Question 1: By default, are Django signals executed synchronously or asynchronously?

By default, Django signals are executed **synchronously**. This means that the signal handlers are called immediately after the signal is sent, and the execution flow waits for the signal handler to complete before moving on.

Here's a simple code snippet to demonstrate this:

python

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```
# Import necessary modules

from django.db.models.signals import post_save

from django.dispatch import receiver

from django.contrib.auth.models import User

import time


# Signal handler

@receiver(post_save, sender=User)

def my_signal_handler(sender, instance, **kwargs):

    print("Signal received")

    time.sleep(5)  # Simulate a time-consuming task

    print("Signal handler finished")


# In your view or shell, create a new user instance

user = User.objects.create(username='testuser', password='password123')


# Output:

# Signal received

# (waits for 5 seconds)

# Signal handler finished
```

This code shows that the signal is handled synchronously because the main thread waits for the signal handler to finish (as shown by the time.sleep(5) pause).

Question 2: Do Django signals run in the same thread as the caller?

Yes, by default, Django signals run in the **same thread** as the caller. To prove this, you can use the threading library to check the current thread's identity in both the view and the signal handler.

Here's a code snippet:

python

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```
import threading
from django.db.models.signals import post_save
from django.dispatch import receiver
from django.contrib.auth.models import User


# Signal handler
@receiver(post_save, sender=User)
def my_signal_handler(sender, instance, **kwargs):
    print("Signal handler thread:", threading.current_thread().name)


# In your view or shell, create a new user instance
print("Main thread:", threading.current_thread().name)
user = User.objects.create(username='testuser', password='password123')


# Output:
# Main thread: MainThread
# Signal handler thread: MainThread
```

This code demonstrates that the signal handler runs in the same thread as the caller (which is MainThread).

Question 3: By default, do Django signals run in the same database transaction as the caller?

Yes, Django signals, such as post_save, run in the **same database transaction** as the caller when using post_save, pre_save, or similar signals tied to database actions. However, you need to be careful when using signals and transactions because a failure in the signal handler can affect the database transaction.

To prove this, you can use Django's transaction.atomic() block to confirm that both the signal handler and the caller are within the same transaction:

python

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```
from django.db import transaction

from django.db.models.signals import post_save

from django.dispatch import receiver

from django.contrib.auth.models import User


@receiver(post_save, sender=User)

def my_signal_handler(sender, instance, **kwargs):

    print("Signal handler in atomic transaction:", transaction.get_connection().in_atomic_block)


# In your view or shell

with transaction.atomic():

    print("In atomic transaction:", transaction.get_connection().in_atomic_block)

    user = User.objects.create(username='testuser', password='password123')


# Output:

# In atomic transaction: True

# Signal handler in atomic transaction: True
```

This shows that the signal handler and the caller both run in the same transaction context.

These snippets should help clarify the default behavior of Django signals in terms of synchronization, threading, and transaction handling.