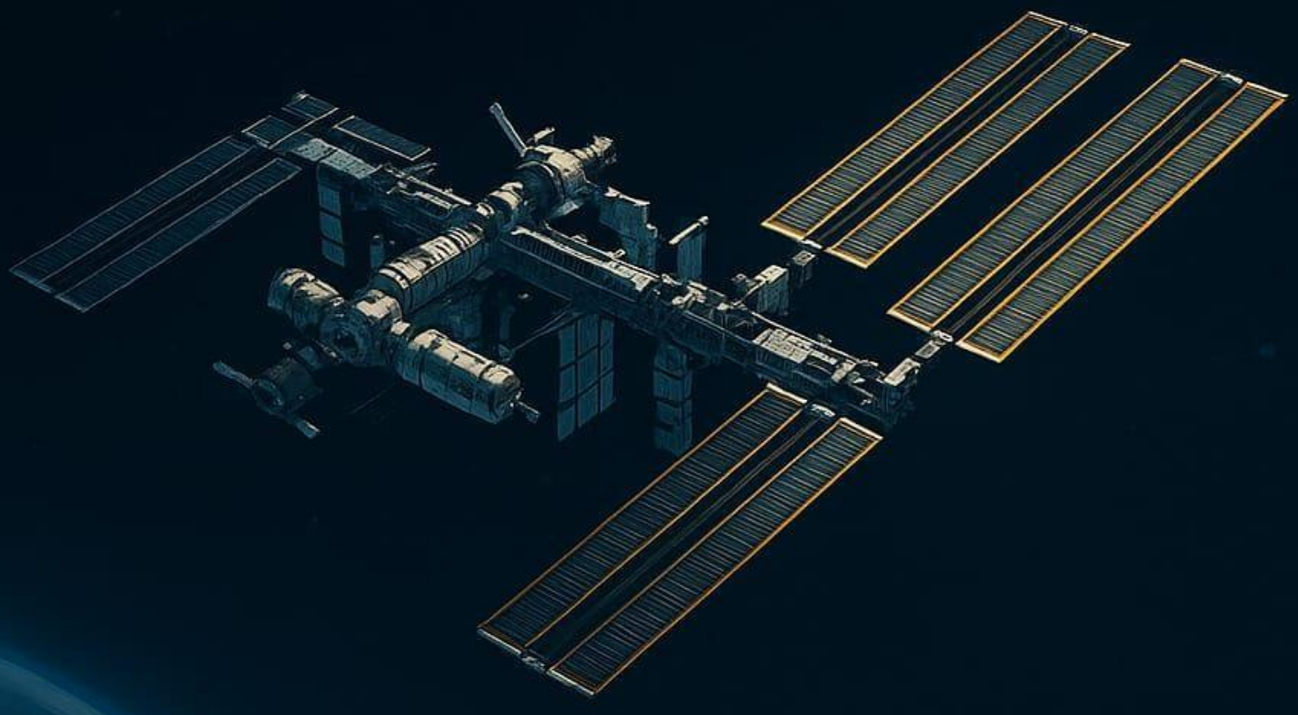
INTERNATIONAL SPACE STATION
DBMS REPORT

CSE 212
DATABASE SYSTEM LAB



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Date of Submission:
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International Space Station (ISS)

INTERNATIONAL SPACE STATION (ISS)

IT WAS FORMED BY 5 SPACE AGENCIES

US National Aeronautics and Space Administration

Russian Federal Space Agency

Japan Aerospace Exploration Agency (JAXA)

European Space Agency (ESA)

Canada Space Agency (CSA)

The first ISS module was launched in **1998**

Low-Earth orbit **space station**

Crewed habitable artificial satellite

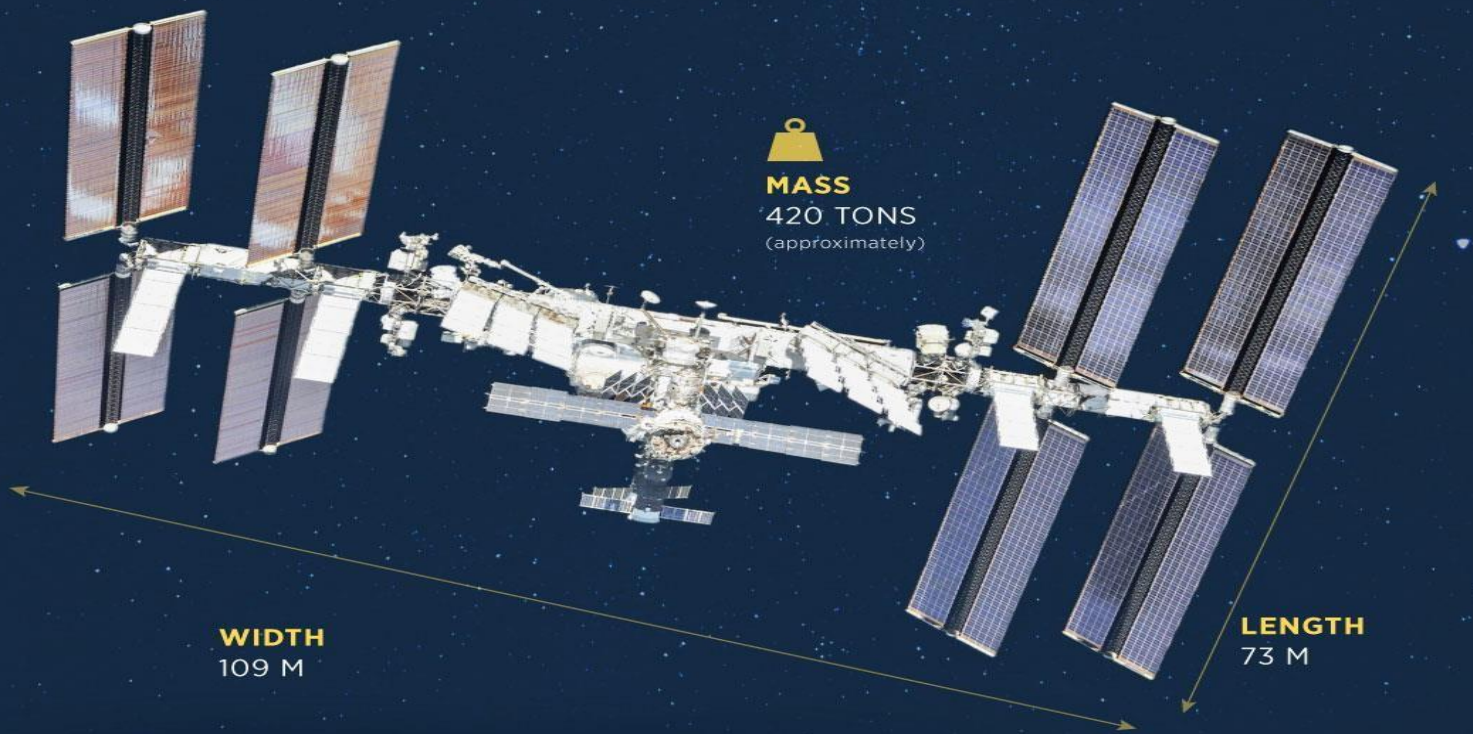
Functions as **a space laboratory**

Fully orbits the Earth in **90 minutes** (16 times per day)

Orbital altitude at **approximately 400 km**

About as **big as a soccer field**

Hosts research in such fields as physics, biology, chemistry, physiology, meteorology



14.06.2022 Source: NASA

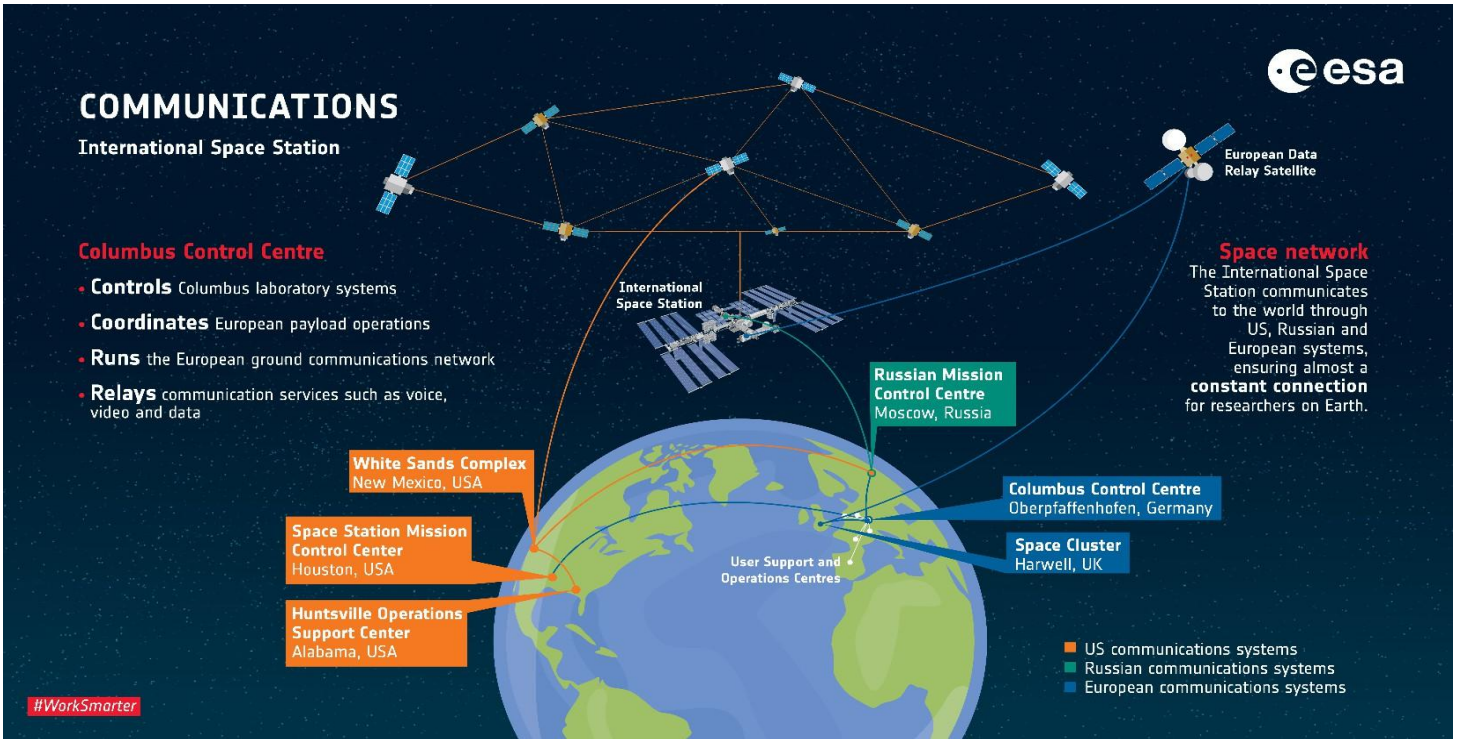
PROJECT TITLE

International Space Station Database Management System (ISS- DBMS)

Introduction

The **International Space Station Database Management System (ISS-DBMS)** is a comprehensive digital solution designed to centralize, manage, and optimize the vast and diverse data generated by the operations of the ISS.

This project is built to serve a wide range of users—**administrators, astronauts, mission control staff, and researchers**—by providing a structured platform that ensures **efficient data handling, informed decision-making, and enhanced scientific research**.



Project Objective

The primary goal of ISS-DBMS is to **simulate a real-world, enterprise-level space operations database** by:

- Organizing mission-critical data into structured tables.
- Enabling powerful and accurate data queries.
- Demonstrating the complex relationships between various operational aspects of the ISS.
- Supporting stakeholder-specific functionalities (e.g., astronauts logging spacewalks, scientists accessing experiment data, doctors reviewing health reports).

Target Users

- **Administrators**: Manage users, system settings, and permissions.
- **Researchers**: Analyze experimental results and module conditions.
- **Mission Control Personnel**: Oversee operations, crew assignments, supply missions.
- **Astronauts**: Access mission plans, log health data, conduct spacewalk entries.

Database Entities & Structure

The ISS-DBMS includes **15 interrelated tables (entities)** designed using principles of normalization and real-world database schema standards.

Entity Overview: Purpose & Functional Role

Entity Name	Purpose & Functionality
space_agencies	Stores global space agency details (e.g., NASA, JAXA) to map astronauts, spacecraft, and experiments to their governing agencies.
astronauts	Captures biographical and professional data of crew members participating in space missions.
spacecraft	Contains specs, launch history, and status of vehicles used in ISS missions and supply runs.
experiments	Holds metadata on scientific research activities conducted aboard the ISS, including lead scientists.
modules	Represents the physical sections of the ISS (labs, storage, living units), enabling mapping of equipment, experiments, and environmental data.
mission	Logs operational details of space missions (start/end dates, name, budget), forming a central entity for assignments and activity logs.
crew_assignments	Bridge table connecting astronauts and missions. Tracks who is assigned to what mission.
spacewalks	Stores records of astronaut EVAs (spacewalks), linked to missions and astronauts with durations and purposes.
docking_events	Logs events where spacecraft dock to modules, linking vehicles to ISS components and tracking resupply events.
supply_missions	Contains resupply records, detailing launch dates and cargo, mapped to docking events.
communications	Stores communication setup for each module: frequency and bandwidth used for real-time ops and research.
research_equipment	Tracks scientific tools used during experiments and which module they’re stored in or used.
health_records	Logs astronauts' vital statistics and medical observations across missions for health tracking.
doctors	Maps medical personnel to astronauts and specific health entries, linking observations to health logs.
environmental_data	Records environmental readings (temperature, pressure, humidity) within modules to monitor life-support integrity.

ER DIAGRAM RELATIONSHIP MAPPING (ORGANIZED)

1. Astronauts ↔ Missions

Relationship: crew_assignments
Type: Many-to-Many
Purpose: Tracks which astronaut is assigned to which mission.
Note: Implemented via a bridge table.

---

2. Astronauts ↔ Spacewalks

Relationship: spacewalks
Type: Many-to-Many
Purpose: Logs each EVA activity and who performed it under which mission.

3. Astronauts ↔ Health Records

Relationship: health_records
Type: One-to-Many
Purpose: Each astronaut can have multiple health records during different missions.

---

4. Health Records ↔ Doctors

Relationship: doctors
Type: One-to-Many
Purpose: Doctors are linked to health observations; tracks which doctor reviewed or submitted which record.

---

5. Experiments ↔ Modules

Relationship: research_equipment
Type: One-to-One / Many-to-One
Purpose: Each experiment takes place in a specific module using specific equipment.

---

6. Experiments ↔ Research Equipment

Relationship: research_equipment
Type: One-to-One / One-to-Many
Purpose: Associates experiment-specific tools and their storage locations.

7. Modules ↔ Environmental Data

Relationship: environmental_data
Type: One-to-Many
Purpose: Each module has environmental readings recorded periodically.

---

8. Modules ↔ Communications

Relationship: communications
Type: One-to-Many
Purpose: Stores communication details for each module.

---

9. Modules ↔ Docking Events

Relationship: docking_events
Type: One-to-Many
Purpose: Tracks which module each spacecraft docks with.

---

10. Spacecraft ↔ Docking Events

Relationship: docking_events
Type: One-to-Many
Purpose: Records each spacecraft's docking history with specific modules.

---

11. Docking Events ↔ Supply Missions

Relationship: supply_missions
Type: One-to-One
Purpose: Each resupply event is linked to a docking event.

---

12. Astronauts ↔ Doctors

Relationship: doctors
Type: One-to-Many (from astronaut to doctor entry)
Purpose: Shows which doctor is responsible for which astronaut's care in a given record

ISS-DBMS: ENTITY-ATTRIBUTE CATALOG

1. space_agencies

Stores information about international space agencies.

Attribute	Description	Key Type
agency_id (🔑)	Unique ID for each agency	Primary Key
name	Name of the space agency	—
country	Country of origin	—
director	Current director of the agency	—

---

2. astronauts

Captures astronaut profiles and demographics.

Attribute	Description	Key Type
astronaut_id (🔑)	Unique identifier for astronauts	Primary Key
name	Full name	—
nationality	Country represented	—
date_of_birth	Date of birth	—
gender	Gender	—

---

3. spacecraft

Contains data on spacecraft used in missions.

Attribute	Description	Key Type
spacecraft_id (🔑)	Unique spacecraft ID	Primary Key
name	Name of the spacecraft	—
manufacturer	Producing company	—
launch_date	Initial launch date	—
status	Active, Inactive, Retired, etc.	—

4. experiments

Tracks all scientific experiments onboard ISS.

Attribute	Description	Key Type
experiment_id (🔑)	Unique experiment ID	Primary Key
name	Title of the experiment	—
description	Overview of the research	—
principal_investigator	Lead researcher	—

---

5. modules

Represents ISS modules where activities are conducted.

Attribute	Description	Key Type
module_id (🔑)	Unique module identifier	Primary Key
name	Module name (e.g., Columbus)	—
description	Function or type of module	—
launch_date	Launch date of module	—

---

6. mission

Details for each mission executed aboard or to the ISS.

Attribute	Description	Key Type
mission_id(🔑)	Unique mission identifier	Primary Key
name	Mission title	—
launch_date	Launch date	—
end_date	Completion date	—
budget	Mission budget (USD)	—

---

7. crew_assignments

Links astronauts to their assigned missions.

Attribute	Description	Key Type
mission_id(🔑)	Refers to mission	Primary & Foreign Key
astronaut_id (🔑)	Refers to astronaut	Primary & Foreign Key

8. spacewalks

Logs spacewalks performed during missions.

Attribute	Description	Key Type
mission_id (🔑)	Related mission	Primary & Foreign Key
astronaut_id(🔑)	Spacewalking astronaut	Primary & Foreign Key
duration	Length of the spacewalk	—
purpose	Objective of the walk	—
spacewalk_date	Date of the activity	—

---

9. docking_events

Tracks each spacecraft docking with ISS modules.

Attribute	Description	Key Type
docking_event_id (🔑)	Unique docking event ID	Primary Key
spacecraft_id	Docking spacecraft	Foreign Key
module_id	Target ISS module	Foreign Key
docking_date	When the docking occurred	—

---

10. supply_missions

Details resupply missions to the ISS.

Attribute	Description	Key Type
supply_mission_id (🔑)	Unique supply mission ID	Primary Key
launch_date	Supply launch date	—
cargo_description	Description of delivered cargo	—
docking_event_id	Linked docking event	Foreign Key

---

11. communications

Communication specs for each module.

Attribute	Description	Key Type
communication_id (🔑)	Unique ID	Primary Key
module_id	Target module	Foreign Key
frequency	Comm frequency	—
bandwidth	Comm bandwidth	—

---

12. research_equipment

Equipment associated with experiments.

Attribute	Description	Key Type
equipment_id(🔑)	Unique equipment ID	Primary Key
experiment_id	Related experiment	Foreign Key
module_id	Module using this equipment	Foreign Key
description	Equipment specifications	—

---

13. health_records

Logs astronauts' health data over time.

Attribute	Description	Key Type
health_record_id (🔑)	Unique record ID	Primary Key
astronaut_id	Related astronaut	Foreign Key
date	Record date	—
parameter	Metric name (e.g., BP, HR)	—
value	Measured value	—

14. doctors

Connects doctor observations with health data.

Attribute	Description	Key Type
doctors_id	Doctor identifier	—
name	Doctor's name	—
observation	Summary or diagnosis	—
health_record_id(🔑)	Associated health record	Primary & Foreign Key
astronaut_id (🔑)	Related astronaut	Primary & Foreign Key

---

15. environmental_data

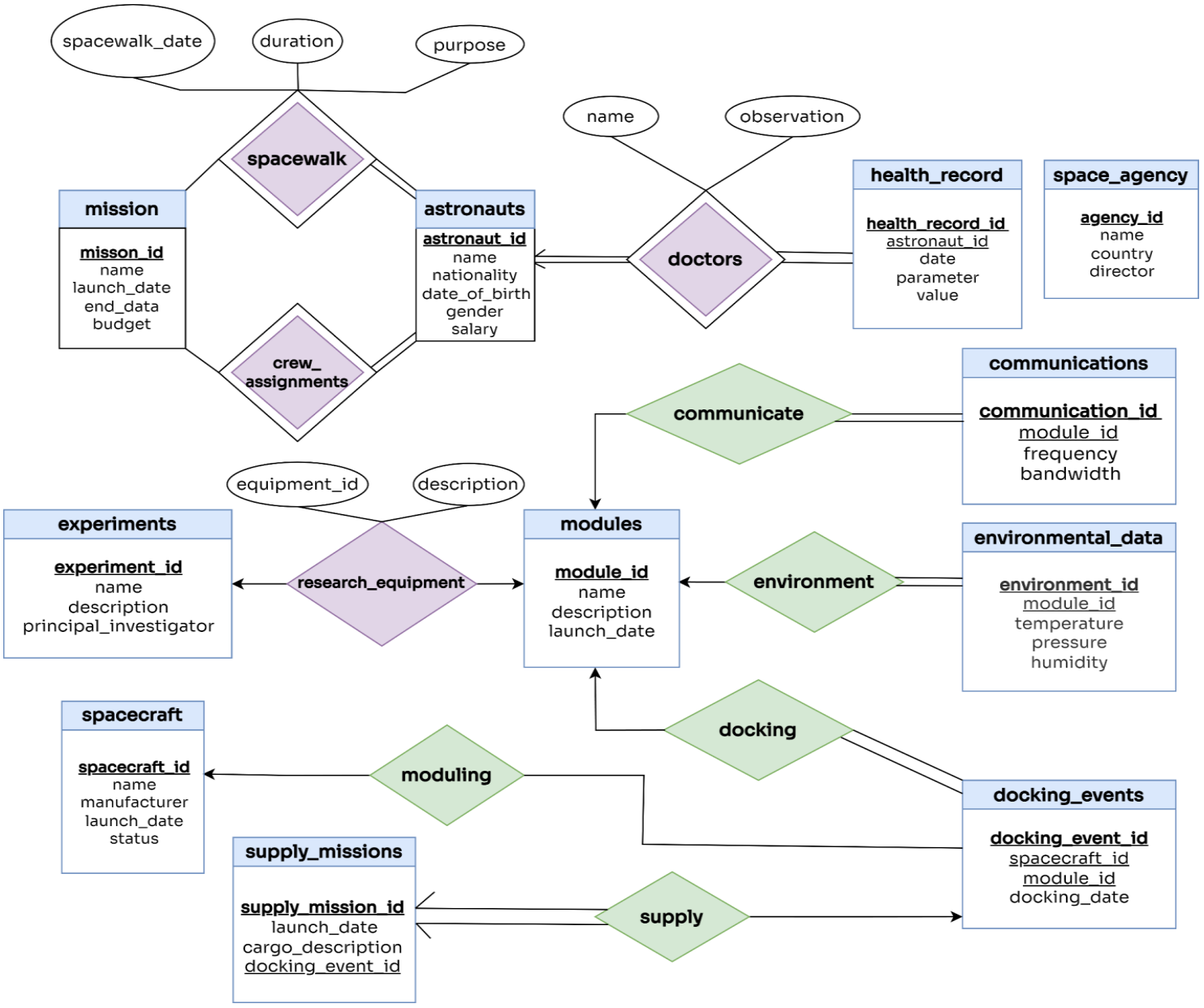
Module environment logs.

Attribute	Description	Key Type
environment_id (🔑)	Unique record ID	Primary Key
module_id	Related module	Foreign Key
temperature	Temperature reading	—
pressure	Atmospheric pressure	—
humidity	Humidity level	—

TECHNOLOGICAL IMPLEMENTATION

- **Database Engine**: Microsoft SQL Server
- **Key Features**:
  - Use of **Primary and Foreign Keys** for integrity.
  - **Normalization** to avoid redundancy.
  - Complex **JOINs**, **GROUP BY**, **HAVING**, and **subqueries** implemented.
  - Real-world queries such as tracking salaries over time, evaluating spacewalk durations, monitoring environmental conditions, etc.

ER DIAGRAM


spacewalk_date
duration
purpose
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mission
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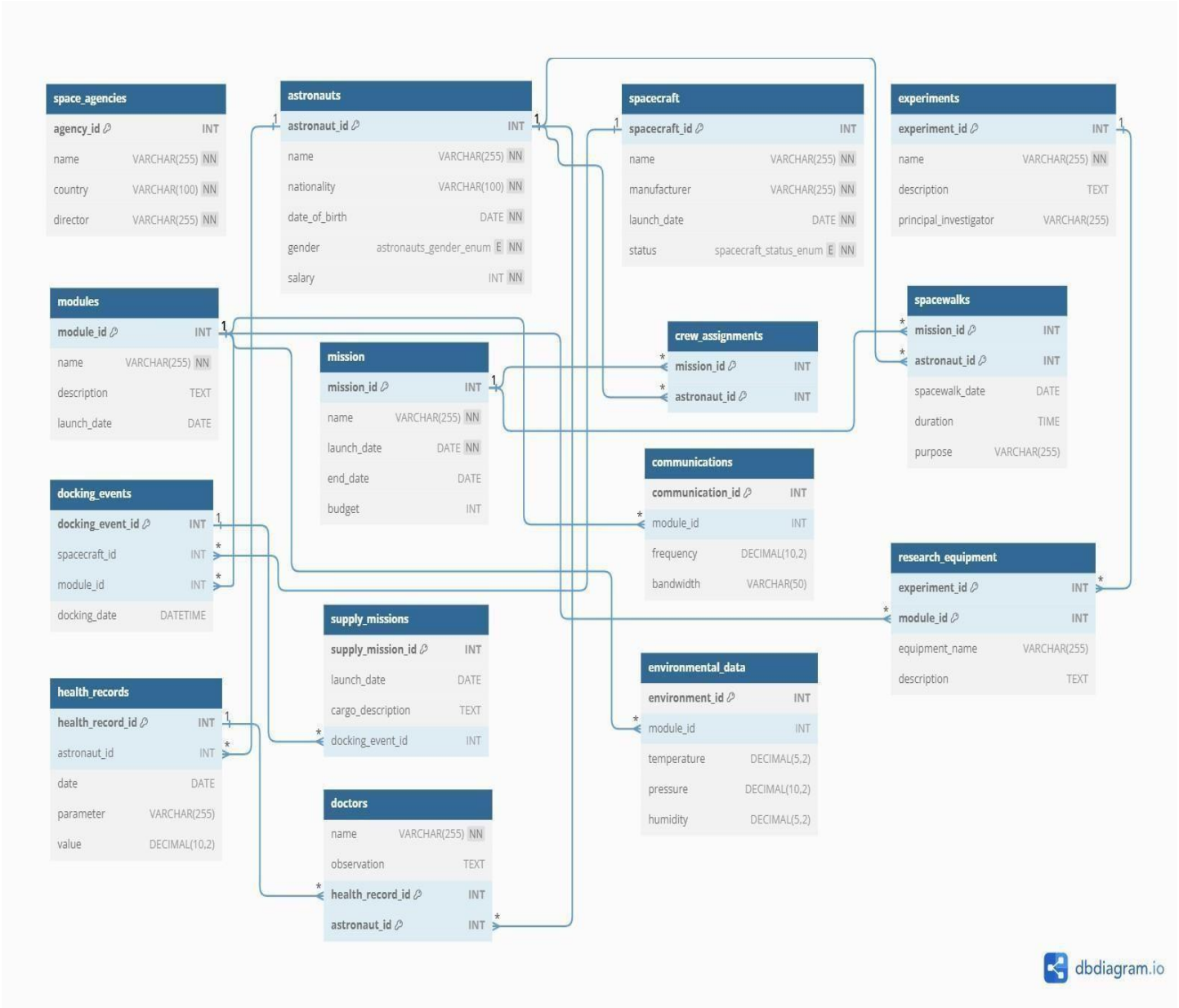
SCHEMA DIAGRAM



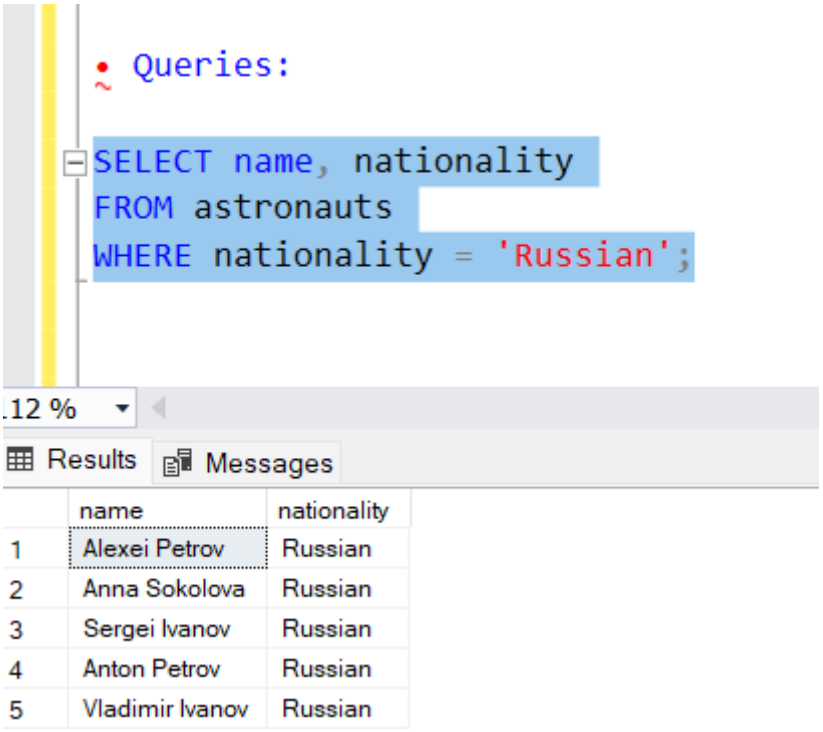
QUERY

1. Basic Query Structure

Query: Finds the names and nationalities of astronauts from the RUSSIA.

```
SELECT name, nationality
FROM astronauts
WHERE nationality = 'Russian';
```

Screenshot



	name	nationality
1	Alexei Petrov	Russian
2	Anna Sokolova	Russian
3	Sergei Ivanov	Russian
4	Anton Petrov	Russian
5	Vladimir Ivanov	Russian

Explanation: Fetches the Names and Nationalities of Astronauts from the RUSSIA.

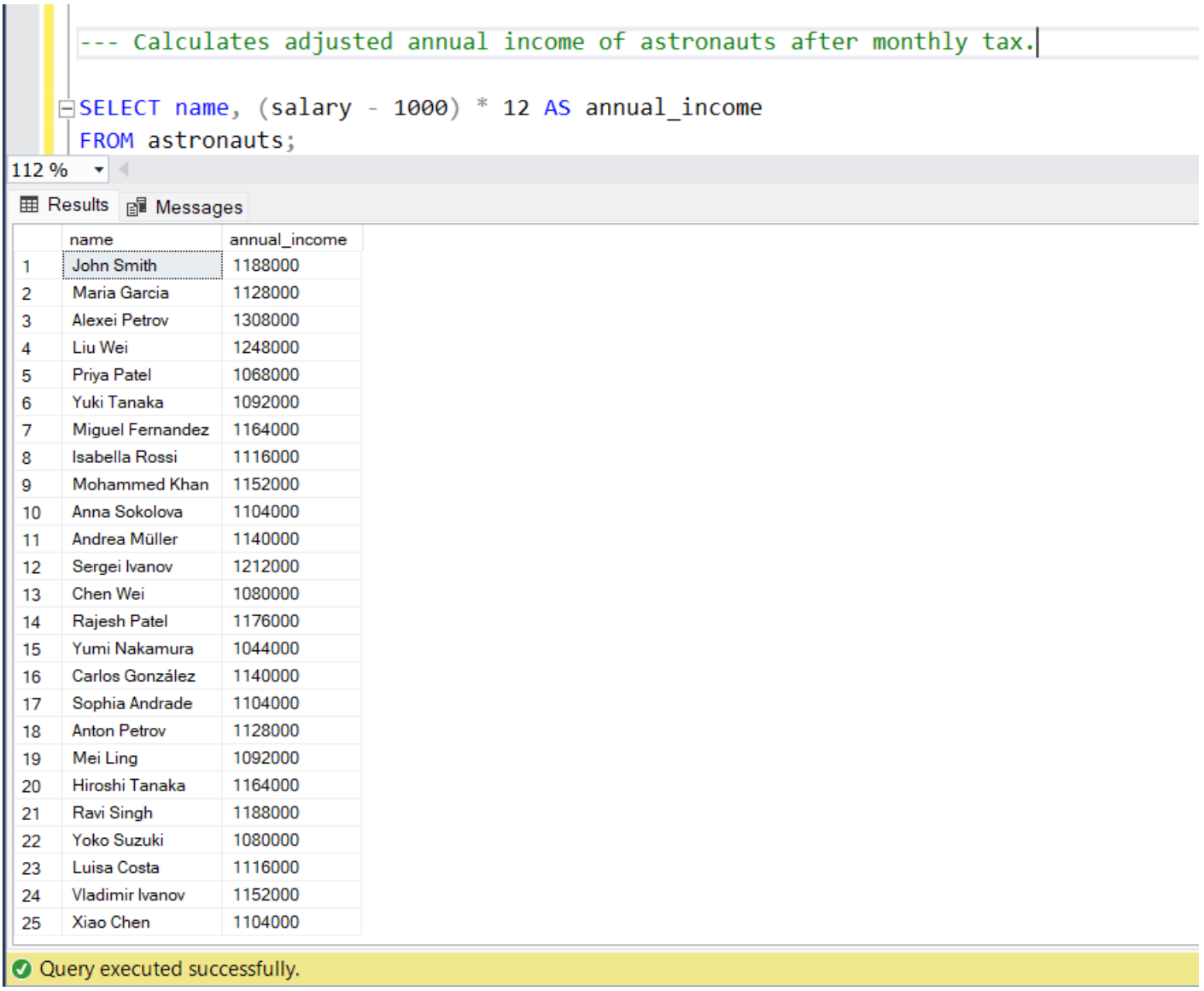
---

2. Additional Basic Operations (Arithmetic)

Query: Calculates adjusted annual income of astronauts after monthly tax.

```
SELECT name, (salary - 1000) * 12 AS annual_income
FROM astronauts;
```

Screenshot



```
--- Calculates adjusted annual income of astronauts after monthly tax.

SELECT name, (salary - 1000) * 12 AS annual_income
FROM astronauts;
```

112 %

Results | Messages

	name	annual_income
1	John Smith	1188000
2	Maria Garcia	1128000
3	Alexei Petrov	1308000
4	Liu Wei	1248000
5	Priya Patel	1068000
6	Yuki Tanaka	1092000
7	Miguel Fernandez	1164000
8	Isabella Rossi	1116000
9	Mohammed Khan	1152000
10	Anna Sokolova	1104000
11	Andrea Müller	1140000
12	Sergei Ivanov	1212000
13	Chen Wei	1080000
14	Rajesh Patel	1176000
15	Yumi Nakamura	1044000
16	Carlos González	1140000
17	Sophia Andrade	1104000
18	Anton Petrov	1128000
19	Mei Ling	1092000
20	Hiroshi Tanaka	1164000
21	Ravi Singh	1188000
22	Yoko Suzuki	1080000
23	Luisa Costa	1116000
24	Vladimir Ivanov	1152000
25	Xiao Chen	1104000

Query executed successfully.

Explanation: Calculates Adjusted Annual Income of Astronauts After Monthly Tax.

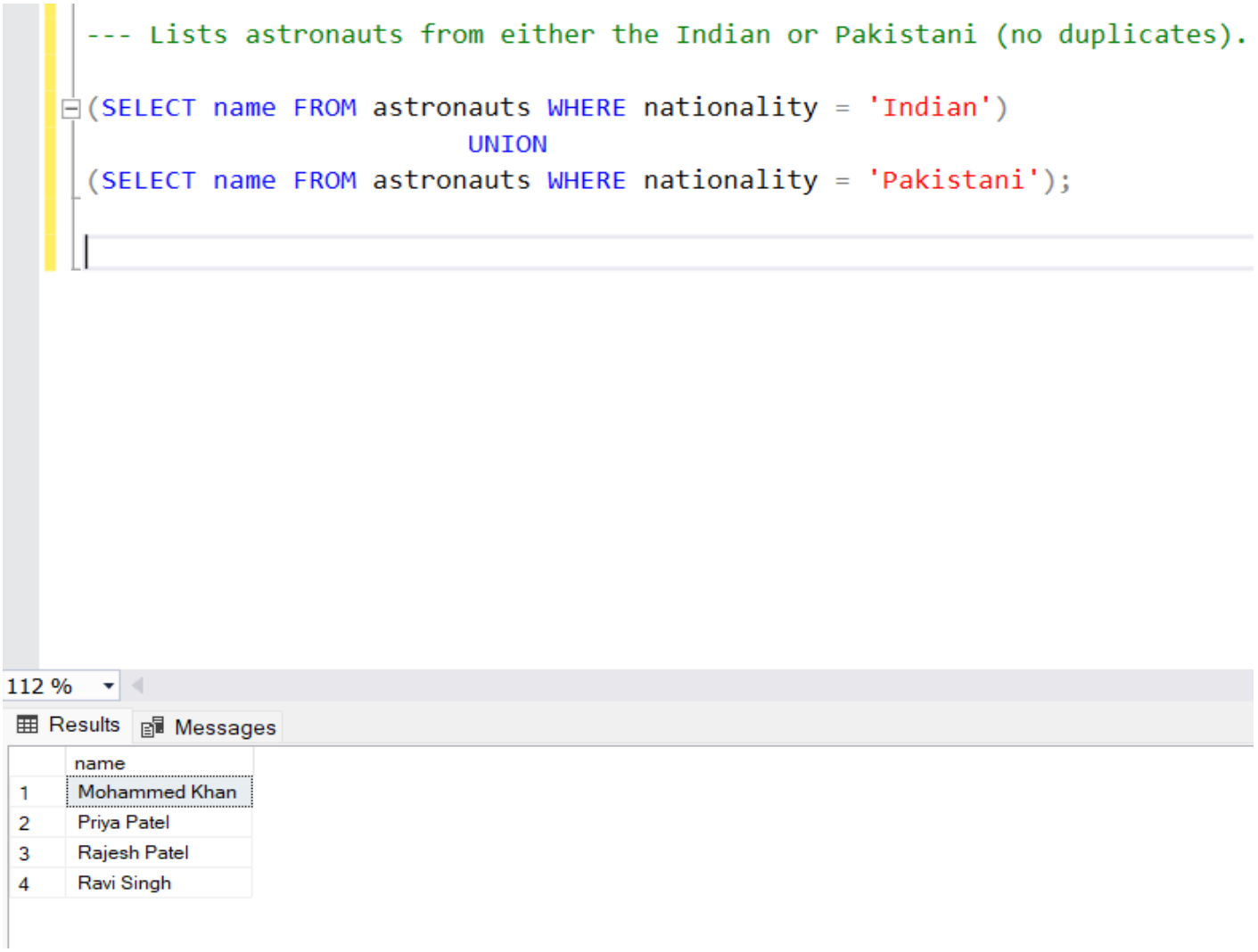
---

3. Set Operations

Query: Lists astronauts from either the Indian or Pakistani (no duplicates).

```
(SELECT name FROM astronauts WHERE nationality = 'Indian')
                    UNION
(SELECT name FROM astronauts WHERE nationality = 'Pakistani');
```

Screenshot



Explanation: Lists Astronauts from Either the USA Or Russia (No Duplicates).

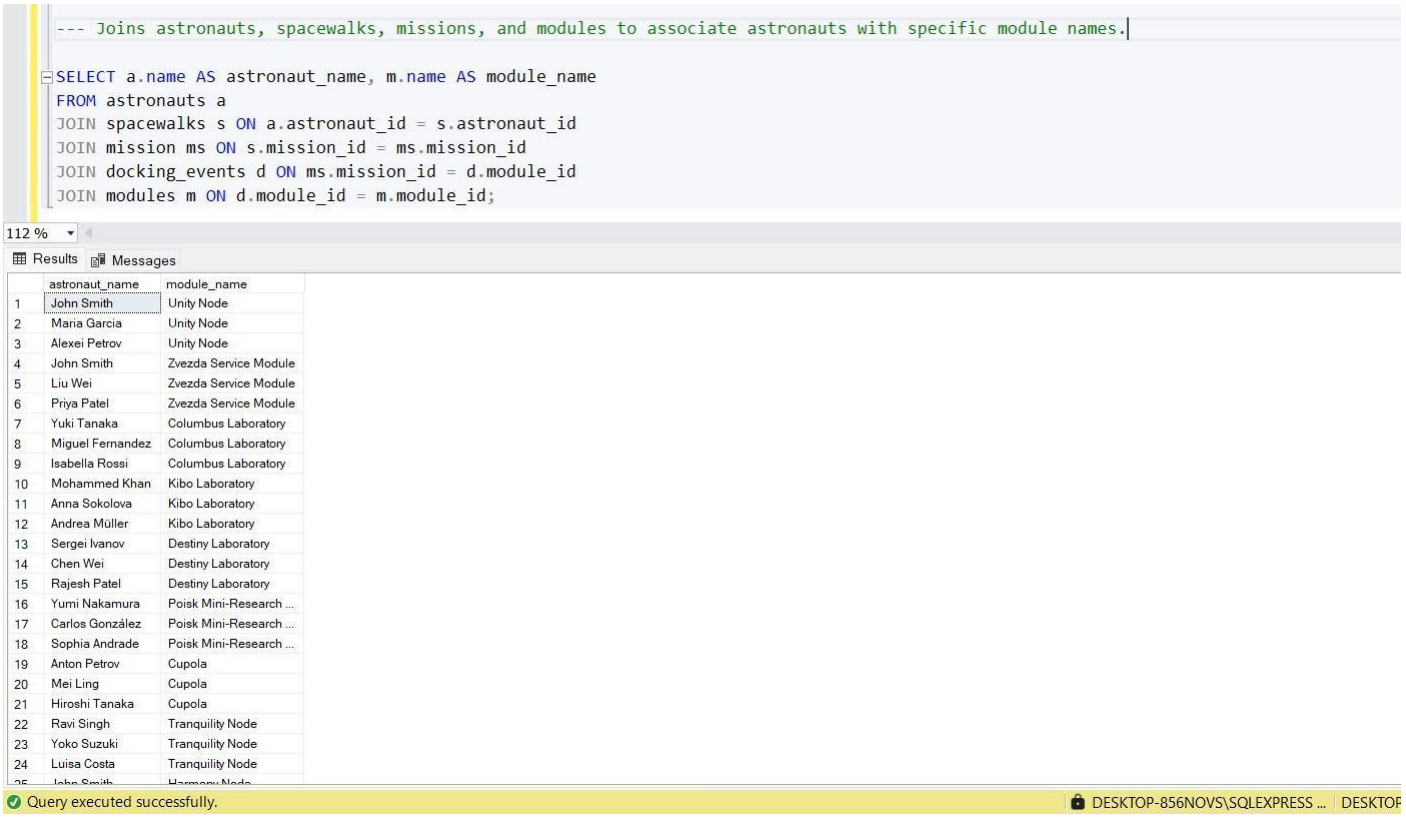
---

4. Join Operation

Query: Show Astronaut Names Along with The Name of The Module They Performed Spacewalks Nearby.

```
SELECT a.name AS astronaut_name, m.name AS module_name
FROM astronauts a
JOIN spacewalks s ON a.astronaut_id = s.astronaut_id
JOIN mission ms ON s.mission_id = ms.mission_id
JOIN docking_events d ON ms.mission_id = d.module_id
JOIN modules m ON d.module_id = m.module_id;
```

Screenshot



	astronaut_name	module_name
1	John Smith	Unity Node
2	Maria Garcia	Unity Node
3	Alexei Petrov	Unity Node
4	John Smith	Zvezda Service Module
5	Liu Wei	Zvezda Service Module
6	Priya Patel	Zvezda Service Module
7	Yuki Tanaka	Columbus Laboratory
8	Miguel Fernandez	Columbus Laboratory
9	Isabella Rossi	Columbus Laboratory
10	Mohammed Khan	Kibo Laboratory
11	Anna Sokolova	Kibo Laboratory
12	Andrea Müller	Kibo Laboratory
13	Sergei Ivanov	Destiny Laboratory
14	Chen Wei	Destiny Laboratory
15	Rajesh Patel	Destiny Laboratory
16	Yumi Nakamura	Poisk Mini-Research ...
17	Carlos González	Poisk Mini-Research ...
18	Sophia Andrade	Poisk Mini-Research ...
19	Anton Petrov	Cupola
20	Mei Ling	Cupola
21	Hiroshi Tanaka	Cupola
22	Ravi Singh	Tranquility Node
23	Yoko Suzuki	Tranquility Node
24	Luisa Costa	Tranquility Node

Explanation:

Joins Astronauts, Spacewalks, Missions, And Modules to Associate Astronauts with Specific Module Names.

---

5. Set Operation (UNION)

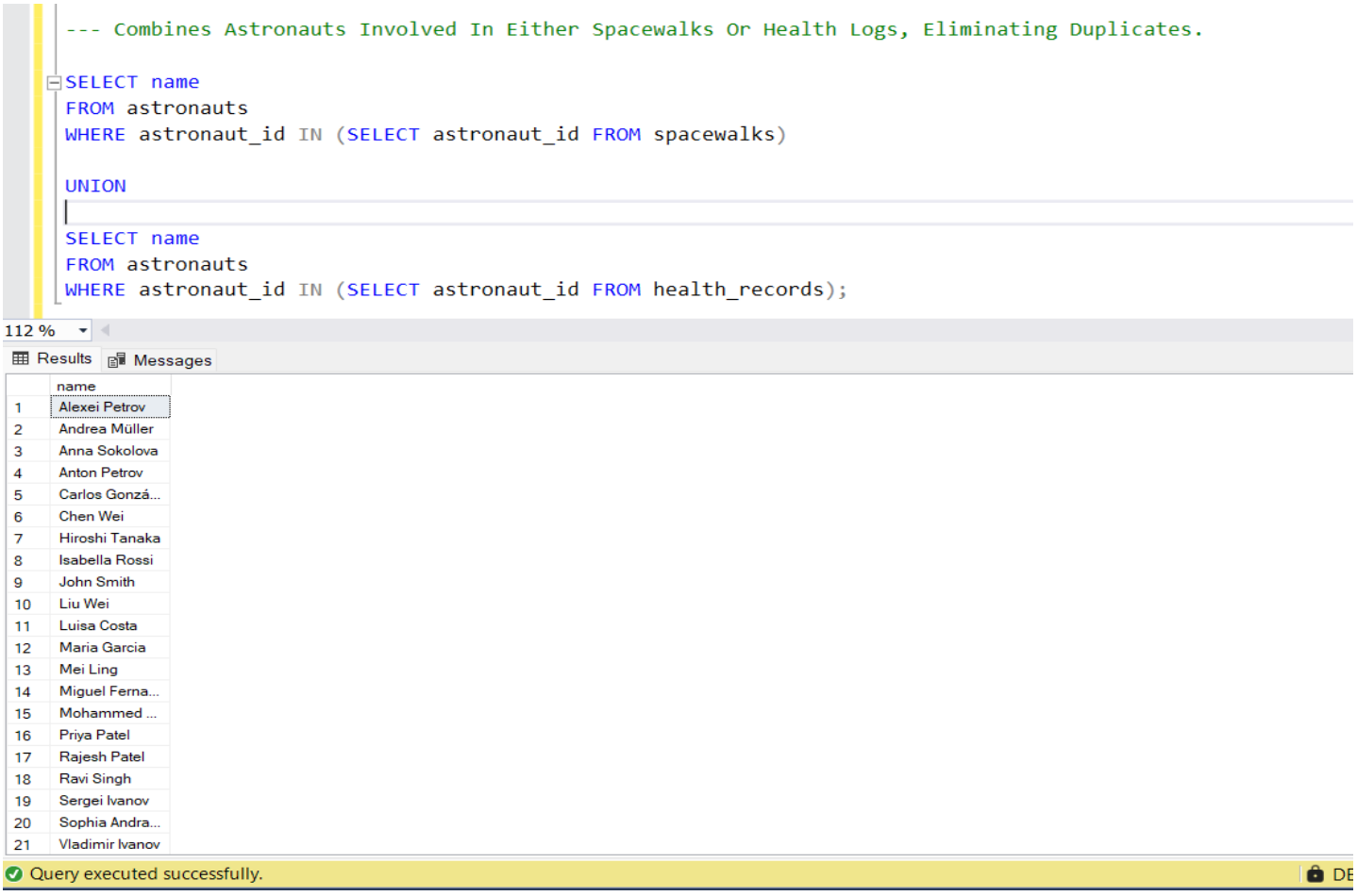
Query: Get Names of Astronauts Who Either Participated in Spacewalks or Have Health Records.

```
SELECT name
FROM astronauts
WHERE astronaut_id IN (SELECT astronaut_id FROM spacewalks)

UNION

SELECT name
FROM astronauts
WHERE astronaut_id IN (SELECT astronaut_id FROM health_records);
```

Screenshot



Explanation:

Combines Astronauts Involved in Either Spacewalks or Health Logs, Eliminating Duplicates.

6. INTERSECT – Finding Common Entries

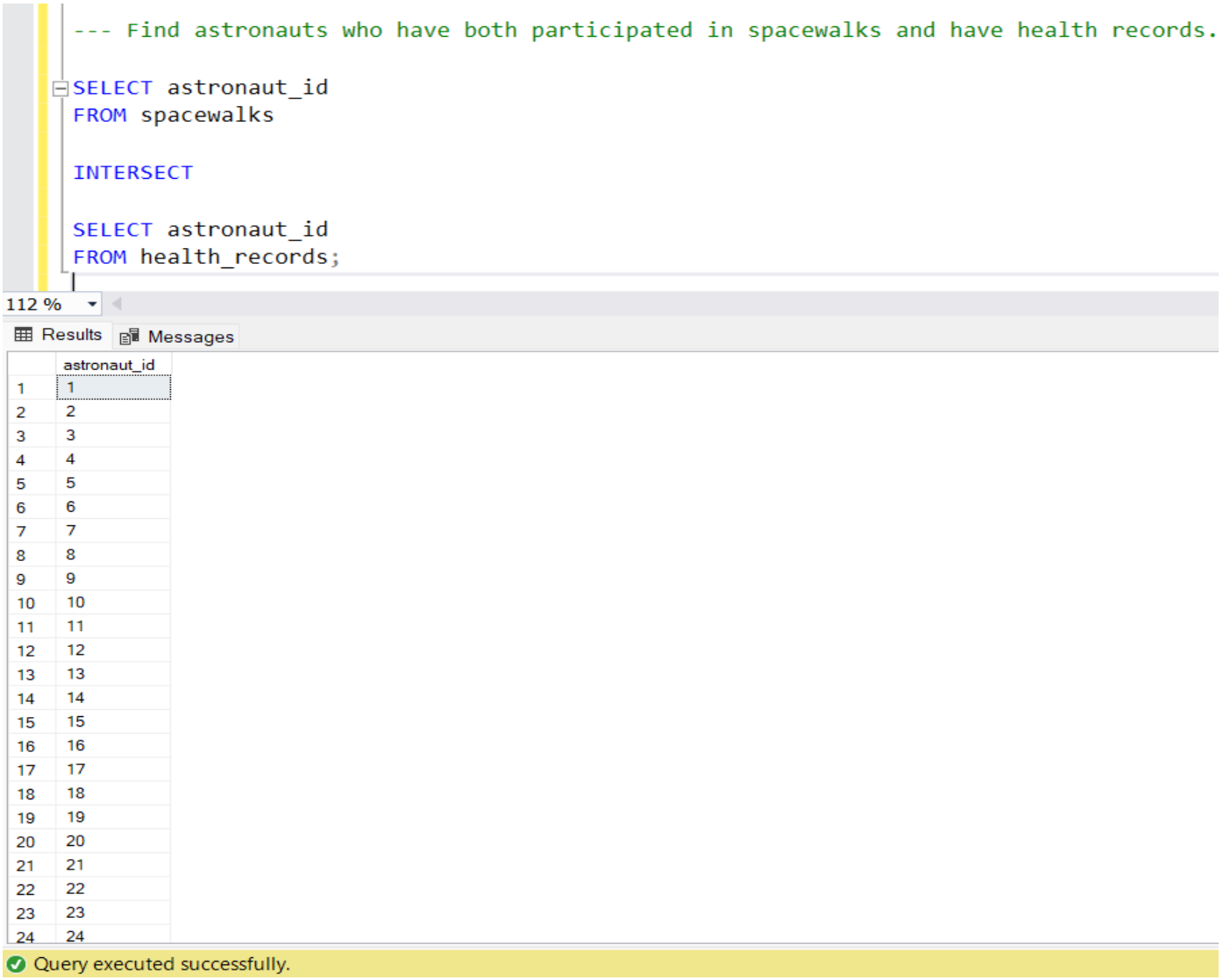
Query: Find astronauts who have **both** participated in spacewalks **and** have health records.

```
SELECT astronaut_id
FROM spacewalks

INTERSECT

SELECT astronaut_id
FROM health_records;
```

Screenshot



Explanation:

This query returns the astronaut_ids of astronauts who are **in both** the spacewalks and health_records tables — meaning they have performed spacewalks **and** have medical records logged.

7. EXCEPT – Finding Exclusive Entries

Query: Find astronauts who have **health records** but have **never participated in any spacewalk**.

```
SELECT astronaut_id
FROM health_records

EXCEPT

SELECT astronaut_id
FROM spacewalks;
```

Screenshot

Explanation:
This query returns astronauts who are **only** in the health_records table but **not** in the spacewalks table — meaning they have never done a spacewalk.

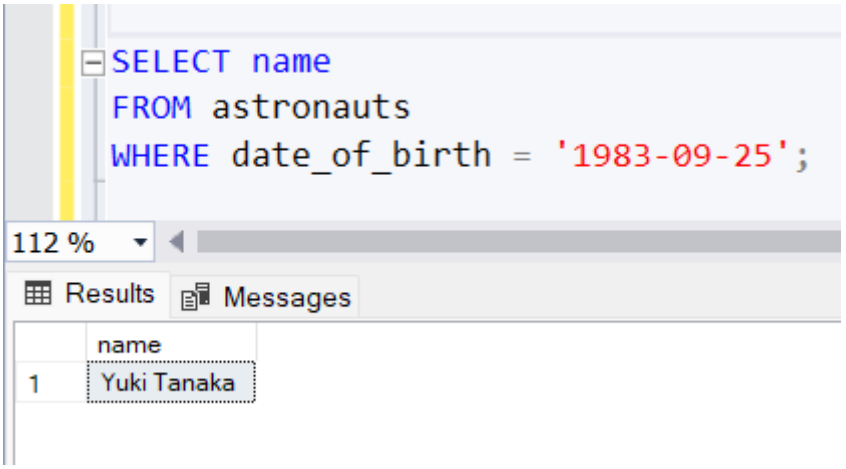
---

8. Birthday Values

Query: Find the astronauts with their birthdates.

```
SELECT name
FROM astronauts
WHERE date_of_birth = '1983-09-25';
```

Screenshot



Explanation: Finds astronauts with birthdates.

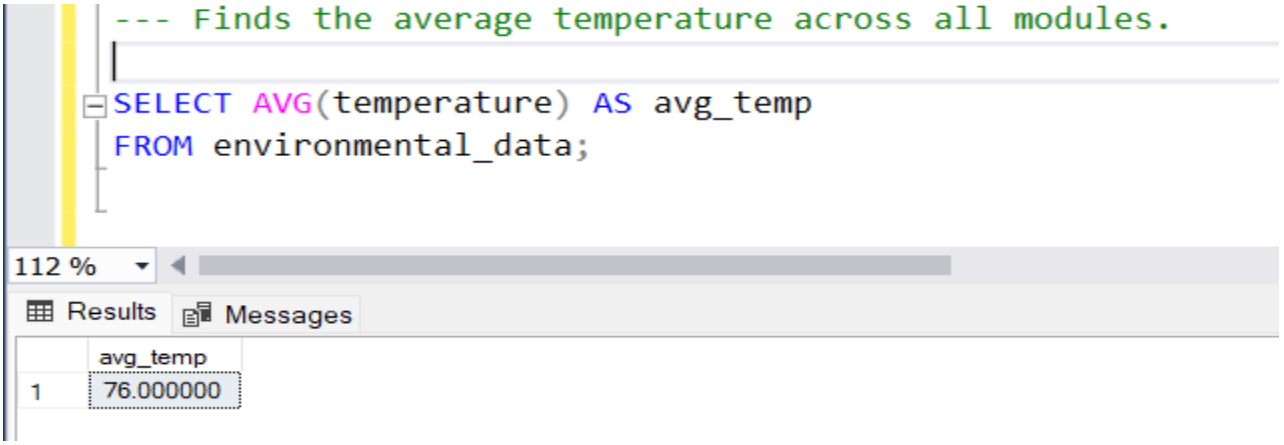
---

9. Aggregate Functions

Query: Find the average temperature across all modules.

```
SELECT AVG(temperature) AS avg_temp
FROM environmental_data;
```

Screenshot



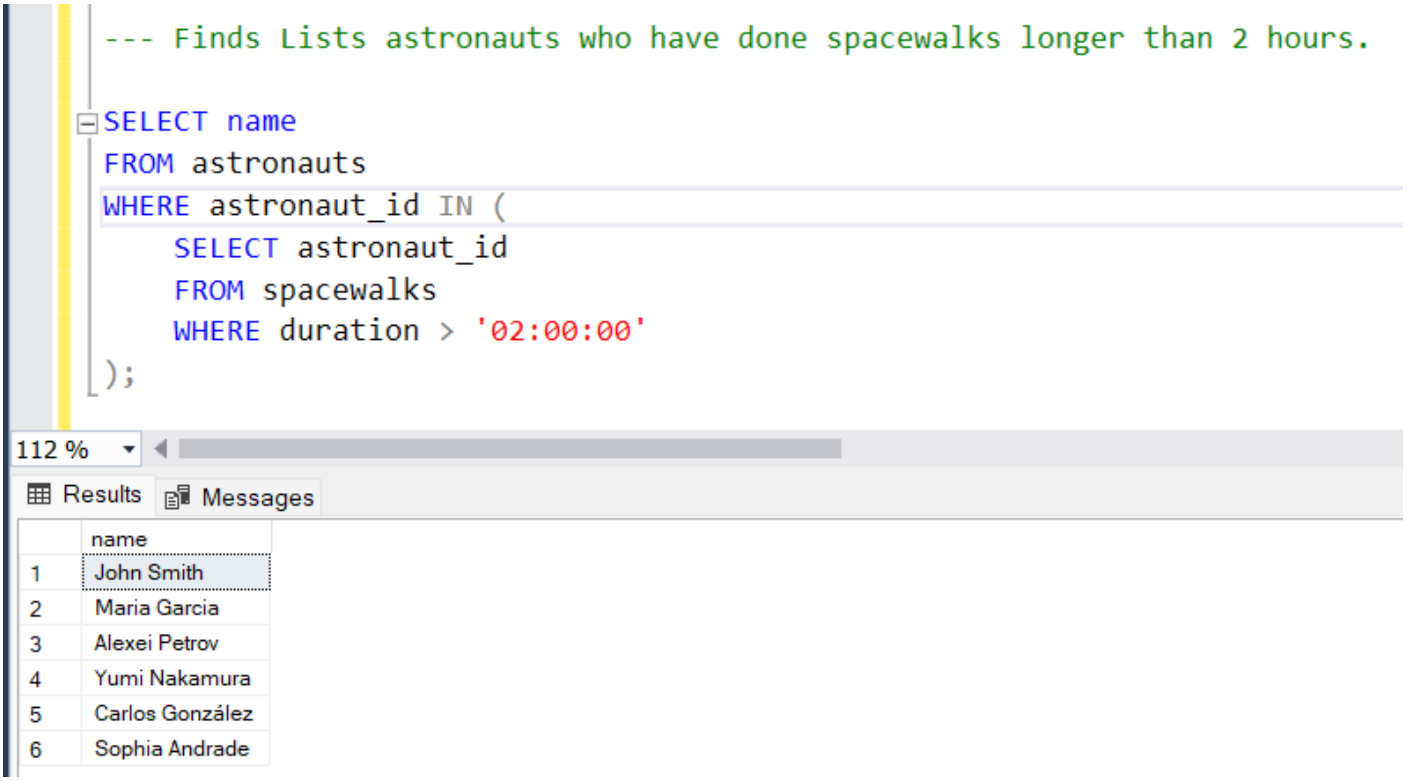
Explanation: Returns the average temperature across all modules

10. Nested Subqueries

Query: Finds Lists astronauts who have done spacewalks longer than 2 hours.

```
SELECT name
FROM astronauts
WHERE astronaut_id IN
(
   SELECT astronaut_id
   FROM spacewalks
   WHERE duration > '02:00:00'
);
```

Screenshot



Explanation: Lists astronauts who have done spacewalks longer than 2 hours.

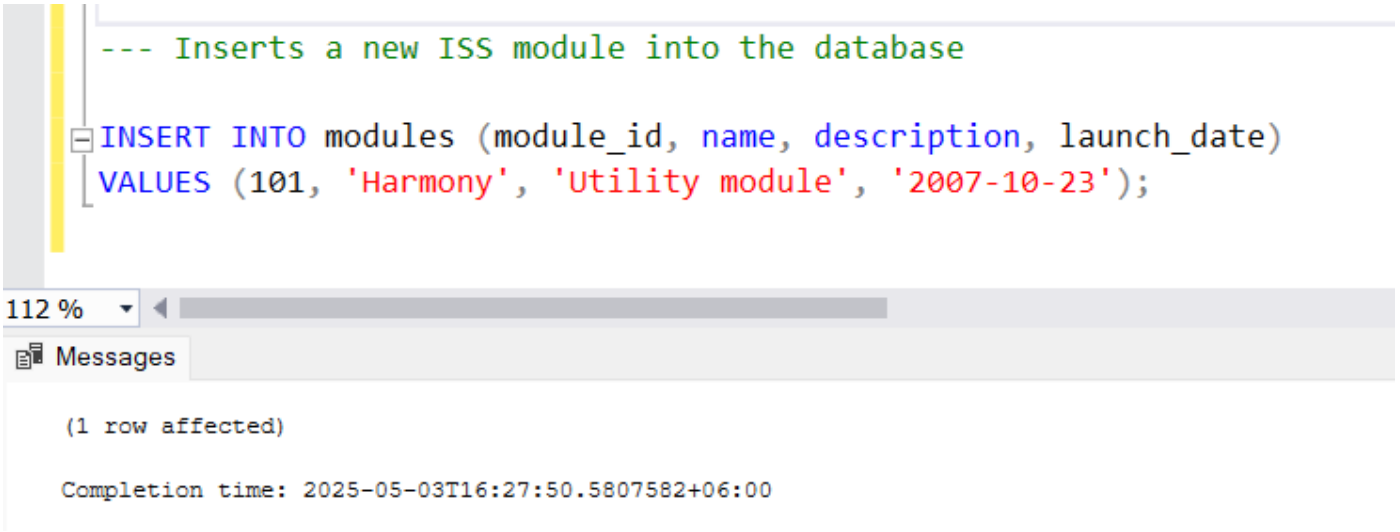
---

11. Modification – INSERT

Query: Helps to insert a new ISS module into the database.

```
INSERT INTO modules (module_id, name, description, launch_date)
VALUES (101, 'Harmony', 'Utility module', '2007-10-23');
```

Screenshot



Explanation: Inserts a new ISS module into the database.

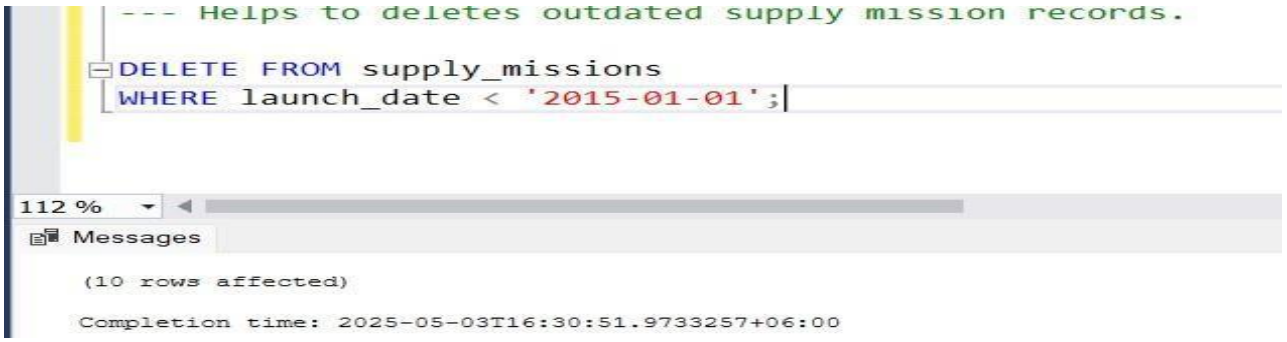
---

12. Modification – DELETE

Query: Helps to deletes outdated supply mission records

```
DELETE FROM supply_missions
WHERE launch_date < '2015-01-01';
```

Screenshot



Explanation: Deletes outdated supply mission records.

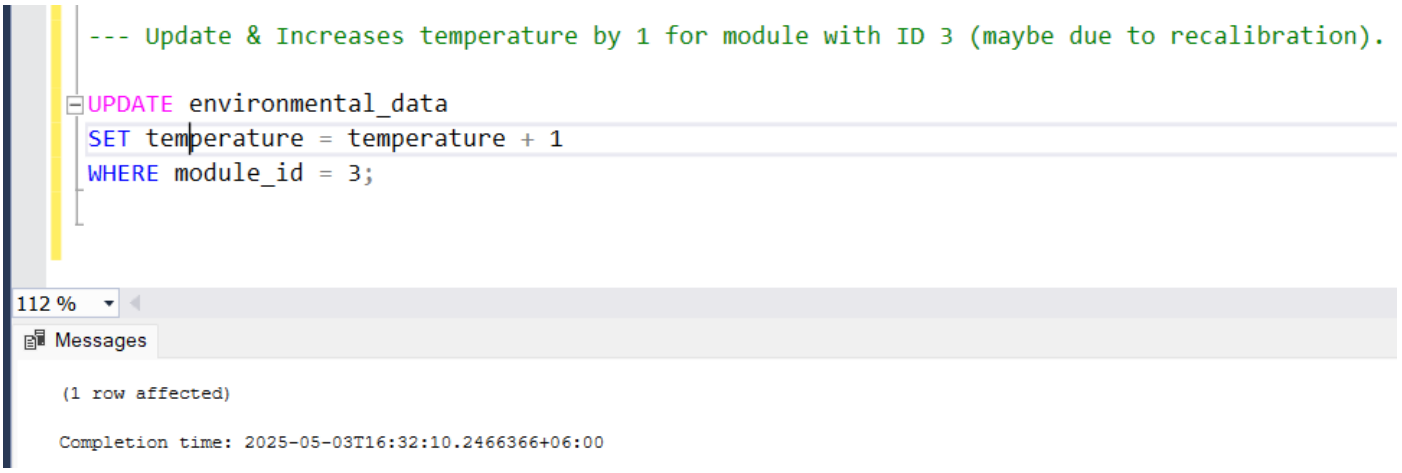
13. Modification – UPDATE

Query: Helps to Increases temperature by 1 for module with ID 3.

```
UPDATE environmental_data
SET temperature = temperature + 1

WHERE module_id = 3;
```

Screenshot



Explanation: Increases temperature by 1 for module with ID 3 (maybe due to recalibration).

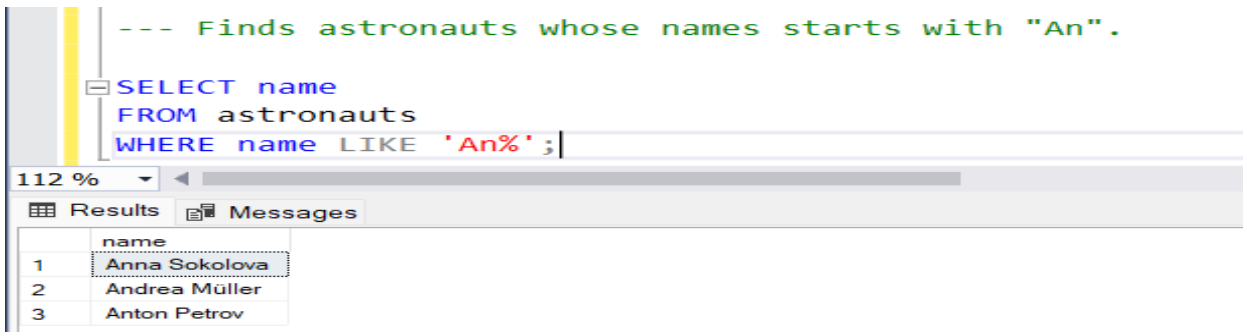
---

14. String Operations

Query: Finds astronauts whose names starts with

```
SELECT name
FROM astronauts
WHERE name LIKE 'An%';
```

Screenshot



Explanation: Finds astronauts whose names contain "An".

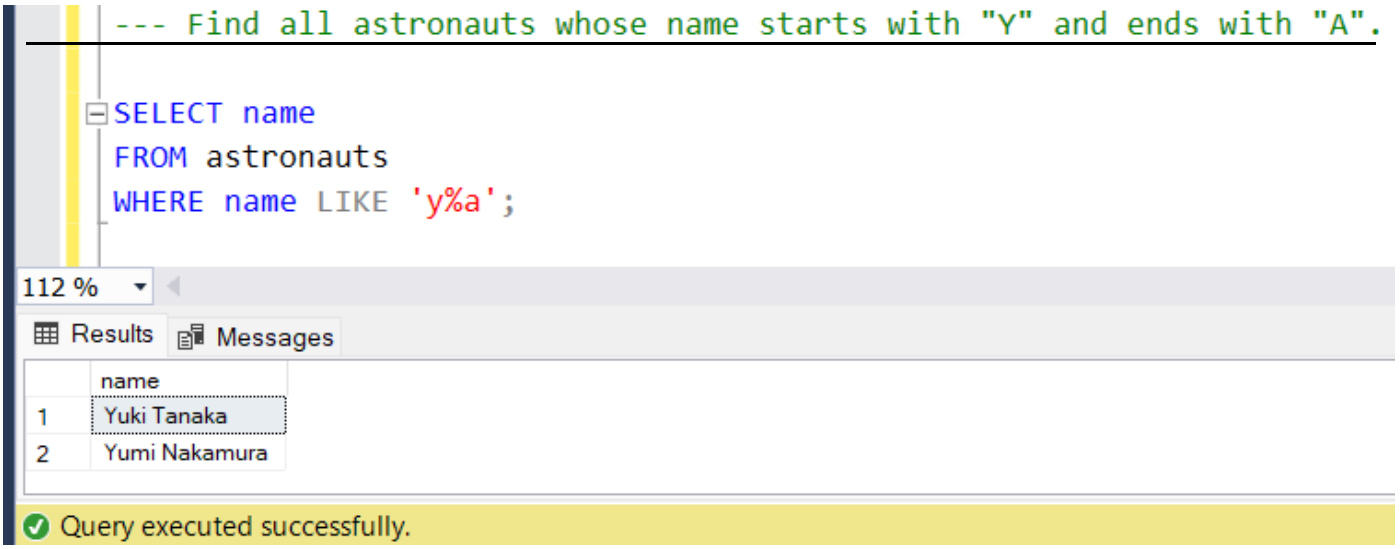
15. String Matching (LIKE)

Query: Find all astronauts whose name starts with "Y" and ends with "A".

```
SELECT name
FROM astronauts

WHERE name LIKE 'y%a';
```

Screenshot



Explanation: Uses % as a wildcard to match names starting with "Y" and ending with "A".

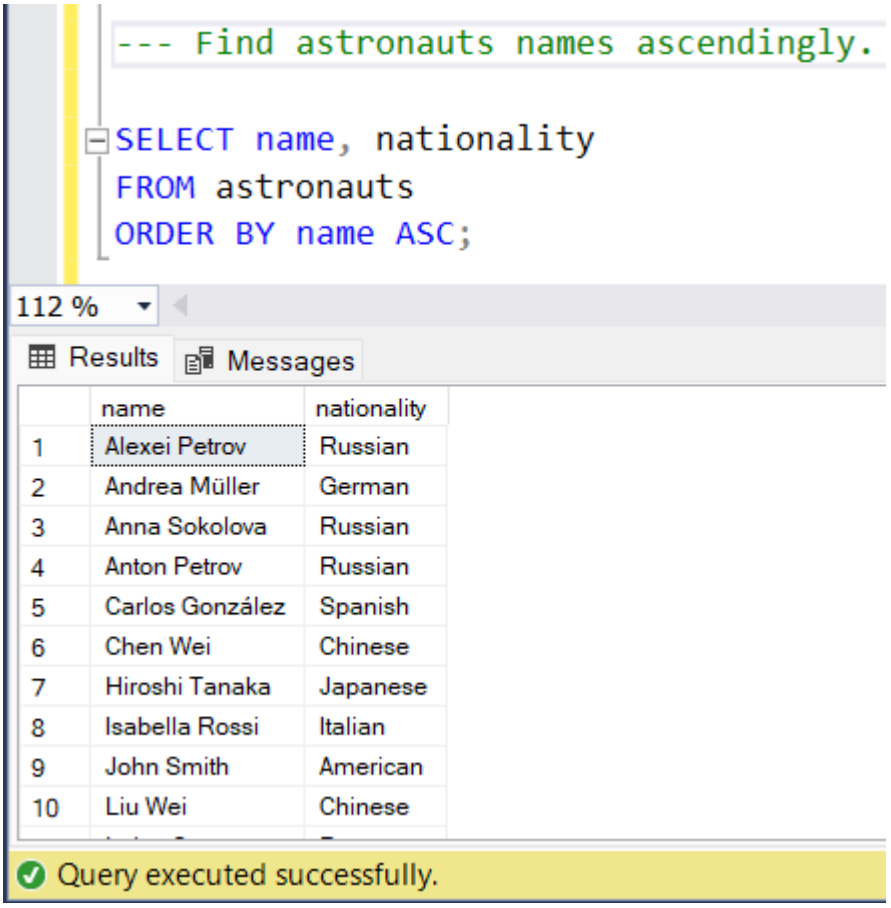
---

16. Ordering Results

Query: Find astronauts names ascendingly.

```
SELECT name, nationality
FROM astronauts
ORDER BY name ASC;
```

Screenshot



Explanation: Lists astronauts alphabetically.

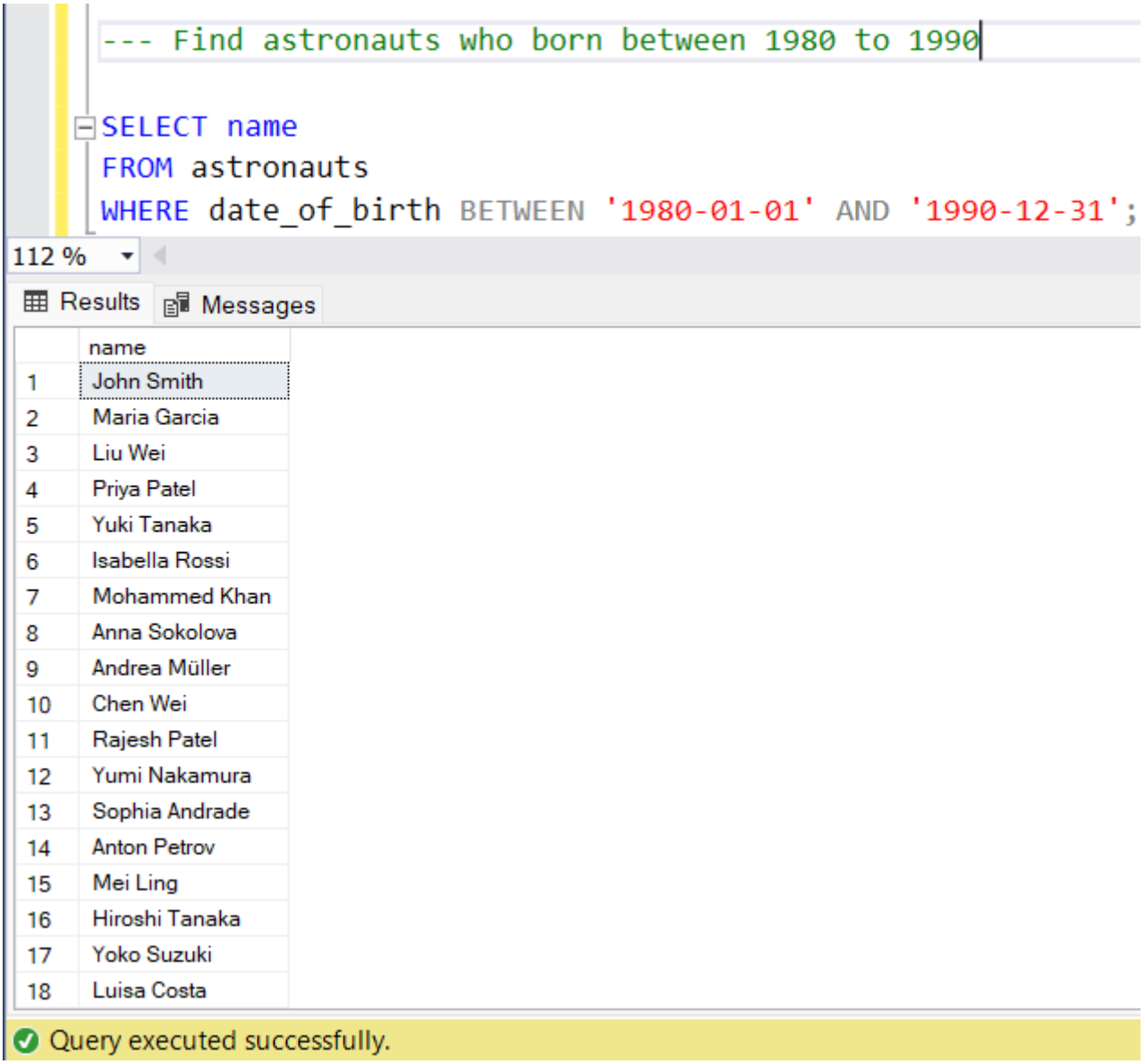
---

17. BETWEEN Operator

Query: Find astronauts who born between 1980 to 1990

```
SELECT name
FROM astronauts
WHERE date_of_birth BETWEEN '1980-01-01' AND '1990-12-31';
```

Screenshot



Explanation: Fetches astronauts born in the 1980s to 1990s.

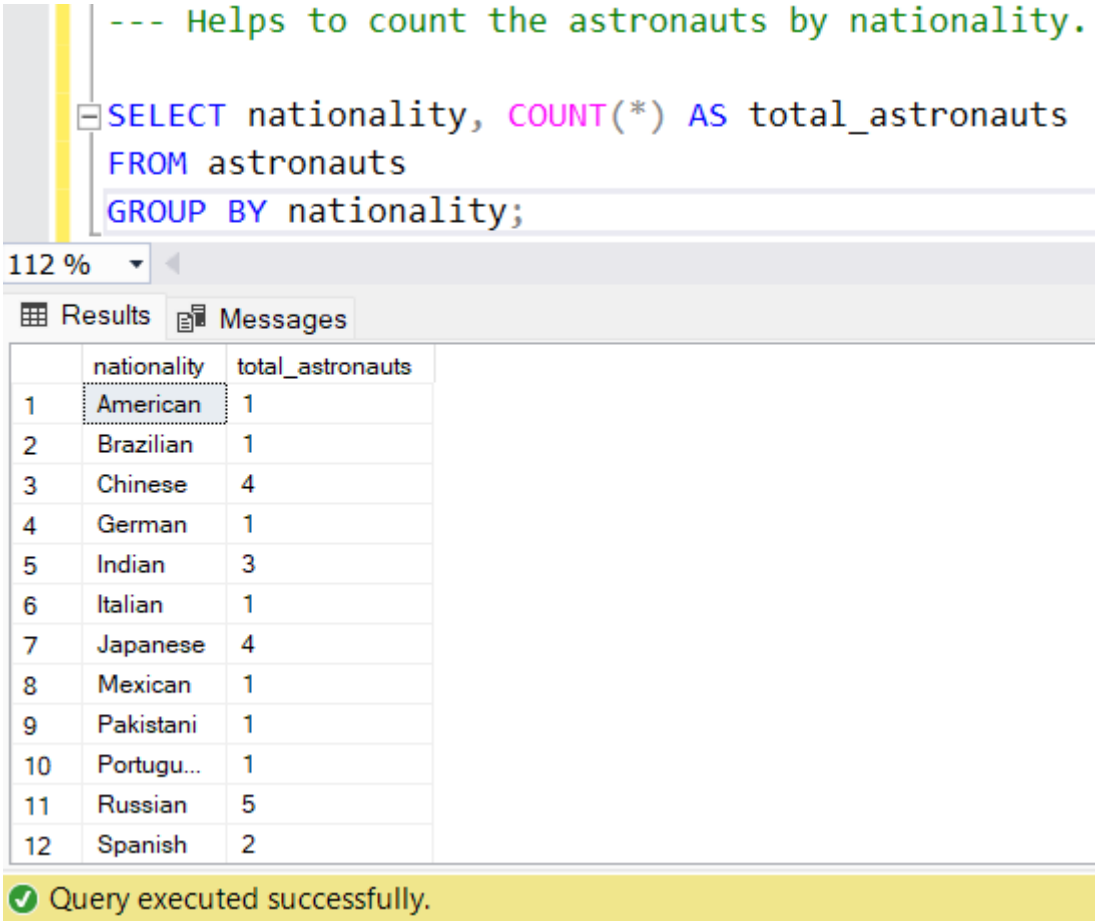
---

18. GROUP BY

Query: Helps to count the astronauts by nationality.

```
SELECT nationality, COUNT(*) AS total_astronauts
FROM astronauts
GROUP BY nationality;
```

Screenshot



	nationality	total_astronauts
1	American	1
2	Brazilian	1
3	Chinese	4
4	German	1
5	Indian	3
6	Italian	1
7	Japanese	4
8	Mexican	1
9	Pakistani	1
10	Portugu...	1
11	Russian	5
12	Spanish	2

Explanation: Counts astronauts by nationality.

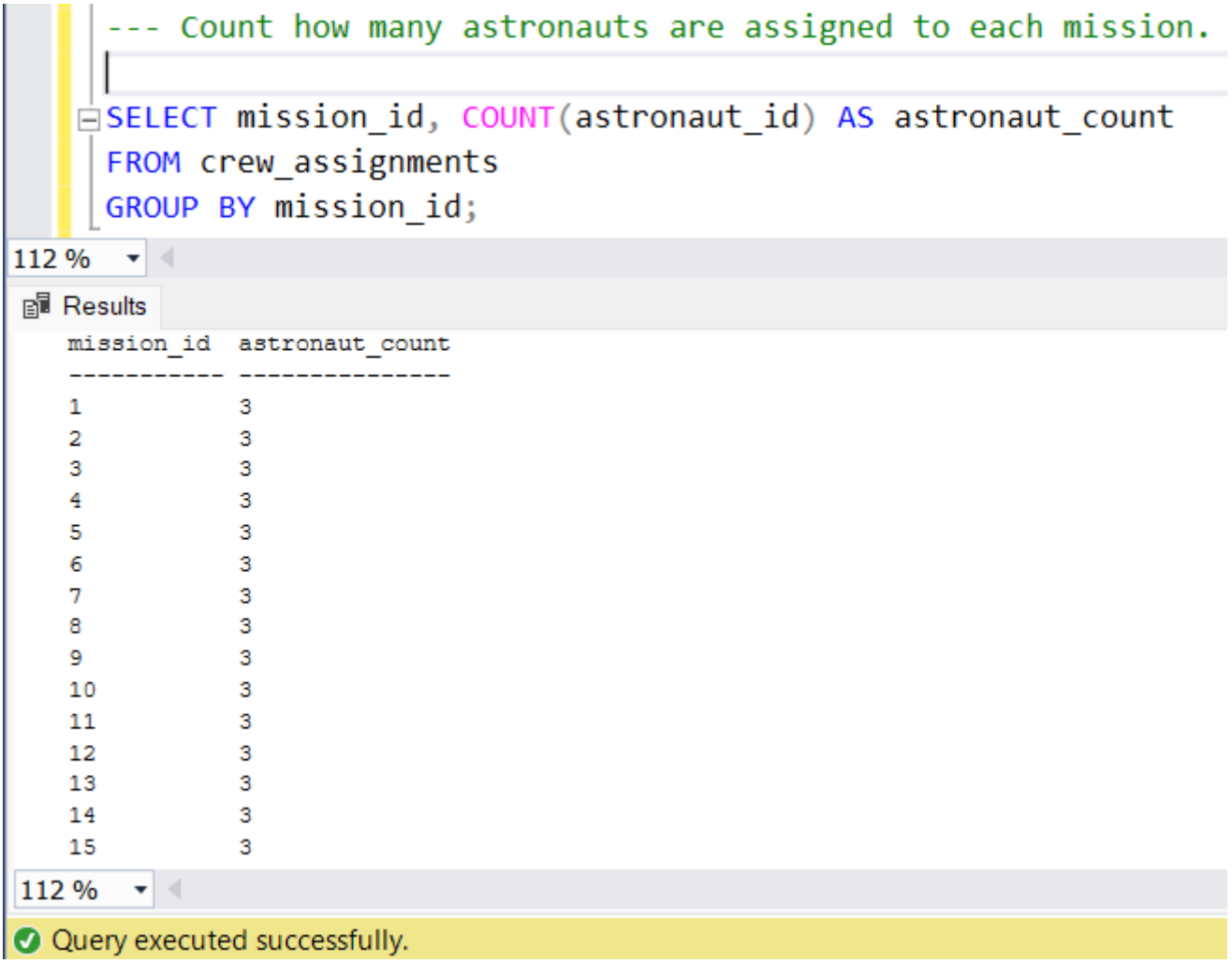
---

19. GROUP BY with Aggregation

Query: Count how many astronauts are assigned to each mission.

```
SELECT mission_id, COUNT(astronaut_id) AS astronaut_count
FROM crew_assignments
GROUP BY mission_id;
```

Screenshot



Explanation: Group records by mission and counts how many astronauts are assigned to each.

---

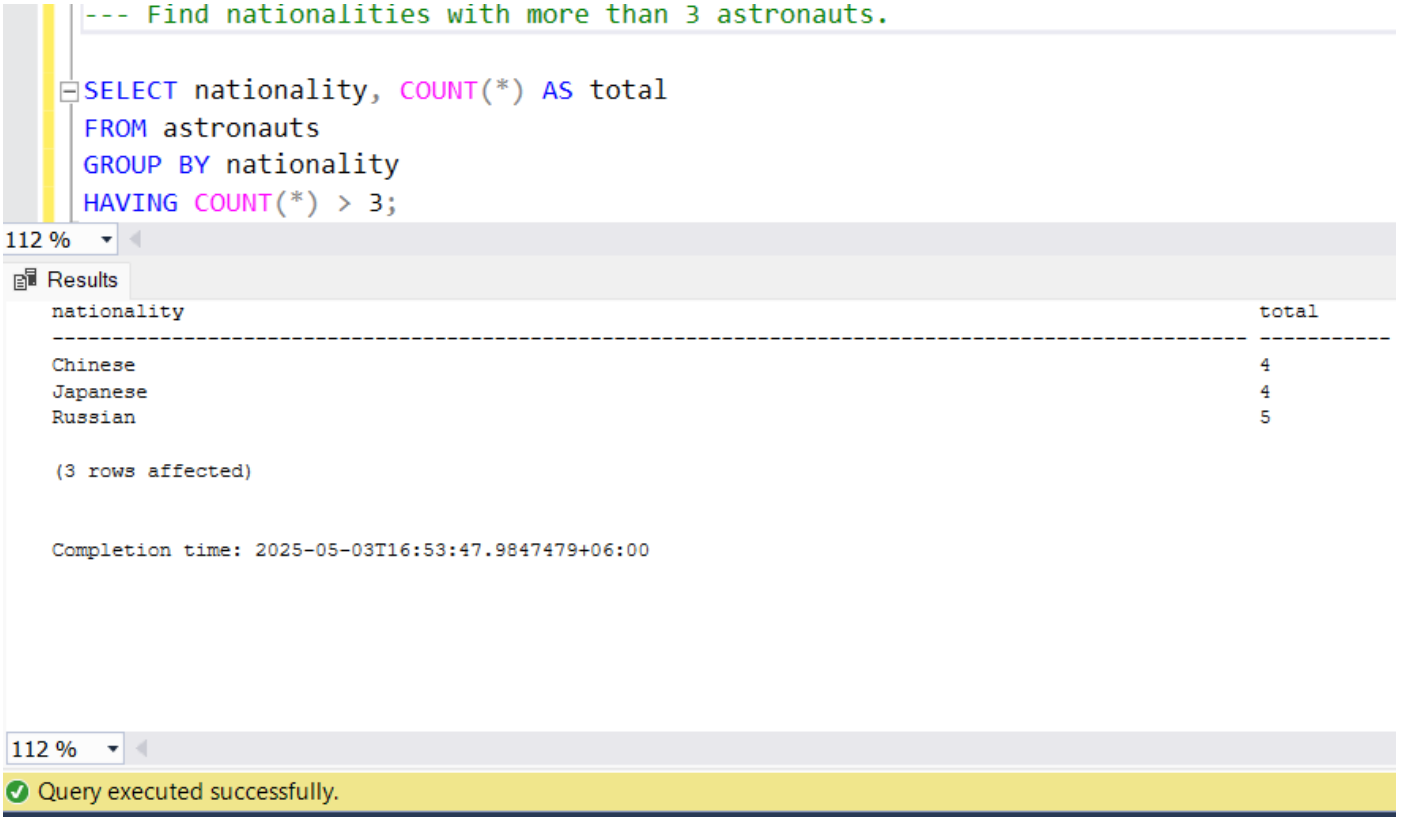
20. HAVING Clause

Query: Find nationalities with more than 3 astronauts.

```
SELECT nationality, COUNT(*) AS total
FROM astronauts
GROUP BY nationality

HAVING COUNT(*) > 3;
```

Screenshot



Explanation: Lists nationalities with more than 3 astronauts.

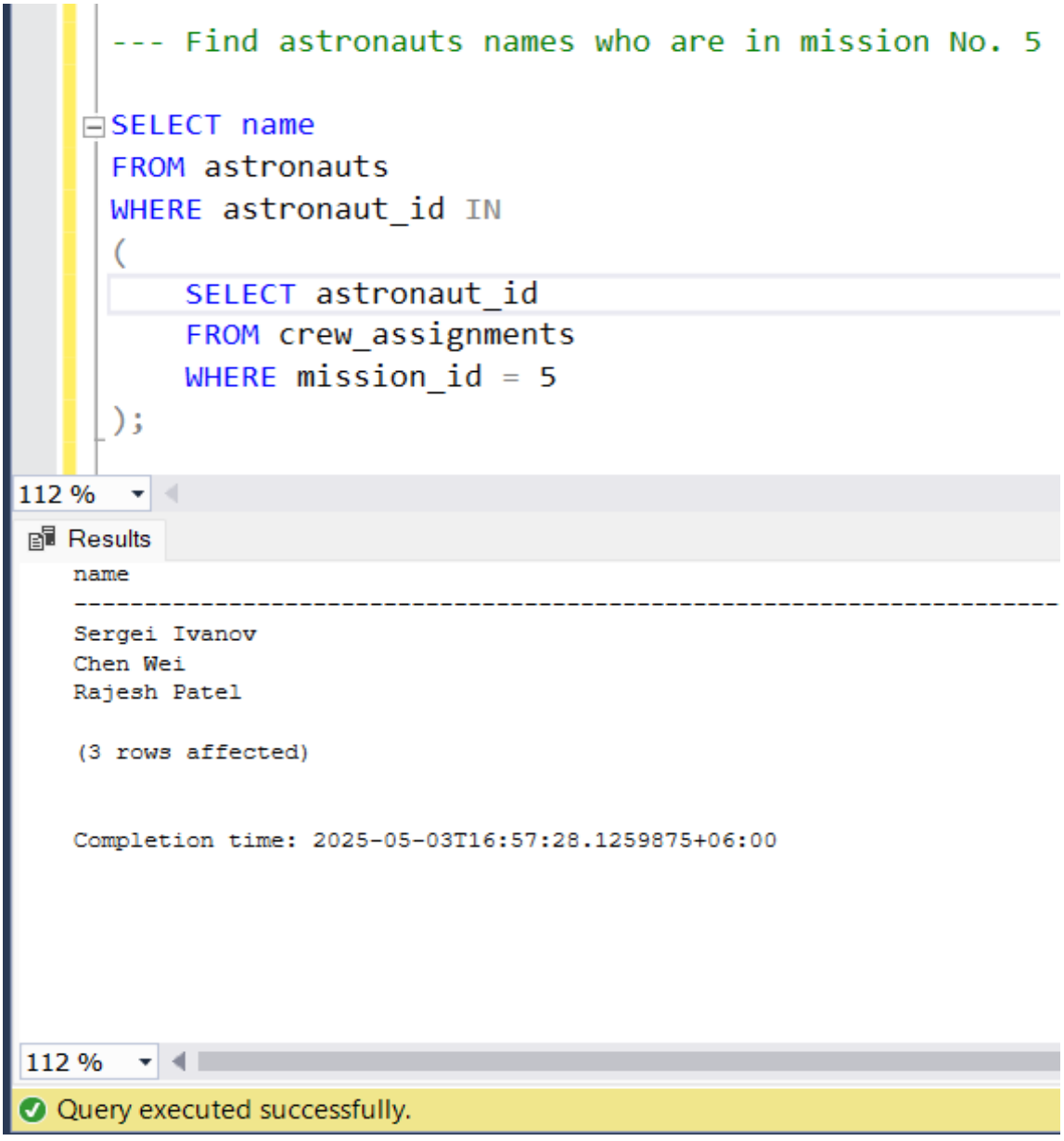
---

21. Subqueries with IN

Query: Find astronauts names who are in mission No. 5

```
SELECT name
FROM astronauts
WHERE astronaut_id IN
(
   SELECT astronaut_id
   FROM crew_assignments
   WHERE mission_id = 5
);
```

Screenshot



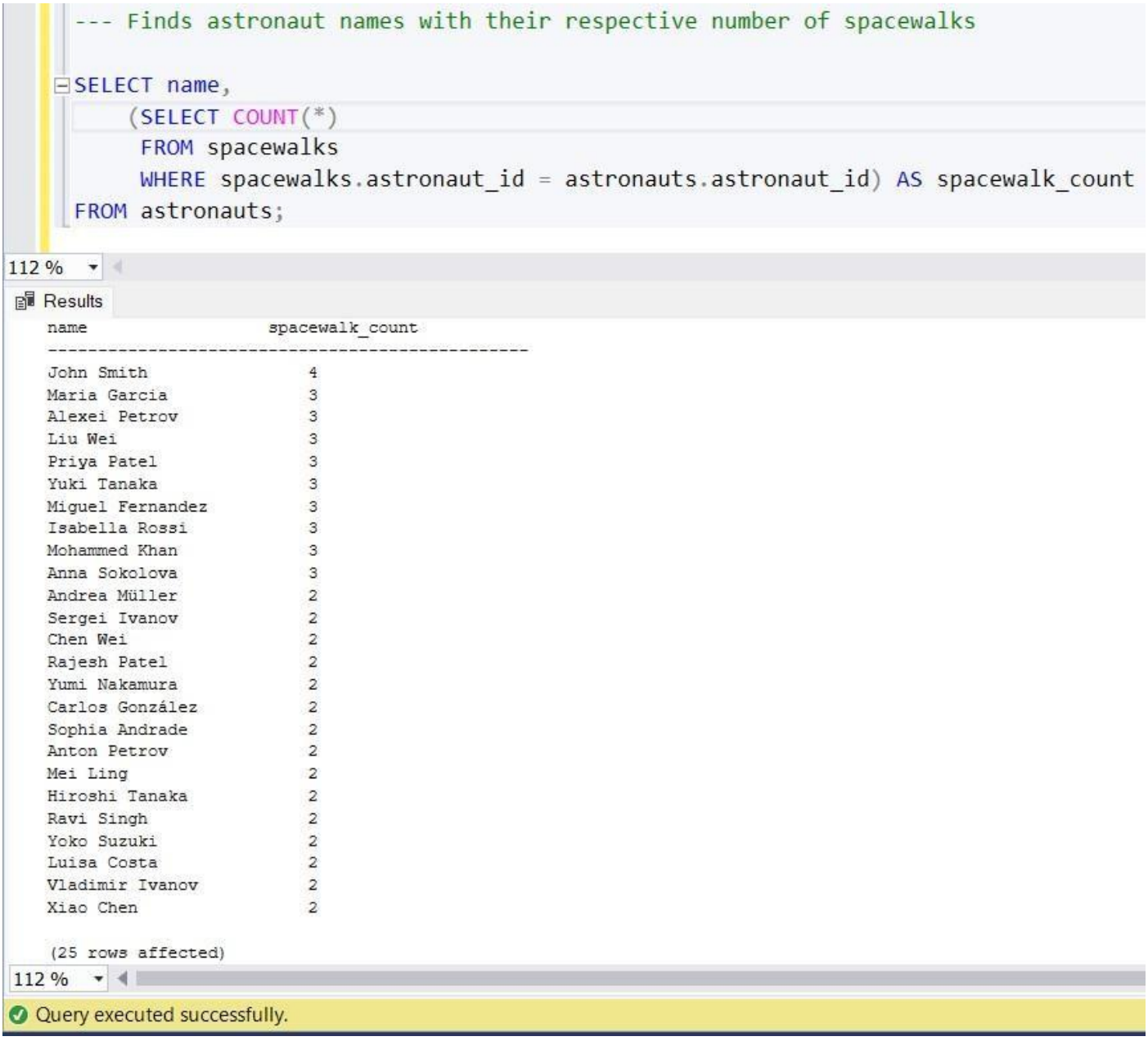
Explanation: Gets astronaut names assigned to mission 5.

22. Scalar Subquery

Query: Find astronaut names with their respective spacewalks numbers.

```
SELECT name,
   (SELECT COUNT(*)
    FROM spacewalks
    WHERE spacewalks.astronaut_id = astronauts.astronaut_id) AS spacewalk_count
            FROM astronauts;
```

Screenshot



```
--- Finds astronaut names with their respective number of spacewalks

SELECT name,
    (SELECT COUNT(*)
     FROM spacewalks
     WHERE spacewalks.astronaut_id = astronauts.astronaut_id) AS spacewalk_count
FROM astronauts;
```

112 %

Results

name	spacewalk_count
John Smith	4
Maria Garcia	3
Alexei Petrov	3
Liu Wei	3
Priya Patel	3
Yuki Tanaka	3
Miguel Fernandez	3
Isabella Rossi	3
Mohammed Khan	3
Anna Sokolova	3
Andrea Müller	2
Sergei Ivanov	2
Chen Wei	2
Rajesh Patel	2
Yumi Nakamura	2
Carlos González	2
Sophia Andrade	2
Anton Petrov	2
Mei Ling	2
Hiroshi Tanaka	2
Ravi Singh	2
Yoko Suzuki	2
Luisa Costa	2
Vladimir Ivanov	2
Xiao Chen	2

(25 rows affected)

112 %

Query executed successfully.

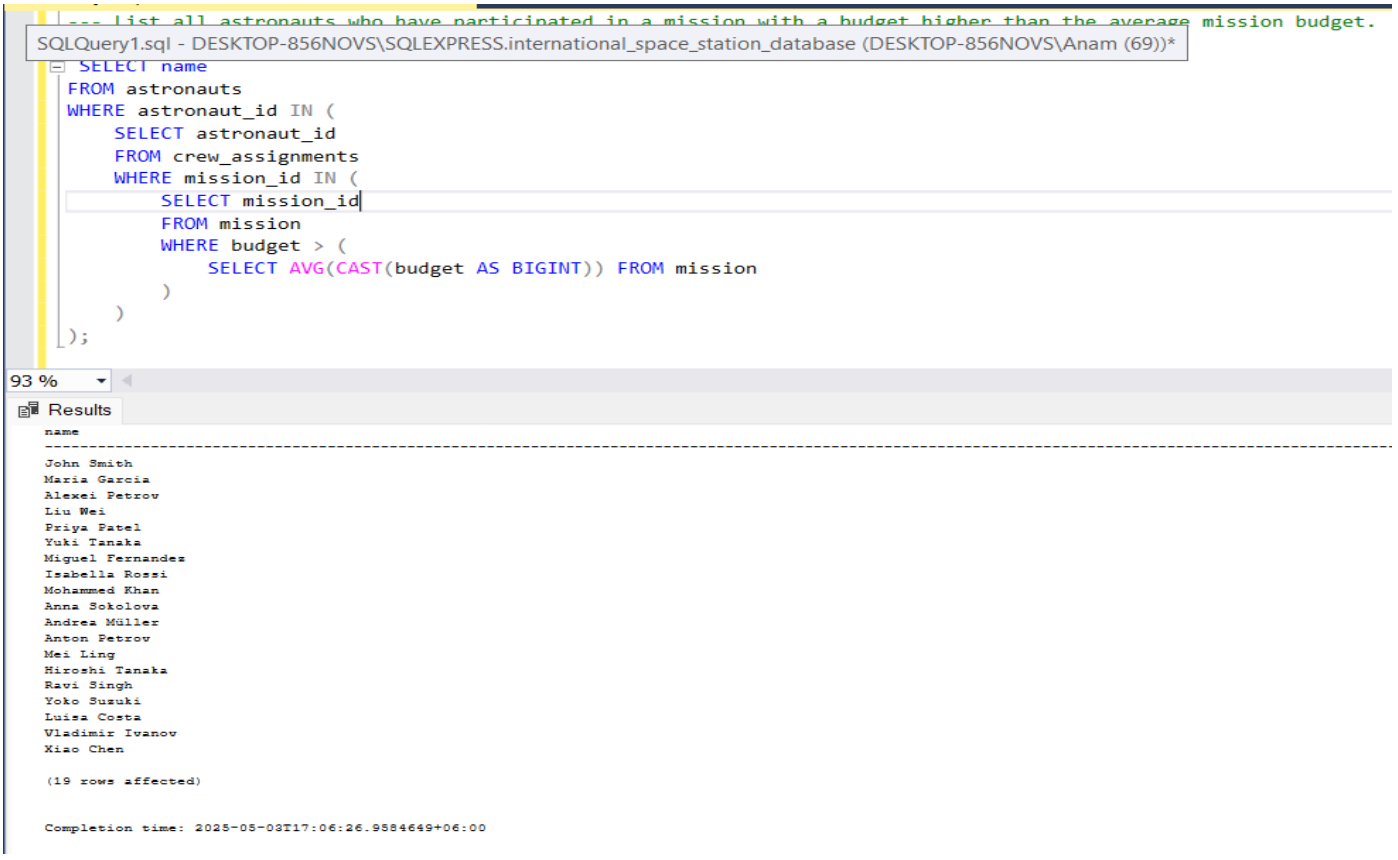
Explanation: Shows astronaut names with their respective number of spacewalks.

23. Subquery

Query: List all astronauts who have participated in a mission with a budget higher than the average mission budget.

```
SELECT name
FROM astronauts
WHERE astronaut_id IN
(
   SELECT astronaut_id
   FROM crew_assignments
   WHERE mission_id IN
(
      SELECT mission_id
      FROM mission
      WHERE budget >
 (
         SELECT AVG(CAST(budget AS BIGINT)) FROM mission
      )
   )
);
```

Screenshot



Explanation: Nested subqueries are used to filter astronauts who were part of higher-than-average-budget missions.

PROJECT MAPPING WITH CEP

Knowledge Profile (K's) Addressed Through Our Project & Mapping Among K's

K's	Attributes	How K's Are Addressed Through Our Project
K2	Mathematics	Conceptual Mathematics and Numerical Analysis Are Utilized in Various Aspects, Such as Calculating Trajectories, Determining Mission Parameters, Calculating Budgets on Missions, and Analysing Experimental Data.
K3	**Engineering Fundamentals**	**A Systematic Formulation of Engineering Fundamentals is Evident in The Design and Operation of Spacecraft Modules, Experiments, and Communication Systems Within the Database.**
K5	**Engineering Design**	**The Project Involves Knowledge Supporting Engineering Design, Exemplified in The Development of The Entity-Relationship (Er) Diagram and Schema Diagram to Represent the Structure of The Database, Facilitating Effective Database Design and Management.**
K6	**Engineering Practice**	**Practical Engineering Knowledge Is Applied in Spacecraft Technology, Demonstrated by The Utilization of MySQL Management, and Query Execution, Showcasing Real-World Engineering Practices in Database Development and Deployment.**
K8	Research Literature	Engagement With Selected Knowledge from the Research Literature is Reflected in The Integration of Research-Based Findings in Experiment Descriptions, Health Record Analyses, and Equipment Specifications.

Complex Engineering Problem (P's) Addressed Through Our Project & Mapping Among P's

P's	Attributes	How P's Are Addressed Through Our Project
P1	**Depth Of Knowledge Required**	**Depth Of Knowledge Required Is Demonstrated Through the Necessity for In-Depth Understanding of Engineering Fundamentals (K3), Practical Engineering Knowledge (K6), And Engagement with Selected Knowledge from Research Literature (K8), Enabling A Comprehensive Approach to Resolving Complex Issues Like Crew Assignments, Module Functionalities, And Equipment Specifications.**
P3	**Depth Of Analysis Required**	**In The Project, Abstract Thinking and Original Analysis Drive the Optimization of Integrity Constraints and Efficiency in Database Management. These Efforts Ensure Robustness and Accuracy, Crucial for Achieving Project Objectives in Space Mission Operations.**
P4	Familiarity Of Issues	The Database Tackles Infrequently Encountered Issues Such as Health Record Management, Spacewalk Scheduling, And Equipment Utilization, Reflecting the Complexity of Real-World Space Missions.
P6	Extent Of Stakeholder Involvement & Conflicting Requirements	Diverse Stakeholder Involvement and Conflicting Requirements Are Managed Through the Allocation of Crew Assignments, Coordination of Supply Missions, And Integration of Research Equipment, Reflecting the Multifaceted Nature of Space Exploration.
P7	**Interdependence**	**High-Level Problems with Many Component Parts Are Addressed Through the Management of Spacecraft Systems, Coordination of Missions, And Execution of Experiments, Illustrating the Interdependence of Various Subsystems in Space Operations.**

Complex Engineering Activities (A's) Addressed Through our Project & Mapping Among A's

A's	Attributes	How P's Are Addressed Through Our Project
A1	**Range Of Resources**	**The Project Involves the Utilization of Diverse Resources Such as Astronaut Skills, Spacecraft Equipment, Experiment Materials, And Mission Budgets, Demonstrating the Range of Resources Required for Space Exploration.**
A2	**Level Of Interaction**	**Significant Interaction Is Required to Resolve Problems Arising from Spacecraft Operations, Crew Assignments, And Experimental Setups, Highlighting the Complexity of Managing Space Missions.**
A3	Innovation	Innovation Is Evident in The Creative Use of Engineering Principles and Research-Based Knowledge to Develop Novel Solutions for Spacecraft Design, Mission Planning, And Experiment Execution.
A5	**Familiarity**	**The Project Extends Beyond Previous Experiences by Applying Principles-Based Approaches to Address Challenges in Space Exploration, Indicating the Project's Contribution to Advancing the Field of Aerospace Engineering.**