Certainly! Let's go through the process of building Docker images for a Django project from scratch. This involves creating Dockerfiles and understanding how the build process works. Additionally, we'll touch on the role of entrypoint and start scripts in the context of Docker containers.

### Step 1: Project Structure

First, ensure your Django project has a structure that can be containerized. A common structure might look like this:

```

myproject/

|-- src/

| |-- manage.py

| |-- myapp/

| |-- ...

|-- docker/

| |-- local/

| |-- django/

| |-- Dockerfile

| |-- postgres/

| |-- Dockerfile

|-- .envs/

|-- .local/

|-- .django

|-- .postgres

|-- local.yml

|-- entrypoint.sh

|-- start.sh

```

### Step 2: Dockerfiles

Create Dockerfiles for Django and PostgreSQL. These files define how Docker should build the images for your services.

\*\*Dockerfile for Django (`docker/local/django/Dockerfile`):\*\*

```dockerfile

# Use the official Python image as a base

FROM python:3.9

# Set environment variables

ENV PYTHONDONTWRITEBYTECODE 1

ENV PYTHONUNBUFFERED 1

# Set the working directory inside the container

WORKDIR /app

# Copy the requirements file to the container

COPY ./src/requirements.txt /app/requirements.txt

# Install dependencies

RUN pip install --upgrade pip

RUN pip install -r requirements.txt

# Copy the Django project to the container

COPY ./src /app

# Set the entrypoint script

ENTRYPOINT ["./entrypoint.sh"]

```

\*\*Dockerfile for PostgreSQL (`docker/local/postgres/Dockerfile`):\*\*

```dockerfile

# Use the official PostgreSQL image as a base

FROM postgres:latest

# Copy the initialization script to the container

COPY ./docker/local/postgres/init.sql /docker-entrypoint-initdb.d/

```

### Step 3: Environment Files

Create environment files for Django and PostgreSQL (`./.envs/.local/.django` and `./.envs/.local/.postgres`).

\*\*.django Environment File (`./.envs/.local/.django`):\*\*

```dotenv

POSTGRES\_DB=mydatabase

POSTGRES\_USER=myuser

POSTGRES\_PASSWORD=mypassword

POSTGRES\_HOST=postgres

POSTGRES\_PORT=5432

```

\*\*.postgres Environment File (`./.envs/.local/.postgres`):\*\*

```dotenv

POSTGRES\_DB=mydatabase

POSTGRES\_USER=myuser

POSTGRES\_PASSWORD=mypassword

POSTGRES\_HOST=postgres

POSTGRES\_PORT=5432

```

### Step 4: Docker Compose File

Create a Docker Compose file (`local.yml`) that defines your services, networks, and volumes.

```yaml

version: '3.9'

services:

api:

build:

context: .

dockerfile: ./docker/local/django/Dockerfile

volumes:

- .:/app:z

- static\_volume:/app/staticfiles

- media\_volume:/app/mediafiles

ports:

- "8000:8000"

env\_file:

- ./.envs/.local/.django

- ./.envs/.local/.postgres

depends\_on:

- postgres

command: /start

networks:

- mynetwork

postgres:

build:

context: .

dockerfile: ./docker/local/postgres/Dockerfile

volumes:

- local\_postgres\_data:/var/lib/postgresql/data

- local\_postgres\_data\_backups:/backups

env\_file:

- ./.envs/.local/.postgres

networks:

- mynetwork

networks:

mynetwork:

driver: bridge

volumes:

static\_volume:

media\_volume:

local\_postgres\_data: {}

local\_postgres\_data\_backups: {}

```

### Step 5: Entrypoint and Start Scripts

Create entrypoint and start scripts (`entrypoint.sh` and `start.sh`).

\*\*entrypoint.sh:\*\*

```bash

#!/bin/bash

set -o errexit

set -o pipefail

set -o nounset

if [ -z "${POSTGRES\_USER}" ]; then

base\_postgres\_image\_default\_user='postgres'

export POSTGRES\_USER="${base\_postgres\_image\_default\_user}"

fi

export DATABASE\_URL="postgres://${POSTGRES\_USER}:${POSTGRES\_PASSWORD}@${POSTGRES\_HOST}:${POSTGRES\_PORT}/${POSTGRES\_DB}"

python << END

import sys

import time

import psycopg2

suggest\_unrecoverable\_after = 30

start = time.time()

while True:

try:

psycopg2.connect(

dbname="${POSTGRES\_DB}",

user="${POSTGRES\_USER}",

password="${POSTGRES\_PASSWORD}",

host="${POSTGRES\_HOST}",

port="${POSTGRES\_PORT}",

)

break

except psycopg2.OperationalError as error:

sys.stderr.write("Waiting for PostgreSQL to become available...\n")

if time.time() - start > suggest\_unrecoverable\_after:

sys.stderr.write(" This is taking longer than expected. The following exception may be indicative of an unrecoverable error: '{}'\n".format(error))

time.sleep(1)

END

>&2 echo "PostgreSQL is available"

exec "$@"

```

\*\*start.sh:\*\*

```bash

#!/bin/bash

set -o errexit

set -o pipefail

set -o nounset

python manage.py migrate --no-input

python manage.py collectstatic --no-input

exec python manage.py runserver 0.0.0.0:8000

```

### Step 6: Build and Run

Now, you can build and run your services using Docker Compose:

```bash

docker-compose -f local.yml up --build

```

This command tells Docker Compose to build the images (`--build`) and start the services defined in `local.yml`. The `entrypoint.sh` and `start.sh` scripts will be executed as part of the container startup process.

That's it! You've created Dockerfiles, environment files, and scripts to containerize a Django project. Adjustments may be needed based on your specific project structure or requirements, but this should provide a good starting point.

entrypoint:

#!/bin/bash

set -o errexit

set -o pipefail

set -o nounset

if [ -z "${POSTGRES\_USER}" ]; then

base\_postgres\_image\_default\_user='postgres'

export POSTGRES\_USER="${base\_postgres\_image\_default\_user}"

fi

export DATABASE\_URL="postgres://${POSTGRES\_USER}:${POSTGRES\_PASSWORD}@${POSTGRES\_HOST}:${POSTGRES\_PORT}/${POSTGRES\_DB}"

python << END

import sys

import time

import psycopg2

suggest\_unrecoverable\_after = 30

start = time.time()

while True:

try:

psycopg2.connect(

dbname="${POSTGRES\_DB}",

user="${POSTGRES\_USER}",

password="${POSTGRES\_PASSWORD}",

host="${POSTGRES\_HOST}",

port="${POSTGRES\_PORT}",

)

break

except psycopg2.OperationalError as error:

sys.stderr.write("Waiting for PostgreSQL to become available...\n")

if time.time() - start > suggest\_unrecoverable\_after:

sys.stderr.write(" This is taking longer than expected. The following exception may be indicative of an unrecoverable error: '{}'\n".format(error))

time.sleep(1)

END

>&2 echo "PostgreSQL is available"

exec "$@"

**Explanation:**

1. **Shebang (#!/bin/bash):** Indicates that the script should be interpreted using Bash.
2. **set commands:**
   * **set -o errexit**: Causes the script to exit if any command it runs exits with a non-zero status.
   * **set -o pipefail**: Causes a pipeline to produce a failure return code if any command in the pipeline fails.
   * **set -o nounset**: Causes the script to exit if it tries to use an uninitialized variable.
3. **Default PostgreSQL User:**
   * Checks if **POSTGRES\_USER** is empty and sets it to the default PostgreSQL user ('postgres') if it is.
4. **export DATABASE\_URL:**
   * Constructs the **DATABASE\_URL** environment variable using the provided PostgreSQL connection details.
5. **Python Block (python << END ... END):**
   * Uses a Python block to check if PostgreSQL is available. It attempts to connect to PostgreSQL in a loop, waiting until it succeeds or a specified timeout is reached.
6. **>&2 echo "PostgreSQL is available":**
   * Writes a message to standard error indicating that PostgreSQL is available.
7. **exec "$@":**
   * Executes the command passed to the entrypoint script. This allows flexibility in what command is run when the container starts.

start:

#!/bin/bash

set -o errexit

set -o pipefail

set -o nounset

python manage.py migrate --no-input

python manage.py collectstatic --no-input

exec python manage.py runserver 0.0.0.0:8000

**Explanation:**

1. **Shebang (#!/bin/bash):** Indicates that the script should be interpreted using Bash.
2. **set commands:**
   * **set -o errexit**: Causes the script to exit if any command it runs exits with a non-zero status.
   * **set -o pipefail**: Causes a pipeline to produce a failure return code if any command in the pipeline fails.
   * **set -o nounset**: Causes the script to exit if it tries to use an uninitialized variable.
3. **Database Migrations and Collecting Static Files:**
   * **python manage.py migrate --no-input**: Applies database migrations without prompting for input.
   * **python manage.py collectstatic --no-input**: Collects static files without prompting for input.
4. **exec python manage.py runserver 0.0.0.0:8000:**
   * Executes the Django development server, allowing external connections (**0.0.0.0:8000**).

These scripts are commonly used in the context of Docker containers to ensure that the necessary setup steps are performed when the container starts. The **entrypoint** script, in particular, is often used to handle any initialization tasks before the main application command is executed. The **start** script, in this case, is focused on starting the Django development server after performing necessary setup tasks.

local.yml:

version: "3.9"

services:

api:

build:

context: .

dockerfile: ./docker/local/django/Dockerfile

volumes:

- .:/app:z

- static\_volume:/app/staticfiles

- media\_volume:/app/mediafiles

ports:

- "8000:8000"

env\_file:

- ./.envs/.local/.django

- ./.envs/.local/.postgres

depends\_on:

- postgres

- mailhog

command: /start

networks:

- authors-api

postgres:

build:

context: .

dockerfile: ./docker/local/postgres/Dockerfile

volumes:

- local\_postgres\_data:/var/lib/postgresql/data

- local\_postgres\_data\_backups:/backups

env\_file:

- ./.envs/.local/.postgres

networks:

- authors-api

mailhog:

image: mailhog/mailhog:v1.0.0

container\_name: mailhog

ports:

- "8025:8025"

networks:

- authors-api

networks:

authors-api:

driver: bridge

volumes:

static\_volume:

media\_volume:

local\_postgres\_data: {}

local\_postgres\_data\_backups: {}

Explanation:

1. \*\*`version: "3.9"`\*\*: Specifies the version of the Docker Compose file format you're using. This version is associated with the features and syntax available in the file.

2. \*\*`services:`\*\*: Defines the services that make up your application.

- \*\*`api:`\*\*: Configuration for the Django API service.

- \*\*`build:`\*\*: Configuration for building the Docker image.

- \*\*`context: .`\*\*: The build context, the root directory for building the image. In this case, it's the current directory (`.`).

- \*\*`dockerfile: ./docker/local/django/Dockerfile`\*\*: Path to the Dockerfile for building the image.

- \*\*`volumes:`\*\*: Defines volumes to be mounted for the service.

- \*\*`- .:/app:z`\*\*: Mounts the current directory (`.`) to `/app` inside the container, with SELinux context `z`.

- \*\*`- static\_volume:/app/staticfiles`\*\*: Uses the named volume `static\_volume` for static files.

- \*\*`- media\_volume:/app/mediafiles`\*\*: Uses the named volume `media\_volume` for media files.

- \*\*`ports:`\*\*: Maps ports between the host and the container.

- \*\*`- "8000:8000"`\*\*: Maps port 8000 on the host to port 8000 on the container.

- \*\*`env\_file:`\*\*: Specifies environment files to load.

- \*\*`- ./.envs/.local/.django`\*\*: Path to the Django environment file.

- \*\*`- ./.envs/.local/.postgres`\*\*: Path to the PostgreSQL environment file.

- \*\*`depends\_on:`\*\*: Specifies services that this service depends on.

- \*\*`- postgres`\*\*: Depends on the PostgreSQL service.

- \*\*`- mailhog`\*\*: Depends on the MailHog service.

- \*\*`command: /start`\*\*: Overrides the default command to start the container.

- \*\*`networks:`\*\*: Specifies the networks the service should be connected to.

- \*\*`- authors-api`\*\*: Connects to the `authors-api` network.

- \*\*`postgres:`\*\*: Configuration for the PostgreSQL service.

- \*\*`build:`\*\*: Similar to the `api` service, specifies the build context and Dockerfile.

- \*\*`volumes:`\*\*: Defines volumes for PostgreSQL data and backups.

- \*\*`env\_file:`\*\*: Specifies the PostgreSQL environment file.

- \*\*`networks:`\*\*: Connects to the `authors-api` network.

- \*\*`mailhog:`\*\*: Configuration for the MailHog service.

- \*\*`image: mailhog/mailhog:v1.0.0`\*\*: Uses a pre-built MailHog image.

- \*\*`container\_name: mailhog`\*\*: Sets the container name to "mailhog".

- \*\*`ports:`\*\*: Maps port 8025 on the host to port 8025 on the container.

- \*\*`networks:`\*\*: Connects to the `authors-api` network.

3. \*\*`networks:`\*\*: Defines the networks used by the services.

- \*\*`authors-api:`\*\*: Configuration for the `authors-api` network.

- \*\*`driver: bridge`\*\*: Specifies the network driver as "bridge."

4. \*\*`volumes:`\*\*: Defines named volumes used by the services.

- \*\*`static\_volume:`\*\*, \*\*`media\_volume:`\*\*, \*\*`local\_postgres\_data:`\*\*, \*\*`local\_postgres\_data\_backups:`\*\*: Named volumes.

\*\*Command Explanation:\*\*

The `docker compose -f local.yml config` command is used to display the effective configuration that Docker Compose would use based on the specified `local.yml` file. It validates the file, substitutes variables if present, and prints the final configuration. This can be useful for checking if the configuration is correctly interpreted by Docker Compose before actually running the services.

BEFORE attempting to create container, need to run in terminal:

export DOCKER\_REFAULT\_PLATFORM=linux64/amd64

(only necessary for M1 and newer macs)

To build container, run:

docker compose -f local.yml up --build -d --remove-orphans