Section 1:Final Version Of SRS

Software Requirements Specification

for

SPACE AGENCY DATABASE

Version 3.0 Final

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Introduction

1.1 Purpose

1. Our System will keep track of all old missions,current missions and future missions launched by our space agency ISRO.
2. Our system will keep track of satellites, it's objectives, overall functionality and it's real time position.
3. Also, we will keep track of important exoplanets which have the potential of earth-like-characteristics and potential life; which will aid in future exoplanetary missions.
4. Also all the important exoplanetary objects such as black holes, stars, big asteroids which are under observations because of their unique behaviour and their potential to impact the nearby galaxies in any way will also be documented in the system along with their detailed description.
5. We will also keep a functionality which enables scientists to automatically get notified about some new event in the exoplanetary objects specified above. This will include, asteroids coming very near to earth, supernova explosions, change in strength of blackholes and more.
6. Also, various experiments being conducted by rovers, satellites will also be mentioned in the system.
7. The system will be part wise accessible to ISRO personnel according to their clearance.

1.2 Intended Audience:

This SRS document is intended for database and website developers, the project manager, section managers and system testing team. This will also be available to read for ISRO scientists and researchers; as they can understand how the system works and contribute to this project as well.

What does this SRS have?

1. This SRS document contains the purpose, Overview of the working of the system, it's functionality, operating environment, design and idea how to implement it.
2. It also contains detailed information about the system design comparing our system with some other already existing systems.
3. This system doesn't already exist but exists as different piecewise systems; Our goal will be to integrate different functionalities into one single system.

1.3 Reading Suggestions:

This document is divided into various sections:

1. Purpose and Overall Description: This is for all the people working on making this system and anyone new who wants to know about this project/system.
2. Overall Description: Will contain how the system functions, who will use this system, in which front end and back end will the system work and assumptions System Features.

1.4 Product Scope:

- Keep track of satellite health, positions and services.
- It should also keep track of stars, planets, black holes, moving stars, big asteroids and notify the scientists when some event occurs, or alert about the future collisions with earth or other entities.
- This system should be able keep track of their experiment and outcomes.
- When needs arise different agencies should be able to work-together to complete the mission by sharing information from this system.
- We are going to make a product which will carry data about ISRO missions name,launching data,launching vehicle and mission outcomes.
- This system can be used to share data to various private sector space agencies on a controlled basis by making them pay a fee for the same.
- Also, other space agencies can collaborate on similar objectives of some missions and save money and manpower.

2. Overall Description

2.1 Product Description

- The name of the project is “Space Agency Database”.
- The name of the product is “xyz.
- This system will be a new product which is not a replacement of any other existing system instead will work alongside them. This won’t be an independent system.
- This system will depend on eportal of ISRO i.e, ISTRAC, etc.
- For data will be updated on the system only if the data on above portals is updated. For independent updation of data, this system will require access to ISRO servers; which right now is not an product objective.

- The tables distribution as follows:
    - A table for a list of satellites with a separate table for each satellite containing relevant information all in the schema “SAT”.
    - A table for current missions with each separate table having information about mission progress recorded at a regular time interval; all in schema “MISSIONS”.
    - Separate tables for black holes, stars, exoplanets and big asteroids with relevant information; all in schema “EXO”.
    - A table for keeping track of Near Earth Objects in schema “NEO”.

2.2 Existing Systems

1. https://solarsystem.nasa.gov/missions/?order=launch_date+desc&per_page=50&page=0& search =&fs=&fc=33&ft=&dp=&category=33

- This system/website focuses on NASA’s. missions to study planets, moons, asteroids, comets, etc
- It also has a filtering mechanism which has a type of satellite/ rover, location based filtering like; Kuiper Belt, Sun, Oort cloud, etc.
- It also shows past, active and future missions.

2. https://www.nasa.gov/open/data.html

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- Just typing a keyword in the search box provides us with each of the links on the web available on that particular keyword.
- It gives us plenty of news articles, nasa links related to it, links to videos and much more. It is very different from the system which we are making, but it gives us an idea about the front end of our database from a civilian point of view.

3. https://directory.eoportal.org/web/eoportal/satellite-missions/space-agencies
   This is a list of space agencies that own, fund or are involved in the missions. To see which missions each agency is associated with, click on the link. This includes information about the Space agency, their respective country, agency website and information about their missions.

4. https://www.isro.gov.in/list-of-spacecrafts
   From this system we got the idea what type of columns will be there in our database and how the data is organised including launch vehicle, launch date and objective/application.

2.3 Real World Flow and Working

- The system is intended to give immediate information about the data asked and inputs from the user will be like start date-time, end date-time and selected attributes. The dates are required because each tuple will be associated with a time stamp; as the data will be updated live.
- The system should be able to send its data to other already existing ISRO systems for computations and calculations. Our system won't do that on it's own.
- The only calculations it will do is that if a celestial object comes very close to earth then it will give an alert message.
- The issues can be data asked and haven't been updated yet from the live data stream due to server issues and it is being queried by the user. This will show an error message, data will be shown soon. Server under maintenance.
- Another issue is that users can ask for data from outside its list of privileges; then as all the people are to be respected and someone's point of view shouldn't hurt; some good appropriate output should be there. The user may be in need of that data in urgency; so there should be some mechanism to handle such requests optimally. We haven't thought this out yet.

2.4 User Classes and Characteristics

The users will be differentiated on the level of responsibility they have in the organization (ISRO).

The user classes can be:

Mission Control:

Mission Manager: This user will have access to the mission data from the particular satellite and can reposition or reconfigure satellite based on current requirements.

Mission Member: Will have access to mission data only.

Satellite Control:

Satellite Manager: All exclusive access to particular satellite data and over it's control.
Satellite Member: Will have access to data from satellite for analysis.

Black holes/asteroids/Exoplanet Researcher:

Will have access to data from satellites from this particular domain only.

NEO Department:
The users (researchers, scientists, managers) will have access to the NEO database of objects which are undergoing study.

NEO Threat Assessment Department:
The users here will have privilege to *raise alerts* and ask for additional data from other satellite databases along with the access as specified above.

Satellite Repair and Troubleshooting Department:
The users here will have access to satellite health data and have privilege to raise alerts accordingly.

3. Background Readings

3.1 Description of some readings

We read everything online, from various ISRO websites which had information about

1. Missions: Like launch vehicle, launch date, orbit type, payload and application.
2. Satellites: Launch date, launch mass, launch vehicle, orbit type. Additional information like current position, health and other data not available.
3. Real time tracking available but it is how much reliable is not known. The website (mentioned below) gives NORAD ID, Latitude, Longitude, Altitude and current speed.
4. We also read about some automated networks of telescopes like HATNet which tracks extrasolar planets.
5. The Jet propulsion Laboratory of California Institute of Technology has CNEOS: Centre for Near Earth Objects Studies. It has impact risk data which includes year range, impact probability, estimated diameter of the object, estimated velocity, etc.

The links for the data read above respectively:

1. https://www.isro.gov.in/all-missions-0
2. https://www.isro.gov.in/spacecraft/list-of-earth-observation-satellites
3. LIVE REAL TIME SATELLITE TRACKING AND PREDICTIONS: BEIDOU 3 G2
4. HATNet Project - Wikipedia
5. Sentry: Earth Impact Monitoring

ISRO

Mock Interview 1

Summary

System: Space Agency Database
Project Reference: Number 10
Interviewee: Hetvi Patel(**Role Play**)
Designation: Scientist/Engineer-H (in) AstroStat Mission

Interviewer:
1) Divyesh Rohit(**Role Play**)
Designation: Business Development Executive DSQL Solutions

2) Tulsi Shah(**Role Play**)
Designation: Developer - DSQL Solutions

Date: 29/09/2020 **Time:** 14:30 Hrs

Duration: 45 minutes **Place:** Ms. Patel's Office, ISRO

Purpose of Interview:

Preliminary meeting to identify problems and requirements regarding the new system being created for ease in access to mission data to ISRO's scientists.

Observations and recommendations by Ms. Patel:

1. Only current mission details being showbiz not of much use to us. Actual details like objective completion, new findings, budget used, failures, successes, mission system health details, instrument health, satellite/payload health, etc should be added.
2. Make a separate schema for civilians to access data which has no sensitive information about ongoing missions.
3. Proper privileges should be used for the users; which will be decided by the mission leader/department head/ the secretary/ the director only.
4. Data of required space elements like satellites, rovers should be accessible by mission control without any authorization from satellite division.

Further discussions needed after some work on the system is done.

ISRO

Mock Interview 2

Summary

System: Space Agency Database
Project Reference: Number 10
Interviewee: Nazeem Siddique (**Role Play**)
Designation: Distinguished Scientist (in) EXO DIvision
Interviewer:

1) Skand Vala(**Role Play**)
Designation: CEO Business Development Executive DSQL Solutions

2) Divyesh Rohit(**Role Play**)
Designation: Business Development Executive DSQL Solutions

Date: 30/09/2020 **Time:** 16:00 Hrs

Duration: 60 minutes **Place:** Mr. Siddique's Office, ISRO

Purpose of Interview:

Preliminary meeting to identify problems and requirements regarding the new system being created for ease in access to EXOP Division of ISRO.

Recommendations from Mr. Siddique :

1. There should be an open source table accessible by anyone who wants to report a new planet discovery. The person has to give all the information like Name, Address, AU distance, location in the celestial coordinate system.
2. Then it should be verified by the current database of exoplanets which is separate and verified by ISRO. If the planet is not there, then if it has some special features which will be notified to the system by an EXO executive, the planet will be added to the main list.
3. (He was quite busy at the moment and asked for a follow up interview next week if he gets any new ideas)

ISRO
Mock Interview 3
Summary

System: Space Agency Database
Project Reference: Number 10
Interviewee: Chintan Senapati (**Role Play**)
Designation: Deputy Associate Administrator
Interviewer:

1) Skand Vala(**Role Play**)
Designation: CEO Business Development Executive DSQL Solutions

2) Janvi Patel(**Role Play**)
Designation: Database System Expert DSQL Solutions

Date: 01/10/2020 **Time:** 10:00 Hrs

Duration: 30 minutes **Place:** Admin Building, ISRO

Purpose of Interview:

To assess how the user classes are divided in the ISRO and how the privileges are distributed and how to share data with other agencies.

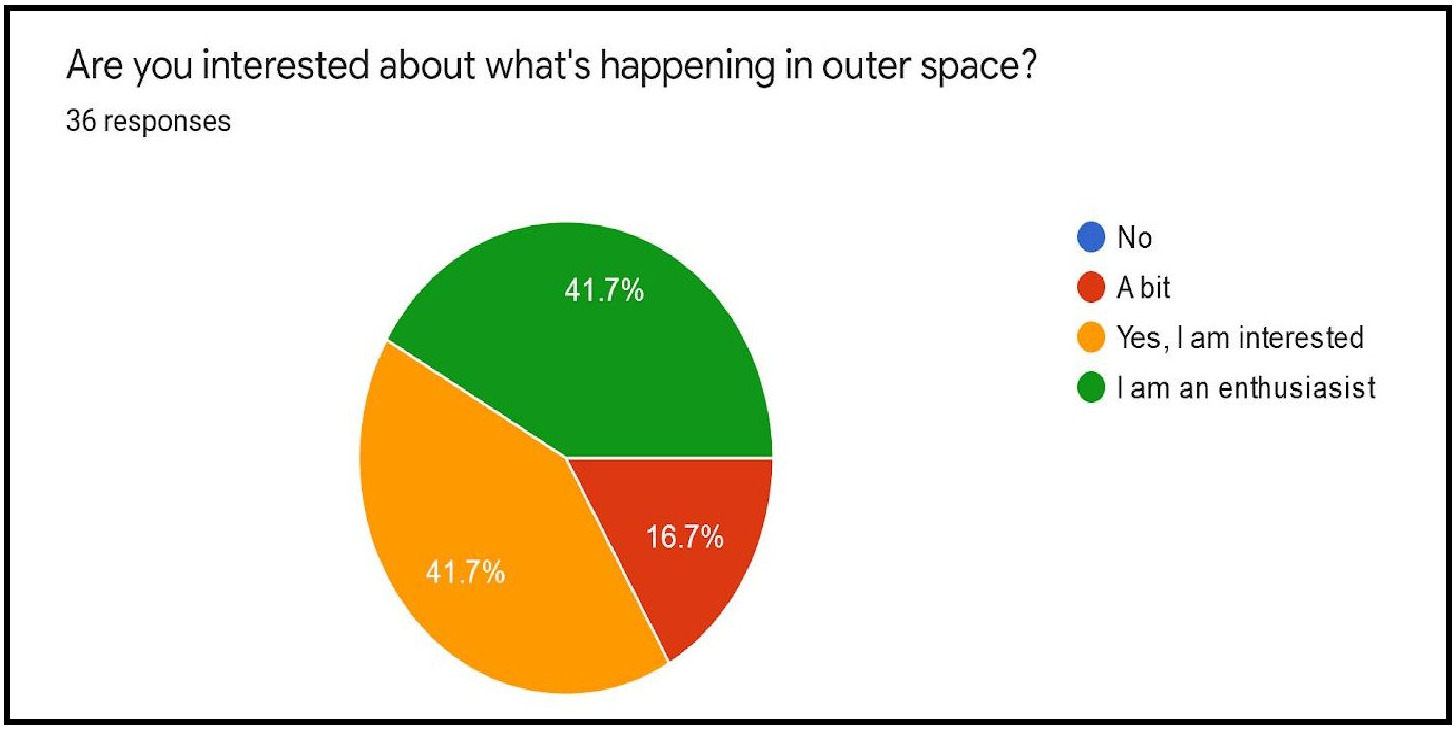
Points to be considered very carefully told by Mr. Senapati:

1. The users are divided into three groups: Admin department, directorates and members of the directorates.
2. The data from hier classes cannot be accessed by below ones, and if needed that is only if there is a separate table for such users with extra privileges that also for the mentioned time period.
3. The sharing of information among various departments has to be documented in a separate table to keep track of information being shared.

Survey Analysis

Q1) Are you interested about what's happening in outer space?

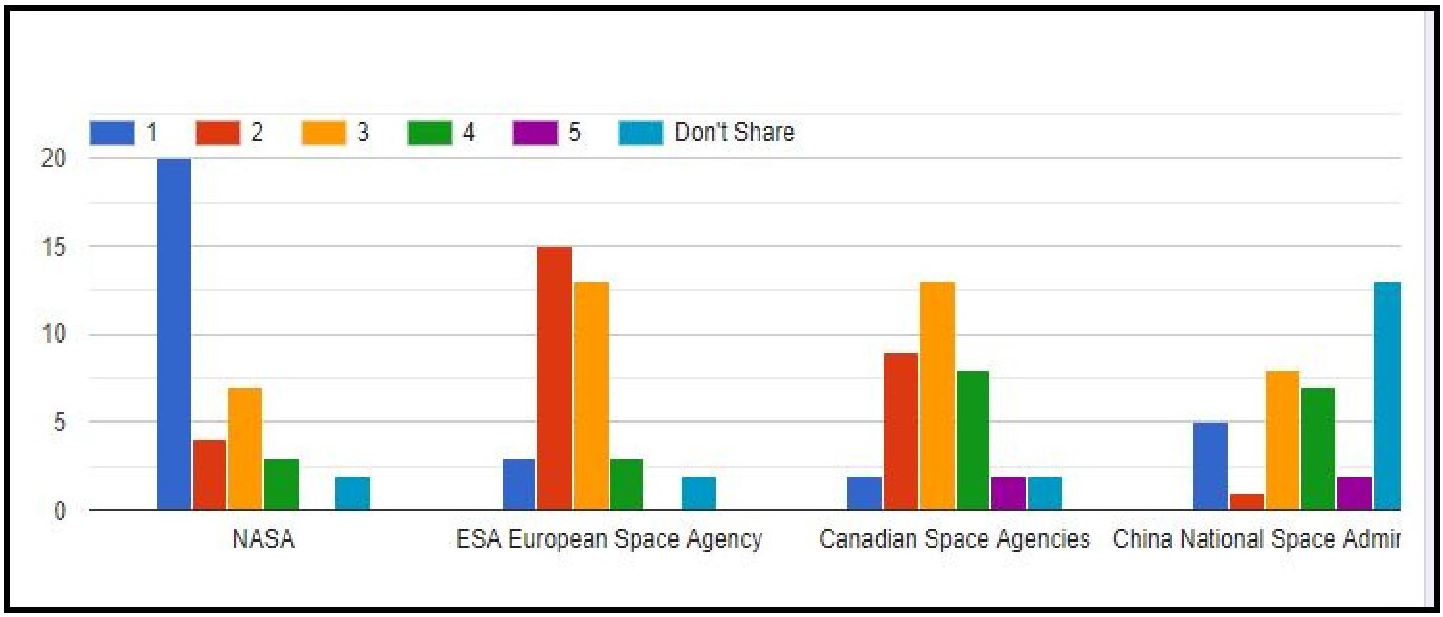
A. No
B. A bit
C. Yes, I am interested
D. I am an enthusiast
E. Other:

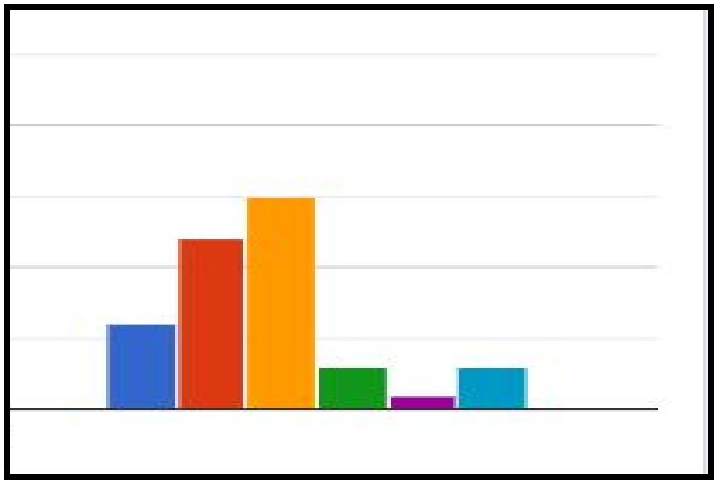


Q_2) Should ISRO share their mission findings and experimental outcomes with what other space agencies? Choose ranking for each Organization.. Number of responses:

- NASA
- ESA European Space Agency
- Canadian Space Agencies
- China National Space Administration
- Japan Aerospace Exploration Agency

Answer in 1 to 5 and Don't Share

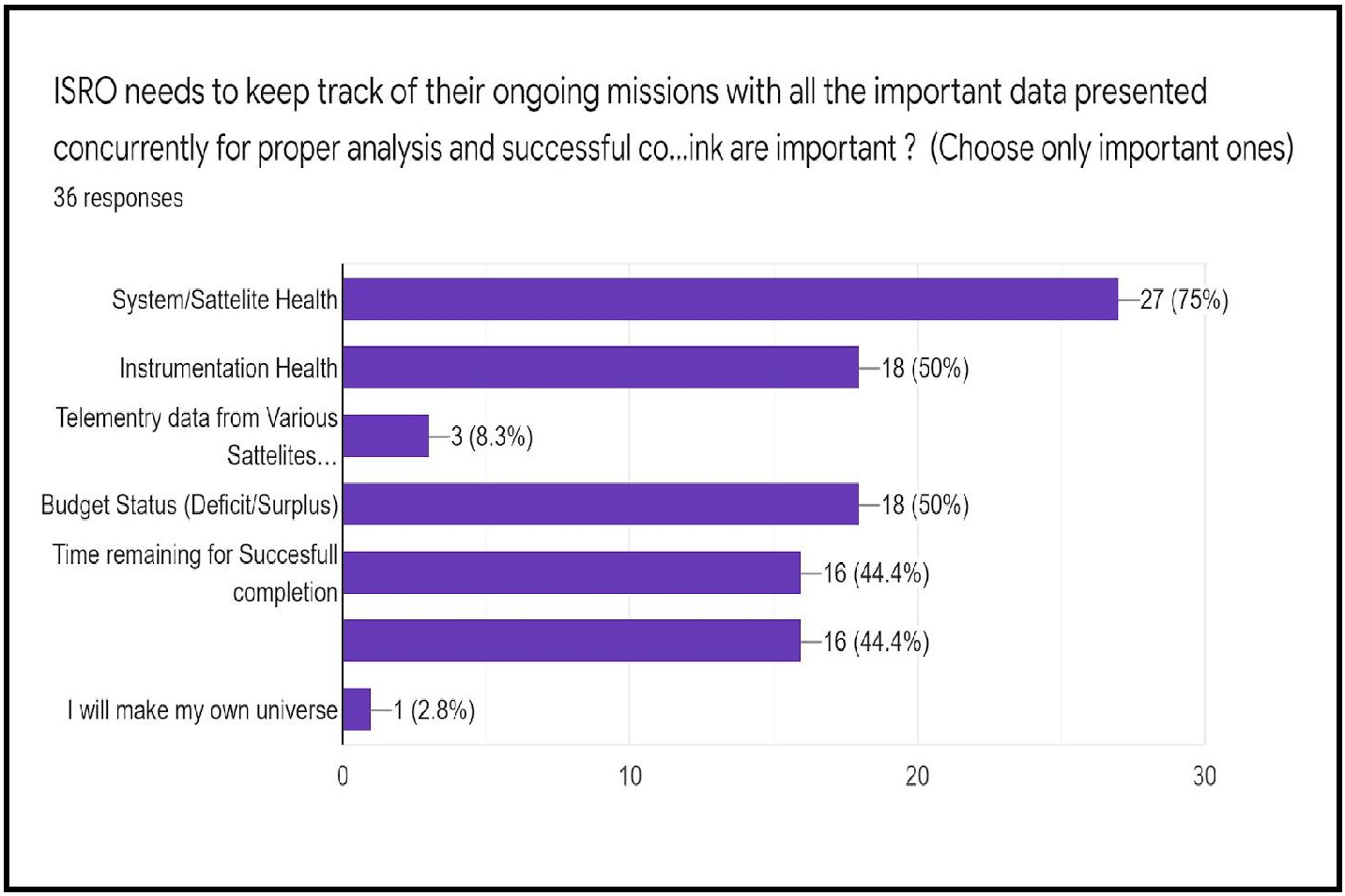




Japan Aerospace Exploration Agency

Q_3)ISRO needs to keep track of their ongoing missions with all the important data presented concurrently for proper analysis and successful completion of objectives. Which ones you think are important ? (Multiple choice)

A. System/Satellite Health
B. Instrumentation Health
C. Telemetry data from Various Satellites like Velocity, disturbance, etc
D. Budget Status (Deficit/Surplus)
E. Time remaining for Successful completion



For the above question if you have any other thoughts.

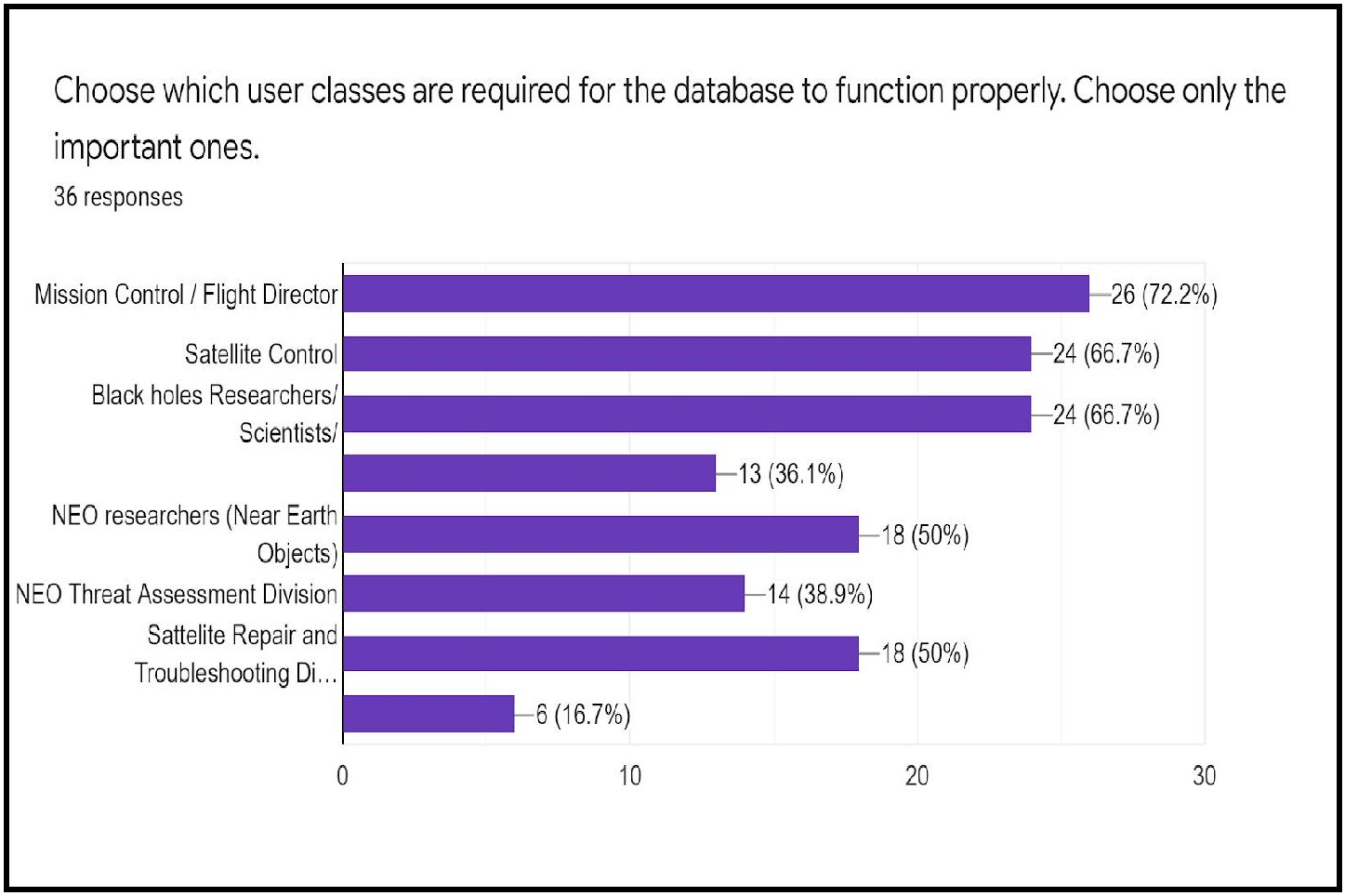
Some Thoughts

1. Tracking of celestial entities will be helpful for scientists.
2. We should make ties with SpaceX.

Q_4)Choose which user classes are required for the database to function properly. Choose only the important ones. (Multiple choice)

A. Mission Control / Flight Director
B. Satellite Control
C. Black holes Researchers/Scientists/
D. Exoplanets Researchers/Scientists/
E. NEO researchers (Near Earth Objects)
F. NEO Threat Assessment Division

G. Satellite Repair and Troubleshooting Division
H. Other:

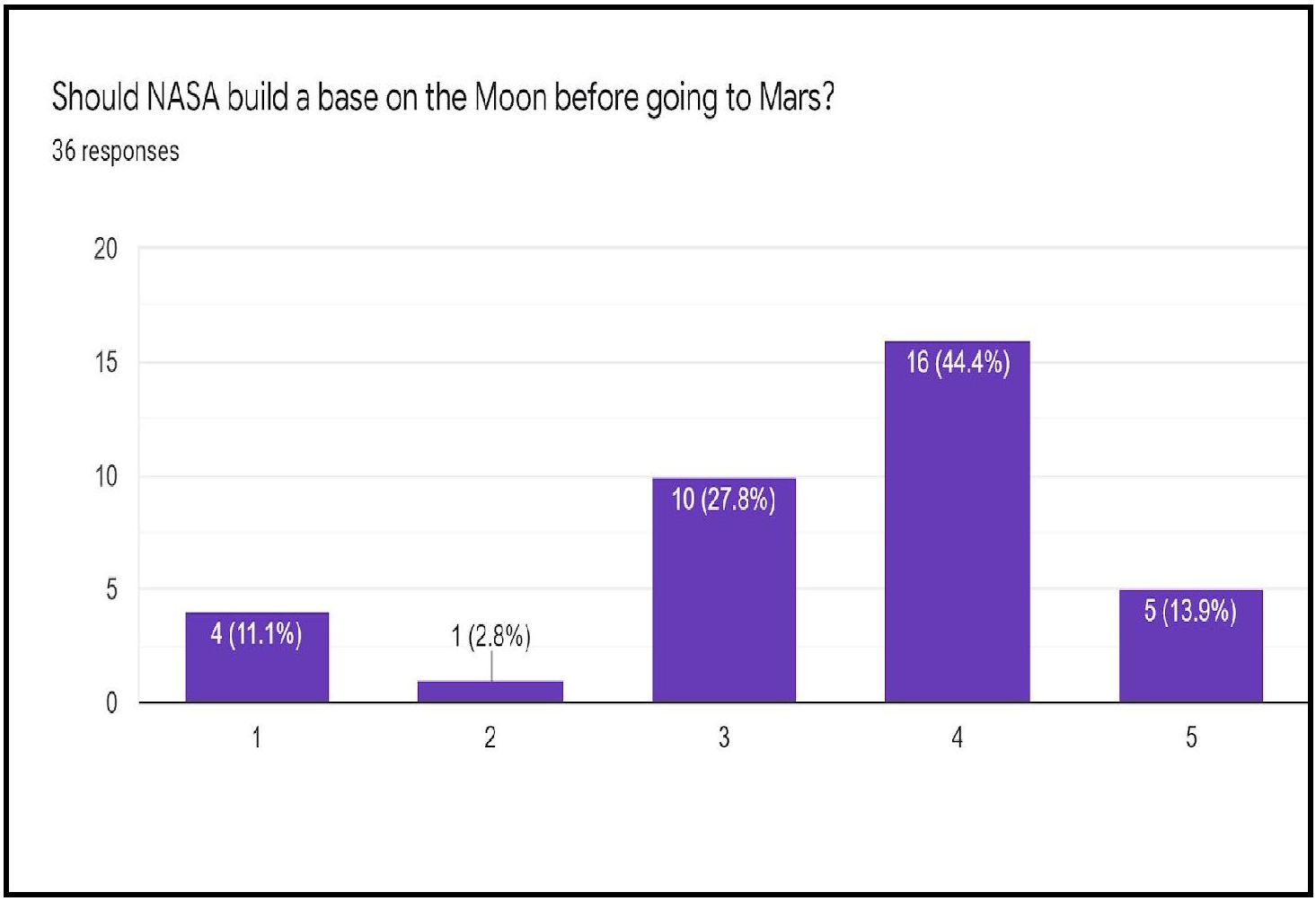


For the above question if you have any other thoughts.

No response came here.

Q_5)Should NASA build a base on the Moon before going to Mars?
(give rating between 1 to 5)

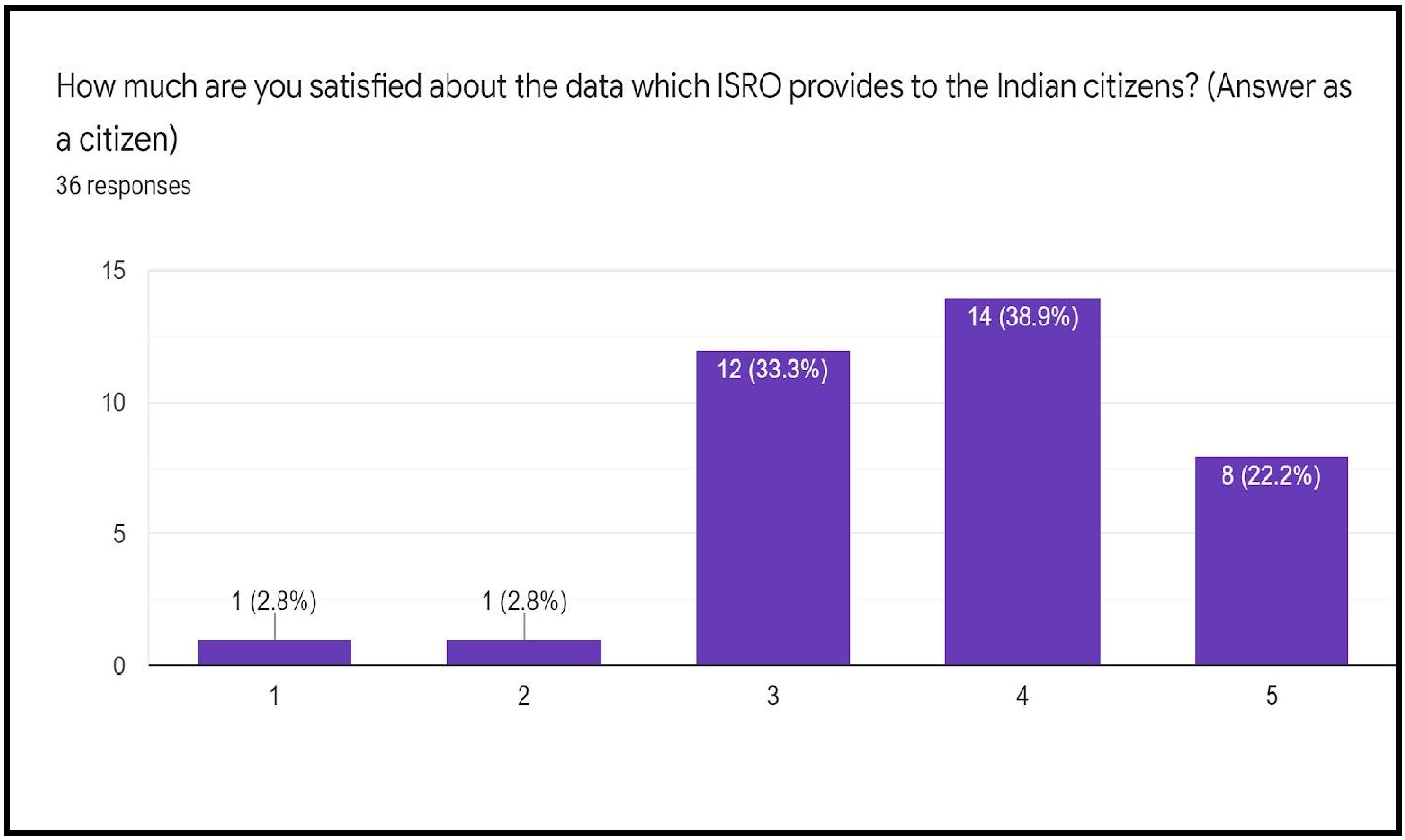
1-strongly disagree….5-strongly agree



Q_6)How much are you satisfied about the data which ISRO provides to the Indian citizens? (Answer as a citizen)

(give rating between 1 to 5)

1- Very Dissatisfied….5-Satisfied



Q_7) If you have any thoughts about the data which should be shared by ISRO to the civilians please let us know below, as it is part of project objective.

Some thoughts came here. We have covered it into Observation.

Observation

From survey we observe below things

- Maximum people(80%) are interested in what's happening in outer space.
- Maximum number of people said that ISRO should share its data with NASA and not with any other(Canadian Space Agencies,China National SpaceAdministrationJapan Aerospace ExplorationAgency) agencies.
- Maximum number(75%) of people think that ISRO needs to keep track of System/Satellite health more than any other operation.
- Above 70% people required mission control/flight control for the database to function properly and 67% people needed blackholes researchers and satellite control.
- Maximum people agree (45%)that NASA should build a base on the Moon before going to Mars.
- Maximum people(39%) are satisfied with ISRO data.some people have their own thoughts like
    1) Apart from missions ISRO should share information regarding satellites, space entities and future threats too.
    2) Data should not be shared more than which they were/are sharing for any project.
    3) Data sharing is good as civilians can know about progress report of ISRO and feels proud
    4) Isro provides information to us which we need to know and the person gets all needed information.

6. List of Requirements:

6.1 Product Requirements

A table for a list of satellites with a separate table for each satellite containing relevant information all in the schema “SAT”.

A table for current missions with each separate table having information about mission progress recorded at a regular time interval; all in schema “MISSIONS”.

Separate tables for black holes, stars, exoplanets and big asteroids with relevant information; all in schema “EXO”.

A table for keeping track of Near Earth Objects in schema “NEO”.
Sensor requirements for notify the scientists when some event occurs, Alert about the future collisions with earth or other entities.

6.2 Safety requirements:

If there's extensive damage to a large portion of the database because of catastrophic failure, like a disk crash, the recovery method restores a past copy of the database that was saved to archival storage (typically tape) and reconstructs a more current state by reapplying or redoing the operations of committed transactions from the saved log, up to the time of failure.

6.3 Security requirements:

Security systems need database storage similar to many other applications. However, the special requirements of the security market mean that clients must choose their database partner carefully.

Also to ease the user interaction with the database, the developers hide internal irrelevant details from users. There are three level of abstraction:
Let's say we are storing some information in a client table. At physical level these records can be described as blocks of storage in memory. These details are often hidden from the programmers.

We will make different relations for the Mission control department,satellite department, NEO department ,Black holes/asteroids/Exoplanet Researcher, NEO Threat Assessment. Department,Satellite Repair and Troubleshooting Department so that Mission department can't see the information about any other department and same for all so privacy will maintain.

6.4 Interview Requirements

- Requirements for actual details like objective completion, new findings, budget used, failures, successes, mission system health details, instrument health, satellite/payload health.
- Separate schema for civilians to access data which has no sensitive information about ongoing missions.
- Proper privileges should be used for the users; which will be decided by the mission leader/department head/ the secretary/ the director only.
- Data of required space elements like satellites, rovers should be accessible by mission control without any authorization from satellite division.
- An open source table accessible by anyone who wants to report a new planet discovery. The person has to give all the information like Name, Address, AU distance, location in the celestial coordinate system.
- Then it should be verified by the current database of exoplanets which is separate and verified by ISRO. If the planet is not there, then if it has some

special features which will be notified to the system by an EXOP executive, the planet will be added to the main list.

6.5 Observations Requirements

- Maximum number(75%) of people think that ISRO needs to keep track of System/Satellite health more than any other operation.
- Above 70% people required mission control/flight control for the database to function properly and 67% people needed blackholes researchers and satellite control.
- Maximum people agree (45%) that there should be a base on the Moon before going to Mars.
- Maximum people(39%) are satisfied with ISRO data.some people have their own thoughts like
    a. Data should not be shared more than which they were/are sharing for any project.
    b. Data sharing is good as civilians can know about the progress report of ISRO and feel proud.
    c. Isro provides information to us which we need to know and the person gets all needed information.
    d. Apart from missions ISRO should share information regarding satellites, space entities and future threats too.

6.6 Software Quality Attributes

- **Availability:** The missions should be available on the specified date and specified time as many clients are doing research.
- **Correctness:** the clients should get the correct information of missions and its launch date & time.
- **Maintainability:** The administrators and mission in chargers should maintain correct schedules of missions.
- **Usability:** The mission schedules and related information should satisfy a maximum number of customer needs.

6.7 Removing duplicates and prioritizing according to Frequency

Note: ***The requirements are listed according to the priority we thought u=is more important rather than frequency of occurrence as this system of prioritizing was not much effective in our case/***

Priority	Requirements	Frequency
1	Requirements for actual details like objective completion, new findings, budget used, failures, successes, mission system health details, instrument health, satellite/payload health.	3
2	Sensor requirements for notify the scientists when some event occurs, Alert about the future collisions with earth or other entities.	1
3	A separate table for each mission and satellite.	1
4	Separate tables for black holes, stars, exoplanets and big asteroids with relevant information; all in schema “EXO”.	2
5	Separate schema for civilians to access data which has no sensitive information about ongoing missions.	3
6	Sharing information with private companies like SpaceX may also be done. So we will add an option which enables us to share data with private entities as well.	2
7	Proper privileges should be used for the users; which will be decided by the mission leader/department head/ the secretary/ the director only.	1
8	If there's extensive damage to a large portion of the database because of catastrophic failure, like a disk crash, the recovery method restores a past copy of the database that was saved to archival storage (typically tape) and reconstructs a more current state by reapplying or redoing the operations of committed transactions from the saved log, up to the time of failure.	1
9	Maximum number of people responded that data shouldn’t be shared with the chinese space agency. Our team agreed with the user’s views. But the main decision lies with the ISRO administration and we will do as they say.	1
10	An open source table accessible by anyone who wants to report a new planet discovery. The person has to give all the	1

	information like Name, Address, AU distance, location in the celestial coordinate system.	

E) User Classes and Requirements:

I. Below Users will be under **DBA class** i.e, **Database Administrator.**

A. Administrator/Director
B. Deputy Administrator/Director
C. Associate Administrator
D. Deputy Associate Administrator
E. Chief of Staff
F. Associate Administrator for Strategy and Plans

The above Users roles will have access to all the schemas and can revoke/add privileges to all the user roles.

II. Below Users will under **RESOURCE class** i.e, They

can Define data,

Create database procedures,
Grant privileges for their database objects to other database users.

A. Mission Directorate
B. Mission Support Directorate
C. Satellite Directorate
D. EXO Division
E. NEO Threat Assessment Division
F. Satellite Repair and Troubleshooting Division

III. Below Users will be under **STANDARD class** i.e, they can

Access data and database procedures with necessary granted privileges
Define view tables, synonyms, and temporary tables

A. Ground Mission Crew (Mission Directorate)
B. Associate of Human Capital Management (MS Directorate)
C. Strategic Infrastructure (MS Directorate)
D. Satellite Control Crew
E. EXO Engineers, scientists and researchers.
F. NEO Engineers, scientists and researchers.
G. Engineers from the Repair and troubleshooting Division.

Operating Requirements

Hardware Requirements:

- A 1 GHz processor
- 2 GB of RAM.
- 512 MB of HDD
- Intel Pentium Processor
- Latest Version of any browser.

Software Requirements:

- **PGSQL**

External Interface Requirements:

- MS Access
- Java IDE
- PHPMyadmin

(We will be using any of the above)

Product Functions:

Our mission will facilitate users to get information about any missions of ISRO.If a user wants any information about any mission he can get it by our product only by mission name.our product will provide information about mission launching date,Orbit type,Application,mission was successful or not.

1. Will let users add new missions, access current live mission data, experiments and outcomes.
2. WIll let users access satellite data along with its health, position and services offered.
3. Will have a dedicated login feature to access each tier of information in the database. Every extra information access will require a different username and password.
4. Will alert the users with DBA class if there is some possibility of future collisions with earth.
5. Will have a feature that lets some data to be shared with other space organizations which will be decided exclusively by DIrector or Deputy Director.

6. There will be a search bar for searching particular data with filters.

Privileges:

1. Live data will be accessible to only the users pertaining to a particular directorate.
2. Old data of missions, experiments and its outcomes will be accessible by anyone as and when the director wants it to go public.
3. Only the directorate head will have access to edit and add new tables.
4. The data received LIVE from sensors cannot be edited unless permission is granted from the administrator.

Assumptions:

1. We assumed that we would have separate directorate/departments for every sub-objective were given. For example, mission control directorate for mission finding and so on.
2. We did this because it will make organising data for separate sections in separate schemas very easy.
3. We also assumed that we would get live data from ISRO servers for our database. In the tables the data will be filled out automatically. For the sake of showing the working, we will input our own random data.
4. In user classes, we made up the user roles in accordance with the organizational hierarchy used in NASA. We searched the same for ISRO but didn't get a proper structure. So, we improvised a bit.
5. We based our questionnaire very specifically on areas which were crucial for the system like which features we need in this one and so on. Also in these areas we were unsure too.

Business Constraints:

1. The most important and serious one will be the dependence on ISRO servers for live data. It's uptime cost will be a bit heavy, because if implemented it will be heavily used by civilians, ISRO and other space organizations too.
2. The other one which we figured out is "Security". As a lot of sensitive information will be in it and also it will be live 24x7, it will be constantly attacked by hackers for that worthy data. So, a big costly 24x7 security team will be a must.
3. We were able to figure out only these two.

Section 2: Final Noun Analysis

Space Agency Database

The original problem description was:
Design a system that helps space agencies like ISRO, NASA to track their missions, findings, and space element movements. Keep track of satellite heath, positions and services.It should also keep track of stars, planets, blackholes,moving stars,big asteroids and notify the scientists when some event occurs,or alert about the future collisions with earth or other entities.This system should be able keep track of their experiment and outcomes.When need arises different agencies should be able to work-together to complete the mission.

Proceeding in an orderly fashion **Design a system which should have at least the below-specified information in your database, which can be in turn helpful to the space organizations like ISRO and NASA; as follows:**

1. Mission details like
    a. Launch Vehicle
    b. Spacecraft
    c. Ground Segment
    d. Mission profile
    e. Payload details
    f. Duration

2. For each mission, there should be
    a. Regular updates about the orbiter/rover/satellite being used.
    b. Update duration can be once a day.
    c. The data can be generated on your own or can be sourced from an external system/database as per your convenience.
    d. The updates should include update time-date, objectives completed for the day, and anything else you want to add.
    e. Also, there should be a brief description of the space elements involved. Suppose the mission is “Mangalyaan” so the relevant space object is Mars. So, the current atmospheric conditions of Mars can be tracked side by side with the probe being sent.

3. Satellites
    a. Celestial coordinates/position

b. Satellite orbit is geostationary, low earth orbit (LEO), medium earth orbit (MEO), High earth orbit (HEO).
c. Orbit Distance and altitude
d. Orbit velocity
e. Orbital Period
f. Navigation system being used
g. Number of malfunctioning parts (if any)
h. Names of the malfunctioning parts
i. Overall health percentage
j. Services provided.

Below is some basic information about stars, planets, black holes, and Asteroids for the student's reference.

Stars

A star is an astronomical object consisting of a luminous spheroid of plasma held together by its own gravity. The nearest star to Earth is the Sun. Many other stars are visible to the naked eye from Earth during the night, appearing as a multitude of fixed luminous points in the sky due to their immense distance from Earth. The stars appear to be always in the same place relative to each other. It is as if they are fixed points in a crystal sphere that rotates around the earth. Once you have a map, you need only an ephemeris to keep track of the pesky ephemeral objects like planets and comets that move against it.

Star's life begins with the gravitational collapse of a gaseous nebula of material composed primarily of hydrogen, along with helium and trace amounts of heavier elements. When the stellar core is sufficiently dense, hydrogen becomes steadily converted into helium through nuclear fusion, releasing energy in the process

Planets

A planet is an astronomical body orbiting a star or stellar remnant that is massive enough to be rounded by its own gravity, is not massive enough to cause thermonuclear fusion, and has cleared its neighbouring regions of planetesimals.

The Milky Way is littered with a vast diversity of planets: giants that blur the line between planet and failed-star brown dwarf; tiny worlds similar in size to Earth's moon; planets that take 100,000 years to orbit their suns or whip around in hours; lava worlds; ice worlds; and planets that circle multiple suns or whirling pulsars.

Scientists find them by watching stars that wobble, change gravity, vary in color, or dip slightly in brightness.

Blackholes

Very massive stars(more than 15 to 20 times the sun's mass)
Black holes cannot suck matter into them except under certain conditions. If the sun instantly turned into a black hole, Earth and even Mercury would continue to orbit the new object and not fall in. There are two common cases in the universe in which matter can be dragged into a black hole.

Case 1: If a body orbits close to the event horizon in an elliptical orbit, it emits gravitational radiation, and its orbit will eventually decay in millions of years.

Case 2: A disk of gas can form around a black hole, and through friction, the matter will slowly slide into the black hole over time.

Asteroids

Asteroids are rocky worlds revolving around the sun that are too small to be called planets. They are also known as planetoids or minor planets. There are millions of asteroids, ranging in size from hundreds of miles to several feet across. In total, the mass of all the asteroids is less than that of Earth's moon.
Asteroids are left over from the formation of our solar system. Our solar system began about 4.6 billion years ago when a big cloud of gas and dust collapsed. When this happened, most of the material fell to the center of the cloud and formed the sun.

Some of the condensing dust in the cloud became planets. The objects in the asteroid belt never had the chance to be incorporated into planets. They are leftovers from that time long ago when planets formed.

4. The following data about the stars is required.
    a. Tracking ID/Name
    b. Classification i.e, yellow/orange/red dwarf, supergiant, neutron star, failed star, etc.
    c. Its size
    d. It's shape
    e. Its angular distance from say, earth
    f. ts Declination
    g. It's composition. Like how much percentage nitrogen, argon, oxygen, etc the star is made up of.

5. About the Planets, the following information should be there in the database:
    a. Its mass, diameter, density
    b. Its gravity
    c. Its length of the day
    d. Its distance from the sun
    e. Its mean temperature
    f. Its number of moons
    g. Is it a ring system or not?

6. The database should contain this information about BlackHoles:
    a. Black-Hole name
    b. Mass
    c. Distance Mass (Light years)
    d. Threat Level to Us

7. Database should contains below information about Asteroids
    a. Asteroid Number and Name
    b. Diameter
    c. Mass
    d. Rotation Period
    e. Orbital Period
    f. Spectral class
    g. Semi Major Axis

    h. Orbital Eccentricity
    i. Orbital Inclination
    j. Current, past and future missions about Asteroids

8. There should be a mechanism to detect collisions and alert the scientists if there is a possibility between some important (for simplicity) space elements.
    a. Suppose a user enters a new asteroid in the database and if it is on the way to collide with earth, or flow past earth at a dangerous distance which will be calculated according to some data, which is left to the student's imagination; then a warning message should be displayed.
    b. There should be alert/notification if there is a supernova explosion, gamma ray burst, etc.

9. If need arises then the agency currently using the database should be able to share the data with other space agencies.
    a. Mention how the data will be shared.
    b. Mention how the authorization will work to share the data.

10. There should be a list with scientists/researchers accessing the database with their clearance level and their department/directorate.

Table.1.
All Extracted Nouns & Verbs from Problem Description

Nouns	**Verbs**
Ongoing Missions	*Mission Updates* **Expedition** *Ongoing Missions*
Past Missions	*Scientists* **Assigned** *Ongoing Missions*
Future Missions	*Satellites* **Satellites Allocated** *Ongoing Missions*
Satellites	*Past Missions* **Mission Archives** *Scientists*
Stars	*Stars, Black Holes, Planets* **Being Studied** *Researchers*
Black holes	*Satellites* **Orbiting** *Planets*
Asteroids	*Asteroids* **NEO** *Collision Threat*
Collision Threat	*Asteroids*

Planets	*Satellites* **Sat Update** *Satellites Updates*
Scientists	*Missions Updates Shared* **Missions Exchanged** *Space Agencies*
Mission Updates (for each mission)	*Satellite Updates Shared* **Satellites Exchanged** *Space Agencies*
Satellite Updates (for each mission)	
Researchers	
Space Agencies	
Missions Updates Shared	
Satellites Updates Shared	

Table.2. Accepted Noun & Verbs list

Candidate entity set	Candidate attribute set	Candidate relationship set
Missions	1. Mission Name 2. Mission ID 3. Launch Vehicle 4. Ground Segment 5. Space Segment 6. Mission profile 7. Payload details 8. Start Date 9. End Date 10. Status	**Expedition** **Assigned**
Satellites	1. Satellite Name 2. Satellite ID 3. Orbit Details 4. Orbit Distance and altitude 5. Orbit velocity 6. Orbital Period 7. Navigation system 8. Number of malfunctioning parts 9. Malfunctioning parts name 10. Health percentage 11. Services Provided	**Orbiting** **Satellite Allocated** **Sat_Update** **Sharing_Staellite_Info**
Stars	1. Star ID 2. Classification 3. Size 4. Shape 5. AU Distance	**Changing_Stars** **Star_Studied**

Blackholes	1. Blackhole ID 2. Name 3. Mass 4. AU Distance	**Blackholes_Studied** **Changing_Blachole**
Asteroids	1. Asteroid Name 2. Asteroid Id 3. Diameter 4. Mass 5. Spectral class	**Asteroid_Studied** **NEO**
Planets	1. Planet ID 2. Name 3. Mass 4. Diameter 5. Density 6. Length of the day 7. Number of moons 8. AU Distance 9. Mean temperature	**Orbiting** **Planet_Studied**
Collision Threat	1. Tracking ID 2. Threat Status 3. Threat Details 4. Date-Time	**NEO**
Mission Updates (for each mission)	1.Date-Time 2.Experiments 3.Outcomes	**Expedition**

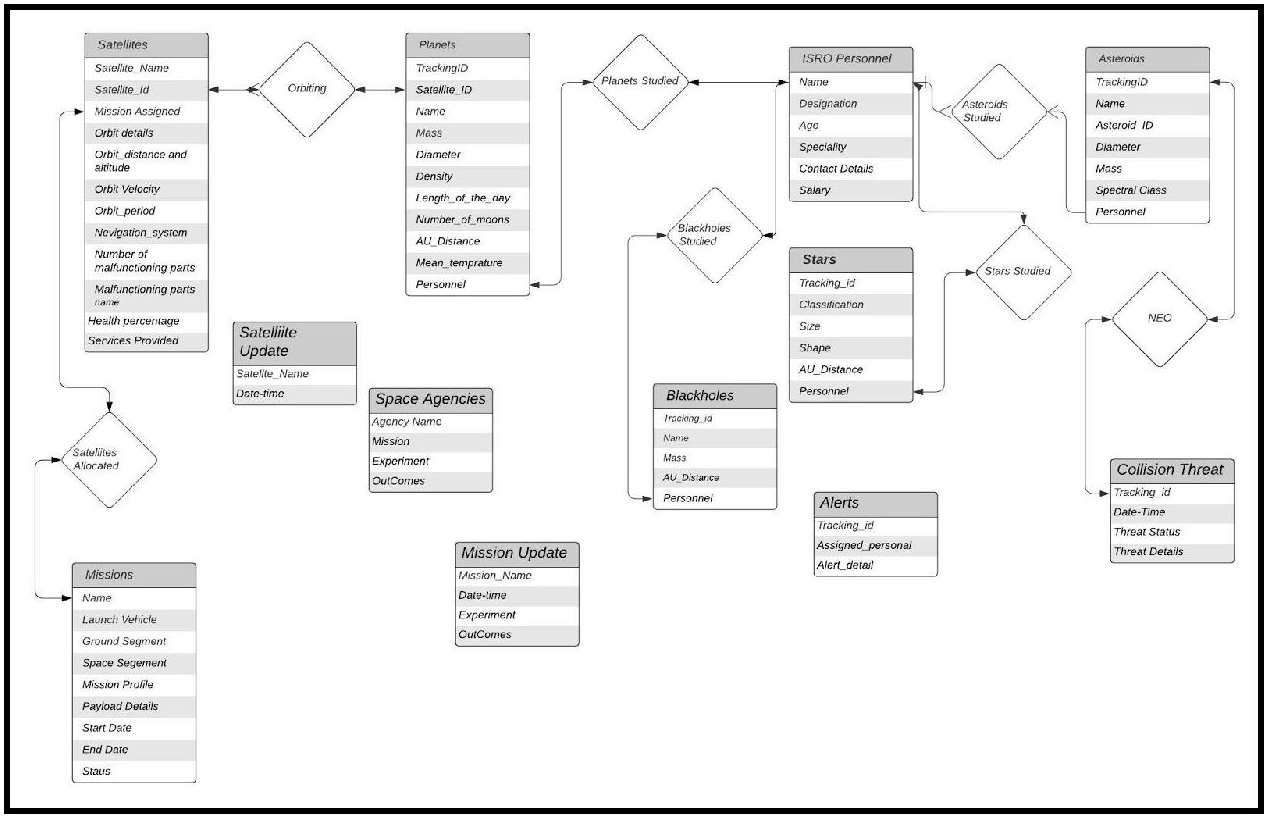
Satellite Updates (for each mission)	1.Update 2.Date-Time	**Sat Update**
ISRO_Personnel	1. Name 2. ID 3. Designation 4. Age 5. Speciality 6. Salary 7. Start-Date 8. {Contact Details}	**Planets Studied** **Blackholes Studied** **Asteroids Studied** **Stars Studied** **Assigned**
Space Agencies	1. Agencies_Name 2.Tracking_ID	**Misson_Exchanged** **Sharing_satelite_info**

Table.3. Rejected Noun & Verbs list

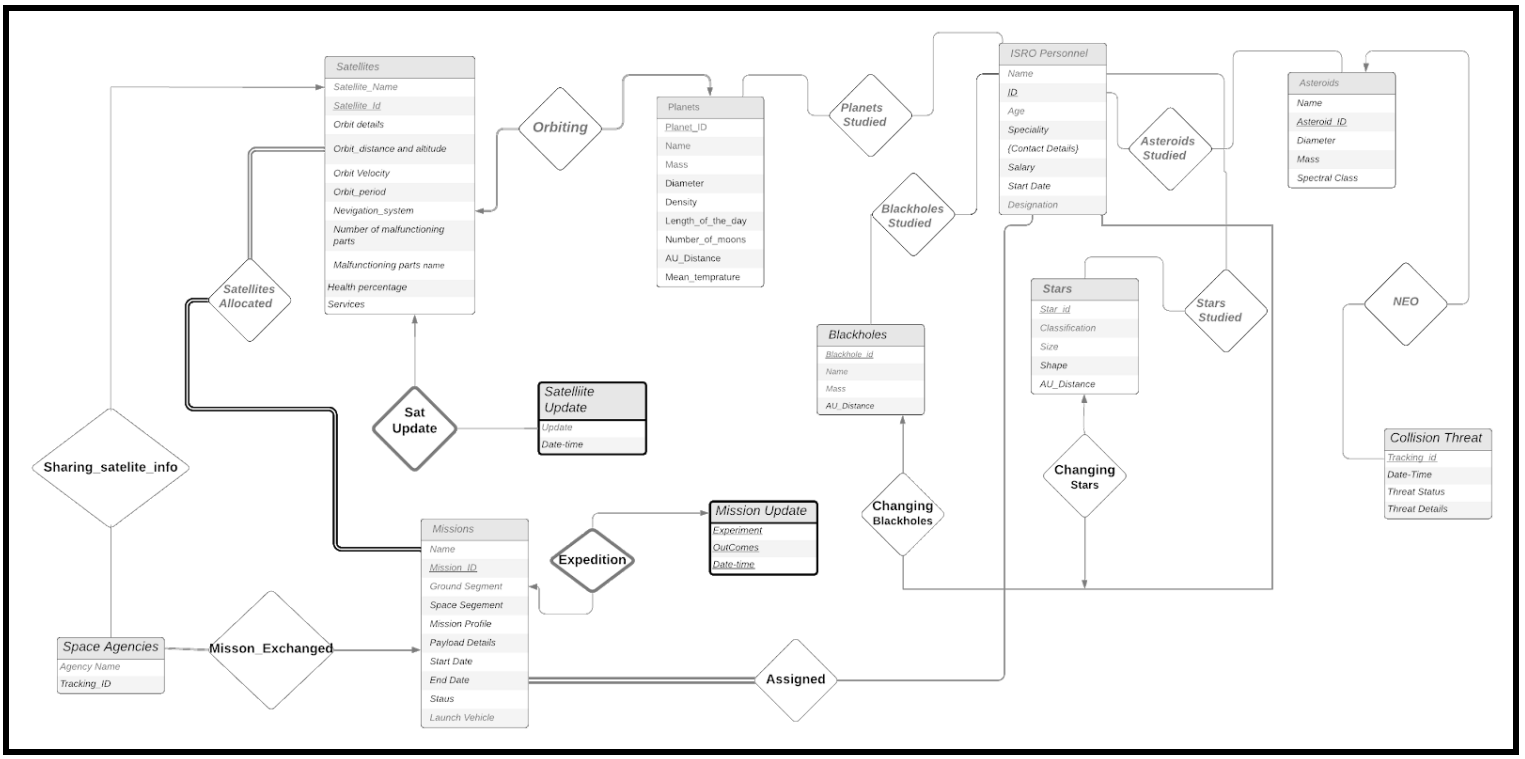
Nouns	**Verbs**
Past Missions	General
Future Missions	General
Researcher	General

Section 3: Final ER Diagrams of all versions

ER Diagram Version 1



ER Dlagram Final Version



Section4: Conversion of Final ER-Diagram to Relational Model

Mapping E-R Model to Relational Model

Satellites(Satelite_ID,Satellite_Name,Orbit Details,Orbit_Distance and Altitude,Orbit Velocity,Orbit_period,Navigation System,Number of malfunctioning parts, malfunctioning parts name,Health Percentage,Services,Planet_ID**)**

ISRO Personnel(ID,Name,Designation,Age,Speciality,Salary,Start-Date**)**

Planet(Planet_id,name,mass,Diameter,Density,length_of_the_day,number_of_moons,AU-distance,Mean_temprature**)**

Missions(Mission ID,Launch Vehicle,Ground Segment, Mission profile,Payload details,Start Date,End Date,Status)

Stars(Star_ID,Classification,Size,Shape,AU_Distance)

Blackholes(Blackhole ID,Planets_ID,Name,Mass,AU_Distance)

Asteroids(Asteroid Id , Asteroid Name,Diameter,Mass,Spectral class)

Collision Threat(Tracking ID,Threat Status,Threat Details,Date-Time,Asteroid_id)

Space Agencies(Tracking_ID ,Agencies_Name,Satellite_id,Mission_id)

Satellite_allocated(Satllite_id,Mission_id**)**
Planet_studied(Planet_id,Personnel_id)
Blackhole_studied(Blackhole_id,Personnel_id)
Asteroids_Studied(Asteroid_ID,Personnel_ID)
Star_studied(Star_id,Personnel_id)
Assigned(Mission_id,Personnel_id)
Personnel_Details(Personnel_Id,Phone_Number)
Satellite_update(satellite_id,update,date_time)
Mission_update(Mission_id,Experiment,outcomes,date_time)

Section5: Normalization and Schema Refinement

PK dependency

1. Satellite_Id - Satellites
2. Personnel_ID - ISRO Personnel
3. Planet_id - Planet
4. Mission ID-Missions
5. star_id-Stars
6. Blackhole ID - Blackholes
7. Asteroid Id-Asteroids
8. Personnel_Id,Phone_Number -Personnel_Details
9. Tracking ID-Collision Threat
10. (Alert_id,Personnel_id) - Alert_assigned
11. Tracking_ID-Space Agencies
12. (Mission_id,Date_Time,Experiments,Outcomes)-Mission Updates
13. (Satellite_id,Update,Date-Time)-Satellite Updates
14. (Blackhole_id,Personnel_id)-Blackhole_studied
15. (Asteroid_ID,Personnel_ID)-Asteroids_Studied
16. (Star_id,Personnel_id)-Star_studied
17. (Mission_id,Personnel_id)-Assigned
18. (Planet_id,Personnel_id)-Planet_studied
19. (Satllite_id,Mission_id)-Satellite_allocated

FK dependencies:

1. **Planet_ID** references to **Satellite, Planet_Studied**
2. **Satellite_ID** references to **Satellite_Updates, Satellite_Allocate, Space_Agencies**

3. **Mission_ID** references to **Satellite_Allocate, Space_Agencies, Mission_updates, Assigned**

4. **Personnel_ID** references to **Planet_Studied, Blackhole_Studied, Asteroids_Studied, Star_Studied, Assigned, Personnel_Studied**

5. **Blackhole_ID** references to **Blackhole_Studied**

6. **Star_ID** references to **Star_Studied**

7. **Asteroid_ID** references to **Asteroids_Studied, Collision_Threat**

Functional dependency

1. Designation -> Salary
2. mass,Diameter->Density
3. Asteroid Name->Diameter
4. Asteroid Name->Mass
5. Asteroid Name->Spectral class

Anomalies

Insert,delete,Update Anomalies

1. Planet_ID
2. Satellite_ID
3. Mission_ID
4. Personnel_ID
5. Blackhole_ID

6. Star_ID
7. Asteroid_ID

1 NF

No composite and multivalued attributes in our database.

2 NF

We don’t have Composite primary keys that are partial. So our schema is in 2NF already.

3NF

Our database is only in 3 NF.

SECTION 6

1. Final DDL scripts:

We've created 5 Schemas as mentioned below:

1.Agency and personnel
2.Threats
3.PABS
4.Satellites
5.Missions

1. Isro_Personnel

```
create table "Agency and personnel".ISRO_Personnel
(
        ID int,
        Name char(50),
        Designation char(50),
        Age int,
        Salary Bigint,
        Start_Date date,
        primary key(id)
);
```

2. Personnel_Details

```
create table "Agency and personnel".Personnel_Details
(
  Personnel_Id int,
  Phone_Number char(10) check (length(Phone_Number) = 10),
  Primary key(personnel_id,Phone_Number),
  Foreign key (Personnel_id) REFERENCES "Agency and
personnel".Isro_personnel(ID) on delete cascade
);
```

3.Stars

```
create table "PABS".Stars
(
        Star_ID int,
        Classification char(50),
        Size Bigint,
        Shape varchar,
        AU_Distance int,
        primary key(Star_id)
);
```

4.blackhole

```
create table "PABS".blackholes
(
        Blackhole_ID int,
        Name char(50),
        Mass bigint,
        AU_Distance int,
        primary key(blackhole_id)
);
```

5.Star Studied

```
create table "PABS".Star_studied
(
   Star_id int,
   Personnel_id int,
   primary key(star_id,Personnel_id),
        FOREIGN KEY (Personnel_id) REFERENCES        "Agency and
personnel".isro_personnel(id) ON
DELETE cascade,
        FOREIGN KEY (star_id) REFERENCES "PABS".stars(star_id) ON
DELETE cascade
);
```

6.blackhole_studied

```
create table "PABS".blackhole_studied
(
        Blackhole_id int,
        Personnel_id int,
        primary key(Blackhole_id,Personnel_id),
        FOREIGN KEY (Personnel_id) REFERENCES        "Agency and
personnel".isro_personnel(id) ON
DELETE cascade,
        FOREIGN KEY (blackhole_id) REFERENCES
"PABS".blackholes(blackhole_id) ON
DELETE cascade
);
```

7.Asteriods

```
create table "PABS".Asteroids
(
        Asteroid_Id  int,
        Asteroid_Name varchar,
        Diameter bigint,
        Mass bigint,
        Spectral_class char(50),
        primary key(Asteroid_Id)
);
```

8.Asteriod_studied

```
create table "PABS".asteroid_studied
(
   asteroid_id int,
    Personnel_id int,
    primary key(asteroid_id,Personnel_id),
        FOREIGN KEY (Personnel_id) REFERENCES        "Agency and
personnel".isro_personnel(id) ON
DELETE cascade,
        FOREIGN KEY (asteroid_id) REFERENCES
"PABS".asteroids(asteroid_id) ON
```

```
DELETE cascade
);
```

9. Planets

```
create table "PABS".Planets
(
    Planet_id int,
    name varchar,
    mass real,
    Diameter bigint,
    Density bigint,
    length_of_the_day bigint,
    number_of_moons bigint,
    AU_distance real,
    Mean_temprature int,
    primary key(planet_id)
);
```

10.Missions

```
create table "Missions".Missions
(
    Mission_ID int,
    Launch_Vehicle varchar,
    Ground_Segment varchar,
    Mission_profile varchar,
    Payload_details varchar,
    Start_Date date,
    End_Date date,
    Status varchar,
    primary key(Mission_ID)
);
```

11.Mission_Updates

```
create table "Missions".Mission_Updates
(
        Mission_id Int,
```

```
        Date_Time date,
        Experiments Varchar,
        Outcomes varchar,
    Primary key(Mission_id,Date_Time,Experiments,Outcomes),

FOREIGN KEY (Mission_id) REFERENCES
"Missions".missions(Mission_ID) ON
DELETE cascade
);
```

12. **Satellites**

```
CREATE TABLE "Satellites".Satellites
(
   Satelite_ID  INTEGER,
   Satellite_Name char varying ,
   Orbit_Details char varying ,
   Orbit_Distance Bigint,
   Orbit_Velocity bigint,
   Orbit_period real,
   Navigation_System char varying,
   Number_of_malfunctioning_parts bigint,
   malfunctioning_parts_name char varying,
   Health_Percentage int,
   Services char varying,
   Planet_ID int,
   primary key (Satelite_ID),
   FOREIGN KEY (Planet_ID) REFERENCES "PABS".Planets(Planet_ID)
ON
DELETE cascade
);
```

13.Space_Agencies

```
create table "Agency and personnel".Space_Agencies
(
    Tracking_ID int,
    Agencies_Name varchar,
```

```
    Satellite_id int,
    Mission_id int,
    primary key(Tracking_ID),
    FOREIGN KEY (Satellite_id) REFERENCES
"Satellites".satellites(Satelite_id) ON
DELETE cascade,
    FOREIGN KEY (Mission_Id) REFERENCES
"Missions".Missions(Mission_id) ON
DELETE cascade
);
```

14. Mission Assigned

```
create table "Missions".assigned
(
    mission_id int,
    Personnel_id int,
    primary key(mission_id,Personnel_id),
        FOREIGN KEY (Personnel_id) REFERENCES        "Agency and
personnel".isro_personnel(id) ON
DELETE cascade,
        FOREIGN KEY (mission_id) REFERENCES
"Missions".missions(mission_id) ON
DELETE cascade

);
```

15.planet_studied

```
create table "PABS".planet_studied
(
    planet_id int,
    Personnel_id int,
    primary key(planet_id,Personnel_id),
        FOREIGN KEY (Personnel_id) REFERENCES        "Agency and
personnel".isro_personnel(id) ON
DELETE cascade,
```

```
        FOREIGN KEY (planet_id) REFERENCES "PABS".planets(planet_id)
ON
DELETE cascade

);
```

16.Collision_Threat

```
create table "Threats".Collision_Threat
(
        Tracking_ID  Int,
        Threat_Status char(50),
        Threat_Details char(50),
        Date_Time date,
        Asteroid_id int,
        primary key(Tracking_id),
        FOREIGN KEY (Asteroid_id) REFERENCES
"PABS".Asteroids(Asteroid_id) ON
DELETE cascade
);
```

17.Satellite_allocated

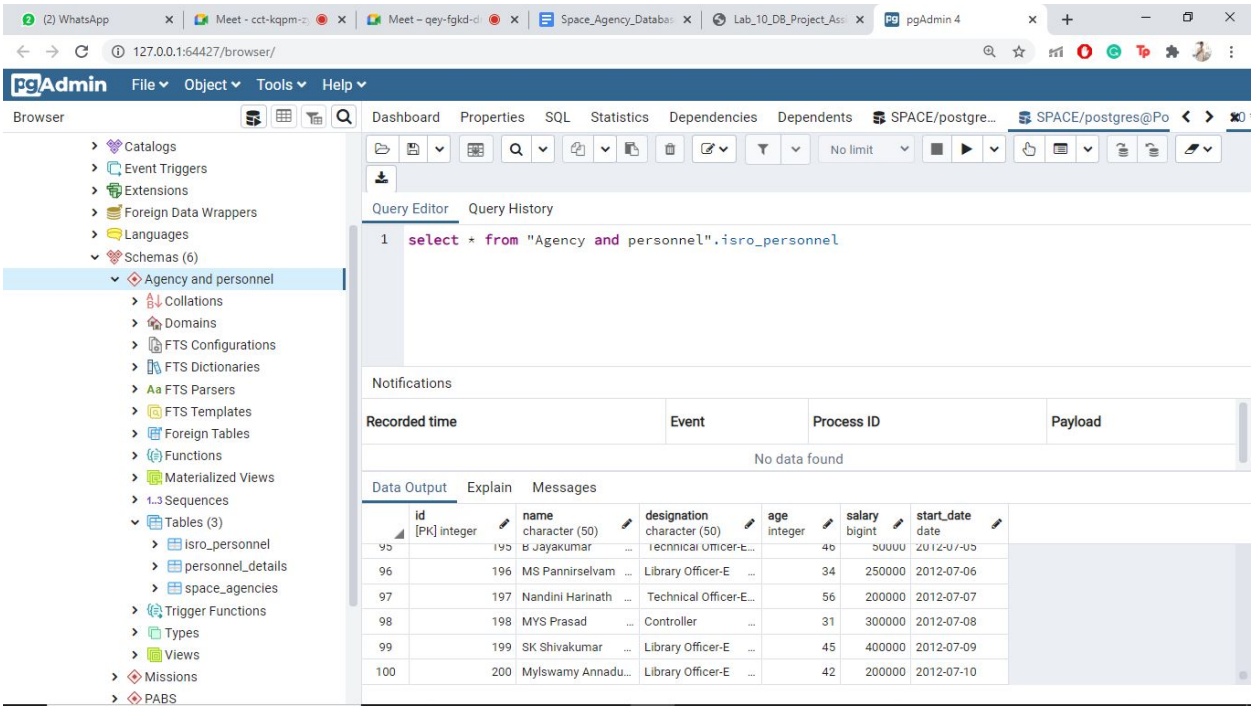
```
create table "Satellites".Satellite_allocated
(
   Satellite_id int,
   Mission_id int,
   primary key(Satellite_id,Mission_id),
        FOREIGN KEY (Satellite_id) REFERENCES
"Satellites".satellites(satelite_id) ON
DELETE cascade,
        FOREIGN KEY (Mission_id) REFERENCES
"Missions".missions(mission_id) ON
DELETE cascade
);
```

18. Satellite_Updates

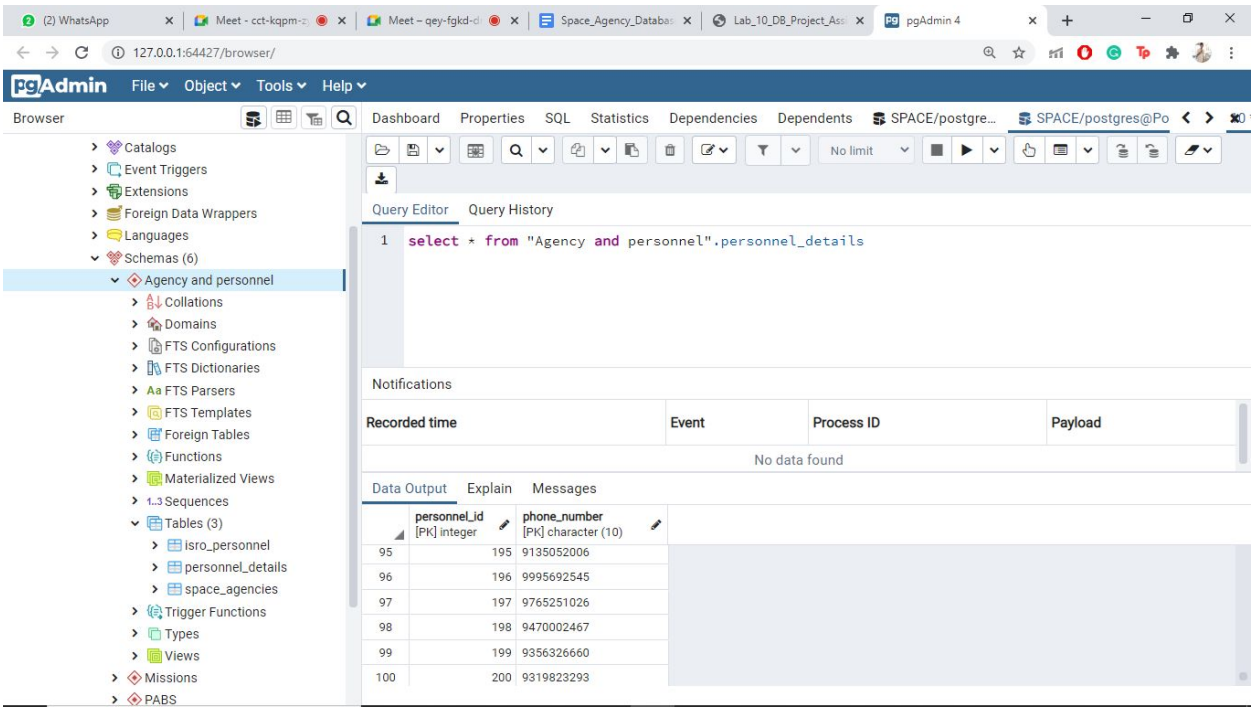
```
create table "Satellites".Satellite_Updates
(
  Satelite_id int,
  Update varchar,
  Date_Time date,
  Primary key(Satelite_id,Update,Date_Time),
  Foreign key (Satelite_id) REFERENCES "Satellites".Satellites(Satelite_id)
on delete cascade
);
```

LAB_9 -- Snapshots of select * queries of all the tables (Data snapshots)

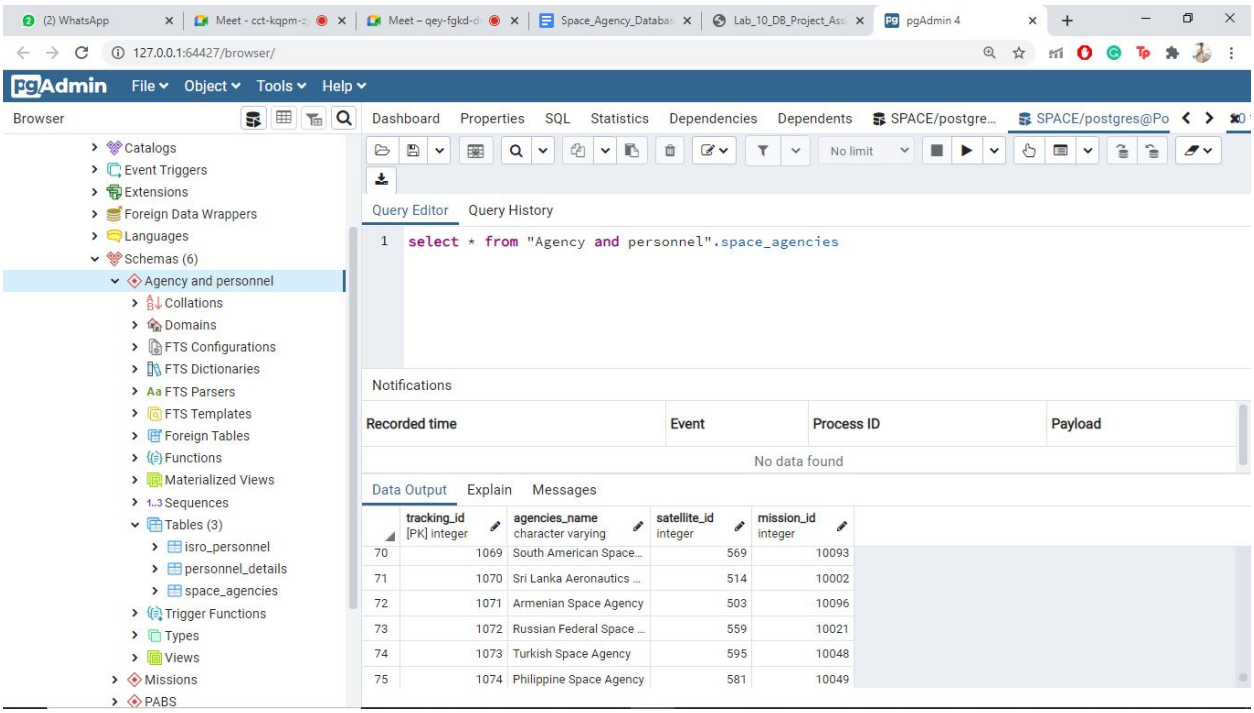
1. Isro_personnel:



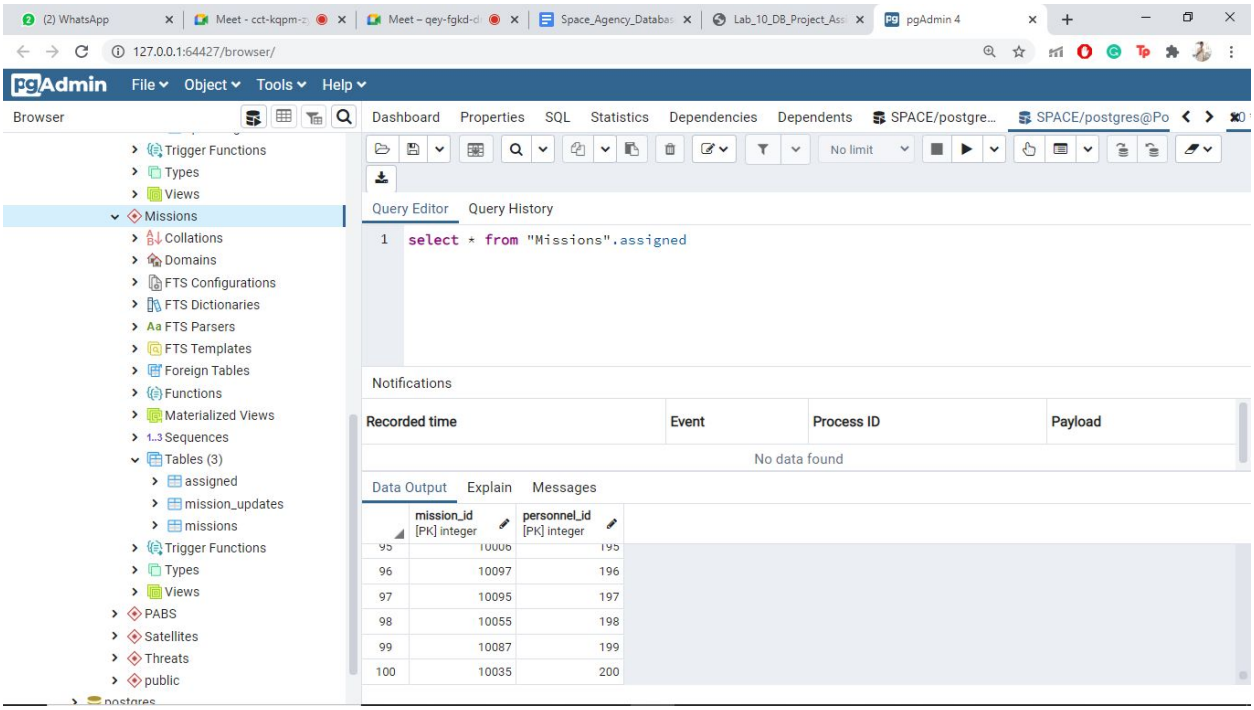
2. Personnel_details:



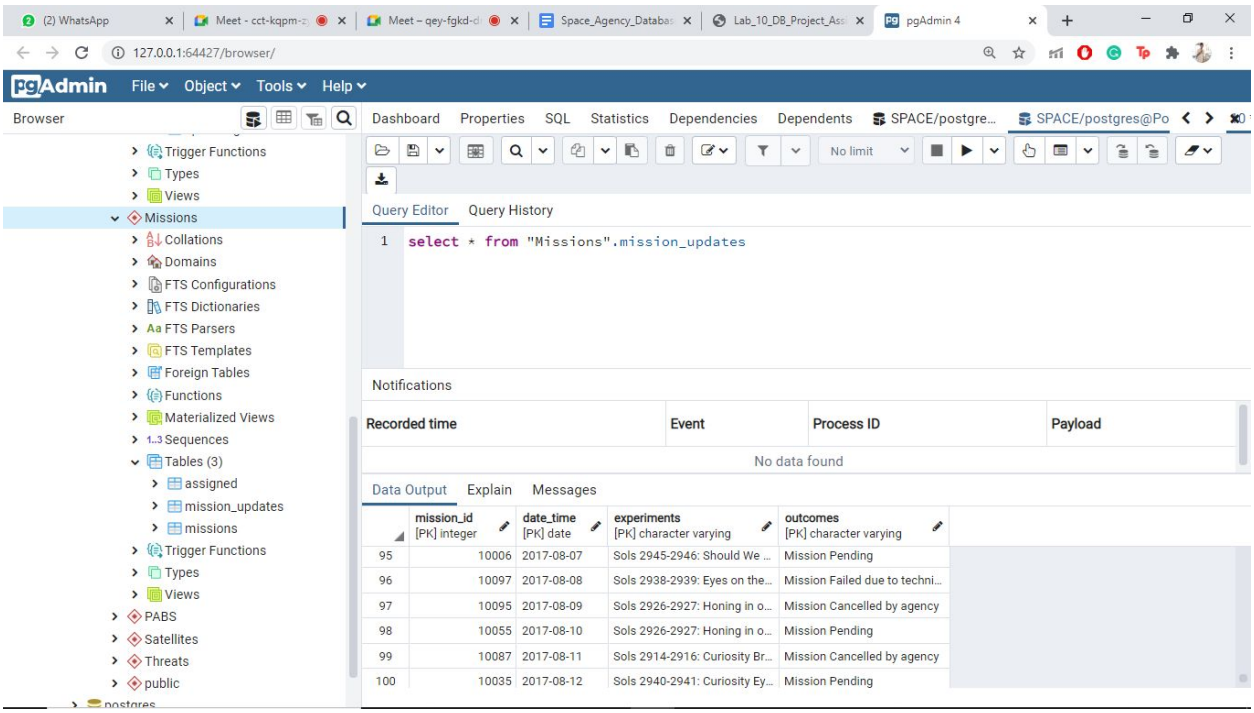
3. Space_agencies



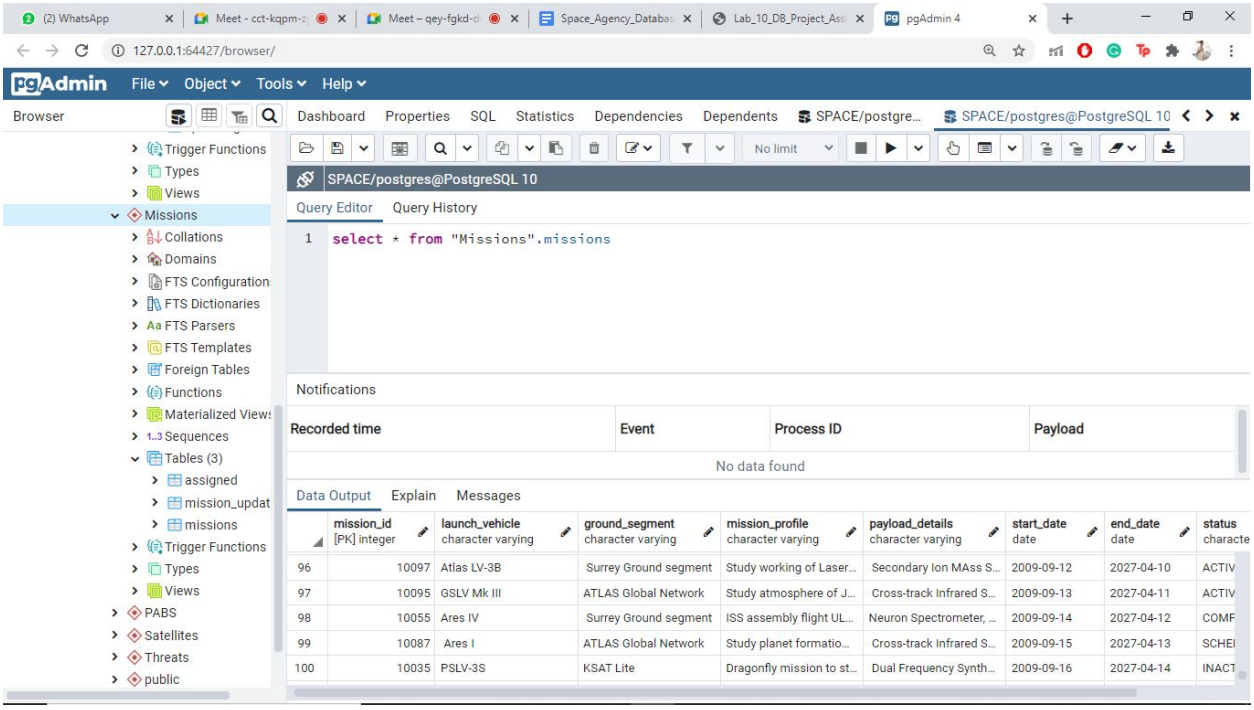
4. Assigned



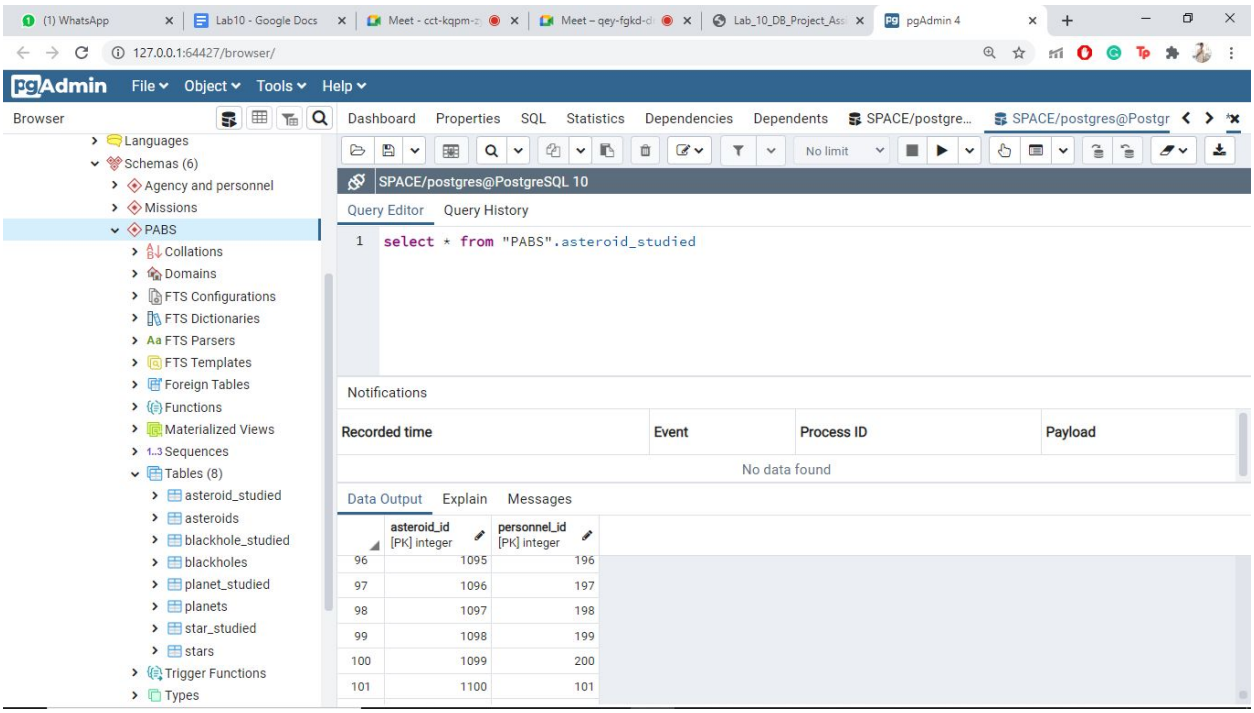
5. Mission_updates



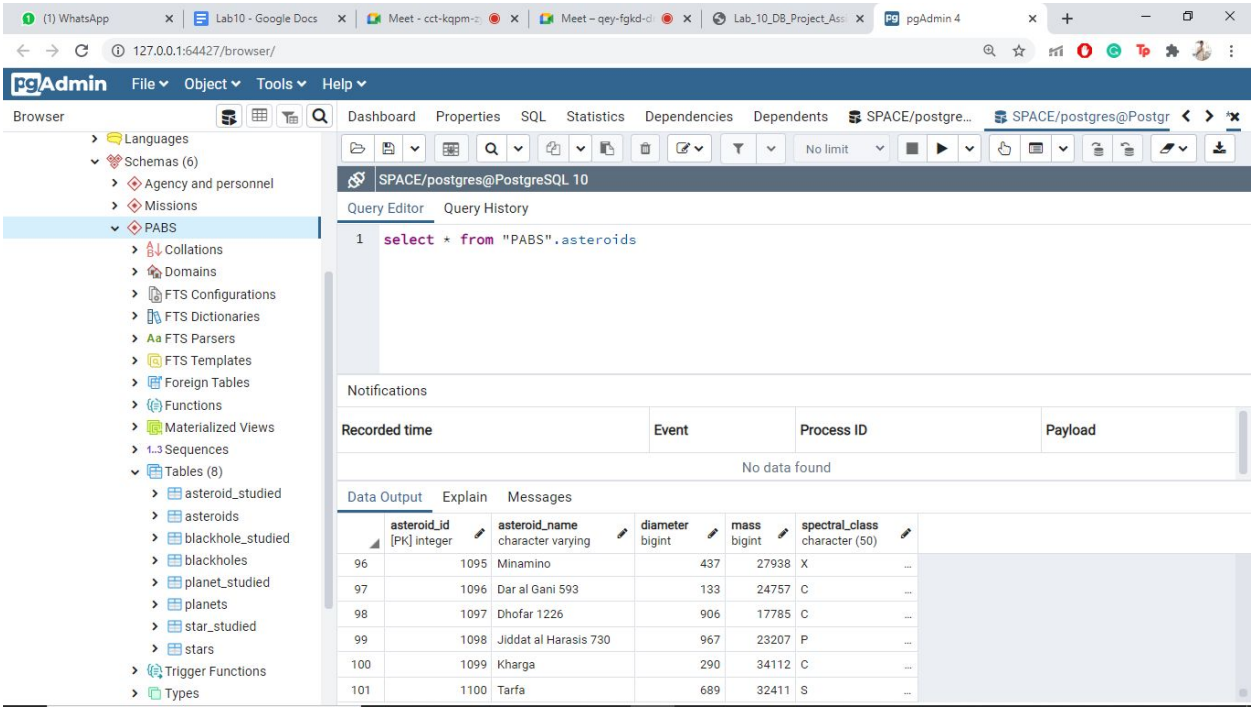
6. Missions



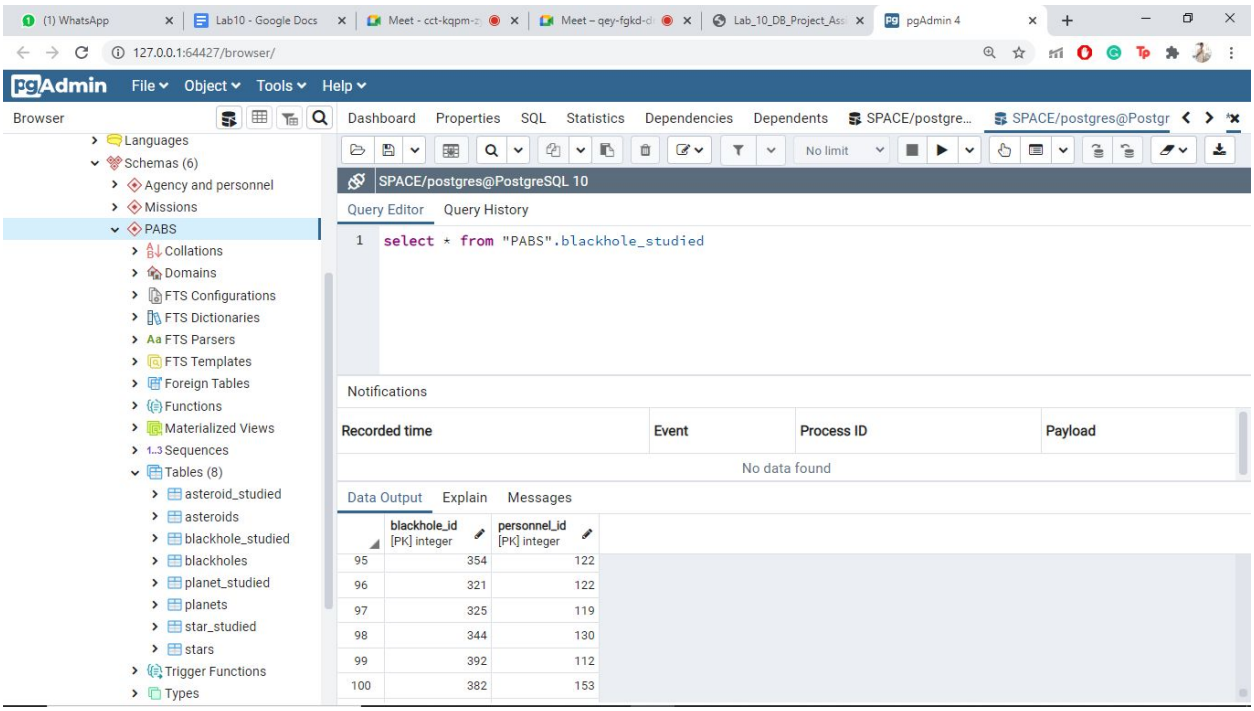
7. Asteroid_studied



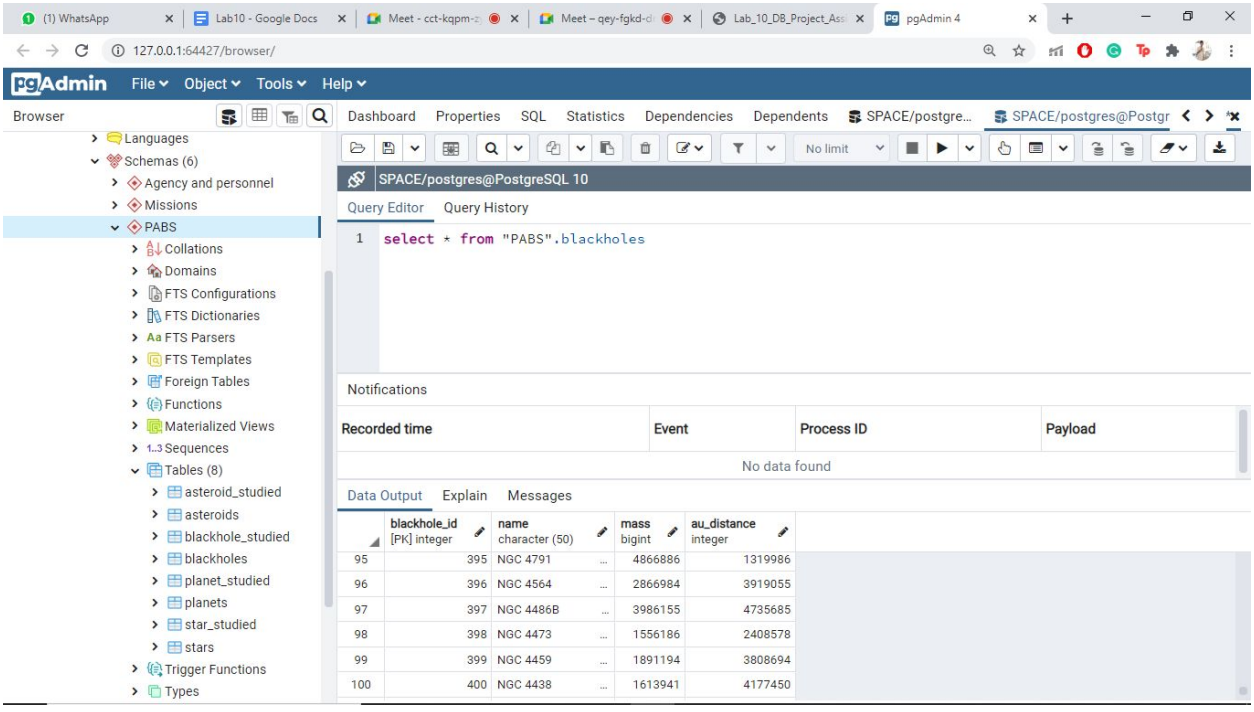
8. Asteroids



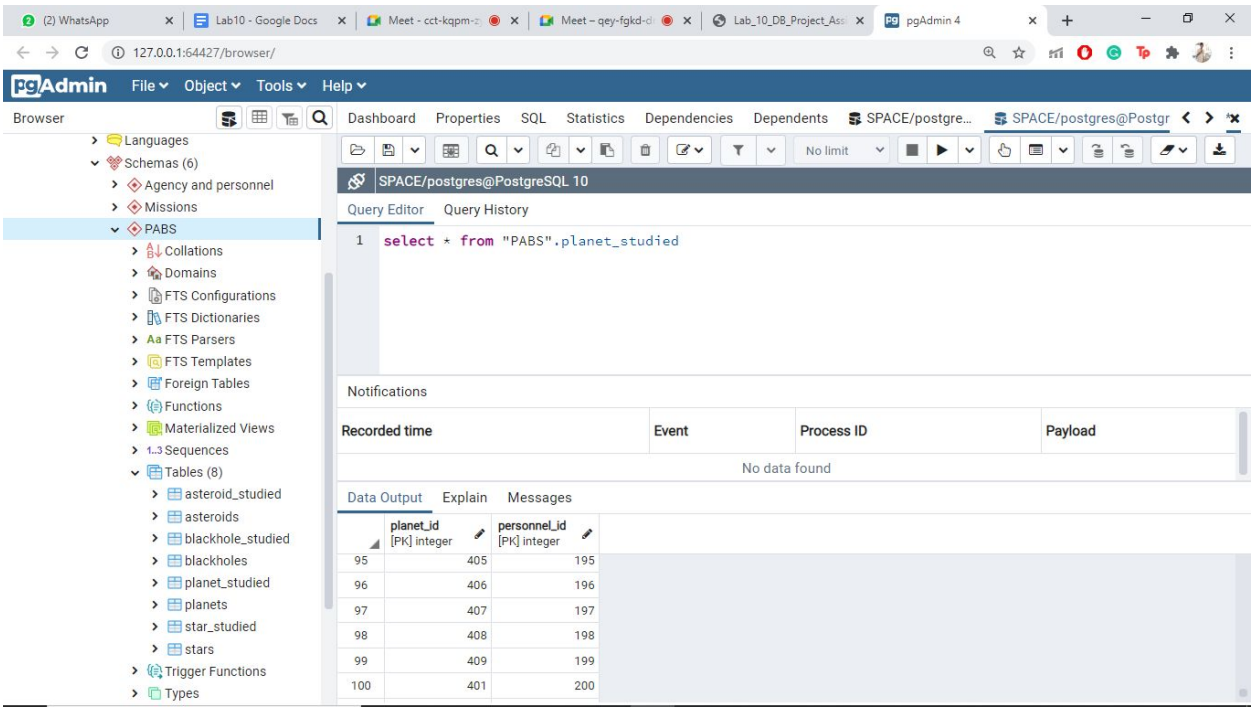
9. Blackhole_studied



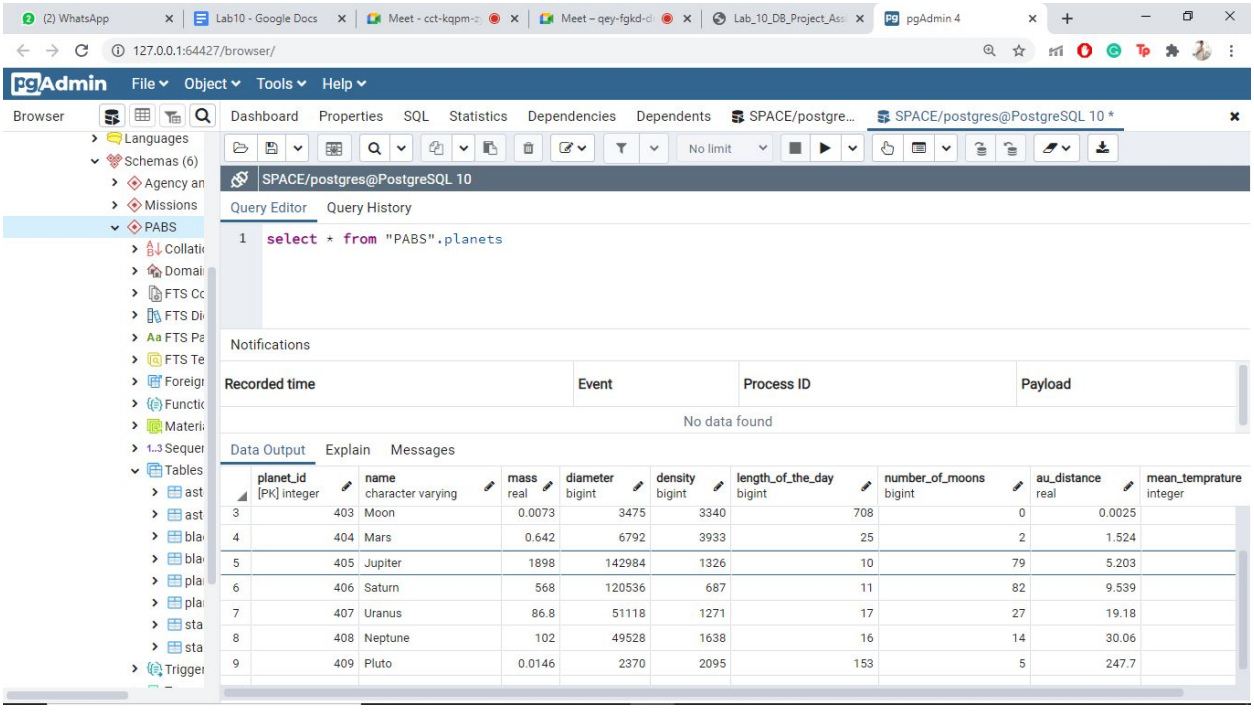
10. Blackholes



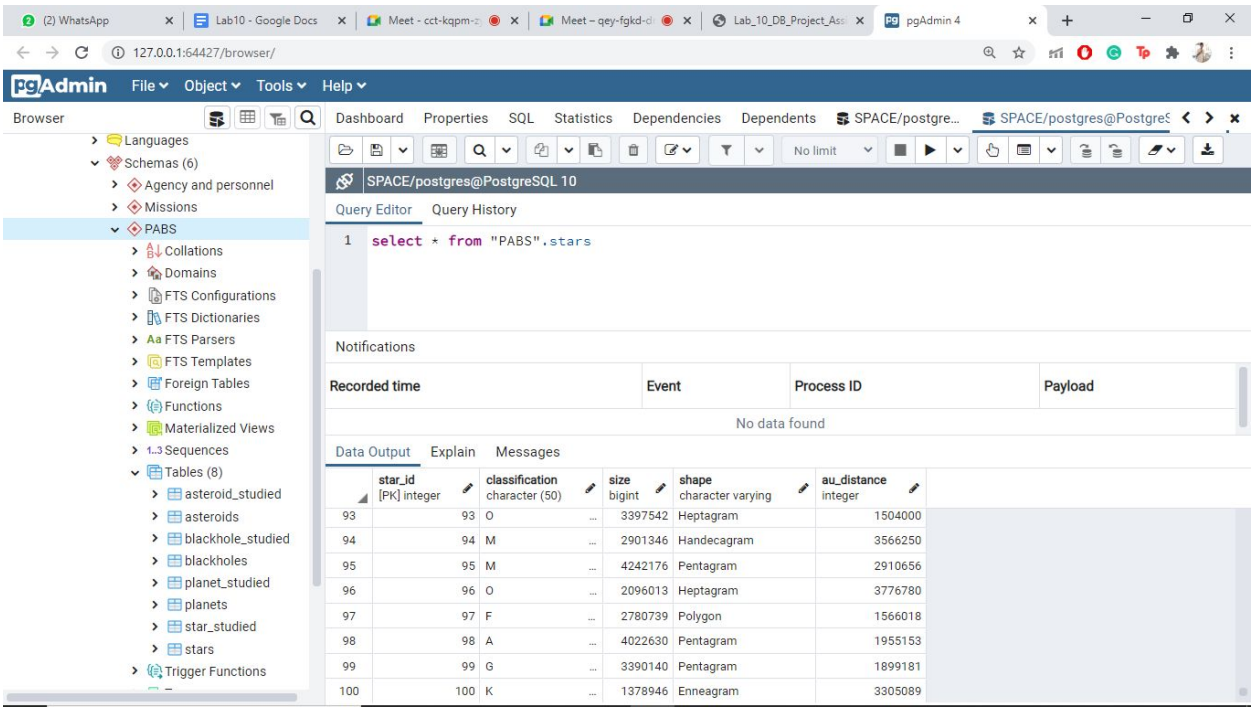
11. Planet_studied



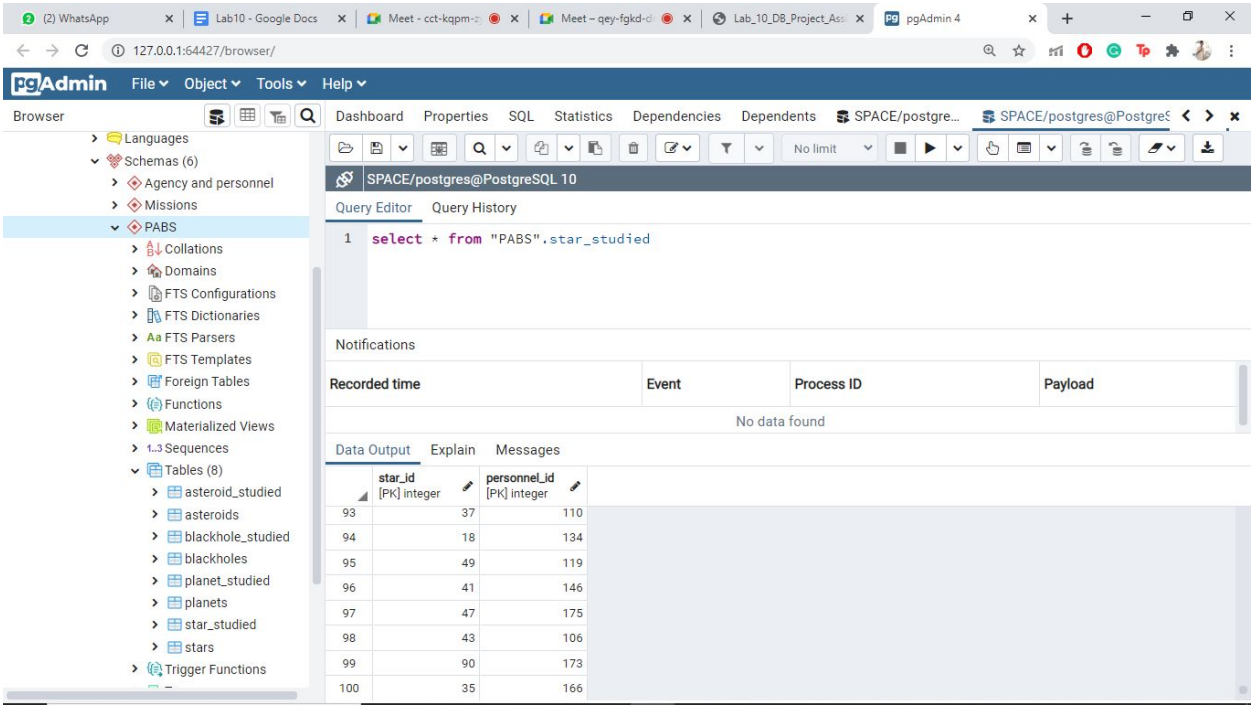
12. Planets



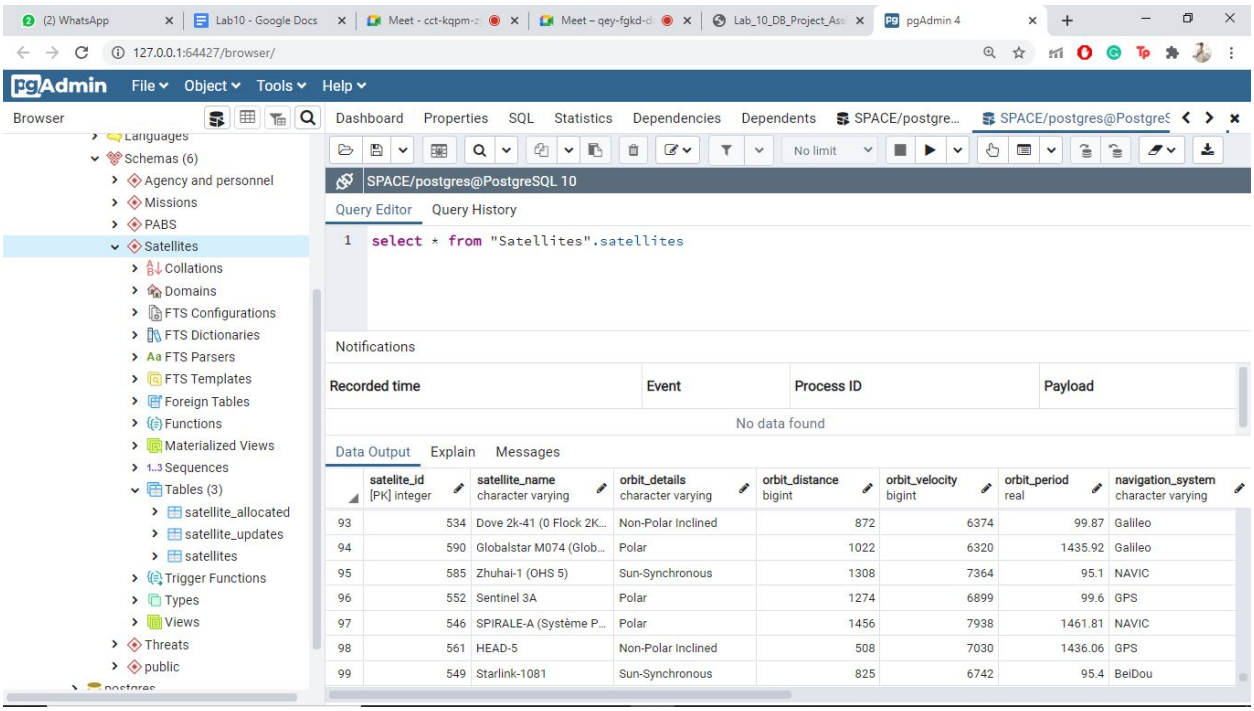
13. Stars



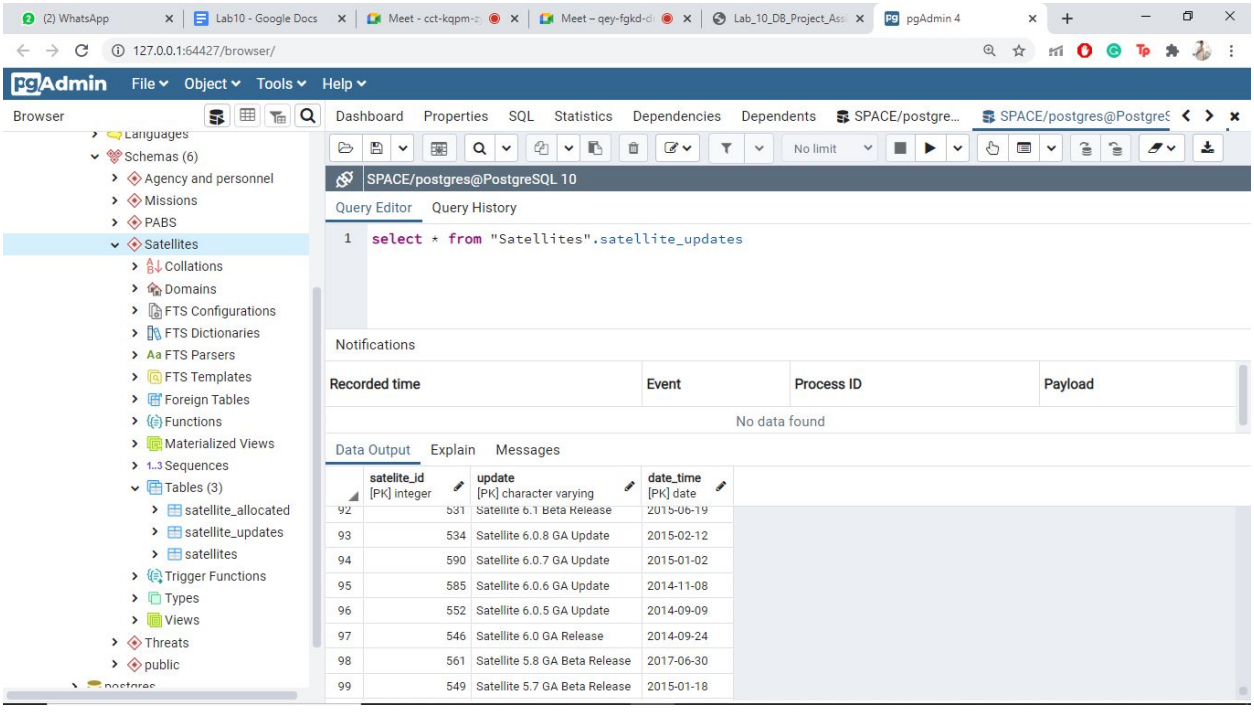
14. Star_studied



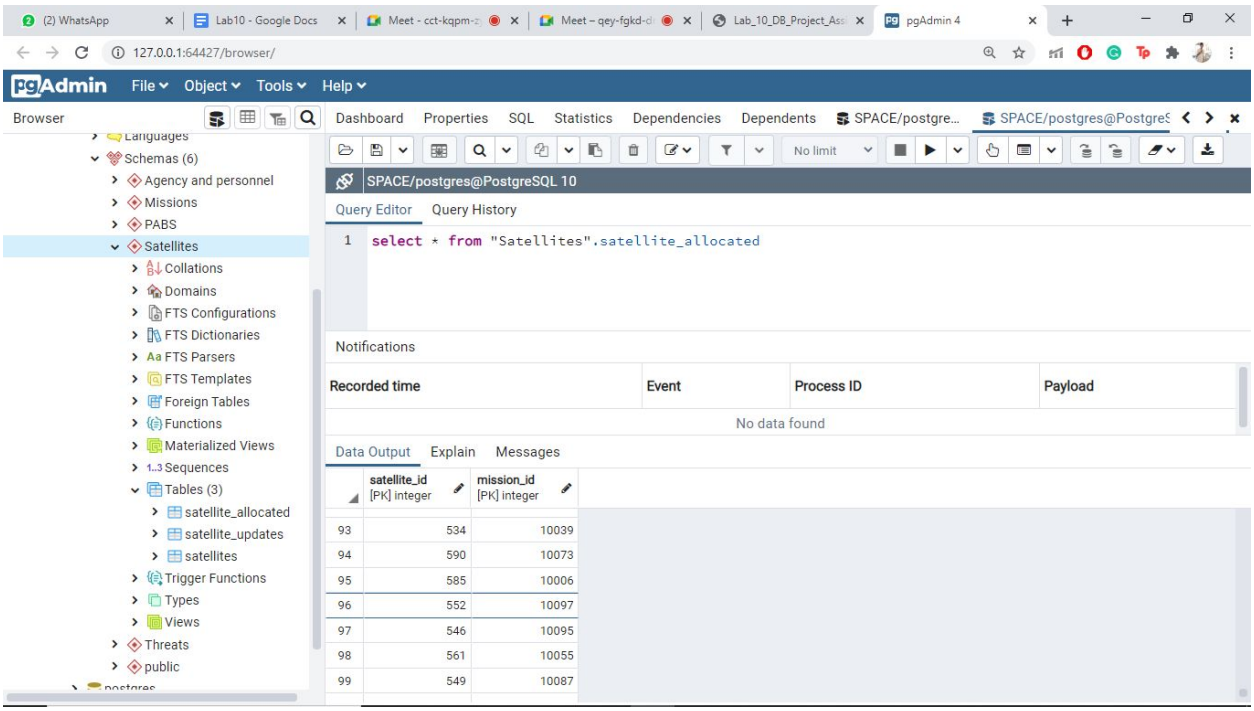
15. Satellites



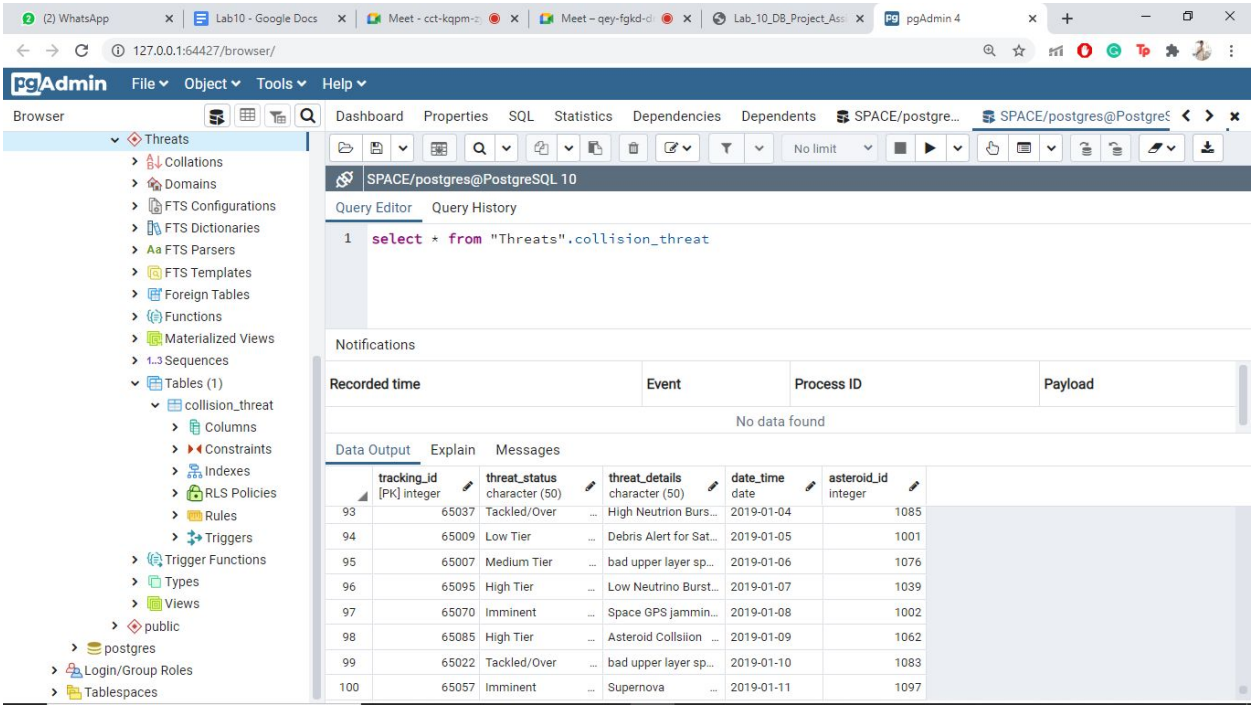
16. Satellite_updates



17. Satellite_allocated



18. Collision_threat



LAB_10 -- SQL Queries

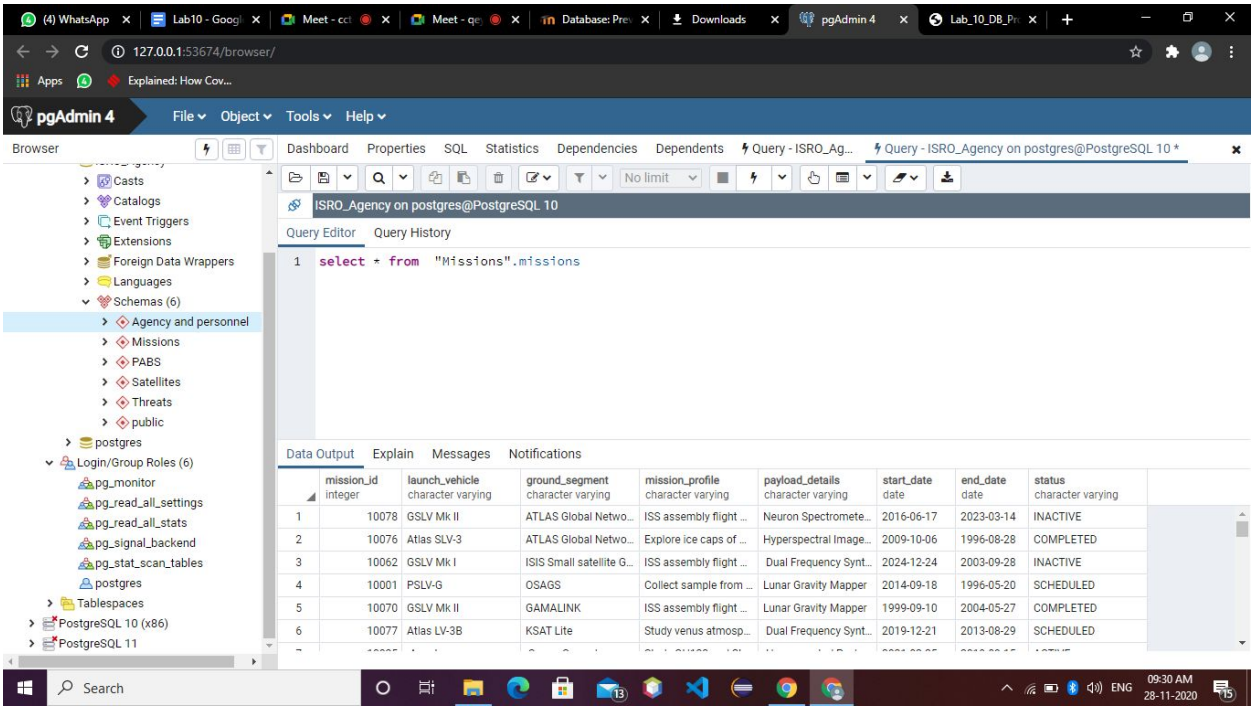
1. Show all the data from Mission table
2. Show mission ground segments whose names start from O
3. Show all the data from Satellites where orbit velocity is greater

Than 7000.

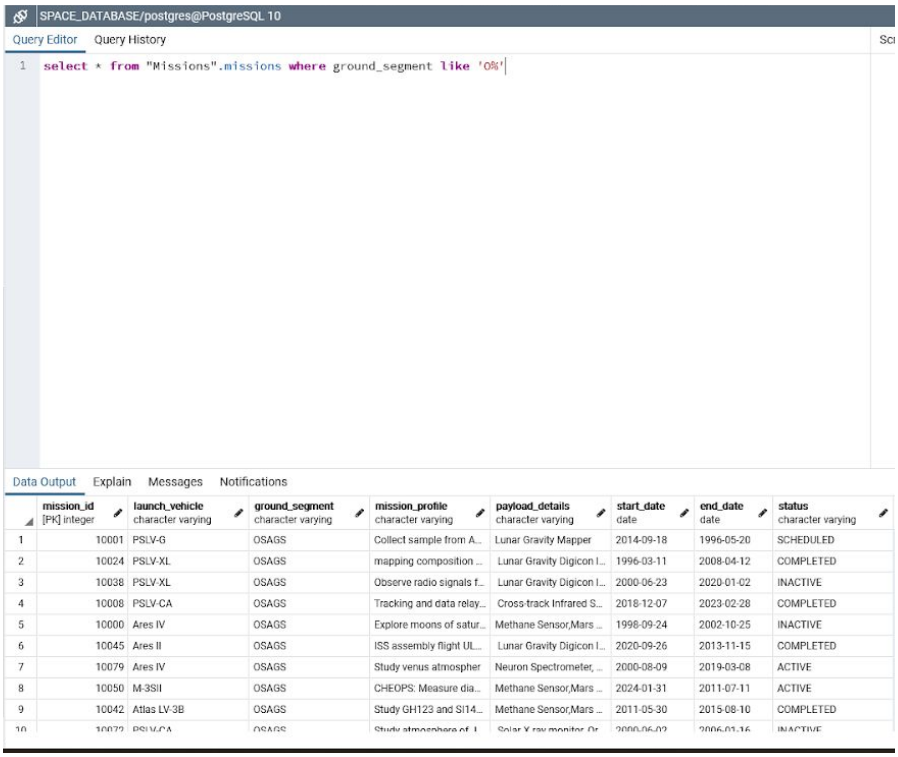
4. Show satellite details where planet id is 405.
5. Show all Satellite names where orbit distance greater than average of orbit distance
6. Show name and designation from isro_personnel where start_date is less than the first january 2010.
7. List personnel ID and phone numbers who have salary greater than 50000 and are currently studying blackholes using joins OR by using a function. This can be a requirement when high level personnel are required during an emergency.
8. List count of tuples from collision threats where status is Tracked/over.
9. Show average of all designations from isro personnel.
10. Show top 10 Asteroids names which have the highest mass.
11. Create a function to show all the imminent threats to earth in the next 6 months caused by asteroids and show the personnel assigned to those extraterrestrial entities if assigned.
12. Select star details which have the highest AU distance.
13. List all the satellite orbiting planet mars and have manufacturing parts more than 20
14. What is the satellite name for tracking ID 1020.
15. List out personnel name,mission profile,launch vehicle details Where mission status is active.
16. Name of mission profile and payload details for given agency name “Australian Space Agency”
17. List the number of satellites for each planet with a planet name.
18. List all the experiments having start date between “6/9/2009” and “6/20/2009”
19. List mission profile,satellite name connected to space agency with agency name.
20. What is the satellite update version of Moon in “9/2/2020”
21. What is threat status for asteroid “4 vesta”
22. Get the mission details and corresponding satellite id for all the future launch missions (hint mission_status “SCHEDULED” as we are considering future missions)
23. List all the phone numbers with name of personnel whose age is between 25 to 35.
24. List all asteroid name related threat status.

25. Display a warning message if a new threat is added which is going to happen in the next one month. Preferably create an INSERT trigger.
26. Create a function which displays all Mars missions updates for experiments whose outcomes are still “Pending” along with associated satellites.
27. Get all the personnel names and designations who is working on the satellite “Gaofen-1-04”
28. Create a trigger that checks whether the primary key exists or not in that table if not then prints it.
29. Create a trigger that checks foreign key exists or not in the referenced table if not then prints it.
30. List star id from star where classification is K and shape is Decagram.
31. List all the health percentages of satellites orbiting Mars.
32. List the mission and its experiments details where the mission was completed and successful.
33. List Scientist name and assigned blackhole name.
34. Sort the personnel details by its personnel salary.
35. Which personnel are working on a ‘M’ type star?
36. Get all the satellite ids whose data is being shared to Australian Space Agency.
37. Write a query when all the satellite data being shared with the UK space agency is immediately halted due to security concerns.
38. Delete missions updates which missions are canceled by agency.
39. Update a salary by 10000 of a personnel whose mission is completed.
40. List all planets name which have negative temperature in decreasing order by mass

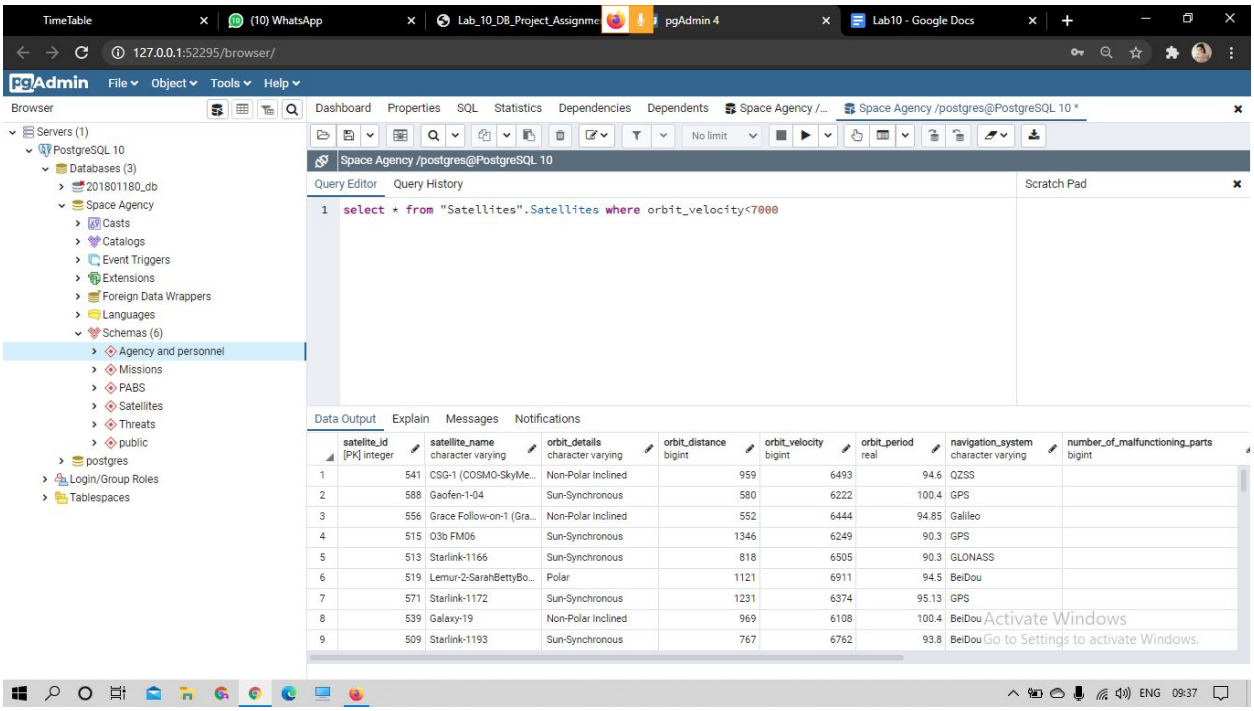
1)Select * from “Missions”.missions



2) e ground_segment like ‘O%’



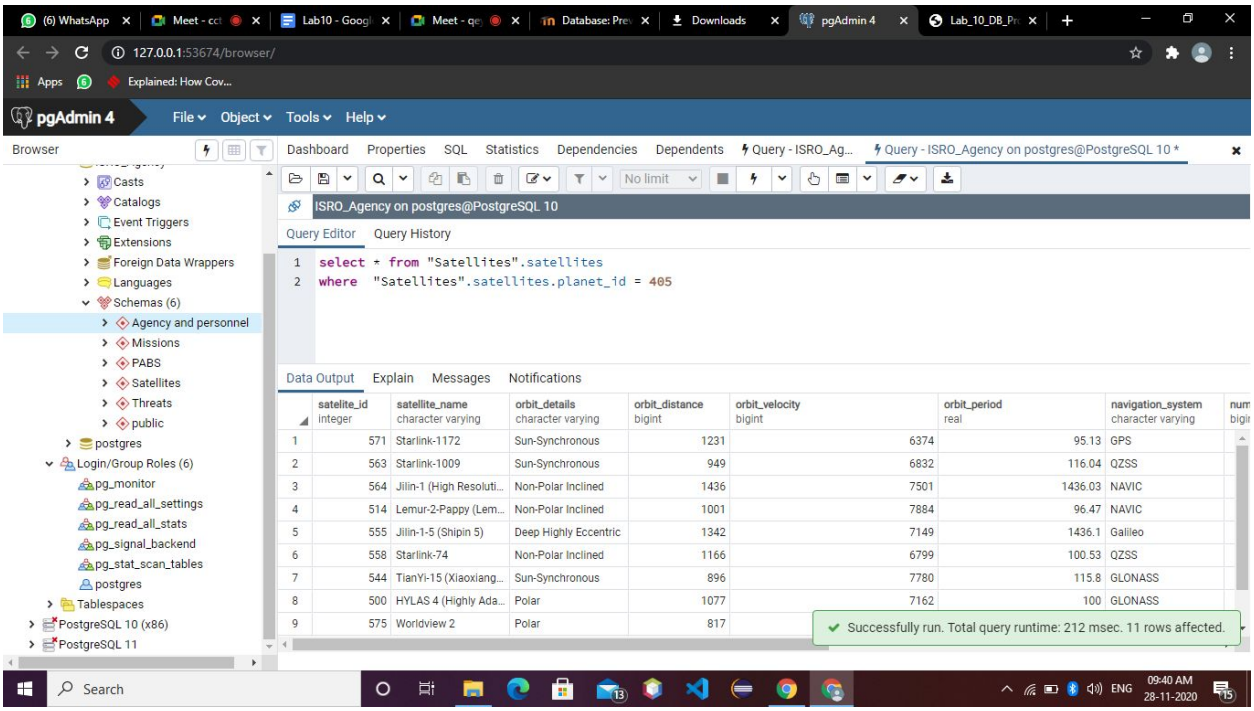
3)select * from "Satellites".Satellites where orbit_velocity<7000



4)

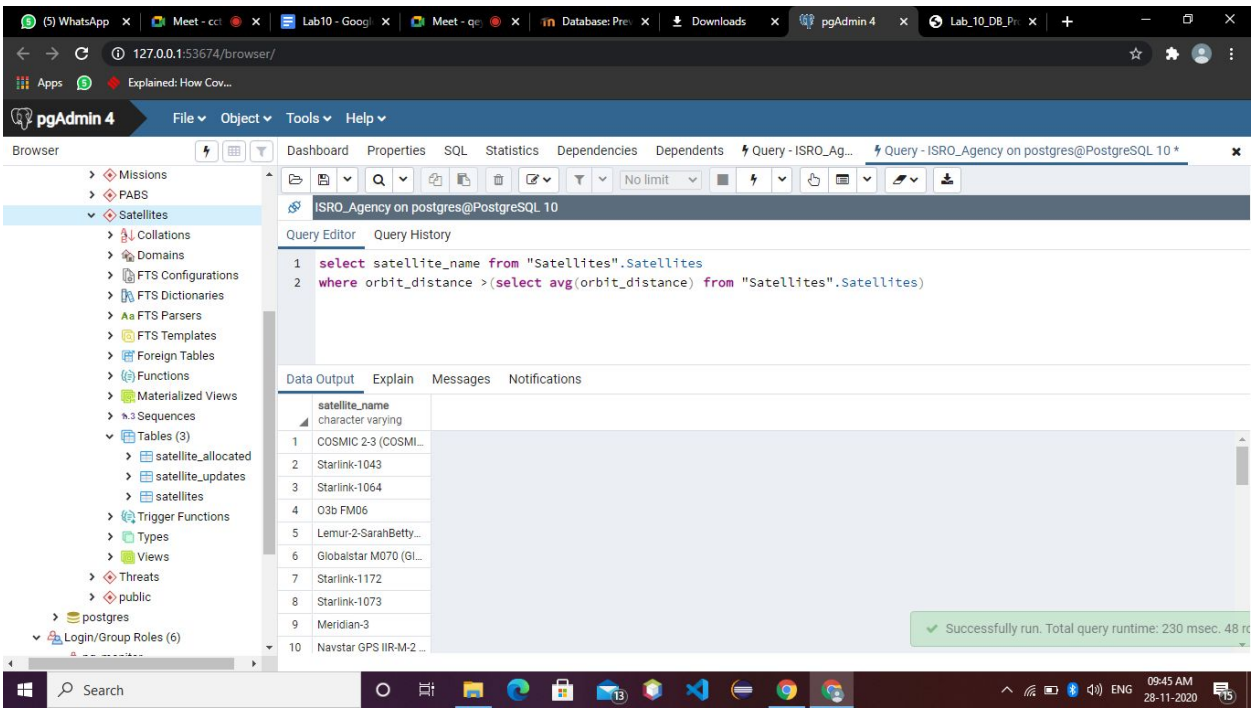
select * from "Satellites".satellites

where "Satellites".satellites.planet_id = 405

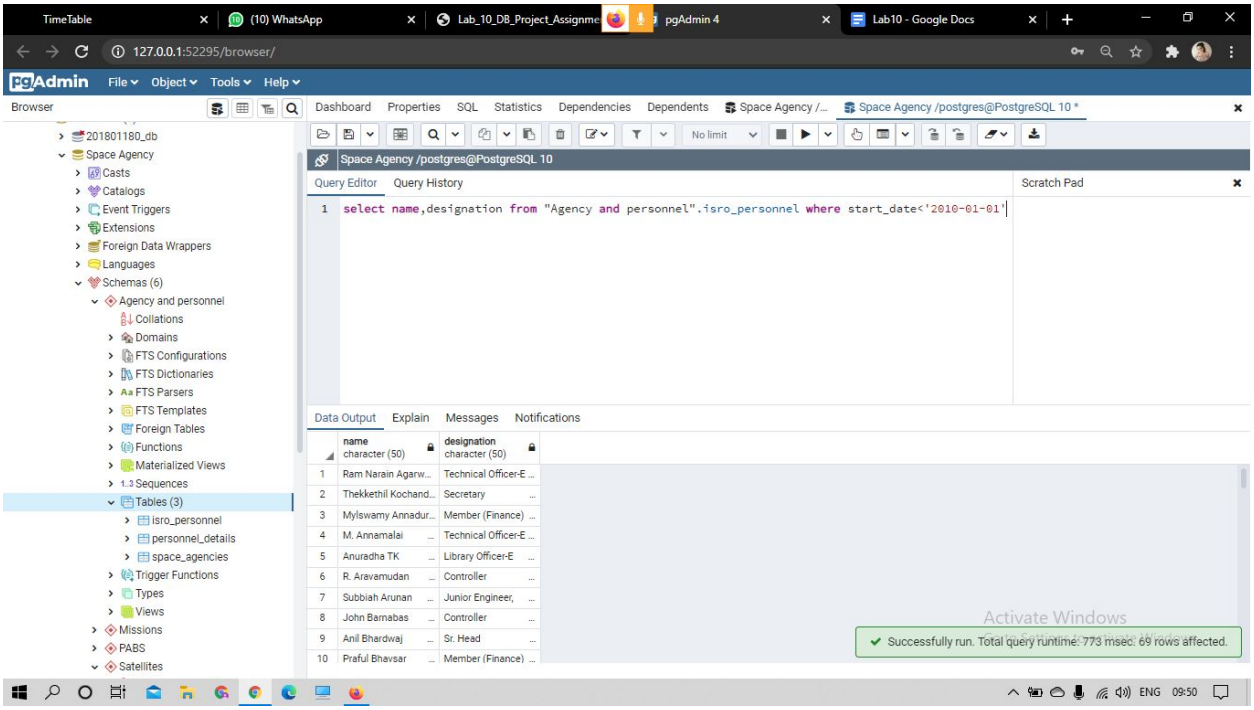


5)

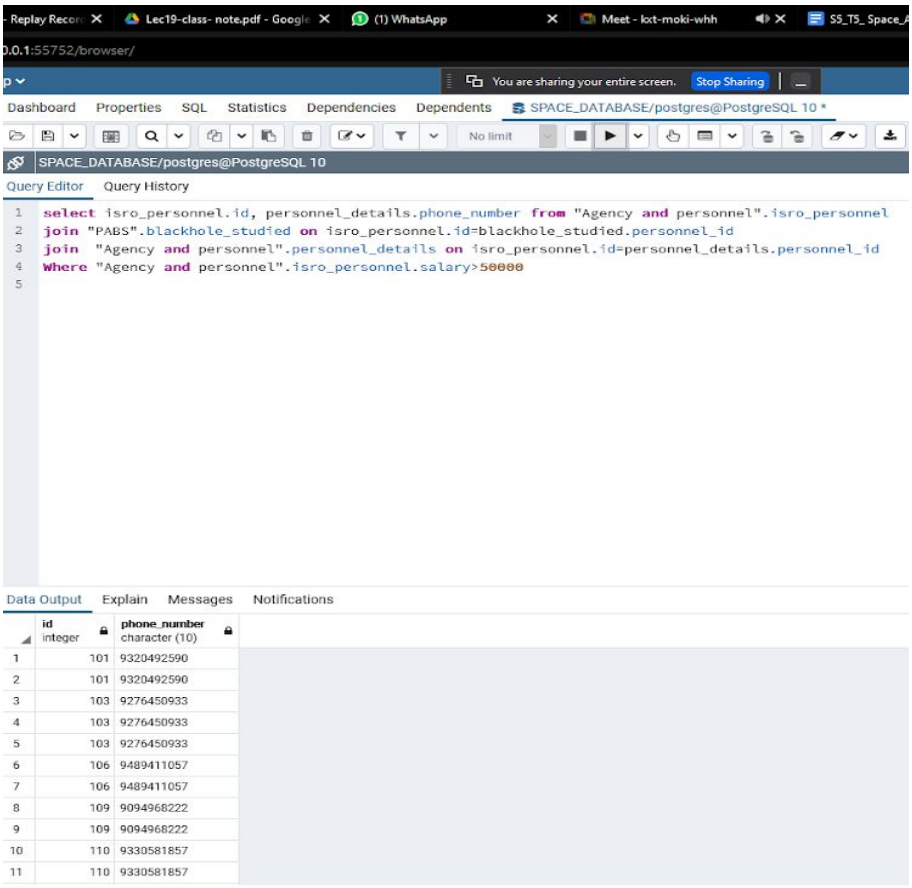
```
select satellite_name from "Satellites".Satellites
where orbit_distance >(select avg(orbit_distance) from "Satellites".Satellites)
```



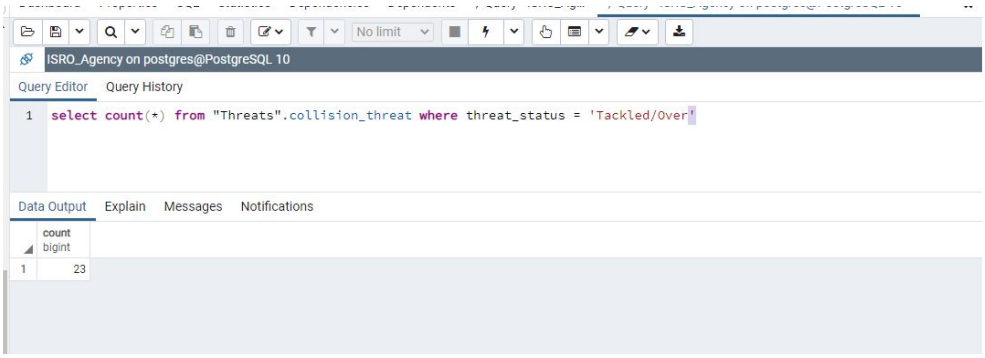
6)
select name,designation from "Agency and personnel".isro_personnel where start_date<'2010-01-01'



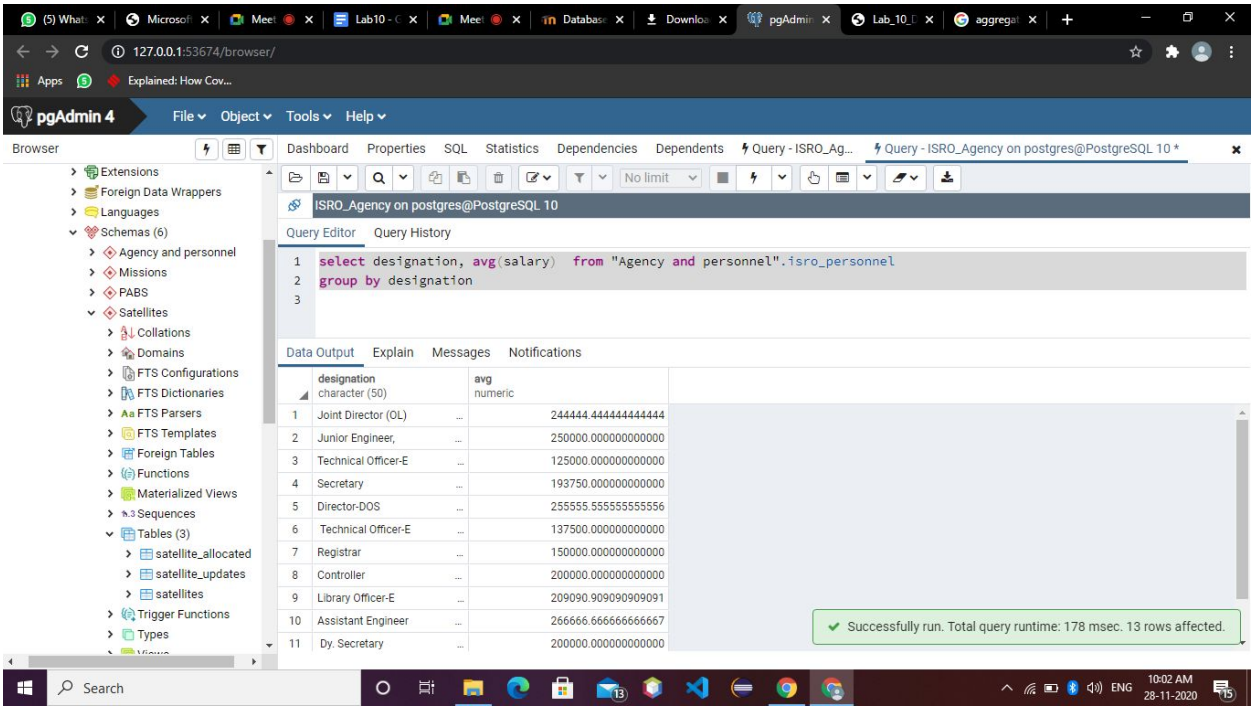
7)
select isro_personnel.id, personnel_details.phone_number from "Agency and personnel".isro_personnel
join "PABS".blackhole_studied on
isro_personnel.id=blackhole_studied.personnel_id
join "Agency and personnel".personnel_details on
isro_personnel.id=personnel_details.personnel_id
Where "Agency and personnel".isro_personnel.salary>50000



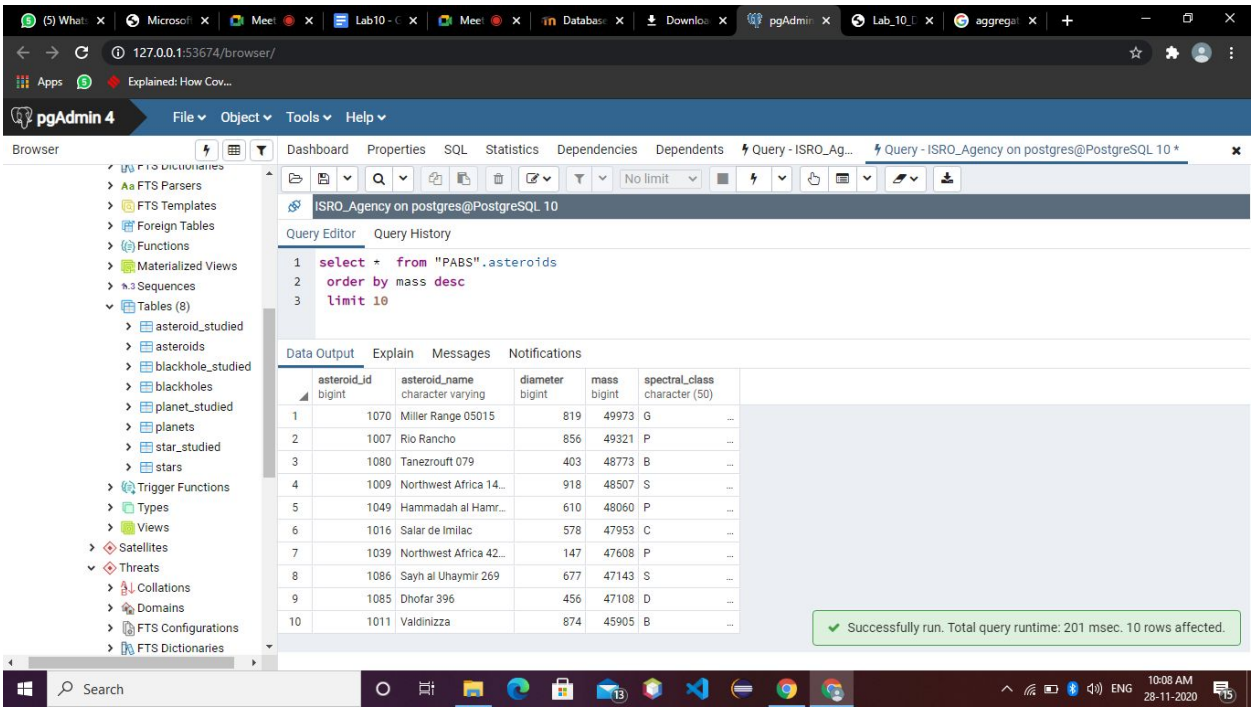
8.select count(*) from "Threats".collision_threat where threat_status = 'Tackled/Over'



9.select designation, avg(salary) from "Agency and personnel".isro_personnel
group by designation



10)select * from "PABS".asteroids
 order by mass desc
 limit 10



11)
create or replace function imminentf()
returns table

```
(
    tracking_id integer, threat_status varchar, date_time date,
personnel_name char(50),
    personnel_id integer, asteroid_id integer, mass bigint
)

LANGUAGE 'plpgsql'
AS $BODY$
BEGIN
return query

select "Threats".collision_threat.tracking_id,
"Threats".collision_threat.threat_status,
"Threats".collision_threat.date_time, "Agency and
personnel".isro_personnel.name,
"Agency and personnel".isro_personnel.id, "PABS".asteroids.asteroid_id,
"PABS".asteroids.mass
from "Threats".collision_threat

join "PABS".asteroids on
"Threats".collision_threat.asteroid_id="PABS".asteroids.asteroid_id
join "PABS".asteroid_studied on
collision_threat.asteroid_id="PABS".asteroid_studied.asteroid_id
join "Agency and personnel".isro_personnel on
"Agency and
personnel".isro_personnel.id="PABS".asteroid_studied.personnel_id

where (collision_threat.date_time between' 28-11-2020' and '28-05-2021');

END
$BODY$;
```

SPACE_DATABASE/postgres@PostgreSQL 10

Query Editor | Query History

```
1  create or replace function imminentf()
2  returns table
3  (
4      tracking_id integer, threat_status varchar, date_time date, personnel_name char(50),
5      personnel_id integer, asteroid_id integer, mass bigint
6  )
7
8  LANGUAGE 'plpgsql'
9  AS $BODY$
10 BEGIN
11 return query
12
13 select "Threats".collision_threat.tracking_id, "Threats".collision_threat.threat_status,
14 "Threats".collision_threat.date_time, "Agency and personnel".isro_personnel.name,
15 "Agency and personnel".isro_personnel.id, "PABS".asteroids.asteroid_id, "PABS".asteroids.mass
16 from "Threats".collision_threat
17
18 join "PABS".asteroids on "Threats".collision_threat.asteroid_id="PABS".asteroids.asteroid_id
19 join "PABS".asteroid_studied on collision_threat.asteroid_id="PABS".asteroid_studied.asteroid_id
20 join "Agency and personnel".isro_personnel on
21 "Agency and personnel".isro_personnel.id="PABS".asteroid_studied.personnel_id
```

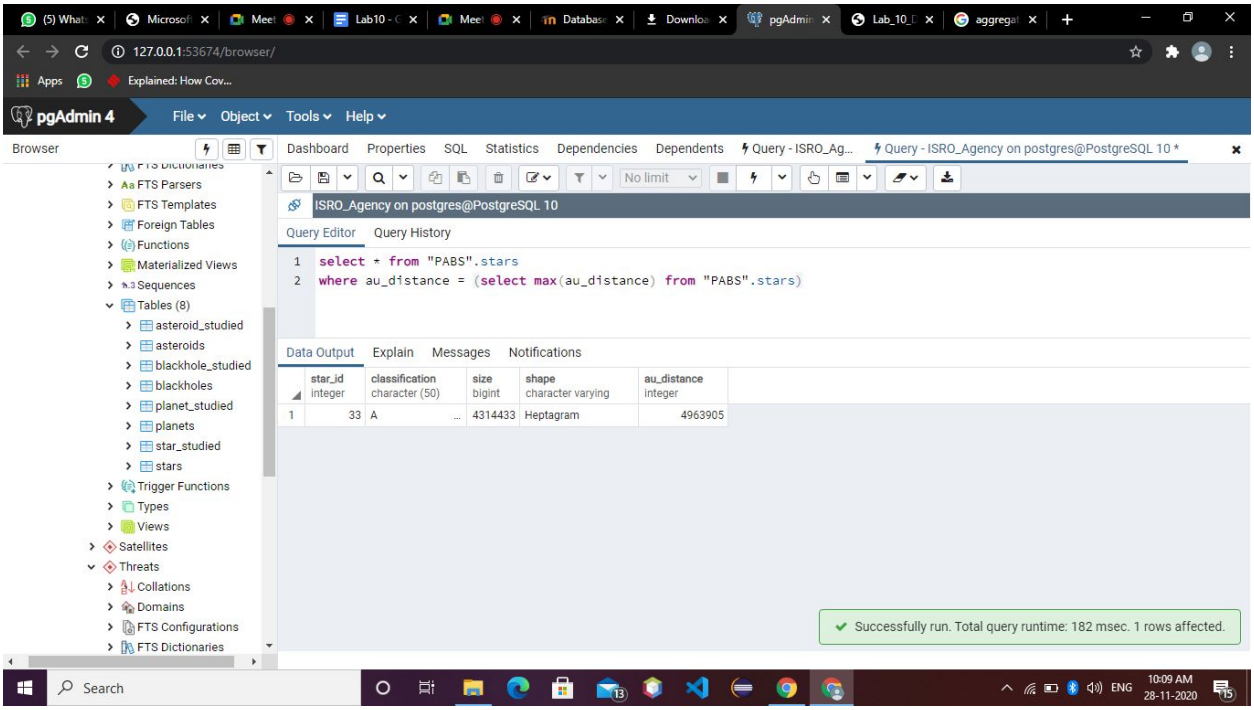
Data Output | Explain | Messages | Notifications

	tracking_id integer	threat_status character varying	date_time date	personnel_name character	personnel_id integer	asteroid_id integer	mass bigint
1	65008	Tackled/Over	2021-05-18	Satish Dhawan	119	1018	24462
2	65072	Imminent	2020-12-11	MS Panniselvam	159	1058	43503
3	65090	Simple Warning	2021-04-26	V. Adimurthy	164	1063	37487

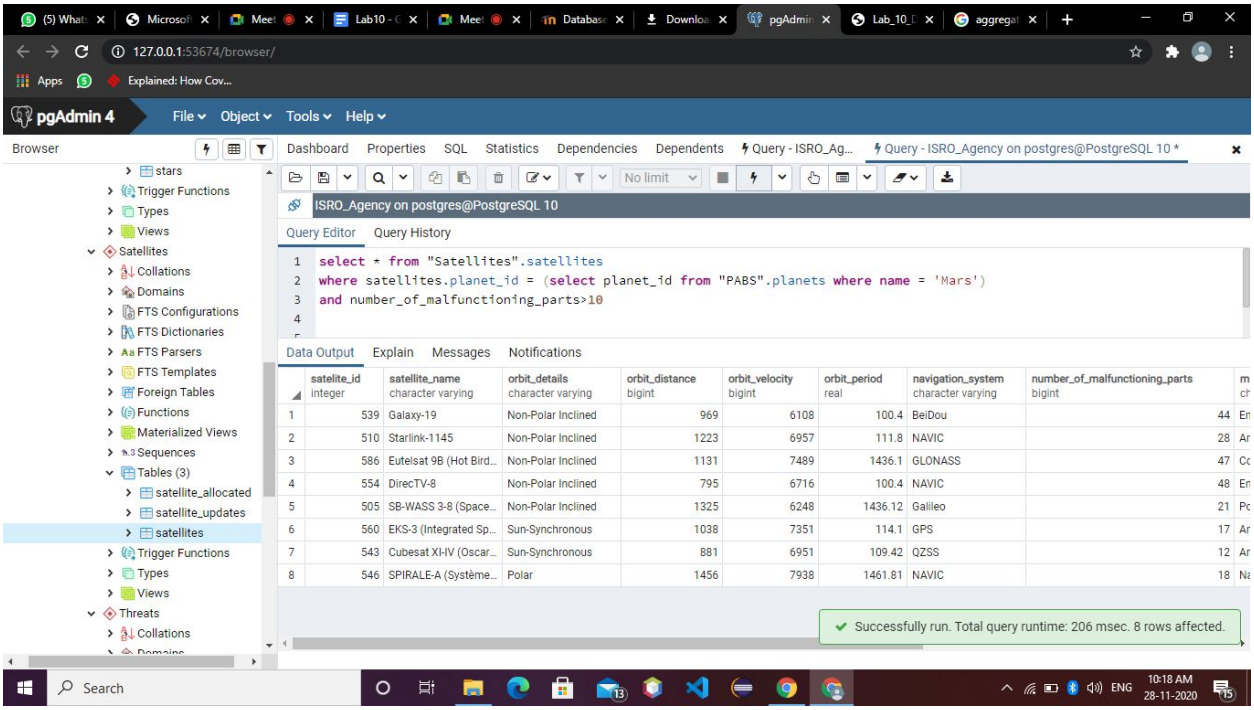
12)

select * from "PABS".stars

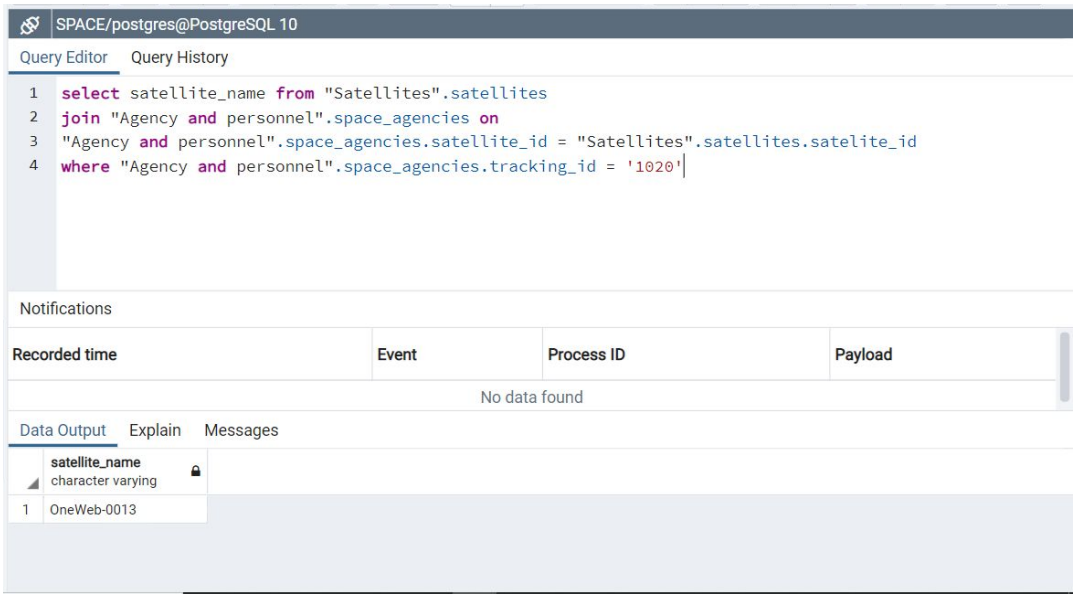
where au_distance = (select max(au_distance) from "PABS".stars)



13)select * from "Satellites".satellites
where satellites.planet_id = (select planet_id from "PABS".planets where name = 'Mars')
and number_of_malfunctioning_parts>10

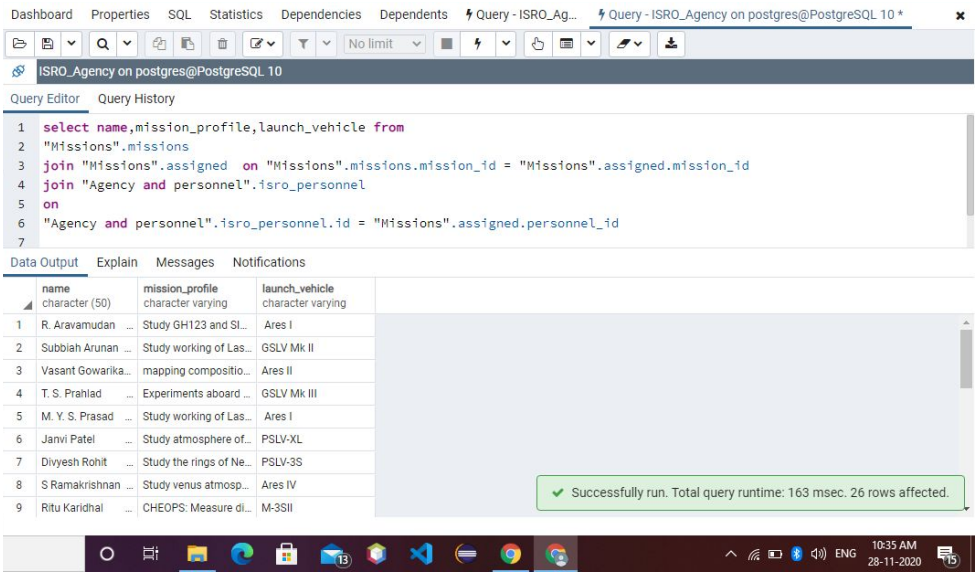


14)
select satellite_name from "Satellites".satellites
join "Agency and personnel".space_agencies on
"Agency and personnel".space_agencies.satellite_id =
"Satellites".satellites.satelite_id
where "Agency and personnel".space_agencies.tracking_id = '1020'

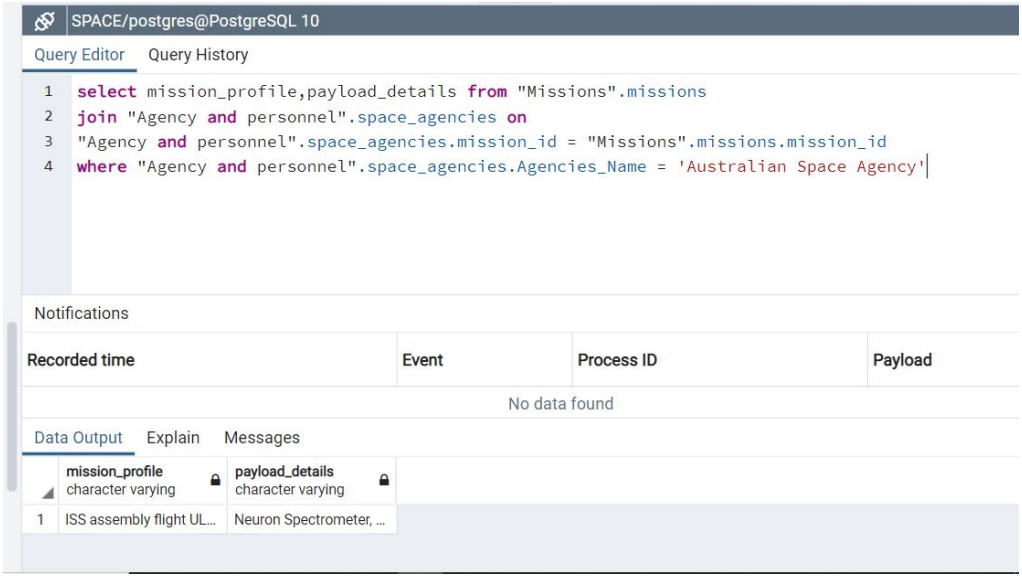


15)

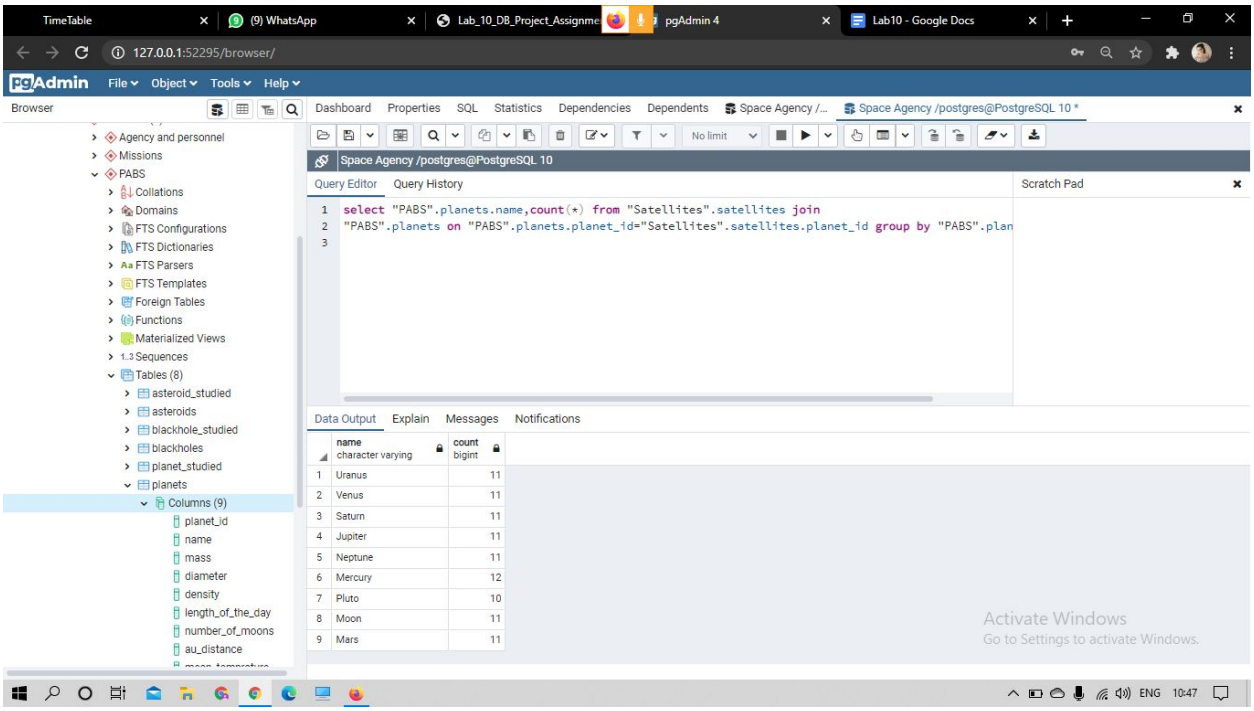
```
select name,mission_profile,launch_vehicle from
"Missions".missions
join "Missions".assigned  on "Missions".missions.mission_id =
"Missions".assigned.mission_id
join "Agency and personnel".isro_personnel
on
"Agency and personnel".isro_personnel.id =
"Missions".assigned.personnel_id

where status = 'ACTIVE'
```



16)
select mission_profile,payload_details from "Missions".missions
join "Agency and personnel".space_agencies on
"Agency and personnel".space_agencies.mission_id =
"Missions".missions.mission_id
where "Agency and personnel".space_agencies.Agencies_Name =
'Australian Space Agency'

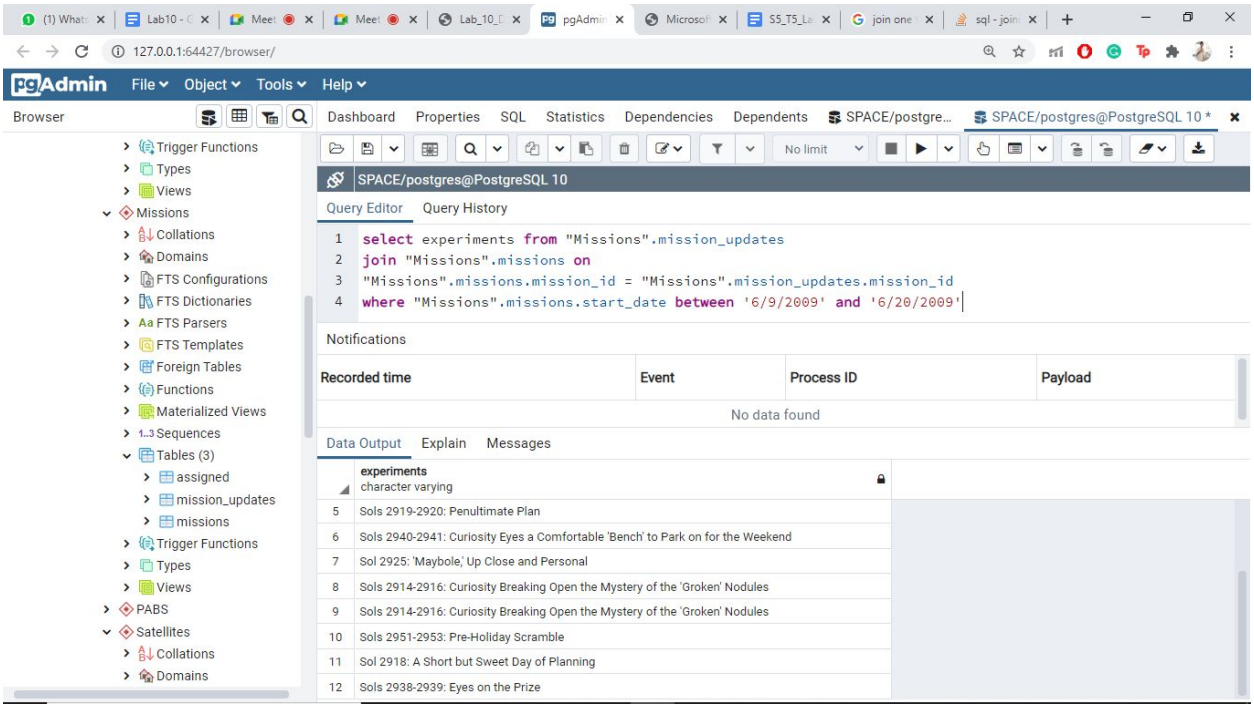


17. select "PABS".planets.name,count(*) from "Satellites".satellites join "PABS".planets on "PABS".planets.planet_id="Satellites".satellites.planet_id group by "PABS".planets.planet_id



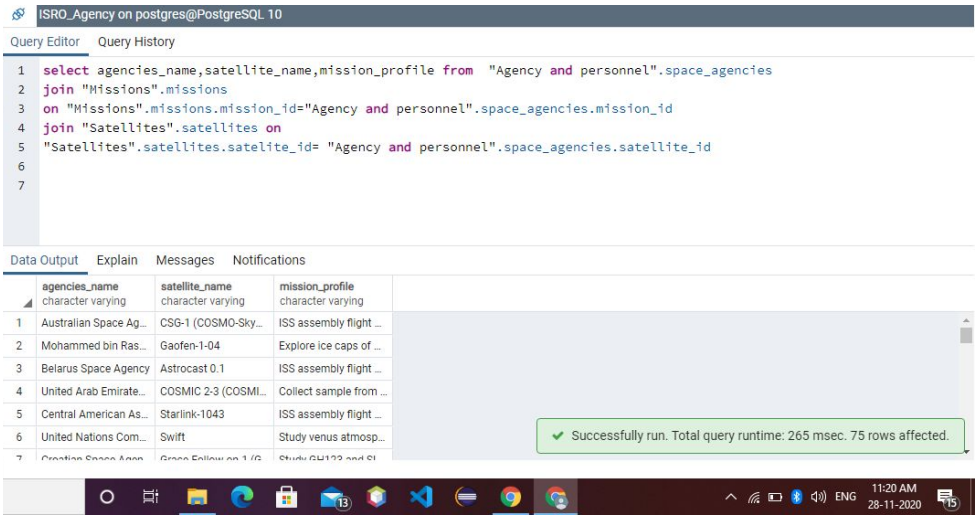
18)

```
select experiments from "Missions".mission_updates
join "Missions".missions on
"Missions".missions.mission_id = "Missions".mission_updates.mission_id
where "Missions".missions.start_date between '6/9/2009' and '6/20/2009'
```



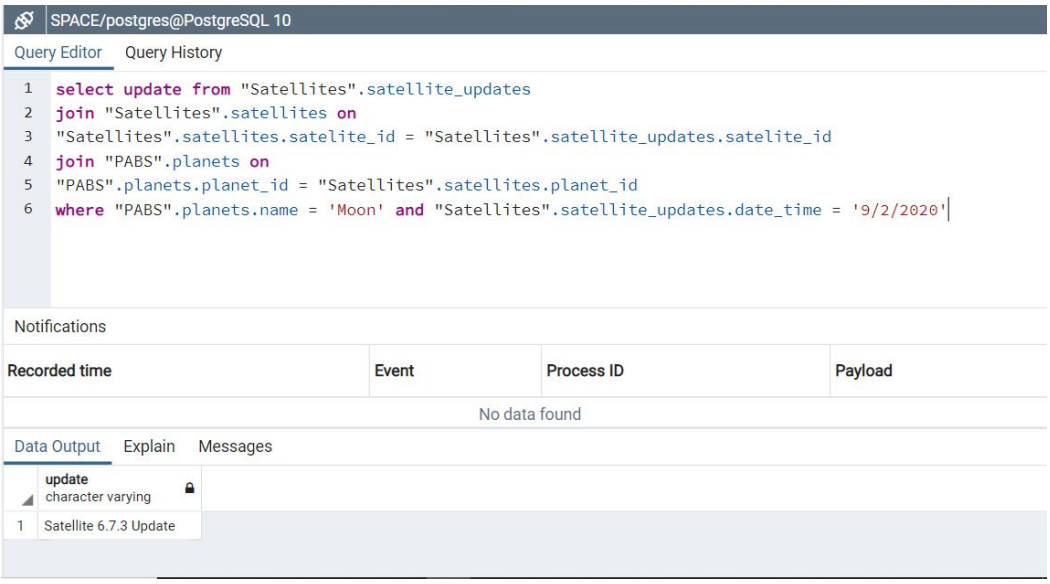
19)

```
select agencies_name,satellite_name,mission_profile from  "Agency and
personnel".space_agencies
join "Missions".missions
on "Missions".missions.mission_id="Agency and
personnel".space_agencies.mission_id
join "Satellites".satellites on
"Satellites".satellites.satelite_id= "Agency and
personnel".space_agencies.satellite_id
```



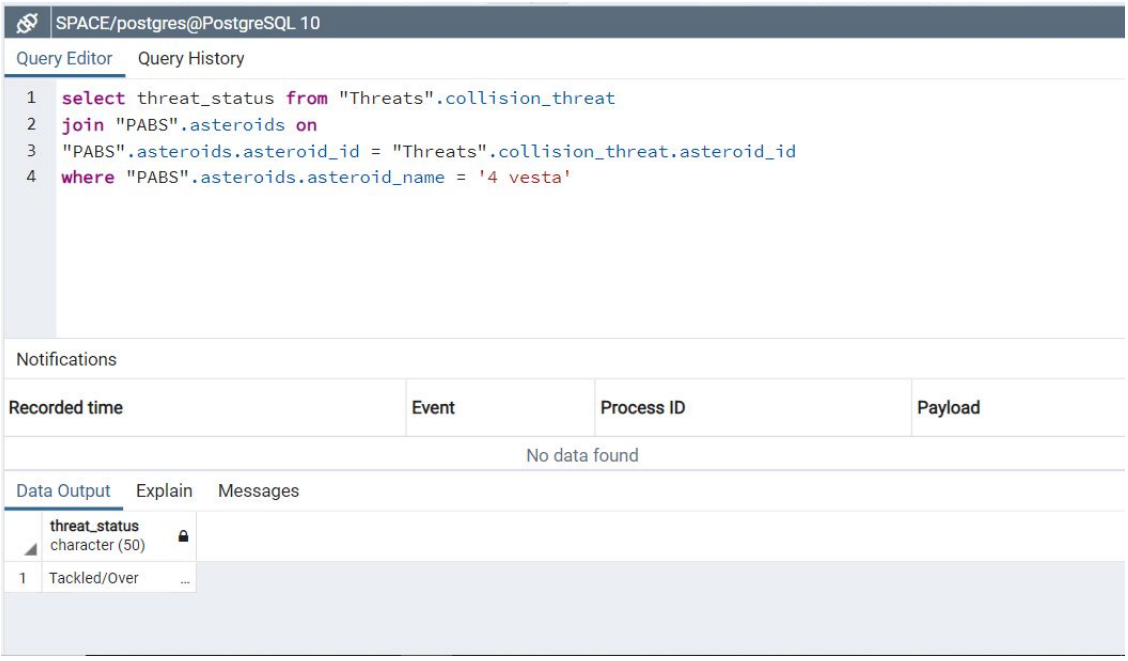
20)

```
select update from "Satellites".satellite_updates
join "Satellites".satellites on
"Satellites".satellites.satelite_id = "Satellites".satellite_updates.satelite_id
join "PABS".planets on
"PABS".planets.planet_id = "Satellites".satellites.planet_id
where "PABS".planets.name = 'Moon' and
"Satellites".satellite_updates.date_time = '9/2/2020'
```



21)

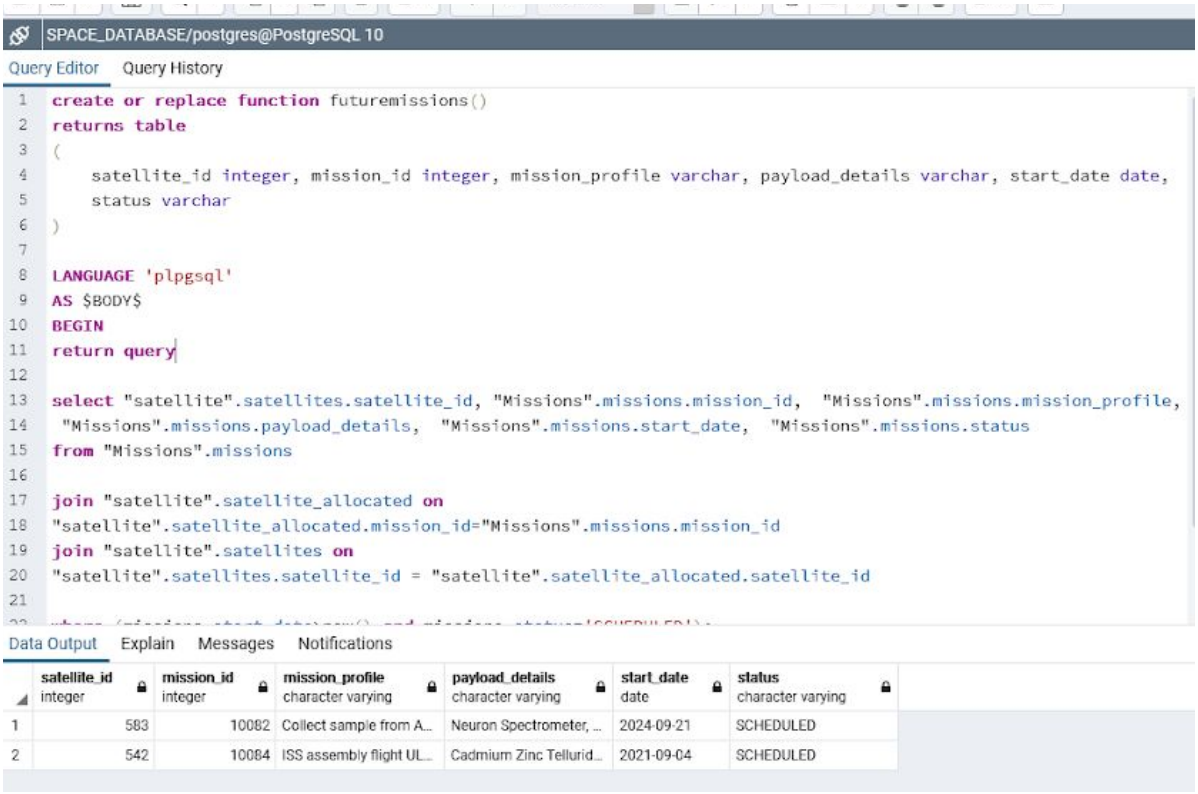
```
select threat_status from "Threats".collision_threat
join "PABS".asteroids on
"PABS".asteroids.asteroid_id = "Threats".collision_threat.asteroid_id
where "PABS".asteroids.asteroid_name = '4 vesta'
```



22)

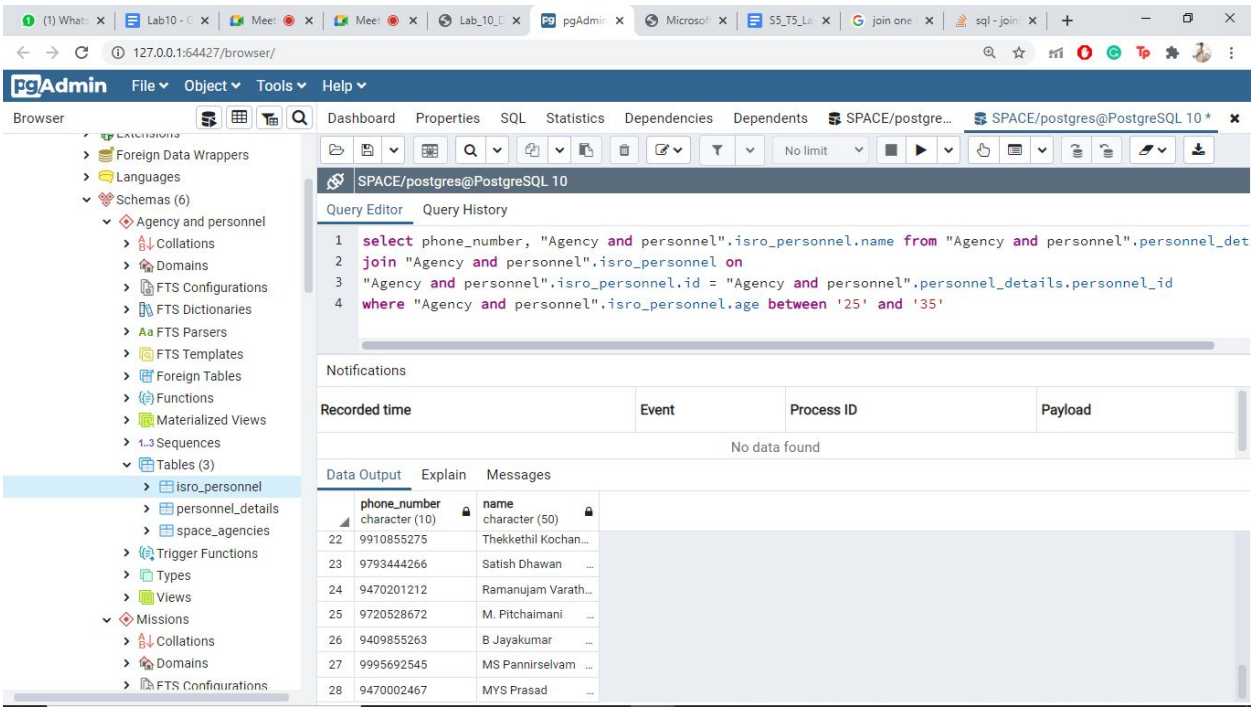
```
create or replace function futuremissions()
returns table
```

```
(
    satellite_id integer, mission_id integer, mission_profile varchar,
payload_details varchar, start_date date,
    status varchar
)

LANGUAGE 'plpgsql'
AS $BODY$
BEGIN
return query

select "satellite".satellites.satellite_id, "Missions".missions.mission_id,
"Missions".missions.mission_profile,
 "Missions".missions.payload_details,  "Missions".missions.start_date,
"Missions".missions.status
from "Missions".missions

join "satellite".satellite_allocated on
"satellite".satellite_allocated.mission_id="Missions".missions.mission_id
join "satellite".satellites on
"satellite".satellites.satellite_id = "satellite".satellite_allocated.satellite_id

where (missions.start_date>now() and missions.status='SCHEDULED');

END
$BODY$;
```

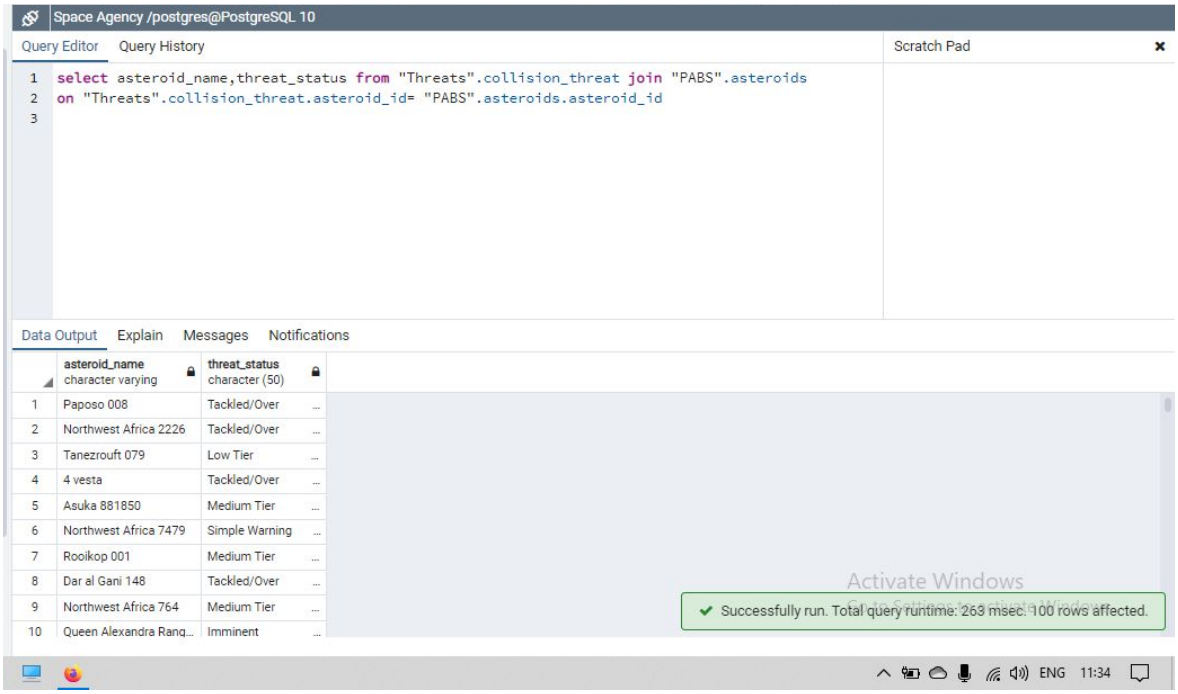


23)

```
select phone_number, "Agency and personnel".isro_personnel.name from
"Agency and personnel".personnel_details
join "Agency and personnel".isro_personnel on
"Agency and personnel".isro_personnel.id = "Agency and
personnel".personnel_details.personnel_id
where "Agency and personnel".isro_personnel.age between '25' and '35'
```

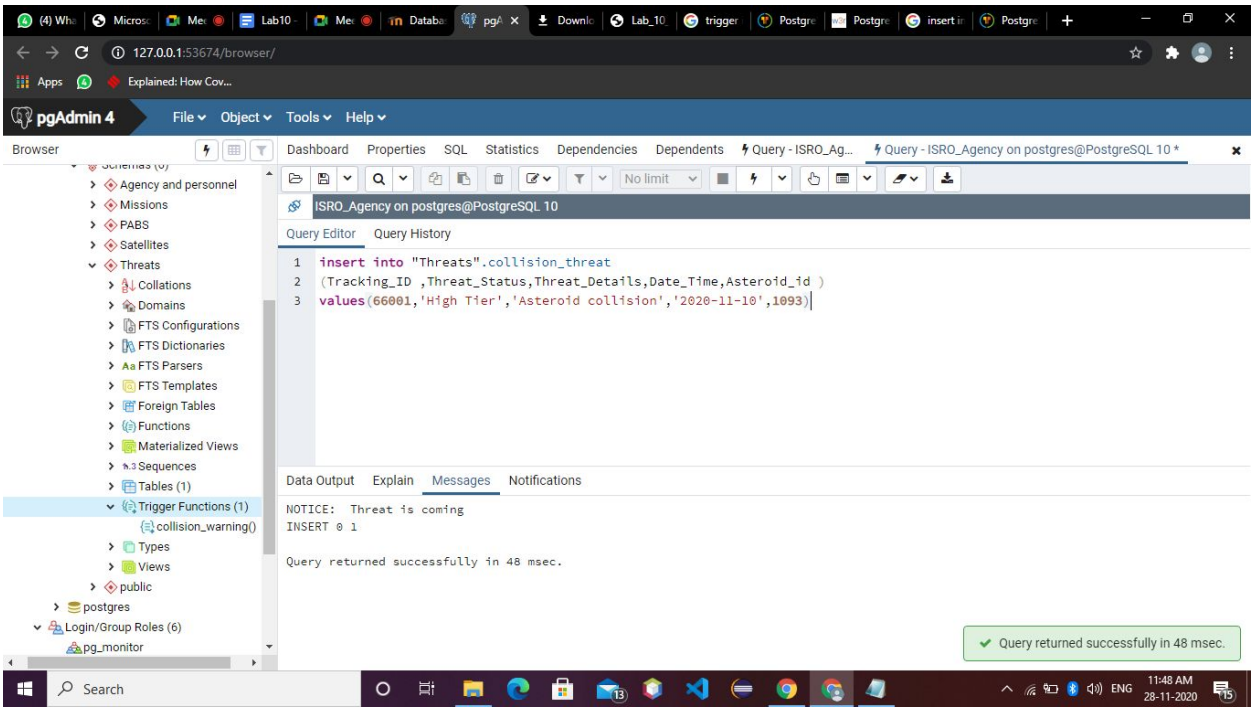


24)select asteroid_name,threat_status from "Threats".collision_threat join "PABS".asteroids
on "Threats".collision_threat.asteroid_id= "PABS".asteroids.asteroid_id



25)
CREATE OR REPLACE FUNCTION "Threats".collision_warning()
RETURNS trigger AS

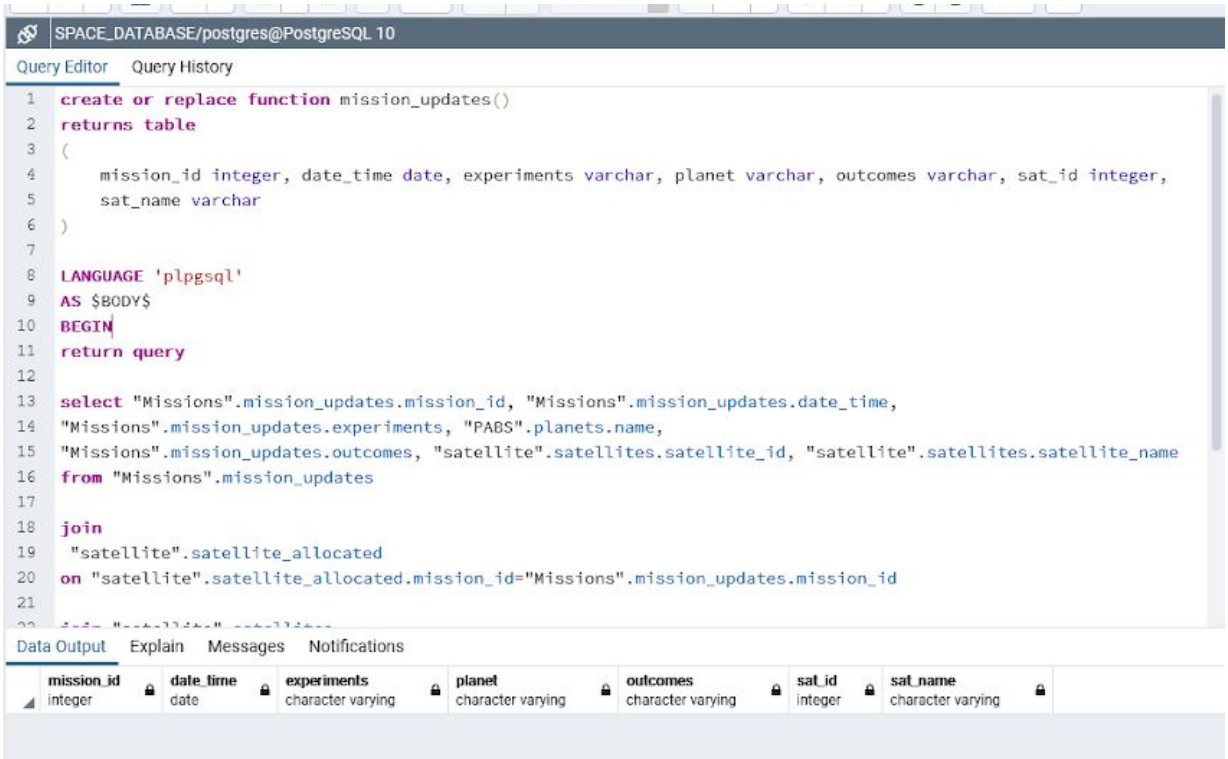
```
$BODY$
BEGIN
  IF (new.date_time-current_date<=30) THEN
    raise notice 'Threat is coming';

  end if;
  return new;

END
$BODY$
LANGUAGE plpgsql;


create trigger collison_warn
after insert
on "Threats".collision_threat
for each row
execute procedure "Threats".collision_warning()


insert into "Threats".collision_threat
(Tracking_ID ,Threat_Status,Threat_Details,Date_Time,Asteroid_id )
values(66001,'High Tier','Asteroid collision','2020-11-10',1093)
```



26)

```
create or replace function mission_updates()
returns table
(
    mission_id integer, date_time date, experiments varchar, planet varchar,
outcomes varchar, sat_id integer,
    sat_name varchar
)

LANGUAGE 'plpgsql'
AS $BODY$
BEGIN
return query

select "Missions".mission_updates.mission_id,
"Missions".mission_updates.date_time,
"Missions".mission_updates.experiments, "PABS".planets.name,
"Missions".mission_updates.outcomes, "satellite".satellites.satellite_id,
"satellite".satellites.satellite_name
from "Missions".mission_updates
```

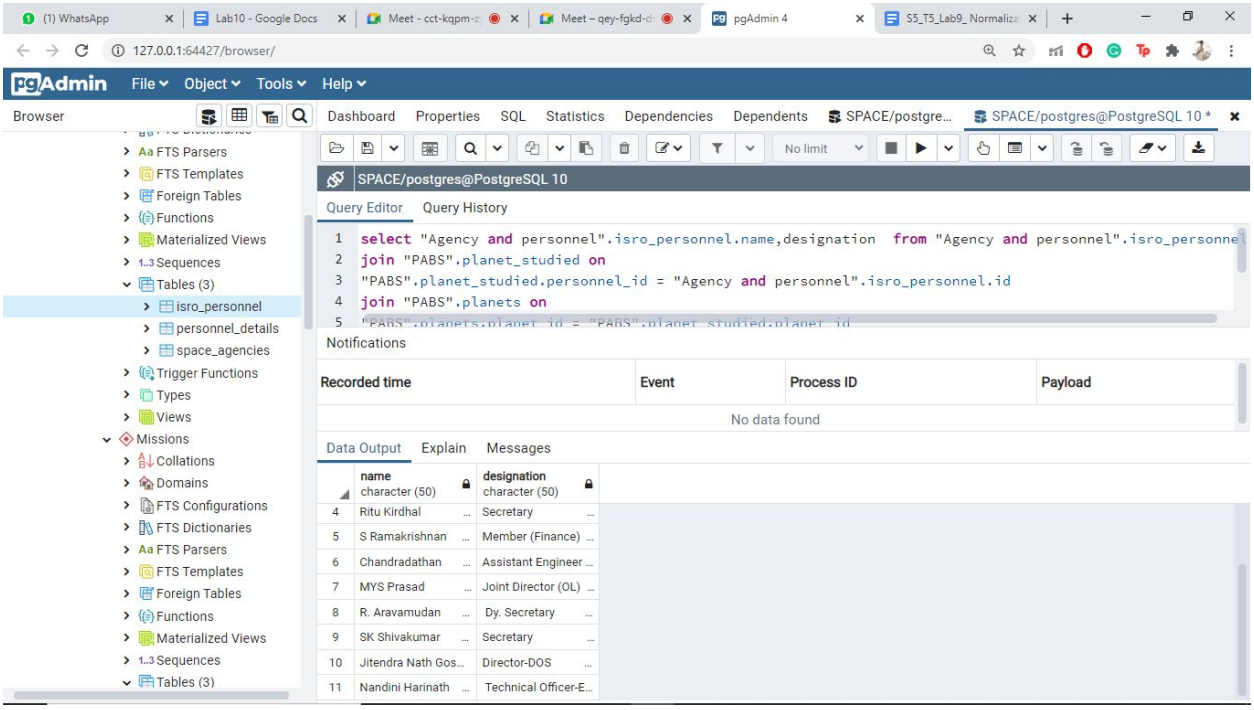
```
join
 "satellite".satellite_allocated
on
"satellite".satellite_allocated.mission_id="Missions".mission_updates.mission
_id

join "satellite".satellites
on "satellite".satellites.satellite_id="satellite".satellite_allocated.satellite_id

join "PABS".planets
on "PABS".planets.planet_id="satellite".satellites.planet_id

where "PABS".planets.name='Mars' and
"Missions".mission_updates.outcomes='PENDING';

END
$BODY$;
```



27)

```
select "Agency and personnel".isro_personnel.name,designation
```

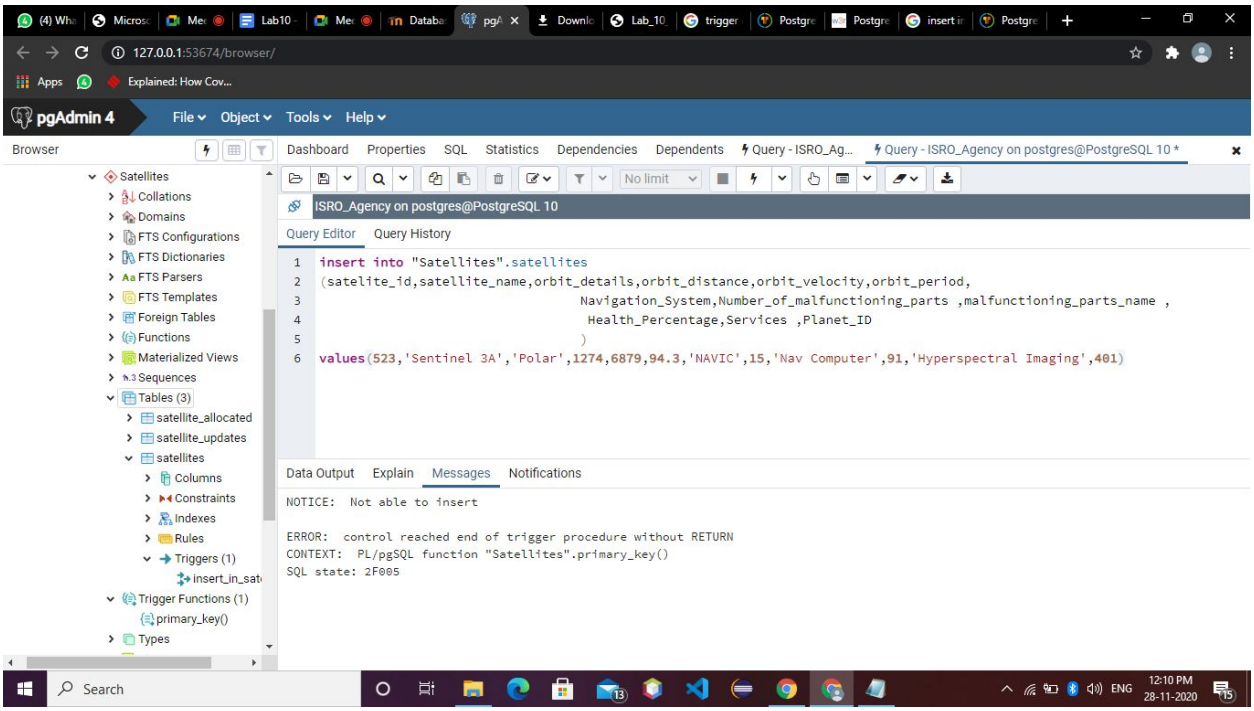
```
from "Agency and personnel".isro_personnel
join "PABS".planet_studied on
"PABS".planet_studied.personnel_id = "Agency and
personnel".isro_personnel.id
join "PABS".planets on
"PABS".planets.planet_id = "PABS".planet_studied.planet_id
join "Satellites".satellites on
"Satellites".satellites.planet_id = "PABS".planets.planet_id
where "Satellites".satellites.satellite_name = 'Gaofen-1-04'
```



28)

```
CREATE OR REPLACE FUNCTION "Satellites".primary_key()
RETURNS trigger AS
$BODY$
BEGIN
  IF (SELECT COUNT(*) FROM "Satellites".satellites WHERE
satellites.satelite_id  = NEW.satelite_id) > 0 THEN
        raise notice 'Not able to insert';
   else
   return new;
        end if;
```

```
END;
$BODY$
LANGUAGE plpgsql;



create trigger insert_in_satellite
before insert on "Satellites".satellites
for each row
execute procedure "Satellites".primary_key();

insert into "Satellites".satellites
(satelite_id,satellite_name,orbit_details,orbit_distance,orbit_velocity,orbit_per
iod,

Navigation_System,Number_of_malfunctioning_parts
,malfunctioning_parts_name ,
                                                    Health_Percentage,Services
,Planet_ID
                                                   )
values(523,'Sentinel 3A','Polar',1274,6879,94.3,'NAVIC',15,'Nav
Computer',91,'Hyperspectral Imaging',401)
```



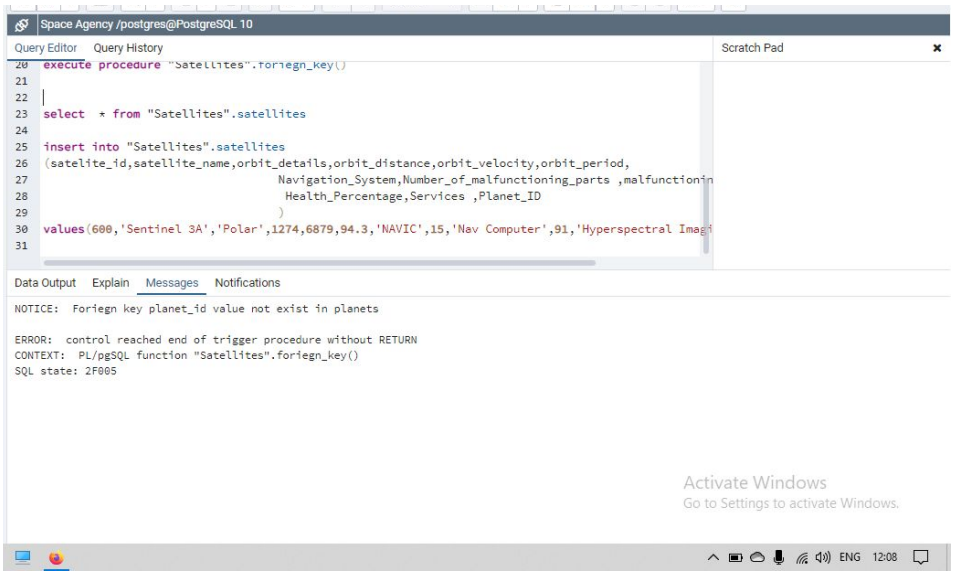
29)

```
CREATE OR REPLACE FUNCTION "Satellites".foriegn_key()
RETURNS trigger AS
$BODY$
BEGIN
  IF (SELECT COUNT(*) FROM "Satellites".satellites WHERE
"Satellites".satellites.planet_id= NEW.planet_id)= 0 THEN
    raise notice 'Foriegn key planet_id value not exist in planets';
  else
  return new;

  end if;

END;
$BODY$
LANGUAGE plpgsql;


create trigger foriegn_id_checking
before insert on "Satellites".satellites
for each row
```

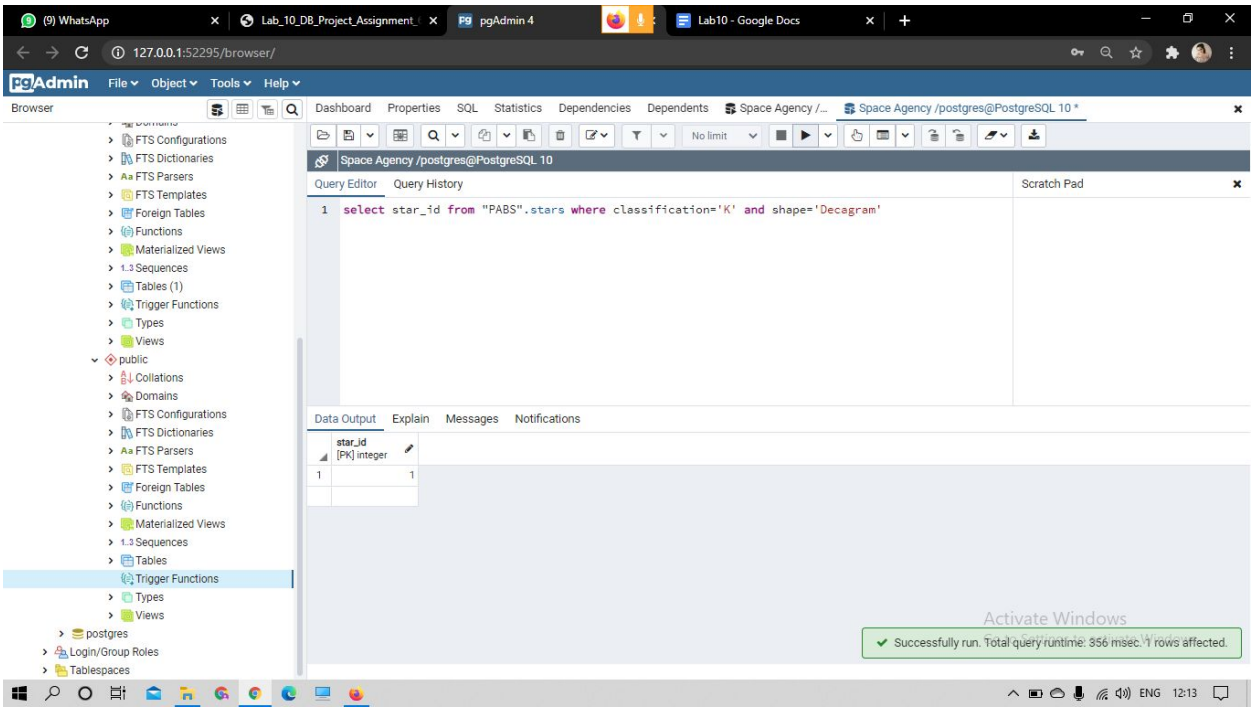
execute procedure "Satellites".foriegn_key()

insert into "Satellites".satellites
(satelite_id,satellite_name,orbit_details,orbit_distance,orbit_velocity,orbit_period,

Navigation_System,Number_of_malfunctioning_parts
,malfunctioning_parts_name ,
Health_Percentage,Services
,Planet_ID
)
values(600,'Sentinel 3A','Polar',1274,6879,94.3,'NAVIC',15,'Nav Computer',91,'Hyperspectral Imaging',410)

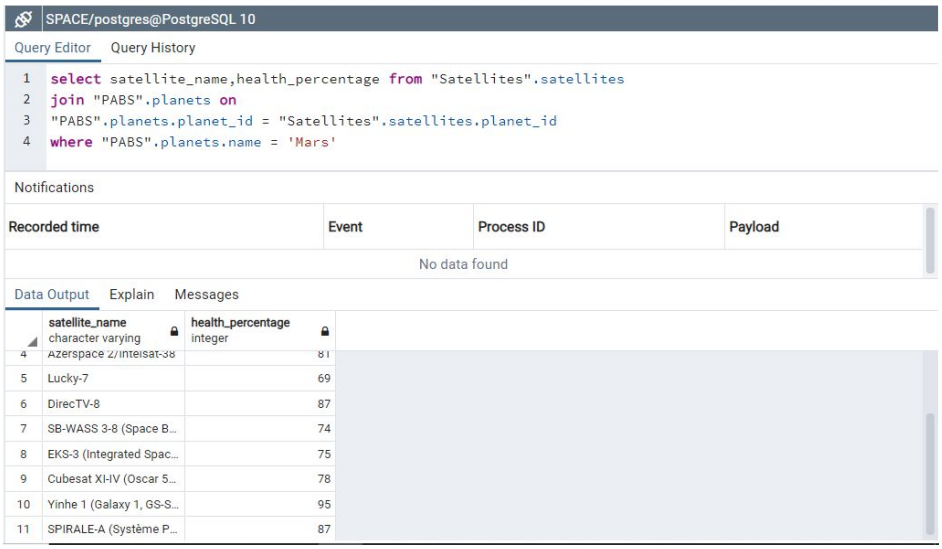


30)select star_id from "PABS".stars where classification='K' and shape='Decagram'



31)

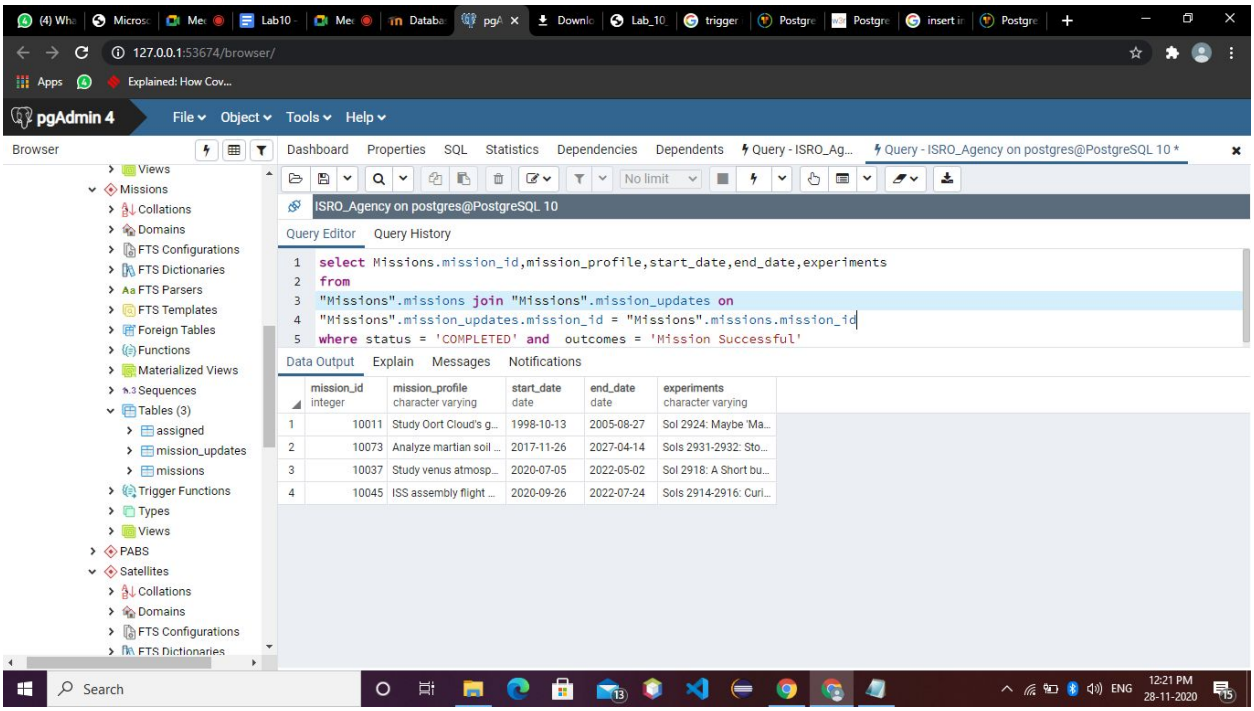
```
select satellite_name,health_percentage from "Satellites".satellites
join "PABS".planets on
"PABS".planets.planet_id = "Satellites".satellites.planet_id
where "PABS".planets.name = 'Mars'
```



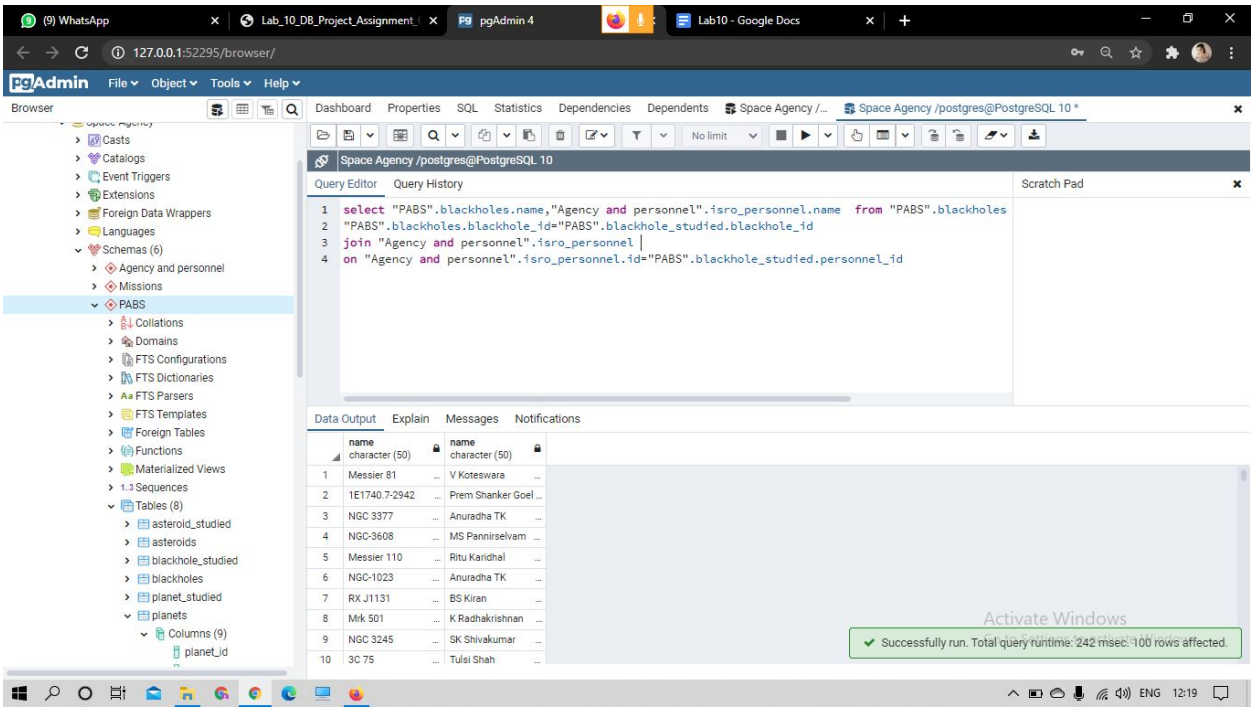
32)

```
select Missions.mission_id,mission_profile,start_date,end_date,experiments
from
"Missions".missions join "Missions".mission_updates on
```

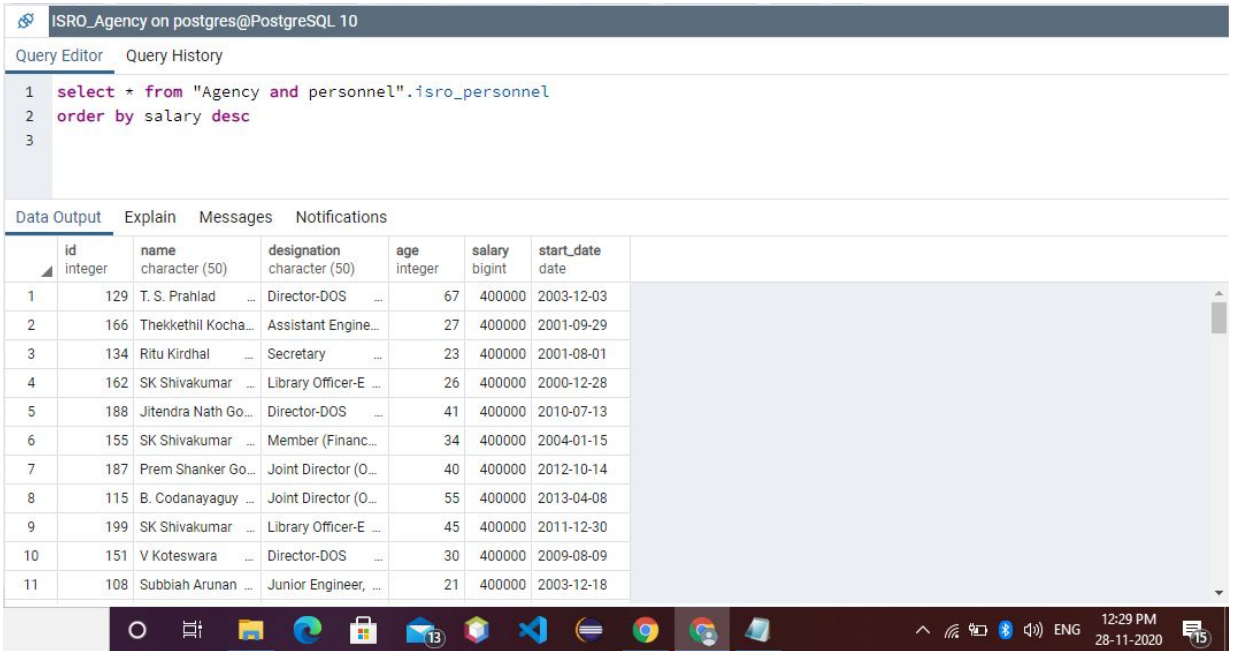
"Missions".mission_updates.mission_id = "Missions".missions.mission_id
where status = 'COMPLETED' and outcomes = 'Mission Successful'



33)
select "PABS".blackholes.name,"Agency and personnel".isro_personnel.name from "PABS".blackholes join "PABS".blackhole_studied on "PABS".blackholes.blackhole_id="PABS".blackhole_studied.blackhole_id
join "Agency and personnel".isro_personnel
on "Agency and personnel".isro_personnel.id="PABS".blackhole_studied.personnel_id

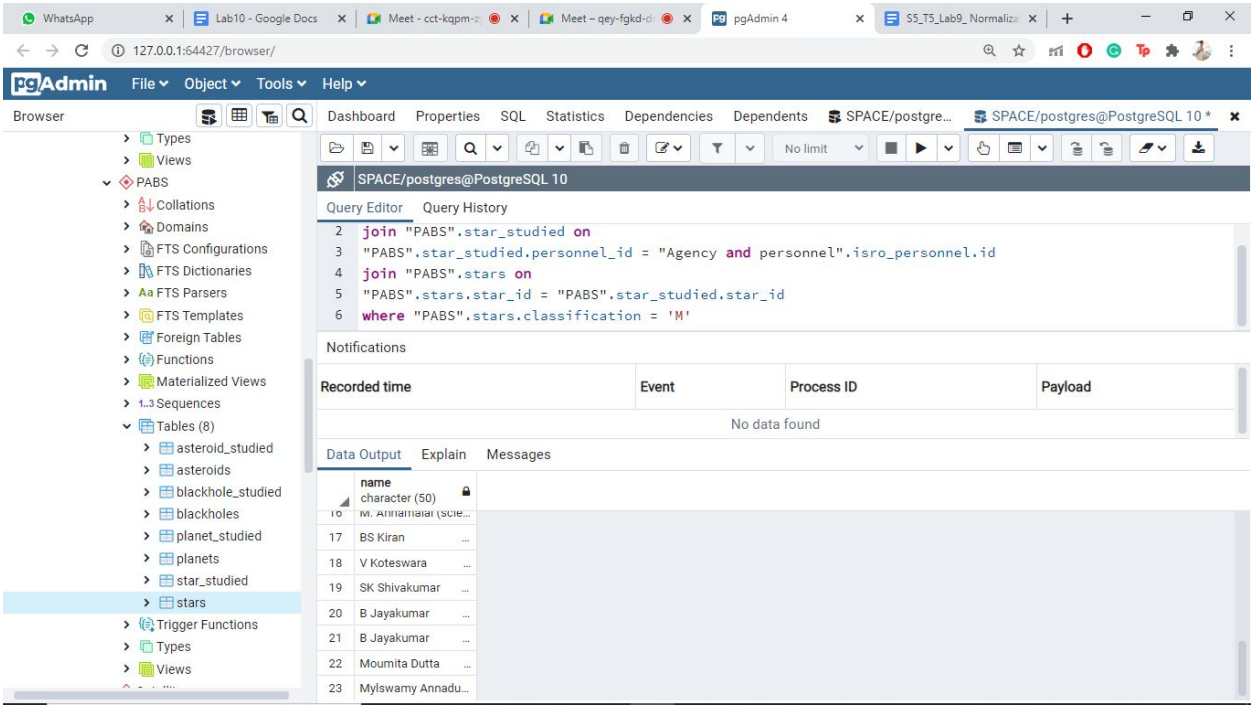


34)
select * from "Agency and personnel".isro_personnel
order by salary

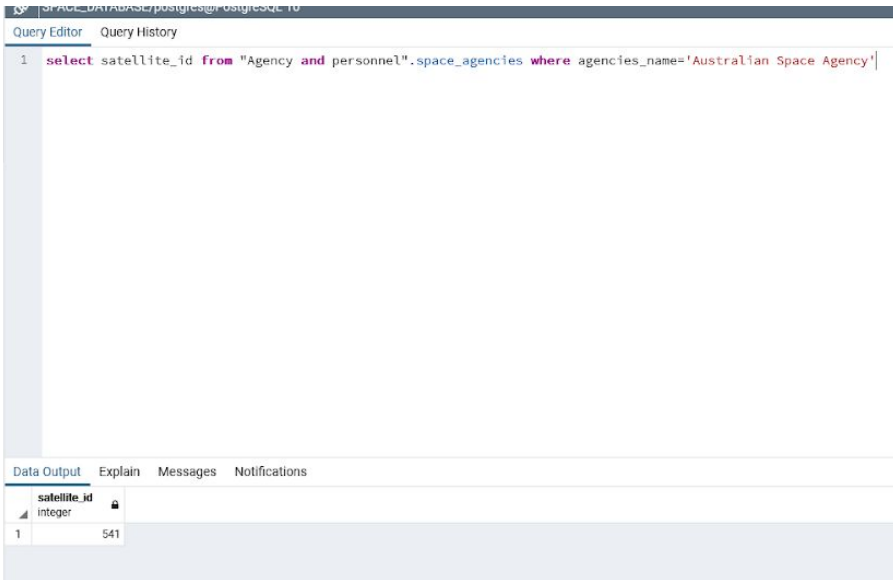


35)
select name from "Agency and personnel".isro_personnel
join "PABS".star_studied on

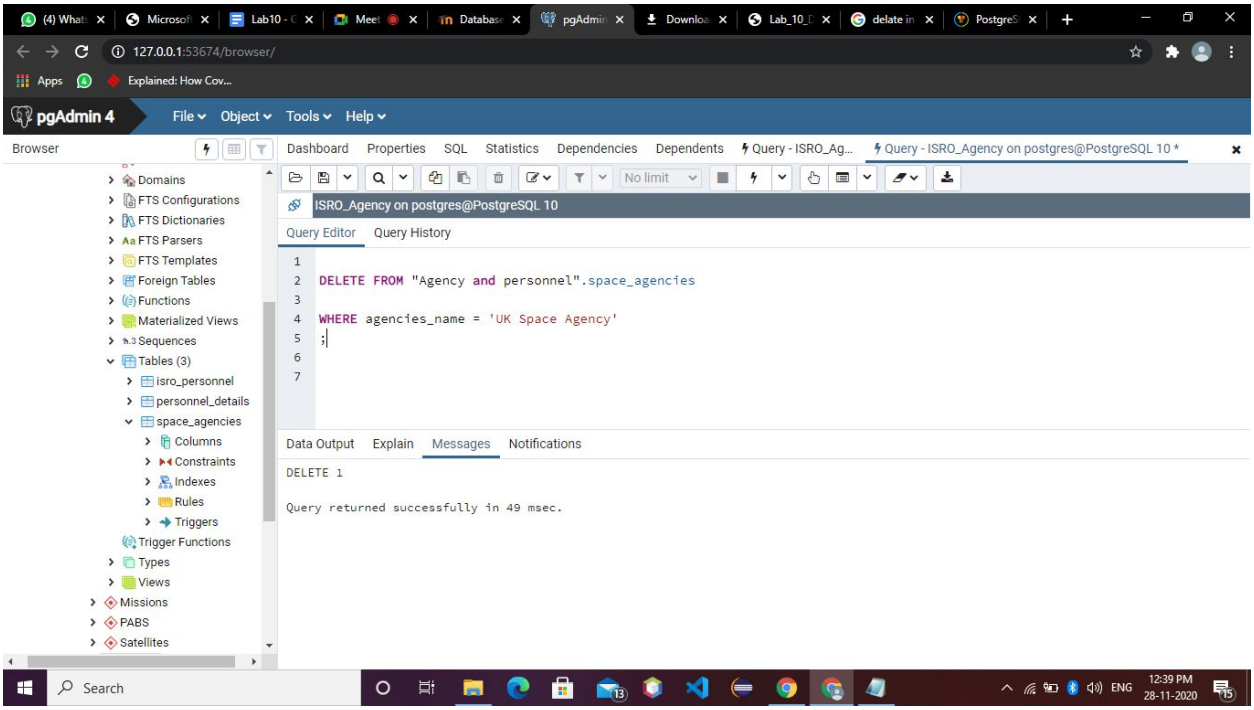
"PABS".star_studied.personnel_id = "Agency and personnel".isro_personnel.id
join "PABS".stars on
"PABS".stars.star_id = "PABS".star_studied.star_id
where "PABS".stars.classification = 'M'



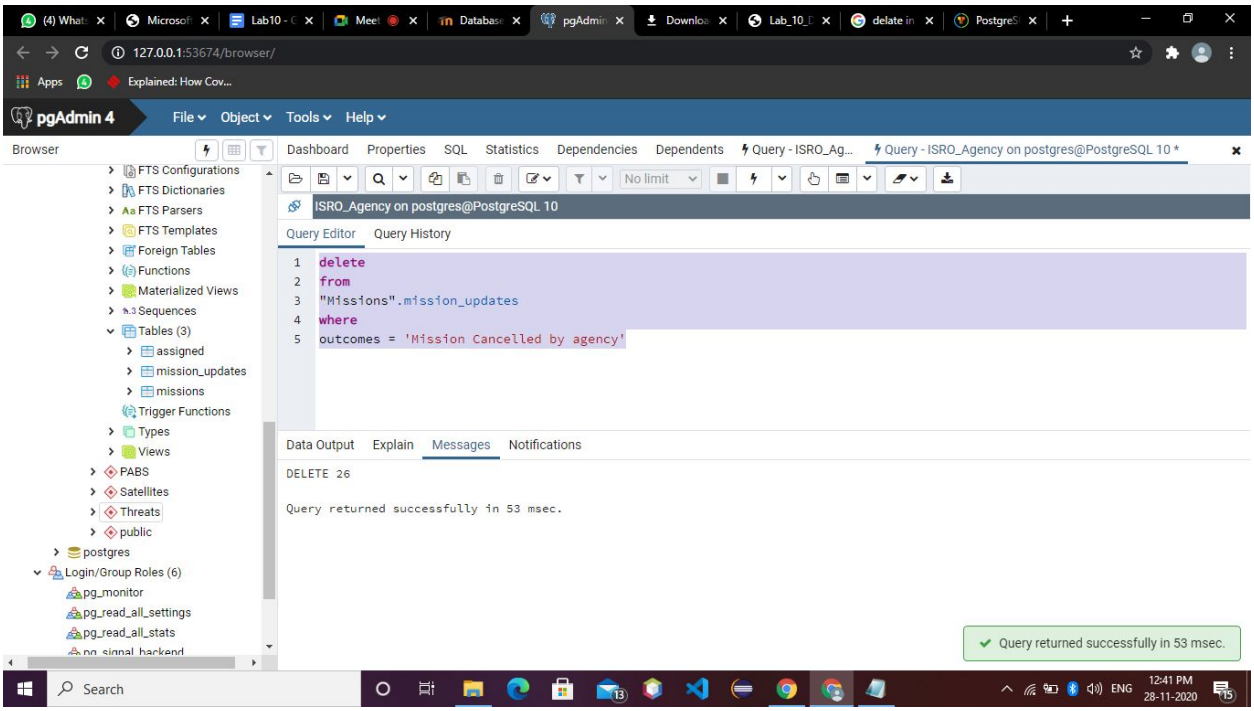
36)
select satellite_id from "Agency and personnel".space_agencies where agencies_name='Australian Space Agency'



37)
DELETE FROM "Agency and personnel".space_agencies
WHERE agencies_name = 'UK Space Agency;

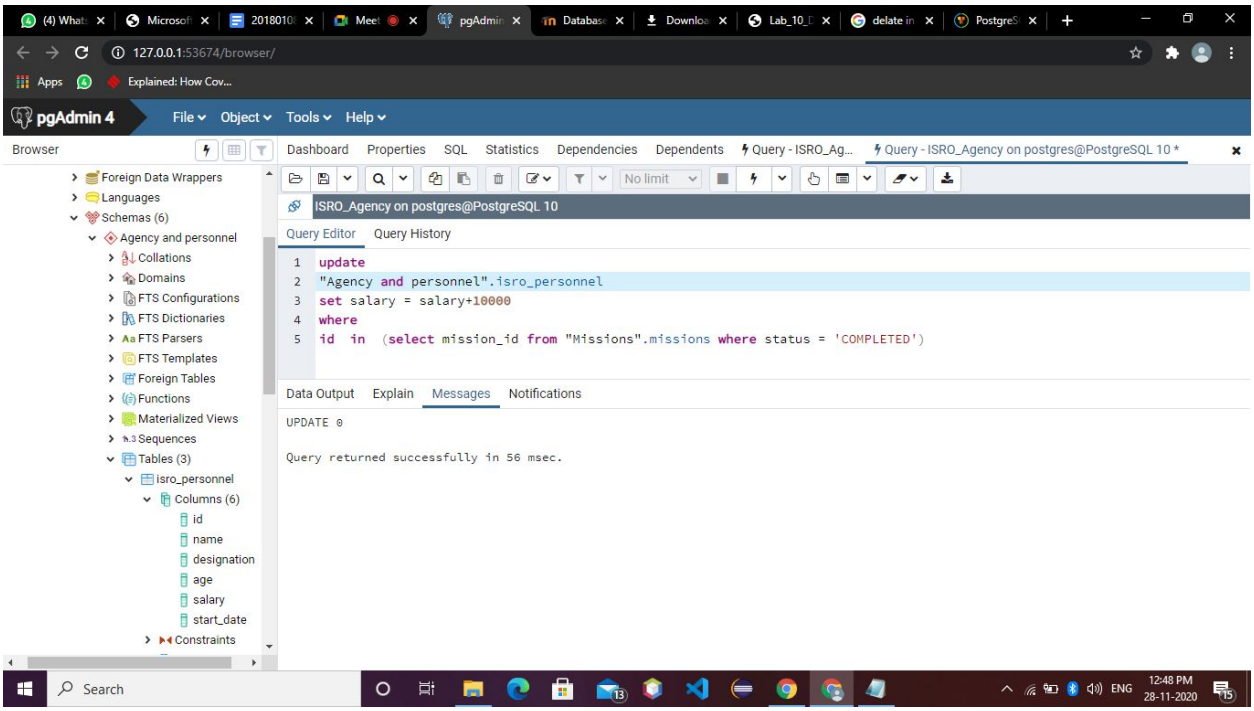


38)
delete
from
"Missions".mission_updates
where
outcomes = 'Mission Cancelled by agency'



39)

```
update
"Agency and personnel".isro_personnel
set salary = salary+10000
where
id  in  (select mission_id from "Missions".missions where status =
'COMPLETED')
```



40)

select name from "PABS".planets where mean_temprature<0 order by mass desc