Data Operations in Django with Queries

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#python-db

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CRUD Overview

Importance of CRUD

What is CRUD?

- An acronym that **stands for**
  - **Create**, **Read**, **Update**, **and Delete**
- A **set** of **four basic** operations used in
  - Web development
  - Database management
- Represents the **fundamental actions**, performed **on data** stored in a database

CRUD – Four Fundamental Actions

- **Create**
  - Creation of new data records/entities in the database
- **Read**
  - Retrieve data from the database
- **Update**
  - Modify or alter existing data records
- **Delete**
  - Remove or delete data records from the database

CRUD Importance

- The **importance** of **CRUD** operations lies in
  - Their ability to provide a **standardized** and **systematic** way to **interact** with databases
- Forming the **foundation** of most web applications
- **Vital** for **managing** data throughout its **lifecycle**
- Developers can **ensure** that users could
  - **Create**, **retrieve**, **update**, and **delete** data in a **controlled** and **consistent** manner
  - Resulting in applications that are **interactive**, **efficient**, and capable of **handling** data **manipulation** tasks

CRUD Importance

- **Understanding** **CRUD** operations is **essential** for
  - Anyone working with databases
  - Web development
- They provide the **basic building blocks** for **data management** in modern applications

Django ORM and CRUD

- **CRUD** operations can be **implemented** using
  - Django's **Object-Relational Mapping** (**ORM**) capabilities
  - Providing a **high-level** API for interacting with databases
  - The **ORM** **abstracts** away the underlying database-specific details
  - Allowing developers to **focus** on writing **Python code**
    - Performing **CRUD operations** on database **models**

Django QuerySet

QuerySet

- A **powerful feature** that allows you to
  - **Retrieve**, **filter**, and **manipulate** data from the database **using Python code**
- Acts as an **intermediary** between your **Python code** and the **database**
- When performing a query on a **model**, **Django returns**
  - A **QuerySet object** that contains the results of the query

QuerySet

- QuerySet contains a collection of objects from the database
- Doesn't **directly** fetch the data from the database
  - until **explicitly** evaluate or access its **data**

caller.py

```
def show_all_employees():
    all_employees = Employee.objects.all()
    print(all_employees)
    # <QuerySet []>
    print(type(all_employees))
    # <class 'django.db.models.query.QuerySet'>
```

QuerySet Key Features

- Lazy Evaluation
- Retrieving Objects
- Chaining Filters
- Querying Related Objects
- Aggregation and Annotation
- Ordering
- Pagination

Django Simple Queries

Create, Read, Update, and Delete

Object Manager

- **Object Manager** is a **class attribute** of a **model**
  - Provides **methods** for **querying** the database
- The **default object manager** is named **`objects`**
  - **Automatically created** for every **model**
  - Allowing to **perform** common database **operations**
    - filtering, retrieving all objects, getting a single object
- You can also define **custom object managers** in your models

Common Object Manager Methods

- `all()`
  - returns a query set containing **all objects** created so far
- `first()`
  - returns the **first record** from the DB
- `get(**kwargs)`
  - returns a **single object** that matches the **given argument**
  - If multiple objects are found it will **throw** a **`Model.MultipleObjectsReturned`** error
  - If `get()` doesn't find **any** object, it **raises** a **`Model.DoesNotExist`** exception
- `create(**kwargs)`
  - creates a **new object** with **given arguments**

Common Object Manager Methods

- `filter(**kwargs)`
  - returns a query set containing **a list of objects** that match the **given arguments**
- `exclude(**kwargs)`
  - it does exactly the **opposite** of **`filter()`** method i.e. returns a **queryset** containing **objects** that **do not match** the **given arguments**
- `order_by(*fields)`
  - sets the **ordering** of the previously returned **queryset** according to the **arguments** passed in it

Creating Records in Database

- **Use Python code** to create records in a database table
  - Use the **object manager's method** `create()`
  - Use it to create and save an object **in a single step**

caller.py

```
def create_employee():
    Employee.objects.create(first_name='Paul', last_name='Smith',
job_title= …)
```

Default object manager

Creates and saves a record with the given arguments

Creating Records in Database

- **Use Python code** to create records in a database table
  - **Instantiate** a **model object**
  - **Call** the **save()** **method** on it

caller.py

```
def create_employee():
    new_employee = Employee(first_name='Paul', last_name='Smith', 
job_title= …)
    new_employee.save()
```

An instance of class Employee

Saving the object into the DB

Problem: Add Students

- You are given an **ORM project skeleton** (you can download it from here) with **one model** called **"Student"**
- **Add these records** to the students' database table

student_id	first_name	last_name	birth_date	email
FC5204	John	Doe	15/05/1995	john.doe@university.com
FE0054	Jane	Smith	*null*	jane.smith@university.com
FH2014	Alice	Johnson	10/02/1998	alice.johnson@university.com
FH2015	Bob	Wilson	25/11/1996	bob.wilson@university.com

Solution: Add Students

```python
# caller.py
def add_students():
    Student.objects.create(
        student_id="FC5204",
        first_name="John",
        last_name="Doe",
        birth_date="1995-05-15",
        email="john.doe@university.com")

    student = Student(
        student_id="FE0054",
        first_name="Jane",
        last_name="Smith",
        email="jane.smith@university.com")
    student.save()
```

Reading Data from the Database

- **Use Python code** to retrieve data from the database
  - Use the **Default Object Manager** on the **model** class
  - Make a **Django query** that returns a **QuerySet** containing **all objects**

caller.py

```
def show_all_employees():
    all_employees = Employee.objects.all()
    ...
```

Default object manager

Retrieve all employee objects method

Problem: Get Students Info

- Create a function called "`get_students_info`" that returns all students' records from the database in the format: **`"Student №{student_id}: {first_name} {last_name}; Email: {email}"`**

Solution: Get Students Info

```
# caller.py
def get_students_info():
    students = Student.objects.all()
    students_info = []
    for student in students:
        students_info.append(
            f"Student №{student.student_id}: "
            f"{student.first_name} {student.last_name}; "
            f"Email: {student.email}"
        )
    return "\n".join(students_info)
```

Updating a Record in Database

- Use Python code to update a record from the database table
  - **Retrieve** the **object** using a **query**
  - **Modify** its **attributes**
  - **Save** it

caller.py

```
def update_first_employee():
    first_employee = Employee.objects.first()
    first_employee.job_level = 'Sr.'
    first_employee.save()
```

Retrieving the first record

Saving the updated object into the DB

Problem: Update Students' Emails

- Create a function called "**`update_students_emails`**" that updates **all students' emails**
  - The current email domain is "**`university.com`**"
  - You need to change it to "**`uni-students.com`**"

Solution: Update Students' Emails

```
# caller.py
def update_students_emails():
    students = Student.objects.all()
    for student in students:
        new_email = student.email.replace(
            'university.com',
            'uni-students.com')
        student.email = new_email
        student.save()
```

Deleting a Record from Database

- **Immediately deletes** the object/s from the database
- You should **explicitly request** the object
- The method returns:
  - The **number of objects deleted**
  - The **number of deletions per object type**

```
employee = Employee.objects.first()
result = employee.delete()
…
# (1, {'main_app.Employee': 1})
```

Deleting Model Object

- Delete a **single** object

```
employee = Employee.objects.first()
employee.delete()
```

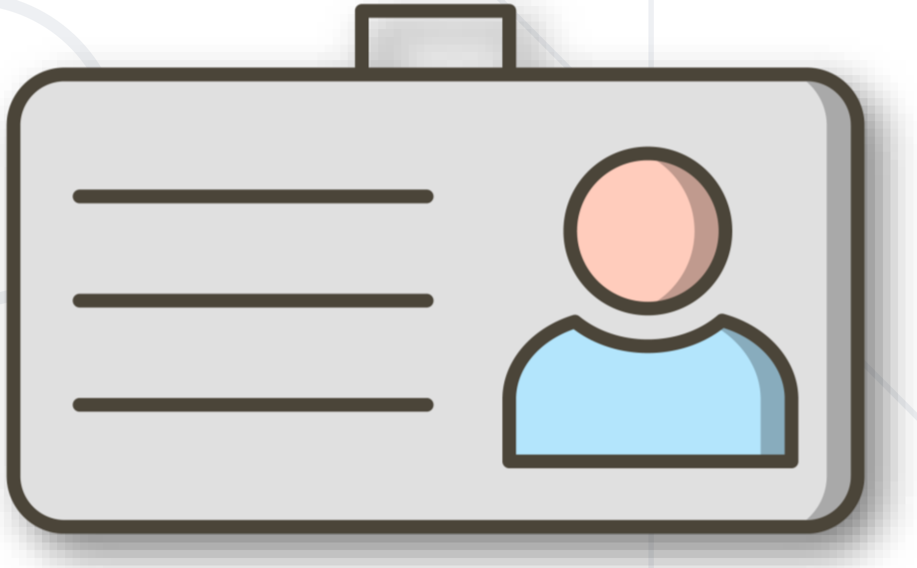
- Delete **multiple** objects in a QuerySet

```
employees = Employee.objects.all()
employees.delete()
```

- **Note**: When deleting an object with **foreign keys**, it will follow the behavior of the **SQL constraint ON DELETE**

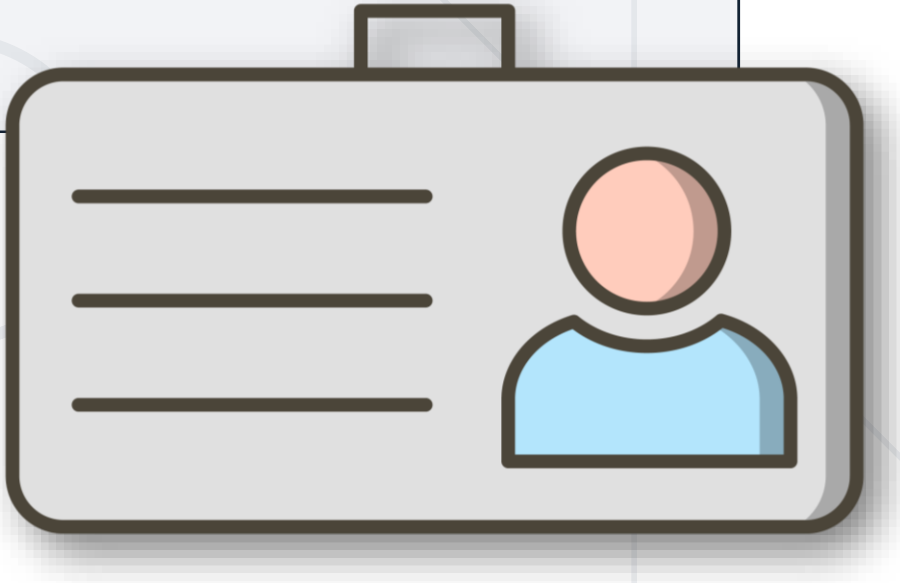
Problem: Truncate Students

- Create a function called **"`truncate_students`"**
- It should **delete all students' records** from the database table



Solution: Truncate Students

```python
# caller.py
def truncate_students():
    students = Student.objects.all()
    students.delete()
```



Django Shell & SQL Logging

Django Shell

- **Django shell** is a **command-line** interface
  - Allows you to **interact** with your **Django project**
  - Uses **Python code**
  - Provides a **convenient** way to
    - Experiment
    - Test
    - Debug

Django Shell Usage

- Run the following **command** in your **project's directory**

```
python manage.py shell
```

- Interact with **models** and perform database **operations**

```
# Import the necessary models
from main_app.models import Employee

# Retrieve all records
all_employees = Employee.objects.all()
```

SQL Logging in Django

- **Capturing and viewing the SQL queries** executed by Django when **interacting** with the database
- Useful for **debugging**
- **Optimize** database-related **operations**
- Provides **details** about
  - The executed SQL statement
  - Execution time
  - Other relevant information
- **Invaluable** in **understanding** and **optimizing** **database performance**

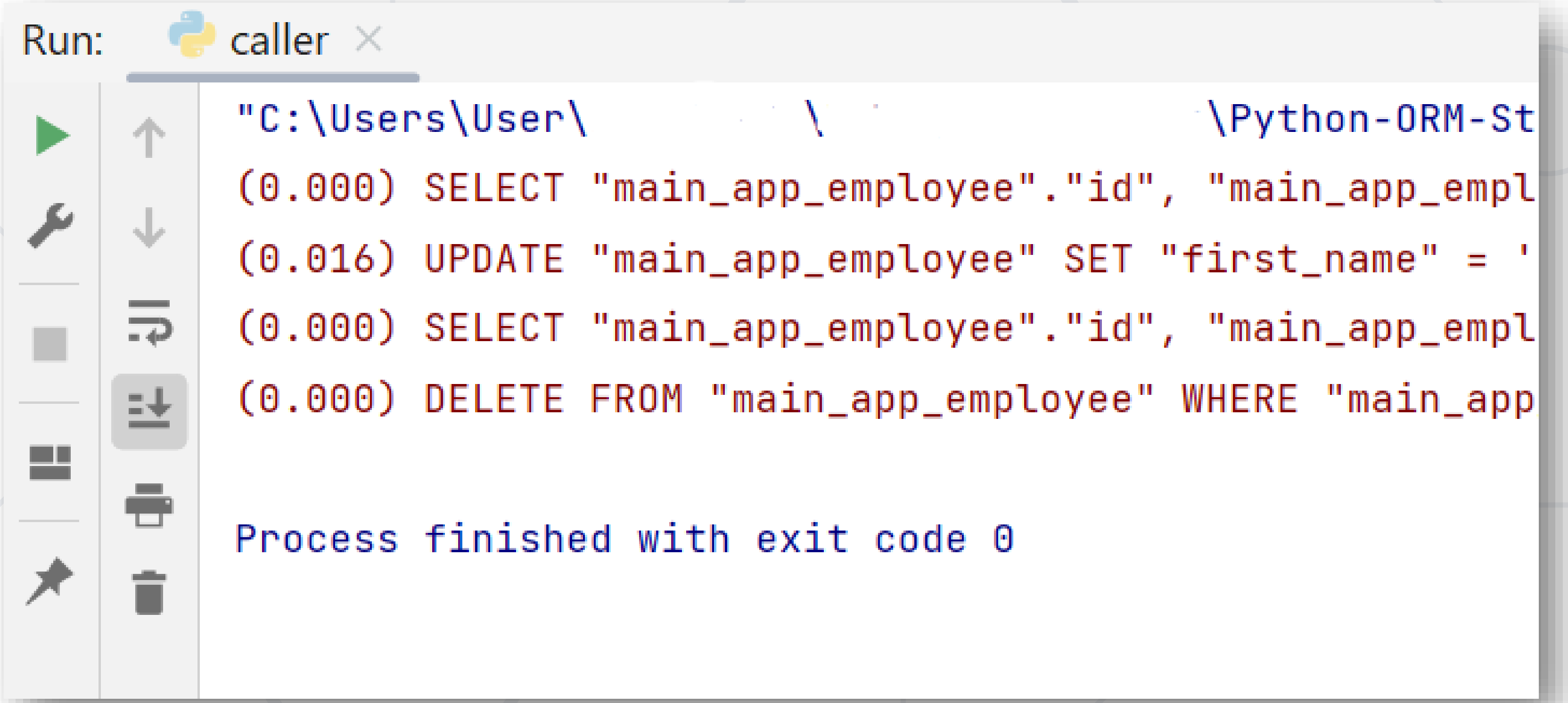
SQL Logging Configuration

- Add the following **configuration** to your **`settings.py`** file to **enable** SQL logging

```
LOGGING = {
    'version': 1,
    'disable_existing_loggers': False,
    'handlers': {
        'console': {
            'class': 'logging.StreamHandler'}},
    'root': {
        'handlers': ['console'],
        'level': 'DEBUG',
    },
    'loggers': {
        'django.db.backends': {
            'handlers': ['console'],
            'level': 'DEBUG',
            'propagate': False,
        }}}
```

SQL Logging - View Results

- **SQL Queries** will be **logged** on the **console**



```
"C:\Users\User\          \                \Python-ORM-St
(0.000) SELECT "main_app_employee"."id", "main_app_empl
(0.016) UPDATE "main_app_employee" SET "first_name" = '
(0.000) SELECT "main_app_employee"."id", "main_app_empl
(0.000) DELETE FROM "main_app_employee" WHERE "main_app

Process finished with exit code 0
```

Live Demo

SQL Logging

Summary

- CRUD
- QuerySet
- Django Simple Queries
  - Default Object Manager
- Django Shell
- SQL Logging

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