Assignment 7 End-to-End IoT

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CECS 327

System Overview

- We built a TCP client-server system that processes real IoT queries using PostgreSQL and metadata from Dataniz.
- Using metadata from Dataniz, our server identifies device types, original units of measurements, and timezones, allowing it to:
  - Filter the correct device and sensor data
  - Convert raw values (e.g., liters to gallons, joules to kWh)
- Client accepts one of these 3 predefined queries and sends it to the server, which performs necessary analysis and returns a human-interpretable result.

Supported Queries

What is the average moisture inside my kitchen fridge in the past three hours?

PostgreSQL:

```
SELECT AVG((payload::json ->> 'Moisture Meter - Moisture Meter')::float) AS moisture

FROM public."Group 14_virtual"

WHERE (payload::json ->> 'Moisture Meter - Moisture Meter')::float is not null AND time >= NOW() - INTERVAL '3 HOURS'
```

Supported Queries

What is the average water consumption per cycle in my smart dishwasher?

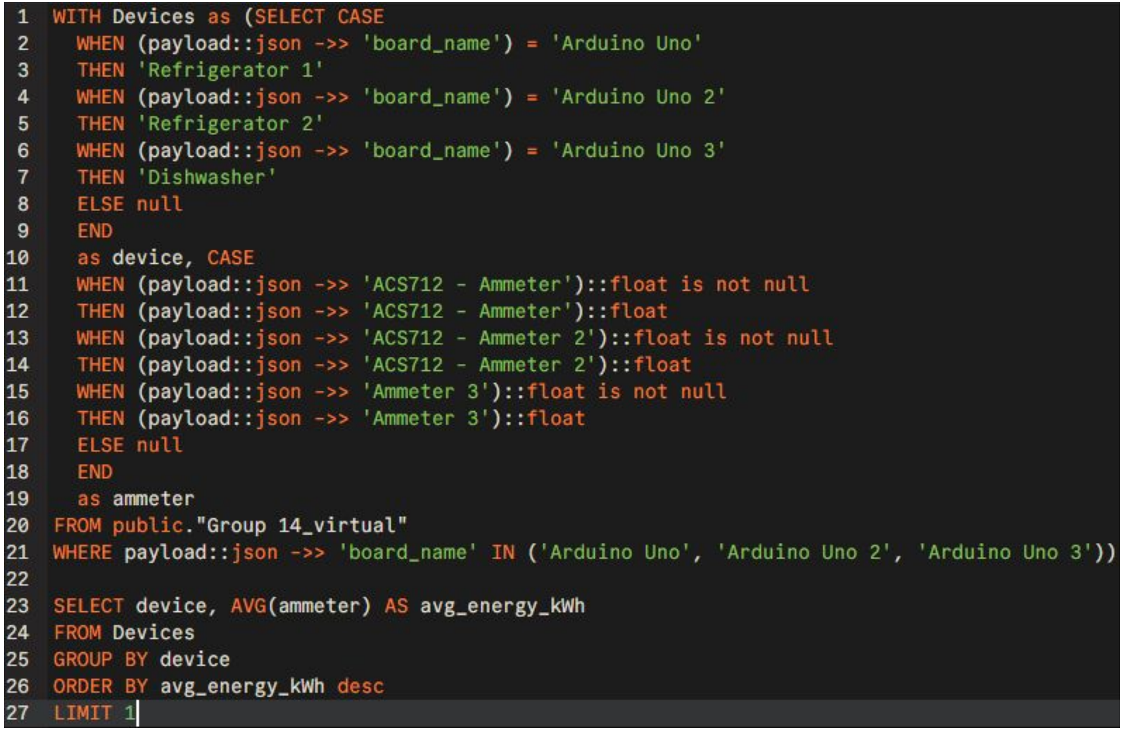
PostgreSQL:

```
SELECT AVG((payload::json ->> 'YF-S201 - WaterFlow')::float)*0.264172 AS water_flow
FROM public."Group 14_virtual"
WHERE (payload::json ->> 'YF-S201 - WaterFlow')::float is not null
```

Supported Queries

Which device consumed more electricity among my three IoT devices?

PostgreSQL:



```sql
WITH Devices as (SELECT CASE
  WHEN (payload::json ->> 'board_name') = 'Arduino Uno'
  THEN 'Refrigerator 1'
  WHEN (payload::json ->> 'board_name') = 'Arduino Uno 2'
  THEN 'Refrigerator 2'
  WHEN (payload::json ->> 'board_name') = 'Arduino Uno 3'
  THEN 'Dishwasher'
  ELSE null
  END
  as device, CASE
  WHEN (payload::json ->> 'ACS712 - Ammeter')::float is not null
  THEN (payload::json ->> 'ACS712 - Ammeter')::float
  WHEN (payload::json ->> 'ACS712 - Ammeter 2')::float is not null
  THEN (payload::json ->> 'ACS712 - Ammeter 2')::float
  WHEN (payload::json ->> 'Ammeter 3')::float is not null
  THEN (payload::json ->> 'Ammeter 3')::float
  ELSE null
  END
  as ammeter
FROM public."Group 14_virtual"
WHERE payload::json ->> 'board_name' IN ('Arduino Uno', 'Arduino Uno 2', 'Arduino Uno 3'))

SELECT device, AVG(ammeter) AS avg_energy_kWh
FROM Devices
GROUP BY device
ORDER BY avg_energy_kWh desc
LIMIT 1
```

Demo

Challenges Encountered

- Connecting to NeonDB using psycopg2
    - Had to ensure connection string format and include a secure connection with SSL
- Querying a column of lists (payload)
    - Had to find each sensor in the payload column which had several Null values that had to be avoided
- Understanding and using metadata effectively
    - Device filtering and unit handling were hardcoded initially, transitioned to map each type and unit after
- Converting values to human-interpretable and realistic values
    - Raw-values were converted to units such as gallons for user responses using helper functions and metadata context

Feedback on Dataniz

What We Liked:

- Easy to simulate virtual IoT devices without needing physical hardware.
- Being able to turn devices on/off and see real-time values.

Suggestions:

- Interface could be cleaner by offering extra tools such as an export or downloading the data in a CSV/Excel format.
- Detailed tutorial or guided walkthrough would help new users for configuring devices
- Adding unit labels and value descriptions