Semestral work DBS 2025

Theme: Sports Complex Database

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CP-0 Topic Statement + Bonus

Theme: Sports Complex Database

Motivation: The motivation is to simplify and accelerate the daily operations of the sports complex, solve issues with scheduling conflicts, payment transactions, and monitoring the use of individual sports facilities.

Short Description: This project focuses on the design and implementation of a database system for managing reservations in the sports complex, which includes group/solo trainings with trainer or without. The goal is to effectively digitize the process of reservations, payments, reservation collisions etc.

Taxonomic and Operational Scope: The proposed system will include several taxonomic levels (records of branches, sports halls, clients, trainers and trainings) and will handle operational data such as attendance at training sessions, payments.

Bonus: Detailed List of Entities and Relationships

Entities(WHO and WHAT):

1. **Branch** - **address**(city, street, house number)
2. **Sports Hall** - **name**, size, specialization
3. **User** - **login**, password
4. **Client** (derives from User) - preferences in sports
5. **Trainer** (derives from User) - specialization, education
6. **Personal Data** - **name**, **surname**, **date of birth**, **e-mail**, **phone number**
7. **Reservation** - status, reservation date
8. **Payment** - amount, payment date, payment method
9. **Training** - type, training date

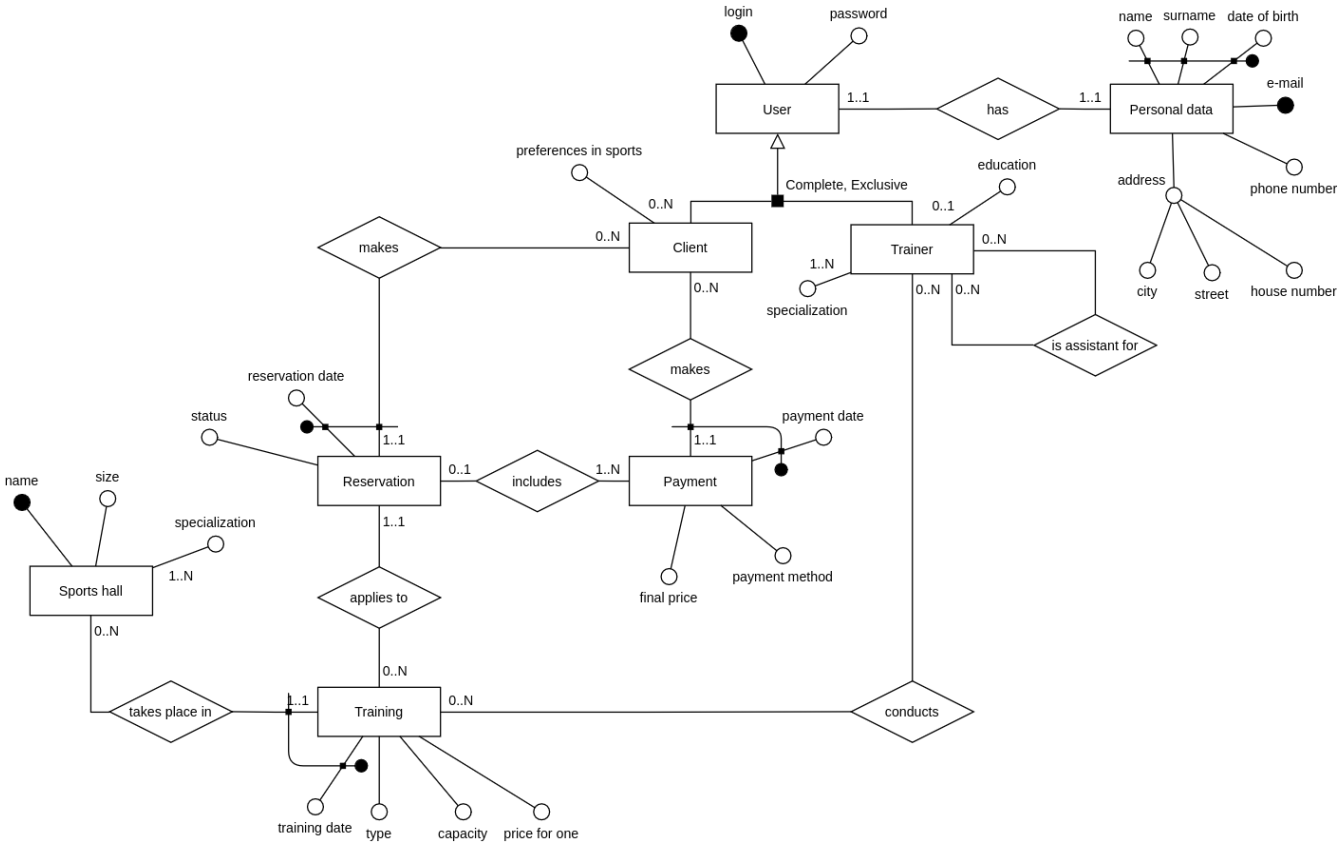
Relationships(What does):

1. Branch **contains** Sports Halls
2. User **has** Personal data
3. Client **makes** Reservation
4. Client **makes** Payment
5. Trainer **is assistant** for trainer
6. Trainer **conducts** trainings
7. Reservation **includes** Payment
8. Reservation **applies to** Training
9. Training **takes place in** Sports hall

CP-1 Conceptual Model

Description: The Sports Complex Database System allows clients to book trainings, make payments, and manage their training schedules efficiently. Users register with a login and password, with clients selecting their preferences in sports and trainers managing their schedules. Reservations are linked to specific trainings and sports halls, ensuring availability and proper allocation of resources. Clients must complete payment using various methods before confirming their reservations. Trainers conduct sessions based on their specialization and may assist each other. Each training session has a defined training date, type, capacity, and price per participant(which make up the full price in Payment). The system ensures structured scheduling, preventing double bookings and optimizing trainer assignments. Personal data, including information about user(name, surname, date of birth, address, e-mail, phone number). This system provides an organized and seamless experience for managing trainings, payments and reservations.

ER Diagram:



Entities:

1. **Sports Hall** - **name**, size, specialization(1..N)
2. **User** - **login**, password
3. **Client** (derives from User) - preferences in sports(0..N)
4. **Trainer** (derives from User) - specialization(1..N), education(0..1)
5. **Personal Data** - **name**, **surname**, **date of birth**, **e-mail**, phone number, address(city, street, house number)
6. **Reservation**(week entity: identified by Client + reservation date) - status, reservation date
7. **Payment**(week entity: identified by Client + payment date) - final price, payment date, payment method
8. **Training**(week entity: identified by Sports hall + training date) - type, training date, capacity, price for one

Relationships:

1. User **has** Personal data (1..1 - 1..1)
2. Client **makes** Reservation (0..N - 1..1)
3. Client **makes** Payment (0..N - 1..1)
4. Trainer **is assistant for** (recursion relationship) trainer (0..N - 0..N)
5. Trainer **conducts** trainings (0..N - 0..N)
6. Reservation **includes** Payment (0..1 - 1..N)
7. Reservation **applies to** Training (1..1 - 0..N)
8. Training **takes place in** Sports hall (1..1 - 0..N)

CP-2 Relational Model

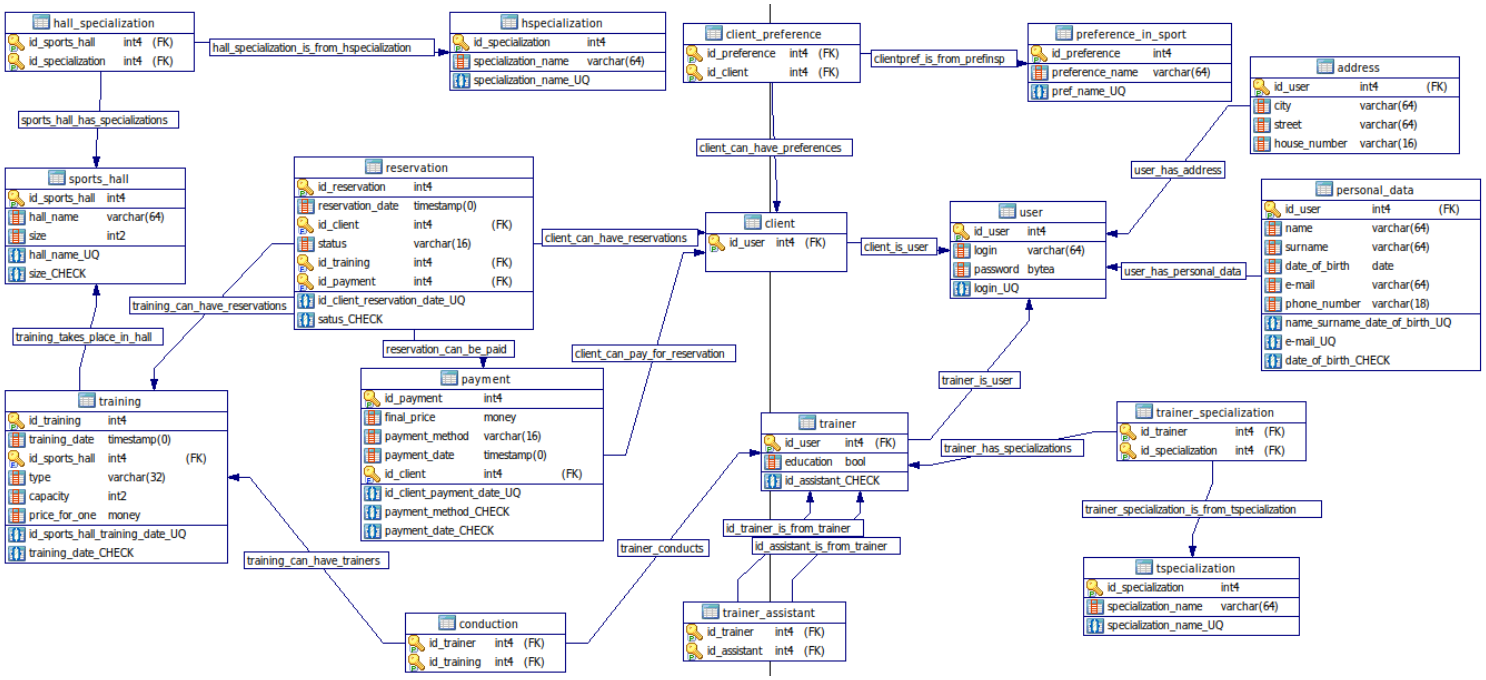
Sports hall(name, size)
Hall specialization(name, specialization)
  FK: (name) ⊆ **Sports hall**(name)
User(login, password)
Personal data(name, surname, date of birth, e-mail, phone number, login)
  FK: (login) ⊆ **User**(login)
Address(e-mail, city, street, house number)
  FK: (e-mail) ⊆ **Personal data**(e-mail)
Client(login)
  FK: (login) ⊆ **User**(login)
Preferences in sports(login, preferences in sports)
  FK: (login) ⊆ **Client**(login)
Trainer(login)
  FK: (login) ⊆ **User**(login)
Trainer specialization(login, name of sport)
  FK: (login) ⊆ **Trainer**(login)
Education(login, education)
  FK: (login) ⊆ **Trainer**(login)
Is assistant for(trainer, assistant)
  FK: (trainer) ⊆ **Trainer**(login)
  FK: (assistant) ⊆ **Trainer**(login)
Training(training date, name, type, capacity, price for one)
  FK: (name) ⊆ **Sports hall**(name)
Conducts(login, name, training date)
  FK: (login) ⊆ **Trainer**(login)
  FK: (name, training date) ⊆ **Training**(name, training date)
Payment(final price, payment method, payment date, login)
  FK: (login) ⊆ **Client**(login)
Reservation(reservation date, login1, status, training date, name, payment_date, login2)
  FK: (login1) ⊆ **Client**(login)
  FK: (payment_date, login2) ⊆ **Payment**(payment_date, login)
  FK: (training date, name) ⊆ **Training**(training date, name)

CP-3 Creating a database, querying data

Relational model with ids:

Sports_hall(id_sports_hall, hall_name, size)
HSpecialization(id_specialization, specialization_name)
Hall_specialization(id_sports_hall, id_specialization)
  FK: (id_sports_hall) ⊆ **Sports hall**(id_sports_hall)
  FK: (id_specialization) ⊆ **HSpecialization**(id_specialization)
User(id_user, login, password)
Personal_data(name, surname, date_of_birth, e-mail, phone_number, id_user)
  FK: (id_user) ⊆ **User**(id_user)
Address(id_user, city, street, house_number)
  FK: (id_user) ⊆ **Personal data**(id_user)
Client(id_user)
  FK: (id_user) ⊆ **User**(id_user)
Preference_in_sports(id_preference, preference_name)
Client_preference(id_client, id_preference)
  FK: (id_client) ⊆ **Client**(id_user)
  FK: (id_preference) ⊆ **Preference_in_sports**(id_preference)
Trainer(id_user, education)
  FK: (id_user) ⊆ **User**(id_user)
TSpecialization(id_specialization, specialization_name)
Trainer_specialization(id_trainer, id_specialization)
  FK: (id_trainer) ⊆ **Trainer**(id_user)
  FK: (id_specialization) ⊆ **TSpecialization**(id_specialization)
Trainer_assistant(id_trainer, id_assistant)
  FK: (id_trainer) ⊆ **Trainer**(id_user)
  FK: (id_assistant) ⊆ **Trainer**(id_user)
Training(id_training, training_date, id_sports_hall, type, capacity, price_for_one)
  FK: (id_sports_hall) ⊆ **Sports hall**(id_sports_hall)
Conduction(id_trainer, id_training)
  FK: (id_trainer) ⊆ **Trainer**(id_user)
  FK: (id_training) ⊆ **Training**(id_training)
Payment(id_payment, final_price, payment_method, payment_date, id_client)
  FK: (id_client) ⊆ **Client**(id_user)
Reservation(id_reservation, reservation_date, id_client, status, training_date, id_sports_hall, id_payment)
  FK: (id_client) ⊆ **Client**(id_user)
  FK: (training date, id_sports_hall) ⊆ **Training**(training date, id_sports_hall)
  FK: (id_payment) ⊆ **Payment**(id_payment)

ER Model:


hall_specialization
id_sports_hall int4 (FK)
id_specialization int4 (FK)
hall_specialization_is_from_hspecialization
hspecialization
id_specialization int4
specialization_name varchar(64)
specialization_name_UQ
client_preference
id_preference int4 (FK)
id_client int4 (FK)
clientpref_is_from_prefinsp
preference_in_sport
id_preference int4
preference_name varchar(64)
pref_name_UQ
address
id_user int4 (FK)
city varchar(64)
street varchar(64)
house_number varchar(16)
sports_hall_has_specializations
client_can_have_preferences
user_has_address
sports_hall
id_sports_hall int4
hall_name varchar(64)
size int2
hall_name_UQ
size_CHECK
reservation
id_reservation int4
reservation_date timestamp(0)
id_client int4 (FK)
status varchar(16)
id_training int4 (FK)
id_payment int4 (FK)
id_client_reservation_date_UQ
satus_CHECK
client_can_have_reservations
client
id_user int4 (FK)
client_is_user
user
id_user int4
login varchar(64)
password bytea
login_UQ
user_has_personal_data
personal_data
id_user int4 (FK)
name varchar(64)
surname varchar(64)
date_of_birth date
e-mail varchar(64)
phone_number varchar(18)
name_surname_date_of_birth_UQ
e-mail_UQ
date_of_birth_CHECK
training_can_have_reservations
training_takes_place_in_hall
reservation_can_be_paid
client_can_pay_for_reservation
trainer_is_user
payment
id_payment int4
final_price money
payment_method varchar(16)
payment_date timestamp(0)
id_client int4 (FK)
id_client_payment_date_UQ
payment_method_CHECK
payment_date_CHECK
training
id_training int4
training_date timestamp(0)
id_sports_hall int4 (FK)
type varchar(32)
capacity int2
price_for_one money
id_sports_hall_training_date_UQ
training_date_CHECK
trainer
id_user int4 (FK)
education bool
id_assistant_CHECK
trainer_has_specializations
trainer_specialization
id_trainer int4 (FK)
id_specialization int4 (FK)
trainer_specialization_is_from_tspecialization
id_trainer_is_from_trainer
id_assistant_is_from_trainer
trainer_conducts
training_can_have_trainers
tspecialization
id_specialization int4
specialization_name varchar(64)
specialization_name_UQ
conduction
id_trainer int4 (FK)
id_training int4 (FK)
trainer_assistant
id_trainer int4 (FK)
id_assistant int4 (FK)

Creating tables:

```
CREATE TABLE sports_hall (
    id_sports_hall    serial     PRIMARY KEY,
    hall_name         varchar(64) NOT NULL UNIQUE,
    size              smallint   NOT NULL
                                 CHECK (size BETWEEN 1 AND 3)
                                 DEFAULT 1
);

CREATE TABLE hspecialization (
    id_specialization serial     PRIMARY KEY,
    specialization_name varchar(64) NOT NULL UNIQUE
);

CREATE TABLE hall_specialization (
    id_sports_hall    int4       NOT NULL REFERENCES sports_hall
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    id_specialization int4       NOT NULL REFERENCES hspecialization
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    PRIMARY KEY (id_sports_hall, id_specialization)
);
```

Technical note:
`ON DELETE CASCADE` ensures that when a sports hall or specialization is deleted, related mappings are also removed.
`ON UPDATE CASCADE` propagates changes in primary keys to dependent rows.

```
CREATE TABLE "user" (
    id_user           serial     PRIMARY KEY,
    login             varchar(64) NOT NULL UNIQUE,
    password          bytea      NOT NULL
);

CREATE TABLE client (
    id_user           int4       PRIMARY KEY REFERENCES "user"
                                 ON DELETE NO ACTION
                                 ON UPDATE CASCADE
);
```

Technical note:
`ON DELETE NO ACTION` prevents deleting a user who is also a client (accidental deletion), but if by the end of the transaction the client is deleted, the user will be deleted too.
`ON UPDATE CASCADE` updates client ID if the user ID changes.

```
CREATE TABLE preference_in_sport (
    id_preference     serial     PRIMARY KEY,
    preference_name   varchar(64) NOT NULL UNIQUE
);

CREATE TABLE client_preference (
    id_client         int4       NOT NULL REFERENCES client (id_user)
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    id_preference     int4       NOT NULL REFERENCES preference_in_sport
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    PRIMARY KEY (id_client, id_preference)
);
```

Technical note:
`ON DELETE CASCADE` ensures that when a client or preference is deleted, related mappings are also removed.
`ON UPDATE CASCADE` propagates changes in primary keys to dependent rows.

```
CREATE TABLE personal_data (
    id_user           int4       PRIMARY KEY REFERENCES "user"
                                 ON DELETE NO ACTION
                                 ON UPDATE CASCADE,
    name              varchar(64) NOT NULL,
    surname           varchar(64) NOT NULL,
    date_of_birth     date       NOT NULL CHECK (
                                          EXTRACT(year FROM date_of_birth)
                                          BETWEEN EXTRACT(year FROM
                                              CURRENT_DATE) - 100
                                          AND EXTRACT(year FROM
                                              CURRENT_DATE)
                                          ),
    email             varchar(64) NOT NULL UNIQUE,
    phone_number      varchar(18) DEFAULT NULL,
    UNIQUE(name, surname, date_of_birth)
);
```

Technical note:
`ON DELETE NO ACTION` prevents deleting a user if their personal data is still stored (accidental deletion), but if by the end of the transaction personal data are deleted, the user will be deleted too.
`ON UPDATE CASCADE` ensures user ID updates propagate to personal data.

```
CREATE TABLE address (
    id_user           int4       PRIMARY KEY REFERENCES "user"
                                 ON DELETE NO ACTION
                                 ON UPDATE CASCADE,
    city              varchar(64) NOT NULL,
    street            varchar(64) NOT NULL,
    house_number      varchar(16) NOT NULL
);
```

Technical note:
`ON DELETE NO ACTION` prevents deleting a user if their address is still stored (accidental deletion), but if by the end of the transaction the address is deleted, the user will be deleted too.
`ON UPDATE CASCADE` ensures address stays linked if user ID changes.

```
CREATE TABLE trainer (
    id_user           int4       PRIMARY KEY REFERENCES "user"
                                 ON DELETE NO ACTION
                                 ON UPDATE CASCADE,
    education         bool       NOT NULL DEFAULT false
);
```

Technical note:
`ON DELETE NO ACTION` prevents deleting a user who is also a trainer (accidental deletion), but if by the end of the transaction the trainer is deleted, the user will be deleted too.
`ON UPDATE CASCADE` updates trainer ID if the user ID changes.

```
CREATE TABLE trainer_assistant (
    id_trainer        int4       NOT NULL REFERENCES trainer (id_user)
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    id_assistant      int4       CHECK (id_assistant <> id_trainer)
                                 REFERENCES trainer (id_user)
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    PRIMARY KEY (id_trainer, id_assistant)
);
```

Technical note:
`ON DELETE CASCADE` removes assistant or trainer relations if one is deleted.
`ON UPDATE CASCADE` ensures relationships remain valid after ID changes.

```
CREATE TABLE tspecialization (
    id_specialization serial     PRIMARY KEY,
    specialization_name varchar(64) NOT NULL UNIQUE
);

CREATE TABLE trainer_specialization (
    id_trainer        int4       NOT NULL REFERENCES trainer (id_user)
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    id_specialization int4       NOT NULL REFERENCES tspecialization
                                 ON DELETE CASCADE
                                 ON UPDATE CASCADE,
    PRIMARY KEY (id_trainer, id_specialization)
);
```

Technical note:
`ON DELETE CASCADE` removes trainer's specialization when either the trainer or specialization is deleted.
`ON UPDATE CASCADE` updates related IDs automatically if they change.

```
CREATE TABLE training (
    id_training       serial     PRIMARY KEY,
    training_date     timestamp(0) NOT NULL CHECK (
                                          EXTRACT(year FROM training_date)
                                          BETWEEN EXTRACT(year FROM
                                              CURRENT_DATE) - 1
                                          AND EXTRACT(year FROM
                                              CURRENT_DATE) + 1
                                          ),
    id_sports_hall    int4       REFERENCES sports_hall
                                 ON DELETE SET NULL
                                 ON UPDATE CASCADE,
    type              varchar(32) NOT NULL,
    capacity          int2       NOT NULL,
    price_for_one     money      NOT NULL,
    UNIQUE (id_sports_hall, training_date)
);
```

Technical note:
`ON DELETE SET NULL` on `id_sports_hall` ensures that if the related sports hall is deleted, the training will remain, but its `id_sports_hall` will be set to `NULL` (because another hall will be found for training).
`ON UPDATE CASCADE` automatically updates `id_sports_hall` if the ID changes in the `sports_hall` table.

```
CREATE TABLE conduction (
    id_trainer          int4        DEFAULT NULL REFERENCES trainer (id_user)
                                    ON DELETE SET DEFAULT
                                    ON UPDATE CASCADE,
    id_training         int4        NOT NULL REFERENCES training
                                    ON DELETE CASCADE
                                    ON UPDATE CASCADE,
    PRIMARY KEY (id_trainer, id_training)
);
```

Technical note:
`ON DELETE SET DEFAULT` on `id_trainer` sets the trainer to the default value (`NULL`) if the trainer is deleted, another trainer will be found.
`ON DELETE CASCADE` on `id_training` deletes conduction records when the corresponding training is deleted.
`ON UPDATE CASCADE` ensures both `id_trainer` and `id_training` are updated if their referenced IDs change.

```
CREATE TABLE payment (
    id_payment          serial      PRIMARY KEY,
    final_price         money       NOT NULL DEFAULT 0,
    payment_method      varchar(16) NOT NULL
                                    CHECK (payment_method IN ('card', 'cash')),
    payment_date        timestamp(0) NOT NULL DEFAULT CURRENT_TIMESTAMP
                                    CHECK (payment_date <= CURRENT_TIMESTAMP),
    id_client           int4        NOT NULL REFERENCES client (id_user)
                                    ON DELETE RESTRICT
                                    ON UPDATE CASCADE,
    UNIQUE (id_client, payment_date)
);
```

Technical note:
`ON DELETE RESTRICT` on `id_client` prevents deleting a client if there are related payment records, because it can be useful for statistics.
`ON UPDATE CASCADE` updates `id_client` if the user ID changes in the `client` table.

```
CREATE TABLE reservation (
    id_reservation    serial     PRIMARY KEY,
    reservation_date  timestamp(0) NOT NULL DEFAULT CURRENT_TIMESTAMP
                                 CHECK (reservation_date <= CURRENT_TIMESTAMP),
    id_client         int4       NOT NULL REFERENCES client (id_user)
                                 ON DELETE RESTRICT
                                 ON UPDATE CASCADE,
    status            varchar(16) NOT NULL DEFAULT 'reserved'
                                 CHECK (status IN ('reserved', 'in process',
                                     'payed')),
    id_training       int4       NOT NULL REFERENCES training
                                 ON DELETE RESTRICT
                                 ON UPDATE CASCADE,
    id_payment        int4       DEFAULT NULL REFERENCES payment
                                 ON DELETE SET DEFAULT
                                 ON UPDATE CASCADE,
    UNIQUE (id_client, reservation_date)
);
```

Technical note:
`ON DELETE RESTRICT` on `id_client` prevents deleting a client if there are related reservation records, because it can be useful for statistics.
`ON DELETE RESTRICT` on `id_training` prevents, because reservation can be paid.
`ON DELETE SET DEFAULT` on `id_payment` sets the field to the default (`NULL`) if the referenced payment is deleted.
`ON UPDATE CASCADE` updates all foreign keys if the referenced IDs are changed.

Python script for generating data:

`writer.py` defines the `DatabaseWriter` class, which provides inserting and updating methods in the sports complex database. The implementation uses the `psycopg2` library.

Constructor:

- `DatabaseWriter(dbname, user, password, host, port)`:
  - `dbname` – the name of the database.
  - `user` – the username.
  - `password` – the password.
  - `host` – the address of the database server
  - `port` – the port.

Methods:

- `_connect()`: used to connect to the database.

```
def _connect(self):
    self.conn = psycopg2.connect(**self.conn_params)
    self.cursor = self.conn.cursor()
```

- `_disconnect()`: used to disconnect from the database

```
def _disconnect(self):
    self.cursor.close()
    self.conn.close()
```

- `_execute_insert(query, values, error_msg)`: A method to execute insert queries with error handling.

```
def _execute_insert(self, query, values, error_msg):
    try:
        self.cursor.execute(sql.SQL(query), values)
        self.num_of_insert += 1
        if(self.num_of_insert > 500):
            self.conn.commit()
            self.num_of_insert = 0
    except Exception as e:
        print(f"{error_msg}: {e}")
```

- `insert_sports_hall(hall_name, size)`: Inserts a sports hall.
- `insert_hspecialization(specialization_name)`: Adds a new hall specialization.
- `insert_hall_specialization(id_sports_hall, id_specialization)`: Links a sports hall to a specialization.
- `insert_user(login, password)`: Creates a new user.
- `insert_client(id_user)`: Registers a new client.
- `insert_preference_in_sport(preference_name)`: Adds a sport preference.
- `insert_client_preference(id_client, id_preference)`: Links a client to their sport preference.
- `insert_personal_data(id_user, name, surname, date_of_birth, email, phone_number)`: Stores personal data.
- `insert_address(id_user, city, street, house_number)`: Adds address.
- `insert_trainer(id_user, education)`: Registers a trainer.
- `insert_trainer_assistant(id_trainer, id_assistant)`: Connects a trainer with their assistant.
- `insert_tspecialization(specialization_name)`: Adds a trainer specialization.
- `insert_trainer_specialization(id_trainer, id_specialization)`: Links a trainer with a specialization.
- `insert_training(training_date, id_sports_hall, type, capacity, price_for_one)`: Adds a training.

- `insert_conduction(id_trainer, id_training)`: Links a trainer with a training.
- `insert_payment(final_price, payment_method, payment_date, id_client)`: Adds a payment.
- `insert_reservation(reservation_date, id_client, status, id_training, id_payment)`: Makes a reservation for a training.

```
    def insert_reservation(self, reservation_date, id_client, status,
        id_training, id_payment):
        self._execute_insert("""
            INSERT INTO reservation (reservation_date, id_client, status,
                id_training, id_payment)
            VALUES (%s, %s, %s, %s, %s)
        """, (reservation_date, id_client, status, id_training,
            id_payment), "Error inserting into reservation")
```

- `update_reservation(id_reservation, id_payment)`: Updates a reservation.

```
    def update_reservation(self, id_reservation, id_payment):
        self._execute_insert("""
            UPDATE reservation
            SET id_payment = %s
            WHERE id_reservation = %s
        """, (id_payment, id_reservation), "Error updating reservation")
```

Note:
All insert functions are like `insert_reservation`.

`my_faker.py` defines the `MyFaker` class, which provides methods for generating data for the sports complex database. The implementation uses the `Faker` library.

Constructor:

- `MyFaker(db, user, password, host, port, num_users, num_trainers, num_halls)`:
  - `db` – the name of the database.
  - `user` – the username.
  - `password` – the password.
  - `host` – the address of the database server.
  - `port` – the port.
  - `num_users` – the number of users to generate.
  - `num_trainers` – the number of trainers to generate.
  - `num_halls` – the number of sports halls to generate.

Methods:

- `gen_password()`: generates password.
- `gen_name(gender)`: generates Czech name depending on gender.
- `gen_surname(gender)`: generates Czech surname depending on gender.
- `gen_date_of_birth()`: generates date of birth.
- `gen_name_surname_dob_UQ()`: generates unique combination - name, surname, date of birth.
- `gen_email_UQ()`: generates unique email.
- `gen_phone_number()`: generates Czech phone number.
- `gen_city()`: generates Czech city.
- `gen_street()`: generates Czech street.
- `gen_house_number()`: generates house number.
- `gen_fake_user_inf()`: generates `self.num_of_user` fake users, their personal data, addresses, etc.
- `separate_trainers_clients()`: chooses `self.num_of_trainers` trainers from users.
- `gen_tspecialization()`: generates all possible trainer specializations.
- `gen_trainer_specialization()`: generates specializations for all trainers.
- `gen_preference_in_sport()`: generates all possible client preferences in sport.
- `gen_client_preference()`: generates preferences for all clients.

- `gen_trainer_assistant()`: chooses assistants for some trainers.
- `gen_hall_name_UQ()`: generates unique hall name.
- `gen_sports_hall()`: generates `self.num_halls` sports halls.
- `gen_hspecialization()`: generates all possible hall specializations.
- `gen_hall_specialization()`: generates specializations for all halls.
- `gen_dates()`: generates time slots for trainings on 15 days back and 15 days in future (9 per day).
- `find_trainers(time_slot, training_spec)`: finds trainer for training.
- `gen_reservation_for_training(date_id, price, training_id, capacity, reservation_i` generates reservations for training.
- `gen_payments()`: generates payments depending on user reservations.
- `gen_training()`: generates trainings.

Note:
The implementation is below.

```python
from faker import Faker
import random
from datetime import *
from unidecode import unidecode

from writer import DatabaseWriter


class MyFaker:  1usage
    SPECIALIZATIONS = ['volleyball', 'basketball', 'football', 'tennis', 'judo', 'karate', 'MMA', 'sambo',
                       'yoga', 'pilates', 'fitness', 'badminton', 'handball', 'futsal', 'squash', 'wrestling',
                       'gymnastics', 'aerobics', 'zumba', 'piloxing', 'bodybuilding', 'kickboxing', 'table tennis',
                       'dance', 'cheerleading', 'martial arts', 'taekwondo', 'fencing', 'rowing', 'indoor cycling',
                       'crossfit', 'weightlifting', 'boxing', 'dodgeball', 'floorball', 'parquet ball', 'indoor archery']
    SPEC_LEN = len(SPECIALIZATIONS)

    PREFERENCES = ['team sports', 'solo sports', 'with ball', 'without ball', 'indoor sports', 'combat sports',
                   'fitness and strength training', 'flexibility and balance', 'endurance sports', 'extreme sports',
                   'aerobic exercises', 'mind-body sports', 'competitive sports']
    PREF_LEN = len(PREFERENCES)

    PRICES_FOR_ONE = {1 : (250, 500),
                      2 : (200, 400),
                      3 : (150, 300)}

    MAX_CAPACITIES = {1 : 14,
                      2 : 28,
                      3 : 42}

    TRAINING_TYPES = ['with trainer', 'without trainer']
    TYPES_LEN = len(TRAINING_TYPES)

    RESERVATIONS_STATUS = ['reserved', 'in process', 'payed']

    PAYMENTS_METHODS = ['cash', 'card']

    def __init__(self, db, user, password, host, port,
                 num_users, num_trainers, num_halls):
        self.num_users = num_users
        self.num_trainers = num_trainers
        self.num_halls = num_halls

        # fakers
        self.fake_global = Faker()
        self.fake_cz = Faker('cz_CZ')

        # database writer
        self.writer = DatabaseWriter(db, user, password, host, port)

        # PRIMARY KEYS
        self.trainer_assistant_PK = [[] for _ in range(self.num_trainers)]
        self.trainer_spec_PK = [[] for _ in range(self.num_trainers)]
        self.client_pref_PK = [[] for _ in range(self.num_users)]
        self.hall_spec_PK = [[] for _ in range(self.num_halls)]

        # UNIQUE
        self.login_UQ = set()
        self.name_sur_dob_UQ = set()
        self.email_UQ = set()
        self.hall_name_UQ = set()
```

```
        self.hall_name_UQ = set()
        self.idcl_paymdate_UQ = set()

        self.spec_trainer = [[] for _ in range(self.SPEC_LEN)]

        self.hall_sizes = []

        self.dates = self.gen_dates()
        self.days_num = 30
        self.one_day_num_train = 9
        self.total_slots = self.one_day_num_train * self.days_num

        self.trainer_occupancy = [[False for _ in range(self.total_slots)] for _ in range(self.num_trainers)]
        self.clients_reservations = set()

        self.clients_reservations_for_pay = [[] for _ in range(self.num_users)]

    # Function to generate password
    def gen_password(self):  1usage
        return self.fake_cz.password()

    # Function to generate Czech name depends on gender
    def gen_name(self, gender):  1usage
        if gender == 'male':
            return self.fake_cz.first_name_male()
        else:
            return self.fake_cz.first_name_female()

    # Function to generate Czech surname depends on gender
    def gen_surname(self, gender):  1usage
        if gender == 'male':
            return self.fake_cz.last_name_male()
        else:
            return self.fake_cz.last_name_female()

    # Function to generate date of birth (interval [-99 years; -10 years] from cur date)
    def gen_date_of_birth(self):  1usage
        return self.fake_cz.date_between(start_date="-99y", end_date="-10y")

    # Function to generate unique combination of name, surname, date of birth
    def gen_name_surname_dob_UQ(self):  1usage
        gender = random.choice(['male', 'female'])

        while True:
            name = self.gen_name(gender)
            surname = self.gen_surname(gender)
            date_of_birth = self.gen_date_of_birth()

            key = (name, surname, date_of_birth)
            if key not in self.name_sur_dob_UQ:
                self.name_sur_dob_UQ.add(key)
                return key

    # Function to generate unique email
    def gen_email_UQ(self):
        while True:
            email = self.fake_cz.email()
            if email not in self.email_UQ:
```

```
                if email not in self.email_UQ:
                    self.email_UQ.add(email)
                    return email

    # Function to generate phone number
    def gen_phone_number(self):  1usage
        phone_number = self.fake_cz.phone_number()
        if phone_number[0] == '0':
            phone_number = '+' + phone_number[2:]
        return phone_number

    # Function to generate Czech city
    def gen_city(self):  1usage
        return self.fake_cz.city()

    # Function to generate Czech street
    def gen_street(self):  1usage
        return self.fake_cz.street_name()

    # Function to generate house number
    def gen_house_number(self):  1usage
        return random.randint( a: 1,  b: 200)

    # Function to generate fake users information
    def gen_fake_user_inf(self):  1usage
        for user_id in range(1, self.num_users + 1):
            name, surname, date_of_birth = self.gen_name_surname_dob_UQ()
            login = unidecode(name + surname).lower() + str(date_of_birth).replace( __old: '-',  __new: '')
            password = self.gen_password()
            email = login + '@gmail.com'
            phone_number = self.gen_phone_number()
            city = self.gen_city()
            street = self.gen_street()
            house_number = self.gen_house_number()

            self.writer.insert_user(login, password)
            self.writer.insert_personal_data(user_id, name, surname, date_of_birth, email, phone_number)
            self.writer.insert_address(user_id, city, street, house_number)

    # Function to separate trainers and clients (first self.num_trainers users are trainers)
    def separate_trainers_clients(self):  1usage
        cur_num_tr = 0
        for user_id in range(1, self.num_users + 1):
            if cur_num_tr < self.num_trainers:
                education = random.choice(['TRUE', 'FALSE'])
                self.writer.insert_trainer(user_id, education)
                cur_num_tr += 1
            else:
                self.writer.insert_client(user_id)

    # Function to generate possible trainer specializations
    def gen_tspecialization(self):  1usage
        for spec in self.SPECIALIZATIONS:
            self.writer.insert_tspecialization(spec)

    # Function to gen specializations for all trainers
    def gen_trainer_specialization(self):  1usage
        for trainer_id in range(self.num_trainers):
```

```
        for trainer_id in range(self.num_trainers):
            num_specs = random.randint( a: 1,  b: 6)
            spec_ids = random.sample(range(self.SPEC_LEN), num_specs)

            for spec_id in spec_ids:
                self.writer.insert_trainer_specialization(trainer_id + 1, spec_id + 1)
                self.trainer_spec_PK[trainer_id].append(spec_id)
                self.spec_trainer[spec_id].append(trainer_id)

    # Function to generate all possible preferences in sports
    def gen_preference_in_sport(self):  1usage
        for pref in self.PREFERENCES:
            self.writer.insert_preference_in_sport(pref)

    # Function to generate preferences for all clients
    def gen_client_preference(self):  1usage
        for client_id in range(self.num_trainers, self.num_users):
            num_prefs = random.randint( a: 0,  b: 5)
            if num_prefs == 0:
                continue

            pref_ids = random.sample(range(self.PREF_LEN), min(num_prefs, self.PREF_LEN))

            for pref_id in pref_ids:
                if pref_id not in self.client_pref_PK[client_id]:
                    self.writer.insert_client_preference(client_id + 1, pref_id + 1)
                    self.client_pref_PK[client_id].append(pref_id)

    # Function to generate assistants for trainers
    def gen_trainer_assistant(self):  1usage
        for trainer_id in range(self.num_trainers):
            num_assistants = random.randint( a: 0,  b: 5)
            if num_assistants == 0:
                continue

            possible_assistants = []
            trainer_specs = set(self.trainer_spec_PK[trainer_id])

            for assistant_id in range(self.num_trainers):
                if assistant_id == trainer_id:
                    continue
                assistant_specs = set(self.trainer_spec_PK[assistant_id])
                if trainer_specs & assistant_specs:
                    possible_assistants.append(assistant_id)

            if not possible_assistants:
                continue

            assistants = random.sample(possible_assistants, min(num_assistants, len(possible_assistants)))

            for assistant_id in assistants:
                if assistant_id not in self.trainer_assistant_PK[trainer_id]:
                    self.writer.insert_trainer_assistant(trainer_id + 1, assistant_id + 1)
                    self.trainer_assistant_PK[trainer_id].append(assistant_id)

    # Function to generate unique halls name
    def gen_hall_name_UQ(self):  1usage
        while True:
```

```
        while True:
            hall_name = self.fake_global.first_name_female()
            if hall_name not in self.hall_name_UQ:
                self.hall_name_UQ.add(hall_name)
                return hall_name

    # Function to generate sport halls
    def gen_sports_hall(self):  1usage
        for _ in range(self.num_halls):
            size = random.randint( a: 1,  b: 3)
            hall_name = self.gen_hall_name_UQ()
            self.hall_sizes.append(size)
            self.writer.insert_sports_hall(hall_name, size)

    # Function to generate all possible hall specializations
    def gen_hspecialization(self):  1usage
        for spec in self.SPECIALIZATIONS:
            self.writer.insert_hspecialization(spec)

    # Function to generate specializations for all halls
    def gen_hall_specialization(self):  1usage
        for hall_id in range(self.num_halls):
            num_specializations = random.randint( a: 1,  b: 6)

            spec_ids = random.sample(range(self.SPEC_LEN), num_specializations)

            for spec_id in spec_ids:
                if spec_id not in self.hall_spec_PK[hall_id]:
                    self.writer.insert_hall_specialization(hall_id + 1, spec_id + 1)
                    self.hall_spec_PK[hall_id].append(spec_id)

    # Function to generate dates slots on 15 days back and 15 days in future
    def gen_dates(self):  1usage
        past_days = 15
        future_days = 15
        interval = timedelta(minutes=90)
        slots = []

        start_date = datetime.today().date() - timedelta(days=past_days)
        total_days = past_days + future_days + 1

        for day_offset in range(total_days):
            current_date = start_date + timedelta(days=day_offset)
            time = timedelta(hours=9)
            while time <= timedelta(hours=22, minutes=30):
                dt = datetime.combine(current_date, datetime.min.time()) + time
                slots.append(dt)
                time += interval

        return slots

    # Function to find trainers for training
    def find_trainers(self, time_slot, training_spec):  1usage
        trainers = []
        for trainer_id in self.spec_trainer[training_spec]:
            if self.trainer_occupancy[trainer_id][time_slot] == False:
                trainers.append(trainer_id)
                assist_num = min(1, random.randint( a: 0, len(self.trainer_assistant_PK[trainer_id])))
```

```
                assist_num = min(1, random.randint( a: 0, len(self.trainer_assistant_PK[trainer_id])))
                if assist_num > 0:
                    for assist_id in self.trainer_assistant_PK[trainer_id]:
                        if training_spec in self.trainer_spec_PK[assist_id] and self.trainer_occupancy[assist_id][time_slot] == False\
                            and assist_id != trainer_id:
                            trainers.append(assist_id)
                            break
                return trainers
        return None

    # Function to generate reservations for training
    def gen_reservation_for_training(self, date_id, price, training_id, capacity, reservation_id):  1usage
        for _ in range(capacity):
            client_id = random.randint(self.num_trainers, self.num_users - 1)
            reservation_date = self.dates[date_id] if self.dates[date_id] < datetime.today() else datetime.today()
            delta = timedelta(days=random.randint( a: 1,  b: 9), hours=random.randint( a: 0,  b: 23), minutes = random.randint( a: 0,  b: 59))
            reservation_date -= delta
            key = (client_id, reservation_date.month, reservation_date.day, reservation_date.hour, reservation_date.minute)
            if key in self.clients_reservations:
                continue

            reservation_status = None
            if self.dates[date_id] < datetime.today():
                reservation_status = 'payed'
            else:
                reservation_status = random.choice(self.RESERVATIONS_STATUS)

            if reservation_status != 'reserved':
                new_client_id = client_id
                if random.random() >= 0.5:
                    new_client_id = random.randint(num_trainers, self.num_users - 1)
                self.clients_reservations_for_pay[new_client_id].append((reservation_id, price, reservation_date, date_id))

            self.writer.insert_reservation(reservation_date, client_id + 1, reservation_status, training_id,  id_payment: None)
            reservation_id += 1
            self.clients_reservations.add(key)

    # Function to generate payments
    def gen_payments(self):  1usage
        payment_id = 1
        for client_id in range(self.num_trainers, self.num_users):
            len_res_for_pay = len(self.clients_reservations_for_pay[client_id])
            for res_for_pay in range(len_res_for_pay):
                reservations = []
                reservation_id, price, reservation_date, date_id = self.clients_reservations_for_pay[client_id][res_for_pay]
                reservations.append(reservation_id)

                max_res_date = reservation_date
                min_train_date = self.dates[date_id]

                if res_for_pay < len_res_for_pay - 1:
                    next_reservation_id, next_price, next_reservation_date, next_date_id = self.clients_reservations_for_pay[client_id][res_for_pay + 1]
                    if reservation_date < self.dates[next_date_id] and next_reservation_date < self.dates[date_id]:
                        reservations.append(next_reservation_id)
                        max_res_date = max(max_res_date, next_reservation_date)
                        min_train_date = min(min_train_date, self.dates[next_date_id])
                        price += next_price
                        res_for_pay += 1
```

```
                    max_res_date = max(max_res_date, next_reservation_date)
                    min_train_date = min(min_train_date, self.dates[next_date_id])
                    price += next_price
                    res_for_pay += 1

                payment_method = random.choice(self.PAYMENTS_METHODS)
                payment_date = datetime.fromtimestamp((max_res_date.timestamp() + min_train_date.timestamp()) / 2)
                if payment_date >= datetime.today():
                    payment_date = datetime.fromtimestamp((max_res_date.timestamp() + datetime.today().timestamp()) / 2)

                while (client_id, payment_date.month, payment_date.day, payment_date.hour, payment_date.minute) in self.idcl_paymdate_
                    payment_date += timedelta(minutes=1)

                self.writer.insert_payment(price, payment_method, payment_date, client_id + 1)

                for reserv_id in reservations:
                    self.writer.update_reservation(reserv_id, payment_id)

                self.idcl_paymdate_UQ.add((client_id, payment_date.month, payment_date.day, payment_date.hour, payment_date.minute))
                payment_id += 1

    # Function to generate trainings
    def gen_training(self):  1usage
        training_id = 1
        reservation_id = 1
        for time_slot in range(self.one_day_num_train * self.days_num):
            for hall_id in range(self.num_halls):
                training_type = random.choice(self.TRAINING_TYPES)
                training_spec = random.choice(self.hall_spec_PK[hall_id])
                hall_size = self.hall_sizes[hall_id]
                capacity = self.MAX_CAPACITIES[hall_size]
                price_for_one = None
                if training_type == 'without trainer':
                    price_for_one = self.PRICES_FOR_ONE[hall_size][0]
                    self.writer.insert_training(self.dates[time_slot], hall_id + 1, self.SPECIALIZATIONS[training_spec] + " " + train
                else:
                    trainers = self.find_trainers(time_slot, training_spec)
                    if trainers is None:
                        training_type = 'without trainer'
                        price_for_one = self.PRICES_FOR_ONE[hall_size][0]
                        self.writer.insert_training(self.dates[time_slot], hall_id + 1, self.SPECIALIZATIONS[training_spec] + " " + t
                    else:
                        price_for_one = self.PRICES_FOR_ONE[hall_size][1]
                        self.writer.insert_training(self.dates[time_slot], hall_id + 1, self.SPECIALIZATIONS[training_spec] + " " + t
                        for trainer_id in trainers:
                            self.trainer_occupancy[trainer_id][time_slot] = True
                            self.writer.insert_conduction(trainer_id + 1, training_id)
                self.gen_reservation_for_training(time_slot, price_for_one, training_id, capacity, reservation_id)
                reservation_id += capacity
                training_id += 1
```

```python
if __name__ == '__main__':
    num_users = 32000
    num_trainers = 100
    num_halls = 10

    faker = MyFaker( db: 'kolesole', user: 'username', password: 'password', host: 'slon.felk.cvut.cz', port: '5432',
                     num_users, num_trainers, num_halls)
    # faker = MyFaker('postgres', 'postgres', 'Razryvaka1', 'localhost', '5432',
                      # num_users, num_trainers, num_halls)
    faker.writer._connect()
    faker.gen_fake_user_inf()
    print('fake users generated')
    faker.separate_trainers_clients()
    print('trainers and clients separated')
    faker.gen_tspecialization()
    print('tspecializations generated')
    faker.gen_trainer_specialization()
    print('trainer_specializations generated')
    faker.gen_preference_in_sport()
    print('preference_in_sport generated')
    faker.gen_client_preference()
    print('client_preference generated')
    faker.gen_trainer_assistant()
    print('trainer_assistant generated')
    faker.gen_sports_hall()
    print('sports_hall generated')
    faker.gen_hspecialization()
    print('hspecialization generated')
    faker.gen_hall_specialization()
    print('hall_specialization generated')
    faker.gen_training()
    print('trainings generated')
    faker.gen_payments()
    print('payments generated')
    faker.writer.conn.commit()
    faker.writer._disconnect()

```

Note:
32000 users, 100 trainers, 10 sports halls, 2700 trainings, etc. are now in the database.

Queries:

```
GRANT CONNECT, TEMP ON DATABASE kolesole TO zhyltser;
GRANT ALL ON ALL TABLES IN SCHEMA public TO zhyltser;
GRANT ALL ON ALL SEQUENCES IN SCHEMA public TO zhyltser;
GRANT ALL ON ALL FUNCTIONS IN SCHEMA public TO zhyltser;

ALTER DEFAULT PRIVILEGES IN SCHEMA public
    GRANT ALL ON TABLES TO zhyltser;

ALTER DEFAULT PRIVILEGES IN SCHEMA public
    GRANT ALL ON SEQUENCES TO zhyltser;
```

Note:
Grants full access rights to the partner `zhyltser` for the database.

```
GRANT CONNECT, TEMP ON DATABASE kolesole TO prokoyul;
GRANT ALL ON ALL TABLES IN SCHEMA public TO prokoyul;
GRANT ALL ON ALL SEQUENCES IN SCHEMA public TO prokoyul;
GRANT ALL ON ALL FUNCTIONS IN SCHEMA public TO prokoyul;

ALTER DEFAULT PRIVILEGES IN SCHEMA public
    GRANT ALL ON TABLES TO prokoyul;

ALTER DEFAULT PRIVILEGES IN SCHEMA public
    GRANT ALL ON SEQUENCES TO prokoyul;
```

Note:
Grants full access rights to the tutor `prokoyul` for the database.

```
SELECT DISTINCT name || ' ' || surname AS trainer_name,
      specialization_name
    FROM trainer t
        JOIN personal_data USING(id_user)
        JOIN trainer_specialization tr_spec ON t.id_user = tr_spec.id_trainer
        JOIN tspecialization tspec ON tr_spec.id_specialization =
            tspec.id_specialization
    LIMIT 10
;
```

Note:
Returns the first 10 trainer names and one of their specializations by joining `trainer`, `personal_data`, `trainer_specialization`, and `tspecialization`.

Output:

	trainer_name	specialization_name
1	Božena Bártová	volleyball
2	Jana Navrátilová	zumba
3	Renáta Němcová	tennis
4	Dalibor Král	judo
5	Adam Dušek	football
6	Radim Sýkora	taekwondo
7	Pavlína Žáková	squash
8	Pavlína Žáková	indoor archery
9	Dana Němcová	indoor cycling
10	Jiřina Procházková	futsal

```
SELECT city,
       count(*) AS num_of_users
    FROM "user"
        JOIN address addr USING(id_user)
    GROUP BY city
    ORDER BY num_of_users DESC
    LIMIT 10
;
```

Note:
Counts the number of users in each city by using `GROUP BY city`. Sorts the cities by the number of users in descending order and returns only the top 10 results and their counts.

Output:

	city	num_of_users
1	Zruč nad Sázavou	89
2	Netolice	87
3	Oslavany	85
4	Všeruby	85
5	Rejštejn	85
6	Hulín	84
7	Zákupy	84
8	Ronov nad Doubravou	83
9	Újezd u Brna	82
10	Polička	82

```
SELECT pd_trainer.name || ' ' || pd_trainer.surname AS trainer_name,
      pd_assistant.name || ' ' || pd_assistant.surname AS assistant_name
    FROM trainer t
        JOIN personal_data pd_trainer USING(id_user)
        LEFT JOIN trainer_assistant train_assist ON t.id_user =
            train_assist.id_trainer
        LEFT JOIN personal_data pd_assistant ON train_assist.id_assistant =
            pd_assistant.id_user
    ORDER BY assistant_name DESC
    LIMIT 30
;
```

Note:
Shows the first 30 trainer–assistant pairs, including trainers without an assistant.

Output:

	trainer_name	assistant_name
1	Žofie Ježková	<null>
2	Richard Kopecký	<null>
3	Jiřina Procházková	<null>
4	Peter Fišer	<null>
5	Klára Křížová	<null>
6	Božena Bártová	<null>
7	Tomáš Staněk	<null>
8	Hubert Hruška	<null>
9	Igor Mach	<null>
10	Kristýna Pavlíková	<null>
11	Alena Mašková	<null>
12	Jana Navrátilová	<null>
13	Milan Kopecký	<null>
14	Marcela Stejskalová	<null>
15	Alena Navrátilová	<null>
16	Nela Beranová	<null>
17	Ivo Kašpar	<null>
18	Slavěna Kadlecová	<null>
19	Olivie Němcová	<null>
20	Věra Fialová	<null>
21	Vratislav Hrubý	<null>
22	Erika Šimková	<null>
23	Františka Pospíšilová	<null>
24	Slavěna Novotná	<null>
25	Dalibor Král	<null>
26	Anastázie Vávrová	Žofie Růžičková
27	Pavel Doležal	Vlasta Mašek
28	Radim Sýkora	Vlasta Mašek
29	Radovan Šimek	Vlasta Mašek
30	Kamila Vaňková	Vladislav Sýkora

```
SELECT DISTINCT name || ' ' || surname AS trainer_name,
       email
    FROM trainer t
        JOIN personal_data USING(id_user)
        JOIN trainer_specialization tr_spec ON t.id_user = tr_spec.id_trainer
        JOIN tspecialization tspec USING(id_specialization)
    WHERE tspec.specialization_name IN ('volleyball')
;
```

Note:
Shows trainers names and emails whose specializations include `volleyball`.

Output:

	trainer_name	email
1	Anastázie Vávrová	anastazievavrova19471029@gmail.com
2	Božena Bártová	bozenabartova20110429@gmail.com
3	Dalibor Král	daliborkral19600704@gmail.com
4	Eva Dušková	evaduskova19960702@gmail.com
5	Olivie Němcová	olivienemcova19620106@gmail.com
6	Petra Marešová	petramaresova19840314@gmail.com
7	Slavěna Kadlecová	slavenakadlecova20121016@gmail.com

```
SELECT name || ' ' || surname AS trainer_name,
       count(*) AS num_of_conducted_trainings
    FROM trainer t
        JOIN personal_data pd USING(id_user)
        JOIN conduction c ON c.id_trainer = t.id_user
    GROUP BY trainer_name
    ORDER BY num_of_conducted_trainings
    LIMIT 10
;
```

Note:
Returns the 10 trainers (full name) with the fewest conducted and future trainings, sorted in ascending order.

Output:

	trainer_name	num_of_conducted_trainings
1	Leoš Dostál	1
2	Judita Beránková	1
3	Pavel Doležal	1
4	Radim Jelínek	1
5	Horymír Müller	2
6	Martin Slavík	2
7	Kristýna Pavlíková	3
8	Miluše Holubová	4
9	Luděk Moravec	7
10	Božena Bártová	8

```
SELECT login,
       count(r.id_reservation) AS num_of_reservations,
       sum(p.final_price) AS sum_of_payments
    FROM "user"
        JOIN client c USING(id_user)
        JOIN reservation r ON r.id_client = c.id_user
        JOIN payment p ON p.id_client = c.id_user
    GROUP BY login
    HAVING sum(p.final_price::numeric) < 5000
    ORDER BY num_of_reservations DESC, sum_of_payments
    LIMIT 10
;
```

Note:
Returns top 10 clients whose sum of payments is less than 5000 and shows their reservation counts.

Output:

	login	num_of_rese…	sum_of_paym…
1	aloisslavik20010527	21	$3,500.00
2	romanmarek19341225	20	$3,000.00
3	nataliejarosova1952…	20	$4,000.00
4	milenasykorova19311…	20	$4,750.00
5	alesmares19300104	20	$4,750.00
6	kamilanovakova19931…	20	$4,750.00
7	johanastastna195308…	18	$3,600.00
8	oliviekucerova19980…	18	$3,600.00
9	bohumilmatousek1948…	18	$3,600.00
10	romanvavra20080208	18	$3,900.00

```
SELECT hall_name,
       count(CASE WHEN tr.type LIKE '% with trainer' THEN 1 END) AS
           num_of_trainings_with_trainer,
       count(CASE WHEN tr.type LIKE '% without trainer' THEN 1 END) AS
           num_of_trainings_without_trainer
    FROM sports_hall
         JOIN training tr USING(id_sports_hall)
    GROUP BY hall_name
    ORDER BY num_of_trainings_with_trainer DESC,
        num_of_trainings_without_trainer DESC
    LIMIT 3
;
```

Note:
Counts trainings with and without a trainer per hall; returns top 3 by number of trainings with a trainer.

Output:

	hall_name	num_of_trainings_with_trainer	num_of_trainings_without_trainer
1	Haley	148	122
2	Kelly	148	122
3	Brenda	147	123

```
SELECT hall_name,
       count(CASE WHEN tr.type LIKE '% with trainer' THEN 1 END) AS
           num_of_trainings_with_trainer,
       count(CASE WHEN tr.type LIKE '% without trainer' THEN 1 END) AS
           num_of_trainings_without_trainer
    FROM sports_hall
         JOIN training tr USING(id_sports_hall)
    GROUP BY hall_name
    ORDER BY num_of_trainings_with_trainer DESC,
        num_of_trainings_without_trainer DESC
    OFFSET 3
;
```

Note:
Same as above, but skips top 3 to return the next halls.

Output:

	hall_name	num_of_trainings_with_trainer	num_of_trainings_without_trainer
1	Tamara	146	124
2	Erin	143	127
3	Catherine	138	132
4	Karen	138	132
5	Jennifer	126	144
6	Cynthia	122	148
7	Julia	112	158

```
SELECT name || ' ' || surname AS client_name
    FROM client c
         JOIN personal_data USING(id_user)
         JOIN client_preference cl_pref ON cl_pref.id_client = c.id_user
         JOIN preference_in_sport pref USING(id_preference)
    WHERE preference_name = 'combat sports'

UNION

SELECT name || ' ' || surname AS client_name
    FROM client c
         JOIN personal_data USING(id_user)
         JOIN client_preference cl_pref ON cl_pref.id_client = c.id_user
         JOIN preference_in_sport pref USING(id_preference)
    WHERE preference_name = 'competitive sports'
LIMIT 10
;
```

Note:
Returns the first ten clients names who prefer either `combat sports` or `competitive sports`, removing duplicates.

Output:

	client_name
1	Tadeáš Kříž
2	Františka Brožová
3	Ján Slavík
4	Kristýna Kopecká
5	Blanka Blažková
6	Ferdinand Horáček
7	Ján Toman
8	Drahomíra Beranová
9	Sabina Veselá
10	Vlastimil Svoboda

```
SELECT name || ' ' || surname AS name_surname
    FROM client
        JOIN personal_data USING(id_user)

INTERSECT

SELECT name || ' ' || surname AS name_surname
    FROM trainer
         JOIN personal_data USING(id_user)
ORDER BY name_surname
LIMIT 10
;
```

Note:
Returns the first ten names and surnames that appear both among clients and among trainers.

Output:

	name_surname
1	Agáta Slavíková
2	Alena Mašková
3	Alexandr Dostál
4	Alice Šmídová
5	Andrea Švecová
6	Bedřich Holub
7	Bohumil Bílek
8	Bohumír Slavík
9	Ctirad Ježek
10	Dalibor Havlíček

```
SELECT login AS client_login,
       name || ' ' || surname AS client_name
    FROM client
        JOIN "user" USING(id_user)
        JOIN personal_data USING(id_user)

EXCEPT

SELECT login AS client_login,
       name || ' ' || surname AS client_name
    FROM client AS c
        JOIN "user" USING(id_user)
        JOIN personal_data USING(id_user)
        JOIN client_preference AS cl_pref ON cl_pref.id_client = c.id_user
LIMIT 10
;
```

Note:
Returns the first ten clients logins and names who have no preferences assigned.

Output:

	client_login	client_name
1	zorabartova20110220	Zora Bártová
2	artursykora19720724	Artur Sýkora
3	nikolbilkova19661208	Nikol Bílková
4	denisakucerova19880927	Denisa Kučerová
5	anetajandova19280406	Aneta Jandová
6	bohuslavmoravec20120122	Bohuslav Moravec
7	martinapospisilova20030205	Martina Pospíšilová
8	monikapetrova19700910	Monika Petrová
9	alicehruskova20120713	Alice Hrušková
10	miroslavurban19511224	Miroslav Urban

```
SELECT name || ' ' || surname AS client_name,
       count (id_reservation) AS num_of_reservations
    FROM client c
         JOIN personal_data USING(id_user)
         JOIN reservation r ON c.id_user = r.id_client
    GROUP BY client_name
    HAVING count (id_reservation) > (
        SELECT AVG (res_count)
        FROM (
             SELECT count (id_reservation) AS res_count
             FROM reservation
             GROUP BY id_client
            ) AS num_of_reservations)
    ORDER BY num_of_reservations DESC
LIMIT 10
;
```

Note:
Returns the first ten clients who have more reservations than the average number of reservations per client.

Output:

	client_name	num_of_reservations
1	Tadeáš Čermák	20
2	Oldřich Tichý	19
3	Věra Krausová	19
4	Květoslava Čermáková	19
5	Vladimíra Kovářová	18
6	René Mach	18
7	Šimon Kolář	18
8	Štěpánka Bednářová	18
9	Jakub Pokorný	18
10	Viktorie Hrubá	18

CP-4 Advanced Database Technologies

Transaction:

- **Idea:**
  The main idea of this transaction is to update the status of a reservation, which corresponds to adding a payment for that reservation.

- **Conflict:**
  Our database contains users who have reservations that can be paid for. A reservation belongs to one user, but it can be paid for by a different user. The payment process is designed so that it first checks whether the reservation has not been paid yet (i.e., the status is `'reserved'`), and only then creates a new payment entry in the `payment` table. A conflict may occur if two users attempt to pay for the same reservation at the same time. Both may see the reservation status as `'reserved'`, and each may proceed to create a new payment. As a result, two payments could be created for the same reservation, leading to a double payment.

- **Isolation level:**
  In this situation, the best-suited isolation level is `SERIALIZABLE`, because it ensures full isolation between concurrent transactions. By using `SERIALIZABLE`, we ensure that only one transaction can successfully verify the reservation's unpaid status and proceed to create the payment, the other will be rolled back or retried.

- **Function:**
  The function `update_reservation_status` handles the logic for processing a reservation payment. It first checks the current status of the reservation and retrieves the price. If the reservation is already paid or the payment method is invalid, an exception is raised. Otherwise, it inserts a new payment into the `payment` table and updates the reservation's status to `'payed'` by assigning the corresponding `id_payment`.

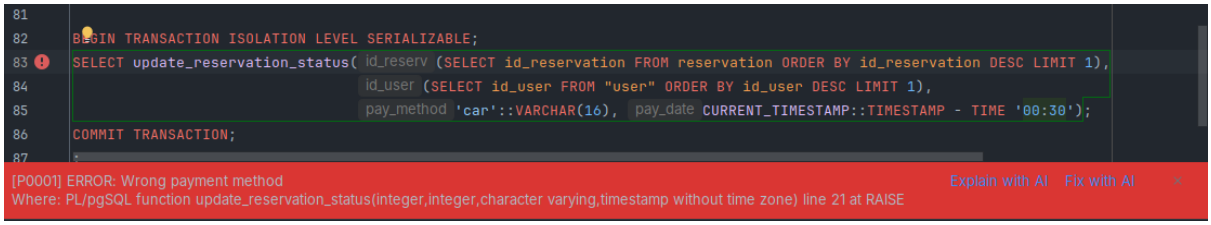
```
CREATE FUNCTION update_reservation_status(id_reserv INTEGER, id_user
    INTEGER, pay_method varchar(16), pay_date TIMESTAMP)
    RETURNS VOID AS $$
DECLARE
    reserv_status VARCHAR(16);
    price MONEY;
    id_paym INTEGER;
BEGIN
    reserv_status := (SELECT status
                      FROM reservation r
                      WHERE r.id_reservation = id_reserv);

    price := (SELECT price_for_one
              FROM training
                       JOIN reservation r USING(id_training)
              WHERE r.id_reservation = id_reserv);

    IF reserv_status NOT IN ('reserved') THEN
        RAISE EXCEPTION 'Reservation is already payed';
    END IF;

    IF pay_method NOT IN ('cash', 'card') THEN
        RAISE EXCEPTION 'Wrong payment method';
    END IF;

    INSERT INTO payment (final_price, payment_method, payment_date,
        id_client)
    VALUES (price, pay_method, pay_date, id_user)
    RETURNING id_payment INTO id_paym;

    UPDATE reservation r
    SET id_payment = id_paym,
        status = 'payed'
    WHERE id_reservation = id_reserv;
END;
$$ LANGUAGE plpgsql;
```

- **Usage:**
  To demonstrate how the transaction works, a new client was created along with their personal data, a training, and a reservation.

```
WITH inserted_user AS (
    INSERT INTO "user" (login, password)
        VALUES ('coolSem', '12345')
        RETURNING id_user
),
inserted_personal_data AS (
    INSERT INTO personal_data (id_user, name, surname, date_of_birth,
        email, phone_number)
        SELECT id_user, 'Sem', 'Smith', '2015-01-01', 'ssmith@gmail.com',
            '+420000000001'
        FROM inserted_user
),
inserted_client AS (
    INSERT INTO client (id_user)
        SELECT id_user FROM inserted_user
),
inserted_training AS (
    INSERT INTO training (training_date, id_sports_hall, type, capacity,
        price_for_one)
        SELECT CURRENT_DATE + INTERVAL '2 months' + TIME '09:30', 1,
            'volleyball without trainer', 12, 150
        RETURNING id_training
)
INSERT INTO reservation (reservation_date, id_client, status,
    id_training, id_payment)
    VALUES (CURRENT_TIMESTAMP,
            (SELECT id_user FROM inserted_user), 'reserved',
            (SELECT id_training FROM inserted_training),NULL)
;
```

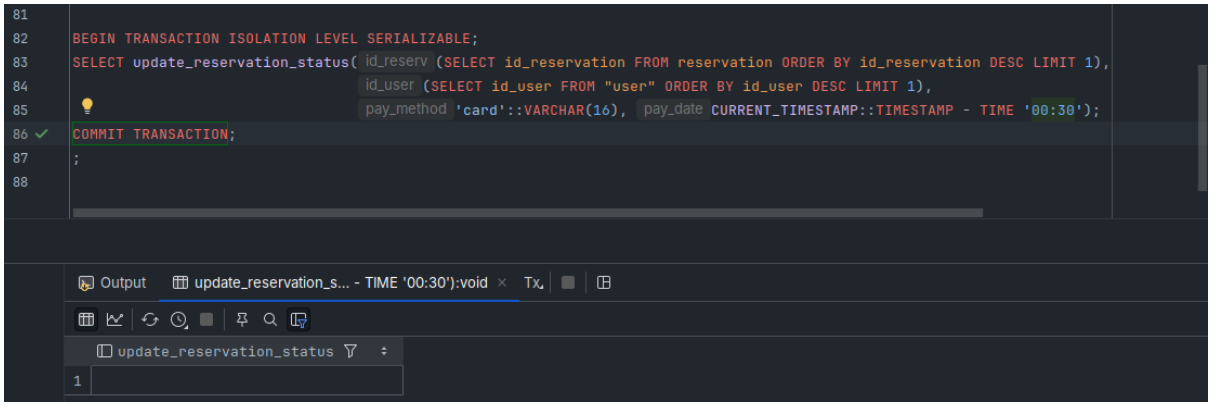
– **Transaction with an invalid payment method:**
The following transaction attempts to make a payment using an unsupported payment method ('car').

```
BEGIN TRANSACTION ISOLATION LEVEL SERIALIZABLE;
SELECT update_reservation_status((SELECT id_reservation FROM
    reservation ORDER BY id_reservation DESC LIMIT 1),
                                 (SELECT id_user FROM "user" ORDER BY
                                     id_user DESC LIMIT 1),
                                 'car'::VARCHAR(16),
                                     CURRENT_TIMESTAMP::TIMESTAMP - TIME
                                     '00:30');
COMMIT TRANSACTION;
;
```



– **Correct transaction (reservation not yet paid, valid payment method):** This transaction uses a valid payment method ('card'), successfully creates a new payment, and updates the reservation status.

```
BEGIN TRANSACTION ISOLATION LEVEL SERIALIZABLE;
SELECT update_reservation_status((SELECT id_reservation FROM
    reservation ORDER BY id_reservation DESC LIMIT 1),
                                 (SELECT id_user FROM "user" ORDER BY
                                     id_user DESC LIMIT 1),
                                 'card'::VARCHAR(16),
                                     CURRENT_TIMESTAMP::TIMESTAMP - TIME
                                     '00:30');
COMMIT TRANSACTION;
;
```



– **Second attempt to pay for the same reservation:** A second attempt to pay for the same reservation results in an exception, as the reservation status is no longer `'reserved'`.

View:

This view identifies trainers who have conducted a low number of training sessions (10 or fewer). It helps monitor trainer engagement and identify potentially inactive personnel.

- **Creating:**

```
CREATE VIEW trainers_at_risk AS
    SELECT id_user AS id_trainer,
           name || ' ' || surname AS trainer_name,
           email,
           count(*) AS num_of_conducted_trainings
    FROM trainer t
        JOIN personal_data USING(id_user)
        JOIN conduction c ON c.id_trainer = t.id_user
    GROUP BY id_user, name, surname, email
    HAVING count(*) <= 10
    ORDER BY count(*), id_user;
```

- **Usage:**

```
SELECT * FROM trainers_at_risk;
```

- **Output:**

id_trainer	trainer_name	email	num_of_conducted_trainings
22	Pavel Doležal	paveldolezal19750823@gmail.com	1
24	Judita Beránková	juditaberankova19951023@gmail.com	1
53	Radim Jelínek	radimjelinek19490421@gmail.com	1
63	Leoš Dostál	leosdostal19560429@gmail.com	1
42	Horymír Müller	horymirmuller19560305@gmail.com	2
52	Martin Slavík	martinslavik19580307@gmail.com	2
27	Kristýna Pavlíková	kristynapavlikova19790514@gmail.com	3
41	Miluše Holubová	miluseholubova19631113@gmail.com	4
55	Luděk Moravec	ludekmoravec19891201@gmail.com	7
9	Božena Bártová	bozenabartova20110429@gmail.com	8

Trigger:

This trigger prevents the insertion of a trainer who is younger than 13 years old. The condition is verified through a BEFORE INSERT trigger.

- **Trigger function:**

```
CREATE FUNCTION check_trainer_age()
    RETURNS TRIGGER AS $$
DECLARE
    dob timestamp(0);
BEGIN
    dob := (SELECT date_of_birth
            FROM personal_data
            WHERE (id_user = NEW.id_user));

    IF EXTRACT (YEAR FROM age(dob)) < 13 THEN
        RAISE EXCEPTION 'Trainer must be at least 13 years old';
    END IF;

    RETURN NEW;
END;
$$ LANGUAGE plpgsql;
```

- **Trigger declaration:**

```
CREATE TRIGGER trainer_trigger
    BEFORE INSERT ON trainer
    FOR EACH ROW
    EXECUTE FUNCTION check_trainer_age();
```

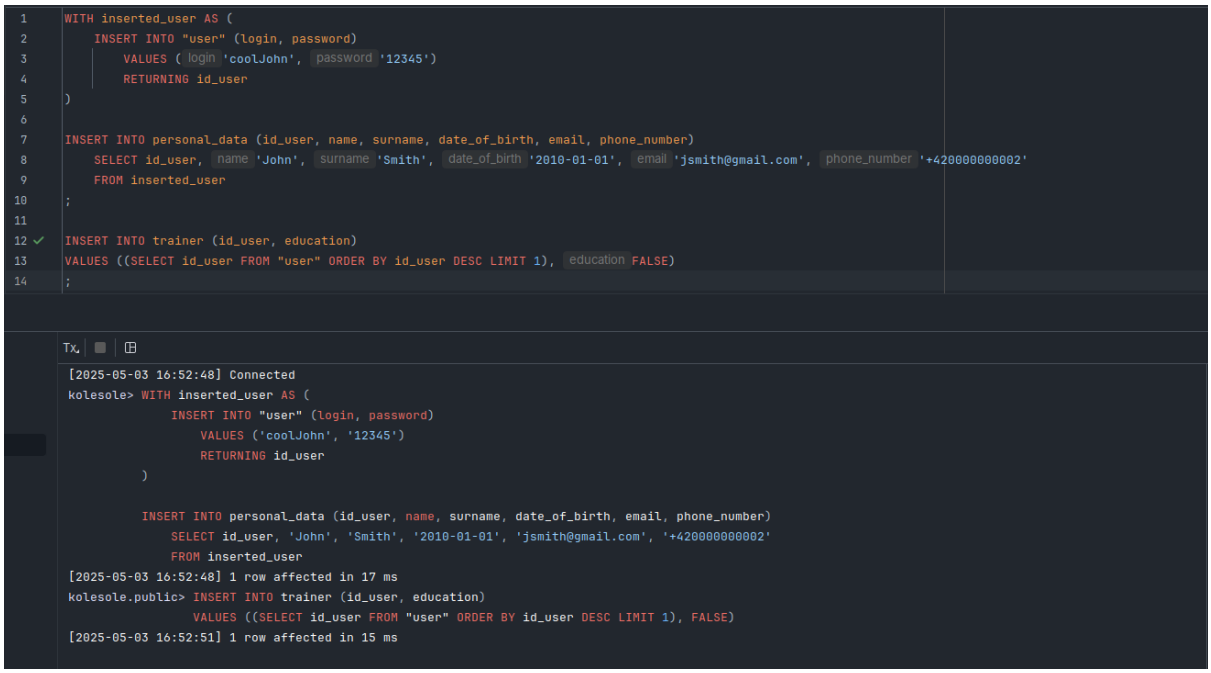
- **Usage:**

  - **Inserting a trainer with age $<$ 13 (should fail):**

```
WITH inserted_user AS (
    INSERT INTO "user" (login, password)
        VALUES ('coolJohn', '12345')
        RETURNING id_user
)

INSERT INTO personal_data (id_user, name, surname, date_of_birth,
    email, phone_number)
    SELECT id_user, 'John', 'Smith', '2015-01-01',
        'jsmith@gmail.com', '+420000000002'
    FROM inserted_user
;

INSERT INTO trainer (id_user, education)
    VALUES ((SELECT id_user FROM "user" ORDER BY id_user DESC LIMIT
        1), FALSE)
;
```

– **Inserting a trainer with age $\geq$ 13 (should succeed):**

```
WITH inserted_user AS (
    INSERT INTO "user" (login, password)
        VALUES ('coolJohn', '12345')
        RETURNING id_user
)

INSERT INTO personal_data (id_user, name, surname, date_of_birth,
    email, phone_number)
    SELECT id_user, 'John', 'Smith', '2010-01-01',
        'jsmith@gmail.com', '+420000000002'
    FROM inserted_user
;

INSERT INTO trainer (id_user, education)
VALUES ((SELECT id_user FROM "user" ORDER BY id_user DESC LIMIT 1),
    FALSE)
;
```

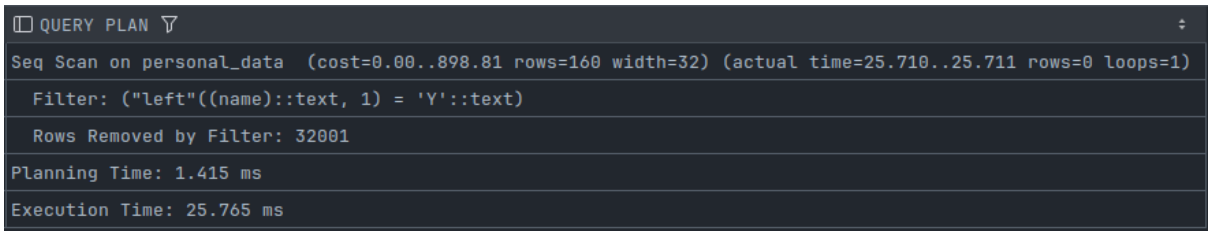


Index:

This index is created on the first character of the `name` column in the `personal_data` table to speed up queries filtering by the first letter.

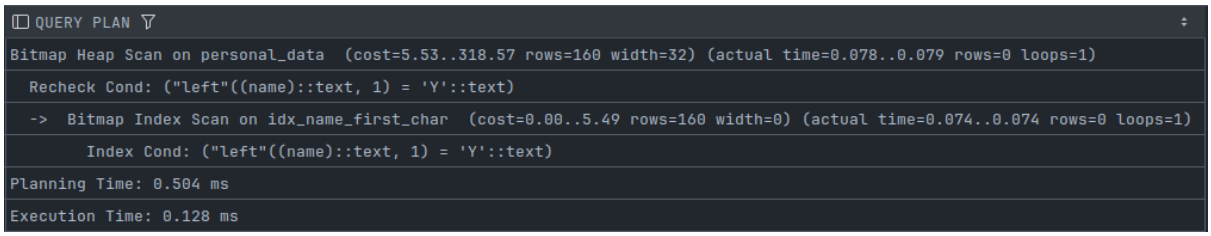
- **Without index:**

```
EXPLAIN ANALYZE
SELECT name || ' ' || surname AS user_name
FROM personal_data
WHERE LEFT(name, 1) = 'Y';
```



- **With index:**

```
CREATE INDEX idx_name_first_char ON personal_data (LEFT(name, 1));

EXPLAIN ANALYZE
SELECT name || ' ' || surname AS user_name
FROM personal_data
WHERE LEFT(name, 1) = 'Y';
```



- **Conclusion:**
  Without the index, a sequential scan is used, with a planning time of `1.415 ms` and an execution time of `25.765 ms`.
  With the index, a bitmap index scan is used, reducing the planning time to `0.504 ms` and the execution time to `0.128 ms`.
  This demonstrates that indexing significantly improves query performance in this case, and the created index is effectively used in the query execution plan.