

CRUD on Django Model Objects



Skills
Network

Estimated time needed: 30 minutes

In this lab, you will practice creating Django Models with relationships, saving objects into databases, querying, updating, and deleting objects.

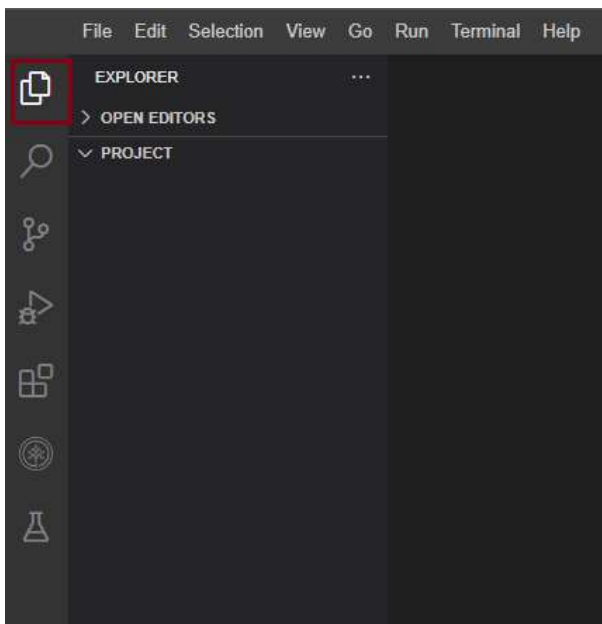
Learning Objectives

- Create Django Models with One-To-One, One-To-Many, and Many-To-Many relationships
- Query model objects with filters
- Delete and update objects

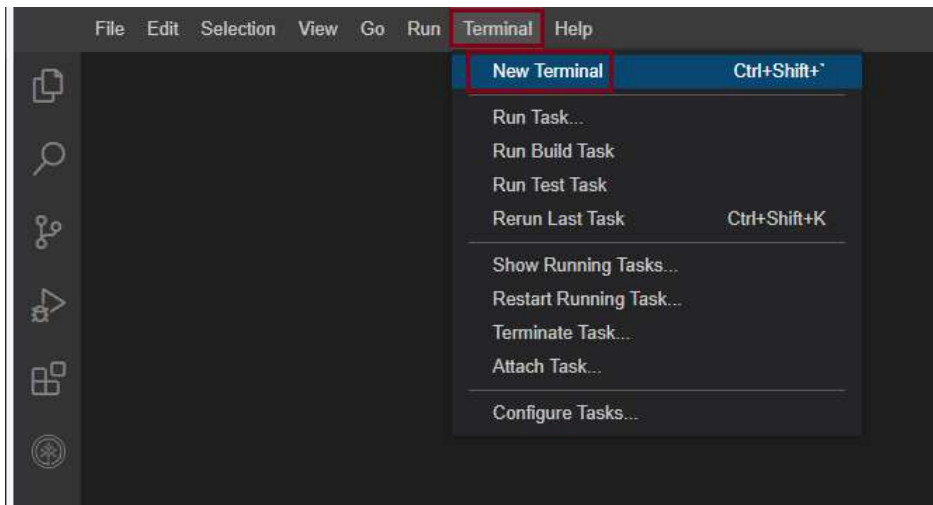
Working with files in Cloud IDE

If you are new to Cloud IDE, this section will show you how to create and edit files, which are part of your project, in Cloud IDE.

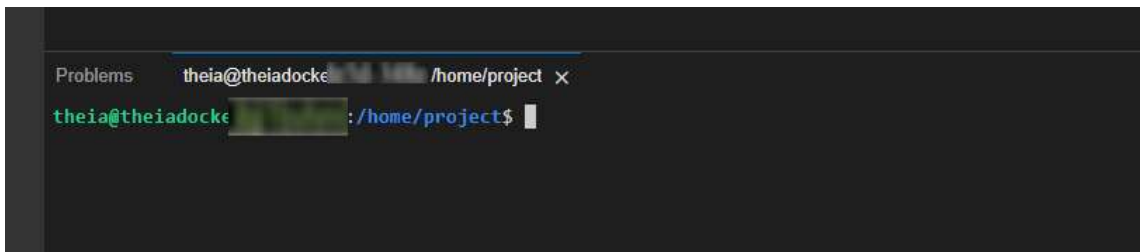
To view your files and directories inside Cloud IDE, click on this files icon to reveal it.



Click on New, and then New Terminal.



This will open a new terminal where you can run your commands.

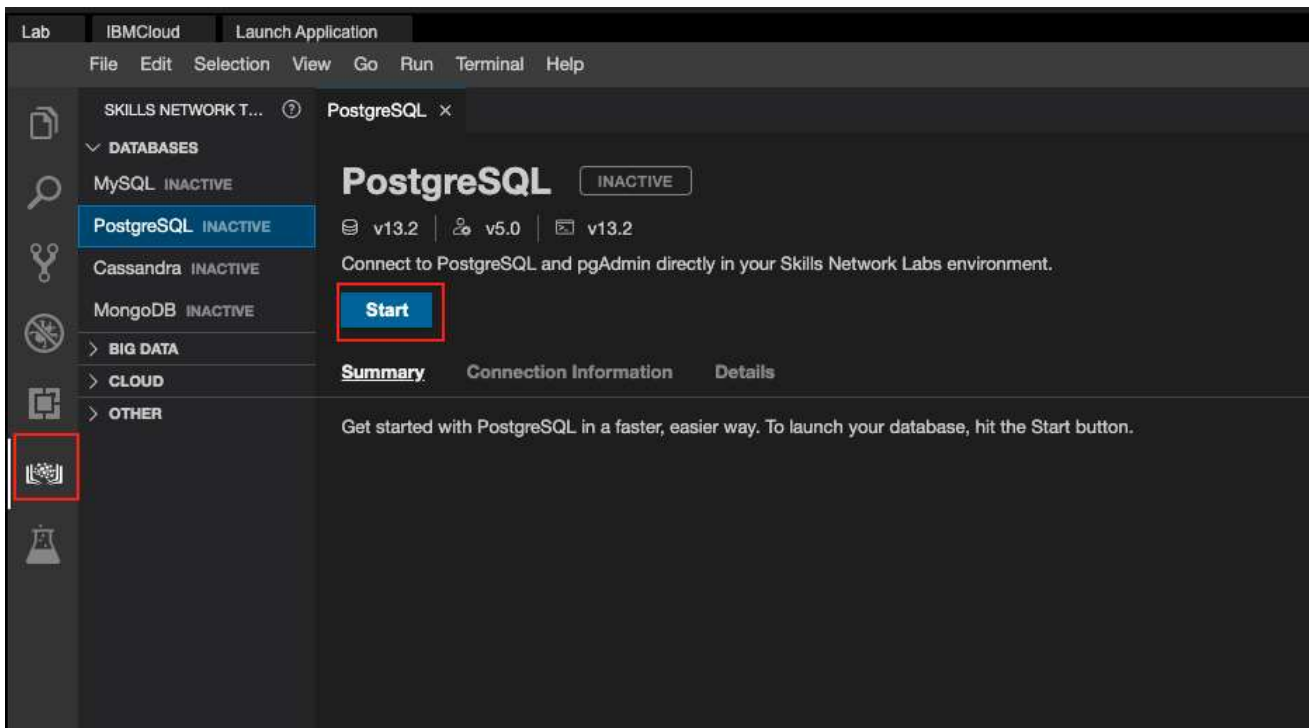


Concepts covered in the lab

1. CRUD operations: Create, Read, Update, and Delete operations
2. QuerySet: Represents a collection of records in a database, and is required to read objects using Django Model API.
3. `all()` method: Returns a QuerySet of all the objects in the database.
4. `filter()` method: Returns only the rows that match the search term. It can have lookup parameters such as **greater than**, **less than**, **contains**, or **is null**.

Start PostgreSQL in Theia

- Start PostgreSQL from UI by finding the SkillsNetwork icon on the left menu bar and selecting PostgreSQL from the DATABASES menu item:



- Once the PostgreSQL has been started, you can check the server connection information from the UI. Please markdown the connection information such as generated username, password, and host, etc, which will be used to configure Django app to connect to this database.

PostgreSQL

ACTIVE

v13.2 | v5.0 | v13.2

Connect to PostgreSQL and pgAdmin directly in your Skills Network Labs environment.

Stop

Summary

Connection Information

Details

Username:

yluo

Password:

ODQyMy15bHVvLTE4

Host:

127.0.0.1

Port:

5432

PostgreSQL CLI Command:

psql --username=postgres --host=localhost

URL:

https://yluo-5050.theiadocker-5-labs-prod-theiak8s-4-tor01.proxy.cognitiveclass.ai/browser/

- You will also see a pgAdmin instance installed and started.

SKILLS NETWORK T... ? PostgreSQL X

DATABASES

MySQL INACTIVE

PostgreSQL ACTIVE

Cassandra INACTIVE

MongoDB INACTIVE

BIG DATA

CLOUD

OTHER

PostgreSQL

ACTIVE

v13.2 | v5.0 | v13.2

Connect to PostgreSQL and pgAdmin directly in your Skills Network Labs environment.

Stop

Summary

Connection Information

Details

Your database and pgAdmin server are now ready to use and available with the following login credentials. For PostgreSQL, please check out the Details section.

Username:

yluo

Password:

ODQyMy15bHVvLTE4

You can manage PostgreSQL via:

pgAdmin

Or to interact with the database in the terminal, select one of these options:

PostgreSQL CLI

New Terminal

Import a standalone Django ORM project template

Before starting the lab, make sure your current Theia directory is /home/project.

First, we need to create a virtual environment and install Django and psycopg related packages.

- If the terminal was not open, go to Terminal > New Terminal and run:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

1. pip install --upgrade distro-info
2. pip3 install --upgrade pip==23.2.1
3. pip install virtualenv
4. virtualenv djangoenv
5. source djangoenv/bin/activate
6. pip install Django psycopg2-binary
```

Copied! Executed!

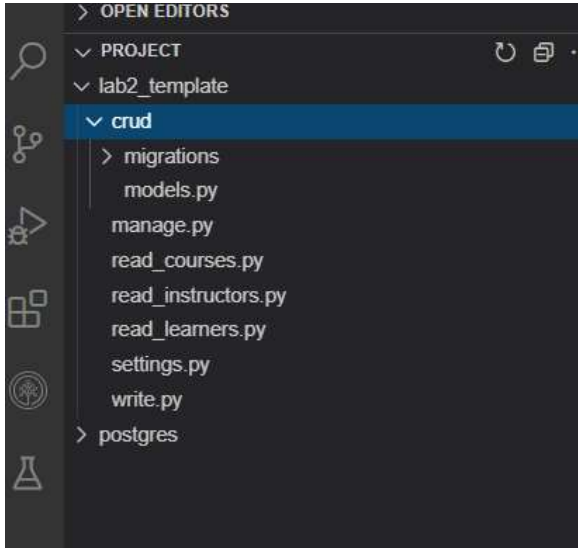
- Run the following command-lines to download a code template for this lab

```
1. 1
2. 2
3. 3

1. wget "https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/IBM-CD0251EN-SkillsNetwork/labs/m3_django_orm/lab2_template.zip"
2. unzip lab2_template.zip
3. rm lab2_template.zip
```

Copied! Executed!

Your Django project should look like the following:



- Open settings.py and find the DATABASES section. Replace the value of the PASSWORD to be the generated PostgreSQL password.

Your settings.py file now should look like the following:

```
# PostgreSQL
DATABASES = {
    'default': {
        'ENGINE': 'django.db.backends.postgresql_psycopg2',
        'NAME': 'postgres',
        'USER': 'postgres',
        'PASSWORD': '#Replace it with generated password#',
        'HOST': 'localhost',
        'PORT': '5432',
    }
}

INSTALLED_APPS = (
    'crud',
)

SECRET_KEY = 'SECRET KEY for this Django Project'
```

Create Models For an Online Course App

Next, you can start to create models for an online course app.

- Open crud/models.py and append first User model

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9

1. # User model
2. class User(models.Model):
3.     first_name = models.CharField(null=False, max_length=30, default='john')
4.     last_name = models.CharField(null=False, max_length=30, default='doe')
5.     dob = models.DateField(null=True)
6.
7.     # Create a toString method for object string representation
8.     def __str__(self):
9.         return self.first_name + " " + self.last_name
```

Copied!

The User model contains common information about a user such as `first_name`, `last_name` as `CharField` and `dob` as `DateField`.

In addition to that, we override the `__str__(self):` method to create a string representation of a user object. This is convenient if you want to print a user object.

Also feel free to add as many primitive fields as you like to the User model such as `email` or `location`. You could find more details about model field definitions here: [Django Model Fields](#)

Next, let's add an Instructor model inherited from User model and make it as One-To-One relationship. Instructor is an extension of User which adds some more instructor specific fields such as `full_time` and `total_learners`.

- Append an Instructor model to `models.py`

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11

1. # Instructor model
2. class Instructor(User):
3.     full_time = models.BooleanField(default=True)
4.     total_learners = models.IntegerField()
5.
6.     # Create a toString method for object string representation
7.     def __str__(self):
8.         return "First name: " + self.first_name + ", " + \
9.             "Last name: " + self.last_name + ", " + \
10.             "Is full time: " + str(self.full_time) + ", " + \
11.             "Total Learners: " + str(self.total_learners)
```

Copied!

Then, let's create a Course model which has a Many-To-Many relationship to Instructor model, defined by the reference field `instructors`.

- Append a Course model to `models.py`

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11

1. # Course model
2. class Course(models.Model):
3.     name = models.CharField(null=False, max_length=100, default='online course')
4.     description = models.CharField(max_length=500)
5.     # Many-To-Many relationship with Instructor
6.     instructors = models.ManyToManyField(Instructor)
7.
8.     # Create a toString method for object string representation
9.     def __str__(self):
10.         return "Name: " + self.name + ", " + \
11.             "Description: " + self.description
```

Copied!

Here we added a Many-To-Many relationship between Course and Instructor by creating a `ManyToManyField` field called `instructors`

A course normally contains several lessons thus has a One-To-Many relationship to a Lesson model, i.e., each course can have zero or many lessons but each lesson only belongs to one course.

- Append a Lesson model to `models.py`

```
1. 1
2. 2
3. 3
4. 4
5. 5

1. # Lesson
2. class Lesson(models.Model):
3.     title = models.CharField(max_length=200, default="title")
4.     course = models.ForeignKey(Course, null=True, on_delete=models.CASCADE)
5.     content = models.TextField()
```

Copied!

Coding Practice: Add a Learner Model

Complete the following code snippet to add a Learner model inherited from User with some learner related fields:

1. You could look at the comments with <HINT> for the missing parts.
2. You need to define Learner model before Course model in `models.py` so that the Course model knows the existence of Learner
3. Remember to save the updated files to make the changes effective.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14
15. 15
16. 16
17. 17
18. 18
19. 19
20. 20
21. 21
22. 22
23. 23

1. # Learner model
2. class Learner(##<HINT> add a user parent model):
3.     STUDENT = 'student'
4.     DEVELOPER = 'developer'
5.     DATA_SCIENTIST = 'data_scientist'
6.     DATABASE_ADMIN = 'dba'
7.     OCCUPATION_CHOICES = [
8.         (STUDENT, 'Student'),
9.         (DEVELOPER, 'Developer'),
10.        (DATA_SCIENTIST, 'Data Scientist'),
11.        (DATABASE_ADMIN, 'Database Admin')
12.    ]
13.    occupation = models.CharField(
14.        null=False,
15.        max_length=20,
16.        choices=OCCUPATION_CHOICES,
17.        default=STUDENT
18.    )
19.    social_link = models.URLField(max_length=200)
20.
21.    ##<HINT> Create a __str__ method returning a string presentation
22.    def __str__(self):
23.        ...
```

Copied!

► [Click here to see solution](#)

Coding Practice: Add an Enrollment Model

Append the following Enrollment class.

Update Course model to add a Many-To-Many relationship with Learner model via the Enrollment class.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14
15. 15
16. 16

1. # Enrollment model as a lookup table with additional enrollment info
2. class Enrollment(models.Model):
3.     AUDIT = 'audit'
4.     HONOR = 'honor'
5.     COURSE_MODES = [
```

```

6.         (AUDIT, 'Audit'),
7.         (HONOR, 'Honor'),
8.     ]
9.     # Add a learner foreign key
10.    learner = models.ForeignKey(Learner, on_delete=models.CASCADE)
11.    # Add a course foreign key
12.    course = models.ForeignKey(Course, on_delete=models.CASCADE)
13.    # Enrollment date
14.    date_enrolled = models.DateField(default=now)
15.    # Enrollment mode
16.    mode = models.CharField(max_length=5, choices=COURSE_MODES, default=AUDIT)

```

Copied!

► [Click here to see solution](#)

Migrate Models

Now, you have defined:

1. User and Instructor models with One-To-One relationship
2. Course and Lessons models with One-To-Many relationship
3. Course and Instructor with Many-To-Many relationship.

Let's run migrations for the crud app to create those tables in our PostgreSQL database.

- If your current working directory is not `/home/project/lab2_template`, cd to the project folder

```

1. 1
1. cd lab2_template

```

Copied!

- Then generate migration scripts for app crud

```

1. 1
1. python3 manage.py makemigrations crud

```

Copied!

and you should see Django is about to create the following tables.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10

1. Migrations for 'crud':
2.   crud/migrations/0001_initial.py
3.   - Create model Course
4.   - Create model User
5.   - Create model Instructor
6.   - Create model Learner
7.   - Create model Lesson
8.   - Create model Enrollment
9.   - Add field instructors to course
10.  - Add field learners to course

```

Copied!

- Run the migrations.

```

1. 1
1. python3 manage.py migrate

```

Copied!

and you should see migration script `crud.0001_initial` was executed.

```

1. 1
2. 2
3. 3
4. 4

1. Operations to perform:
2.   Apply all migrations: crud
3. Running migrations:
4.   Applying crud.0001_initial... OK

```

Copied!

Create and Delete Objects

At this point, you have defined all models for this lab.

Let's try to perform some create and delete operations on those models.

- Open `write.py` and append a `write_instructors()` method to save some instructors objects.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14
15. 15
16. 16
17. 17
18. 18
19. 19

1.
2. def write_instructors():
3.     # Add instructors
4.     # Create a user
5.     user_john = User(first_name='John', last_name='Doe', dob=date(1962, 7, 16))
6.     user_john.save()
7.     instructor_john = Instructor(full_time=True, total_learners=30050)
8.     # Update the user reference of instructor_john to be user_john
9.     instructor_john.user = user_john
10.    instructor_john.save()
11.
12.    instructor_yan = Instructor(first_name='Yan', last_name='Luo', dob=date(1962, 7, 16), full_time=True, total_learners=30050)
13.    instructor_yan.save()
14.
15.    instructor_joy = Instructor(first_name='Joy', last_name='Li', dob=date(1992, 1, 2), full_time=False, total_learners=10040)
16.    instructor_joy.save()
17.    instructor_peter = Instructor(first_name='Peter', last_name='Chen', dob=date(1982, 5, 2), full_time=True, total_learners=2002)
18.    instructor_peter.save()
19.    print("Instructor objects all saved... ")
```

Copied!

For the `instructor_john`, we first create his parent class model `user` and update `instructor_john.user` to be `user_john`.

For other instructors, Django will automatically assign values of `first_name`, `last_name`, `dob` to their parent user objects.

- Append a `write_courses()` method to add some course objects.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11

1. def write_courses():
2.     # Add Courses
3.     course_cloud_app = Course(name="Cloud Application Development with Database",
4.                               description="Develop and deploy application on cloud")
5.     course_cloud_app.save()
6.     course_python = Course(name="Introduction to Python",
7.                             description="Learn core concepts of Python and obtain hands-on "
8.                             "experience via a capstone project")
9.     course_python.save()
10.
11.    print("Course objects all saved... ")
```

Copied!

- Append a `write_lessons()` method to add some lessons

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7

1. def write_lessons():
2.     # Add lessons
3.     lesson1 = Lesson(title='Lesson 1', content="Object-relational mapping project")
4.     lesson1.save()
5.     lesson2 = Lesson(title='Lesson 2', content="Django full stack project")
6.     lesson2.save()
7.     print("Lesson objects all saved... ")
```


Copied!

- To conveniently clean up your database tables, you can add a `clean_data()` method like the following code snippet. It uses the model manager objects to get all objects first and then delete them from database.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. def clean_data():
2.     # Delete all data to start from fresh
3.     Enrollment.objects.all().delete()
4.     User.objects.all().delete()
5.     Learner.objects.all().delete()
6.     Instructor.objects.all().delete()
7.     Course.objects.all().delete()
8.     Lesson.objects.all().delete()
```

Copied!

Next, let's call those populating methods to actually save the objects

- Append the following methods call to `write.py`

```
1. 1
2. 2
3. 3
4. 4
5. 5

1. # Clean any existing data first
2. clean_data()
3. write_courses()
4. write_instructors()
5. write_lessons()
```

Copied!

- At last, run the `write.py` in terminal

```
1. 1

1. python3 write.py
```

Copied!

You should see objects all saved messages in the terminal indicating the save operations were done successfully.

```
1. 1
2. 2
3. 3

1. Course objects all saved...
2. Instructor objects all saved...
3. Lesson objects all saved...
```

Copied!

In the next step, let's try to query those saved objects.

Coding Practice: Create and Save More Learner Objects

Complete and the following code snippet `write_learners()` method by saving more learners objects into database:

1. You could look at the comments with `<HINT>` for the missing parts.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14
15. 15
16. 16
17. 17
18. 18
19. 19
20. 20
21. 21
22. 22
```

23. 23

```
1. def write_learners():
2.     # Add Learners
3.     learner_james = Learner(first_name='James', last_name='Smith', dob=date(1982, 7, 16),
4.                             occupation='data_scientist',
5.                             social_link='https://www.linkedin.com/james/')
6.     learner_james.save()
7.     learner_mary = Learner(first_name='Mary', last_name='Smith', dob=date(1991, 6, 12), occupation='dba',
8.                             social_link='https://www.facebook.com/mary/')
9.     learner_mary.save()
10.    learner_robert = Learner(first_name='Robert', last_name='Lee', dob=date(1999, 1, 2), occupation='student',
11.                              social_link='https://www.facebook.com/robert/')
12.    learner_robert.save()
13.    learner_david = Learner(first_name='David', last_name='Smith', dob=date(1983, 7, 16),
14.                             occupation='developer',
15.                             social_link='https://www.linkedin.com/david/')
16.    learner_david.save()
17.    learner_john = Learner(first_name='John', last_name='Smith', dob=date(1986, 3, 16),
18.                             occupation='developer',
19.                             social_link='https://www.linkedin.com/john/')
20.    learner_john.save()
21.    print("Learner objects all saved... ")
22.    #<HINT> Add more learners objects#
23.    #...
```

Copied!

2. Add the write_learners() method call to write.py

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

1. # Clean any existing data first
2. clean_data()
3. write_courses()
4. write_instructors()
5. write_lessons()
6. write_learners()
```

Copied!

3. Run the write.py file in terminal again

```
1. 1

1. python3 write.py
```

Copied!

Query objects

We first read all courses.

- Open read_courses.py and add the following code snippet:

```
1. 1
2. 2
3. 3

1. #Find all courses
2. courses = Course.objects.all()
3. print(courses)
```

Copied!

In the above code snippet, we call the model managers objects to return us all the courses.

- Let's run the Python script file to test the result

```
1. 1

1. python3 read_courses.py
```

Copied!

You should see a QuerySet object containing the two courses we created in the previous step.

```
1. 1
2. 2
3. 3
4. 4

1. <QuerySet [
2. <Course: Name: Cloud Application Development with Database,Description: Develop and deploy application on cloud>,
3. <Course: Name: Introduction to Python,Description: Learn core concepts of Python and obtain hands-on experience via a capstone project>
4. ]>
```

Copied!

- Next, let's query instructors with filters to select subsets of instructors meeting following criteria:

1. Find a single instructor with first name Yan
2. Try to find a non-existing instructor with first name Andy
3. Find all part time instructors
4. Find all full time instructors with First Name starts with Y and learners count greater than 30000
5. Find all full time instructors with First Name starts with Y and learners count greater than 30000 using multiple parameters

- Open `read_instructor.py`, and add the following code snippets to perform queries:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14
15. 15
16. 16
17. 17
18. 18
19. 19
20. 20
21. 21
22. 22
23. 23
24. 24
25. 25
26. 26
27. 27
28. 28
29. 29
30. 30

1.
2. instructor_yan = Instructor.objects.get(first_name="Yan")
3. print("1. Find a single instructor with first name `Yan`")
4. print(instructor_yan)
5.
6. print("\n")
7. # Note that there is no instructor with first name `Andy`
8. # So the manager will throw an exception
9. try:
10.     instructor_andy = Instructor.objects.get(first_name="Andy")
11. except Instructor.DoesNotExist:
12.     print("2. Try to find a non-existing instructor with first name `Andy`")
13.     print("Instructor Andy doesn't exist")
14.
15. print("\n")
16. part_time_instructors = Instructor.objects.filter(full_time=False)
17. print("3. Find all part time instructors: ")
18. print(part_time_instructors)
19.
20. print("\n")
21. full_time_instructors = Instructor.objects.exclude(full_time=False).filter(total_learners__gt=30000).\
22.     filter(first_name__startswith='Y')
23. print("4. Find all full time instructors with First Name starts with `Y` and learners count greater than 30000")
24. print(full_time_instructors)
25.
26. print("\n")
27. full_time_instructors = Instructor.objects.filter(full_time=True, total_learners__gt=30000,
28.     first_name__startswith='Y')
29. print("5. Find all full time instructors with First Name starts with `Y` and learners count greater than 30000")
30. print(full_time_instructors)
```

Copied!

Review the above code examples to understand how each filter and parameters were made.

- Run `read_instructors.py` in the terminal

```
1. 1
1. python3 read_instructors.py
```

Copied!

Query results:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
```

```
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14

1. 1. Find a single instructor with first name `Yan`
2. First name: Yan, Last name: Luo, Is full time: True, Total Learners: 30050
3.
4. 2. Try to find a non-existing instructor with first name `Andy`
5. Instructor Andy doesn't exist
6.
7. 3. Find all part time instructors:
8. <QuerySet [<Instructor: First name: Joy, Last name: Li, Is full time: False, Total Learners: 10040>]>
9.
10. 4. Find all full time instructors with First Name starts with `Y` and learners count greater than 30000
11. <QuerySet [<Instructor: First name: Yan, Last name: Luo, Is full time: True, Total Learners: 30050>]>
12.
13. 5. Find all full time instructors with First Name starts with `Y` and learners count greater than 30000
14. <QuerySet [<Instructor: First name: Yan, Last name: Luo, Is full time: True, Total Learners: 30050>]>
```

Copied!

Coding practice: Query Learners with Filters

Open `read_learners.py`, complete and append the code snippet to query subset learners based on the following criterions:

- 1. Find learners with last name Smith
- 2. Find two youngest learners (ordered by dob)

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9

1. # Find students with last name "Smith"
2. learners_smith = Learner.objects.filter(#<HINT> add last_name check)
3. print("1. Find learners with last name `Smith`")
4. print(learners_smith)
5. print("\n")
6. # Order by dob descending, and select the first two objects
7. learners = Learner.objects.order_by(#<HINT> add dob with - as descending )[#<HINT> add index 0:2]
8. print("2. Find top two youngest learners")
9. print(learners)
```

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Summary

In this lab, you have imported a standalone Django ORM project template. Based on the template, you learned and practiced creating Django Models with relationships, saving those Django Models objects into databases, performing update and delete operations, and querying them with filters.

Next, you will learn how to access related objects.

Author(s)

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Changelog

Date	Version	Changed by	Change Description
30-Nov-2020	1.0	Yan Luo	Initial version created
30-Nov-2022	1.1	K Sundararajan	Small update in the instructions for clarity
04-Jul-2023	1.2	K Sundararajan	Updated screenshots as per latest UI
10-Jul-2023	1.3	K Sundararajan	Updated instructions as per SME's feedback
26-Jul-2023	1.4	K Sundararajan	Updates based on QA review

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