Django Models

COMP 8347

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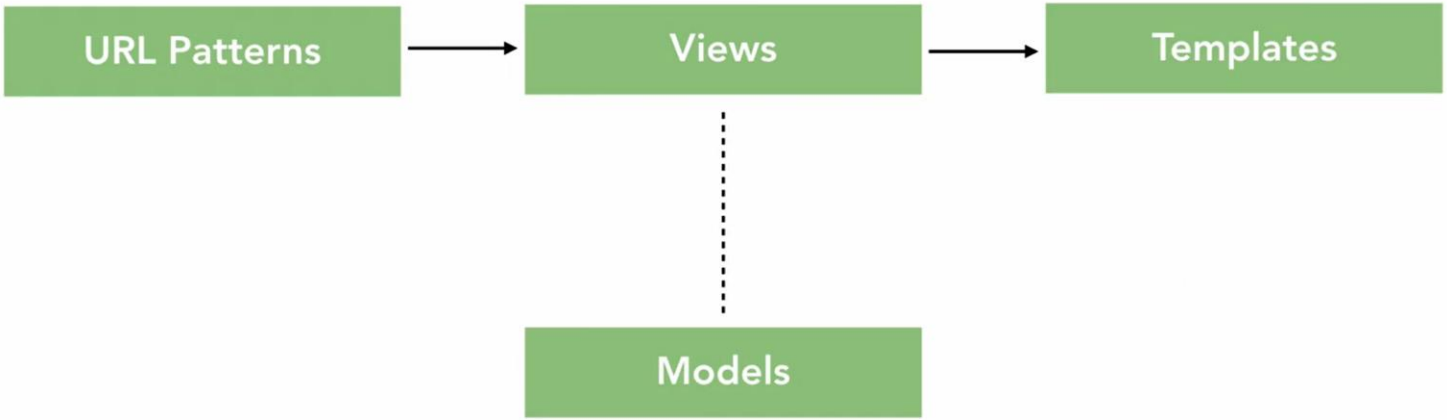
Django Models

- Topics
  - Creating simple models
  - Relationships between models
  - Advanced usage
  - Querying Django database

Review MTV Architecture

- When a Django application receives a request, it uses URL patterns to decide which view to select
- View manages the logic/control flow portion of a project
- Models are used to manage the database
- Templates deal with the view of HTML pages to be returned



More on Models

- Models:
  - Create the data layer of a Django app
  - Define database structure
  - Allow us to query from the DB
  - Contain “models.py” file
  - A model is inherited from django.db.models.Model

Why Use ORM?

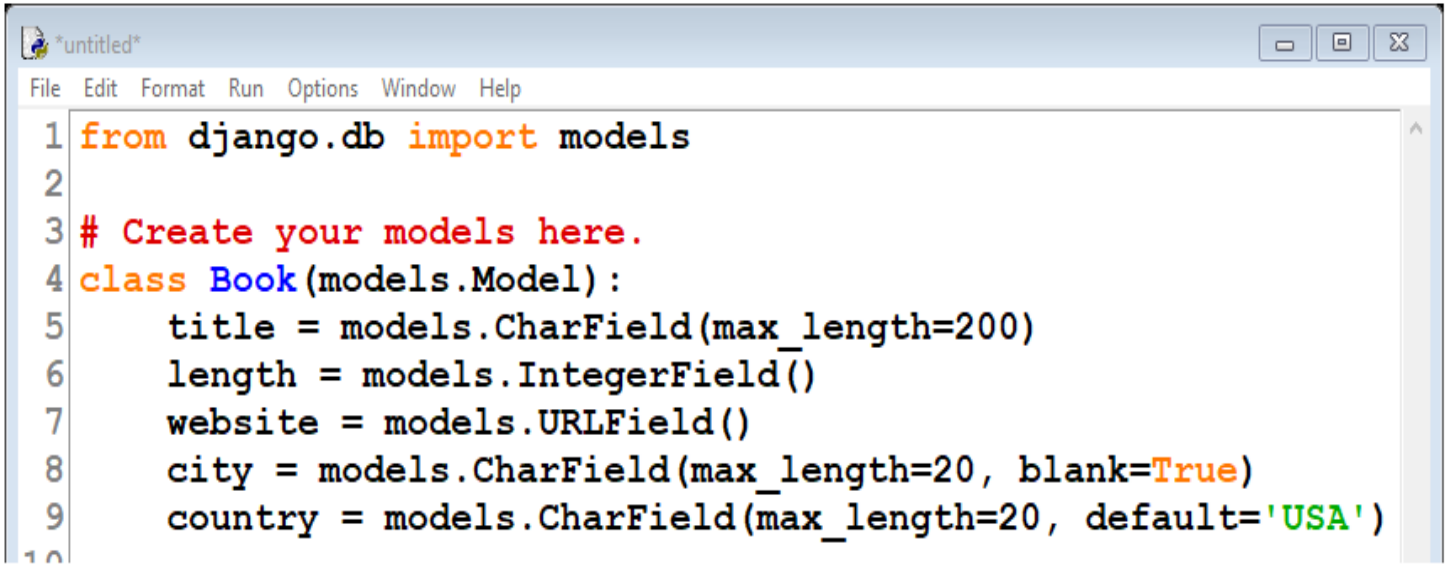
- Django provides rich db access layer
  - Bridges underlying relational db with Python's object-oriented nature
    - ***Portability***: support multiple database backends
    - ***Safety***: less prone to security issues (e.g., SQL injection attacks) arising from malformed or poorly protected query strings.
    - ***Encapsulation***: Easy integration with programming language; ability to define arbitrary instance methods

Defining Models

- ***Model*** is an object that inherits from Model class.
  - Model → represented by a table in the db
  - Field → represented by a table column

- Models are defined and stored in the APP's ***models.py*** file.
- *models.py* is automatically created when you start the APP
  - Contains one line: from django.db import models
  - This allows you to import the base model from Django

Defining Models: An Example



Field Types – For Textual Data

Field	Example Values
CharField	"Product Name"
TextField	"To elaborate on my point…"
EmailField	george@site.com
URLField	www.example.com

Field Types – For Numeric and Miscellaneous Data

Field	Example Values
IntegerField	-1, 0, 1, 20
DecimalField	0.5, 3.14

Field	Example Values
BooleanField	True, False
DateTimeField	datetime(1960, 1, 1, 8, 0, 0)

Field Types – Null and Blank

null

If **True**, Django will store empty values as **NULL** in the database.
Default is **False**.

blank

If **True**, the field is allowed to be blank. Default is **False**.

```
models.CharField(max_length=10, blank=True)
```

Primary Keys

- By default, Django automatically creates a primary key field.
  - All models without an explicit primary key field are given an **id** attribute (of type AutoField).
    - id = models.BigAutoField(**primary_key**=True)
  - Autofield: behaves like normal integers; incremented for each new row in table.
  - To define your own primary key:
    - specify **primary_key = True** for one of your model fields.
    - this field becomes the primary key for the table.
    - it is now your responsibility to ensure this field is unique.

Example

- Person Model:

```
from django.db import models
class Person(models.Model):
        first_name = models.CharField(max_length=30)
        last_name = models.CharField(max_length=30)
```

The above model is created in database as:

```
CREATE TABLE myapp_person (
        "id" NOT NULL PRIMARY KEY,
        "first_name" (30) NOT NULL,
        "last_name" (30) NOT NULL );
```

Example

- Employee Model:

```
class Employee(models.Model):
    emp_no = models.IntegerField(default=999,
     primary_key = True)
     name = models.CharField(max_length=50)
     age = models.IntegerField()
     email = models.EmailField(max_length=100)
     start_date = models.DateField()
```

Field Types – Foreign Key and Many-to-Many

Field	Example Values
ForeignKey	1 (id of record in another table)
ManyToManyField	NA

```
class Company(models.Model):
    co_name = models.CharField(max_length=50)

class Car(models.Model):
    type = models.Charfield(max_length=20)
    company = models.ForeignKey(Company, on_delete=models.CASCADE)
```

Many-to-Many Relationship

- Uses the ManytoManyField.
- Syntax is similar to ForeignKey field.
- Needs to be defined on one side of the relationship only.
  - Django automatically grants necessary methods and attributes to other side.
  - Relationship is symmetrical by default → doesn't matter which side it is defined on.

Example

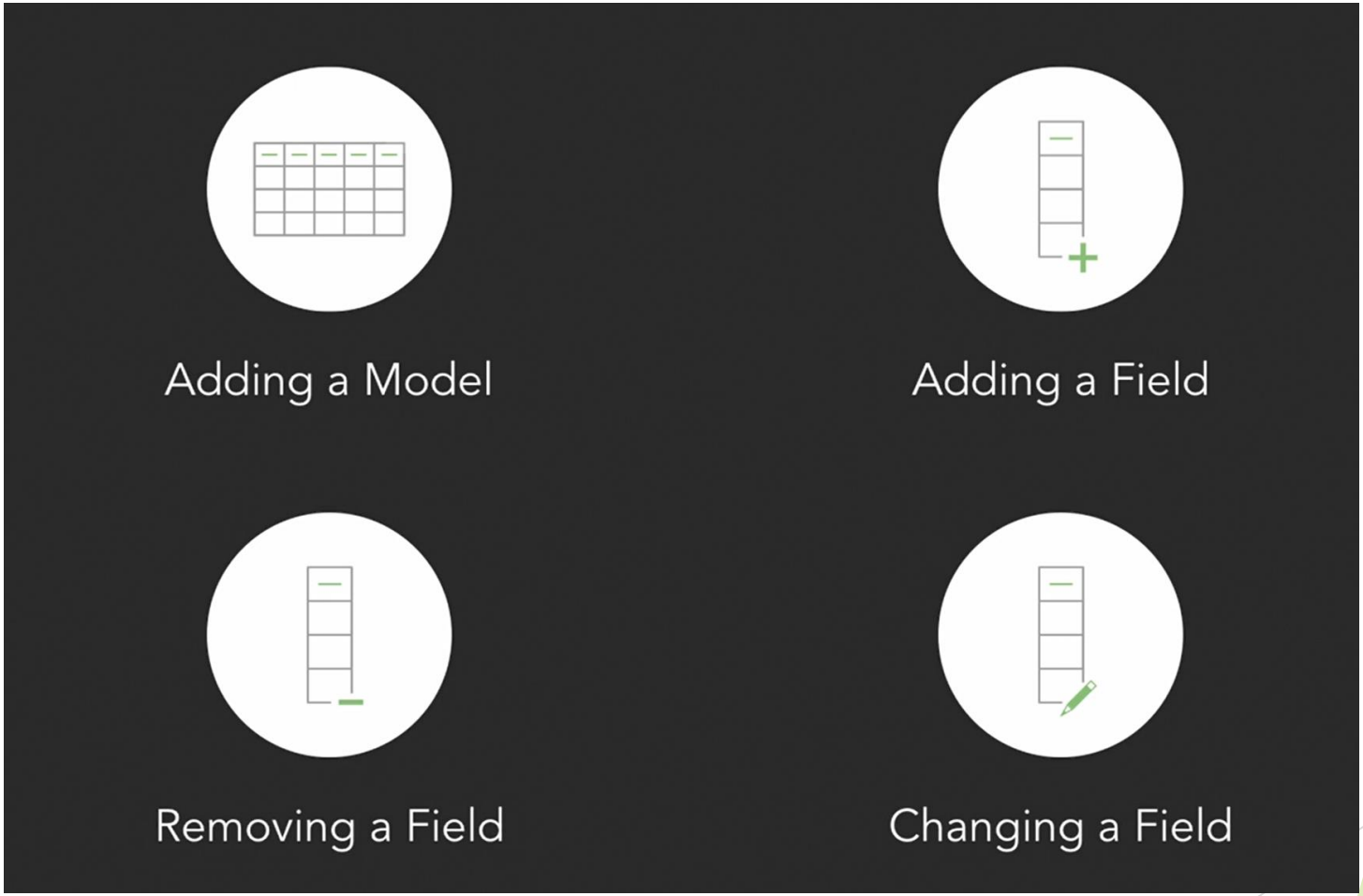
```
class Book(models.Model):
    title = models.CharField(max_length=100)
    length = models.IntegerField()
    pub_date = models.DateField()

class Author(models.Model):
        name = models.CharField(max_length=50)
        books = models.ManyToManyField(Book)
```

NOTE: The Many-to-Many relation is only defined in one model.

Migrations

- **Migrations**: propagate changes to your models (adding a field, deleting a model, etc.) into your database schema.
  - Prior to version 1.7, Django only supported adding new models to the database; could not alter or remove existing models.
  - Used the syncdb command (the predecessor to migrate)

When do we need Migrations?

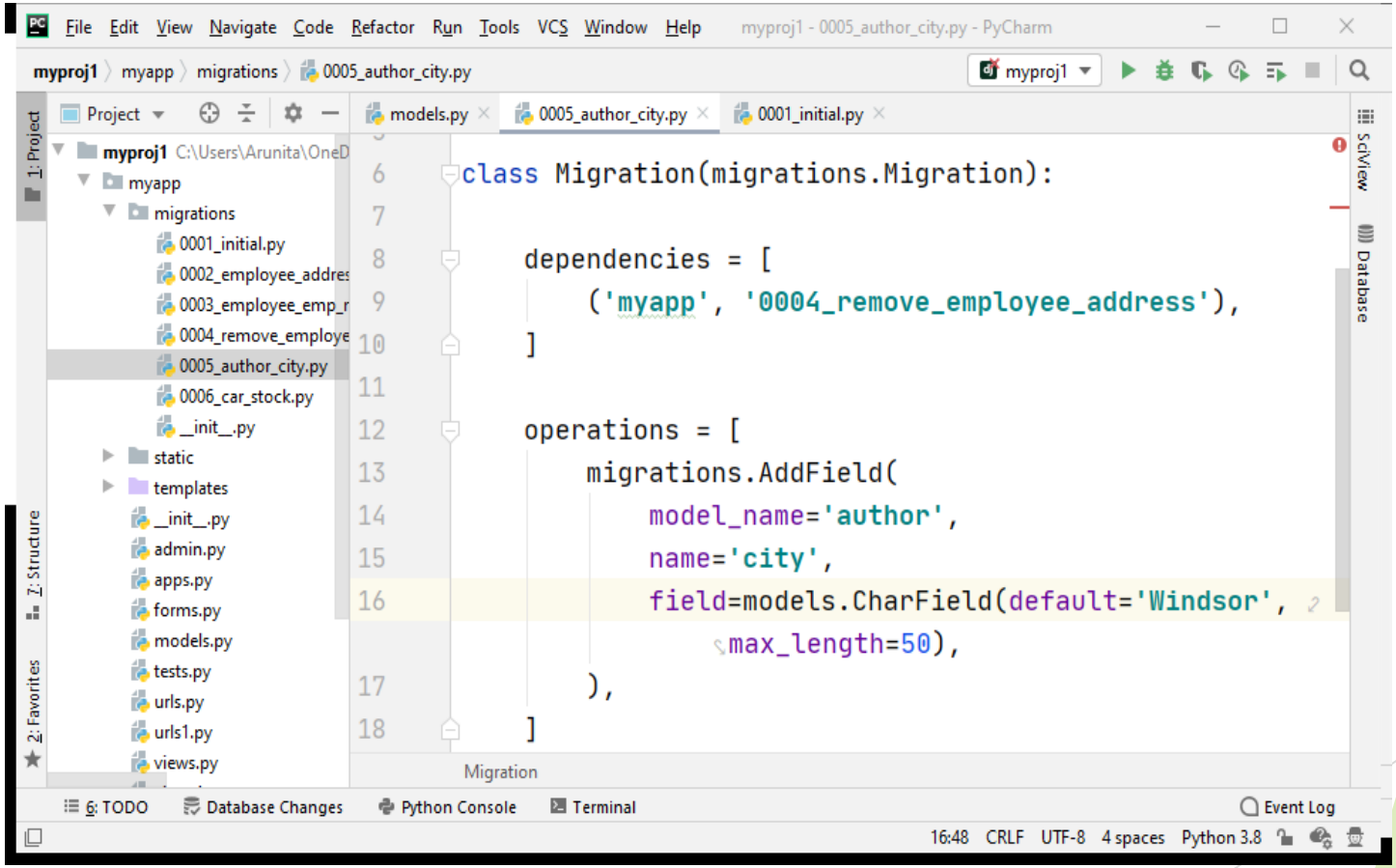


Migration Commands

- ***makemigrations*** : responsible for creating new migrations based on the changes made to your models.
- ***sqlmigrate***: displays the SQL statements for a migration.
- ***migrate***: run all the migrations that have not yet run.

Example of Migrations

```
class Author(models.Model):
    name = models.CharField(max_length=50)
    city = models.CharField(max_length=50, default='Windsor')
```



Model Inheritance

- Models can inherit from one another, similar to regular Python classes.

- Previously defined Empolyee class

```
class Employee(models.Model):
    name = models.CharField(max_length=50)
    age = models.IntegerField()
    email = models.EmailField(max_length=100)
    start_date = models. DateField()
```

- Suppose there are 2 types of employees
  - programmers and supervisors

Model Inheritance

- Option 1: Create 2 different models
  - duplicate all common fields and violate DRY principle.

- Option 2: Inherit from **Employee** class

```
class Supervisor(Employee):
    dept = models.CharField(max_length=50)

class Programmer(Employee):
    boss = models.ForeignKey(Supervisor, on_delete=models.CASCADE)
```

Adding Methods to Models

- Since a model is represented as a class, it can have *attributes* and *methods*.
- One useful method is the __str__ method which is a dunder method
  - It controls how the object will be displayed.

```
class Book(models.Model):
    title = models.CharField(max_length=100)
    length = models.IntegerField()
    pub_date = models.DateField()
    def __str__(self):
     return self.title
```

Other dunder methods = del, lt, add, sub, mul, abs, len and so on

https://www.pythonmorsels.com/what-are-dunder-methods/

Meta Inner Class

- ***Meta class***: Used to inform Django of various metadata about the model.
  - E.g., display options, ordering, multi-field uniqueness etc.

```
class Employee(models.Model):
        name = models.CharField(max_length=50)
       age = models.IntegerField()
      email = models.EmailField(max_length=100)
      start_date = models.DateField()

      class Meta:
            ordering = ['name']
```

Other examples: verbose_name, unique_together, etc

Query Syntax

- Querying makes use of two similar classes: Manager and QuerySet
- ***Manager*:** Interface through which database query operations are provided to Django models
  - At least one Manager exists for every model
  - By default, Django adds a Manager with the name objects to every Django model class.

Manager Class

- Manager class has the following methods:
  - ***all***: returns a QuerySet containing all db records for the specified model
  - ***filter***: returns a QuerySet containing model records matching specific criteria
  - ***exclude***: inverse of filter; return records that don't match the criteria
  - ***get***: return a single record (model instance) matching criteria
    - raises error if no match or multiple matches.

Query Examples

```
class Company(models.Model):
        co_name = models.CharField(max_length=50)
class Car(models.Model):
        type = models.Charfield(max_length=20)
        company = models.ForeignKey(Company,
          on_delete=models.CASCADE)
```

- Get all cars in the db.

  car_list = Car.objects.all()

- Get the car of type ‘Lexus’.

  car1 = Car.objects.get(type=‘Lexus’)

- Get all the cars made by ‘Ford’

  company = Company.objects.get(co_name=‘Ford’)

  cars = company.car_set.all()

https://docs.djangoproject.com/en/4.2/ref/models/relations/

QuerySet

- **QuerySet**: Can be thought of as a list of model class instances (records/rows)
  - above is a simplification – actually much more powerful
  - QuerySet examples:
    - List of all books:

```
all_books = Book.objects.all()
```

    - List of books with the word “Python” in title:

```
python_books =  Book.objects.filter(title__contains=“Python”)
```

    - The book with id == 1:

```
book = Book.objects.get(id=1)
```

QuerySet

- **QuerySet** as container: QuerySet implements a partial list interface and can be iterated over, indexed, sliced, and measured.
- Example 1:

```
python_books = Book.objects.filter(title__contains="Python')
for book in python_books:
    print(book.title)
```

- Example 2:

```
all_books = Book.objects.all()
```

How many books in db?

```
num_books = len(all_books)
```

Get the first book:

```
first_book = all_books[0]
```

Get a list of first five books:

```
first_five = all_books[:5]
```

QuerySet

- QuerySet as building blocks: QuerySets can be *composed* into complex or nested queries.

- Example:

```
python_books = Book.objects.filter(title__contains="Python')
short_python_books = python_books.filter(length__lt=100)
```

- Equivalently:

```
short_python_books =
 Book.objects.filter(title__contains="Python').filter(length__lt=
 100)
```

References

- https://docs.djangoproject.com/en/5.0/intro/tutorial02
- https://docs.djangoproject.com/en/5.0/topics/db/models/
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- Slides from Dr. Arunita and Dr. Saja