LAB 8

Normalization and Schema Refinement

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- person(**id**, first_name, middle_name, last_name, contact_no, age, email_address, user_type, username, password)
  - Primary key : id
  - Partial dependency : None
  - Transitive dependency: None

  - Insert Anomaly: Nothing found
  - (Attributes and Reason)
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

  - 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
  - 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
  - 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
  - BCNF : All functional dependencies are on Primary key (id). So, This relation is already in BCNF form.

- roles(**r_name**, work_hours, salary)
  - Primary key : r_name
  - Partial dependency: None
  - Transitive dependency: None

  - Insert Anomaly: Nothing found
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

  - 1NF: There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
  - 2NF: There is no partial dependency in this relation. So this relation is already in 2NF form.
  - 3NF: There is no transitive dependency in this relation. So this relation is already in 3NF form.
  - BCNF: This relation is already in BCNF form.

- player(**player_id** , height ,weight ,team_id)
  - Primary key : player_id
  - Foreign key : player_id(player), team_id(team)
  - Partial dependency : None
  - Transitive dependency: None

  - Insert Anomaly: Nothing found
  - (Attributes and Reason)
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF : This relation is already in BCNF form.

❖ account(**account_no**, player_id, debit_card_no, date_of_joining, balance)

- ➢ Primary key : account_no
- ➢ Foreign key : player_id(player)
- ➢ Partial dependency: None
- ➢ Transitive dependency: None

- ➢ Insert Anomaly: Nothing found
- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF: There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF: There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF: There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF: This relation is already in BCNF form.

❖ game(**game_id**, game_name, type, mode, price, reward, age, height, weight)

- ➢ Primary key : game_id
- ➢ Foreign key : None
- ➢ Partial Dependencies: None

- ➢ Transitive Dependencies: None

- ➢ Insert Anomaly: Nothing found
- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF : This relation is already in BCNF form.

❖ game_table(**table_no**, game_id, capacity)

- ➢ Primary key : table_no
- ➢ Foreign key : game_id (game)
- ➢ Partial dependency: None
- ➢ Transitive dependency: None
- ➢ Insert Anomaly: Nothing found
- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF: There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF: There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF: There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF: This relation is already in BCNF form.

- GameZone_balance(account_no, balance)
  - Partial dependency: None
  - Transitive dependency: None

  - Insert Anomaly: Nothing found
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

  - 1NF: There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
  - 2NF: There is no partial dependency in this relation. So this relation is already in 2NF form.
  - 3NF: There is no transitive dependency in this relation. So this relation is already in 3NF form.
  - BCNF: This relation is already in BCNF form.

- purchase(**purchase_id**, player_id, game_id, no_hour)
  - Primary key : purchase_id
  - Foreign key : game_id(game), player_id(player)
  - Partial Dependencies: None
  - Transitive Dependencies: None

  - Insert Anomaly: Nothing found
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

  - 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.

- ➢ 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF : This relation is already in BCNF form.

❖ transactions(**<u>transaction_id</u>,** account_no, date_and_time, amount, type, method)

- ➢ Primary key : transaction_id
- ➢ Foreign key : account_no(account)
- ➢ Partial Dependencies: None
- ➢ Transitive Dependencies: None

- ➢ Insert Anomaly: Nothing found
- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF : This relation is already in BCNF form.

❖ team(**<u>team_id</u>**, t_name, no_players)

- ➢ Primary key : team_id
- ➢ Partial dependency: None
- ➢ Transitive dependency: None

- ➢ Insert Anomaly: Nothing found

- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF: There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF: There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF: There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF: This relation is already in BCNF form.

❖ manager(**<u>manager_id</u>**, role)

- ➢ Primary key : manager_id
- ➢ Foreign key : manager_id(person(id)), role(roles(r_name))
- ➢ Partial dependency : None
- ➢ Transitive dependency: None

- ➢ Insert Anomaly: Nothing found
- ➢ (Attributes and Reason)
- ➢ Update Anomaly: Nothing found
- ➢ Delete Anomaly: Nothing found

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ BCNF : This relation is already in BCNF form.

- worker(**worker_id,** role, speciality)
  - Primary key : worker_id
  - Foreign key : worker_id(person(id)), role(roles(r_name))
  - Partial dependency : None
  - Transitive dependency: None

  - Insert Anomaly: Nothing found
  - Update Anomaly: Nothing found
  - Delete Anomaly: Nothing found

  - 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
  - 2NF : There is no partial dependency in this relation. So this relation is already in 2NF form.
  - 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
  - BCNF : This relation is already in BCNF form.

- game_history(**record_no**, game_id, player_id, date_and_time, rank, score, level, wins, losses, win_rate)
  - Primary key : record_no
  - Foreign key : game_id(game), player_id(player)
  - Partial Dependencies:
    - game_id, player_id -> rank
    - game_id, player_id -> wins
    - game_id, player_id -> losses

  - Transitive Dependencies:

- record_no-> wins,losses
  wins,losses -> win_rate
  record_no -> win_rate
- record_no, player_id,game_id -> score
  score -> rank
  record_no, player_id,game_id -> rank

➢ Insert Anomaly: For multiplayer games, if we insert any tuple in game_history then rank will be inconsistent as rank depends on score and number of players playing the game at that time, but at a time we can insert only one tuple. And without rank we can't calculate wins and losses and so winrate.

➢ Update Anomaly: If we change the score of any player then it reflects the change in rank of player in a particular game. And also if we change wins and losses, it also reflects a change in win_rate.

➢ Delete Anomaly: If we delete any tuble in game_history then we lose the information about the rank of player for a specific game and how many times the player wins or loses the game.

➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.

➢ 2NF : This relation is not in 2NF form. There is some partial dependency in this relation as mentioned above.

➢ 3NF : This relation is not in 3NF form. There is some transitive dependency in this relation as mentioned above.

➢ Updated schema:
- player_history(player_id, table_no, date_and_time, score, win)
- player_records(player_id, game_id, total_games, wins)

- ➢ BCNF : This relation is already in BCNF form.

- ❖ team_history(**record_no**, team_id, game_id, rank, date_and_time, score, level, wins, losses, win_rate)
  - ➢ Primary key : record_no
  - ➢ Foreign key : game_id(game), team_id(team)
  - ➢ Partial Dependencies:
    - ■ game_id, team_id -> rank
    - ■ game_id, team_id -> wins
    - ■ game_id, team_id -> losses
  - ➢ Transitive Dependencies:
    - ■ record_no-> wins,losses
      wins,losses -> win_rate
      record_no -> win_rate
    - ■ record_no, team_id, game_id -> score
      score -> rank
      record_no, team_id, game_id -> rank
  - ➢ Insert Anomaly: For multiplayer games, if we insert any tuple in game_history then rank will be inconsistent as rank depends on score and number of teams playing the game at that time, but at a time we can insert only one tuple. And without rank we can't calculate wins and losses and so winrate.
  - ➢ Update Anomaly: If we change the score of any team then it reflects the change in rank of team in a particular game. And also if we change wins and losses, it also reflects a change in win_rate.
  - ➢ Delete Anomaly: If we delete any tuble in game_history then we lose the information about the rank of team for a specific game and how many times the team wins or loses the game.

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : This relation is not in 2NF form. There is some partial dependency in this relation as mentioned above.
- ➢ 3NF : This relation is not in 3NF form. There is some transitive dependency in this relation as mentioned above.
- ➢ Updated schema :
  - team_history(team_id, table_no, date_and_time, score, win)
  - team_records(team_id, game_id, total_games, wins)
- ➢ BCNF : This relation is already in BCNF form.

❖ lobby(**date_and_time**, **player_id, game_id**, no_of_players, status, login_time)

- ➢ Primary key : date_and_time, player_id, game_id
- ➢ Foreign key : game_id, player_id
- ➢ Partial Dependencies:
  - data_and_time -> login_time
- ➢ Transitive Dependencies: None

- ➢ Insert Anomaly: In a chase when two players are playing on the same table, then there are two tuples which have different values of no_of_players, which is inconsistent. So, this is the insert anomaly in this relation.
- ➢ Update Anomaly: if we update no_of_players, then it leads to inconsistency in status of players.
- ➢ Delete Anomaly: If we delete any tuple from this relation then it leads to the same problem in no_of_players and status values as we discussed above.

- ➢ 1NF : There is no multi-valued attribute in this relation. So this relation is already in 1NF form.
- ➢ 2NF : There is a partial dependency in this relation. So this relation is not in 2NF form.
  We removed the login_time attribute from this relation. It removes partial dependency.
- ➢ 3NF : There is no transitive dependency in this relation. So this relation is already in 3NF form.
- ➢ Redundancy : Here we can measure no_of_player and login time from the value of other attributes.
- ➢ Update schema:
  - lobby(**date_and_time**, **player_id**, **table_no**, status)
- ➢ BCNF : This relation is already in BCNF form.

DDL Scripts:

1. **Person**

```
CREATE TABLE IF NOT EXISTS person (
  id int,
  first_name varchar(20) COLLATE pg_catalog."default" not null,
  middle_name varchar(20) COLLATE pg_catalog."default" not null,
  last_name varchar(20) COLLATE pg_catalog."default" not null,
  age int not null,
  contact_no char(10),
  email_address varchar(20) COLLATE pg_catalog."default" not NULL UNIQUE,
  user_type varchar(20) COLLATE pg_catalog."default" not null,
  username varchar(20) COLLATE pg_catalog."default" not null UNIQUE,
  password varchar(20) COLLATE pg_catalog."default" NOT NULL,
```

```
  PRIMARY KEY (id),
  CHECK(user_type in ('manager','player','worker'))
);
```

2. **team**

```
CREATE TABLE IF NOT EXISTS team (
  team_id int,
  t_name varchar(30) not null unique,
  no_players int not null CHECK(no_players > 1),
  PRIMARY KEY (team_id)
);
```

3. **Roles**

```
CREATE TABLE IF NOT EXISTS Roles (
  r_name varchar(20) COLLATE pg_catalog."default",
  workhours int not null check(workhours > 0),
  salary int not null check(salary > 0),
  PRIMARY KEY (r_name)
);
```

4. **player**

```
CREATE TABLE IF NOT EXISTS player (
  player_id int,
  height int not NULL,
  weight int not NULL,
  team_id int,
  PRIMARY KEY (player_id),
```

```
  FOREIGN KEY (player_id) REFERENCES person(id) MATCH SIMPLE ON UPDATE
CASCADE ON DELETE CASCADE,
  FOREIGN KEY (team_id) REFERENCES team(team_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

5. **manager**

```
CREATE TABLE IF NOT EXISTS manager (
  manager_id int,
  role varchar(20) COLLATE pg_catalog."default" NOT NULL,
  PRIMARY KEY (manager_id),
  FOREIGN KEY (role) REFERENCES roles(r_name) MATCH SIMPLE ON UPDATE
CASCADE ON DELETE CASCADE,
  FOREIGN KEY (manager_id) REFERENCES person(id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

6. **worker**

```
CREATE TABLE IF NOT EXISTS worker (
  worker_id int,
  role varchar(20) COLLATE pg_catalog."default" not NULL,
  PRIMARY KEY (worker_id),
  FOREIGN KEY (role) REFERENCES roles(r_name) MATCH SIMPLE ON UPDATE
CASCADE ON DELETE CASCADE,
  FOREIGN KEY (worker_id) REFERENCES person(id) MATCH SIMPLE ON UPDATE
CASCADE ON DELETE CASCADE
);
```

7. **account**

```
CREATE TABLE IF NOT EXISTS account (
  account_no char(11),
  player_id int not NULL UNIQUE,
  debit_card_no char(16) not NULL ,
  date_of_joining date not NULL,
  balance int default 1000,
  PRIMARY KEY (account_no),
  FOREIGN KEY (player_id) REFERENCES player(player_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

8. **transactions**

```
CREATE TABLE IF NOT EXISTS transactions (
  transaction_id char(15),
  account_no char(11) not NULL,
  date_and_time timestamp not NULL,
  amount int not NULL,
  type varchar(20) COLLATE pg_catalog."default" not NULL,
  method varchar(15),
  PRIMARY KEY (transaction_id),
  FOREIGN KEY (account_no) REFERENCES account(account_no) MATCH
SIMPLE ON UPDATE RESTRICT ON DELETE RESTRICT
);
```

9. game

```
CREATE TABLE IF NOT EXISTS game (
  game_id int,
  game_name varchar(20) COLLATE pg_catalog."default"  not null unique,
  type varchar(20) COLLATE pg_catalog."default" ,
  mode varchar(20) COLLATE pg_catalog."default"  not null,
  price int not null CHECK(price > 0),
  reward int default 0,
  age int default 5,
  height int,
  weight int,
  PRIMARY KEY (game_id),
  CHECK(mode in ('online','offline'))
);
```

10. purchase

```
CREATE TABLE IF NOT EXISTS purchase (
  purchase_id int,
  player_id int,
  game_id int ,
  no_hours int not null CHECK(no_hours > 0),
  PRIMARY KEY (purchase_id),
  FOREIGN KEY (player_id) REFERENCES  player(player_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (game_id) REFERENCES  game(game_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

11. game_table

```
CREATE TABLE IF NOT EXISTS game_table (
  table_no int,
  game_id int,
  capacity int not null check(capacity>0),
  PRIMARY KEY (table_no),
  FOREIGN KEY (game_id) REFERENCES  game(game_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

12. player_history

```
CREATE TABLE IF NOT EXISTS player_history (
  player_id int,
  table_no int,
  date_and_time timestamp not NULL,
  score int not NULL CHECK(score >=0),
  win boolean default false,
  PRIMARY KEY (player_id,table_no),
  FOREIGN KEY (table_no) REFERENCES game_table(table_no) MATCH SIMPLE
ON UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (player_id) REFERENCES player(player_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

13. player_records

```
CREATE TABLE IF NOT EXISTS player_records (
  player_id int,
  game_id int,
```

```
  total_games int default 0,
  wins int default 0 check(wins<=total_games),
  PRIMARY KEY (player_id,game_id),
  FOREIGN KEY (game_id) REFERENCES  game(game_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (player_id) REFERENCES  player(player_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

14. team_history

```
CREATE TABLE IF NOT EXISTS team_history (
  team_id int,
  table_no int,
  date_and_time timestamp not NULL,
  score int not NULL CHECK(score >=0),
  win boolean default false,
  PRIMARY KEY (team_id,table_no),
  FOREIGN KEY (table_no) REFERENCES game_table(table_no) MATCH SIMPLE
ON UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (team_id) REFERENCES team(team_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

15. team_records

```
CREATE TABLE IF NOT EXISTS team_records (
  team_id int,
  game_id int,
  total_games int default 0,
  wins int default 0 check(wins<=total_games),
```

```
  PRIMARY KEY (team_id,game_id),
  FOREIGN KEY (game_id) REFERENCES  game(game_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (team_id) REFERENCES  team(team_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE
);
```

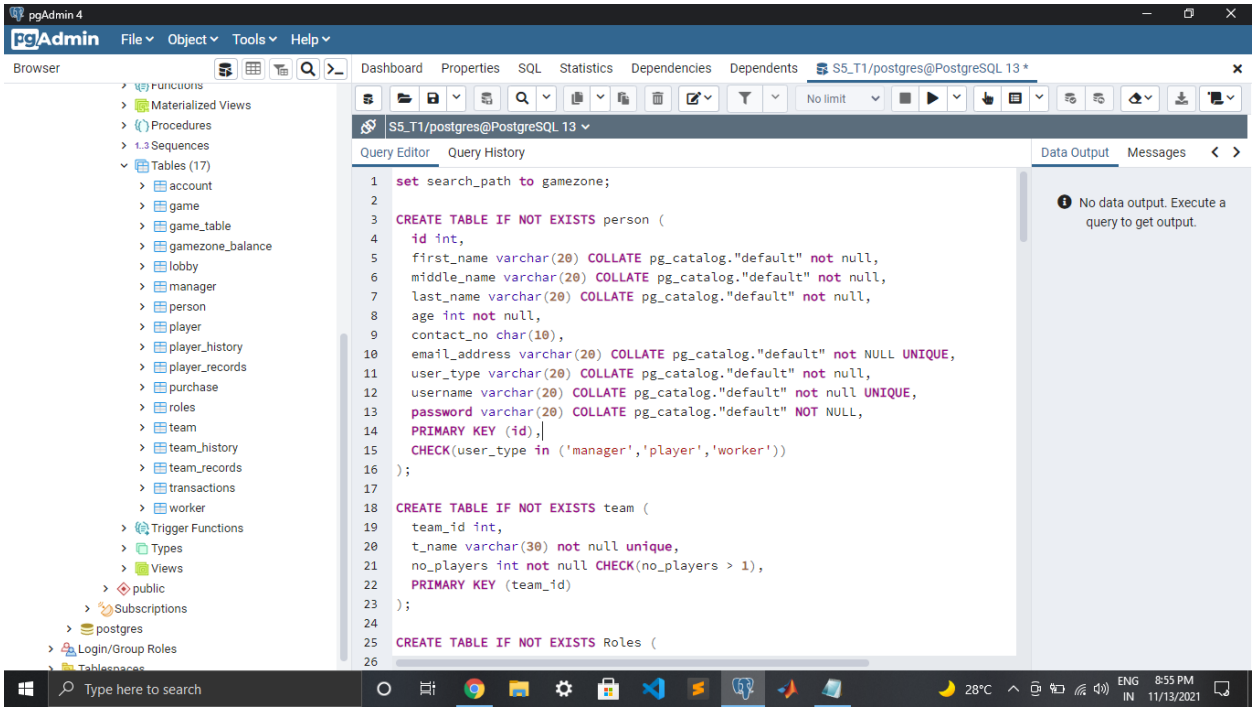
16. lobby

```
CREATE TABLE IF NOT EXISTS lobby (
  player_id int,
  table_no int,
  date_and_time timestamp,
  status varchar(20) COLLATE pg_catalog."default",
  PRIMARY KEY (player_id, table_no, date_and_time),
  FOREIGN KEY (player_id) REFERENCES  player(player_id) MATCH SIMPLE ON
UPDATE CASCADE ON DELETE CASCADE,
  FOREIGN KEY (table_no) REFERENCES  game_table(table_no) MATCH SIMPLE
ON UPDATE CASCADE ON DELETE CASCADE,
  CHECK (status in ('playing','waiting'))
);
```

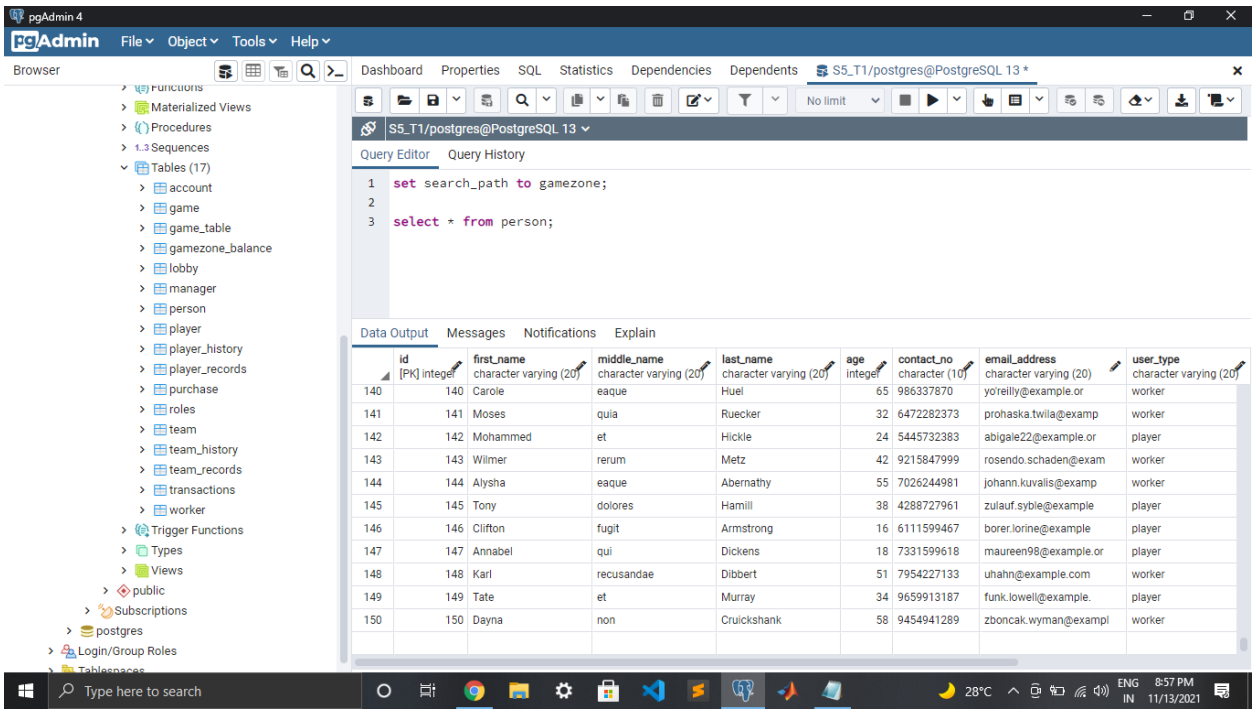
17. GameZone_balance

```
CREATE TABLE IF NOT EXISTS GameZone_balance (
   account_no char(11) NOT NULL,
   balance int default 50000
);
```

DDL SnapShot:

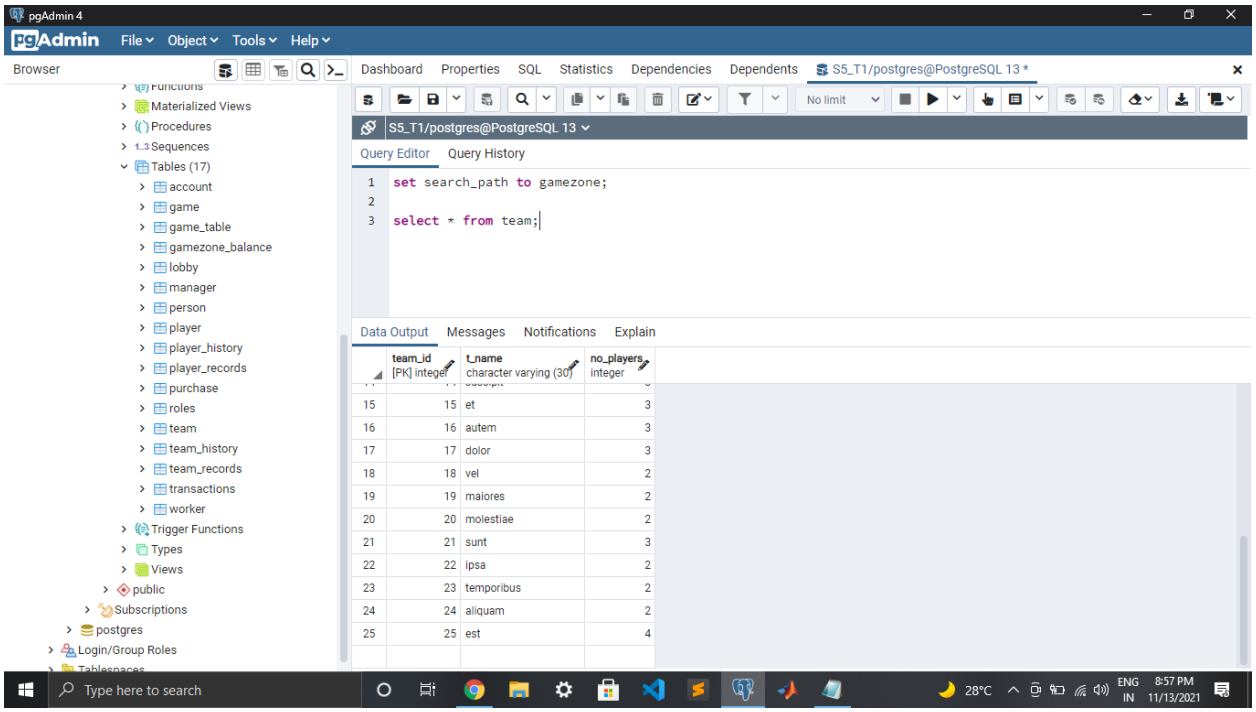


person:



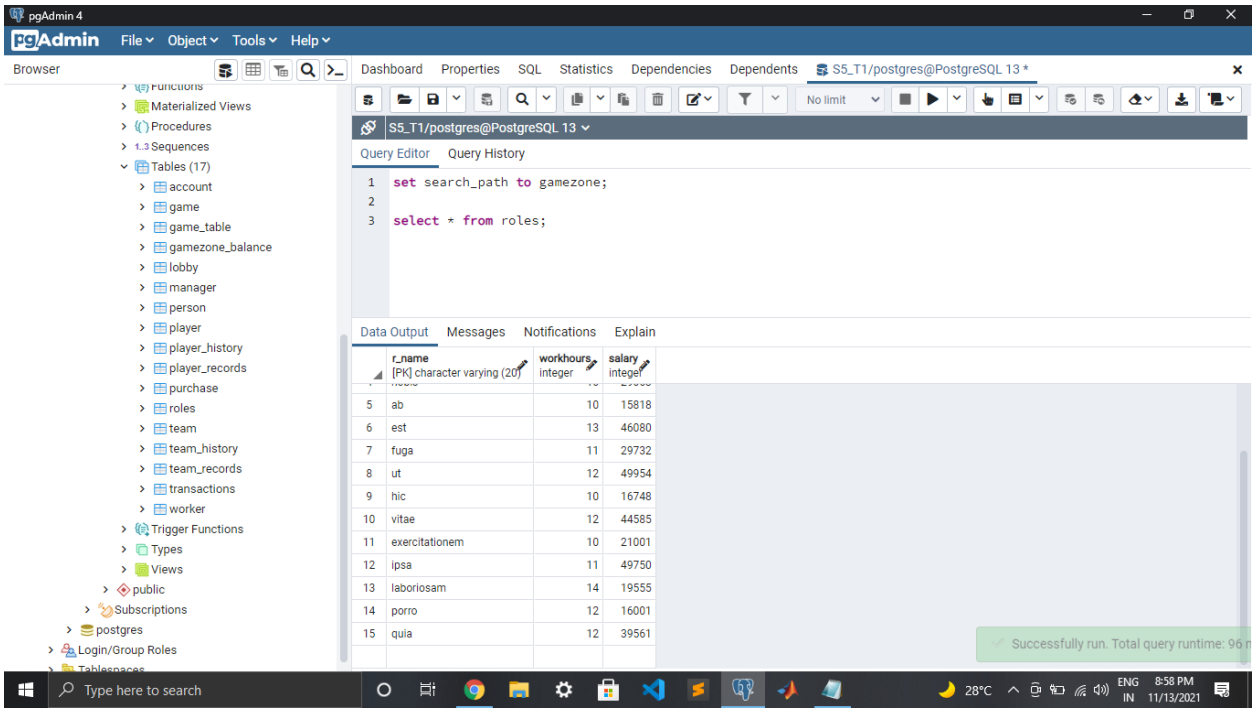
No. of Tuples = 150

team:



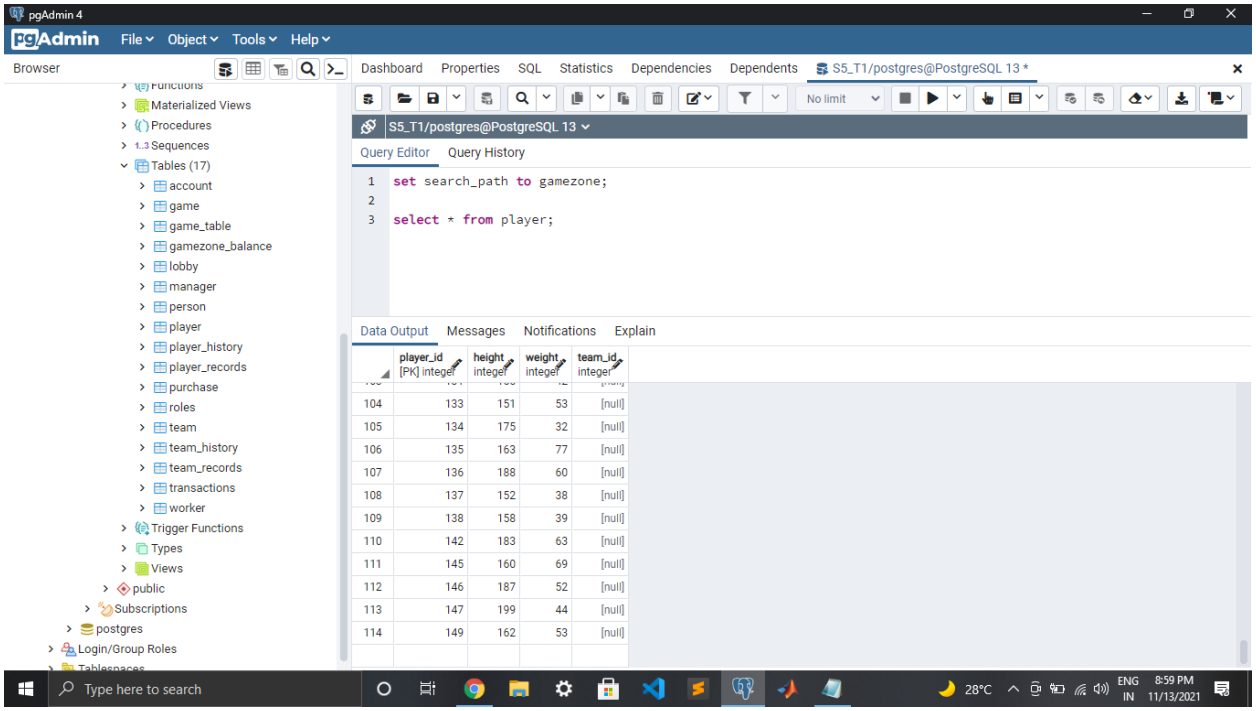
No of Tuples: 25

roles:



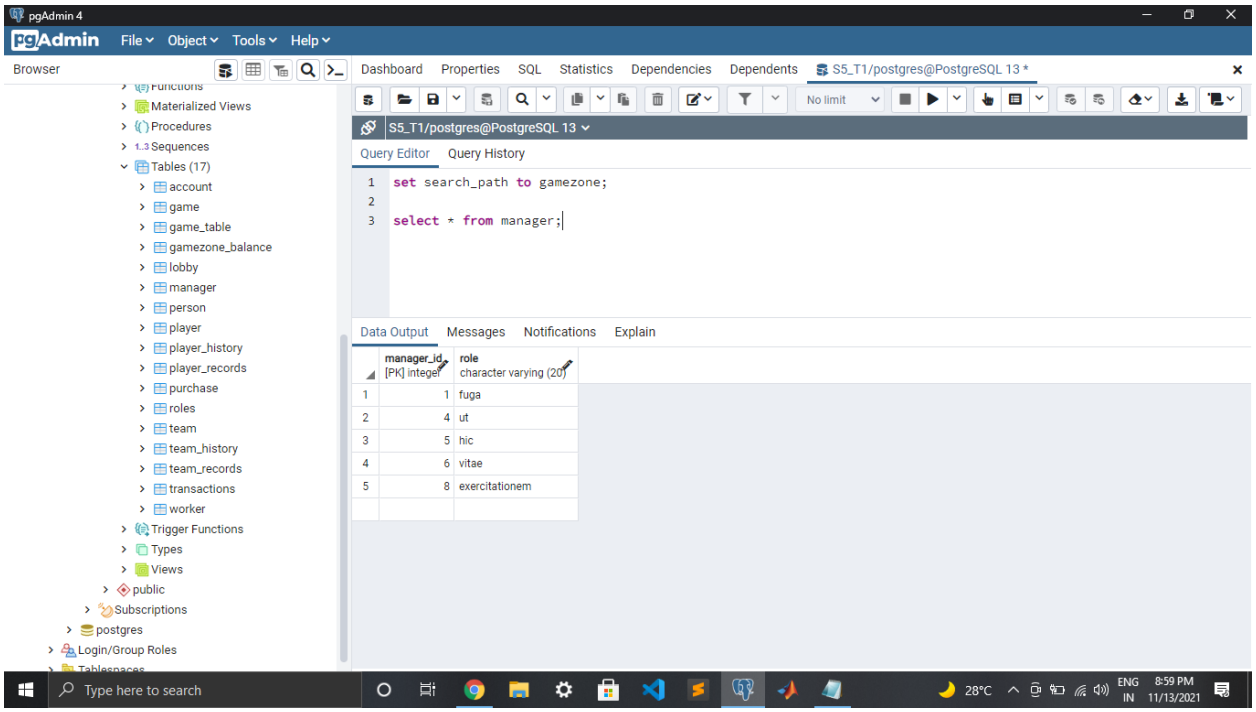
No of Tuples: 15

player:



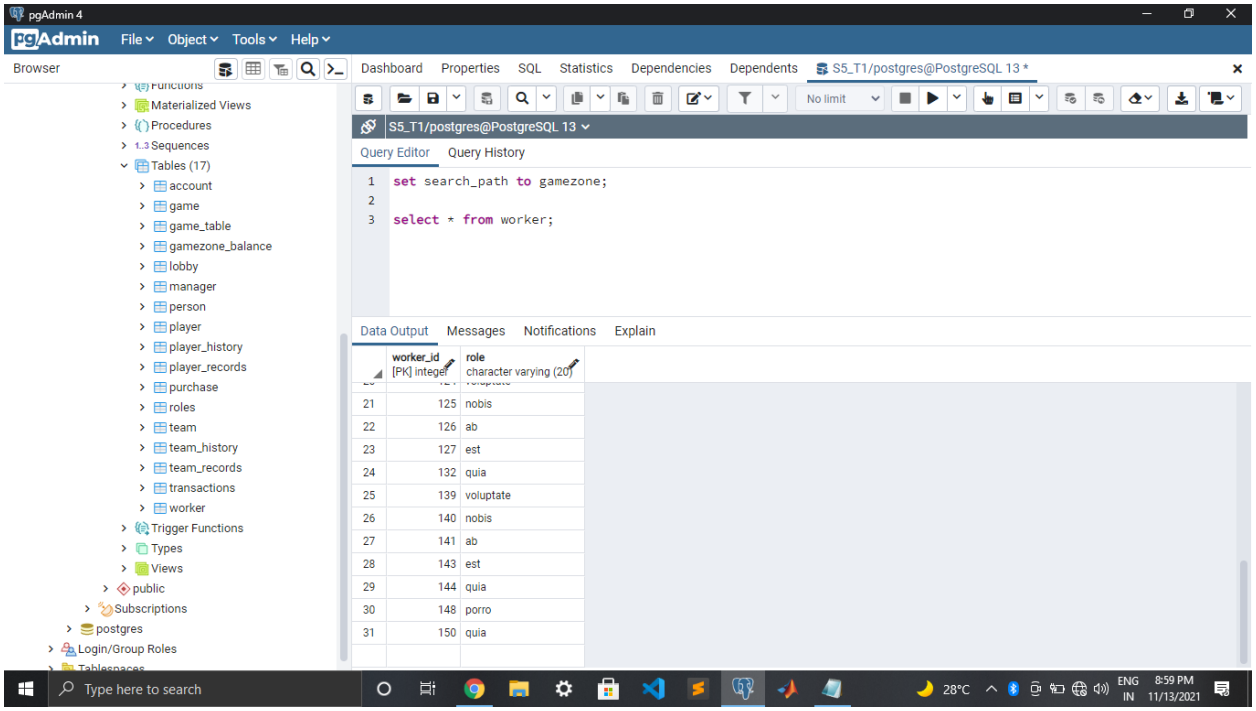
No of Tuples: 114

manager:



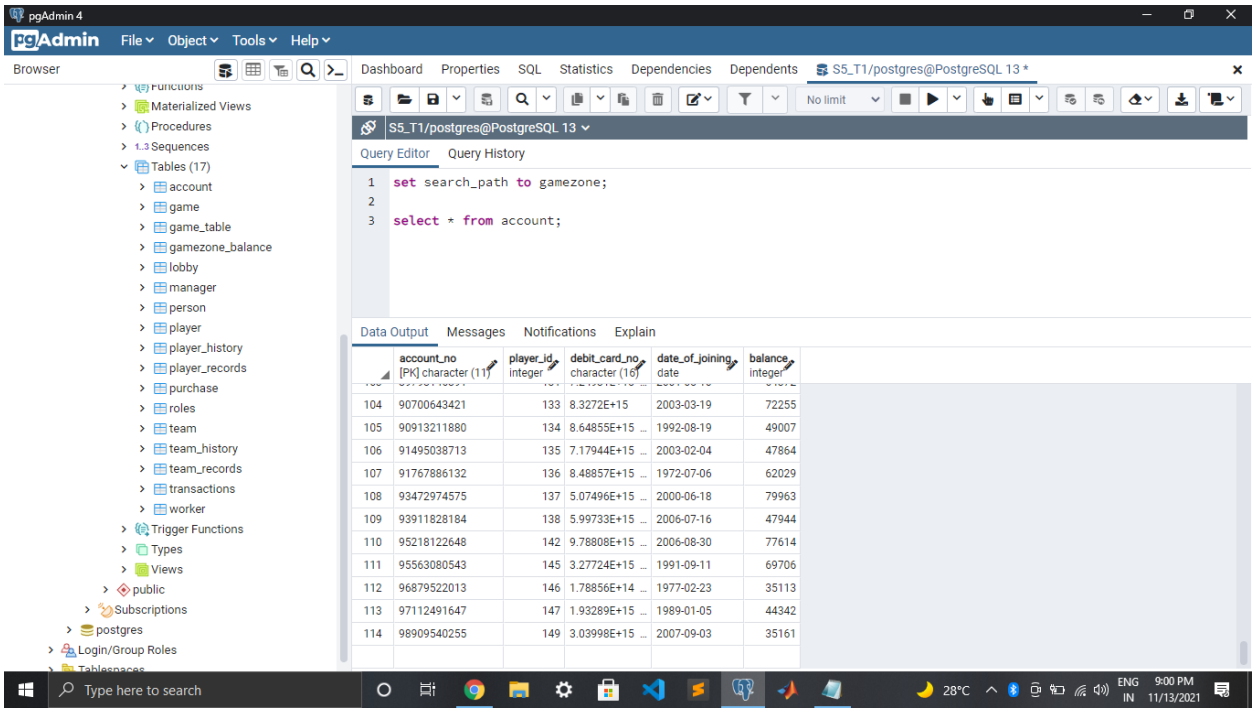
No of Tuples: 5

worker:



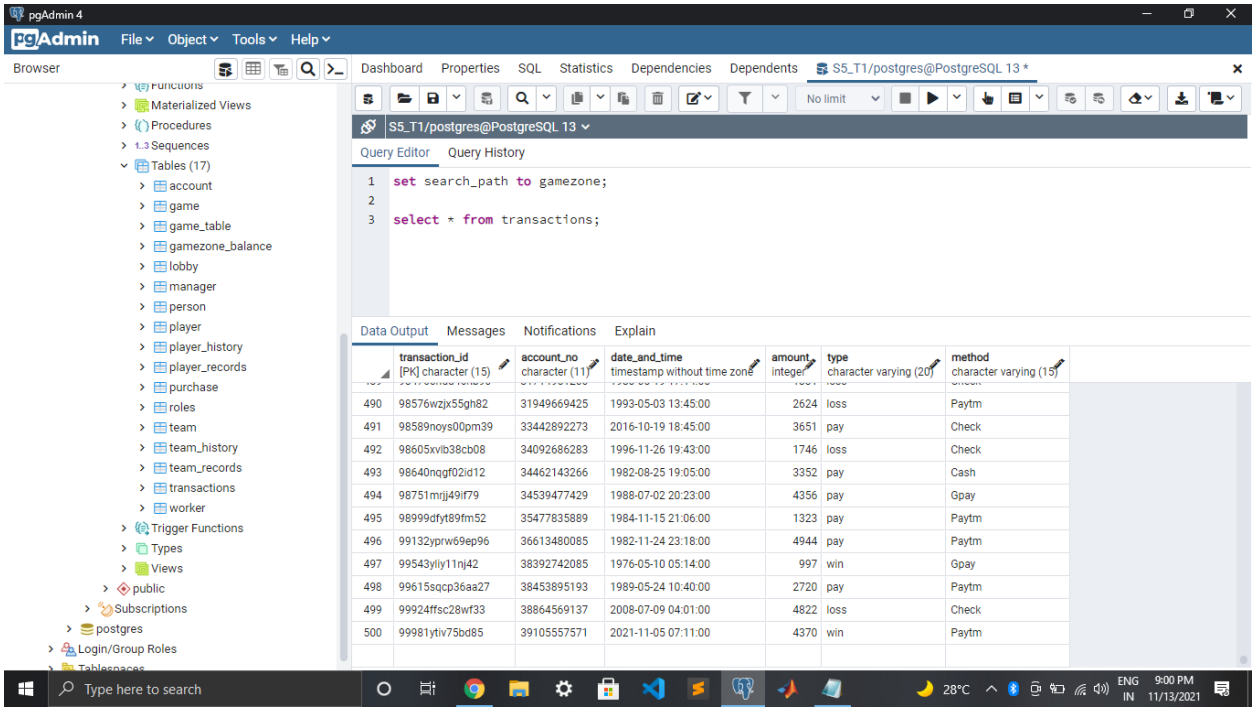
No of Tuples: 31

account:



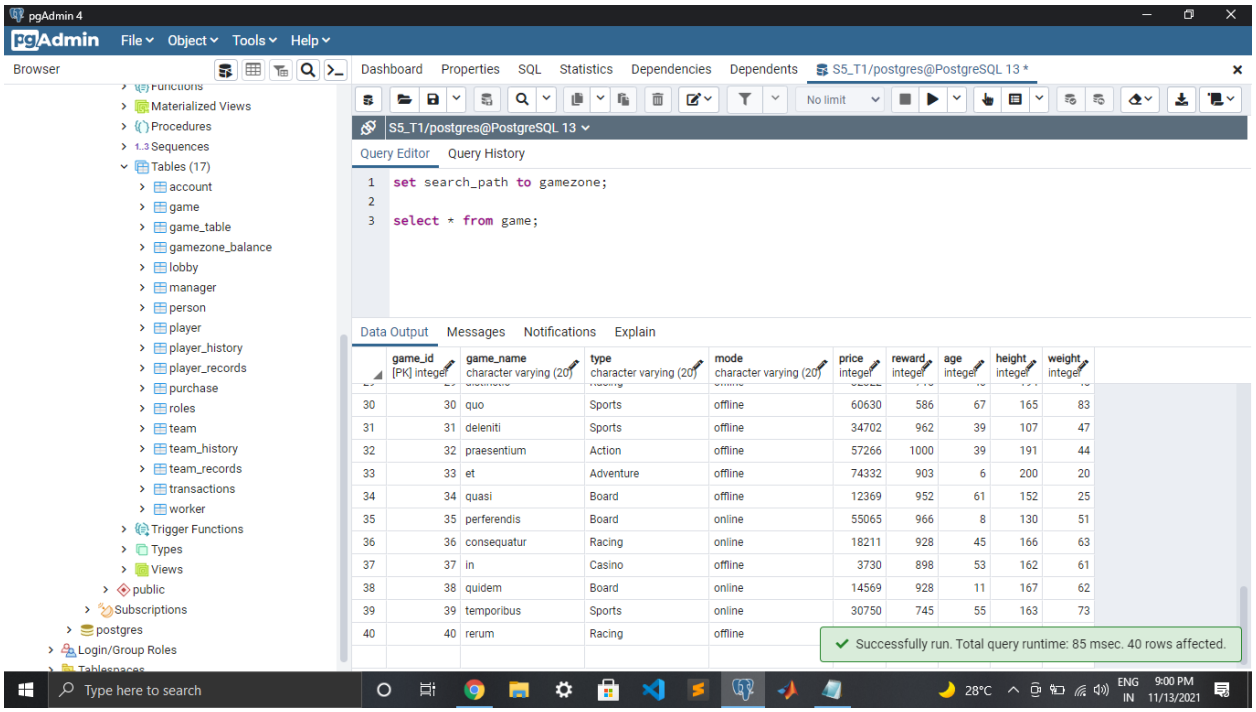
No of Tuples: 114

transaction:



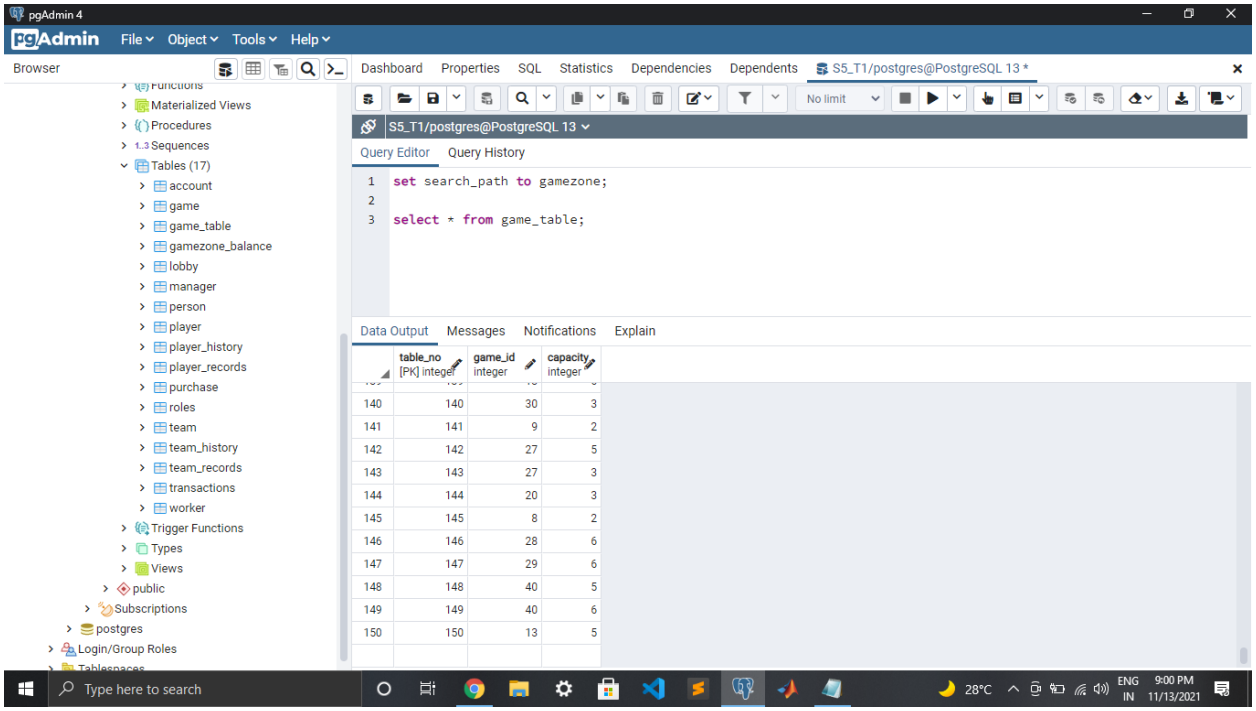
No of Tuples: 500

game:



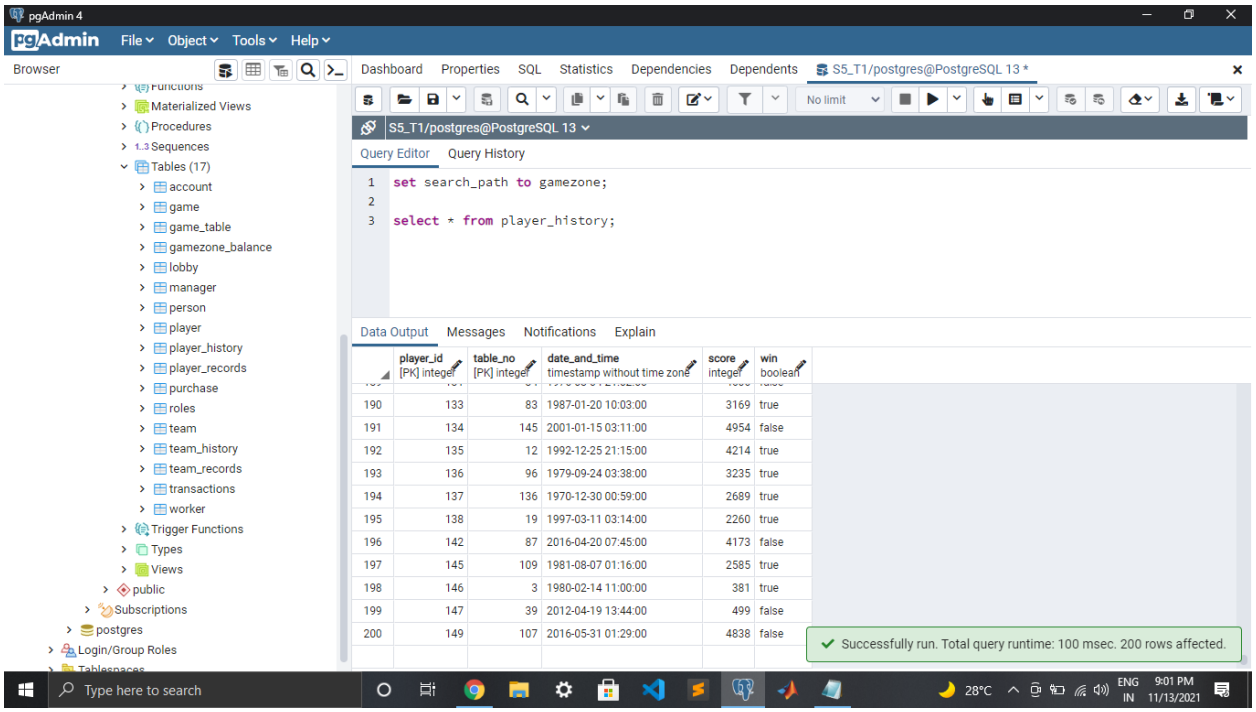
No of Tuples: 40

game_table:



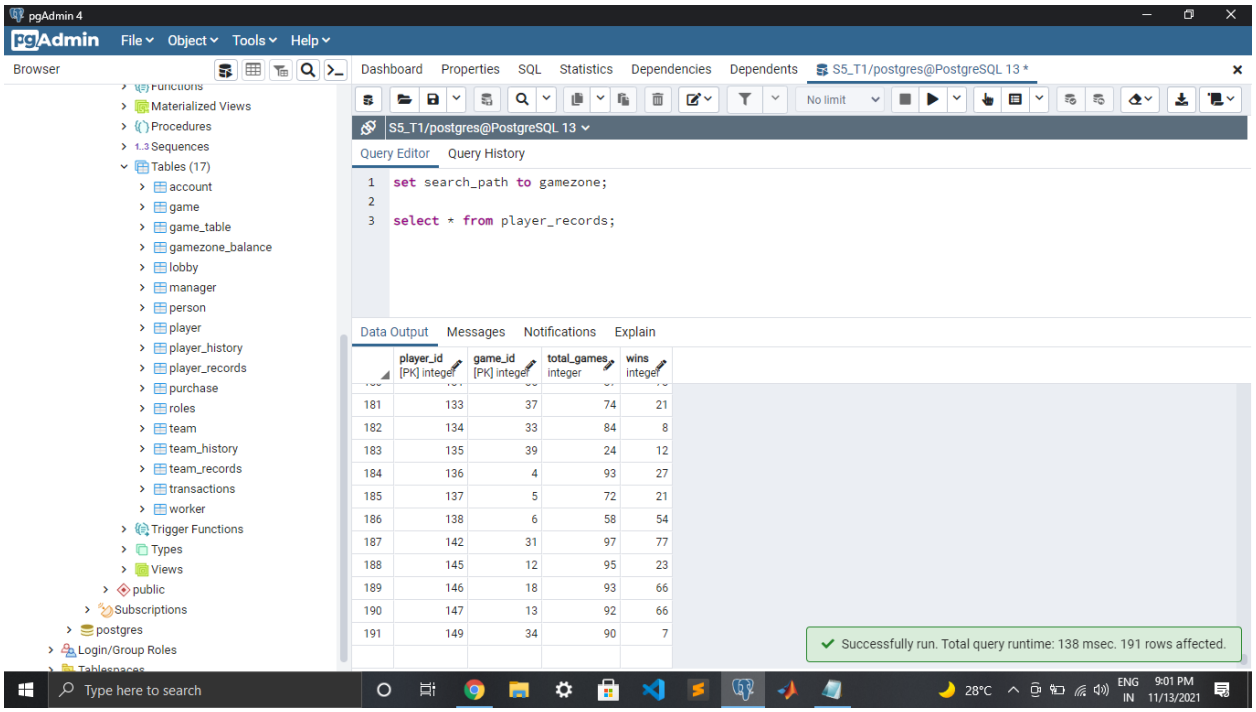
No of Tuples: 150

player_history:



No of Tuples: 200

player_records:



No of Tuples: 191

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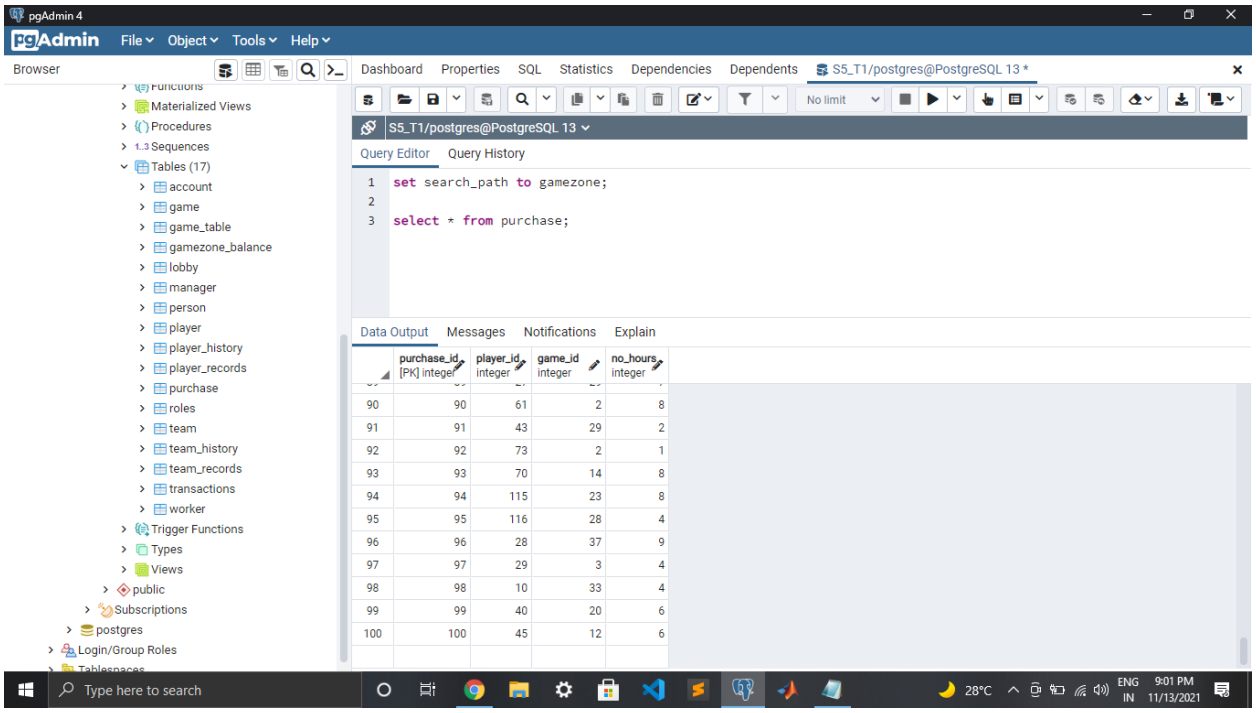
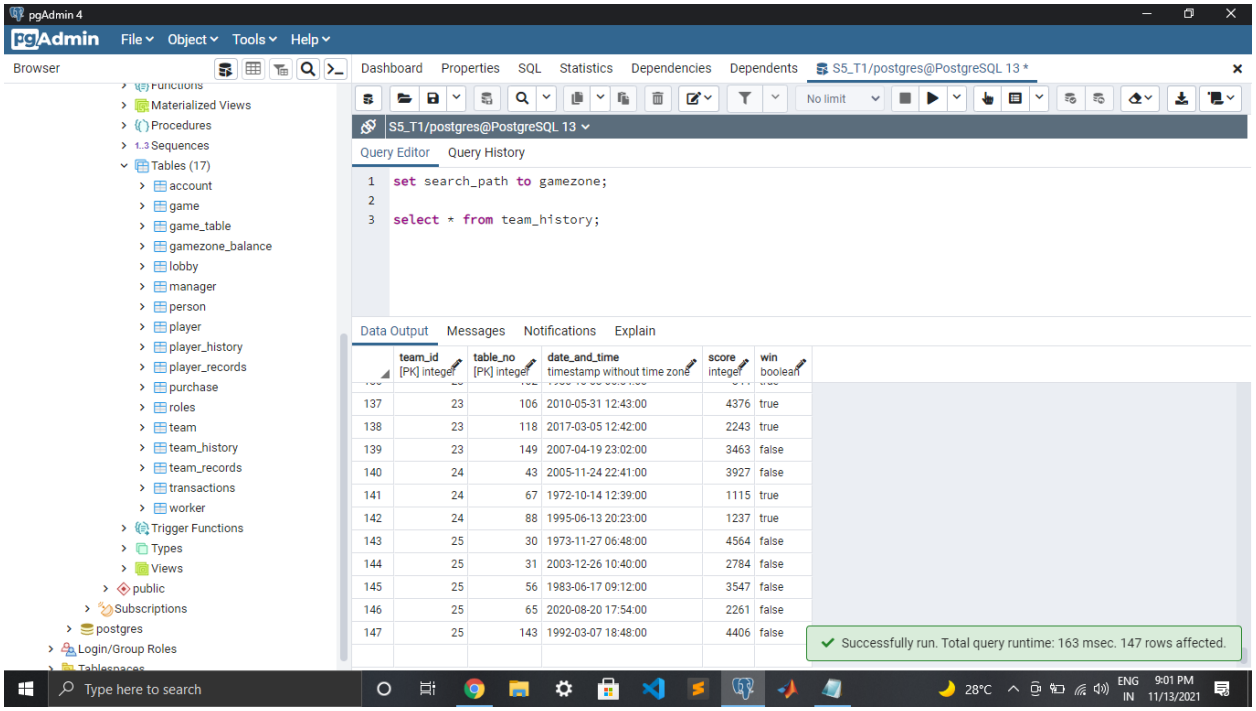


No of Tuples: 100

team_history:



No of Tuples: 147

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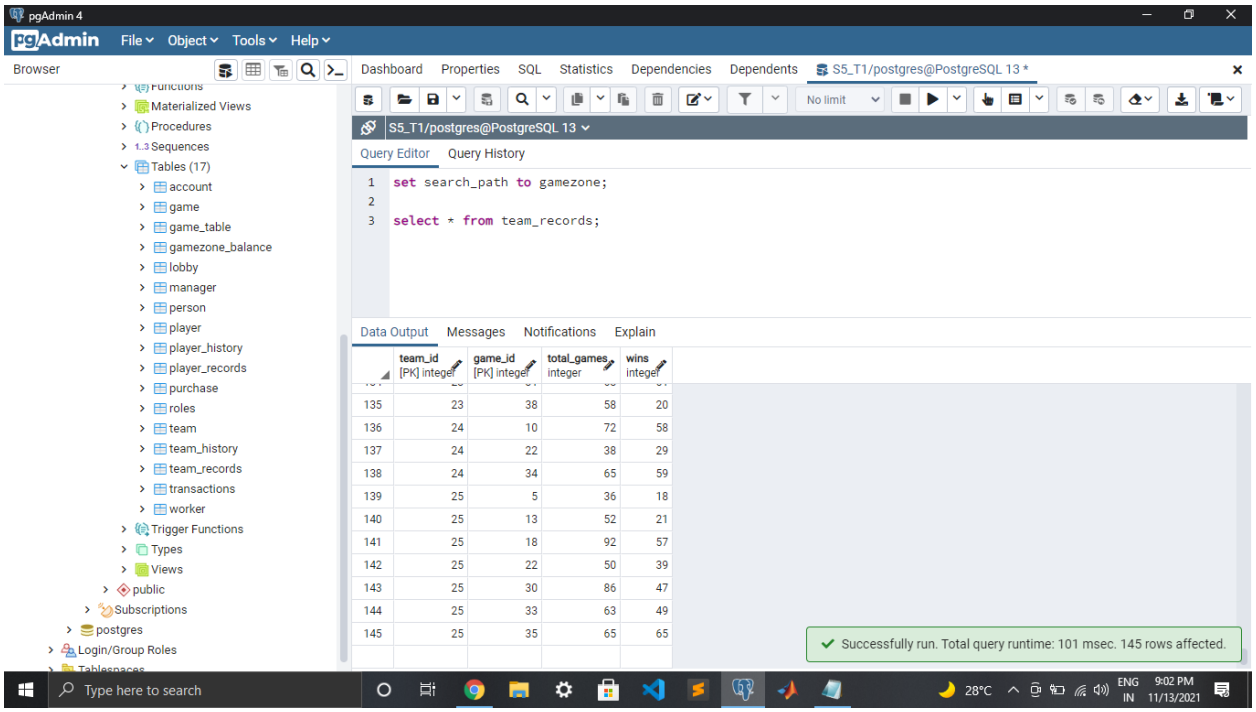
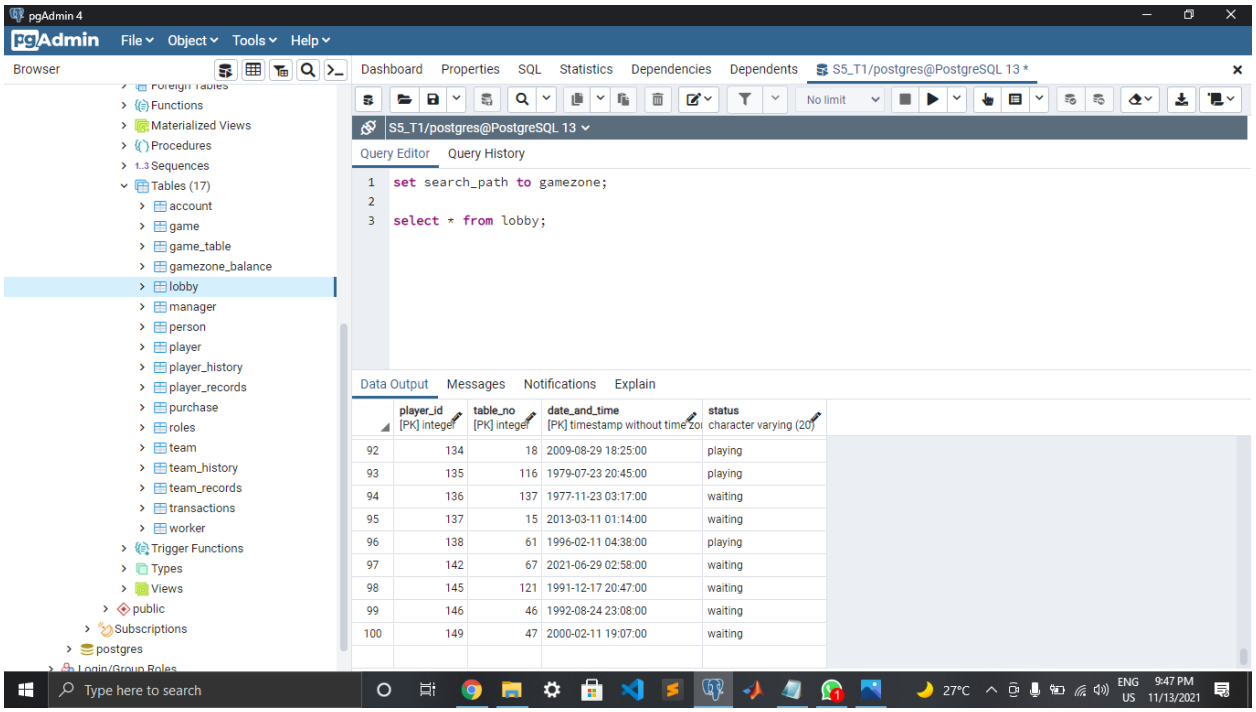


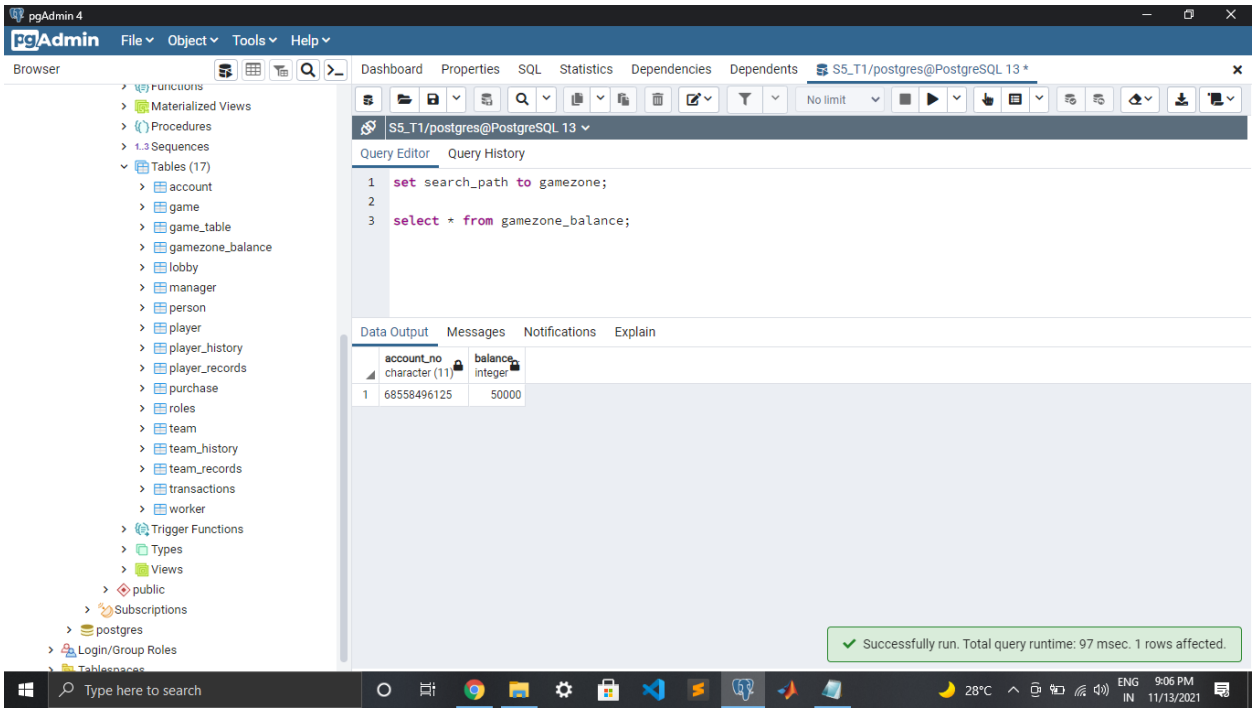
No of Tuples: 145

lobby:



No of Tuples: 100

gamezone_balance:



No of Tuples: 1