY (vessel_id) REFERENCES vessels(id)
36 );
37
38
39
40
```

Data Output Messages Notifications

CREATE TABLE

Query returned successfully in 55 msec.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```
23 drop table if exists Positions;
24
25 CREATE TABLE Positions (
26     id bigint NOT NULL,
27     vessel_id varchar(64),
28     t timestamp,
29     lon double precision,
30     lat double precision,
31     heading double precision,
32     course double precision,
33     speed double precision,
34     PRIMARY KEY (id),
35     FOREIGN KEY (vessel_id) REFERENCES vessels(id)
36 );
37
38 copy Positions from 'C:\University\Positions.csv' with csv header delimiter ',';
39
40
```

Data Output Messages Notifications

COPY 7036651

Query returned successfully in 1 min 28 secs.

Total rows: 0 of 0 | Query complete 00:01:28.597

Τώρα ανανεώνουμε τα στατιστικά με τη χρήση της εντολής VACUUM

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit ▾

Query History

```
28     t timestamp,
29     lon double precision,
30     lat double precision,
31     heading double precision,
32     course double precision,
33     speed double precision,
34     PRIMARY KEY (id),
35     FOREIGN KEY (vessel_id) REFERENCES vessels(id)
36 );
37
38 copy Positions from 'C:\University\Positions.csv' with csv header delimiter ',';
39
40 VACUUM FULL VesselTypes;
41 VACUUM FULL Vessels;
42 VACUUM FULL Positions;
43
44
45
```

Data Output Messages Notifications

VACUUM

Query returned successfully in 49 msec.

Total rows: 0 of 0 Query complete 00:00:00.049

✓ Query returned successfully in 49 msec. × Ln 40, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit ▾

Query History

```
28     t timestamp,
29     lon double precision,
30     lat double precision,
31     heading double precision,
32     course double precision,
33     speed double precision,
34     PRIMARY KEY (id),
35     FOREIGN KEY (vessel_id) REFERENCES vessels(id)
36 );
37
38 copy Positions from 'C:\University\Positions.csv' with csv header delimiter ',';
39
40 VACUUM FULL VesselTypes;
41 VACUUM FULL Vessels;
42 VACUUM FULL Positions;
43
44
45
```

Data Output Messages Notifications

VACUUM

Query returned successfully in 47 msec.

Total rows: 0 of 0 Query complete 00:00:00.047

✓ Query returned successfully in 47 msec. × Ln 41, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit E S ?

Query History Scratch Pad

```
28     t timestamp,
29     lon double precision,
30     lat double precision,
31     heading double precision,
32     course double precision,
33     speed double precision,
34     PRIMARY KEY (id),
35     FOREIGN KEY (vessel_id) REFERENCES vessels(id)
36 );
37
38 copy Positions from 'C:\University\Positions.csv' with csv header delimiter ',';
39
40 VACUUM FULL VesselTypes;
41 VACUUM FULL Vessels;
42 VACUUM FULL Positions;
```

Data Output Messages Notifications

VACUUM

Query returned successfully in 17 secs 163 msec.

Total rows: 0 of 0 Query complete 00:00:17.163 Ln 42, Col 1

✓ Query returned successfully in 17 secs 163 msec. X

## Ερώτημα 1 i.

### η Εκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```
1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
```

Data Output Messages Explain Notifications

	calendarday	numofoccurrences
1	2019-08-05	695757
2	2019-08-04	543604
3	2019-08-28	515392
4	2019-08-06	490819
5	2019-08-11	408012
6	2019-08-10	406090
7	2019-08-03	357393
8	2019-08-29	356825
9	2019-08-16	350259
10	2019-08-07	341773
11	2019-08-27	305732

✓ Successfully run. Total query runtime: 1 secs 392 msec. 24 rows affected. ✘

Total rows: 24 of 24 Query complete 00:00:01.392 Ln 2, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

	calendarday	numofoccurrences
1	2019-08-05	695757
2	2019-08-04	543604
3	2019-08-28	515392
4	2019-08-06	490819
5	2019-08-11	408012
6	2019-08-10	406090
7	2019-08-03	357393
8	2019-08-29	356825
9	2019-08-16	350259
10	2019-08-07	341773
11	2019-08-27	305732
12	2019-08-17	303885
13	2019-08-12	284402
14	2019-08-01	253844
15	2019-08-02	251133
16	2019-08-15	248170
17	2019-08-09	216958
18	2019-08-08	207113
19	2019-08-18	201904
20	2019-08-19	126262
21	2019-08-30	90467
22	2019-08-14	720064

Total rows: 24 of 24 Query complete 00:00:01.392 Ln 2, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

calendarday date numofoccurrences

	calendarday date	numofoccurrences
1	2019-08-26	310392
4	2019-08-06	490819
5	2019-08-11	408012
6	2019-08-10	406090
7	2019-08-03	357393
8	2019-08-29	356825
9	2019-08-16	350259
10	2019-08-07	341773
11	2019-08-27	305732
12	2019-08-17	303885
13	2019-08-12	284402
14	2019-08-01	253844
15	2019-08-02	251133
16	2019-08-15	248170
17	2019-08-09	216958
18	2019-08-08	207113
19	2019-08-18	201904
20	2019-08-19	126262
21	2019-08-30	90467
22	2019-08-14	72994
23	2019-08-13	4427
24	2019-08-26	3436

Total rows: 24 of 24 Query complete 00:00:01.392 Ln 2, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 1 secs 392 msec.  
24 rows affected.

Total rows: 24 of 24 Query complete 00:00:01.392 Ln 2, Col 1

The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with links like Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and the current connection name, Ships/postgres@PostgreSQL 16\*. Below the navigation bar is a toolbar with various icons for file operations, search, and database management.

The main area contains a query editor tab labeled "Query" and a scratch pad tab. The query editor contains the following SQL code:

```

1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;

```

Below the query editor are tabs for Data Output, Messages, Explain, Notifications, Graphical, Analysis, and Statistics. The Explain tab is currently selected, showing a query execution plan with nodes: positions → Aggregate → Sort → Gather Merge → Aggregate → Sort. Each node has a small icon above it.

At the bottom of the interface, there's a status bar with the message "Successfully run. Total query runtime: 52 msec. 1 rows affected.", the total rows (1 of 1), the query completion time (00:00:00.052), and the current line and column (Ln 2, Col 1).

Στο παραπάνω query, επιλέγουμε να εμφανίσουμε την ημερομηνία, από τον πίνακα Positions εξάγοντας την ημερομηνία από το αποκόπτει τα υπόλοιπα μέρη της ημερομηνίας (δηλαδή την ώρα, τα λεπτά, τα δευτερόλεπτα). Έπειτα, μετράμε το πλήθος των καταχωρήσεων στιγμάτων για κάθε ημερομηνία. Στη συνέχεια, το αποτέλεσμα ομαδοποιείται ανά ημερομηνία και ταξινομείται σε φθίνουσα σειρά με βάση τον αριθμό των καταχωρήσεων των στιγμάτων.

## η Εκτέλεση query

Τώρα θα τρέξουμε ξανά το query ώστε να δούμε τη διαφορά στο χρόνο εκτέλεσης.

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab for "Ships/postgres@PostgreSQL 16\*".
- Query Editor:** Contains the following SQL code:

```
1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
```
- Data Output:** Displays a table with two columns: "calendarday" (date) and "numofoccurrences" (bigint). The data is as follows:

	calendarday	numofoccurrences
1	2019-08-05	695757
2	2019-08-04	543604
3	2019-08-28	515392
4	2019-08-06	490819
5	2019-08-11	408012
6	2019-08-10	406090
7	2019-08-03	357393
8	2019-08-29	356825
9	2019-08-16	350259
10	2019-08-07	341773
11	2019-08-27	305732

- Status Bar:** Shows "Total rows: 24 of 24" and "Query complete 00:00:00.818".
- Message Bar:** A green box indicates "Successfully run. Total query runtime: 818 msec. 24 rows affected." with a close button.
- Bottom Right:** Shows "Ln 2, Col 1".

The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with links: Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab labeled "Ships/postgres@PostgreSQL 16\*". Below the navigation bar is a toolbar with various icons for database management tasks. The main area is divided into two tabs: "Query" (which is active) and "Query History". The "Query" tab contains the following SQL code:

```
1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
```

Below the code, there are tabs for "Data Output", "Messages" (which is selected), "Explain", and "Notifications". A message in the "Messages" tab states: "Successfully run. Total query runtime: 818 msec. 24 rows affected." At the bottom of the interface, there are status messages: "Total rows: 24 of 24" and "Query complete 00:00:00.818", along with a cursor position indicator "Ln 2, Col 1".

## η Εκτέλεση query

Τώρα θα τρέξουμε ξανά το query ώστε να δούμε τη διαφορά στο χρόνο εκτέλεσης.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

calendarday	numofoccurrences
2019-08-05	695757
2019-08-04	543604
2019-08-28	515392
2019-08-06	490819
2019-08-11	408012
2019-08-10	406090
2019-08-03	357393
2019-08-29	356825
2019-08-16	350259
2019-08-07	341773
2019-08-27	305732

Successfully run. Total query runtime: 785 msec. 24 rows affected. X

Total rows: 24 of 24 Query complete 00:00:00.785 Ln 2, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

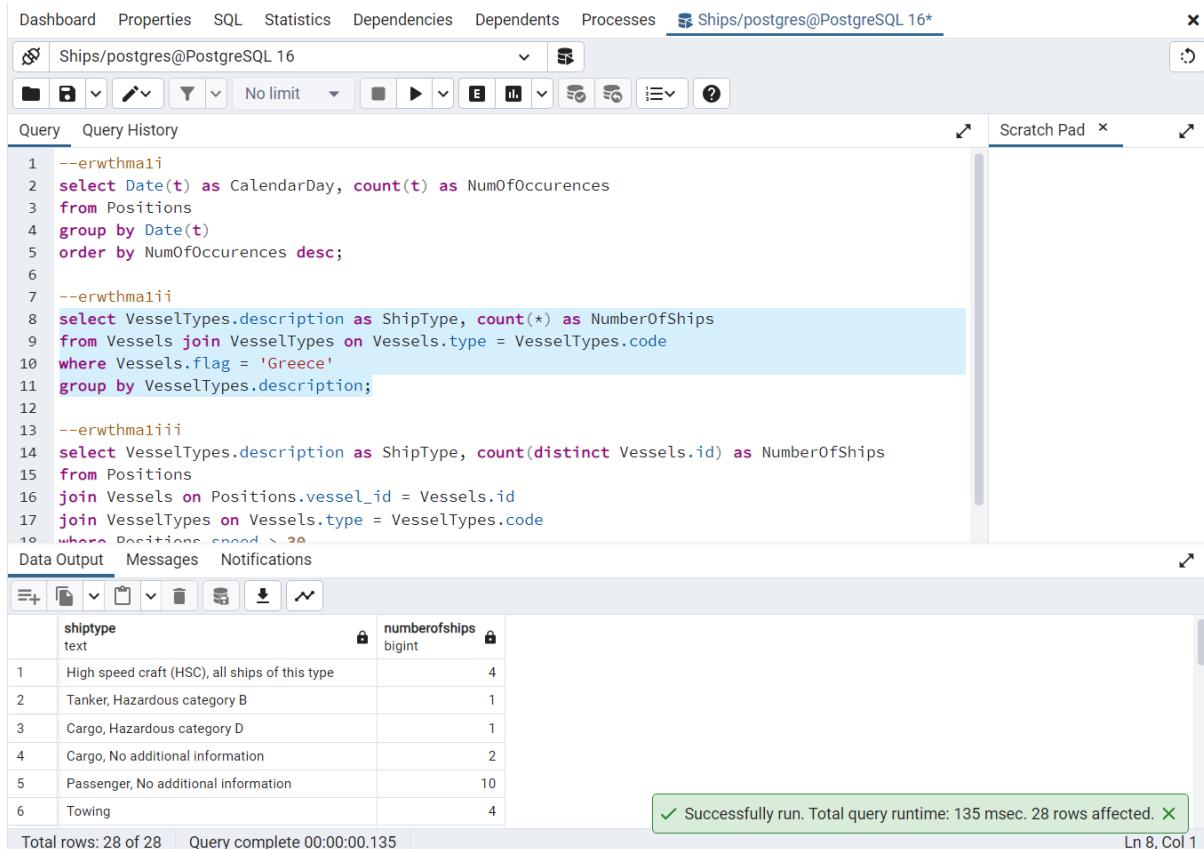
Data Output Messages Explain Notifications

Successfully run. Total query runtime: 785 msec.  
24 rows affected.

Total rows: 24 of 24 Query complete 00:00:00.785 Ln 2, Col 1

## Ερώτημα 1 ii.

### 1η Εκτέλεση query



```
Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16*
Ships/postgres@PostgreSQL 16* Query History Scratch Pad
Query
1 --erwthmaili
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaili
14 select VesselTypes.description as ShipType, count(distinct Vessels.id) as NumberOfShips
15 from Positions
16 join Vessels on Positions.vessel_id = Vessels.id
17 join VesselTypes on Vessels.type = VesselTypes.code
18 where Positions.speed > 20
Data Output Messages Notifications
shiptype numberofships
text bigint
1 High speed craft (HSC), all ships of this type 4
2 Tanker, Hazardous category B 1
3 Cargo, Hazardous category D 1
4 Cargo, No additional information 2
5 Passenger, No additional information 10
6 Towing 4
Total rows: 28 of 28 Query complete 00:00:00.135 Ln 8, Col 1
Successfully run. Total query runtime: 135 msec. 28 rows affected.
```

Σε αυτό το query, επιλέγουμε την περιγραφή του τύπου του σκάφους και την ονομάζουμε ShipType. Έπειτα, μετράμε τον αριθμό των σκαφών για κάθε τύπο πλοίου. Στην συνέχεια, γίνεται join στους πίνακες VesselTypes και Vessels στα αντίστοιχα πεδία τύπου και κωδικού. Επιπλέον, το αποτέλεσμα φιλτράρεται ώστε να συμπεριλαμβάνονται μόνο πλοία που έχουν ελληνική σημαία. Τέλος, το αποτέλεσμα ομαδοποιείται με βάση την περιγραφή του τύπου πλοίου.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit E

Data Output Messages Notifications

	shiptype	numberofships
	text	bigint
1	High speed craft (HSC), all ships of this type	4
2	Tanker, Hazardous category B	1
3	Cargo, Hazardous category D	1
4	Cargo, No additional information	2
5	Passenger, No additional information	10
6	Towing	4
7	Pilot Vessel	4
8	Tanker, all ships of this type	34
9	Pleasure Craft	25
10	Cargo, all ships of this type	14
11	Tanker, Hazardous category A	10
12	Anti-pollution equipment	1
13	Reserved for future use	1
14	High speed craft (HSC), No additional information	3
15	Sailing	29
16	Passenger, all ships of this type	40
17	Not available (default)	4
18	High speed craft (HSC), Hazardous category B	1
19	Wing in ground (WIG), Reserved for future use	1
20	Other Type, Hazardous category A	1
21	Tanker, Hazardous category C	1
22	Tanker, No additional information	7

Total rows: 28 of 28 Query complete 00:00:00.135 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit E

Data Output Messages Notifications

	shiptype	numberofships
	text	bigint
7	Pilot Vessel	4
8	Tanker, all ships of this type	34
9	Pleasure Craft	25
10	Cargo, all ships of this type	14
11	Tanker, Hazardous category A	10
12	Anti-pollution equipment	1
13	Reserved for future use	1
14	High speed craft (HSC), No additional information	3
15	Sailing	29
16	Passenger, all ships of this type	40
17	Not available (default)	4
18	High speed craft (HSC), Hazardous category B	1
19	Wing in ground (WIG), Reserved for future use	1
20	Other Type, Hazardous category A	1
21	Tanker, Hazardous category C	1
22	Tanker, No additional information	7
23	Search and Rescue vessel	1
24	Other Type, no additional information	4
25	Other Type, all ships of this type	3
26	Tug	29
27	Fishing	6
28	Passenger, Hazardous category A	1

Total rows: 28 of 28 Query complete 00:00:00.135 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Notifications

Successfully run. Total query runtime: 135 msec.  
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.135 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Explain Notifications

Graphical Analysis Statistics

vessels Hash Inner Join Aggregate

vesseltypes Hash

✓ Successfully run. Total query runtime: 56 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.056 Ln 8, Col 1

## **2<sup>η</sup> Εκτέλεση query**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

shiptype	numberofships
High speed craft (HSC), all ships of this type	4
Tanker, Hazardous category B	1
Cargo, Hazardous category D	1
Cargo, No additional information	2
Passenger, No additional information	10
Towing	4
Pilot Vessel	4
Tanker, all ships of this type	34
Pleasure Craft	25
Cargo, all ships of this type	14
Tanker, Hazardous category A	10

Successfully run. Total query runtime: 73 msec. 28 rows affected. Ln 8, Col 1

Total rows: 28 of 28 Query complete 00:00:00.073

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthma1i
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthma1ii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 73 msec.  
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.073 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit E H ? Scratch Pad

Query History

```

1 --erwthmai1
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmai1i
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

vessels vesseltypes Hash Hash Inner Join Aggregate

Successfully run. Total query runtime: 39 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.039 Ln 8, Col 1

### 3η Εκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthmalii
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

shiptype	numberofships
High speed craft (HSC), all ships of this type	4
Tanker, Hazardous category B	1
Cargo, Hazardous category D	1
Cargo, No additional information	2
Passenger, No additional information	10
Towing	4
Pilot Vessel	4
Tanker, all ships of this type	34
Pleasure Craft	25
Cargo, all ships of this type	14
Tanker, Hazardous category A	10

Successfully run. Total query runtime: 61 msec. 28 rows affected. X

Total rows: 28 of 28 Query complete 00:00:00.061 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 --erwthmalii
2 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 61 msec.  
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.061 Ln 8, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit E II ? Scratch Pad

Query History

```

1 --erwthmai1
2 select Date(t) as CalendarDay, count(*) as NumOfOccurrences
3 from Positions
4 group by Date(t)
5 order by NumOfOccurrences desc;
6
7 --erwthmai11
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

vessels vesseltypes Hash Hash Inner Join Aggregate

✓ Successfully run. Total query runtime: 48 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.048 Ln 8, Col 1

## Ερώτημα 1 iii.

### η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface. At the top, there's a toolbar with various icons for file operations like Open, Save, and Print. Below the toolbar is a menu bar with options like Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab labeled 'Ships/postgres@PostgreSQL 16\*'. The main area has tabs for 'Query' and 'Query History', with 'Query' currently selected. The query editor contains the following SQL code:

```

10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmailii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15     count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;

```

Below the query editor is a 'Data Output' tab, which is currently active. It displays a table with the following data:

vessel_id	shiptype	numberofships
1	Cargo, Hazardous category A	2
2	High speed craft (HSC), all ships of this type	4599
3	High speed craft (HSC), No additional information	5430
4	High speed craft (HSC), all ships of this type	8436
5	High speed craft (HSC), all ships of this type	32971
6	Tanker, all ships of this type	4
7	High speed craft (HSC), No additional information	10859
8	High speed craft (HSC), all ships of this type	9782
9	Passenger, all ships of this type	16
10	High speed craft (HSC), Hazardous category B	68564
11	High speed cra	

A message at the bottom right of the results grid says "Successfully run. Total query runtime: 658 msec. 16 rows affected.".

Στο συγκεκριμένο query, επιλέγουμε την περιγραφή του τύπου του σκάφους από τον πίνακα VesselTypes και την ονομάζουμε σκαφών για κάθε τύπο πλοίου που πληροί τα κριτήρια. Στην συνέχεια, γίνεται ένα διπλό JOIN: ένα του πίνακα Positions με τον Vessels και ένα του πίνακα Vessels με τον VesselTypes. Τέλος, το αποτέλεσμα ομαδοποιείται με βάση την περιγραφή του τύπου πλοίου.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Notifications

vessel\_id shiptype numberofships

	vessel_id	shiptype	numberofships
1	7475bb3647d8bb62aa76547601ddf92dc356b5de07fcdd3fcfb2c1c43e8d9be	Cargo, Hazardous category A	2
2	d8424a3a6af4a7a3aedb80308bc6a000c5a6b99511706aa04a79d32262a2b7...	High speed craft (HSC), all ships of this type	4599
3	53880c54896ed4abe0fc51d4173ca486a97f679a8e34b6dc3ebe4a6586bc3f31	High speed craft (HSC), No additional information	5430
4	b6ce45e37aff96757b2a87fd26dc99a7ec30482321646863e08061e01c3a6c6a	High speed craft (HSC), all ships of this type	8436
5	1eee5599ef5de5c07df6698ab4d4a6e6bbe4a2be25208864a8876cf6050452ad	High speed craft (HSC), all ships of this type	32971
6	8e75c1624d2d78c03df3598aaa14f5fce6252557fb7b3f8b0426df5d5edbc	Tanker, all ships of this type	4
7	3fc28f4d2b3c7cb5f68d5b71f6fd727e4f8cd66515d98466fd3d1066e624ede	High speed craft (HSC), No additional information	10859
8	f695447603e623ec3e0f9d7667932e9a81880b56757f966cf6d647d6ce355a6	High speed craft (HSC), all ships of this type	9782
9	c7264ef76fbcb3a6695a16313e0bda49aa753d1fe3a5aa625be915ad756122a	Passenger, all ships of this type	16
10	57139e85177dea04c5a366a3c24ca31a613754c1379d3e5cd844995e479ddf...	High speed craft (HSC), Hazardous category B	68564
11	9d6bce74b377738891597e999b99deaa67fd5b90466d8d40b56dbe0d295d13...	High speed craft (HSC), all ships of this type	12786
12	4babbc0d3d48cf988de1a317acb5a62ce72bf0a17e5510fa3d4ebdcff6fb7b	Towing	37
13	eb538d8d3b4da934559c3bc761faf1fb6414f00e54b037d915a6172b32f7aabf	High speed craft (HSC), all ships of this type	56212
14	9a0729a6294dcf984fb483879732a7b9cc864ef7cd70003c0f7befb8a1252d	Cargo, all ships of this type	15
15	9ea327071a3ab8fb39601c3c7ff79397fc7de77f7fb2aa8d25daa2631400b133	Pleasure Craft	14
16	26199b57ef2b787a02bf09d81b98aa7ca1a984091c6a2b6d00ee43237a2535...	Tanker, all ships of this type	7

Total rows: 16 of 16 Query complete 00:00:00.658 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

7 --erwthmali
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmali
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15     count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Notifications

Successfully run. Total query runtime: 658 msec.  
16 rows affected.

Total rows: 16 of 16 Query complete 00:00:00.658 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaliii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.060 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaliii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.060 Ln 14, Col 1

## 2<sup>η</sup> Εκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaili
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15     count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

vessel_id	shiptype	numberofships
7475b03647d8bb2aa76547601ddf92dc356b5de07fcddd3fcfb2c1c43e8d9be	Cargo, Hazardous category A	2
d8424a3a6af4a7a3aedb80308bc6a000c5a6b9951706aa04a79d32262a2b7...	High speed craft (HSC), all ships of this type	4599
53880c54896ed4abe0fc51d4173ca486a97f679a8e34b6dc3ebe4a6586bc3f31	High speed craft (HSC), No additional information	5430
b6ce45e37aff96757b2a87fd26dc99a7ec30482321646863e08061e01c3a6c6a	High speed craft (HSC), all ships of this type	8436
1eee5599ef5de5c07df6698ab4d4a6e6bbe4a2be25208864a8876cf6050452ad	High speed craft (HSC), all ships of this type	32971
8e75c1624d2d78c0f3df3598aaa14f5fce6252557fb7b3f8b0426df5d5edbc	Tanker, all ships of this type	4
3fc28f4d2b3c7cb5f68d5b71f6da727e4f8cd66515d98466fd3d1066e624ede	High speed craft (HSC), No additional information	10859
f695447603e623ec3e0f9d7667932e9a81880b56757f966cfdd647d6ce355a6	High speed craft (HSC), All ships	16
q -7244d76f110b3a6695a16213a01a0aa753a1f2a5aa625he915aa756122a	Passenger, all	

Total rows: 16 of 16    Query complete 00:00:00.651    Successfully run. Total query runtime: 651 msec. 16 rows affected. Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaili
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15     count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 651 msec.  
16 rows affected.

Total rows: 16 of 16    Query complete 00:00:00.651    Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmalii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Successful run. Total query runtime: 56 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.056 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

7 --erwthmalii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmalii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Successful run. Total query runtime: 56 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.056 Ln 14, Col 1

### 3<sup>η</sup> Εκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaili
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

vessel_id	shiptype	numberofships
7475bb3647d8bb2aa76547601ddf92dc356b5de07fcdd3fcfb2c1c43e8d9be	Cargo, Hazardous category A	2
d8424a3a6af4a7a3aedb80308bc6a000c5a6b9951706aa04a79d32262a2b7...	High speed craft (HSC), all ships of this type	4599
53880c54896ed4abe0fc51d4173ca486a97f679a8e34b6dc3ebe4a6586bc3f31	High speed craft (HSC), No additional information	5430
b6ce45e37aff96757b2a87fd26dc99a7ec30482321646863e08061e01c3a6c6a	High speed craft (HSC), all ships of this type	8436
1eee5599ef5de5cd07df6698ab4d4a6e6bbe4a2be25208864a8876cf16050452ad	High speed craft (HSC), all ships of this type	32971
8e75c1624d2d78c0f3df3598aaa14f5fce6252557fb7b3f8b0426df1f5d5edbc	Tanker, all ships of this type	4
3fc28f4d2b3c7cb5f68d5b71f6da727e4f8cd66515d98466fd3d1066e624ede	High speed craft (HSC), No additional information	10859
f695447603e623ec3e0f9d7667932e9a81880b56757f966cfdd6d647d6ce355a6	High speed craft (HSC), All ships	
q c7264af76fbfbch3a6605a1a313a0fbfa49aa753d11fe2a5aa675he015ad756122a	Passenger, all	

Successfully run. Total query runtime: 629 msec. 16 rows affected. X

Total rows: 16 Query complete 00:00:00.629 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

7 --erwthmaili
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmaili
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 629 msec.

16 rows affected.

Total rows: 16 Query complete 00:00:00.629 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit ▾

Query History Scratch Pad

```

7 --erwthmailii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmailii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Successfully run. Total query runtime: 36 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.036 Ln 14, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit ▾

Query History Scratch Pad

```

7 --erwthmailii
8 select VesselTypes.description as ShipType, count(*) as NumberOfShips
9 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
10 where Vessels.flag = 'Greece'
11 group by VesselTypes.description;
12
13 --erwthmailii
14 select Positions.vessel_id, VesselTypes.description as ShipType,
15 count(Vessels.id) as NumberOfShips
16 from Positions
17 join Vessels on Positions.vessel_id = Vessels.id
18 join VesselTypes on Vessels.type = VesselTypes.code
19 where Positions.speed > 30
20 group by VesselTypes.description, Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Successfully run. Total query runtime: 36 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.036 Ln 14, Col 1

## Ερώτημα 1 iv.

### η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab for "Ships/postgres@PostgreSQL 16\*".
- Query Editor:** Contains the following SQL code:

```
1 --erwthma1iv
2 select
3     date(Positions.t) as RecordedDay,
4     count(*) as NumberOfSpots
5 from
6     Positions
7 join
8     Vessels on Positions.vessel_id = Vessels.id
9 join
10    VesselTypes on Vessels.type = VesselTypes.code
11 where
12     VesselTypes.description like 'Passenger%' and
13     date(Positions.t) between '2019-08-14' and '2019-08-18'
14 group by
15     date(Positions.t)
16 order by
17     RecordedDay;
```
- Data Output:** Displays a table with the following data:

	recordedday date	numberofspots bigint
1	2019-08-14	20933
2	2019-08-15	69960
3	2019-08-16	109647
4	2019-08-17	97092
5	2019-08-18	63861
- Message Bar:** Shows a green message: "Successfully run. Total query runtime: 649 msec. 5 rows affected." with a close button.
- Bottom Status:** Shows "Total rows: 5 of 5" and "Query complete 00:00:00.649".
- Bottom Right:** Shows "Ln 1, Col 1".

Σε αυτό το query, αρχικά εξάγουμε το τμήμα της ημερομηνίας από το t, το ονομάζουμε RecordedDay και μετράμε τον αριθμό των καταχωρήσεων θέσης για κάθε μέρα. Έπειτα, κάνουμε join τον πίνακα Positions με τον πίνακα Vessels και μετά κάνουμε join τον Vessels με τον VesselTypes. Φιλτράρουμε τα αποτελέσματα ώστε να περιλαμβάνουν μόνο τα πλοία των οποίων η περιγραφή ξεκινάει από 'Passenger..' και η ημερομηνία τους είναι στο συγκεκριμένο εύρος. Τέλος, ομαδοποιούμε τα προηγούμενα αποτελέσματα κατά ημέρα καταγραφής και τα ταξινομούμε με βάσει της ημέρας.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit Data Output Messages Notifications

	recordedday	numberofspots
	date	bigint
1	2019-08-14	20933
2	2019-08-15	69960
3	2019-08-16	109647
4	2019-08-17	97092
5	2019-08-18	63861

Total rows: 5 of 5 Query complete 00:00:00.649 Ln 1, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit Query History Scratch Pad

```

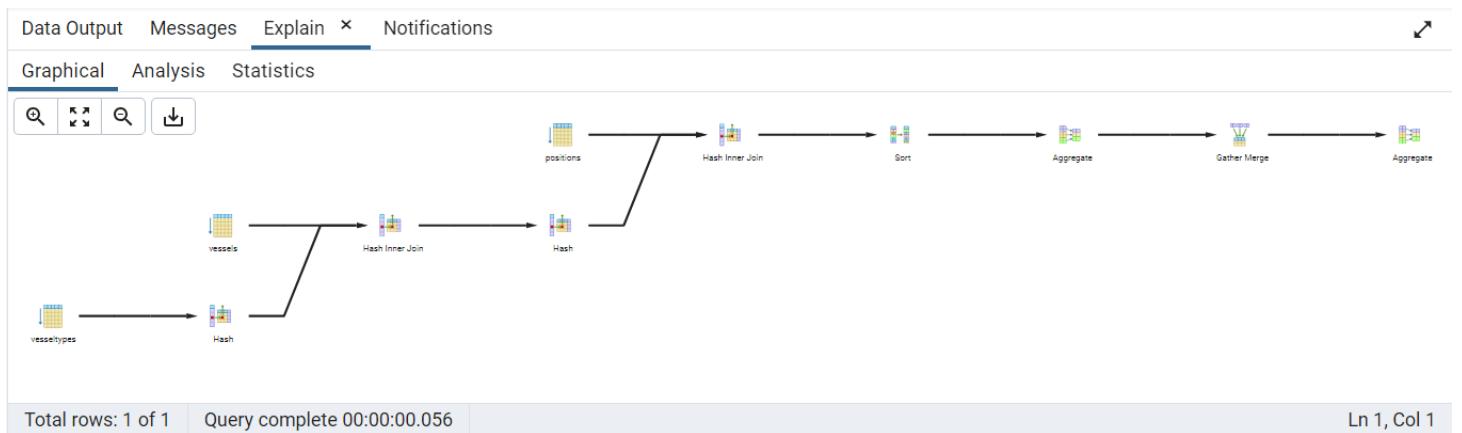
1 --erwthmaiiv
2 select
3   date(Positions.t) as RecordedDay,
4   count(*) as NumberOfSpots
5 from
6   Positions
7 join
8   Vessels on Positions.vessel_id = Vessels.id
9 join
10  VesselTypes on Vessels.type = VesselTypes.code
11 where

```

Data Output Messages Notifications

Successfully run. Total query runtime: 649 msec.  
5 rows affected.

Total rows: 5 of 5 Query complete 00:00:00.649 Ln 1, Col 1



## η Εκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

1 --erwthmaliv
2 select
3     date(Positions.t) as RecordedDay,
4     count(*) as NumberOfSpots
5 from
6     Positions
7 join
8     Vessels on Positions.vessel_id = Vessels.id
9 join
10    VesselTypes on Vessels.type = VesselTypes.code
11 where
12     VesselTypes.description like 'Passenger%' and
13     date(Positions.t) between '2019-08-14' and '2019-08-18'
14 group by
15     date(Positions.t)
16 order by
17     RecordedDay;
    
```

Data Output Messages Explain X Notifications

Successfully run. Total query runtime: 625 msec.  
5 rows affected.

Total rows: 5 of 5 | Query complete 00:00:00.625 | Ln 1, Col 1

## η Εκτέλεση query

The screenshot shows a PostgreSQL query editor interface. At the top, there's a navigation bar with tabs: Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a selected tab labeled "Ships/postgres@PostgreSQL 16\*". Below the navigation bar is a toolbar with various icons for database management tasks like creating tables, views, and functions.

The main area is divided into two panes: "Query" on the left and "Scratch Pad" on the right. The "Query" pane contains the following SQL code:

```
1 --erwthma1iv
2 select
3     date(Positions.t) as RecordedDay,
4     count(*) as NumberOfSpots
5 from
6     Positions
7 join
8     Vessels on Positions.vessel_id = Vessels.id
9 join
10    VesselTypes on Vessels.type = VesselTypes.code
11 where
12     VesselTypes.description like 'Passenger%' and
13     date(Positions.t) between '2019-08-14' and '2019-08-18'
14 group by
15     date(Positions.t)
16 order by
17     RecordedDay;
```

Below the query editor, there are tabs for "Data Output", "Messages" (which is currently selected), "Explain", and "Notifications". The "Messages" tab displays the following output:

Successfully run. Total query runtime: 660 msec.  
5 rows affected.

At the bottom of the interface, there are status messages: "Total rows: 5 of 5", "Query complete 00:00:00.660", and "Ln 1, Col 1".

## Ερώτημα 1 ν (α).

### η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres@PostgreSQL 16\*
- Query Editor:** Shows the query code:

```
16 order by
17     RecordedDay;
18
19
20 --erwthmaiv(a)
21 select distinct
22     Positions.vessel_id
23     from
24         Positions
25     join
26         Vessels on Positions.vessel_id = Vessels.id
27     join
28         VesselTypes on Vessels.type = VesselTypes.code
29     where
30         VesselTypes.description like 'Cargo%' and
31         Positions.speed = 0 and
32         date(positions.t) between '2019-08-15' and '2019-08-18';
```
- Data Output:** A table showing the results of the query, with the first few rows:

vessel_id
character varying (64)
1 04b6c84a518f833b7206a114ada7660d56888de1af6cabc7bbe2c46ea6a7...
2 05edaaf038e80b4952faf8ea6ee12f2e95066896dc0bc91fdaea37c491246...
3 065809b408897ba8c70edf8ebd41aa8a52517815c144f952f25bc20eb79c...
4 0d90e6842e1454ddcbc14e7832be23e7b4472c442e9598c6b81aad72f58...
5 0f716f97f000431fee902e552d9f059fe7c126268f8ceeb65ac26205c5b659...
6 1c90dbcba952d48ac3f00b0e2ce18c784830b331d8c46b31f1da68b47e53...
- Message Bar:** Successfully run. Total query runtime: 1 secs 119 msec. 34 rows affected.
- Status Bar:** Total rows: 34 of 34 Query complete 00:00:01.119 Ln 20, Col 1

Αρχικά, επιλέγουμε τα μοναδικά αναγνωριστικά των πλοίων. Έπειτα, κάνουμε πλοίων. Στην συνέχεια, κάνουμε άλλο ένα join των πίνακα Vessels με τον ώστε να περιέχει μόνο σκάφη των οποίων η περιγραφή ξεκινάει με “Cargo”, η ταχύτητά τους είναι μηδέν και η ημερομηνία του στίγματός τους να είναι η ζητούμενη.

	<b>id</b> character varying 
1	04b6c84a518f83...
2	05edaaf038e80b...
3	065809b408897...
4	0d90e6842e145...
5	0f716f97f000431...
6	1c90dbcba952d4...
7	404a6c642206c3...
8	40de79bc837859...
9	40e17976df71c8...
10	484148639e0c82...
11	5b53cea1893df6...
12	60c934a8d1afcc...
13	66d16aac6efd45...
14	69cb1c8b3a1d7c...
15	6bbe3d8b3472cf...
16	7475bb3647d8b...
17	78557b0569d70...
18	7b6523e23ee408...
19	7bf6ebddc7d705...
20	80bc912679dfb6...
21	8d56a28f51163c...
22	8dfb0b67f2fb00...
23	9001bc01dfc3c3...
24	9461996576cf9b...
25	a22a17d47bff1c...
26	b3f3ee37465e4a...
27	bac263db165c5c...
28	bf6e7816d1c33f...
29	d030cef60611b7...
30	d6b4ca21a3677d...
31	da8ce411f6eb03...
32	db7c5e070cb552...
33	e3d1c069fc2718...
34	f83722e1d3a9ed...

Dashboard Properties SQL Statistics Dependencies Dependents Processes [Ships/postgres@PostgreSQL 16\\*](#) 

 Ships/postgres@PostgreSQL 16                    

Query Query History  Scratch Pad 

```

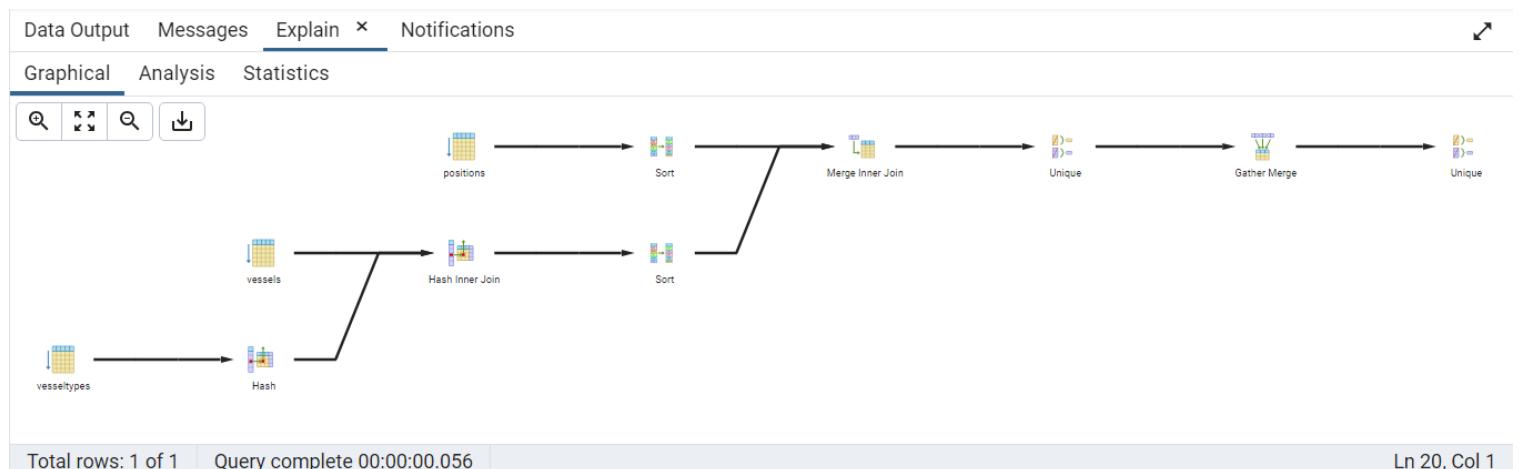
12   VesselTypes.description like 'Passenger%' and
13   date(Positions.t) between '2019-08-14' and '2019-08-18'
14   group by
15     date(Positions.t)
16   order by
17     RecordedDay;
18
19
20 --erwthma1v(a)
21 select distinct
22   Positions.vessel_id
23 from
24   Positions
25 join
26   Vessels on Positions.vessel_id = Vessels.id
27 join
28   VesselTypes on Vessels.type = VesselTypes.code
29 where
30   VesselTypes.description like 'Cargo%' and
31   Positions.speed = 0 and
32   date(Positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain  Notifications

Successfully run. Total query runtime: 1 secs 119 msec.  
34 rows affected.

Total rows: 34 of 34 | Query complete 00:00:01.119 | Ln 20, Col 1



## Έκτέλεση query

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

Query History Scratch Pad

```

18
19
20 --erwthma1v(a)
21 select distinct
22   Positions.vessel_id
23 from
24   Positions
25 join
26   Vessels on Positions.vessel_id = Vessels.id
27 join
28   VesselTypes on Vessels.type = VesselTypes.code
29 where
30   VesselTypes.description like 'Cargo%' and
31   Positions.speed = 0 and
32   date(positions.t) between '2019-08-15' and '2019-08-18';
  
```

Data Output Messages Explain x Notifications

Successfully run. Total query runtime: 948 msec.  
34 rows affected.

Total rows: 34 of 34    Query complete 00:00:00.948    Ln 20, Col 1

## η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres@PostgreSQL 16\*
- Query Editor:** Shows a SQL query with line numbers 18 to 32. The query selects distinct vessel IDs from Positions, joining with Vessels and VesselTypes, filtering by cargo type, speed 0, and date between 2019-08-15 and 2019-08-18.
- Data Output:** Shows the message "Successfully run. Total query runtime: 1 secs 56 msec." and "34 rows affected."
- Status Bar:** Total rows: 34 of 34 | Query complete 00:00:01.056 | Ln 20, Col 1

## Ερώτημα 1 v (β).

### η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres@PostgreSQL 16\*
- Query Editor:** Shows a multi-line SQL query (numbered 33 to 49) for selecting distinct vessel IDs, descriptions, and speeds from three tables: Positions, Vessels, and VesselTypes, filtered by cargo type, date range, and speed.
- Data Output:** A table showing the results of the query, with two rows of data.

vessel_id	description	speed
80bc912679dfb6ff8574a0876f2ec400a43a5f4faef41d76c4345d28ca27c91a	Cargo, Hazardous categor...	0
d6b4ca21a3677d0cc9d9f8f3bcae8138af5a54c52eef8f7935eb09e93cd3a...	Cargo, all ships of this type	0

- Message Bar:** Total rows: 2 of 2 | Query complete 00:00:01.232 | Ln 34, Col 1

Αρχικά, επιλέγουμε τα αναγνωριστικά των πλοίων, την περιγραφή του πλοίου και την ταχύτητα του. Επίσης, κάνουμε join τον πίνακα Positions με τον Vessels ώστε να αντιστοιχηθούν οι θέσεις με τα πλοία. Ύστερα, κάνουμε join τον πίνακα Vessels με τον VesselTypes το οποίο δίνει πρόσβαση στην περιγραφή του τύπου κάθε πλοίου. Στην συνέχεια, τα αποτελέσματα φίλτραρονται ώστε να περιέχουν μόνο τα πλοία των οποίων η περιγραφή αρχίζει από "Cargo", το στίγμα τους είναι στο ζητούμενο εύρος ημερομηνίας και η ταχύτητά τους είναι 0. Τέλος, αφού ομαδοποιηθούν και γίνει έλεγχος ότι οι ζητούμενες συνθήκες ισχύουν για κάθε διακριτή μέρα στο διάστημα '2019-08-12' και '2019-08-19', τα αποτελέσματα ταξινομούνται με βάση τα αναγνωριστικά των πλοίων.

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres@PostgreSQL 16\*

Ships/postgres@PostgreSQL 16

No limit

Query History

```

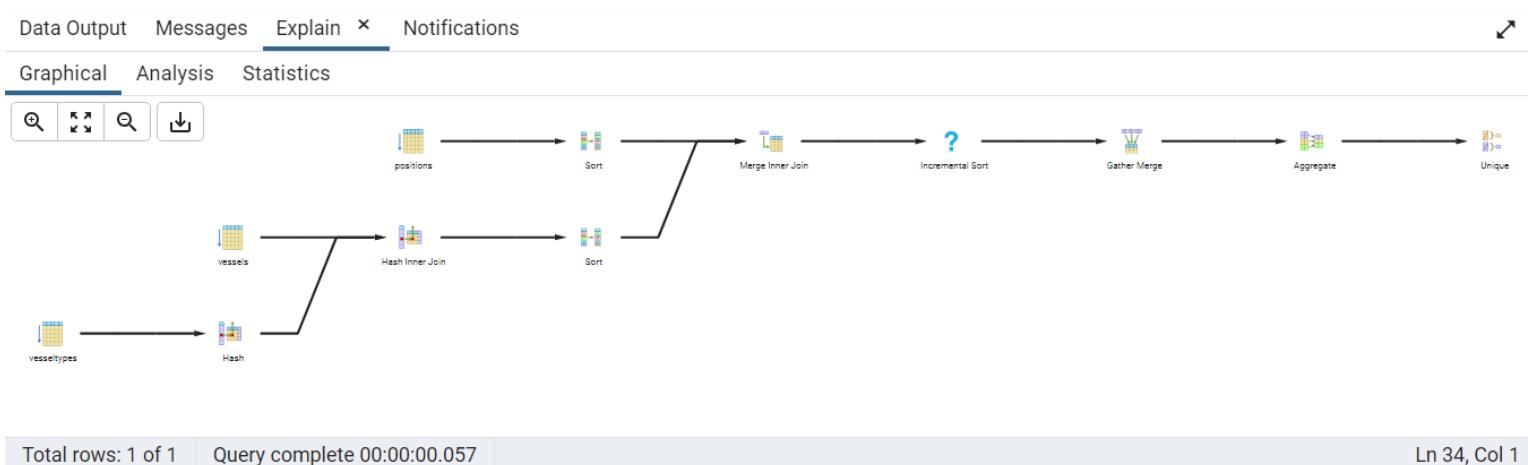
30   VesselTypes.description like 'Cargo%' and
31   Positions.speed = 0 and
32   date(Positions.t) between '2019-08-15' and '2019-08-18';
33
34 --erwthma1v(b)
35 select distinct
36   Positions.vessel_id, VesselTypes.description, Positions.speed
37 from
38   Positions
39 join
40   Vessels on Positions.vessel_id = Vessels.id
41 join
42   VesselTypes on Vessels.type = VesselTypes.code
43 where
44   VesselTypes.description like 'Cargo%' and
45   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
46   and Positions.speed = 0
47 group by Positions.vessel_id, VesselTypes.description, Positions.speed
48 having count(distinct date(Positions.t)) = 8
49 order by Positions.vessel_id;

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 1 secs 232 msec.  
2 rows affected.

Total rows: 2 of 2 Query complete 00:00:01.232 Ln 34, Col 1



## Η Εκτέλεση query

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab labeled "Ships/postgres@PostgreSQL 16\*". Below the navigation is a toolbar with various icons for file operations, search, and database management. The main area is divided into two tabs: "Query" (selected) and "Query History". The "Query" tab contains the following SQL code:

```
35 select distinct
36     Positions.vessel_id, VesselTypes.description, Positions.speed
37 from
38     Positions
39 join
40     Vessels on Positions.vessel_id = Vessels.id
41 join
42     VesselTypes on Vessels.type = VesselTypes.code
43 where
44     VesselTypes.description like 'Cargo%' and
45     DATE(Positions.t) between '2019-08-12' and '2019-08-19'
46     and Positions.speed = 0
47 group by Positions.vessel_id, VesselTypes.description, Positions.speed
48 having count(distinct date(Positions.t)) = 8
49 order by Positions.vessel_id;
```

Below the code, there are tabs for Data Output, Messages, Explain, and Notifications. The status bar at the bottom indicates "Successfully run. Total query runtime: 1 secs 248 msec." and "2 rows affected." The footer shows "Total rows: 2 of 2" and "Query complete 00:00:01.248" along with the line and column information "Ln 34, Col 1".

## η Εκτέλεση query

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar indicates the connection is to 'Ships/postgres@PostgreSQL 16\*'. The main area contains a SQL query:

```
35 select distinct
36     Positions.vessel_id, VesselTypes.description, Positions.speed
37   from
38     Positions
39   join
40     Vessels on Positions.vessel_id = Vessels.id
41   join
42     VesselTypes on Vessels.type = VesselTypes.code
43   where
44     VesselTypes.description like 'Cargo%' and
45     DATE(Positions.t) between '2019-08-12' and '2019-08-19'
46     and Positions.speed = 0
47   group by Positions.vessel_id, VesselTypes.description, Positions.speed
48   having count(distinct date(Positions.t)) = 8
49   order by Positions.vessel_id;
```

Below the query, the status bar shows: 'Successfully run. Total query runtime: 1 secs 100 msec.' and '2 rows affected.'

At the bottom left, it says 'Total rows: 2 of 2' and 'Query complete 00:00:01.100'. At the bottom right, it says 'Ln 34, Col 1'.

## Ερώτημα 2 (15 %)

Σε αυτό το ερώτημα θα αλλάξουμε την τιμή των shared buffers ώστε να χρησιμοποιείται περισσότερη από την RAM. Αρχικά, ελέγχουμε την αρχική τιμή των shared buffers:

Query    Query History

```

1
2
3 show shared_buffers;
4
5

```

Data output    Messages    Explain    Notifications

	shared_buffers	text
1	128MB	

Έπειτα, αλλάζουμε την τιμή σε 1024 MB και επανεκκινούμε τον PgAdmin

Dashboard    Properties    SQL    Statistics    Dependencies    Dependents    Processes    erwthma2.sql

Ships/postgres@PostgreSQL 16

Query    Query History

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthmai
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthmai
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthmai
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19     count(Vessels.id) as NumberOfShips
20 from Positions

```

Data Output    Messages    Notifications

ALTER SYSTEM

Query returned successfully in 40 msec.

Total rows: 0 of 0    Query complete 00:00:00.040



✓ Query returned successfully in 40 msec. ×  
Ln 3, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19 count(Vessels.id) as NumberOfShips
20 from Positions
```

Data Output Messages Notifications

shared\_buffers text  
1 1GB

Total rows: 1 of 1 Query complete 00:00:00.040 ✓ Successfully run. Total query runtime: 40 msec. 1 rows affected. Ln 1, Col 1

Θα ξανατρέξουμε τώρα τα ερωτήματα i-v με τα καινούργια δεδομένα και θα σημειώσουμε την διαφορά χρόνου εκτέλεσης.

### Ερώτημα i) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma2.sql\*". The main area contains the following SQL code:

```
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
```

Below the code, the "Messages" tab is selected, showing the output:

```
Successfully run. Total query runtime: 853 msec.
24 rows affected.
```

At the bottom, a green message box indicates the success of the run:

```
✓ Successfully run. Total query runtime: 853 msec. 24 rows affected. ✘
```

Other tabs at the bottom include "Data Output" and "Notifications". The status bar at the bottom shows "Total rows: 24 of 24" and "Query complete 00:00:00.853".

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 853 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History Scratch Pad

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.052    ✓ Successfully run. Total query runtime: 52 msec. 1 rows affected. X    Ln 5, Col 1

Q  
U  
E  
R  
Y  
P  
L  
A  
N

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii

```

Data Output Messages Explain Notifications

QUERY PLAN

text
1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=745.000..758.832 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=744.980..758.824 rows=24 loops=1)
5 Group Key: (date(t))
6 -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=744.975..758.812 rows=72 loops=1)

✓ Successfully run. Total query runtime: 783 msec. 21 rows affected. X

Total rows: 21 of 21    Query complete 00:00:00.783    Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

QUERY PLAN

text
1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=745.000..758.832 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=744.980..758.824 rows=24 loops=1)
5 Group Key: (date(t))
6 -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=744.975..758.812 rows=72 loops=1)
7 Workers Planned: 2
8 Workers Launched: 2
9 -> Sort (cost=438453.61..439550.41 rows=438719 width=12) (actual time=719.483..719.485 rows=24 loops=3)
10 Sort Key: (date(t))
11 Sort Method: quicksort Memory: 25kB
12 Worker 0: Sort Method: quicksort Memory: 25kB
13 Worker 1: Sort Method: quicksort Memory: 25kB
14 -> Partial HashAggregate (cost=355722.50..389838.70 rows=438719 width=12) (actual time=719.154..719.462 rows=24 loops=3)
15 Group Key: date(t)
16 Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
17 Worker 0: Batches: 1 Memory Usage: 3097kB
18 Worker 1: Batches: 1 Memory Usage: 3097kB
19 -> Parallel Seq Scan on positions (cost=0.00..167895.22 rows=2931938 width=12) (actual time=0.016..476.754 rows=2345550 loops=3)
20 Planning Time: 0.130 ms
21 Execution Time: 759.372 ms

Total rows: 21 of 21    Query complete 00:00:00.783    Ln 5, Col 1

## Ερώτημα i) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window titled 'erwthma2.sql\*'. The window contains the following SQL code:

```
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
```

Below the code, the status bar shows 'Successfully run. Total query runtime: 720 msec.' and '24 rows affected.'

A green success message box at the bottom right of the editor area displays: '✓ Successfully run. Total query runtime: 720 msec. 24 rows affected. X'.

The bottom status bar also shows 'Total rows: 24 of 24' and 'Query complete 00:00:00.720'.

**Χρόνος εκτέλεσης 128 MB**

m  
s  
e  
c  
→      720 msec

**Χρόνος εκτέλεσης 1024 MB**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.054    ✓ Successfully run. Total query runtime: 54 msec. 1 rows affected.    Ln 5, Col 1

Q  
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R  
Y  
P  
L  
A  
N

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1i

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=773.358..785.508 rows=24 loops=1)
2   Sort Key: (count(t)) DESC
3   Sort Method: quicksort Memory: 25kB
4     -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=773.337..785.500 rows=24 loops=1)
5       Group Key: (date(t))
6         -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=773.331..785.487 rows=72 loops=1)
7           Workers Planned: 2
8           Workers Launched: 2
9             -> Sort (cost=438453.61..439550.41 rows=438719 width=12) (actual time=714.925..714.926 rows=24 loops=3)
10            Sort Key: (date(t))
11            Sort Method: quicksort Memory: 25kB

```

Successfully run. Total query runtime: 824 msec. 21 rows affected.

Total rows: 21 of 21 Query complete 00:00:00.824 Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=773.358..785.508 rows=24 loops=1)
2   Sort Key: (count(t)) DESC
3   Sort Method: quicksort Memory: 25kB
4     -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=773.337..785.500 rows=24 loops=1)
5       Group Key: (date(t))
6         -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=773.331..785.487 rows=72 loops=1)
7           Workers Planned: 2
8           Workers Launched: 2
9             -> Sort (cost=438453.61..439550.41 rows=438719 width=12) (actual time=714.925..714.926 rows=24 loops=3)
10            Sort Key: (date(t))
11            Sort Method: quicksort Memory: 25kB
12            Worker 0: Sort Method: quicksort Memory: 25kB
13            Worker 1: Sort Method: quicksort Memory: 25kB
14              -> Partial HashAggregate (cost=355722.50..389838.70 rows=438719 width=12) (actual time=714.600..714.905 rows=24 loops=3)
15                Group Key: date(t)
16                Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
17                Worker 0: Batches: 1 Memory Usage: 3097kB
18                Worker 1: Batches: 1 Memory Usage: 3097kB
19                  -> Parallel Seq Scan on positions (cost=0.00..167895.22 rows=2931938 width=12) (actual time=0.037..468.950 rows=2345550 loops=3)
20 Planning Time: 0.114 ms
21 Execution Time: 786.060 ms

```

Total rows: 21 of 21 Query complete 00:00:00.824 Ln 5, Col 1

## Ερώτημα i) (Τρίτη εκτέλεση)

```
Dashboard Properties SQL Statistics Dependencies Dependents Processes erwthma2.sql*
Ships/postgres@PostgreSQL 16
No limit
Query Query History Scratch Pad
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from VesselTypes inner join VesselTypes on VesselTypes.type = VesselTypes.code
Data Output Messages Explain Notifications
Successfully run. Total query runtime: 697 msec.
24 rows affected.

Total rows: 24 of 24 | Query complete 00:00:00.697 | Ln 5, Col 1
```

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 697 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

positions → Aggregate → Sort → Gather Merge → Aggregate → Sort

Total rows: 1 of 1 Query complete 00:00:00.076 ✓ Successfully run. Total query runtime: 76 msec. 1 rows affected. Ln 5, Col 1

The screenshot shows the pgAdmin 4 interface. In the top navigation bar, the 'erwthma2.sql\*' tab is active. Below it, the connection details 'Ships/postgres@PostgreSQL 16' and 'No limit' are shown. The main area contains a query editor with several lines of SQL code. The 'Explain' tab is selected, displaying a graphical execution plan with nodes: 'positions', 'Aggregate', 'Sort', 'Gather Merge', 'Aggregate', and 'Sort'. A green status bar at the bottom indicates the query was successfully run with a runtime of 76 msec and 1 row affected.

Q  
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Y  
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L  
A  
N

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=723.311..735.102 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=723.291..735.093 rows=24 loops=1)
5   Group Key: (date(t))
6   -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=723.284..735.080 rows=72 loops=1)
7     Workers Planned: 2
8     Workers Launched: 2
9     -> Sort (cost=438453.61..439550.41 rows=438719 width=12) (actual time=697.067..697.069 rows=24 loops=3)
10    Sort Key: (date(t))

```

✓ Successfully run. Total query runtime: 758 msec. 21 rows affected. Ln 5, Col 1

Total rows: 21 of 21 Query complete 00:00:00.758

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Sort (cost=600314.64..601411.44 rows=438719 width=12) (actual time=723.311..735.102 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=439453.63..551699.73 rows=438719 width=12) (actual time=723.291..735.093 rows=24 loops=1)
5   Group Key: (date(t))
6   -> Gather Merge (cost=439453.63..541828.55 rows=877438 width=12) (actual time=723.284..735.080 rows=72 loops=1)
7     Workers Planned: 2
8     Workers Launched: 2
9     -> Sort (cost=438453.61..439550.41 rows=438719 width=12) (actual time=697.067..697.069 rows=24 loops=3)
10    Sort Key: (date(t))
11    Sort Method: quicksort Memory: 25kB
12    Worker 0: Sort Method: quicksort Memory: 25kB
13    Worker 1: Sort Method: quicksort Memory: 25kB
14    -> Partial HashAggregate (cost=355722.50..389838.70 rows=438719 width=12) (actual time=696.708..697.048 rows=24 loops=3)
15      Group Key: date(t)
16      Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
17      Worker 0: Batches: 1 Memory Usage: 3097kB
18      Worker 1: Batches: 1 Memory Usage: 3097kB
19      -> Parallel Seq Scan on positions (cost=0.00..167895.22 rows=2931938 width=12) (actual time=0.014..457.688 rows=2345550 loop...
20 Planning Time: 0.116 ms
21 Execution Time: 735.621 ms

```

Total rows: 21 of 21 Query complete 00:00:00.758 Ln 5, Col 1

Για το query 1, παρατηρούμε πως αρχικά χρόνος εκτέλεσης αυξάνεται όμως με τις επόμενες επαναλήψεις αρχίζει και μειώνεται.

## Ερώτημα ii) (Πρώτη εκτέλεση)

```
Dashboard Properties SQL Statistics Dependencies Dependents Processes erwthma2.sql*
Ships/postgres@PostgreSQL 16
Query History
Query
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1444
Data Output Messages Explain Notifications
Successfully run. Total query runtime: 60 msec.
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.060 Ln 11, Col 1
✓ Successfully run. Total query runtime: 60 msec. 28 rows affected. X
```

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 60 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History

```

11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20   from Positions

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    vessels[vessels] --> Hash1[Hash]
    Hash1 --> HashJoin[Hash Inner Join]
    HashJoin --> Aggregate[Aggregate]
    vesseltypes[vesseltypes] --> Hash1

```

Total rows: 1 of 1 Query complete 00:00:00.052 Ln 11, Col 1

Q  
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The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar indicates the connection is to 'Ships/postgres@PostgreSQL 16' and the file is 'erwthma2.sql\*'. The main area contains the following SQL code:

```
11 --erwthma1jj
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
```

Below the code, the 'Data Output' tab is selected, showing the following query plan:

	QUERY PLAN
1	text
1	HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.193..0.197 rows=28 loops=1)
2	Group Key: vesseltypes.description
3	Batches: 1 Memory Usage: 24kB
4	-> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.068..0.148 rows=242 loops=1)
5	Hash Cond: (vessels.type = vesseltypes.code)
6	-> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.014..0.061 rows=244 loops=1)
7	Filter: ((flag)::text = 'Greece'::text)
8	Rows Removed by Filter: 245
9	-> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.032..0.032 rows=106 loops=1)
10	Buckets: 1024 Batches: 1 Memory Usage: 15kB
11	-> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.006..0.013 rows=106 loop...
12	Planning Time: 0.215 ms
13	Execution Time: 0.223 ms

At the bottom of the window, status information is displayed: 'Total rows: 13 of 13' and 'Query complete 00:00:00.055'. To the right, it says 'Ln 11, Col 1'.

## Ερώτημα ii) (Δεύτερη εκτέλεση)

```
Dashboard Properties SQL Statistics Dependencies Dependents Processes erwthma2.sql*
Ships/postgres@PostgreSQL 16
Query History
Query Scratch Pad
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
```

Data Output Messages Explain × Notifications

Successfully run. Total query runtime: 60 msec.  
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.060 Ln 11, Col 1

**Χρόνος εκτέλεσης 128 MB**

m  
s  
e  
c  
→ 60 msec

**Χρόνος εκτέλεσης 1024 MB**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

9  order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20
Data Output Messages Explain Notifications

```

Graphical Analysis Statistics

```

graph LR
    vessels[vessels] --> Hash[Hash]
    Hash --> HashInnerJoin[Hash Inner Join]
    HashInnerJoin --> Aggregate[Aggregate]
    vesseltypes[vesseltypes] --> Hash

```

Total rows: 1 of 1 Query complete 00:00:00.050 Ln 11, Col 1

**Q**

**U**

**E**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

9  order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
Data Output Messages Explain Notifications

```

QUERY PLAN text

1	HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.152..0.155 rows=28 loops=1)
2	Group Key: vesseltypes.description
3	Batches: 1 Memory Usage: 24kB
4	-> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.045..0.114 rows=242 loops=1)
5	Hash Cond: (vessels.type = vesseltypes.code)
6	-> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.012..0.053 rows=244 loops=1)
7	Filter: ((flag)::text = 'Greece'::text)
8	Rows Removed by Filter: 245
9	-> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.025..0.026 rows=106 loops=1)
10	Buckets: 1024 Batches: 1 Memory Usage: 15kB
11	-> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.005..0.010 rows=106 loops=1)
12	Planning Time: 0.204 ms
13	Execution Time: 0.190 ms

Total rows: 13 of 13 Query complete 00:00:00.057 Ln 11, Col 1

## Ερώτημα ii) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma2.sql\*". The connection is "Ships/postgres@PostgreSQL 16". The toolbar has various icons for file operations, search, and execution. The main area contains a multi-line SQL script:

```
1 show shared_buffers;
2
3 alter system set shared_buffers to '1024 MB';
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
```

The 12th line of the script is highlighted with a large blue rectangular selection. Below the script, there are tabs for "Data Output", "Messages", "Explain", and "Notifications". A message at the bottom says "Successfully run. Total query runtime: 49 msec. 28 rows affected." At the very bottom of the window, status bars show "Total rows: 28 of 28", "Query complete 00:00:00.049", and "Ln 11, Col 1".

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 49 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Explain Notifications

Graphical Analysis Statistics

```

11 --erwthma111
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 erwthma111
  
```

Data Output Messages Explain Notifications

Total rows: 1 of 1 Query complete 00:00:00.053 Ln 11, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Explain Notifications

QUERY PLAN text

```

1 HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.160..0.163 rows=28 loops=1)
  2 Group Key: vesseltypes.description
  3 Batches: 1 Memory Usage: 24kB
  4   -> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.058..0.124 rows=242 loops=1)
  5     Hash Cond: (vessels.type = vesseltypes.code)
  6     -> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.024..0.061 rows=244 loops=1)
  7       Filter: ((flag)::text = 'Greece'::text)
  8       Rows Removed by Filter: 245
  9     -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.027..0.027 rows=106 loops=1)
 10       Buckets: 1024 Batches: 1 Memory Usage: 15kB
 11     -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.005..0.011 rows=106 loop...
 12 Planning Time: 0.235 ms
 13 Execution Time: 0.189 ms
  
```

Successfully run. Total query runtime: 52 msec. 13 rows affected.

Total rows: 13 of 13 Query complete 00:00:00.052 Ln 11, Col 1

Για το query 2, παρατηρούμε πως ο χρόνος εκτέλεσης στις δυο πρώτες επαναλήψεις είναι σχεδόν ίδιος και στην τρίτη μειώνεται αμελητέα.

### Ερώτημα iii) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says 'erwthma2.sql\*'. The query tab contains the following SQL code:

```
16 --erwthma1iii
17 select Positions.vessel_id, VesselTypes.description as ShipType,
18       count(Vessels.id) as NumberOfShips
19  from Positions
20 join Vessels on Positions.vessel_id = Vessels.id
21 join VesselTypes on Vessels.type = VesselTypes.code
22 where Positions.speed > 30
23 group by VesselTypes.description, Positions.vessel_id;
24
25
26 --erwthma1iv
```

Below the code, the status bar shows: 'Successfully run. Total query runtime: 199 msec.' and '16 rows affected.'

At the bottom right of the main window, there is a green message box: 'Successfully run. Total query runtime: 199 msec. 16 rows affected. ✘' with 'Ln 17, Col 1' below it.

At the bottom left of the main window, it says 'Total rows: 16 of 16' and 'Query complete 00:00:00.199'.

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 199 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25
26 --erwthma1iv

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.053 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	Finalize HashAggregate (cost=175374.94..175633.58 rows=25864 width=103) (actual time=128.120..136.590 rows=16 loops=1)
2	Group Key: vesseltypes.description, positions.vessel_id
3	Batches: 1 Memory Usage: 793kB
4	-> Gather (cost=169555.54..174986.98 rows=51728 width=103) (actual time=127.735..136.495 rows=43 loops=1)
5	Workers Planned: 2
6	Workers Launched: 2
7	-> Partial HashAggregate (cost=168555.54..168814.18 rows=25864 width=103) (actual time=96.016..96.127 rows=14 loops=3)
8	Group Key: vesseltypes.description, positions.vessel_id
9	Batches: 1 Memory Usage: 793kB
10	Worker 0: Batches: 1 Memory Usage: 793kB
11	Worker 1: Batches: 1 Memory Usage: 793kB
12	-> Hash Join (cost=3800.33..167925.50 rows=84006 width=160) (actual time=8.263..79.099 rows=69911 loops=3)
13	Hash Cond: (vessels.type = vesseltypes.code)

Total rows: 28 of 28 Query complete 00:00:00.161 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#) x

Ships/postgres@PostgreSQL 16 erwthma2.sql No limit E II S ? ☰ ↻

Data Output Messages Explain x Notifications ↗

☰ File New Open Save Save As Download Print

**QUERY PLAN**  
text

```

8 > Parallel HashAggregate  (cost=1600000.04..1600014.70 rows=2000 width=160) (actual time=20.070..20.127 rows=14 loops=1)
8   Group Key: vesseltypes.description, positions.vessel_id
9   Batches: 1  Memory Usage: 793kB
10  Worker 0: Batches: 1  Memory Usage: 793kB
11  Worker 1: Batches: 1  Memory Usage: 793kB
12    -> Hash Join  (cost=3800.33..167925.50 rows=84006 width=160) (actual time=8.263..79.099 rows=69911 loops=3)
13      Hash Cond: (vessels.type = vesseltypes.code)
14      -> Hash Join  (cost=3796.94..167693.50 rows=84006 width=134) (actual time=8.157..69.408 rows=69914 loops=3)
15          Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16          -> Parallel Bitmap Heap Scan on positions  (cost=3778.94..167453.07 rows=84006 width=65) (actual time=7.949..49.134 rows=69914 loops=...)
17              Recheck Cond: (speed > '30'::double precision)
18              Heap Blocks: exact=18403
19              -> Bitmap Index Scan on idx_positions_speed  (cost=0.00..3728.54 rows=201614 width=0) (actual time=19.237..19.237 rows=209741 loo...
20                  Index Cond: (speed > '30'::double precision)
21                  -> Hash  (cost=11.89..11.89 rows=489 width=69) (actual time=0.187..0.188 rows=489 loops=3)
22                      Buckets: 1024  Batches: 1  Memory Usage: 58kB
23                      -> Seq Scan on vessels  (cost=0.00..11.89 rows=489 width=69) (actual time=0.032..0.092 rows=489 loops=3)
24                      -> Hash  (cost=2.06..2.06 rows=106 width=34) (actual time=0.061..0.062 rows=106 loops=3)
25                          Buckets: 1024  Batches: 1  Memory Usage: 15kB
26                          -> Seq Scan on vesseltypes  (cost=0.00..2.06 rows=106 width=34) (actual time=0.040..0.046 rows=106 loops=3)
27  Planning Time: 0.395 ms
28  Execution Time: 138.841 ms

```

Total rows: 28 of 28    Query complete 00:00:00.161    Ln 17, Col 1

### Ερώτημα iii) (Δεύτερη εκτέλεση)

The screenshot shows a PostgreSQL query editor interface. The top menu bar includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a file named 'erwthma2.sql\*'. The main window has tabs for Query, Query History, and Scratch Pad. The Query tab contains the following SQL code:

```
14 where Vessels.flag = 'Greece'  
15 group by VesselTypes.description;  
16  
17 --erwthma1ii  
18 select Positions.vessel_id, VesselTypes.description as ShipType,  
19 count(Vessels.id) as NumberOfShips  
20 from Positions  
21 join Vessels on Positions.vessel_id = Vessels.id  
22 join VesselTypes on Vessels.type = VesselTypes.code  
23 where Positions.speed > 30  
24 group by VesselTypes.description, Positions.vessel_id;  
25  
26
```

Below the code, the Data Output tab is selected, showing the message: "Successfully run. Total query runtime: 145 msec." and "16 rows affected." At the bottom of the editor, status bars indicate "Total rows: 16 of 16", "Query complete 00:00:00.145", and "Ln 17, Col 1".

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

145 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthmaiiii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    A[idx_positions_speed_d] --> B[positions]
    C[vessels] --> D[Hash]
    D --> E[Hash Inner Join]
    E --> F[Hash Inner Join]
    F --> G[Aggregate]
    G --> H[Gather]
    I[vesseltypes] --> J[Hash]
    J --> K[Hash]
    K --> L[Hash Inner Join]
    L --> M[Aggregate]
    M --> N[Gather]

```

Total rows: 1 of 1    Query complete 00:00:00.053    Ln 17, Col 1

✓ Successfully run. Total query runtime: 53 msec. 1 rows affected. X

Q  
U  
E  
R  
Y  
P  
L  
A  
N

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History

```

17 --erwthma1ii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19   count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;

```

Data Output Messages Explain Notifications

QUERY PLAN

```

text
1 Finalize HashAggregate (cost=175374.94..175633.58 rows=25864 width=103) (actual time=116.359..125.172 rows=16 loops=1)
2  Group Key: vesseltypes.description, positions.vessel_id
3  Batches: 1 Memory Usage: 793kB
4    -> Gather (cost=169555.54..174986.98 rows=51728 width=103) (actual time=115.894..125.076 rows=45 loops=1)
5      Workers Planned: 2
6      Workers Launched: 2
7        -> Partial HashAggregate (cost=168555.54..168814.18 rows=25864 width=103) (actual time=90.684..90.781 rows=15 loops=3)
8          Group Key: vesseltypes.description, positions.vessel_id
9          Batches: 1 Memory Usage: 793kB
10         Worker 0: Batches: 1 Memory Usage: 793kB
11         Worker 1: Batches: 1 Memory Usage: 793kB
12           -> Hash Join (cost=3800.33..167925.50 rows=84006 width=160) (actual time=5.157..74.530 rows=69911 loops=3)
13             Hash Cond: (vessels.type = vesseltypes.code)
14               -> Hash Join (cost=3796.94..167693.50 rows=84006 width=134) (actual time=5.080..65.238 rows=69914 loops=3)
15                 Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16                 -> Parallel Bitmap Heap Scan on positions (cost=3778.94..167453.07 rows=84006 width=65) (actual time=4.925..45.999 rows=69914 loops=...)
17                   Recheck Cond: (speed > '30'::double precision)
18                   Heap Blocks: exact=18451
19                     -> Bitmap Index Scan on idx_positions_speed (cost=0.00..3728.54 rows=20164 width=0) (actual time=10.507..10.507 rows=209741 loo...
20                       Index Cond: (speed > '30'::double precision)
21                     -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.141..0.141 rows=489 loops=3)
22                       Buckets: 1024 Batches: 1 Memory Usage: 58kB
23                         -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.029..0.078 rows=489 loops=3)
24                         -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.055..0.056 rows=106 loops=3)
25                           Buckets: 1024 Batches: 1 Memory Usage: 15kB
26                             -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.037..0.043 rows=106 loops=3)
27 Planning Time: 0.455 ms
28 Execution Time: 125.889 ms

```

Total rows: 28 of 28 Query complete 00:00:00.161 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History

QUERY PLAN

```

text
8  Group Key: vesseltypes.description, positions.vessel_id
9  Batches: 1 Memory Usage: 793kB
10 Worker 0: Batches: 1 Memory Usage: 793kB
11 Worker 1: Batches: 1 Memory Usage: 793kB
12 -> Hash Join (cost=3800.33..167925.50 rows=84006 width=160) (actual time=5.157..74.530 rows=69911 loops=3)
13   Hash Cond: (vessels.type = vesseltypes.code)
14   -> Hash Join (cost=3796.94..167693.50 rows=84006 width=134) (actual time=5.080..65.238 rows=69914 loops=3)
15     Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16     -> Parallel Bitmap Heap Scan on positions (cost=3778.94..167453.07 rows=84006 width=65) (actual time=4.925..45.999 rows=69914 loops=...)
17       Recheck Cond: (speed > '30'::double precision)
18       Heap Blocks: exact=18451
19         -> Bitmap Index Scan on idx_positions_speed (cost=0.00..3728.54 rows=20164 width=0) (actual time=10.507..10.507 rows=209741 loo...
20           Index Cond: (speed > '30'::double precision)
21         -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.141..0.141 rows=489 loops=3)
22           Buckets: 1024 Batches: 1 Memory Usage: 58kB
23             -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.029..0.078 rows=489 loops=3)
24             -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.055..0.056 rows=106 loops=3)
25               Buckets: 1024 Batches: 1 Memory Usage: 15kB
26                 -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.037..0.043 rows=106 loops=3)
27 Planning Time: 0.455 ms
28 Execution Time: 125.889 ms

```

Total rows: 28 of 28 Query complete 00:00:00.161 Ln 17, Col 1

### Ερώτημα iii) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma2.sql\*". The query tab contains the following SQL code:

```
--erwthma1iii
select Positions.vessel_id, VesselTypes.description as ShipType,
       count(Vessels.id) as NumberOfShips
  from Positions
 join Vessels on Positions.vessel_id = Vessels.id
 join VesselTypes on Vessels.type = VesselTypes.code
 where Positions.speed > 30
 group by VesselTypes.description, Positions.vessel_id;
```

The "Messages" tab shows the output: "Successfully run. Total query runtime: 137 msec. 16 rows affected." A green success message box at the bottom right also displays this information. The status bar at the bottom shows "Total rows: 16 of 16" and "Query complete 00:00:00.137".

**Χρόνος εκτέλεσης 128 MB**

m  
s  
e  
c  
→      137 msec

**Χρόνος εκτέλεσης 1024 MB**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```
--erwthma1ii
select Positions.vessel_id, VesselTypes.description as ShipType,
       count(Vessels.id) as NumberOfShips
from Positions
join Vessels on Positions.vessel_id = Vessels.id
join VesselTypes on Vessels.type = VesselTypes.code
where Positions.speed > 30
group by VesselTypes.description, Positions.vessel_id;
25
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    subgraph Input [Input]
        I1[Idx_positions_speed_d] --> P1[positions]
        I2[vessels] --> H1[Hash]
        I3[vesseltypes] --> H2[Hash]
    end
    P1 --> H1
    P1 --> H2
    H1 --> H3[Hash Inner Join]
    H2 --> H3
    H3 --> H4[Hash Inner Join]
    H4 --> A1[Aggregate]
    A1 --> G1[Gather]
    G1 --> A2[Aggregate]

```

Total rows: 1 of 1    Query complete 00:00:00.050    ✓ Successfully run. Total query runtime: 50 msec. 1 rows affected.

Ln 17, Col 1

Q

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```
--erwthma1ii
explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
       count(Vessels.id) as NumberOfShips
from Positions
join Vessels on Positions.vessel_id = Vessels.id
join VesselTypes on Vessels.type = VesselTypes.code
where Positions.speed > 30
group by VesselTypes.description, Positions.vessel_id;
25
```

Data Output Messages Explain Notifications

QUERY PLAN

	text
1	Finalize HashAggregate (cost=175374.94..175633.58 rows=25864 width=103) (actual time=121.649..130.977 rows=16 loops=1)
2	Group Key: vesseltypes.description, positions.vessel_id
3	Batches: 1 Memory Usage: 793kB
4	-> Gather (cost=169555.54..174986.98 rows=51728 width=103) (actual time=121.144..130.877 rows=44 loops=1)
5	Workers Planned: 2
6	Workers Launched: 2
7	-> Partial HashAggregate (cost=168555.54..168814.18 rows=25864 width=103) (actual time=94.047..94.144 rows=15 loops=3)
8	Group Key: vesseltypes.description, positions.vessel_id
9	Batches: 1 Memory Usage: 793kB
10	Worker 0: Batches: 1 Memory Usage: 793kB
11	Worker 1: Batches: 1 Memory Usage: 793kB
12	-> Hash Join (cost=3800.33..167925.50 rows=84006 width=160) (actual time=5.919..76.958 rows=69911 loops=3)
13	Hash Cond: (vessels.type = vesseltypes.code)

Total rows: 28 of 28    Query complete 00:00:00.186    Ln 17, Col 1

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes erwthma2.sql*
Ships/postgres@PostgreSQL 16 No limit Data Output Messages Explain Notifications
QUERY PLAN
text
8   Group Key: vesseltypes.description, positions.vessel_id
9     Batches: 1 Memory Usage: 793kB
10    Worker 0: Batches: 1 Memory Usage: 793kB
11    Worker 1: Batches: 1 Memory Usage: 793kB
12      -> Hash Join (cost=3800.33..167925.50 rows=84006 width=160) (actual time=5.919..76.958 rows=69911 loops=3)
13        Hash Cond: (vessels.type = vesseltypes.code)
14        -> Hash Join (cost=3796.94..167693.50 rows=84006 width=134) (actual time=5.817..67.350 rows=69914 loops=3)
15          Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16            -> Parallel Bitmap Heap Scan on positions (cost=3778.94..167453.07 rows=84006 width=65) (actual time=5.649..46.874 rows=69914 loops=...)
17              Recheck Cond: (speed > '30)::double precision
18              Heap Blocks: exact=18247
19              -> Bitmap Index Scan on idx_positions_speed (cost=0.00..3728.54 rows=201614 width=0) (actual time=11.659..11.659 rows=209741 loo...
20                Index Cond: (speed > '30)::double precision
21                -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.149..0.149 rows=489 loops=3)
22                  Buckets: 1024 Batches: 1 Memory Usage: 58kB
23                  -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.034..0.084 rows=489 loops=3)
24                  -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.063..0.064 rows=106 loops=3)
25                    Buckets: 1024 Batches: 1 Memory Usage: 15kB
26                    -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.044..0.050 rows=106 loops=3)
27      Planning Time: 0.369 ms
28      Execution Time: 131.795 ms
Total rows: 28 of 28 Query complete 00:00:00.186 Ln 17, Col 1

```

Για το query 3, παρατηρούμε πως ο χρόνος εκτέλεσης μειώνεται σημαντικά και στις τρεις επαναλήψεις.

## Ερώτημα iv) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma2.sql\*". The main area contains the following SQL code:

```
26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;
```

Below the code, the status bar shows "Successfully run. Total query runtime: 577 msec." and "5 rows affected.". A green message bar at the bottom right says "✓ Successfully run. Total query runtime: 577 msec. 5 rows affected. X".

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

577 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```
26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 | Query complete 00:00:00.041 | Ln 26, Col 1

Q  
U  
E  
R  
Y  
**PLAN**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Finalize GroupAggregate (cost=191045.40..191447.64 rows=3319 width=12) (actual time=535.717..546.396 rows=5 loops=1)
2 Group Key: (date(positions.t))
3 -> Gather Merge (cost=191045.40..191392.32 rows=2766 width=12) (actual time=533.517..546.378 rows=15 loops=1)
4   Workers Planned: 2
5   Workers Launched: 2
6     -> Partial GroupAggregate (cost=190045.37..190073.03 rows=1383 width=12) (actual time=499.124..507.787 rows=5 loops=3)

```

✓ Successfully run. Total query runtime: 566 msec. 29 rows affected. X

Total rows: 29 of 29 Query complete 00:00:00.566 Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Finalize GroupAggregate (cost=191045.40..191447.64 rows=3319 width=12) (actual time=535.717..546.396 rows=5 loops=1)
2 Group Key: (date(positions.t))
3 -> Gather Merge (cost=191045.40..191392.32 rows=2766 width=12) (actual time=533.517..546.378 rows=15 loops=1)
4   Workers Planned: 2
5   Workers Launched: 2
6     -> Partial GroupAggregate (cost=190045.37..190073.03 rows=1383 width=12) (actual time=499.124..507.787 rows=5 loops=3)
7       Group Key: (date(positions.t))
8       -> Sort (cost=190045.37..190048.83 rows=1383 width=4) (actual time=498.594..502.078 rows=120498 loops=3)
9         Sort Key: (date(positions.t))
10        Sort Method: quicksort Memory: 3073kB
11        Worker 0: Sort Method: quicksort Memory: 3073kB
12        Worker 1: Sort Method: quicksort Memory: 3073kB
13       -> Hash Join (cost=16.24..189973.22 rows=1383 width=4) (actual time=134.181..491.746 rows=120498 loops=3)
14         Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
15         -> Parallel Seq Scan on positions (cost=0.00..189884.76 rows=14660 width=73) (actual time=133.624..443.919 rows=392404 loops=1)
16           Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
17           Rows Removed by Filter: 1953146
18         -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.272..0.275 rows=64 loops=3)
19           Buckets: 1024 Batches: 1 Memory Usage: 15kB
20           -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.186..0.258 rows=64 loops=3)
21             Hash Cond: (vessels.type = vesseltypes.code)
22               -> Seq Scan on vesseltypes (cost=0.00..11.90 rows=400 width=60) (actual time=0.077..0.117 rows=400 loops=3)

```

Total rows: 29 of 29 Query complete 00:00:00.566 Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit Data Output Messages Explain Notifications

QUERY PLAN text

```
text
9      Sort Key: (date(positions.t))
10     Sort Method: quicksort Memory: 3073kB
11     Worker 0: Sort Method: quicksort Memory: 3073kB
12     Worker 1: Sort Method: quicksort Memory: 3073kB
13   -> Hash Join (cost=16.24..189973.22 rows=1383 width=4) (actual time=134.181..491.746 rows=120498 loops=3)
        Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
        -> Parallel Seq Scan on positions (cost=0.00..189884.76 rows=14660 width=73) (actual time=133.624..443.919 rows=392404 loop...
        Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
        Rows Removed by Filter: 1953146
18   -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.272..0.275 rows=64 loops=3)
19     Buckets: 1024 Batches: 1 Memory Usage: 15kB
20   -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.186..0.258 rows=64 loops=3)
        Hash Cond: (vessels.type = vesseltypes.code)
        -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.077..0.117 rows=489 loops=3)
23   -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.078..0.079 rows=10 loops=3)
24     Buckets: 1024 Batches: 1 Memory Usage: 9kB
25   -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.065..0.069 rows=10 loops=3)
26     Filter: (description ~~ 'Passenger%':text)
27     Rows Removed by Filter: 96
28 Planning Time: 0.416 ms
29 Execution Time: 546.617 ms
```

Total rows: 29 of 29 Query complete 00:00:00.566 Ln 26, Col 1

## Ερώτημα iv) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar indicates the connection is to 'Ships/postgres@PostgreSQL 16'. The main area contains the following SQL code:

```
26 --erwthma1iv
27 select
28     date(Positions.t) as RecordedDay,
29     count(*) as NumberOfSpots
30 from
31     Positions
32 join
33     Vessels on Positions.vessel_id = Vessels.id
34 join
35     VesselTypes on Vessels.type = VesselTypes.code
36 where
37     VesselTypes.description like 'Passenger%' and
38     date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40     date(Positions.t)
41 order by
42     RecordedDay;
```

Below the code, the status bar shows: 'Successfully run. Total query runtime: 566 msec.' and '5 rows affected.'

At the bottom right of the status bar, there is a green success message: '✓ Successfully run. Total query runtime: 566 msec. 5 rows affected. X' with the text 'Ln 26, Col 1'.

**Χρόνος εκτέλεσης 128 MB**

m  
s  
e  
c  
→      566 msec

**Χρόνος εκτέλεσης 1024 MB**

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.054 Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

Data Output Messages Explain Notifications

QUERY PLAN

	text
1	Finalize GroupAggregate (cost=191045.40..191447.64 rows=3319 width=12) (actual time=553.563..561.950 rows=5 loops=1)
2	Group Key: (date(positions.t))
3	-> Gather Merge (cost=191045.40..191392.32 rows=2766 width=12) (actual time=551.301..561.933 rows=15 loops=1)
4	Workers Planned: 2
5	Workers Launched: 2
6	-> Partial GroupAggregate (cost=190045.37..190073.03 rows=1383 width=12) (actual time=480.853..489.785 rows=5 loops=3)

Total rows: 29 of 29 Query complete 00:00:00.583 Ln 26, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print, etc.), search, and connection management.
- Header:** Shows the current connection as "Ships/postgres@PostgreSQL 16" and the active tab as "erwthma2.sql\*".
- Menu Bar:** Options include Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a Help section.
- Data Output Tab:** Active tab, showing the results of the query execution.
- Query Plan Section:** Titled "QUERY PLAN", it displays the execution plan for the query, including stages like Finalize GroupAggregate, Group Key, Gather Merge, and various Sort and Hash operations.
- Log Section:** Shows the log output with entries such as "Workers Planned: 2", "Workers Launched: 2", and specific timing information for each step.
- Bottom Status:** Displays "Total rows: 29 of 29" and "Query complete 00:00:00.583".

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit Data Output Messages Explain Notifications

QUERY PLAN

text

Sort Key: (date(positions.t))

Sort Method: quicksort Memory: 3073kB

Worker 0: Sort Method: quicksort Memory: 3073kB

Worker 1: Sort Method: quicksort Memory: 3073kB

> Hash Join (cost=16.24..189973.22 rows=1383 width=4) (actual time=118.560..473.603 rows=120498 loops=3)

Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text)

> Parallel Seq Scan on positions (cost=0.00..189884.76 rows=14660 width=73) (actual time=118.061..426.230 rows=392404 loop...  
Filter: ((date(t) > '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))

Rows Removed by Filter: 1953146

> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.273..0.277 rows=64 loops=3)  
Buckets: 1024 Batches: 1 Memory Usage: 15kB

> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.187..0.262 rows=64 loops=3)  
Hash Cond: (vessels.type = vesseltypes.code)

> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.092..0.130 rows=489 loops=3)  
> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.061..0.063 rows=10 loops=3)  
Buckets: 1024 Batches: 1 Memory Usage: 9kB

> Seq Scan on vesseltypes (cost=0.00..0.23 rows=10 width=4) (actual time=0.047..0.051 rows=10 loops=3)  
Filter: (description ~~ 'Passenger%'::text)

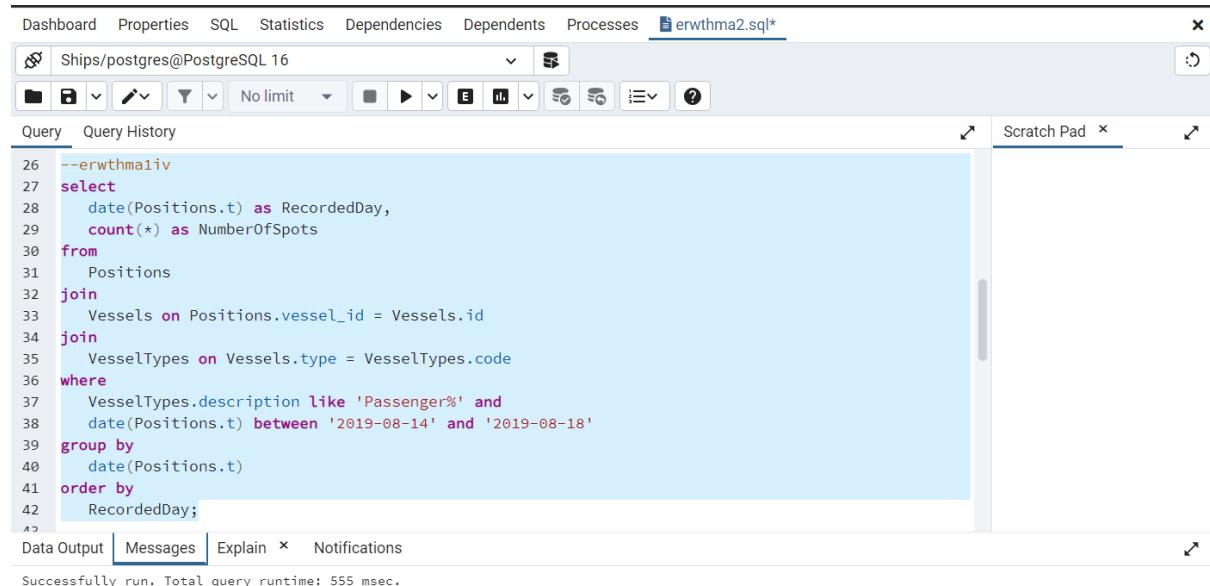
Rows Removed by Filter: 96

Planning Time: 0.421 ms

Execution Time: 562.091 ms

Total rows: 29 of 29 Query complete 00:00:00.583 Ln 26, Col 1

## Ερώτημα iv) (Τρίτη εκτέλεση)



```
--erwthma1iv
select
    date(Positions.t) as RecordedDay,
    count(*) as NumberOfSpots
from
    Positions
join
    Vessels on Positions.vessel_id = Vessels.id
join
    VesselTypes on Vessels.type = VesselTypes.code
where
    VesselTypes.description like 'Passenger%' and
    date(Positions.t) between '2019-08-14' and '2019-08-18'
group by
    date(Positions.t)
order by
    RecordedDay;
```

Successfully run. Total query runtime: 555 msec.  
5 rows affected.

Total rows: 5 of 5    Query complete 00:00:00.555    Ln 26, Col 1

Χρόνος εκτέλεσης 128 MB

m  
s  
e  
c  
→ 555 msec

Χρόνος εκτέλεσης 1024 MB

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.066 Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

Data Output Messages Explain Notifications

QUERY PLAN

	text
1	Finalize GroupAggregate (cost=191045.40..191447.64 rows=3319 width=12) (actual time=561.877..570.604 rows=5 loops=1)
2	Group Key: (date(positions.t))
3	-> Gather Merge (cost=191045.40..191392.32 rows=2766 width=12) (actual time=558.167..570.581 rows=15 loops=1)
4	Workers Planned: 2
5	Workers Launched: 2
6	-> Partial GroupAggregate (cost=190045.37..190073.03 rows=1383 width=12) (actual time=516.166..527.782 rows=5 loops=3)

Total rows: 29 of 29 Query complete 00:00:00.600 Ln 26, Col 1

erwthma2.sql

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

QUERY PLAN  
text

1 Finalize GroupAggregate (cost=191045.40..191447.64 rows=3319 width=12) (actual time=561.877..570.604 rows=5 loops=1)

2 Group Key: (date(positions.t))

3 -> Gather Merge (cost=191045.40..191392.32 rows=2766 width=12) (actual time=558.167..570.581 rows=15 loops=1)

4 Workers Planned: 2

5 Workers Launched: 2

6 -> Partial GroupAggregate (cost=190045.37..190073.03 rows=1383 width=12) (actual time=516.166..527.782 rows=5 loops=3)

7 Group Key: (date(positions.t))

8 -> Sort (cost=190045.37..190048.83 rows=1383 width=4) (actual time=515.598..519.992 rows=120498 loops=3)

9 Sort Key: (date(positions.t))

10 Sort Method: quicksort Memory: 3073kB

11 Worker 0: Sort Method: quicksort Memory: 3073kB

12 Worker 1: Sort Method: quicksort Memory: 3073kB

13 -> Hash Join (cost=16.24..189973.22 rows=1383 width=4) (actual time=140.912..507.418 rows=120498 loops=3)

14 Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text)

15 -> Parallel Seq Scan on positions (cost=0.00..189884.76 rows=14660 width=73) (actual time=140.544..458.633 rows=392404 loops=1)

16 Filter: ((date(t) >='2019-08-14::date') AND (date(t) <='2019-08-18::date'))

17 Rows Removed by Filter: 1953146

18 -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.300..0.302 rows=64 loops=3)

19 Buckets: 1024 Batches: 1 Memory Usage: 15kB

20 -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.196..0.284 rows=64 loops=3)

21 Hash Cond: (vessels.type = vesseltypes.code)

22 Seq Scan on vessels (cost=0.00..11.99 rows=499 width=60) (actual time=0.006..0.141 rows=499 loops=3)

Total rows: 29 of 29 Query complete 00:00:00.600 Ln 26, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print, Copy, Paste, Find, Filter, Refresh), a search bar, and various connection and session management buttons.
- Menu Bar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, **erwthma2.sql\*** (selected tab), and a close button.
- Session Bar:** Ships/postgres@PostgreSQL 16
- Tool Buttons:** Data Output, Messages, Explain, Notifications.
- Query Plan Section:** A large pane displaying the execution plan for the query. It includes sections for text, Sort Key, Sort Method, Worker 0, Worker 1, Hash Join, Hash Cond, Parallel Seq Scan, Filter, Rows Removed by Filter, Hash, Buckets, Hash Join, Hash Cond, Seq Scan on vessels, Hash, Buckets, Hash Join, Seq Scan on vesseltypes, Filter, and Rows Removed by filter. It also shows Planning Time (0.419 ms) and Execution Time (570.761 ms).

Για το query 4, παρατηρούμε ότι ο χρόνος εκτέλεσης μειώνεται αμελητέα και στις τρεις επαναλήψεις.

## Ερώτημα v) (α) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, **erwthma2.sql\***.
- Connections:** Ships/postgres@PostgreSQL 16.
- Query Pad:** Contains the SQL query code.
- Scratch Pad:** Tab labeled "Scratch Pad".
- Data Output:** Tab selected, showing the query results.
- Messages:** Tab showing the message: "Successfully run. Total query runtime: 905 msec. 34 rows affected."
- Explain:** Tab.
- Notifications:** Tab.
- Status Bar:** Total rows: 34 of 34 | Query complete 00:00:00.905 | Ln 44, Col 1.

```
--erwthma1v(a)
select distinct
    Positions.vessel_id
from
    Positions
join
    Vessels on Positions.vessel_id = Vessels.id
join
    VesselTypes on Vessels.type = VesselTypes.code
where
    VesselTypes.description like 'Cargo%' and
    Positions.speed = 0 and
    date(positions.t) between '2019-08-15' and '2019-08-18';
```

Χρόνος εκτέλεσης 128 MB

1 secs 56 msec



Χρόνος εκτέλεσης 1024 MB

905 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

✓ Successfully run. Total query runtime: 55 msec. 1 rows affected. X

Total rows: 1 of 1 Query complete 00:00:00.055 Ln 44, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=859.728..901.892 rows=34 loops=1)
2	-> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=859.727..901.875 rows=94 loops=1)
3	Workers Planned: 2
4	Workers Launched: 2
5	-> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=791.150..831.076 rows=31 loops=3)
6	-> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=791.149..830.623 rows=7727 loops=3)
7	Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
8	-> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=790.417..819.481 rows=195797 loops=3)
9	Sort Key: positions.vessel_id

✓ Successfully run. Total query runtime: 936 msec. 30 rows affected. X

Total rows: 30 of 30 Query complete 00:00:00.936 Ln 44, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, **erwthma2.sql\***, and a refresh icon.
- Connection:** Ships/postgres@PostgreSQL 16
- Menu Bar:** Data Output, Messages, Explain, Notifications.
- Query Plan:** A table showing the execution plan.

	QUERY PLAN
1	Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=859.728..901.892 rows=34 loops=1)
2	-> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=859.727..901.875 rows=94 loops=1)
3	Workers Planned: 2
4	Workers Launched: 2
5	-> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=791.150..831.076 rows=31 loops=3)
6	-> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=791.149..830.623 rows=7727 loops=3)
7	Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
8	-> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=790.417..819.481 rows=195797 loops=3)
9	Sort Key: positions.vessel_id
10	Sort Method: external merge Disk: 13232kB
11	Worker 0: Sort Method: external merge Disk: 13504kB
12	Worker 1: Sort Method: external merge Disk: 13296kB
13	-> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=148.539..484.471 rows=197248 loop=1)
14	Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
15	Rows Removed by Filter: 2148302
16	-> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.724..0.974 rows=7800 loops=3)
17	Sort Key: vessels.id
18	Sort Method: quicksort Memory: 33kB
19	Worker 0: Sort Method: quicksort Memory: 33kB
20	Worker 1: Sort Method: quicksort Memory: 33kB
21	-> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.306..0.412 rows=104 loops=3)
22	Hash Cond: (vessels.id = positions.vessel_id)
- Bottom Status:** Total rows: 30 of 30, Query complete 00:00:00.936, Ln 44, Col 1

The screenshot shows the pgAdmin interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print), search, and various database management functions.
- Header:** Shows the connection name "Ships/postgres@PostgreSQL 16" and the current tab "erwthma2.sql".
- Menu Bar:** Contains "Dashboard", "Properties", "SQL", "Statistics", "Dependencies", "Dependents", "Processes", and "erwthma2.sql".
- Sub-Header:** "Data Output", "Messages", "Explain", and "Notifications".
- Buttons:** A set of small icons for navigating and managing the query results.
- Table:** The main content area displays the "QUERY PLAN" for the query. It includes numbered rows (10 to 30) detailing the execution plan:
  - Row 10: Sort Method: external merge Disk: 13232kB
  - Row 11: Worker 0: Sort Method: external merge Disk: 13504kB
  - Row 12: Worker 1: Sort Method: external merge Disk: 13296kB
  - Row 13: -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=148.539..484.471 rows=197248 loops=...
  - Row 14: Filter: ((speed = '0'::double precision) AND (date(t) >='2019-08-15'::date) AND (date(t) <='2019-08-18'::date))
  - Row 15: Rows Removed by Filter: 2148302
  - Row 16: -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.724..0.974 rows=7800 loops=3)
  - Row 17: Sort Key: vessels.id
  - Row 18: Sort Method: quicksort Memory: 33kB
  - Row 19: Worker 0: Sort Method: quicksort Memory: 33kB
  - Row 20: Worker 1: Sort Method: quicksort Memory: 33kB
  - Row 21: -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.306..0.412 rows=104 loops=3)
  - Row 22: Hash Cond: (vessels.type = vesseltypes.code)
  - Row 23: -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.099..0.149 rows=489 loops=3)
  - Row 24: -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.084..0.085 rows=10 loops=3)
  - Row 25: Buckets: 1024 Batches: 1 Memory Usage: 9kB
  - Row 26: -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.076..0.079 rows=10 loops=3)
  - Row 27: Filter: (description ~~ '%Cargo%'::text)
  - Row 28: Rows Removed by Filter: 96
  - Row 29: Planning Time: 0.442 ms
  - Row 30: Execution Time: 903.397 ms
- Bottom Status Bar:** "Total rows: 30 of 30 Query complete 00:00:00.936 Ln 44, Col 1"

## Ερώτημα v) (α) (Δεύτερη εκτέλεση)

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a tab for the current file, "erwthma2.sql\*". Below the navigation is a toolbar with various icons for file operations like Open, Save, and Print. The main area is divided into two panes: "Query" on the left and "Scratch Pad" on the right. The "Query" pane contains the following SQL code:

```
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Below the code, there are tabs for Data Output, Messages (which is selected), Explain, and Notifications. A message at the bottom of the editor states: "Successfully run. Total query runtime: 876 msec. 34 rows affected." The status bar at the bottom shows "Total rows: 34 of 34" and "Query complete 00:00:00.876". On the far right of the status bar, it says "Ln 44, Col 1".

Χρόνος εκτέλεσης 128 MB

1 secs 56 msec



Χρόνος εκτέλεσης 1024 MB

876 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    positions[positions] -- Sort --> hashJoin1[Hash Inner Join]
    vessels[vessels] -- Sort --> hashJoin1
    hashJoin1 --> mergeJoin1[Merge Inner Join]
    vesseltypes[vesseltypes] -- Hash --> mergeJoin1
    mergeJoin1 -- Unique --> gatherMerge[Gather Merge]
    gatherMerge -- Unique --> output[Output]

```

✓ Successfully run. Total query runtime: 51 msec. 1 rows affected.

Total rows: 1 of 1 Query complete 00:00:00.051 Ln 44, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

QUERY PLAN

1	Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=800.290..838.933 rows=34 loops=1)
2	-> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=800.289..838.916 rows=95 loops=1)
3	Workers Planned: 2
4	Workers Launched: 2
5	-> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=738.727..774.987 rows=32 loops=3)
6	-> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=738.726..774.576 rows=7727 loops=3)
7	Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
8	-> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=738.255..764.720 rows=195797 loops=3)
9	Sort Key: positions.vessel_id

✓ Successfully run. Total query runtime: 862 msec. 30 rows affected.

Total rows: 30 of 30 Query complete 00:00:00.862 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=800.290..838.933 rows=34 loops=1)
2   -> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=800.289..838.916 rows=95 loops=1)
3     Workers Planned: 2
4     Workers Launched: 2
5       -> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=738.727..774.987 rows=32 loops=3)
6         -> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=738.726..774.576 rows=7727 loops=3)
7           Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
8           -> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=738.255..764.720 rows=195797 loops=3)
9             Sort Key: positions.vessel_id
10            Sort Method: external merge Disk: 13296kB
11            Worker 0: Sort Method: external merge Disk: 13256kB
12            Worker 1: Sort Method: external merge Disk: 13488kB
13             -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=148.029..472.903 rows=197248 loops=3)
14               Filter: ((speed < '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
15               Rows Removed by Filter: 2148302
16             -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.465..0.697 rows=7800 loops=3)
17               Sort Key: vessels.id
18               Sort Method: quicksort Memory: 33kB
19               Worker 0: Sort Method: quicksort Memory: 33kB
20               Worker 1: Sort Method: quicksort Memory: 33kB
21             -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.213..0.281 rows=104 loops=3)
22               Hash Cond: (vessels.type = vesseltypes.code)
23             -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.076..0.109 rows=489 loops=3)
24             -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.048..0.049 rows=10 loops=3)
25               Buckets: 1024 Batches: 1 Memory Usage: 9kB
26             -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.041..0.044 rows=10 loops=3)
27               Filter: (description ~~ 'Cargo%::text')
28               Rows Removed by Filter: 96
29 Planning Time: 0.439 ms
30 Execution Time: 840.405 ms

```

Total rows: 30 of 30    Query complete 00:00:00.862    Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
10 Sort Method: external merge Disk: 13296kB
11 Worker 0: Sort Method: external merge Disk: 13256kB
12 Worker 1: Sort Method: external merge Disk: 13488kB
13 -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=148.029..472.903 rows=197248 loops=3)
14   Filter: ((speed < '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
15   Rows Removed by Filter: 2148302
16 -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.465..0.697 rows=7800 loops=3)
17   Sort Key: vessels.id
18   Sort Method: quicksort Memory: 33kB
19   Worker 0: Sort Method: quicksort Memory: 33kB
20   Worker 1: Sort Method: quicksort Memory: 33kB
21 -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.213..0.281 rows=104 loops=3)
22   Hash Cond: (vessels.type = vesseltypes.code)
23 -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.076..0.109 rows=489 loops=3)
24 -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.048..0.049 rows=10 loops=3)
25   Buckets: 1024 Batches: 1 Memory Usage: 9kB
26 -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.041..0.044 rows=10 loops=3)
27   Filter: (description ~~ 'Cargo%::text')
28   Rows Removed by Filter: 96
29 Planning Time: 0.439 ms
30 Execution Time: 840.405 ms

```

Total rows: 30 of 30    Query complete 00:00:00.862    Ln 44, Col 1

## Ερώτημα v) (α) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, erwthma2.sql\*
- Connection:** Ships/postgres@PostgreSQL 16
- Query Pad:** Contains the SQL code for query v).  
The code is:

```
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57
```
- Data Output:** Shows the message "Successfully run. Total query runtime: 875 msec." and "34 rows affected."
- Status Bar:** Total rows: 34 of 34 | Query complete 00:00:00.875 | Ln 44, Col 1

Χρόνος εκτέλεσης 128 MB

1 secs 56 msec



Χρόνος εκτέλεσης 1024 MB

875 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Successful run. Total query runtime: 57 msec. 1 rows affected.

Total rows: 1 of 1 Query complete 00:00:00.057 Ln 44, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57

```

Data Output Messages Explain Notifications

QUERY PLAN

text	1 Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=859.383..897.232 rows=34 loops=1)
	2   -> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=859.382..897.214 rows=97 loops=1)
	3   Workers Planned: 2
	4   Workers Launched: 2
	5   -> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=798.736..835.769 rows=32 loops=3)
	6    -> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=798.735..835.361 rows=7727 loops=3)
	7    Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
	8    -> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=798.267..825.254 rows=195797 loops=3)
	9       Sort Key: positions.vessel_id

Successful run. Total query runtime: 921 msec. 30 rows affected.

Total rows: 30 of 30 Query complete 00:00:00.921 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=198758.05..198911.96 rows=424 width=65) (actual time=859.383..897.232 rows=34 loops=1)
2   -> Gather Merge (cost=198758.05..198909.84 rows=848 width=65) (actual time=859.382..897.214 rows=97 loops=1)
3     Workers Planned: 2
4     Workers Launched: 2
5       -> Unique (cost=197758.03..197811.93 rows=424 width=65) (actual time=798.736..835.769 rows=32 loops=3)
6         -> Merge Join (cost=197758.03..197810.02 rows=765 width=65) (actual time=798.735..835.361 rows=7727 loops=3)
7           Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
8             -> Sort (cost=197741.09..197761.36 rows=8109 width=65) (actual time=798.267..825.254 rows=195797 loops=3)
9               Sort Key: positions.vessel_id
10              Sort Method: external merge Disk: 13496kB
11              Worker 0: Sort Method: external merge Disk: 13232kB
12              Worker 1: Sort Method: external merge Disk: 13304kB
13                -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=149.465..488.639 rows=197248 loops=3)
14                  Filter: ((speed <= 0)::double precision AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
15                  Rows Removed by Filter: 2148302
16                -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.461..0.692 rows=7799 loops=3)
17                  Sort Key: vessels.id
18                  Sort Method: quicksort Memory: 33kB
19                  Worker 0: Sort Method: quicksort Memory: 33kB
20                  Worker 1: Sort Method: quicksort Memory: 33kB
21                    -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.195..0.274 rows=104 loops=3)
22                      Hash Cond: (vessels.type = vesseltypes.code)

```

Total rows: 30 of 30    Query complete 00:00:00.921    Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
10 Sort Key: positions.vessel_id
11 Sort Method: external merge Disk: 13496kB
12 Worker 0: Sort Method: external merge Disk: 13232kB
13 Worker 1: Sort Method: external merge Disk: 13304kB
14   -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=65) (actual time=149.465..488.639 rows=197248 loops=3)
15     Filter: ((speed <= 0)::double precision AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
16     Rows Removed by Filter: 2148302
17   -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.461..0.692 rows=7799 loops=3)
18     Sort Key: vessels.id
19     Sort Method: quicksort Memory: 33kB
20     Worker 0: Sort Method: quicksort Memory: 33kB
21     Worker 1: Sort Method: quicksort Memory: 33kB
22       -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.195..0.274 rows=104 loops=3)
23         Hash Cond: (vessels.type = vesseltypes.code)
24           -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.068..0.108 rows=489 loops=3)
25           -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.048..0.049 rows=10 loops=3)
26             Buckets: 1024 Batches: 1 Memory Usage: 9kB
27             -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.041..0.043 rows=10 loops=3)
28               Filter: (description ~~ 'Cargo%::text')
29               Rows Removed by Filter: 96
30 Planning Time: 0.414 ms
31 Execution Time: 898.823 ms

```

Total rows: 30 of 30    Query complete 00:00:00.921    Ln 44, Col 1

Για το query 5α, παρατηρούμε ότι ο χρόνος εκτέλεσης μειώνεται όλο και περισσότερο σε κάθε επανάληψη.

## Ερώτημα v) (β) (Πρώτη εκτέλεση)

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a tab labeled "erwthma2.sql\*". Below the navigation is a toolbar with various icons for file operations, search, and database management. The main area is divided into two panes: "Query" (active) and "Scratch Pad". The "Query" pane contains the following SQL code:

```
57 --erwthma1v(b)
58 select distinct
59   Positions.vessel_id, VesselTypes.description, Positions.speed
60 from
61   Positions
62 join
63   Vessels on Positions.vessel_id = Vessels.id
64 join
65   VesselTypes on Vessels.type = VesselTypes.code
66 where
67   VesselTypes.description like 'Cargo%' and
68   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
69   and Positions.speed = 0
70 group by Positions.vessel_id, VesselTypes.description, Positions.speed
71 having count(distinct date(Positions.t)) = 8
72 order by Positions.vessel_id;
```

Below the code, there are tabs for Data Output, Messages, Explain, Notifications, and a status message: "Successfully run. Total query runtime: 1 secs 292 msec. 2 rows affected." At the bottom right, it says "Ln 58, Col 1".

Χρόνος εκτέλεσης 128 MB

1 secs 100 msec

Χρόνος εκτέλεσης 1024 MB



1 secs 292 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
  
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 | Query complete 00:00:00.059 | Ln 58, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Query History

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
  
```

Data Output Messages Explain Notifications

QUERY PLAN

text
1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=979.745..1053.972 rows=2 loops=1)
2 -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=979.744..1053.967 rows=2 loops=1)
3 Group Key: positions.vessel_id, vesseltypes.description
4 Filter: (count(DISTINCT date(positions.t)) = 8)
5 Rows Removed by Filter: 42
6 -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=919.316..1049.723 rows=34666 loops=1)
7 Workers Planned: 2

✓ Successfully run. Total query runtime: 1 secs 89 msec. 42 rows affected. X

Total rows: 42 of 42 | Query complete 00:00:01.089 | Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=979.745..1053.972 rows=2 loops=1)
2   -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=979.744..1053.967 rows=2 loops=1)
3     Group Key: positions.vessel_id, vesseltypes.description
4     Filter: (count(DISTINCT date(positions.t)) = 8)
5     Rows Removed by Filter: 42
6     -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=919.316..1049.723 rows=34666 loops=1)
7       Workers Planned: 2
8       Workers Launched: 2
9         -> Incremental Sort (cost=197758.16..197832.51 rows=765 width=111) (actual time=877.722..943.938 rows=11555 loops=3)
10        Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11        Presorted Key: positions.vessel_id
12        Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13        Pre-sorted Groups: 34 Sort Method: quicksort Average Memory: 250kB Peak Memory: 423kB
14        Worker 0: Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15        Pre-sorted Groups: 37 Sort Method: quicksort Average Memory: 269kB Peak Memory: 585kB
16        Worker 1: Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17        Pre-sorted Groups: 37 Sort Method: quicksort Average Memory: 295kB Peak Memory: 582kB
18        -> Merge Join (cost=197758.03..197810.02 rows=765 width=111) (actual time=877.470..938.881 rows=11555 loops=3)
19          Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
20          -> Sort (cost=197741.09..197761.36 rows=8109 width=81) (actual time=876.905..919.817 rows=284139 loops=3)
21            Sort Key: positions.vessel_id
22            Sort Method: external merge Disk: 29096kB

```

Total rows: 42 of 42    Query complete 00:00:01.089    Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
23 Sort Key: positions.vessel_id
24 Sort Method: external merge Disk: 29096kB
25 Worker 0: Sort Method: external merge Disk: 26160kB
26 Worker 1: Sort Method: external merge Disk: 27168kB
27 -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=81) (actual time=97.142..473.334 rows=286120 loops=1)
28   Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
29   Rows Removed by Filter: 2059430
30   -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.509..0.923 rows=11618 loops=3)
31     Sort Key: vessels.id
32     Sort Method: quicksort Memory: 37kB
33     Worker 0: Sort Method: quicksort Memory: 37kB
34     Worker 1: Sort Method: quicksort Memory: 37kB
35     -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.251..0.322 rows=104 loops=3)
36       Hash Cond: (vessels.type = vesseltypes.code)
37       -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.102..0.138 rows=489 loops=3)
38       -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.052..0.052 rows=10 loops=3)
39       Buckets: 1024 Batches: 1 Memory Usage: 9kB
40       -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.044..0.047 rows=10 loops=3)
41     Filter: (description ~~ 'Cargo%'::text)
42     Rows Removed by Filter: 96
43 Planning Time: 0.695 ms
44 Execution Time: 1057.396 ms

```

Total rows: 42 of 42    Query complete 00:00:01.089    Ln 58, Col 1

## Ερώτημα v) (β) (Δεύτερη εκτέλεση)

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., and a file named erwthma2.sql\*. Below the navigation is a toolbar with various icons for database management. The main area is divided into two tabs: Query and Scratch Pad. The Query tab contains the following SQL code:

```
57
58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
```

Below the code, the status bar indicates "Successfully run. Total query runtime: 1 secs 120 msec. 2 rows affected." At the bottom, it shows "Total rows: 2 of 2" and "Query complete 00:00:01.120".

Χρόνος εκτέλεσης 128 MB

1 secs 100 msec

Χρόνος εκτέλεσης 1024 MB

1 secs 120 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma2.sql\*

Ships/postgres@PostgreSQL 16

Query History Scratch Pad

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

✓ Successfully run. Total query runtime: 57 msec. 1 rows affected.

Total rows: 1 of 1 | Query complete 00:00:00.057 | Ln 58, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma2.sql\*

Ships/postgres@PostgreSQL 16

Query History Scratch Pad

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
74

```

Data Output Messages Explain Notifications

QUERY PLAN text

- 1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=1052.330..1115.181 rows=2 loops=1)
- 2 -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=1052.328..1115.176 rows=2 loops=1)
- 3 Group Key: positions.vessel\_id, vesseltypes.description
- 4 Filter: (count(DISTINCT date(positions.t)) = 8)
- 5 Rows Removed by Filter: 42
- 6 -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=992.332..1110.663 rows=34666 loops=1)
- 7 Workers Planned: 2

✓ Successfully run. Total query runtime: 1 secs 140 msec. 42 rows affected.

Total rows: 42 of 42 | Query complete 00:00:01.140 | Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma2.sql

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=1052.330..1115.181 rows=2 loops=1)
2   -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=1052.328..1115.176 rows=2 loops=1)
3     Group Key: positions.vessel_id, vesseltypes.description
4     Filter: (count(DISTINCT date(positions.t)) = 8)
5     Rows Removed by Filter: 42
6     -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=992.332..1110.663 rows=34666 loops=1)
7       Workers Planned: 2
8       Workers Launched: 2
9       -> Incremental Sort (cost=197758.16..197832.51 rows=765 width=111) (actual time=952.146..1018.238 rows=11555 loops=3)
10      Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11      Presorted Key: positions.vessel_id
12      Full-sort Groups: 37 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13      Pre-sorted Groups: 35 Sort Method: quicksort Average Memory: 299kB Peak Memory: 474kB
14      Worker 0: Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15      Pre-sorted Groups: 36 Sort Method: quicksort Average Memory: 235kB Peak Memory: 575kB
16      Worker 1: Full-sort Groups: 37 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17      Pre-sorted Groups: 36 Sort Method: quicksort Average Memory: 267kB Peak Memory: 542kB
18      -> Merge Join (cost=197758.03..197810.02 rows=765 width=111) (actual time=951.863..1013.504 rows=11555 loops=3)
19        Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
20        -> Sort (cost=197741.09..197761.36 rows=8109 width=81) (actual time=951.235..994.432 rows=284139 loops=3)
21          Sort Key: positions.vessel_id
22          Sort Method: external merge Disk: 28264kB
Total rows: 42 of 42 Query complete 00:00:01.140 Ln 58, Col 1

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma2.sql

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
22 Sort Key: positions.vessel_id
23   Sort Method: external merge Disk: 28264kB
24     Worker 0: Sort Method: external merge Disk: 27168kB
25     Worker 1: Sort Method: external merge Disk: 26976kB
26     -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=81) (actual time=93.419..529.398 rows=286120 loops=1)
27       Filter: ((speed = '0::double precision') AND (date(t) >='2019-08-12::date') AND (date(t) <='2019-08-19::date'))
28       Rows Removed by Filter: 2059430
29       -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.565..1.022 rows=11617 loops=3)
30         Sort Key: vessels.id
31         Sort Method: quicksort Memory: 37kB
32           Worker 0: Sort Method: quicksort Memory: 37kB
33           Worker 1: Sort Method: quicksort Memory: 37kB
34           -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.296..0.371 rows=104 loops=3)
35             Hash Cond: (vessels.type = vesseltypes.code)
36             -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.120..0.158 rows=489 loops=3)
37             -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.071..0.072 rows=10 loops=3)
38               Buckets: 1024 Batches: 1 Memory Usage: 9kB
39               -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.062..0.066 rows=10 loops=3)
40                 Filter: (description ~~ 'Cargo%::text')
41                 Rows Removed by Filter: 96
42 Planning Time: 0.502 ms
Execution Time: 1117.513 ms
Total rows: 42 of 42 Query complete 00:00:01.140 Ln 58, Col 1

```

## Ερώτημα v) (β) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, **erwthma2.sql\***.
- Connection:** Ships/postgres@PostgreSQL 16.
- Query Editor:** Contains a multi-line SQL query (lines 54-73). The code is a complex join query involving VesselTypes, Positions, and Vessels tables, filtering for cargo ships, speeds of 0, and specific dates, then grouping by vessel ID and date.
- Scratch Pad:** Tab labeled "Scratch Pad" is visible on the right.
- Status Bar:** Shows "Successfully run. Total query runtime: 1 secs 78 msec. 2 rows affected." and "Total rows: 2 of 2 | Query complete 00:00:01.078 | Ln 58, Col 1".

**Χρόνος εκτέλεσης 128 MB**

1 secs 100 msec



**Χρόνος εκτέλεσης 1024 MB**

1 secs 78 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
  
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.059    Ln 58, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
74

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=983.960..1056.009 rows=2 loops=1)
2 -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=983.958..1056.004 rows=2 loops=1)
3   Group Key: positions.vessel_id, vesseltypes.description
4   Filter: (count(DISTINCT date(positions.t)) = 8)
5   Rows Removed by Filter: 42
6 -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=927.062..1051.692 rows=34666 loops=1)
7   Workers Planned: 2

```

✓ Successfully run. Total query runtime: 1 secs 90 msec. 42 rows affected.

Total rows: 42 of 42 Query complete 00:00:01.090 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes [erwthma2.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=198758.19..199085.81 rows=9 width=103) (actual time=983.960..1056.009 rows=2 loops=1)
2 -> GroupAggregate (cost=198758.19..199085.76 rows=9 width=103) (actual time=983.958..1056.004 rows=2 loops=1)
3   Group Key: positions.vessel_id, vesseltypes.description
4   Filter: (count(DISTINCT date(positions.t)) = 8)
5   Rows Removed by Filter: 42
6 -> Gather Merge (cost=198758.19..199044.45 rows=1836 width=111) (actual time=927.062..1051.692 rows=34666 loops=1)
7   Workers Planned: 2
8   Workers Launched: 2
9 -> Incremental Sort (cost=197758.16..197832.51 rows=765 width=111) (actual time=886.671..956.837 rows=11555 loops=3)
10   Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11   Presorted Key: positions.vessel_id
12   Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13   Pre-sorted Groups: 32 Sort Method: quicksort Average Memory: 224kB Peak Memory: 428kB
14   Worker 0: Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15   Pre-sorted Groups: 35 Sort Method: quicksort Average Memory: 324kB Peak Memory: 556kB
16   Worker 1: Full-sort Groups: 36 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17   Pre-sorted Groups: 38 Sort Method: quicksort Average Memory: 278kB Peak Memory: 607kB
18 -> Merge Join (cost=197758.03..197810.02 rows=765 width=111) (actual time=886.377..951.885 rows=11555 loops=3)
19   Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
20 -> Sort (cost=197741.09..197761.36 rows=8109 width=81) (actual time=885.821..932.213 rows=284139 loops=3)
21   Sort Key: positions.vessel_id
22   Sort Method: external merge Disk: 25464kB

```

Total rows: 42 of 42 Query complete 00:00:01.090 Ln 58, Col 1

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes erwthma2.sql*
Ships/postgres@PostgreSQL 16
Data Output Messages Explain Notifications
QUERY PLAN
text
z1 Sort Key: positions.vessel_id
22 Sort Method: external merge Disk: 25464kB
23 Worker 0: Sort Method: external merge Disk: 28960kB
24 Worker 1: Sort Method: external merge Disk: 27992kB
25 -> Parallel Seq Scan on positions (cost=0.00..197214.60 rows=8109 width=81) (actual time=94.748..471.865 rows=286120 loops=...
26 Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
27 Rows Removed by Filter: 2059430
28 -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.499..0.921 rows=11618 loops=3)
29 Sort Key: vessels.id
30 Sort Method: quicksort Memory: 37kB
31 Worker 0: Sort Method: quicksort Memory: 37kB
32 Worker 1: Sort Method: quicksort Memory: 37kB
33 -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.238..0.311 rows=104 loops=3)
34 Hash Cond: (vessels.type = vesseltypes.code)
35 -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.094..0.131 rows=489 loops=3)
36 -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.053..0.054 rows=10 loops=3)
37 Buckets: 1024 Batches: 1 Memory Usage: 9kB
38 -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.044..0.047 rows=10 loops=3)
39 Filter: (description ~~ 'Cargo%':text)
40 Rows Removed by Filter: 96
41 Planning Time: 0.530 ms
42 Execution Time: 1058.681 ms
Total rows: 42 of 42 Query complete 00:00:01.090 Ln 58, Col 1

```

Για το ερώτημα 5β, παρατηρούμε ότι ο χρόνος εκτέλεσης έχει καθοδική πορεία σε κάθε επανάληψη. Στις δυο πρώτες επαναλήψεις είναι χειρότερος από πριν και στην Τρίτη υπάρχει μια αμελητέα βελτίωση.

Συμπερασματικά, σε γενικές γραμμές υπάρχει μείωση του χρόνου εκτέλεσης σε όλα τα ερωτήματα με την αλλαγή της τιμής των shared buffers. Αυτό οφείλεται στο ότι πλέον η Postgres εγχωρεί 1024 MB μνήμης στο κοινό buffer στην κύρια μνήμη. Με άλλα λόγια, χρησιμοποιείται μεγαλύτερο ποσοστό των πόρων του συστήματος, δηλαδή της μνήμης RAM, κι έτσι βελτιώνεται η απόδοση της Βάσης Δεδομένων.

### Ερώτημα 3 (15 %)

Εκτελούμε τη παρακάτω εντολή για να δούμε πόσοι πυρήνες χρησιμοποιούνται. Άρα παρατηρούμε ότι by default χρησιμοποιούνται 2 πυρήνες.

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection tab for "erwthma2.sql\*".
- Query Editor:** Shows the query `show max_parallel_workers_per_gather;`.
- Data Output:** A table with one row showing the result:

	max_parallel_workers_per_gather
1	2
- Status Bar:** Shows "Total rows: 1 of 1" and "Query complete 00:00:00.055".
- Message Bar:** A green message box indicates "Successfully run. Total query runtime: 55 msec. 1 rows affected." with a close button.
- Bottom Right:** "Ln 1, Col 1"

Τώρα, θα αυξήσουμε τους πυρήνες που χρησιμοποιούνται για να εξετάσουμε τις διαφορές στους χρόνους εκτέλεσης που θα προκύψουν, με την παρακάτω εντολή:

The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with tabs for Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a file tab labeled 'erwthma2.sql\*'. Below the navigation bar is a toolbar with various icons for database management. The main area is divided into two panes: 'Query' on the left and 'Scratch Pad' on the right. The 'Query' pane contains the following SQL code:

```
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
```

Below the Query pane, there are tabs for Data Output, Messages, and Notifications. The 'Messages' tab is selected, showing the message: "SET". Underneath it, it says "Query returned successfully in 58 msec.". At the bottom of the interface, there's a status bar with the text "Total rows: 1 of 1" and "Query complete 00:00:00.058". To the right of the status bar, a green notification box displays the message "✓ Query returned successfully in 58 msec. X".

Έπειτα, εκτελούμε ξανά την εντολή show οι πυρήνες.

The screenshot shows the pgAdmin 4 interface. At the top, there's a navigation bar with links like Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a file tab labeled 'erwthma2.sql\*'. Below the navigation bar is a toolbar with various icons for database management. The main area has two tabs: 'Query' (selected) and 'Query History'. The 'Query' tab contains the following SQL code:

```
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
```

Below the query editor is a 'Data Output' tab which displays the results of the 'show' command:

	max_parallel_workers_per_gather
text	8

At the bottom of the interface, there's a status bar with the message 'Successfully run. Total query runtime: 35 msec. 1 rows affected.' and 'Ln 1, Col 1'.

Αφού έχουν αλλάξει επιτυχώς οι πυρήνες από 2 που ήταν σε 8, τώρα θα εκτελέσουμε ξανά τα query i-v.

### Ερώτημα i) (Πρώτη εκτέλεση)

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql*
Ships/postgres@PostgreSQL 16
No limit
Query History Scratch Pad
Query
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
Data Output Messages Explain Notifications
Successfully run. Total query runtime: 524 msec.
24 rows affected.
Total rows: 24 of 24 Query complete 00:00:00.524 Ln 5, Col 1

```

✓ Successfully run. Total query runtime: 524 msec. 24 rows affected. X

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

m  
s  
e  
c  
→

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

524 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthmaii
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthmaii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    A[positions] --> B[Aggregate]
    B --> C[Sort]
    C --> D[Gather Merge]
    D --> E[Aggregate]
    E --> F[Sort]

```

Total rows: 1 of 1 Query complete 00:00:00.053 Ln 5, Col 1

✓ Successfully run. Total query runtime: 53 msec. 1 rows affected.

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthmaii
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10

```

Data Output Messages Explain Notifications

QUERY PLAN

	text
1	Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=531.876..538.041 rows=24 loops=1)
2	Sort Key: (count(t)) DESC
3	Sort Method: quicksort Memory: 25kB
4	-> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=531.839..538.030 rows=24 loops=1)
5	Group Key: (date(t))
6	-> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=531.823..538.004 rows=141 loops=1)
7	Workers Planned: 5
8	Workers Launched: 5
9	-> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=477.616..477.620 rows=24 loops=6)
10	Sort Key: (date(t))
11	Sort Method: quicksort Memory: 25kB
12	Worker 0: Sort Method: quicksort Memory: 25kB
13	Worker 1: Sort Method: quicksort Memory: 25kB

Total rows: 27 of 27 Query complete 00:00:00.555 Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Data Output Messages Explain Notifications

QUERY PLAN

text

1 Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=531.876..538.041 rows=24 loops=1)

2 Sort Key: (count(t)) DESC

3 Sort Method: quicksort Memory: 25kB

4 -> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=531.839..538.030 rows=24 loops=1)

5 Group Key: (date(t))

6 -> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=531.823..538.004 rows=141 loops=1)

7 Workers Planned: 5

8 Workers Launched: 5

9 -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=477.616..477.620 rows=24 loops=6)

10 Sort Key: (date(t))

11 Sort Method: quicksort Memory: 25kB

12 Worker 0: Sort Method: quicksort Memory: 25kB

13 Worker 1: Sort Method: quicksort Memory: 25kB

14 Worker 2: Sort Method: quicksort Memory: 25kB

15 Worker 3: Sort Method: quicksort Memory: 25kB

16 Worker 4: Sort Method: quicksort Memory: 25kB

17 -> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=476.785..477.574 rows=24 loops=6)

18 Group Key: date(t)

19 Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB

20 Worker 0: Batches: 1 Memory Usage: 3097kB

21 Worker 1: Batches: 1 Memory Usage: 3097kB

22 Worker 2: Batches: 1 Memory Usage: 3097kB

Total rows: 27 of 27 Query complete 00:00:00.555

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

QUERY PLAN

text

Workers Planned: 5

Workers Launched: 5

> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=477.616..477.620 rows=24 loops=6)

Sort Key: (date())

Sort Method: quicksort Memory: 25kB

Worker 0: Sort Method: quicksort Memory: 25kB

Worker 1: Sort Method: quicksort Memory: 25kB

Worker 2: Sort Method: quicksort Memory: 25kB

Worker 3: Sort Method: quicksort Memory: 25kB

Worker 4: Sort Method: quicksort Memory: 25kB

> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=476.785..477.574 rows=24 loops=6)

Group Key: date()

Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB

Worker 0: Batches: 1 Memory Usage: 3097kB

Worker 1: Batches: 1 Memory Usage: 3097kB

Worker 2: Batches: 1 Memory Usage: 3097kB

Worker 3: Batches: 1 Memory Usage: 3097kB

Worker 4: Batches: 1 Memory Usage: 3097kB

> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=1407330 width=12) (actual time=0.116..338.094 rows=1172775 loops=24)

Planning Time: 0.120 ms

Execution Time: 538.615 ms

Total rows: 27 of 27 Query complete 00:00:00.555 Ln 5, Col 1

## Ερώτημα i) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The connection is set to 'Ships/postgres@PostgreSQL 16'. The current tab is 'erwthma3.sql\*'. The query window contains the following SQL code:

```
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
```

The status bar at the bottom indicates: 'Total rows: 24 of 24' and 'Query complete 00:00:00.514'. A green message box in the center says: 'Successfully run. Total query runtime: 514 msec. 24 rows affected.' with a close button.

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
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→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

514 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) X

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Query History Scratch Pad X

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthmai
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
11 --erwthmai
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthmai
18 select Positions.vessel_id, VesselTypes.description as ShipType
  
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.062    Ln 5, Col 1

✓ Successfully run. Total query runtime: 62 msec. 1 rows affected. X

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) X

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Query History Scratch Pad X

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthmai
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
  
```

Data Output Messages Explain Notifications

≡ ☰ 🖨️ ⬇️ ⬆️ ✖️ ➕ ⬇️ ↗️

QUERY PLAN text

1	Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=538.144..543.978 rows=24 loops=1)
2	Sort Key: (count(t)) DESC
3	Sort Method: quicksort Memory: 25kB
4	> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=538.095..543.961 rows=24 loops=1)
5	Group Key: (date(t))
6	> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=538.088..543.937 rows=141 loops=1)
7	Workers Planned: 5
8	Workers Launched: 5
9	> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=482.181..482.183 rows=24 loops=6)
10	Sort Key: (date(t))
11	Sort Method: quicksort Memory: 25kB
12	Worker 0: Sort Method: quicksort Memory: 25kB

✓ Successfully run. Total query runtime: 562 msec. 27 rows affected. X

Total rows: 27 of 27    Query complete 00:00:00.562    Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
1 Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=538.144..543.978 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=538.095..543.961 rows=24 loops=1)
5 Group Key: (date(t))
6 -> Gather Merge (cost=307937.14..573097.21 rows=2193595 width=12) (actual time=538.088..543.937 rows=141 loops=1)
7 Workers Planned: 5
8 Workers Launched: 5
9 -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=482.181..482.183 rows=24 loops=6)
10 Sort Key: (date(t))
11 Sort Method: quicksort Memory: 25kB
12 Worker 0: Sort Method: quicksort Memory: 25kB
13 Worker 1: Sort Method: quicksort Memory: 25kB
14 Worker 2: Sort Method: quicksort Memory: 25kB
15 Worker 3: Sort Method: quicksort Memory: 25kB
16 Worker 4: Sort Method: quicksort Memory: 25kB
17 -> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=481.456..482.139 rows=24 loops=6)
18 Group Key: date(t)
19 Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
20 Worker 0: Batches: 1 Memory Usage: 3097kB
21 Worker 1: Batches: 1 Memory Usage: 3097kB
22 Worker 2: Batches: 1 Memory Usage: 3097kB
23 Worker 3: Batches: 1 Memory Usage: 3097kB
24 Worker 4: Batches: 1 Memory Usage: 3097kB
25 -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=1407330 width=12) (actual time=0.114..343.924 rows=1172775 loops=1)
26 Planning Time: 0.133 ms
27 Execution Time: 544.522 ms
Total rows: 27 of 27 Query complete 00:00:00.562

```

Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
-> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=538.095..543.961 rows=141 loops=1)
7 Workers Planned: 5
8 Workers Launched: 5
9 -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=482.181..482.183 rows=24 loops=6)
10 Sort Key: (date(t))
11 Sort Method: quicksort Memory: 25kB
12 Worker 0: Sort Method: quicksort Memory: 25kB
13 Worker 1: Sort Method: quicksort Memory: 25kB
14 Worker 2: Sort Method: quicksort Memory: 25kB
15 Worker 3: Sort Method: quicksort Memory: 25kB
16 Worker 4: Sort Method: quicksort Memory: 25kB
17 -> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=481.456..482.139 rows=24 loops=6)
18 Group Key: date(t)
19 Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
20 Worker 0: Batches: 1 Memory Usage: 3097kB
21 Worker 1: Batches: 1 Memory Usage: 3097kB
22 Worker 2: Batches: 1 Memory Usage: 3097kB
23 Worker 3: Batches: 1 Memory Usage: 3097kB
24 Worker 4: Batches: 1 Memory Usage: 3097kB
25 -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=1407330 width=12) (actual time=0.114..343.924 rows=1172775 loops=1)
26 Planning Time: 0.133 ms
27 Execution Time: 544.522 ms
Total rows: 27 of 27 Query complete 00:00:00.562

```

Ln 5, Col 1

## Ερώτημα i) (Τρίτη εκτέλεση)

```
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
```

Data Output Messages Explain × Notifications

Successfully run. Total query runtime: 513 msec.  
24 rows affected.

Total rows: 24 of 24 Query complete 00:00:00.513 Ln 5, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

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→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

513 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql](#) [x](#)

[Ships/postgres@PostgreSQL 16](#) [▼](#) [↻](#)

[File](#) [Edit](#) [Insert](#) [Select](#) [No limit](#) [Run](#) [Stop](#) [Kill](#) [Save](#) [Copy](#) [Reset](#) [Help](#)

Query Query History [Scratch Pad](#) [x](#)

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthma1i
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10

```

Data Output Messages Explain [x](#) Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.040    ✓ Successfully run. Total query runtime: 40 msec. 1 rows affected. [X](#)    Ln 5, Col 1

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**PLAN**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

[Ships/postgres@PostgreSQL 16](#) v

No limit E II

Query [Query History](#) Scratch Pad x

```

1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthma1i
6 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;

```

Data Output Messages Explain Notifications

QUERY PLAN text

text
1 Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=551.292..556.742 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=551.260..556.733 rows=24 loops=1)
5 Group Key: (date(t))
6 -> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=551.253..556.716 rows=141 loops=1)
7 Workers Planned: 5
8 Workers Launched: 5
9 -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=488.710..488.712 rows=24 loops=6)
10 Sort Key: (date(t))
11 Sort Method: quicksort Memory: 25kB
12 Worker 0: Sort Method: quicksort Memory: 25kB
13 Worker 1: Sort Method: quicksort Memory: 25kB
Total rows: 27 of 27 Query complete 00:00:00.589

Ln 5, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

[Ships/postgres@PostgreSQL 16](#) v

No limit E II

Data Output Messages Explain Notifications

QUERY PLAN text

text
7 Workers Planned: 5
8 Workers Launched: 5
9 -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=488.710..488.712 rows=24 loops=6)
10 Sort Key: (date(t))
11 Sort Method: quicksort Memory: 25kB
12 Worker 0: Sort Method: quicksort Memory: 25kB
13 Worker 1: Sort Method: quicksort Memory: 25kB
14 Worker 2: Sort Method: quicksort Memory: 25kB
15 Worker 3: Sort Method: quicksort Memory: 25kB
16 Worker 4: Sort Method: quicksort Memory: 25kB
17 -> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=488.043..488.668 rows=24 loops=6)
18 Group Key: date(t)
19 Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
20 Worker 0: Batches: 1 Memory Usage: 3097kB
21 Worker 1: Batches: 1 Memory Usage: 3097kB
22 Worker 2: Batches: 1 Memory Usage: 3097kB
23 Worker 3: Batches: 1 Memory Usage: 3097kB
24 Worker 4: Batches: 1 Memory Usage: 3097kB
25 -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=1407330 width=12) (actual time=0.148..348.569 rows=1172775 loop...
26 Planning Time: 0.137 ms
27 Execution Time: 557.349 ms

Total rows: 27 of 27 Query complete 00:00:00.589

Ln 5, Col 1

## Ερώτημα ii) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Connections:** Ships/postgres@PostgreSQL 16
- Query Pad:** Contains the following SQL code:

```
--erwthma1ii
select VesselTypes.description as ShipType, count(*) as NumberOfShips
from Vessels join VesselTypes on Vessels.type = VesselTypes.code
where Vessels.flag = 'Greece'
group by VesselTypes.description;
--erwthma1iii
select Positions.vessel_id, VesselTypes.description as ShipType,
```
- Messages:** NATALIA VORIZANAKI (p20035@unipi.gr) is signed in
- Status Bar:** Total rows: 28 of 28 | Query complete 00:00:00.146 | Ln 11, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

146 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

Query History Scratch Pad x

```

11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

🔍 ↻ 🔍 ↻

Total rows: 1 of 1 | Query complete 00:00:00.060 | Ln 11, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

Query History Scratch Pad x

```

11 --erwthma1ii
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

≡+ 📁 ↻ 🗃 ↻

QUERY PLAN	
	text
1	HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.189..0.192 rows=28 loops=1)
2	Group Key: vesseltypes.description
3	Batches: 1 Memory Usage: 24kB
4	-> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.061..0.144 rows=242 loops=1)
5	Hash Cond: (vessels.type = vesseltypes.code)
6	-> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.021..0.070 rows=244 loops=1)
7	Filter: ((flag)::text = 'Greece'::text)
8	Rows Removed by Filter: 245
9	-> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.026..0.026 rows=106 loops=1)
10	Buckets: 1024 Batches: 1 Memory Usage: 15kB
11	-> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.006..0.013 rows=106 loop...
12	Planning Time: 0.235 ms
13	Execution Time: 0.220 ms

Total rows: 13 of 13 | Query complete 00:00:00.061 | Ln 11, Col 1

## Ερώτημα ii) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Query Editor:** Shows a multi-line SQL script. Lines 11-15 and 17-18 are visible, both starting with '--erwthma1ii'. Line 18 contains a SELECT statement. The Data Output tab is selected.
- Output Panel:** Displays the message "Successfully run. Total query runtime: 49 msec." and "28 rows affected."
- Status Bar:** Total rows: 28 of 28 | Query complete 00:00:00.049 | Ln 11, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
s  
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→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

49 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit Explain Notifications

Query History Scratch Pad

```

11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

vessels vesseltypes Hash Hash Inner Join Aggregate

Total rows: 1 of 1 Query complete 00:00:00.049 Ln 11, Col 1

✓ Successfully run. Total query runtime: 49 msec. 1 rows affected.

**Q  
U  
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R  
Y  
PLAN**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit

Scratch Pad

```

11 --erwthma11i
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma11ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.146..0.150 rows=28 loops=1)
2	Group Key: vesseltypes.description
3	Batches: 1 Memory Usage: 24kB
4	-> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.039..0.107 rows=242 loops=1)
5	Hash Cond: (vessels.type = vesseltypes.code)
6	-> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.012..0.053 rows=244 loops=1)
7	Filter: ((flag)::text = 'Greece'::text)
8	Rows Removed by Filter: 245
9	-> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.021..0.021 rows=106 loops=1)
10	Buckets: 1024 Batches: 1 Memory Usage: 15kB
11	-> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.005..0.012 rows=106 loops=1)
12	Planning Time: 0.189 ms
13	Execution Time: 0.174 ms

Total rows: 13 of 13    Query complete 00:00:00.054    Ln 11, Col 1

## Ερώτημα ii) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The query pane contains two numbered SQL statements:

```
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
```

Below the query pane, status messages indicate: "Successfully run. Total query runtime: 47 msec.", "28 rows affected.", "Total rows: 28 of 28", and "Query complete 00:00:00.047". A green success message at the bottom right says "Successfully run. Total query runtime: 47 msec. 28 rows affected." with a timestamp of "Ln 11, Col 1".

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

m  
s  
e  
c  
→

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

**47 msec**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.044    ✓ Successfully run. Total query runtime: 44 msec. 1 rows affected. Ln 11, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

11 --erwthma1ii
12 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	HashAggregate (cost=18.38..18.99 rows=61 width=38) (actual time=0.152..0.155 rows=28 loops=1)
2	Group Key: vesseltypes.description
3	Batches: 1 Memory Usage: 24kB
4	-> Hash Join (cost=3.39..17.16 rows=244 width=30) (actual time=0.051..0.115 rows=242 loops=1)
5	Hash Cond: (vessels.type = vesseltypes.code)
6	-> Seq Scan on vessels (cost=0.00..13.11 rows=244 width=4) (actual time=0.027..0.066 rows=244 loops=1)
7	Filter: ((flag)::text = 'Greece'::text)
8	Rows Removed by Filter: 245
9	-> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.019..0.019 rows=106 loops=1)
10	Buckets: 1024 Batches: 1 Memory Usage: 15kB
11	-> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.005..0.010 rows=106 loop...
12	Planning Time: 0.193 ms
13	Execution Time: 0.179 ms

Total rows: 13 of 13    Query complete 00:00:00.046    ✓ Successfully run. Total query runtime: 46 msec. 13 rows affected. Ln 11, Col 1

### Ερώτημα iii) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Session:** Ships/postgres@PostgreSQL 16
- Query Editor:** Contains the following SQL code:

```
16
17 --erwthmaiii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25
```
- Data Output:** Shows the message "Successfully run. Total query runtime: 441 msec. 16 rows affected."
- Messages:** Shows the message "Total rows: 16 of 16 Query complete 00:00:00.441 Ln 17, Col 1"
- Status Bar:** Shows a green notification bar with the message "Successfully run. Total query runtime: 441 msec. 16 rows affected. X".

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m

s

e

c

→

441 msec

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

The graphical plan illustrates the execution flow. It starts with three input tables: 'positions', 'vessels', and 'vesseltypes'. The 'vessels' table undergoes a 'Hash' operation. The 'positions' and 'vesseltypes' tables also undergo 'Hash' operations. These three hash results then participate in three 'Hash Inner Join' operations. The outputs of these joins then pass through an 'Aggregate' stage, followed by a 'Gather' stage, and finally another 'Aggregate' stage at the end.

Total rows: 1 of 1    Query complete 00:00:00.061    Ln 17, Col 1

✓ Successfully run. Total query runtime: 61 msec. 1 rows affected. X

**Q  
U  
E  
R  
Y  
PLAN**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19     count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=423.346..429.266 rows=16 loops=1)
2 Group Key: vesseltypes.description, positions.vessel_id
3 Batches: 1 Memory Usage: 793kB
4 -> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=422.975..429.132 rows=71 loops=1)
5   Workers Planned: 5
6   Workers Launched: 5
7     -> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=361.408..361.549 rows=12 loops=6)
8       Group Key: vesseltypes.description, positions.vessel_id
9       Batches: 1 Memory Usage: 793kB
10      Worker 0: Batches: 1 Memory Usage: 793kB
11      Worker 1: Batches: 1 Memory Usage: 793kB
12      Worker 2: Batches: 1 Memory Usage: 793kB

```

Total rows: 29 of 29 Query complete 00:00:00.456 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=423.346..429.266 rows=16 loops=1)
2 Group Key: vesseltypes.description, positions.vessel_id
3 Batches: 1 Memory Usage: 793kB
4 -> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=422.975..429.132 rows=71 loops=1)
5   Workers Planned: 5
6   Workers Launched: 5
7     -> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=361.408..361.549 rows=12 loops=6)
8       Group Key: vesseltypes.description, positions.vessel_id
9       Batches: 1 Memory Usage: 793kB
10      Worker 0: Batches: 1 Memory Usage: 793kB
11      Worker 1: Batches: 1 Memory Usage: 793kB
12      Worker 2: Batches: 1 Memory Usage: 793kB
13      Worker 3: Batches: 1 Memory Usage: 793kB
14      Worker 4: Batches: 1 Memory Usage: 793kB
15     -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=2.571..351.127 rows=34956 loops=6)
16       Hash Cond: (vessels.type = vesseltypes.code)
17     -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=2.372..345.029 rows=34957 loops=6)
18       Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19         -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=2.039..335.030 rows=34957 loop...
20           Filter: (speed > 30::double precision)
21           Rows Removed by Filter: 1137818

```

Total rows: 29 of 29 Query complete 00:00:00.456 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
Group Key: vesseltypes.description, positions.vessel_id
9   Batches: 1 Memory Usage: 793kB
10  Worker 0: Batches: 1 Memory Usage: 793kB
11  Worker 1: Batches: 1 Memory Usage: 793kB
12  Worker 2: Batches: 1 Memory Usage: 793kB
13  Worker 3: Batches: 1 Memory Usage: 793kB
14  Worker 4: Batches: 1 Memory Usage: 793kB
15  -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=2.571..351.127 rows=34956 loops=6)
16    Hash Cond: (vessels.type = vesseltypes.code)
17    -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=2.372..345.029 rows=34957 loops=6)
18      Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19      -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=2.039..335.030 rows=34957 loops=6)
20        Filter: (speed > '30)::double precision
21        Rows Removed by Filter: 1137818
22        -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.289..0.290 rows=489 loops=6)
23        Buckets: 1024 Batches: 1 Memory Usage: 58kB
24        -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.066..0.143 rows=489 loops=6)
25        -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.131..0.132 rows=106 loops=6)
26        Buckets: 1024 Batches: 1 Memory Usage: 15kB
27        -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.068..0.079 rows=106 loops=6)
28  Planning Time: 0.440 ms
29  Execution Time: 429.421 ms

```

Total rows: 29 of 29    Query complete 00:00:00.456    Ln 17, Col 1

### Ερώτημα iii) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The query tab contains the following SQL code:

```
16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19     count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25
```

Below the code, the status bar shows "Successfully run. Total query runtime: 421 msec. 16 rows affected." and "Ln 17, Col 1".

Χρόνος εκτέλεσης 1024 MB  
και 2 πυρήνες

m  
s  
e  
c  
→ 421 msec

Χρόνος εκτέλεσης 1024 MB  
και 8 πυρήνες

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.058 Ln 17, Col 1

✓ Successfully run. Total query runtime: 58 msec. 1 rows affected.

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=365.022..371.421 rows=16 loops=1)
2	Group Key: vesseltypes.description, positions.vessel_id
3	Batches: 1 Memory Usage: 793kB
4	-> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=364.661..371.300 rows=67 loops=1)
5	Workers Planned: 5
6	Workers Launched: 5
7	-> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=307.682..307.837 rows=11 loops=6)
8	Group Key: vesseltypes.description, positions.vessel_id
9	Batches: 1 Memory Usage: 793kB
10	Worker 0: Batches: 1 Memory Usage: 793kB
11	Worker 1: Batches: 1 Memory Usage: 793kB
12	Worker 2: Batches: 1 Memory Usage: 793kB

Total rows: 29 of 29 Query complete 00:00:00.392 Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=365.022..371.421 rows=16 loops=1)
2   Group Key: vesseltypes.description, positions.vessel_id
3   Batches: 1 Memory Usage: 793kB
4     -> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=364.661..371.300 rows=67 loops=1)
5       Workers Planned: 5
6       Workers Launched: 5
7         -> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=307.682..307.837 rows=11 loops=6)
8           Group Key: vesseltypes.description, positions.vessel_id
9           Batches: 1 Memory Usage: 793kB
10          Worker 0: Batches: 1 Memory Usage: 793kB
11          Worker 1: Batches: 1 Memory Usage: 793kB
12          Worker 2: Batches: 1 Memory Usage: 793kB
13          Worker 3: Batches: 1 Memory Usage: 793kB
14          Worker 4: Batches: 1 Memory Usage: 793kB
15         -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=2.227..298.109 rows=34956 loops=6)
16           Hash Cond: (vessels.type = vesseltypes.code)
17         -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=2.112..292.635 rows=34957 loops=6)
18           Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19             -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=1.843..283.621 rows=34957 loop...
20               Filter: (speed > '30'::double precision)
21               Rows Removed by Filter: 1137818
22             -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.235..0.235 rows=489 loops=6)
23               Buckets: 1024 Batches: 1 Memory Usage: 58kB
24             -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.063..0.136 rows=489 loops=6)
25             -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.080..0.081 rows=106 loops=6)
26               Buckets: 1024 Batches: 1 Memory Usage: 15kB
27             -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.053..0.061 rows=106 loops=6)
28   Planning Time: 0.566 ms
29   Execution Time: 372.096 ms
Total rows: 29 of 29 Query complete 00:00:00.392

```

Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
Group Key: vesseltypes.description, positions.vessel_id
9   Batches: 1 Memory Usage: 793kB
10  Worker 0: Batches: 1 Memory Usage: 793kB
11  Worker 1: Batches: 1 Memory Usage: 793kB
12  Worker 2: Batches: 1 Memory Usage: 793kB
13  Worker 3: Batches: 1 Memory Usage: 793kB
14  Worker 4: Batches: 1 Memory Usage: 793kB
15  -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=2.227..298.109 rows=34956 loops=6)
16    Hash Cond: (vessels.type = vesseltypes.code)
17  -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=2.112..292.635 rows=34957 loops=6)
18    Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19      -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=1.843..283.621 rows=34957 loop...
20      Filter: (speed > '30'::double precision)
21      Rows Removed by Filter: 1137818
22  -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.235..0.235 rows=489 loops=6)
23    Buckets: 1024 Batches: 1 Memory Usage: 58kB
24    -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.063..0.136 rows=489 loops=6)
25    -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.080..0.081 rows=106 loops=6)
26      Buckets: 1024 Batches: 1 Memory Usage: 15kB
27      -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.053..0.061 rows=106 loops=6)
28   Planning Time: 0.566 ms
29   Execution Time: 372.096 ms
Total rows: 29 of 29 Query complete 00:00:00.392

```

Ln 17, Col 1

### Ερώτημα iii) (Τρίτη εκτέλεση)

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes links for Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection to Ships/postgres. The current tab is 'erwthma3.sql'. The main area contains a SQL query:

```
--erwthmaiii  
select Positions.vessel_id, VesselTypes.description as ShipType,  
       count(Vessels.id) as NumberOfShips  
  from Positions  
  join Vessels on Positions.vessel_id = Vessels.id  
  join VesselTypes on Vessels.type = VesselTypes.code  
 where Positions.speed > 30  
group by VesselTypes.description, Positions.vessel_id;
```

Below the query, the status bar indicates "Successfully run. Total query runtime: 409 msec." and "16 rows affected.". At the bottom, it shows "Total rows: 16 of 16" and "Query complete 00:00:00.409".

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

409 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

16
17 --erwthma1ii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
19      count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    positions[positions] --> H1[Hash]
    vessels[vessels] --> H2[Hash]
    vesseltypes[vesseltypes] --> H3[Hash]
    H1 --> H1_HIJ[Hash Inner Join]
    H2 --> H1_HIJ
    H3 --> H2_HIJ[Hash Inner Join]
    H1_HIJ --> H2_HIJ
    H2_HIJ --> Aggregate[Aggregate]
    Aggregate --> Gather[Gather]
    Gather --> Aggregate2[Aggregate]

```

Total rows: 1 of 1 Query complete 00:00:00.054 Ln 17, Col 1

## QUERY PLAN

The screenshot shows the pgAdmin 4 interface. The top bar has tabs for Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection to Ships/postgres... (erwthma3.sql\*). The main area has a toolbar with icons for file operations, search, and execution. Below the toolbar are tabs for Query and Query History, with 'Query' selected. The code editor contains the following SQL query:

```
16
17 --erwthmaiii
18 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
19     count(Vessels.id) as NumberOfShips
20 from Positions
21 join Vessels on Positions.vessel_id = Vessels.id
22 join VesselTypes on Vessels.type = VesselTypes.code
23 where Positions.speed > 30
24 group by VesselTypes.description, Positions.vessel_id;
25
```

Below the code editor are tabs for Data Output, Messages, Explain, and Notifications. The Explain tab is active, showing a query plan in text format:

```
QUERY PLAN
text
1 Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=355.142..360.943 rows=16 loops=1)
2   Group Key: vesseltypes.description, positions.vessel_id
3   Batches: 1 Memory Usage: 793kB
4   -> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=354.744..360.786 rows=67 loops=1)
5     Workers Planned: 5
6     Workers Launched: 5
7     -> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=303.764..303.916 rows=11 loops=6)
8       Group Key: vesseltypes.description, positions.vessel_id
9       Batches: 1 Memory Usage: 793kB
10      Worker 0: Batches: 1 Memory Usage: 793kB
11      Worker 1: Batches: 1 Memory Usage: 793kB
12      Worker 2: Batches: 1 Memory Usage: 793kB
13      Worker 3: Batches: 1 Memory Usage: 793kB
14      Worker 4: Batches: 1 Memory Usage: 793kB
```

At the bottom, a message box says "Successfully run. Total query runtime: 387 msec. 29 rows affected." and shows the status "Ln 17, Col 1". The footer also displays "Total rows: 29 of 29" and "Query complete 00:00:00.387".

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection to "Ships/postgres@PostgreSQL 16".
- Header:** Shows the current file as "erwthma3.sql\*".
- Data Output:** A tab bar with "Data Output" selected, followed by Messages, Explain, and Notifications.
- Query Plan:** A table showing the execution plan with rows numbered 1 to 22. The columns include:
  - Line Number:** Row numbers 1 through 22.
  - Step Description:** The type of operation and its cost/rows/width.
  - Actual Time:** The actual time taken for each step.
  - Loops:** The number of loops for each step.
- Total Rows:** Total rows processed: 29 of 29.
- Completion:** Query complete 00:00:00.387.
- Page Footer:** Ln 17, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Data Output Messages Explain Notifications

**QUERY PLAN**

```

text
  Group Key: vesseltypes.description, positions.vessel_id
9   Batches: 1 Memory Usage: 793kB
10  Worker 0: Batches: 1 Memory Usage: 793kB
11  Worker 1: Batches: 1 Memory Usage: 793kB
12  Worker 2: Batches: 1 Memory Usage: 793kB
13  Worker 3: Batches: 1 Memory Usage: 793kB
14  Worker 4: Batches: 1 Memory Usage: 793kB
15    -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=2.062..294.399 rows=34956 loops=6)
16      Hash Cond: (vessels.type = vesseltypes.code)
17      -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=1.945..288.961 rows=34957 loops=6)
18        Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19        -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=1.702..279.915 rows=34957 loops=6)
20          Filter: (speed > 30::double precision)
21          Rows Removed by Filter: 1137818
22          -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.211..0.212 rows=489 loops=6)
23          Buckets: 1024 Batches: 1 Memory Usage: 58kB
24          -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.060..0.128 rows=489 loops=6)
25          -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.083..0.083 rows=106 loops=6)
26          Buckets: 1024 Batches: 1 Memory Usage: 15kB
27          -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.057..0.064 rows=106 loops=6)
28 Planning Time: 0.376 ms
29 Execution Time: 361.100 ms

```

Total rows: 29 of 29 Query complete 00:00:00.387 Ln 17, Col 1

## Ερώτημα iv) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The query window contains the following SQL code:

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

The status bar at the bottom indicates "Successfully run. Total query runtime: 476 msec. 5 rows affected." and "Ln 26, Col 1".

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

m  
s  
e  
c  
→

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

**476 msec**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
  
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.055 Ln 26, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;
  
```

Data Output Messages Explain Notifications

QUERY PLAN text

1	GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=420.597..475.998 rows=5 loops=1)
2	Group Key: (date(positions.t))
3	-> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=417.601..458.067 rows=361493 loops=1)
4	Workers Planned: 5
5	Workers Launched: 5
6	-> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=361.006..363.136 rows=602)
7	Sort Key: (date(positions.t))

Total rows: 30 of 30 Query complete 00:00:00.503

Successfully run. Total query runtime: 503 msec. 30 rows affected. X

Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=420.597..475.998 rows=5 loops=1)
  Group Key: (date(positions.t))
  -> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=417.601..458.067 rows=361493 loops=1)
    Workers Planned: 5
    Workers Launched: 5
    -> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=361.006..363.136 rows=60249 loops=6)
      Sort Key: (date(positions.t))
      Sort Method: quicksort Memory: 3073kB
      Worker 0: Sort Method: quicksort Memory: 3073kB
      Worker 1: Sort Method: quicksort Memory: 1537kB
      Worker 2: Sort Method: quicksort Memory: 1537kB
      Worker 3: Sort Method: quicksort Memory: 1537kB
      Worker 4: Sort Method: quicksort Memory: 1537kB
      -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=27.514..355.551 rows=60249 loops=6)
        Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
        -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=27.048..326.896 rows=196202 loops=1)
          Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
          Rows Removed by Filter: 976573
        -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.325..0.328 rows=64 loops=6)
          Buckets: 1024 Batches: 1 Memory Usage: 15kB
          -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.226..0.305 rows=64 loops=6)
            Hash Cond: (vessels.type = vesseltypes.code)

```

Total rows: 30 of 30    Query complete 00:00:00.503    Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
10 Worker 0: Sort Method: quicksort Memory: 3073kB
11 Worker 1: Sort Method: quicksort Memory: 1537kB
12 Worker 2: Sort Method: quicksort Memory: 1537kB
13 Worker 3: Sort Method: quicksort Memory: 1537kB
14 Worker 4: Sort Method: quicksort Memory: 1537kB
15 -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=27.514..355.551 rows=60249 loops=6)
16   Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
17   -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=27.048..326.896 rows=196202 loops=1)
18     Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
19     Rows Removed by Filter: 976573
20   -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.325..0.328 rows=64 loops=6)
21     Buckets: 1024 Batches: 1 Memory Usage: 15kB
22     -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.226..0.305 rows=64 loops=6)
23       Hash Cond: (vessels.type = vesseltypes.code)
24       -> Seq Scan on vessel (cost=0.00..11.89 rows=489 width=69) (actual time=0.072..0.118 rows=489 loops=6)
25       -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.078..0.079 rows=10 loops=6)
26         Buckets: 1024 Batches: 1 Memory Usage: 9kB
27         -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.067..0.071 rows=10 loops=6)
28           Filter: (description ~~ 'Passenger%::text')
29           Rows Removed by Filter: 96
30 Planning Time: 0.446 ms
31 Execution Time: 476.155 ms

```

Total rows: 30 of 30    Query complete 00:00:00.503    Ln 26, Col 1

## Ερώτημα iv) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Query Editor:** Shows a SQL query (Query 1) with line numbers 26 to 42. The query selects the date of recording, counts the number of spots, and groups by date for passenger vessels between August 14 and 18, 2019.
- Status Bar:** Successfully run. Total query runtime: 490 msec.  
5 rows affected.
- Bottom Status:** Total rows: 5 of 5 | Query complete 00:00:00.490 | Ln 26, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

490 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit E II

Query History Scratch Pad

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1    Query complete 00:00:00.055    Ln 26, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit E II

Query History Scratch Pad

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=407.147..466.272 rows=5 loops=1)
2	Group Key: (date(positions.t))
3	-> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=403.932..446.818 rows=361493 loops=1)
4	Workers Planned: 5
5	Workers Launched: 5
6	-> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=347.133..349.331 rows=602 loops=1)
7	Sort Key: (date(positions.t))

✓ Successfully run. Total query runtime: 509 msec. 30 rows affected. X

Total rows: 30 of 30    Query complete 00:00:00.509    Ln 26, Col 1

```
Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql*
Ships/postgres@PostgreSQL 16
Data Output Messages Explain Notifications
QUERY PLAN
text
1 GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=407.147..466.272 rows=5 loops=1)
2   Group Key: (date(positions.t))
3   -> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=403.932..446.818 rows=361493 loops=1)
4     Workers Planned: 5
5     Workers Launched: 5
6     -> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=347.133..349.331 rows=60249 loops=6)
7       Sort Key: (date(positions.t))
8       Sort Method: quicksort Memory: 3073kB
9       Worker 0: Sort Method: quicksort Memory: 1537kB
10      Worker 1: Sort Method: quicksort Memory: 3073kB
11      Worker 2: Sort Method: quicksort Memory: 1537kB
12      Worker 3: Sort Method: quicksort Memory: 1537kB
13      Worker 4: Sort Method: quicksort Memory: 1537kB
14      -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=27.178..342.643 rows=60249 loops=6)
15        Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16        -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=26.761..315.866 rows=196202 loop...
17          Filter: ((date(t) >='2019-08-14':date) AND (date(t) <='2019-08-18':date))
18          Rows Removed by Filter: 976573
19        -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.288..0.291 rows=64 loops=6)
20          Buckets: 1024 Batches: 1 Memory Usage: 15kB
21          -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.174..0.272 rows=64 loops=6)
22
Total rows: 30 of 30  Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
Query complete 00:00:00.509
Ln 26, Col 1
```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

Data Output Messages Explain Notifications

QUERY PLAN

text

Worker 0: Sort Method: quicksort Memory: 1537kB

10 Worker 1: Sort Method: quicksort Memory: 3073kB

11 Worker 2: Sort Method: quicksort Memory: 1537kB

12 Worker 3: Sort Method: quicksort Memory: 1537kB

13 Worker 4: Sort Method: quicksort Memory: 1537kB

14 -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=27.178..342.643 rows=60249 loops=6)

15 Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text)

16 -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=26.761..315.866 rows=196202 loops=6)

17 Filter: ((date(t) > '2019-08-14'::date) AND (date(t) <='2019-08-18'::date))

18 Rows Removed by Filter: 976573

19 -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.288..0.291 rows=64 loops=6)

20 Buckets: 1024 Batches: 1 Memory Usage: 15kB

21 -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.174..0.272 rows=64 loops=6)

22 Hash Cond: (vessels.type = vesseltypes.code)

23 -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.065..0.122 rows=489 loops=6)

24 -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.070..0.071 rows=10 loops=6)

25 Buckets: 1024 Batches: 1 Memory Usage: 9kB

26 -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.060..0.065 rows=10 loops=6)

27 Filter: (description ~~ 'Passenger%'::text)

28 Rows Removed by Filter: 96

29 Planning Time: 0.387 ms

30 Execution Time: 466.423 ms

Total rows: 30 of 30 Query complete 00:00:00.509

## Ερώτημα iv) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The query is:

```
--erwthma1iv
select
    date(Positions.t) as RecordedDay,
    count(*) as NumberOfSpots
from
    Positions
join
    Vessels on Positions.vessel_id = Vessels.id
join
    VesselTypes on Vessels.type = VesselTypes.code
where
    VesselTypes.description like 'Passenger%' and
    date(Positions.t) between '2019-08-14' and '2019-08-18'
group by
    date(Positions.t)
order by
    RecordedDay;
```

The status bar at the bottom indicates "Successfully run. Total query runtime: 492 msec. 5 rows affected." and "Total rows: 5 of 5".

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m  
s  
e  
c  
→

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

✓ Successfully run. Total query runtime: 492 msec. 5 rows affected. X

Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
  
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.060 Ln 26, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

26 --erwthma1iv
27 explain analyze select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;
  
```

Data Output Messages Explain Notifications

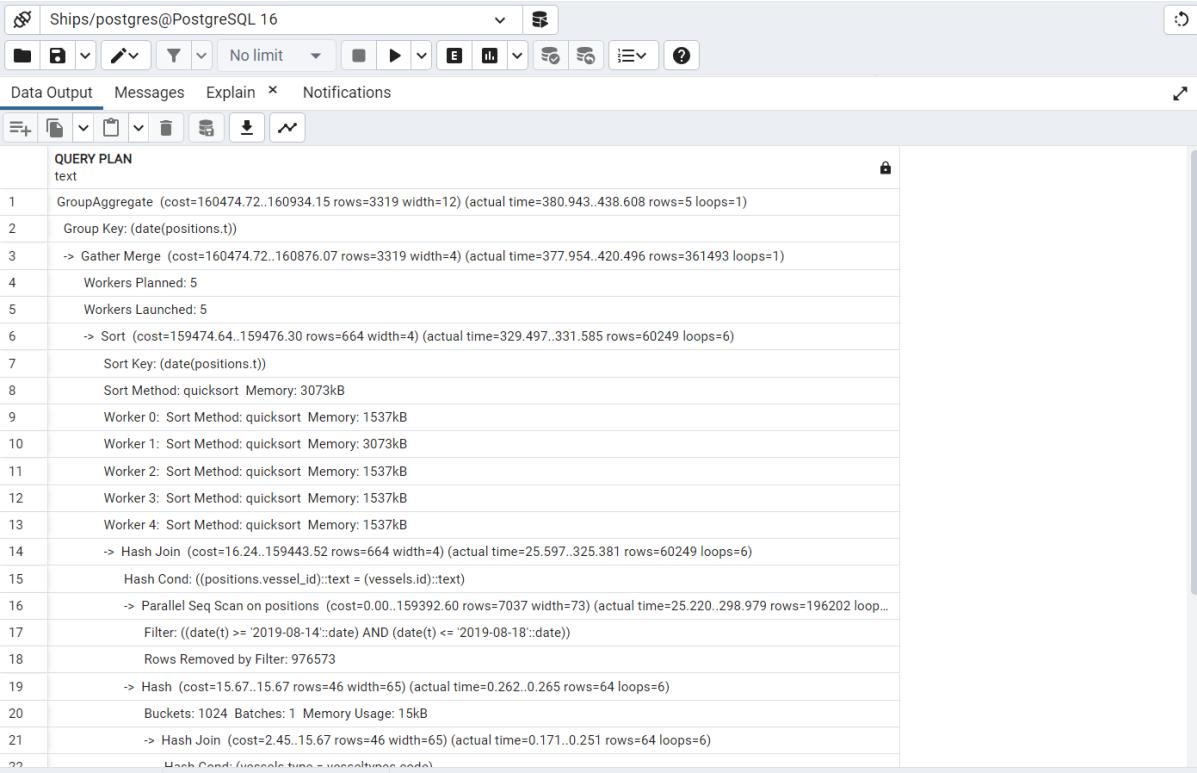
QUERY PLAN text

1	GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=380.943..438.608 rows=5 loops=1)
2	Group Key: (date(positions.t))
3	-> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=377.954..420.496 rows=361493 loops=1)
4	Workers Planned: 5
5	Workers Launched: 5
6	-> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=329.497..331.585 rows=602)

Successful run. Total query runtime: 459 msec. 30 rows affected.

Total rows: 30 of 30 Query complete 00:00:00.459 Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x



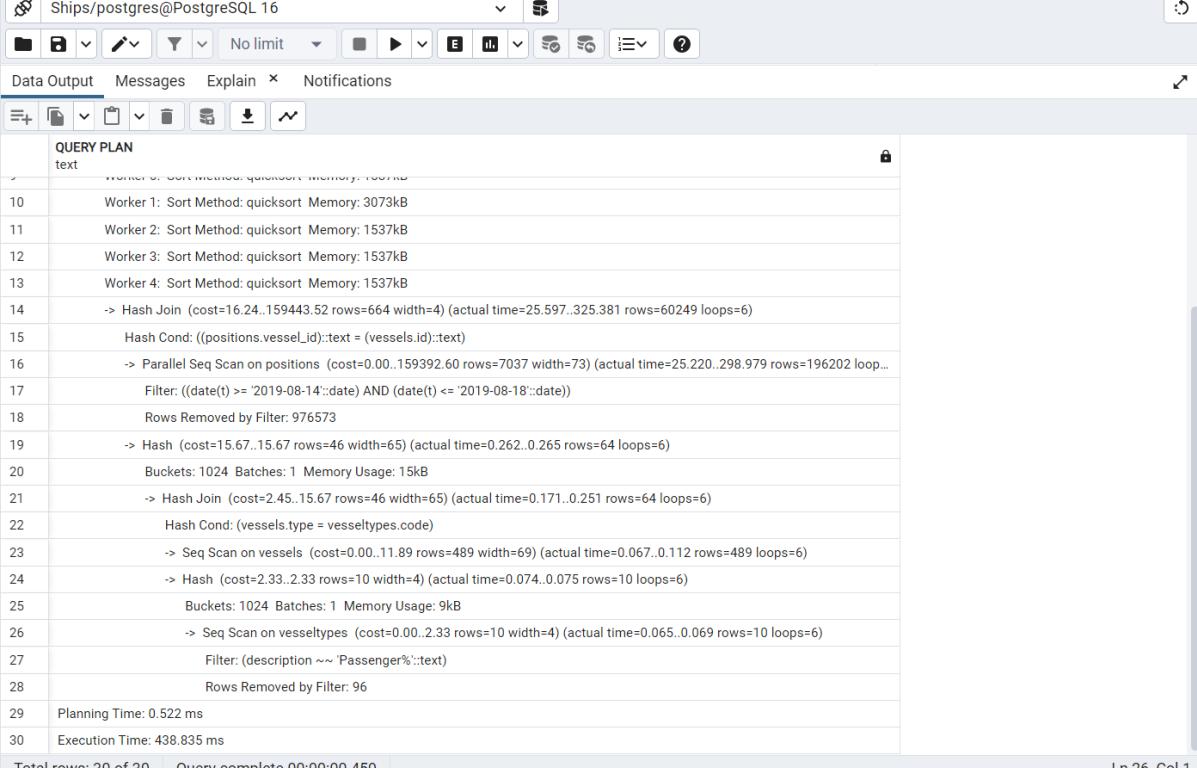
```

1 GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=380.943..438.608 rows=5 loops=1)
2   Group Key: (date(positions.t))
3     -> Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=377.954..420.496 rows=361493 loops=1)
4       Workers Planned: 5
5       Workers Launched: 5
6         -> Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=329.497..331.585 rows=60249 loops=6)
7           Sort Key: (date(positions.t))
8           Sort Method: quicksort Memory: 3073kB
9           Worker 0: Sort Method: quicksort Memory: 1537kB
10          Worker 1: Sort Method: quicksort Memory: 3073kB
11          Worker 2: Sort Method: quicksort Memory: 1537kB
12          Worker 3: Sort Method: quicksort Memory: 1537kB
13          Worker 4: Sort Method: quicksort Memory: 1537kB
14         -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=25.597..325.381 rows=60249 loops=6)
15           Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
16           -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=25.220..298.979 rows=196202 loop...
17             Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
18             Rows Removed by Filter: 976573
19           -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.262..0.265 rows=64 loops=6)
20             Buckets: 1024 Batches: 1 Memory Usage: 15kB
21             -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.171..0.251 rows=64 loops=6)
22               Hash Cond: (vessels.type = vesseltypes.code)

```

Total rows: 30 of 30    Query complete 00:00:00.459    Ln 26, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x



```

10          Worker 0: Sort Method: quicksort Memory: 1537kB
11          Worker 1: Sort Method: quicksort Memory: 3073kB
12          Worker 2: Sort Method: quicksort Memory: 1537kB
13          Worker 3: Sort Method: quicksort Memory: 1537kB
14          Worker 4: Sort Method: quicksort Memory: 1537kB
15         -> Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=25.597..325.381 rows=60249 loops=6)
16           Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
17           -> Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=25.220..298.979 rows=196202 loop...
18             Filter: ((date(t) >= '2019-08-14'::date) AND (date(t) <= '2019-08-18'::date))
19             Rows Removed by Filter: 976573
20           -> Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.262..0.265 rows=64 loops=6)
21             Buckets: 1024 Batches: 1 Memory Usage: 15kB
22             -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.171..0.251 rows=64 loops=6)
23               Hash Cond: (vessels.type = vesseltypes.code)
24               -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.067..0.112 rows=489 loops=6)
25               -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.074..0.075 rows=10 loops=6)
26                 Buckets: 1024 Batches: 1 Memory Usage: 9kB
27                 -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.065..0.069 rows=10 loops=6)
28                   Filter: (description ~~ 'Passenger%'::text)
29                   Rows Removed by Filter: 96
30

```

Total rows: 30 of 30    Query complete 00:00:00.459    Ln 26, Col 1

## Ερώτημα v) (α) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The main area contains the following SQL code:

```

43
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Below the code, the status bar shows "Successfully run. Total query runtime: 661 msec." and "34 rows affected.". A green message box at the bottom right says "✓ Successfully run. Total query runtime: 661 msec. 34 rows affected. X".

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

m  
s  
e  
c

QUERY PLAN

661 msec

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

43
44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=550.883..623.340 rows=34 loops=1)
2   -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=550.882..621.836 rows=23182 loops=1)
3     Workers Planned: 5
4     Workers Launched: 5
5       -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=480.265..504.769 rows=3864 loops=6)
6         Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7         -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=479.621..498.124 rows=97899 loops=6)
8           Sort Key: positions.vessel_id
9           Sort Method: external merge Disk: 8616kB

```

Successfully run. Total query runtime: 667 msec. 35 rows affected.

Total rows: 35 of 35 Query complete 00:00:00.667 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=550.883..623.340 rows=34 loops=1)
2   -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=550.882..621.836 rows=23182 loops=1)
3     Workers Planned: 5
4     Workers Launched: 5
5       -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=480.265..504.769 rows=3864 loops=6)
6         Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7         -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=479.621..498.124 rows=97899 loops=6)
8           Sort Key: positions.vessel_id
9           Sort Method: external merge Disk: 8616kB
10          Worker 0: Sort Method: external merge Disk: 7240kB
11          Worker 1: Sort Method: external merge Disk: 7984kB
12          Worker 2: Sort Method: external merge Disk: 5024kB
13          Worker 3: Sort Method: external merge Disk: 5040kB
14          Worker 4: Sort Method: external merge Disk: 6128kB
15       -> Parallel Seq Scan on positions (cost=0.0..162910.93 rows=3892 width=65) (actual time=0.083..330.030 rows=98624 loop...
16         Filter: ((speed = 0::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
17         Rows Removed by Filter: 1074151
18       -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.636..0.779 rows=3938 loops=6)
19         Sort Key: vessels.id
20         Sort Method: quicksort Memory: 33kB
21         Worker 0: Sort Method: quicksort Memory: 33kB
22         Worker 1: Sort Method: quicksort Memory: 33kB

```

Total rows: 35 of 35 Query complete 00:00:00.667 Ln 44, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print, etc.), a search bar, and various connection and session management buttons.
- Header:** Shows the current database connection as "Ships/postgres@PostgreSQL 16" and the active schema as "erwthma3.sql".
- Menu Bar:** Contains "Dashboard", "Properties", "SQL", "Statistics", "Dependencies", "Dependents", "Processes", "Ships/postgres...", and "erwthma3.sql\*".
- Tool Buttons:** A row of buttons for "Data Output", "Messages", "Explain", and "Notifications".
- Query Plan Section:** Titled "QUERY PLAN" with a "text" tab selected. It displays the execution plan for the query, including parallel scans, sort operations, hash joins, and sequential scans.
- Log Area:** Shows the log output with entries like "Planning Time: 0.508 ms" and "Execution Time: 624.487 ms".
- Status Bar:** Shows "Total rows: 35 of 35" and "Query complete 00:00:00.667".
- Bottom Right:** Displays "Ln 44, Col 1".

**Ερώτημα v) (α) (Δεύτερη εκτέλεση)**

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The query tab contains the following SQL code:

```
43 --erwthma1v(a)
44 select distinct
45   Positions.vessel_id
46 from
47   Positions
48 join
49   Vessels on Positions.vessel_id = Vessels.id
50 join
51   VesselTypes on Vessels.type = VesselTypes.code
52 where
53   VesselTypes.description like 'Cargo%' and
54   Positions.speed = 0 and
55   date(positions.t) between '2019-08-15' and '2019-08-18';
56
```

The status bar at the bottom shows "Successfully run. Total query runtime: 647 msec." and "34 rows affected." A green message box also appears in the status bar.

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

m  
s  
e  
c  
→

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

647 msec

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

Query History No limit E II

Query Scratch Pad

```

43
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.055 Ln 44, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

Query History No limit E II

Query Scratch Pad

```

43
44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
57

```

Data Output Messages Explain Notifications

**QUERY PLAN**

	text
1	Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=535.327..617.472 rows=34 loops=1)
2	-> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=535.326..615.655 rows=23182 loops=1)
3	Workers Planned: 5
4	Workers Launched: 5
5	-> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=452.679..478.994 rows=3864 loops=6)
6	Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7	-> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=452.045..471.620 rows=97899 loops=6)
8	Sort Key: positions.vessel_id
9	Sort Method: external merge Disk: 8656kB

Total rows: 35 of 35 Query complete 00:00:00.655 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=535.327..617.472 rows=34 loops=1)
   -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=535.326..615.655 rows=23182 loops=1)
      Workers Planned: 5
      Workers Launched: 5
      -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=452.679..478.994 rows=3864 loops=6)
         Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
         -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=452.045..471.620 rows=97899 loops=6)
            Sort Key: positions.vessel_id
            Sort Method: external merge Disk: 8656kB
            Worker 0: Sort Method: external merge Disk: 7544kB
            Worker 1: Sort Method: external merge Disk: 4920kB
            Worker 2: Sort Method: external merge Disk: 4624kB
            Worker 3: Sort Method: external merge Disk: 6912kB
            Worker 4: Sort Method: external merge Disk: 7360kB
            -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=19.811..301.102 rows=98624 loops=6)
               Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
            Rows Removed by Filter: 1074151
            -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.626..0.779 rows=3939 loops=6)
               Sort Key: vessels.id
               Sort Method: quicksort Memory: 33kB
               Worker 0: Sort Method: quicksort Memory: 33kB
               -> Worker 1: Sort Method: quicksort Memory: 33kB
Total rows: 35 of 35 Query complete 00:00:00.656

```

Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
15 -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=19.811..301.102 rows=98624 loops=6)
16   Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
17   Rows Removed by Filter: 1074151
18 -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.626..0.779 rows=3939 loops=6)
19   Sort Key: vessels.id
20   Sort Method: quicksort Memory: 33kB
21   Worker 0: Sort Method: quicksort Memory: 33kB
22   Worker 1: Sort Method: quicksort Memory: 33kB
23   Worker 2: Sort Method: quicksort Memory: 33kB
24   Worker 3: Sort Method: quicksort Memory: 33kB
25   Worker 4: Sort Method: quicksort Memory: 33kB
26 -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.331..0.413 rows=104 loops=6)
27   Hash Cond: (vessels.type = vesseltypes.code)
28     -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.106..0.148 rows=489 loops=6)
29     -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.075..0.076 rows=10 loops=6)
30       Buckets: 1024 Batches: 1 Memory Usage: 9kB
31     -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.066..0.069 rows=10 loops=6)
32       Filter: (description ~~ 'Cargo%::text')
33       Rows Removed by Filter: 96
34 Planning Time: 0.513 ms
35 Execution Time: 618.680 ms

```

Total rows: 35 of 35 Query complete 00:00:00.656

Ln 44, Col 1

## Ερώτημα v) (α) (Τρίτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Query Editor:** Shows a multi-step query (erwthma1v(a)) involving joins between Positions, Vessels, and VesselTypes tables, filtering for cargo ships at 0 speed between August 15 and 18, 2019.
- Status Bar:** Successfully run. Total query runtime: 660 msec.  
34 rows affected.
- Bottom Status:** Total rows: 34 of 34 | Query complete 00:00:00.660 | Ln 44, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

m

s

e

c

→

660 msec

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

43
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.062 Ln 44, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit Explain Notifications

```

43
44 --erwthma1v(a)
45 explain analyze select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';

```

Data Output Messages Explain Notifications

QUERY PLAN text

1	Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=573.452..650.852 rows=34 loops=1)
2	-> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=573.450..649.155 rows=23182 loops=1)
3	Workers Planned: 5
4	Workers Launched: 5
5	-> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=499.838..524.224 rows=3864 loops=6)
6	Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7	-> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=499.213..517.686 rows=97899 loops=6)
8	Sort Key: positions.vessel_id
9	Sort Method: external merge Disk: 8616kB

✓ Successfully run. Total query runtime: 683 msec. 35 rows affected. X

Total rows: 35 of 35 Query complete 00:00:00.683 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Data Output Messages Explain x Notifications ↗

**QUERY PLAN**  
text

```

1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=573.452..650.852 rows=34 loops=1)
2   -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=573.450..649.155 rows=23182 loops=1)
3     Workers Planned: 5
4     Workers Launched: 5
5       -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=499.838..524.224 rows=3864 loops=6)
6         Merge Cond: (positions.vessel_id)::text = (vessels.id)::text
7           -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=499.213..517.686 rows=97899 loops=6)
8             Sort Key: positions.vessel_id
9             Sort Method: external merge Disk: 8616kB
10            Worker 0: Sort Method: external merge Disk: 7984kB
11            Worker 1: Sort Method: external merge Disk: 7056kB
12            Worker 2: Sort Method: external merge Disk: 3656kB
13            Worker 3: Sort Method: external merge Disk: 4744kB
14            Worker 4: Sort Method: external merge Disk: 7984kB
15           -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=31.156..324.155 rows=98624 loops=6)
16             Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
17               Rows Removed by Filter: 1074151
18           -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.617..0.762 rows=3938 loops=6)
19             Sort Key: vessels.id
20             Sort Method: quicksort Memory: 33kB
21             Worker 0: Sort Method: quicksort Memory: 33kB
22             Worker 1: Sort Method: quicksort Memory: 33kB
23             Worker 2: Sort Method: quicksort Memory: 33kB
24             Worker 3: Sort Method: quicksort Memory: 33kB
25             Worker 4: Sort Method: quicksort Memory: 33kB
26           -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.338..0.417 rows=104 loops=6)
27             Hash Cond: (vessels.type = vesseltypes.code)
28               -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.113..0.155 rows=489 loops=6)
29               -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.076..0.077 rows=10 loops=6)
30                 Buckets: 1024 Batches: 1 Memory Usage: 9kB
31               -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.067..0.070 rows=10 loops=6)
32                 Filter: (description ~~ 'Cargo%':text)
33                 Rows Removed by Filter: 96
34 Planning Time: 0.414 ms
35 Execution Time: 652.378 ms

```

Total rows: 35 of 35 Query complete 00:00:00.683 Ln 44, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Data Output Messages Explain x Notifications ↗

**QUERY PLAN**  
text

```

15   Worker 0: Sort Method: external merge Disk: 7984kB
16     -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=31.156..324.155 rows=98624 loops=6)
17       Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
18         Rows Removed by Filter: 1074151
19         -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.617..0.762 rows=3938 loops=6)
20           Sort Key: vessels.id
21           Sort Method: quicksort Memory: 33kB
22           Worker 0: Sort Method: quicksort Memory: 33kB
23           Worker 1: Sort Method: quicksort Memory: 33kB
24           Worker 2: Sort Method: quicksort Memory: 33kB
25           Worker 3: Sort Method: quicksort Memory: 33kB
26           Worker 4: Sort Method: quicksort Memory: 33kB
27             -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.338..0.417 rows=104 loops=6)
28               Hash Cond: (vessels.type = vesseltypes.code)
29                 -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.113..0.155 rows=489 loops=6)
30                 -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.076..0.077 rows=10 loops=6)
31                   Buckets: 1024 Batches: 1 Memory Usage: 9kB
32                 -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.067..0.070 rows=10 loops=6)
33                   Filter: (description ~~ 'Cargo%':text)
34                   Rows Removed by Filter: 96
35 Planning Time: 0.414 ms
36 Execution Time: 652.378 ms

```

Total rows: 35 of 35 Query complete 00:00:00.683 Ln 44, Col 1

## Ερώτημα v) (β) (Πρώτη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma3.sql\*
- Query Editor:** Shows a multi-line SQL query (erwthma1v(b)) with syntax highlighting.
- Data Output:** Shows the results of the query execution.
- Messages:** Shows a green message indicating success: "Successfully run. Total query runtime: 828 msec. 2 rows affected."
- Statistics:** Total rows: 2 of 2, Query complete 00:00:00.828, Ln 58, Col 1

Χρόνος εκτέλεσης 1024 MB

και 2 πυρήνες

s  
e  
c  
s  
m  
s  
e  
c  
→ 828 msec

Χρόνος εκτέλεσης 1024 MB

και 8 πυρήνες

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

[Ships/postgres@PostgreSQL 16](#) ↻

Query History No limit ↻

Scratch Pad x

Query ↶ Scratch Pad ↶

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;

```

Data Output Messages Explain x Notifications

Graphical Analysis Statistics ↶

Total rows: 1 of 1 Query complete 00:00:00.062 Ln 58, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

[Ships/postgres@PostgreSQL 16](#) ↻

Query History No limit ↻

Scratch Pad x

Query ↶ Scratch Pad ↶

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;

```

Data Output Messages Explain x Notifications

QUERY PLAN text

1	Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=771.159..823.771 rows=2 loops=1)
2	-> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=771.158..823.766 rows=2 loops=1)
3	Group Key: positions.vessel_id, vesseltypes.description
4	Filter: (count(DISTINCT date(positions.t)) = 8)
5	Rows Removed by Filter: 42
6	-> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=729.435..818.979 rows=34666 loops=1)
7	Workers Planned: 5
8	Workers Launched: 5

✓ Successfully run. Total query runtime: 846 msec. 54 rows affected. x

Total rows: 54 of 54 Query complete 00:00:00.846 Ln 58, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for connection management, schema browser, and various database operations.
- Menu Bar:** Contains links for Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and a connection to Ships/postgres.
- Current File:** The file "erwthma3.sql" is currently open.
- Data Output Tab:** Active tab showing the query plan.
- Query Plan Table:** Displays the execution plan with numbered steps:
  - Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=771.159..823.771 rows=2 loops=1)
  - > GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=771.158..823.766 rows=2 loops=1)
    - Group Key: positions.vessel\_id, vesseltypes.description
  - Filter: (count(DISTINCT date(positions.t)) = 8)
  - Rows Removed by Filter: 42
  - > Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=729.435..818.979 rows=34666 loops=1)
    - Workers Planned: 5
    - Workers Launched: 5
      - Incremental Sort (cost=163160.03..163201.42 rows=367 width=111) (actual time=645.145..687.692 rows=5778 loops=6)
        - Sort Key: positions.vessel\_id, vesseltypes.description, (date(positions.t))
      - Presorted Key: positions.vessel\_id
      - Full-sort Groups: 27 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
      - Pre-sorted Groups: 30 Sort Method: quicksort Average Memory: 117kB Peak Memory: 241kB
      - Worker 0: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
      - Pre-sorted Groups: 26 Sort Method: quicksort Average Memory: 112kB Peak Memory: 220kB
      - Worker 1: Full-sort Groups: 35 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
      - Pre-sorted Groups: 23 Sort Method: quicksort Average Memory: 125kB Peak Memory: 295kB
      - Worker 2: Full-sort Groups: 32 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
      - Pre-sorted Groups: 22 Sort Method: quicksort Average Memory: 154kB Peak Memory: 256kB
      - Worker 3: Full-sort Groups: 33 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
      - Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 177kB Peak Memory: 263kB
- Total Rows:** 54 of 54
- Completion Time:** 00:00:00.846
- Page Number:** Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

QUERY PLAN text

```
21 Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 177kB Peak Memory: 263kB
22 Worker 4: Full-sort Groups: 31 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
23 Pre-sorted Groups: 26 Sort Method: quicksort Average Memory: 128kB Peak Memory: 245kB
24 -> Merge Join (cost=163159.95..163184.90 rows=367 width=111) (actual time=644.773..684.450 rows=5778 loops=6)
25   Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
26   -> Sort (cost=163143.02..163152.75 rows=3892 width=81) (actual time=643.845..672.714 rows=142070 loops=6)
27     Sort Key: positions.vessel_id
28     Sort Method: external merge Disk: 12592kB
29     Worker 0: Sort Method: external merge Disk: 13072kB
30     Worker 1: Sort Method: external merge Disk: 14392kB
31     Worker 2: Sort Method: external merge Disk: 14432kB
32     Worker 3: Sort Method: external merge Disk: 14688kB
33     Worker 4: Sort Method: external merge Disk: 13256kB
34   -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=93.563..347.693 rows=143060 loops=6)
35     Filter: ((speed = '0::double precision) AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
36     Rows Removed by Filter: 1029715
37   -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.873..1.114 rows=5841 loops=6)
38     Sort Key: vessels.id
39     Sort Method: quicksort Memory: 37kB
40     Worker 0: Sort Method: quicksort Memory: 37kB
41     Worker 1: Sort Method: quicksort Memory: 37kB
```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit E M N

Data Output Messages Explain Notifications

**QUERY PLAN**

text

```

34      >- Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=93.563..347.693 rows=143060 loops=1)
35          Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
36          Rows Removed by Filter: 1029715
37      -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.873..1.114 rows=5841 loops=6)
38          Sort Key: vessels.id
39          Sort Method: quicksort Memory: 37kB
40          Worker 0: Sort Method: quicksort Memory: 37kB
41          Worker 1: Sort Method: quicksort Memory: 37kB
42          Worker 2: Sort Method: quicksort Memory: 37kB
43          Worker 3: Sort Method: quicksort Memory: 37kB
44          Worker 4: Sort Method: quicksort Memory: 37kB
45      -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.419..0.545 rows=104 loops=6)
46          Hash Cond: (vessels.type = vesseltypes.code)
47          -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.121..0.182 rows=489 loops=6)
48          -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.115..0.116 rows=10 loops=6)
49          Buckets: 1024 Batches: 1 Memory Usage: 9kB
50          -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.092..0.097 rows=10 loops=6)
51          Filter: (description ~~ 'Cargo%'::text)
52          Rows Removed by Filter: 96
53 Planning Time: 0.465 ms
54 Execution Time: 825.458 ms

```

Total rows: 54 of 54 Query complete 00:00:00.846 Ln 58, Col 1

## Ερώτημα v) (β) (Δεύτερη εκτέλεση)

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The main area contains the following SQL code:

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
--
```

Below the code, the status bar shows "Successfully run. Total query runtime: 873 msec." and "2 rows affected." A message bar at the bottom right says "✓ Successfully run. Total query runtime: 873 msec. 2 rows affected. X".

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

s  
e  
c  
s  
m  
s  
e  
c  
→      873 msec

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

58 --erwthma1v(b)
59 select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
--
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

✓ Successfully run. Total query runtime: 56 msec. 1 rows affected.

Total rows: 1 of 1 Query complete 00:00:00.056 Ln 58, Col 1

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query Explain Analyze Scratch Pad

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;
--
```

Data Output Messages Explain Notifications

QUERY PLAN text

1	Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=700.743..758.166 rows=2 loops=1)
2	-> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=700.741..758.160 rows=2 loops=1)
3	Group Key: positions.vessel_id, vesseltypes.description
4	Filter: (count(DISTINCT date(positions.t)) = 8)
5	Rows Removed by Filter: 42
6	-> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=661.024..753.552 rows=34666 loops=1)
7	Workers Planned: 5

✓ Successfully run. Total query runtime: 787 msec. 54 rows affected.

Total rows: 54 of 54 Query complete 00:00:00.787 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
1 Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=700.743..758.166 rows=2 loops=1)
2   -> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=700.741..758.160 rows=2 loops=1)
3     Group Key: positions.vessel_id, vesseltypes.description
4     Filter: (count(DISTINCT date(positions.t)) = 8)
5     Rows Removed by Filter: 42
6     -> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=661.024..753.552 rows=34666 loops=1)
7       Workers Planned: 5
8       Workers Launched: 5
9         -> Incremental Sort (cost=163160.03..163201.42 rows=367 width=111) (actual time=595.642..635.541 rows=5778 loops=6)
10        Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11        Presorted Key: positions.vessel_id
12        Full-sort Groups: 33 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13        Pre-sorted Groups: 25 Sort Method: quicksort Average Memory: 192kB Peak Memory: 292kB
14        Worker 0: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15        Pre-sorted Groups: 22 Sort Method: quicksort Average Memory: 202kB Peak Memory: 257kB
16        Worker 1: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17        Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 131kB Peak Memory: 231kB
18        Worker 2: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
19        Pre-sorted Groups: 29 Sort Method: quicksort Average Memory: 143kB Peak Memory: 244kB
20        Worker 3: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
21        Pre-sorted Groups: 25 Sort Method: quicksort Average Memory: 97kB Peak Memory: 235kB
22        Worker 4: Full-sort Groups: 29 Sort Method: quicksort Average Memory: 241kB Peak Memory: 241kB

```

Total rows: 54 of 54 Query complete 00:00:00.787 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

text
21 Pre-sorted Groups: 25 Sort Method: quicksort Average Memory: 97kB Peak Memory: 235kB
22 Worker 4: Full-sort Groups: 29 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
23 Pre-sorted Groups: 28 Sort Method: quicksort Average Memory: 66kB Peak Memory: 261kB
24   -> Merge Join (cost=163159.95..163184.90 rows=367 width=111) (actual time=595.382..632.718 rows=5778 loops=6)
25     Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
26     -> Sort (cost=163143.02..163152.75 rows=3892 width=81) (actual time=594.663..621.859 rows=142070 loops=6)
27       Sort Key: positions.vessel_id
28       Sort Method: external merge Disk: 17232kB
29       Worker 0: Sort Method: external merge Disk: 13544kB
30       Worker 1: Sort Method: external merge Disk: 14512kB
31       Worker 2: Sort Method: external merge Disk: 14000kB
32       Worker 3: Sort Method: external merge Disk: 11600kB
33       Worker 4: Sort Method: external merge Disk: 11536kB
34     -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=11.093..345.682 rows=143060 loops=6)
35       Filter: ((speed = '0':double precision) AND (date(t) >= '2019-08-12::date') AND (date(t) <= '2019-08-19::date'))
36       Rows Removed by Filter: 1029715
37     -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.635..0.865 rows=5842 loops=6)
38       Sort Key: vessels.id
39       Sort Method: quicksort Memory: 37kB
40       Worker 0: Sort Method: quicksort Memory: 37kB
41       Worker 1: Sort Method: quicksort Memory: 37kB
42
```

Total rows: 54 of 54 Query complete 00:00:00.787 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**QUERY PLAN**

```

34      Worker 0: Sort Method: quicksort Memory: 37kB
35          -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=11.093..345.682 rows=143060 loops=1)
36              Filter: ((speed = '0'::double precision) AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
37              Rows Removed by Filter: 1029715
38          -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.635..0.865 rows=5842 loops=6)
39              Sort Key: vessels.id
40              Sort Method: quicksort Memory: 37kB
41          Worker 0: Sort Method: quicksort Memory: 37kB
42          Worker 1: Sort Method: quicksort Memory: 37kB
43          Worker 2: Sort Method: quicksort Memory: 37kB
44          Worker 3: Sort Method: quicksort Memory: 37kB
45          Worker 4: Sort Method: quicksort Memory: 37kB
46          -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.326..0.407 rows=104 loops=6)
47              Hash Cond: (vessels.type = vesseltypes.code)
48                  -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.114..0.154 rows=489 loops=6)
49                  -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.077..0.078 rows=10 loops=6)
50                      Buckets: 1024 Batches: 1 Memory Usage: 9kB
51                      -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.067..0.071 rows=10 loops=6)
52                          Filter: (description ~~ 'Cargo%'::text)
53                          Rows Removed by Filter: 96
54
Planning Time: 0.594 ms
Execution Time: 760.430 ms

```

Total rows: 54 of 54 Query complete 00:00:00.787 Ln 58, Col 1

## Ερώτημα v) (β) (Τρίτη εκτέλεση)

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16

No limit Explain Notifications

**Query**

```

--erwthma1v(b)
select distinct
    Positions.vessel_id, VesselTypes.description, Positions.speed
from
    Positions
join
    Vessels on Positions.vessel_id = Vessels.id
join
    VesselTypes on Vessels.type = VesselTypes.code
where
    VesselTypes.description like 'Cargo%' and
    DATE(Positions.t) between '2019-08-12' and '2019-08-19'
    and Positions.speed = 0
group by Positions.vessel_id, VesselTypes.description, Positions.speed
having count(distinct date(Positions.t)) = 8
order by Positions.vessel_id;

```

**Scratch Pad**

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 871 msec.  
2 rows affected.

✓ Successfully run. Total query runtime: 871 msec. 2 rows affected. ×

Total rows: 2 of 2 Query complete 00:00:00.871 Ln 58, Col 1

**Χρόνος εκτέλεσης 1024 MB**

**και 2 πυρήνες**

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C

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit E

Query History Scratch Pad

```
--erwthma1v(b)
select distinct
  Positions.vessel_id, VesselTypes.description, Positions.speed
from
  Positions
join
  Vessels on Positions.vessel_id = Vessels.id
join
  VesselTypes on Vessels.type = VesselTypes.code
where
  VesselTypes.description like 'Cargo%' and
  DATE(Positions.t) between '2019-08-12' and '2019-08-19'
  and Positions.speed = 0
group by Positions.vessel_id, VesselTypes.description, Positions.speed
having count(distinct date(Positions.t)) = 8
order by Positions.vessel_id;
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.049 Ln 58, Col 1

**Χρόνος εκτέλεσης 1024 MB**

**και 8 πυρήνες**

## QUERY PLAN

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

58 --erwthma1v(b)
59 explain analyze select distinct
60   Positions.vessel_id, VesselTypes.description, Positions.speed
61 from
62   Positions
63 join
64   Vessels on Positions.vessel_id = Vessels.id
65 join
66   VesselTypes on Vessels.type = VesselTypes.code
67 where
68   VesselTypes.description like 'Cargo%' and
69   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
70   and Positions.speed = 0
71 group by Positions.vessel_id, VesselTypes.description, Positions.speed
72 having count(distinct date(Positions.t)) = 8
73 order by Positions.vessel_id;

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=661.822..706.131 rows=2 loops=1)
2   -> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=661.820..706.126 rows=2 loops=1)
3     Group Key: positions.vessel_id, vesseltypes.description
4     Filter: (count(DISTINCT date(positions.t)) = 8)
5     Rows Removed by Filter: 42
6     -> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=623.256..701.437 rows=34666 loops=1)
7       Workers Planned: 5

```

Successfully run. Total query runtime: 732 msec. 54 rows affected.

Total rows: 54 of 54 Query complete 00:00:00.732 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma3.sql\*

Ships/postgres@PostgreSQL 16 No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=661.822..706.131 rows=2 loops=1)
2   -> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=661.820..706.126 rows=2 loops=1)
3     Group Key: positions.vessel_id, vesseltypes.description
4     Filter: (count(DISTINCT date(positions.t)) = 8)
5     Rows Removed by Filter: 42
6     -> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=623.256..701.437 rows=34666 loops=1)
7       Workers Planned: 5
8       Workers Launched: 5
9       -> Incremental Sort (cost=163160.03..163201.42 rows=367 width=111) (actual time=556.684..595.151 rows=5778 loops=6)
10      Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11      Presorted Key: positions.vessel_id
12      Full-sort Groups: 29 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13      Pre-sorted Groups: 29 Sort Method: quicksort Average Memory: 106kB Peak Memory: 199kB
14      Worker 0: Full-sort Groups: 32 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15      Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 241kB Peak Memory: 383kB
16      Worker 1: Full-sort Groups: 28 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17      Pre-sorted Groups: 21 Sort Method: quicksort Average Memory: 120kB Peak Memory: 209kB
18      Worker 2: Full-sort Groups: 27 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
19      Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 103kB Peak Memory: 244kB
20      Worker 3: Full-sort Groups: 31 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
21      Pre-sorted Groups: 24 Sort Method: quicksort Average Memory: 88kB Peak Memory: 260kB
22      Worker 4: Full-sort Groups: 21 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB

```

Total rows: 54 of 54 Query complete 00:00:00.732 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Data Output Messages Explain x Notifications ↗

≡ + ✖

**QUERY PLAN**  
text

```

21      Pre-sorted Groups: 24 Sort Method: quicksort Average Memory: 88kB Peak Memory: 260kB
22      Worker 4: Full-sort Groups: 31 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
23      Pre-sorted Groups: 26 Sort Method: quicksort Average Memory: 174kB Peak Memory: 273kB
24      -> Merge Join (cost=163159.95..163184.90 rows=367 width=111) (actual time=556.453..592.479 rows=5778 loops=6)
25          Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
26          -> Sort (cost=163143.02..163152.75 rows=3892 width=81) (actual time=555.811..581.758 rows=142070 loops=6)
27              Sort Key: positions.vessel_id
28              Sort Method: external merge Disk: 15056kB
29              Worker 0: Sort Method: external merge Disk: 17264kB
30              Worker 1: Sort Method: external merge Disk: 12152kB
31              Worker 2: Sort Method: external merge Disk: 11688kB
32              Worker 3: Sort Method: external merge Disk: 11880kB
33              Worker 4: Sort Method: external merge Disk: 14392kB
34              -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=0.059..318.144 rows=143060 loop...
35                  Filter: ((speed = '0'::double precision) AND (date(t) >='2019-08-12'::date) AND (date(t) <='2019-08-19'::date))
36                  Rows Removed by Filter: 1029715
37                  -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.603..0.821 rows=5842 loops=6)
38                      Sort Key: vessels.id
39                      Sort Method: quicksort Memory: 37kB
40                      Worker 0: Sort Method: quicksort Memory: 37kB
41                      Worker 1: Sort Method: quicksort Memory: 37kB
42                      Worker 2: Sort Method: quicksort Memory: 37kB
43                      Worker 3: Sort Method: quicksort Memory: 37kB
44                      Worker 4: Sort Method: quicksort Memory: 37kB
45                      -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.306..0.388 rows=104 loops=6)
46                          Hash Cond: (vessels.type = vesseltypes.code)
47                          -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.097..0.140 rows=489 loops=6)
48                          -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.083..0.083 rows=10 loops=6)
49                              Buckets: 1024 Batches: 1 Memory Usage: 9kB
50                              -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.072..0.075 rows=10 loops=6)
51                                  Filter: (description ~~ 'Cargo%::text')
52                                  Rows Removed by Filter: 96

```

Total rows: 54 of 54 Query complete 00:00:00.732 Ln 58, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma3.sql\\*](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Data Output Messages Explain x Notifications ↗

≡ + ✖

**QUERY PLAN**  
text

```

--> WORKER 4: Sort Method: external merge Disk: 15056kB
34      -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=0.059..318.144 rows=143060 loop...
35          Filter: ((speed = '0'::double precision) AND (date(t) >='2019-08-12'::date) AND (date(t) <='2019-08-19'::date))
36          Rows Removed by Filter: 1029715
37          -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.603..0.821 rows=5842 loops=6)
38              Sort Key: vessels.id
39              Sort Method: quicksort Memory: 37kB
40              Worker 0: Sort Method: quicksort Memory: 37kB
41              Worker 1: Sort Method: quicksort Memory: 37kB
42              Worker 2: Sort Method: quicksort Memory: 37kB
43              Worker 3: Sort Method: quicksort Memory: 37kB
44              Worker 4: Sort Method: quicksort Memory: 37kB
45              -> Hash Join (cost=2.45..15.67 rows=46 width=95) (actual time=0.306..0.388 rows=104 loops=6)
46                  Hash Cond: (vessels.type = vesseltypes.code)
47                  -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.097..0.140 rows=489 loops=6)
48                  -> Hash (cost=2.33..2.33 rows=10 width=34) (actual time=0.083..0.083 rows=10 loops=6)
49                      Buckets: 1024 Batches: 1 Memory Usage: 9kB
50                      -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=34) (actual time=0.072..0.075 rows=10 loops=6)
51                          Filter: (description ~~ 'Cargo%::text')
52                          Rows Removed by Filter: 96

```

Planning Time: 0.444 ms  
Execution Time: 708.254 ms  
Total rows: 54 of 54 Query complete 00:00:00.732 Ln 58, Col 1

## Ερώτημα 4 (20 %)

Σε αυτό το ερώτημα θα δημιουργήσουμε τα ευρετήρια που επιθυμούμε και θα ελέγξουμε για κάθε query αν βελτιώνεται ο χρόνος εκτέλεσης. Όλα τα ευρετήρια που θα δημιουργήσουμε είναι ευρετήρια B-Tree, που είναι η default επιλογή της PostgreSQL, καθώς η εφαρμογή μας απαιτεί πιο ευέλικτες δυνατότητες και πολλά από τα queries περιέχουν αναζήτηση εύρους.

### ◦ ευρετήριο

Αυτό το ευρετήριο είναι multicolumn και βρίσκεται πάνω στις στήλες t και s

The screenshot shows a PostgreSQL query editor interface. At the top, there are tabs for 'Query' (which is selected) and 'Query History'. Below the tabs, a query is entered in the main area:

```
1 create index idx_positions_t_speed on Positions(t,speed);
```

Below the query area, there are three tabs: 'Data output', 'Messages' (which is selected), and 'Notifications'. Under 'Messages', the output of the query is displayed:

CREATE INDEX  
Query returned successfully in 21 secs 116 msec.

Έπιλέξαμε αυτό το ευρετήριο, διότι παρατηρήσαμε ότι αρκετά επερωτήματα γίνονται με βάση την ημερομηνία και την ταχύτητα του σκάφους

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### ◦ ευρετήριο

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Αυτό το ευρετήριο βρίσκεται πάνω στην στήλη description του πίνακα

Query    Query History

```
1 create index idx_vesselsType_description on VesselTypes(description);
```

Data output    Messages    Notifications

CREATE INDEX

Query returned successfully in 154 msec.

Το επιλέξαμε λόγω του ότι θα διευκολύνει το τρέξιμο των query ii, iii, iv, και ν τα οποία βασίζονται στην περιγραφή του τύπου του πλοίου.

### ◦ ευρετήριο

Αυτό το ευρετήριο βρίσκεται πάνω στην στήλη flag του πίνακα Vessels.

Query    Query History

```
1 create index idx_vessels_flag on Vessels(flag);
```

Data output    Messages    Notifications

CREATE INDEX

Query returned successfully in 113 msec.

Το επιλέξαμε για την βελτίωση της απόδοσης του επερωτήματος ii, καθώς αυτό βασίζεται στην σημαία του σκάφους.

Τώρα θα τρέξουμε όλα τα επερωτήματα και θα ελέγχουμε την διαφορά χρόνου σε σχέση με πριν την δημιουργία των ευρετηρίων.

Q

## Ηριν την δημιουργία ευρετηρίων

P

The screenshot shows a PostgreSQL query editor interface. The top navigation bar includes 'Dashboard', 'Properties', 'SQL', 'Statistics', 'Dependencies', 'Dependents', 'Processes', 'Ships/postgres...', and 'erwthma3.sql\*'. The main area displays a SQL query:

```
1 show max_parallel_workers_per_gather;
2
3 set max_parallel_workers_per_gather = 8;
4
5 --erwthmai1
6 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
7 from Positions
8 group by Date(t)
9 order by NumOfOccurrences desc;
10
```

Below the query, tabs for 'Data Output' (selected), 'Messages', 'Explain', and 'Notifications' are visible. A message at the bottom states: 'Successfully run. Total query runtime: 513 msec. 24 rows affected.' The status bar at the bottom left shows 'Total rows: 24 of 24' and 'Query complete 00:00:00.513'. The status bar at the bottom right shows 'Ln 5, Col 1'.

## Μετά την δημιουργία ευρετηρίων

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

6
7 --erwthma1i
8 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
9 from Positions
10 group by Date(t)
11 order by NumOfOccurrences desc;
12
13 --erwthma1ii
14 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
15 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
16 where Vessels.flag = 'Greece'

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 506 msec.  
24 rows affected.

Total rows: 24 of 24 Query complete 00:00:00.506

✓ Successfully run. Total query runtime: 506 msec. 24 rows affected. Ln 7, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query Explain Scratch Pad

```

6
7 --erwthma1i
8 select Date(t) as CalendarDay, count(t) as NumOfOccurrences
9 from Positions
10 group by Date(t)
11 order by NumOfOccurrences desc;
12
13 --erwthma1ii
14 explain analyze select VesselTypes.description as ShipType, count(*) as NumberOfShips
15 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
16 where Vessels.flag = 'Greece'

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Graphical Analysis Statistics

✓ Successfully run. Total query runtime: 43 msec. 1 rows affected. Ln 7, Col 1

Total rows: 1 of 1 Query complete 00:00:00.043

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

6
7 --erwthma1i
8 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
9 from Positions
10 group by Date(t)
11 order by NumOfOccurrences desc;
12

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Sort (cost=638164.08..639260.88 rows=438719 width=12) (actual time=522.938..529.270 rows=24 loops=1)
2 Sort Key: (count(t)) DESC
3 Sort Method: quicksort Memory: 25kB
4 -> Finalize GroupAggregate (cost=307837.14..589549.17 rows=438719 width=12) (actual time=522.905..529.260 rows=24 loops=1)
5   Group Key: (date(t))
6   -> Gather Merge (cost=307837.14..573097.21 rows=2193595 width=12) (actual time=522.898..529.242 rows=140 loops=1)
7     Workers Planned: 5
8     Workers Launched: 5
9     -> Sort (cost=306837.06..307933.86 rows=438719 width=12) (actual time=468.220..468.222 rows=23 loops=6)
10    Sort Key: (date(t))
11    Sort Method: quicksort Memory: 25kB
12    Worker 0: Sort Method: quicksort Memory: 25kB
13    Worker 1: Sort Method: quicksort Memory: 25kB
14    Worker 2: Sort Method: quicksort Memory: 25kB
15    Worker 3: Sort Method: quicksort Memory: 25kB

```

Total rows: 27 of 27 Query complete 00:00:00.568 Ln 7, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql\\*](#)

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

6
7 --erwthma1i
8 explain analyze select Date(t) as CalendarDay, count(t) as NumOfOccurrences
9 from Positions
10 group by Date(t)
11 order by NumOfOccurrences desc;
12

```

Data Output Messages Explain Notifications

QUERY PLAN text

```

13   Worker 1: Sort Method: quicksort Memory: 25kB
14   Worker 2: Sort Method: quicksort Memory: 25kB
15   Worker 3: Sort Method: quicksort Memory: 25kB
16   Worker 4: Sort Method: quicksort Memory: 25kB
17   -> Partial HashAggregate (cost=238994.71..258222.15 rows=438719 width=12) (actual time=467.582..468.185 rows=23 loops=6)
18     Group Key: date(t)
19     Planned Partitions: 8 Batches: 1 Memory Usage: 3097kB
20     Worker 0: Batches: 1 Memory Usage: 3097kB
21     Worker 1: Batches: 1 Memory Usage: 3097kB
22     Worker 2: Batches: 1 Memory Usage: 3097kB
23     Worker 3: Batches: 1 Memory Usage: 3097kB
24     Worker 4: Batches: 1 Memory Usage: 3097kB
25     -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=1407330 width=12) (actual time=0.065..328.386 rows=1172775 loop...
26 Planning Time: 0.152 ms
27 Execution Time: 529.862 ms

```

Total rows: 27 of 27 Query complete 00:00:00.568 Ln 7, Col 1

Βλέπουμε πως στο επερώτημα 1 ο χρόνος εκτέλεσης μειώνεται από 513msec σε 506msec. Αυτό οφείλεται στο ευρετήριο ***idx\_positions\_t\_speed***, το οποίο διευκολύνει τις πράξεις που αφορούν την ημερομηνία.

Q

## Ηριν την δημιουργία ευρετηρίων

E

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "Ships/postgres@PostgreSQL 16". The main area contains the following SQL code:

```
11 --erwthma1ii
12 select VesselTypes.description as ShipType, count(*) as NumberOfShips
13 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
14 where Vessels.flag = 'Greece'
15 group by VesselTypes.description;
16
17 --erwthma1iii
18 select Positions.vessel_id, VesselTypes.description as ShipType,
```

Below the code, the status bar shows: "Successfully run. Total query runtime: 47 msec. 28 rows affected." and "Ln 11, Col 1".

Μετά την δημιουργία ευρετηρίων

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

Query History

```

11 order by NumOfOccurrences desc;
12
13 --erwthmaii
14 select VesselTypes.description as ShipType, count(*) as NumberOfShips
15 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
16 where Vessels.flag = 'Greece'
17 group by VesselTypes.description;
18

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 49 msec.  
28 rows affected.

Total rows: 28 of 28 Query complete 00:00:00.049

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

Query History

```

11 order by NumOfOccurrences desc;
12
13 --erwthmaii
14 select VesselTypes.description as ShipType, count(*) as NumberOfShips
15 from Vessels join VesselTypes on Vessels.type = VesselTypes.code
16 where Vessels.flag = 'Greece'
17 group by VesselTypes.description;
18

```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

```

graph LR
    vessels[vessels] --> Hash[Hash]
    Hash --> HashInnerJoin[Hash Inner Join]
    HashInnerJoin --> Aggregate[Aggregate]
    vesseltypes[vesseltypes] --> Hash

```

✓ Successfully run. Total query runtime: 58 msec. 1 rows affected.

Total rows: 1 of 1 Query complete 00:00:00.058

Βλέπουμε πως στο επερώτημα 2 ο χρόνος εκτέλεσης μειώνεται από 58msec σε 50msec. Αυτό οφείλεται στο ευρετήριο ***idx\_vessels\_flag***, το οποίο διευκολύνει την αναζήτηση στην στήλη των σημαιών.

## Q

### Ηριν την δημιουργία ευρετηρίων

```
--erwthma1iij
select Positions.vessel_id, VesselTypes.description as ShipType,
       count(Vessels.id) as NumberOfShips
  from Positions
 join Vessels on Positions.vessel_id = Vessels.id
 join VesselTypes on Vessels.type = VesselTypes.code
 where Positions.speed > 30
 group by VesselTypes.description, Positions.vessel_id;
```

Total rows: 16 of 16 | Query complete 00:00:00.409 | Ln 17, Col 1

### Μετά την δημιουργία ευρετηρίων

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

No limit

Query History Scratch Pad

```

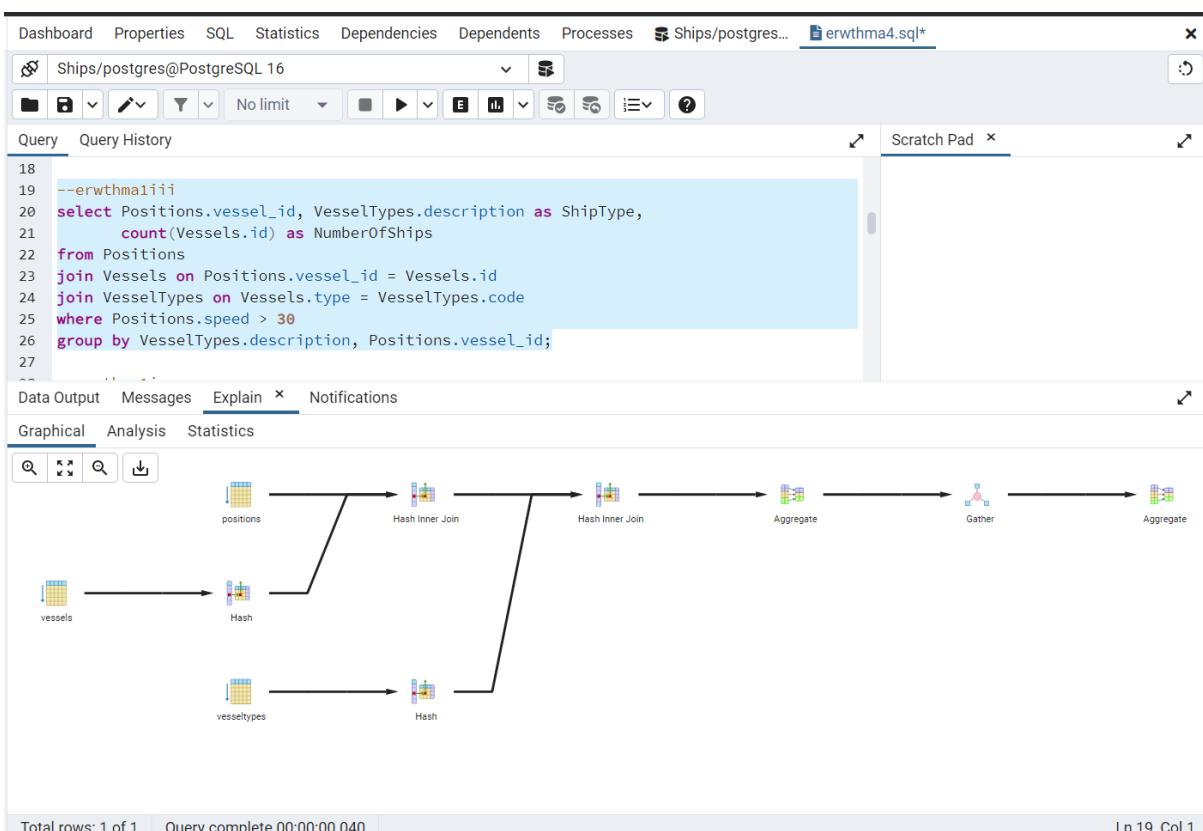
18
19 --erwthma1ii
20 select Positions.vessel_id, VesselTypes.description as ShipType,
21     count(Vessels.id) as NumberOfShips
22 from Positions
23 join Vessels on Positions.vessel_id = Vessels.id
24 join VesselTypes on Vessels.type = VesselTypes.code
25 where Positions.speed > 30
26 group by VesselTypes.description, Positions.vessel_id;
27

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 388 msec.  
16 rows affected.

Total rows: 16 of 16 Query complete 00:00:00.388 Ln 19, Col 1



Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

No limit ▾

Query History

Scratch Pad

```
18
19 --erwthma4iiii
20 explain analyze select Positions.vessel_id, VesselTypes.description as ShipType,
21     count(Vessels.id) as NumberOfShips
22 from Positions
23 join Vessels on Positions.vessel_id = Vessels.id
24 join VesselTypes on Vessels.type = VesselTypes.code
25 where Positions.speed > 30
26 group by VesselTypes.description, Positions.vessel_id;
27
```

Data Output Messages Explain Notifications

QUERY PLAN

text

1 Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=372.478..380.379 rows=16 loops=1)

2 Group Key: vesseltypes.description, positions.vessel\_id

3 Batches: 1 Memory Usage: 793kB

4 -> Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=372.080..380.240 rows=68 loops=1)

5 Workers Planned: 5

6 Workers Launched: 5

7 -> Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=308.103..308.248 rows=11 loops=6)

8 Group Key: vesseltypes.description, positions.vessel\_id

9 Batches: 1 Memory Usage: 793kB

10 Worker 0: Batches: 1 Memory Usage: 793kB

11 Worker 1: Batches: 1 Memory Usage: 793kB

12 Worker 2: Batches: 1 Memory Usage: 793kB

Total rows: 29 of 29 Query complete 00:00:00.414

Successfully run. Total query runtime: 414 msec. 29 rows affected.

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma4.sql\*
- Session:** Ships/postgres@PostgreSQL 16
- Data Output:** Messages, Explain, Notifications
- Query Plan:** A detailed text-based plan for the query, showing the following steps:
  - Finalize HashAggregate (cost=164538.47..164797.11 rows=25864 width=103) (actual time=372.478..380.379 rows=16 loops=1)
  - Group Key: vesseltypes.description, positions.vessel\_id
  - Batches: 1 Memory Usage: 793kB
  - > Gather (cost=150377.93..163568.57 rows=129320 width=103) (actual time=372.080..380.240 rows=68 loops=1)
    - Workers Planned: 5
    - Workers Launched: 5
    - > Partial HashAggregate (cost=149377.93..149636.57 rows=25864 width=103) (actual time=308.103..308.248 rows=11 loops=6)
      - Group Key: vesseltypes.description, positions.vessel\_id
      - Batches: 1 Memory Usage: 793kB
      - Worker 0: Batches: 1 Memory Usage: 793kB
      - Worker 1: Batches: 1 Memory Usage: 793kB
      - Worker 2: Batches: 1 Memory Usage: 793kB
      - Worker 3: Batches: 1 Memory Usage: 793kB
      - Worker 4: Batches: 1 Memory Usage: 793kB
    - > Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=1.416..298.670 rows=34956 loops=6)
      - Hash Cond: (vessels.type = vesseltypes.code)
      - > Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=1.294..293.178 rows=34957 loops=6)
        - Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text)
        - > Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=1.048..284.266 rows=34957 loops=6)
      - Filter: (speed > '30'::double precision)
    - Rows Removed by Filter: 1137818
  - Total rows: 29 of 29 Query complete 00:00:00.414

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql*
Ships/postgres@PostgreSQL 16 No limit Explain Notifications
Data Output Messages
QUERY PLAN
text
Group Key: vesseltypes.description, positions.vessel_id
9  Batches: 1 Memory Usage: 793kB
10  Worker 0: Batches: 1 Memory Usage: 793kB
11  Worker 1: Batches: 1 Memory Usage: 793kB
12  Worker 2: Batches: 1 Memory Usage: 793kB
13  Worker 3: Batches: 1 Memory Usage: 793kB
14  Worker 4: Batches: 1 Memory Usage: 793kB
15  -> Hash Join (cost=21.39..149075.51 rows=40323 width=160) (actual time=1.416..298.670 rows=34956 loops=6)
16    Hash Cond: (vessels.type = vesseltypes.code)
17    -> Hash Join (cost=18.00..148962.39 rows=40323 width=134) (actual time=1.294..293.178 rows=34957 loops=6)
18      Hash Cond: ((positions.vessel_id)::text = (vessels.id)::text)
19      -> Parallel Seq Scan on positions (cost=0.00..148837.63 rows=40323 width=65) (actual time=1.048..284.266 rows=34957 loop...
20        Filter: (speed > '30)::double precision
21        Rows Removed by Filter: 1137818
22        -> Hash (cost=11.89..11.89 rows=489 width=69) (actual time=0.213..0.213 rows=489 loops=6)
23        Buckets: 1024 Batches: 1 Memory Usage: 58kB
24        -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.060..0.129 rows=489 loops=6)
25        -> Hash (cost=2.06..2.06 rows=106 width=34) (actual time=0.078..0.079 rows=106 loops=6)
26        Buckets: 1024 Batches: 1 Memory Usage: 15kB
27        -> Seq Scan on vesseltypes (cost=0.00..2.06 rows=106 width=34) (actual time=0.054..0.061 rows=106 loops=6)
28  Planning Time: 0.475 ms
29  Execution Time: 380.547 ms
Total rows: 29 of 29  Query complete 00:00:00.414 Ln 19, Col 1

```

Βλέπουμε πως στο επερώτημα 3 ο χρόνος εκτέλεσης **μειώνεται** σημαντικά από και ***idx\_vesselType\_description*** τα οποία επιταχύνουν την αναζήτηση σε εύρος στην στήλη των ταχυτήτων και διευκολύνουν τις πράξεις που περιλαμβάνουν την περιγραφή του σκάφους αντίστοιχα.

Q

H  
e  
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o

Ηριν την δημιουργία ευρετηρίων

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar indicates the connection is to 'Ships/postgres@PostgreSQL 16' and the file is 'erwthma3.sql'. The main area contains the following SQL code:

```
26 --erwthma1iv
27 select
28   date(Positions.t) as RecordedDay,
29   count(*) as NumberOfSpots
30 from
31   Positions
32 join
33   Vessels on Positions.vessel_id = Vessels.id
34 join
35   VesselTypes on Vessels.type = VesselTypes.code
36 where
37   VesselTypes.description like 'Passenger%' and
38   date(Positions.t) between '2019-08-14' and '2019-08-18'
39 group by
40   date(Positions.t)
41 order by
42   RecordedDay;
```

Below the code, the status bar shows 'Successfully run. Total query runtime: 492 msec.' and '5 rows affected.'

## Μετά την δημιουργία ευρετηρίων

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

27
28 --erwthma1iv
29 select
30   date(Positions.t) as RecordedDay,
31   count(*) as NumberOfSpots
32 from
33   Positions
34 join
35     Vessels on Positions.vessel_id = Vessels.id
36 join
37   VesselTypes on Vessels.type = VesselTypes.code
38 where
39   VesselTypes.description like 'Passenger%' and
40   date(Positions.t) between '2019-08-14' and '2019-08-18'
41 group by
42   date(Positions.t)
43 order by
44   RecordedDay;

```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 466 msec.  
5 rows affected.

Total rows: 5 of 5 Query complete 00:00:00.466 Ln 28, Col 1

✓ Successfully run. Total query runtime: 466 msec. 5 rows affected. X

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

28 --erwthma1iv
29 select
30   date(Positions.t) as RecordedDay,
31   count(*) as NumberOfSpots
32 from
33   Positions
34 join
35     Vessels on Positions.vessel_id = Vessels.id
36 join
37   VesselTypes on Vessels.type = VesselTypes.code
38 where
39   VesselTypes.description like 'Passenger%' and
40   date(Positions.t) between '2019-08-14' and '2019-08-18'
41 group by
42   date(Positions.t)
43 order by
44   RecordedDay;

```

Data Output Explain Notifications

Graphical Analysis Statistics

The diagram illustrates the query execution plan. It starts with three tables: 'positions', 'vessels', and 'vesseltypes'. The 'positions' table is hashed and then joined with the 'vessels' table via a Hash Inner Join. The result of this join is then hashed again and joined with the 'vesseltypes' table via a Hash Inner Join. The final output is an Aggregate step, which produces 5 rows. The nodes are represented by icons: a grid for tables, a hash symbol for hashing, a join symbol for joins, and a bar chart for aggregation.

Total rows: 1 of 1 Query complete 00:00:00.055 Ln 28, Col 1

The screenshot shows the pgAdmin interface with the following details:

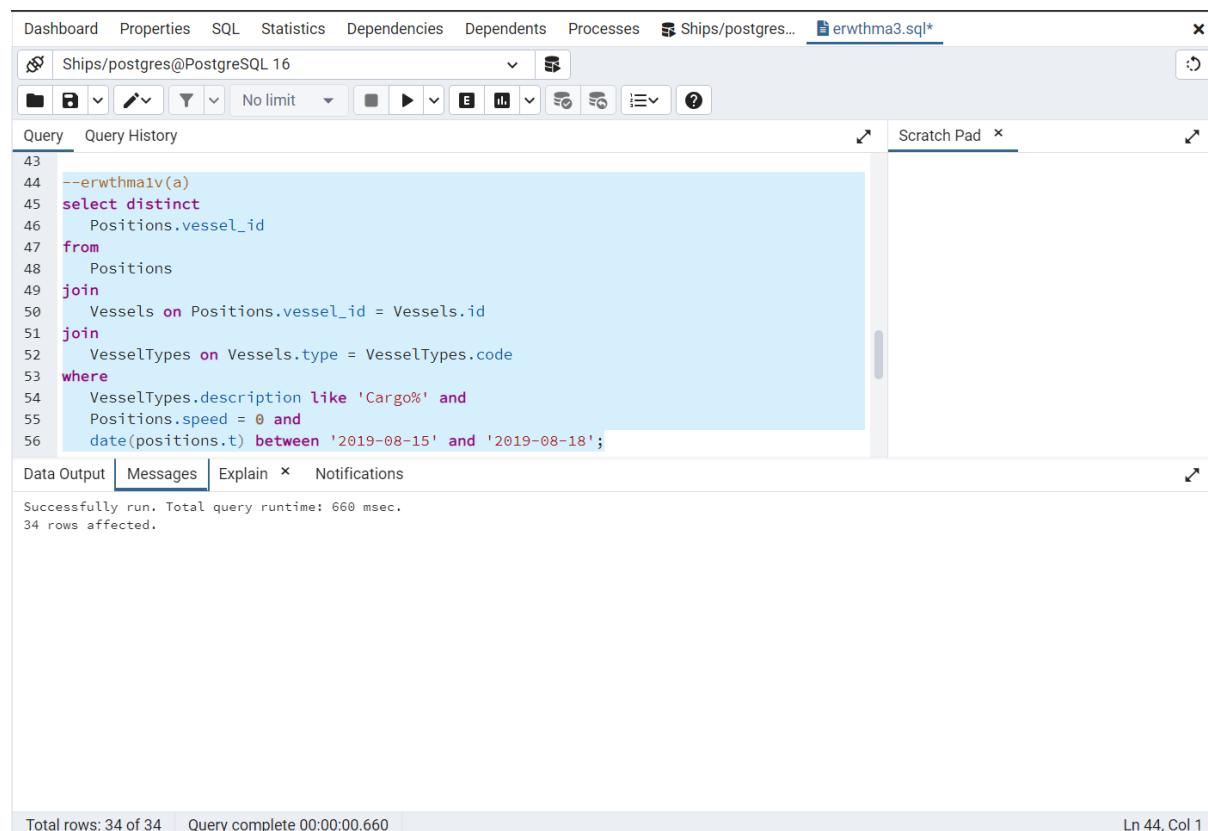
- Toolbar:** Includes icons for file operations (New, Open, Save, Print, Copy, Paste, Find, Replace, Refresh, Help), zoom controls, and a search bar.
- Menu Bar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma4.sql\*
- Submenu Bar:** Data Output, Messages, Explain, Notifications.
- Query Plan Section:** A large pane displaying the execution plan for the query. The plan includes:
  - GroupAggregate (cost=160474.72..160934.15 rows=3319 width=12) (actual time=402.442..455.316 rows=5 loops=1)
  - Group Key: (date(positions.t))
  - > Gather Merge (cost=160474.72..160876.07 rows=3319 width=4) (actual time=399.514..438.140 rows=361493 loops=1)
  - Workers Planned: 5
  - Workers Launched: 5
  - > Sort (cost=159474.64..159476.30 rows=664 width=4) (actual time=346.512..348.460 rows=60249 loops=6)
    - Sort Key: (date(positions.t))
    - Sort Method: quicksort Memory: 3073kB
  - Worker 0: Sort Method: quicksort Memory: 1537kB
  - Worker 1: Sort Method: quicksort Memory: 3073kB
  - Worker 2: Sort Method: quicksort Memory: 769kB
  - Worker 3: Sort Method: quicksort Memory: 1537kB
  - Worker 4: Sort Method: quicksort Memory: 1537kB
  - > Hash Join (cost=16.24..159443.52 rows=664 width=4) (actual time=26.233..342.372 rows=60249 loops=6)
    - Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text)
    - > Parallel Seq Scan on positions (cost=0.00..159392.60 rows=7037 width=73) (actual time=25.790..315.558 rows=196202 loops=6)
      - Filter: ((date(t) >='2019-08-14':date) AND (date(t) <='2019-08-18':date))
    - Rows Removed by Filter: 976573
    - > Hash (cost=15.67..15.67 rows=46 width=65) (actual time=0.275..0.278 rows=64 loops=6)
    - Buckets: 1024 Batches: 1 Memory Usage: 15kB
    - > Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.177..0.261 rows=64 loops=6)
      - Hash Cond: (vessel\_type = vesseltypes.code)

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print, etc.), a search bar, and various configuration buttons.
- Menu Bar:** Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, Ships/postgres..., erwthma4.sql\*
- Current Connection:** Ships/postgres@PostgreSQL 16
- Data Output Tab:** Active tab, showing "Data Output", "Messages", "Explain", and "Notifications".
- Query Plan Section:** Titled "QUERY PLAN", showing the execution plan for the query. The plan includes:
  - Workers: 4 (Worker 1-4) using quicksort sort method with varying memory usage (3073kB to 1537kB).
  - A Hash Join node with cost=16.24, rows=664, width=4, taking 26.233..342.372 ms for 60249 loops.
  - Hash Cond: ((positions.vessel\_id)::text = (vessels.id)::text).
  - A Parallel Seq Scan on positions with cost=0.00..159392.60, rows=7037, width=73, taking 25.790..315.558 ms for 196202 loops.
  - Filter: ((date(t) > '2019-08-14'::date) AND (date(t) <='2019-08-18'::date))
  - Rows Removed by Filter: 976573.
  - A Hash node with cost=15.67, rows=46, width=65, taking 0.275..0.278 ms for 64 loops.
  - Buckets: 1024 Batches: 1 Memory Usage: 15kB.
  - A Hash Join node with cost=2.45..15.67, rows=46, width=65, taking 0.177..0.261 ms for 64 loops.
  - Hash Cond: (vessels.type = vesseltypes.code).
  - A Seq Scan on vessels with cost=0.00..11.89, rows=489, width=69, taking 0.071..0.120 ms for 489 loops.
  - A Hash node with cost=2.33..2.33, rows=10, width=4, taking 0.070..0.072 ms for 10 loops.
  - Buckets: 1024 Batches: 1 Memory Usage: 9kB.
  - A Seq Scan on vesseltypes with cost=0.00..2.33, rows=10, width=4, taking 0.060..0.064 ms for 10 loops.
  - Filter: (description ~~ 'Passenger%'::text).
  - Rows Removed by Filter: 96.
- Summary:** Planning Time: 0.661 ms, Execution Time: 455.451 ms, Total rows: 30 of 30, Query complete 00:00:00.486.

Βλέπουμε πως στο επερώτημα 4 ο χρόνος εκτέλεσης μειώνεται από 492msec σε 466msec. Αυτό οφείλεται στα ευρετήρια ***idx\_positions\_t\_speed*** και στην στήλη των ημερομηνιών και την αναζήτηση στην στήλη της περιγραφής του σκάφους αντίστοιχα.

## Q H e r



The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The main area contains the following SQL code:

```
43
44 --erwthma1v(a)
45 select distinct
46   Positions.vessel_id
47 from
48   Positions
49 join
50   Vessels on Positions.vessel_id = Vessels.id
51 join
52   VesselTypes on Vessels.type = VesselTypes.code
53 where
54   VesselTypes.description like 'Cargo%' and
55   Positions.speed = 0 and
56   date(positions.t) between '2019-08-15' and '2019-08-18';
```

Below the code, the status bar shows: "Successfully run. Total query runtime: 660 msec." and "34 rows affected."

## Μετά την δημιουργία ευρετηρίων

Ships/postgres@PostgreSQL 16    erwthma4.sql\*

Query History    Scratch Pad

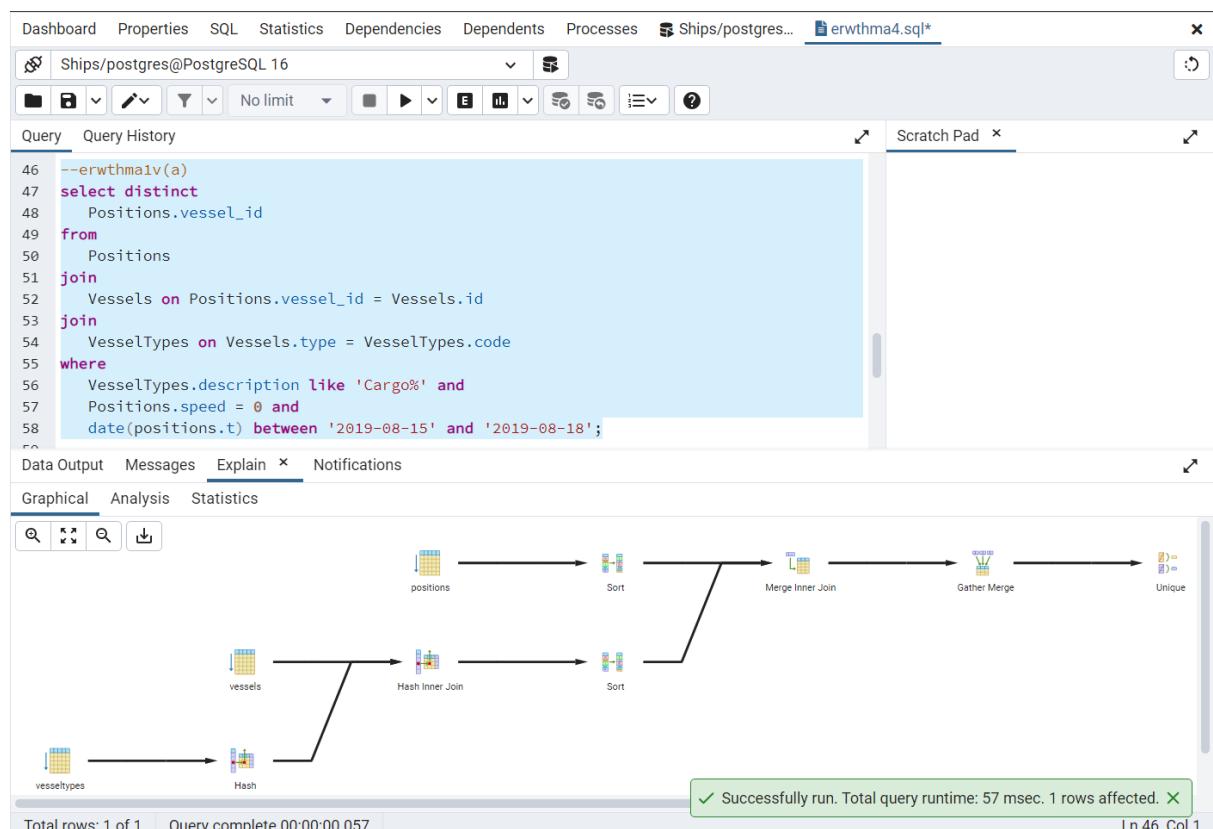
```
--erwthma1v(a)
select distinct
    Positions.vessel_id
from
    Positions
join
    Vessels on Positions.vessel_id = Vessels.id
join
    VesselTypes on Vessels.type = VesselTypes.code
where
    VesselTypes.description like 'Cargo%' and
    Positions.speed = 0 and
    date(positions.t) between '2019-08-15' and '2019-08-18';
--
```

Data Output    Messages    Explain    Notifications

Successfully run. Total query runtime: 646 msec.  
34 rows affected.

Total rows: 34 of 34    Query complete 00:00:00.646    Ln 46, Col 1

✓ Successfully run. Total query runtime: 646 msec. 34 rows affected. X



Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Query History Scratch Pad

```

46 --erwthma4(a)
47 explain analyze select distinct
48   Positions.vessel_id
49 from
50   Positions
51 join
52   Vessels on Positions.vessel_id = Vessels.id
53 join
54   VesselTypes on Vessels.type = VesselTypes.code
55 where
56   VesselTypes.description like 'Cargo%' and
57   Positions.speed = 0 and
58   date(positions.t) between '2019-08-15' and '2019-08-18';
59

```

Data Output Messages Explain Notifications

**QUERY PLAN**

text
1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=620.331..686.771 rows=34 loops=1)
2 -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=620.330..685.356 rows=23182 loops=1)
3 Workers Planned: 5
4 Workers Launched: 5
5 -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=510.244..534.236 rows=3864 loops=6)
6 Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7 -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=509.616..528.113 rows=97899 loops=6)
8 Sort Key: positions.vessel_id
9 Sort Method: external merge Disk: 8000kB

✓ Successfully run. Total query runtime: 706 msec. 35 rows affected. x

Total rows: 35 of 35 Query complete 00:00:00.706 Ln 46, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql](#) x

Ships/postgres@PostgreSQL 16 ↻

No limit ▼

Data Output Messages Explain Notifications

**QUERY PLAN**

text
1 Unique (cost=164160.03..164410.67 rows=424 width=65) (actual time=620.331..686.771 rows=34 loops=1)
2 -> Gather Merge (cost=164160.03..164406.08 rows=1836 width=65) (actual time=620.330..685.356 rows=23182 loops=1)
3 Workers Planned: 5
4 Workers Launched: 5
5 -> Merge Join (cost=163159.95..163184.90 rows=367 width=65) (actual time=510.244..534.236 rows=3864 loops=6)
6 Merge Cond: ((positions.vessel_id)::text = (vessels.id)::text)
7 -> Sort (cost=163143.02..163152.75 rows=3892 width=65) (actual time=509.616..528.113 rows=97899 loops=6)
8 Sort Key: positions.vessel_id
9 Sort Method: external merge Disk: 8000kB
10 Worker 0: Sort Method: external merge Disk: 5560kB
11 Worker 1: Sort Method: external merge Disk: 7120kB
12 Worker 2: Sort Method: external merge Disk: 6088kB
13 Worker 3: Sort Method: external merge Disk: 7896kB
14 Worker 4: Sort Method: external merge Disk: 5376kB
15 -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=24.839..329.232 rows=98624 loop=1)
16 Filter: ((speed = 0::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
17 Rows Removed by Filter: 1074151
18 -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.621..0.764 rows=3936 loops=6)
19 Sort Key: vessels.id
20 Sort Method: quicksort Memory: 33kB
21 Worker 0: Sort Method: quicksort Memory: 33kB
22 Worker 1: Sort Method: quicksort Memory: 33kB

Total rows: 35 of 35 Query complete 00:00:00.706 Ln 46, Col 1

```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql*
Ships/postgres@PostgreSQL 16 No limit Data Output Messages Explain Notifications
QUERY PLAN
text
15      -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=65) (actual time=24.839..329.232 rows=98624 loops=1)
16          Filter: ((speed = 0::double precision) AND (date(t) >= '2019-08-15'::date) AND (date(t) <= '2019-08-18'::date))
17          Rows Removed by Filter: 1074151
18      -> Sort (cost=16.94..17.05 rows=46 width=65) (actual time=0.621..0.764 rows=3936 loops=6)
19          Sort Key: vessels.id
20          Sort Method: quicksort Memory: 33kB
21          Worker 0: Sort Method: quicksort Memory: 33kB
22          Worker 1: Sort Method: quicksort Memory: 33kB
23          Worker 2: Sort Method: quicksort Memory: 33kB
24          Worker 3: Sort Method: quicksort Memory: 33kB
25          Worker 4: Sort Method: quicksort Memory: 33kB
26      -> Hash Join (cost=2.45..15.67 rows=46 width=65) (actual time=0.339..0.417 rows=104 loops=6)
27          Hash Cond: (vessels.type = vesseltypes.code)
28              -> Seq Scan on vessels (cost=0.00..11.89 rows=489 width=69) (actual time=0.110..0.151 rows=489 loops=6)
29              -> Hash (cost=2.33..2.33 rows=10 width=4) (actual time=0.077..0.078 rows=10 loops=6)
30                  Buckets: 1024 Batches: 1 Memory Usage: 9kB
31              -> Seq Scan on vesseltypes (cost=0.00..2.33 rows=10 width=4) (actual time=0.068..0.072 rows=10 loops=6)
32                  Filter: (description ~~ 'Cargo%':text)
33                  Rows Removed by Filter: 96
34      Planning Time: 0.444 ms
35      Execution Time: 687.630 ms
Total rows: 35 of 35 Query complete 00:00:00.706 Ln 46, Col 1

```

Βλέπουμε πως στο επερώτημα 5α ο χρόνος εκτέλεσης **μειώνεται** από 660msec σε 646 msec. Αυτό οφείλεται στα ευρετήρια ***idx\_positions\_t\_speed*** και στην στήλη των ημερομηνιών, αναζήτηση στην στήλη των ταχυτήτων και την αναζήτηση στην στήλη της περιγραφής του σκάφους αντίστοιχα.

Q

## Ηριν την δημιουργία ευρετηρίων

The screenshot shows the pgAdmin 4 interface with a query editor window. The title bar says "erwthma3.sql\*". The query tab contains the following SQL code:

```
57 --erwthma1v(b)
58 select distinct
59   Positions.vessel_id, VesselTypes.description, Positions.speed
60 from
61   Positions
62 join
63   Vessels on Positions.vessel_id = Vessels.id
64 join
65   VesselTypes on Vessels.type = VesselTypes.code
66 where
67   VesselTypes.description like 'Cargo%' and
68   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
69   and Positions.speed = 0
70 group by Positions.vessel_id, VesselTypes.description, Positions.speed
71 having count(distinct date(Positions.t)) = 8
72
73 order by Positions.vessel_id;
```

The status bar at the bottom shows "Total rows: 2 of 2" and "Query complete 00:00:00.871". A green message box indicates "Successfully run. Total query runtime: 871 msec. 2 rows affected." with a close button.

## Μετά την δημιουργία ευρετηρίων

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit E II ? Scratch Pad

```
58 date(positions.t) between '2019-08-15' and '2019-08-18';
59
60 --erwthma1v(b)
61 select distinct
62   Positions.vessel_id, VesselTypes.description, Positions.speed
63 from
64   Positions
65 join
66   Vessels on Positions.vessel_id = Vessels.id
67 join
68   VesselTypes on Vessels.type = VesselTypes.code
69 where
70   VesselTypes.description like 'Cargo%' and
71   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
72   and Positions.speed = 0
73 group by Positions.vessel_id, VesselTypes.description, Positions.speed
74 having count(distinct date(Positions.t)) = 8
75 order by Positions.vessel_id;
```

Data Output Messages Explain Notifications

Successfully run. Total query runtime: 794 msec.  
2 rows affected.

Total rows: 2 of 2 Query complete 00:00:00.794

Ln 60, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

Query History No limit E II ? Scratch Pad

```
60 --erwthma1v(b)
61 select distinct
62   Positions.vessel_id, VesselTypes.description, Positions.speed
63 from
64   Positions
65 join
66   Vessels on Positions.vessel_id = Vessels.id
67 join
68   VesselTypes on Vessels.type = VesselTypes.code
69 where
70   VesselTypes.description like 'Cargo%' and
71   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
72   and Positions.speed = 0
73 group by Positions.vessel_id, VesselTypes.description, Positions.speed
74 having count(distinct date(Positions.t)) = 8
75 order by Positions.vessel_id.
```

Data Output Messages Explain Notifications

Graphical Analysis Statistics

Total rows: 1 of 1 Query complete 00:00:00.062

Ln 60, Col 1

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Query History Scratch Pad

```

60 --erwthma1v(b)
61 explain analyze select distinct
62   Positions.vessel_id, VesselTypes.description, Positions.speed
63 from
64   Positions
65 join
66   Vessels on Positions.vessel_id = Vessels.id
67 join
68   VesselTypes on Vessels.type = VesselTypes.code
69 where
70   VesselTypes.description like 'Cargo%' and
71   DATE(Positions.t) between '2019-08-12' and '2019-08-19'
72   and Positions.speed = 8
73 group by Positions.vessel_id, VesselTypes.description, Positions.speed
74 having count(distinct date(Positions.t)) = 8
75 order by Positions.vessel_id;
```

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=731.752..786.768 rows=2 loops=1)
2 -> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=731.750..786.763 rows=2 loops=1)
3   Group Key: positions.vessel_id, vesseltypes.description
4   Filter: (count(DISTINCT date(positions.t)) = 8)
5   Rows Removed by Filter: 42
6   -> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=691.428..781.713 rows=34666 loops=1)
7     Workers Planned: 5

Total rows: 54 of 54 Query complete 00:00:00.818 Ln 60, Col 1
```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... [erwthma4.sql\\*](#)

Ships/postgres@PostgreSQL 16 No limit

Data Output Messages Explain Notifications

QUERY PLAN text

```

1 Unique (cost=164160.11..164463.95 rows=9 width=103) (actual time=731.752..786.768 rows=2 loops=1)
2 -> GroupAggregate (cost=164160.11..164463.91 rows=9 width=103) (actual time=731.750..786.763 rows=2 loops=1)
3   Group Key: positions.vessel_id, vesseltypes.description
4   Filter: (count(DISTINCT date(positions.t)) = 8)
5   Rows Removed by Filter: 42
6   -> Gather Merge (cost=164160.11..164422.60 rows=1836 width=111) (actual time=691.428..781.713 rows=34666 loops=1)
7     Workers Planned: 5
8     Workers Launched: 5
9     -> Incremental Sort (cost=163160.03..163201.42 rows=367 width=111) (actual time=608.863..650.836 rows=5778 loops=6)
10    Sort Key: positions.vessel_id, vesseltypes.description, (date(positions.t))
11    Presorted Key: positions.vessel_id
12    Full-sort Groups: 32 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
13    Pre-sorted Groups: 30 Sort Method: quicksort Average Memory: 124kB Peak Memory: 297kB
14    Worker 0: Full-sort Groups: 28 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
15    Pre-sorted Groups: 27 Sort Method: quicksort Average Memory: 193kB Peak Memory: 256kB
16    Worker 1: Full-sort Groups: 29 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
17    Pre-sorted Groups: 33 Sort Method: quicksort Average Memory: 131kB Peak Memory: 219kB
18    Worker 2: Full-sort Groups: 32 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
19    Pre-sorted Groups: 26 Sort Method: quicksort Average Memory: 125kB Peak Memory: 238kB
20    Worker 3: Full-sort Groups: 29 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB
21    Pre-sorted Groups: 29 Sort Method: quicksort Average Memory: 129kB Peak Memory: 225kB
22    Worker 4: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB

Total rows: 54 of 54 Query complete 00:00:00.818 Ln 60, Col 1
```

Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql\*

Ships/postgres@PostgreSQL 16

No limit E II

Data Output Messages Explain Notifications

QUERY PLAN

text

21 Pre-sorted Groups: 29 Sort Method: quicksort Average Memory: 129kB Peak Memory: 225kB

22 Worker 4: Full-sort Groups: 30 Sort Method: quicksort Average Memory: 34kB Peak Memory: 34kB

23 Pre-sorted Groups: 23 Sort Method: quicksort Average Memory: 125kB Peak Memory: 285kB

24 -> Merge Join (cost=163159.95..163184.90 rows=367 width=111) (actual time=608.520..647.648 rows=5778 loops=6)

25 Merge Cond: ((positions.vessel\_id)::text = (vessels.id)::text)

26 -> Sort (cost=163143.02..163152.75 rows=3892 width=81) (actual time=607.522..636.122 rows=142070 loops=6)

27 Sort Key: positions.vessel\_id

28 Sort Method: external merge Disk: 12752kB

29 Worker 0: Sort Method: external merge Disk: 14136kB

30 Worker 1: Sort Method: external merge Disk: 13832kB

31 Worker 2: Sort Method: external merge Disk: 14392kB

32 Worker 3: Sort Method: external merge Disk: 14208kB

33 Worker 4: Sort Method: external merge Disk: 13096kB

34 -> Parallel Seq Scan on positions (cost=0.00..162910.93 rows=3892 width=81) (actual time=16.447..338.949 rows=143060 loo...

35 Filter: ((speed = '0':double precision) AND (date(t) >= '2019-08-12':date) AND (date(t) <= '2019-08-19':date))

36 Rows Removed by Filter: 1029715

37 -> Sort (cost=16.94..17.05 rows=46 width=95) (actual time=0.934..1.175 rows=5841 loops=6)

38 Sort Key: vessels.id

39 Sort Method: quicksort Memory: 37kB

40 Worker 0: Sort Method: quicksort Memory: 37kB

41 Worker 1: Sort Method: quicksort Memory: 37kB

Total rows: 54 of 54 Query complete 00:00:00.818 Ln 60, Col 1

The screenshot shows the pgAdmin 4 interface with the following details:

- Toolbar:** Includes icons for file operations (New, Open, Save, Print, etc.), a search bar, and various database management tools.
- Menu Bar:** Contains links to Dashboard, Properties, SQL, Statistics, Dependencies, Dependents, Processes, and the current query tab, "erwthma4.sql".
- Results Pane:** Titled "erwthma4.sql", it displays the query plan for the executed query. The plan is organized into numbered steps (34 to 54) and includes information such as cost, rows, width, actual time, and memory usage. It also shows worker statistics and sort methods used.

```
Dashboard Properties SQL Statistics Dependencies Dependents Processes Ships/postgres... erwthma4.sql*
Ships/postgres@PostgreSQL 16
Data Output Messages Explain Notifications
QUERY PLAN
text
  Worker 0: Sort Method: quicksort Memory: 37kB
34    -> Parallel Seq Scan on positions  (cost=0.00..162910.93 rows=3892 width=81) (actual time=16.447..338.949 rows=143060 loops=...
35      Filter: ((speed < '0)::double precision AND (date(t) >= '2019-08-12'::date) AND (date(t) <= '2019-08-19'::date))
36      Rows Removed by Filter: 1029715
37      -> Sort  (cost=16.94..17.05 rows=46 width=95) (actual time=0.934..1.175 rows=5841 loops=6)
38          Sort Key: vessels.id
39          Sort Method: quicksort Memory: 37kB
40          Worker 0: Sort Method: quicksort Memory: 37kB
41          Worker 1: Sort Method: quicksort Memory: 37kB
42          Worker 2: Sort Method: quicksort Memory: 37kB
43          Worker 3: Sort Method: quicksort Memory: 37kB
44          Worker 4: Sort Method: quicksort Memory: 37kB
45      -> Hash Join  (cost=2.45..15.67 rows=46 width=95) (actual time=0.499..0.630 rows=104 loops=6)
46          Hash Cond: (vessels.type = vesseltypes.code)
47          -> Seq Scan on vessels  (cost=0.00..11.89 rows=489 width=69) (actual time=0.150..0.218 rows=489 loops=6)
48          -> Hash  (cost=2.33..2.33 rows=10 width=34) (actual time=0.146..0.147 rows=10 loops=6)
49              Buckets: 1024 Batches: 1 Memory Usage: 9kB
50              -> Seq Scan on vesseltypes  (cost=0.00..2.33 rows=10 width=34) (actual time=0.117..0.125 rows=10 loops=6)
51                  Filter: (description ~~ 'Cargo%':text)
52                  Rows Removed by Filter: 96
53 Planning Time: 0.457 ms
54 Execution Time: 788.780 ms

Total rows: 54 of 54   Query complete 00:00:00.818
Ln 60, Col 1
```

Βλέπουμε πως στο επερώτημα 5β ο χρόνος εκτέλεσης **μειώνεται** από 871msec σε 794msec. Αυτό οφείλεται στα ευρετήρια ***idx\_positions\_t\_speed*** και

***i***

***d***

***x***

***v***

***e***

Συμπερασματικά, εύκολα μπορεί να δει κανείς ότι με την δημιουργία των ευρετηρίων η εκτέλεση των επερωτημάτων έγινε πιο γρήγορη, αλλού με μικρή διαφορά και αλλού με μεγάλη διαφορά. Αυτό αποδεικνύει πόσο πιο απλή γίνεται η διαδικασία χρησιμοποιώντας ευρετήρια.

***s***

***T***

## **Ερώτημα 5 (20 %)**

Επιλέγουμε τη μέθοδο της κληρονομικότητας για να σπάσουμε το dataset σε χρόνου εκτέλεσης.

***description*** τα οποία επιταχύνουν την αναζήτηση σε εύρος στην στήλη των ημερομηνιών, αναζήτηση στην στήλη των ταχυτήτων και την αναζήτηση στην Προστηρούμενή στη διάσπαση του πίνακα ωρών. Οι χρόνοι εκτέλεσης παρουσιάζουν μείωση τις περισσότερες φορές σε σχέση με τους αρχικούς χρόνους, βέβαια όχι ιδιαίτερες.

### **Συγκεκριμένα:**

Στο πρώτο query υπήρξε μείωση του χρόνου εκτέλεσης κατά 41 ms.

Στο δεύτερο query υπήρξε μείωση του χρόνου εκτέλεσης κατά 11 ms.

Στο τρίτο query υπήρξε μείωση του χρόνου εκτέλεσης κατά 16 ms.

Στο τέταρτο query υπήρξε αύξηση του χρόνου εκτέλεσης κατά 32 ms.

Στο πρώτο μέρος του πέμπτου query υπήρξε μείωση του χρόνου εκτέλεσης κατά 182 ms.

Στο δεύτερο μέρος του πέμπτου query υπήρξε μείωση του χρόνου εκτέλεσης κατά 291 ms.

**Κώδικας:**

```
create table positions_1
```

```
(
```

```
check(id>=0 and id<1000000)
```

```
)
```

```
inherits(positions);
```

```
create table positions_2
```

```
(
```

```
check(id>=1000000 and id<2000000)
```

```
)
```

```
inherits(positions);
```

```
create table positions_3
```

```
(
```

```
check(id>=2000000 and id<3000000)
```

```
)
```

```
inherits(positions);
```

```
create table positions_4
```

```
(
```

```
check(id>=3000000 and id<4000000)
```

```
)
```

```
inherits(positions);
```

```
create table positions_5
(
check(id>=4000000 and id<5000000)
)
inherits(positions);
```

```
create table positions_6
(
check(id>=5000000 and id<6000000)
)
inherits(positions);
```

```
create table positions_7
(
check(id>=6000000 and id<7000000)
)
inherits(positions);
```

```
create table positions_8
(
check(id>=7000000 and id<8000000)
)
inherits(positions);
create table positions_9
(
check(id>=8000000 and id<9000000)
```

```
)  
inherits(positions);  
  
create table positions_10  
(  
    check(id>=9000000 and id<10000000)  
)  
inherits(positions);  
  
create index idx_positions_1_id on positions_1(id)  
create index idx_positions_2_id on positions_2(id)  
create index idx_positions_3_id on positions_3(id)  
create index idx_positions_4_id on positions_4(id)  
create index idx_positions_5_id on positions_5(id)  
create index idx_positions_6_id on positions_6(id)  
create index idx_positions_7_id on positions_7(id)  
create index idx_positions_8_id on positions_8(id)  
create index idx_positions_9_id on positions_9(id)  
create index idx_positions_10_id on positions_10(id)  
  
create or replace function positions_insert_trigger()  
    returns trigger as $$  
begin  
    if(new.id>=0 and new.id<1000000) then  
        insert into positions values (new.*);  
    elseif(new.id>=1000000 and new.id<2000000) then
```

```
    insert into positions values (new.*);
elseif(new.id>=2000000 and new.id<3000000) then
    insert into positions values (new.*);
elseif(new.id>=3000000 and new.id<4000000) then
    insert into positions values (new.*);
elseif(new.id>=4000000 and new.id<5000000) then
    insert into positions values (new.*);
elseif(new.id>=5000000 and new.id<6000000) then
    insert into positions values (new.*);
elseif(new.id>=6000000 and new.id<7000000) then
    insert into positions values (new.*);
elseif(new.id>=7000000 and new.id<8000000) then
    insert into positions values (new.*);
elseif(new.id>=8000000 and new.id<9000000) then
    insert into positions values (new.*);
elseif(new.id>=9000000 and new.id<1000000) then
    insert into positions values (new.*);
else
    raise exception 'id out of range!';
end if;

return null;
end;
$$language
plpgsql;
```