How To Set Up Laravel, Nginx, and MySQL with Docker Compose

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Introduction

Over the past few years, Docker has become a frequently used solution for deploying applications thanks to how it simplifies running and deploying applications in ephemeral containers. When using a LEMP application stack, for example, with PHP, Nginx, MySQL and the Laravel framework, Docker can significantly streamline the setup process.

Docker Compose has further simplified the development process by allowing developers to define their infrastructure, including application services, networks, and volumes, in a single file. Docker Compose offers an efficient alternative to running multiple `docker container create` and `docker container run` commands.

In this tutorial, you will build a web application using the Laravel framework, with Nginx as the web server and MySQL as the database, all inside Docker containers. You will define the entire stack configuration in a `docker-compose` file, along with configuration files for PHP, MySQL, and Nginx.

Prerequisites

Before you start, you will need:

- One Ubuntu 18.04 server, and a non-root user with `sudo` privileges. Follow the Initial Server Setup with Ubuntu 18.04 tutorial to set this

up.
- Docker installed, following Steps 1 and 2 of How To Install and Use Docker on Ubuntu 18.04.
- Docker Compose installed, following Step 1 of How To Install Docker Compose on Ubuntu 18.04.

Step 1 — Downloading Laravel and Installing Dependencies

As a first step, we will get the latest version of Laravel and install the dependencies for the project, including Composer, the application-level package manager for PHP. We will install these dependencies with Docker to avoid having to install Composer globally.

First, check that you are in your home directory and clone the latest Laravel release to a directory called `laravel-app`:

```
cd ~
git clone https://github.com/laravel/laravel.git laravel-app
```

Move into the `laravel-app` directory:

```
cd ~/laravel-app
```

Next, use Docker's `composer` image to mount the directories that you will need for your Laravel project and avoid the overhead of installing Composer globally:

```
docker run --rm -v $(pwd):/app composer install
```

Using the `-v` and `--rm` flags with `docker run` creates an ephemeral container that will be bind-mounted to your current directory before being removed. This will copy the contents of your `~/laravel-app` directory to the container and also ensure that the `vendor` folder Composer creates inside the container is copied to your current directory.

As a final step, set permissions on the project directory so that it is owned by your non-**root** user:

```
• sudo chown -R $USER:$USER ~/laravel-app
```

This will be important when you write the Dockerfile for your application image in Step 4, as it will allow you to work with your application code and run processes in your container as a non-**root** user.

With your application code in place, you can move on to defining your services with Docker Compose.

Step 2 — Creating the Docker Compose File

Building your applications with Docker Compose simplifies the process of setting up and versioning your infrastructure. To set up our Laravel application, we will write a `docker-compose` file that defines our web server, database, and application services.

Open the file:

```
• nano ~/laravel-app/docker-compose.yml
```

In the `docker-compose` file, you will define three services: `app`, `webserver`, and `db`. Add the following code to the file, being sure to replace the **root** password for `MYSQL_ROOT_PASSWORD`, defined as an environment variable under the `db` service, with a strong password of your choice:

~/laravel-app/docker-compose.yml

```
version: '3'
services:

  #PHP Service
  app:
    build:
      context: .
      dockerfile: Dockerfile
    image: digitalocean.com/php
    container_name: app
    restart: unless-stopped
    tty: true
    environment:
      SERVICE_NAME: app
      SERVICE_TAGS: dev
    working_dir: /var/www
    networks:
      - app-network

  #Nginx Service
  webserver:
    image: nginx:alpine
    container_name: webserver
    restart: unless-stopped
    tty: true
    ports:
      - "80:80"
      - "443:443"
    networks:
      - app-network

  #MySQL Service
  db:
    image: mysql:5.7.22
    container_name: db
    restart: unless-stopped
    tty: true
    ports:
      - "3306:3306"
    environment:
      MYSQL_DATABASE: laravel
      MYSQL_ROOT_PASSWORD: your_mysql_root_password
      SERVICE_TAGS: dev
      SERVICE_NAME: mysql
    networks:
      - app-network

#Docker Networks
networks:
  app-network:
    driver: bridge
```

The services defined here include:

- `app`: This service definition contains the Laravel application and runs a custom Docker image, `digitalocean.com/php`, that you will define in Step 4. It also sets the `working_dir` in the container to `/var/www`.
- `webserver`: This service definition pulls the `nginx:alpine` image from Docker and exposes ports `80` and `443`.
- `db`: This service definition pulls the `mysql:5.7.22` image from Docker and defines a few environmental variables, including a database called `laravel` for your application and the **root** password for the database. You are free to name the database whatever you would like, and you should replace `your_mysql_root_password` with your own strong password. This service definition also maps port `3306` on the host to port `3306` on the container.

Each `container_name` property defines a name for the container, which corresponds to the name of the service. If you don't define this property, Docker will assign a name to each container by combining a historically famous person's name and a random word separated by an underscore.

To facilitate communication between containers, the services are connected to a bridge network called `app-network`. A bridge network uses a software bridge that allows containers connected to the same bridge network to communicate with each other. The bridge driver automatically installs rules in the host machine so that containers on different bridge networks cannot communicate directly with each other. This creates a greater level of security for applications, ensuring that only related services can communicate with one another. It also means that you can define multiple networks and services connecting to related functions: front-end application services can use a `frontend` network, for example, and back-end services can use a `backend` network.

Let's look at how to add volumes and bind mounts to your service definitions to persist your application data.

Step 3 — Persisting Data

Docker has powerful and convenient features for persisting data. In our application, we will make use of *volumes* and *bind mounts* for persisting the database, and application and configuration files. Volumes offer flexibility for backups and persistence beyond a container's lifecycle, while bind mounts facilitate code changes during development, making changes to your host files or directories immediately available in your containers. Our setup will make use of both.

Warning: By using bind mounts, you make it possible to change the host filesystem through processes running in a container, including creating, modifying, or deleting important system files or directories. This is a powerful ability with security implications, and could impact non-Docker processes on the host system. Use bind mounts with care.

In the `docker-compose` file, define a volume called `dbdata` under the `db` service definition to persist the MySQL database:

~/laravel-app/docker-compose.yml

```
...
```

```
#MySQL Service
db:
  ...
    volumes:
      - dbdata:/var/lib/mysql
    networks:
      - app-network
  ...
```

The named volume `dbdata` persists the contents of the `/var/lib/mysql` folder present inside the container. This allows you to stop and restart the `db` service without losing data.

At the bottom of the file, add the definition for the `dbdata` volume:

~/laravel-app/docker-compose.yml

```
...
#Volumes
volumes:
  dbdata:
    driver: local
```

With this definition in place, you will be able to use this volume across services.

Next, add a bind mount to the `db` service for the MySQL configuration files you will create in Step 7:

~/laravel-app/docker-compose.yml

```
...
#MySQL Service
db:
  ...
    volumes:
      - dbdata:/var/lib/mysql
      - ./mysql/my.cnf:/etc/mysql/my.cnf
  ...
```

This bind mount binds `~/laravel-app/mysql/my.cnf` to `/etc/mysql/my.cnf` in the container.

Next, add bind mounts to the `webserver` service. There will be two: one for your application code and another for the Nginx configuration definition that you will create in Step 6:

~/laravel-app/docker-compose.yml

```
#Nginx Service
webserver:
  ...
  volumes:
      - ./:/var/www
      - ./nginx/conf.d/:/etc/nginx/conf.d/
  networks:
      - app-network
```

The first bind mount binds the application code in the `~/laravel-app` directory to the `/var/www` directory inside the container. The configuration file that you will add to `~/laravel-app/nginx/conf.d/` will also be mounted to `/etc/nginx/conf.d/` in the container, allowing you to add or modify the configuration directory's contents as needed.

Finally, add the following bind mounts to the `app` service for the application code and configuration files:

~/laravel-app/docker-compose.yml

```
#PHP Service
app:
  ...
  volumes:
       - ./:/var/www
       - ./php/local.ini:/usr/local/etc/php/conf.d/local.ini
  networks:
      - app-network
```

The `app` service is bind-mounting the `~/laravel-app` folder, which contains the application code, to the `/var/www` folder in the container. This will speed up the development process, since any changes made to your local application directory will be instantly reflected inside the container. You are also binding your PHP configuration file, `~/laravel-app/php/local.ini`, to `/usr/local/etc/php/conf.d/local.ini` inside the container. You will create the local PHP configuration file in Step 5.

Your `docker-compose` file will now look like this:

~/laravel-app/docker-compose.yml

```
version: '3'
services:

  #PHP Service
  app:
    build:
      context: .
      dockerfile: Dockerfile
    image: digitalocean.com/php
    container_name: app
    restart: unless-stopped
    tty: true
    environment:
      SERVICE_NAME: app
      SERVICE_TAGS: dev
    working_dir: /var/www
    volumes:
      - ./:/var/www
      - ./php/local.ini:/usr/local/etc/php/conf.d/local.ini
    networks:
      - app-network
  #Nginx Service
  webserver:
    image: nginx:alpine
    container_name: webserver
    restart: unless-stopped
    tty: true
    ports:
      - "80:80"
      - "443:443"
    volumes:
      - ./:/var/www
      - ./nginx/conf.d/:/etc/nginx/conf.d/
    networks:
      - app-network

  #MySQL Service
  db:
    image: mysql:5.7.22
    container_name: db
    restart: unless-stopped
    tty: true
    ports:
      - "3306:3306"
    environment:
      MYSQL_DATABASE: laravel
      MYSQL_ROOT_PASSWORD: your_mysql_root_password
      SERVICE_TAGS: dev
      SERVICE_NAME: mysql
    volumes:
      - dbdata:/var/lib/mysql/
      - ./mysql/my.cnf:/etc/mysql/my.cnf
    networks:
      - app-network

#Docker Networks
networks:
  app-network:
    driver: bridge
#Volumes
volumes:
  dbdata:
    driver: local
```

Save the file and exit your editor when you are finished making changes.

With your `docker-compose` file written, you can now build the custom image for your application.

Step 4 — Creating the Dockerfile

Docker allows you to specify the environment inside of individual containers with a *Dockerfile*. A Dockerfile enables you to create custom images that you can use to install the software required by your application and configure settings based on your requirements. You can push the custom images you create to Docker Hub or any private registry.

Our `Dockerfile` will be located in our `~/laravel-app` directory. Create the file:

```
• nano ~/laravel-app/Dockerfile
```

This `Dockerfile` will set the base image and specify the necessary commands and instructions to build the Laravel application image. Add the following code to the file:

~/laravel-app/php/Dockerfile

```
FROM php:7.2-fpm

# Copy composer.lock and composer.json
COPY composer.lock composer.json /var/www/

# Set working directory
WORKDIR /var/www

# Install dependencies
RUN apt-get update && apt-get install -y \
    build-essential \
    mysql-client \
    libpng-dev \
    libjpeg62-turbo-dev \
    libfreetype6-dev \
    locales \
    zip \
    jpegoptim optipng pngquant gifsicle \
    vim \
    unzip \
    git \
    curl

# Clear cache
RUN apt-get clean && rm -rf /var/lib/apt/lists/*

# Install extensions
RUN docker-php-ext-install pdo_mysql mbstring zip exif pcntl
RUN docker-php-ext-configure gd --with-gd --with-freetype-dir=/usr/include/
RUN docker-php-ext-install gd

# Install composer
RUN curl -sS https://getcomposer.org/installer | php -- --install-dir=/usr/

# Add user for laravel application
RUN groupadd -g 1000 www
RUN useradd -u 1000 -ms /bin/bash -g www www

# Copy existing application directory contents
COPY . /var/www

# Copy existing application directory permissions
COPY --chown=www:www . /var/www

# Change current user to www
USER www

# Expose port 9000 and start php-fpm server
EXPOSE 9000
CMD ["php-fpm"]
```

First, the Dockerfile creates an image on top of the `php:7.2-fpm` Docker image. This is a Debian-based image that has the PHP FastCGI implementation PHP-FPM installed. The file also installs the prerequisite packages for Laravel: `mcrypt`, `pdo_mysql`, `mbstring`, and `imagick` with `composer`.

The `RUN` directive specifies the commands to update, install, and configure settings inside the container, including creating a dedicated user and group called **www**. The `WORKDIR` instruction specifies the `/var/www` directory as the working directory for the application.

Creating a dedicated user and group with restricted permissions mitigates the inherent vulnerability when running Docker containers, which run by default as **root**. Instead of running this container as **root**, we've created the **www** user, who has read/write access to the `/var/www` folder thanks to the `COPY` instruction that we are using with the `--chown` flag to copy the application folder's permissions.

Finally, the `EXPOSE` command exposes a port in the container, `9000`, for the `php-fpm` server. `CMD` specifies the command that should run once the container is created. Here, `CMD` specifies `"php-fpm"`, which will start the server.

Save the file and exit your editor when you are finished making changes.

You can now move on to defining your PHP configuration.

Step 5 — Configuring PHP

Now that you have defined your infrastructure in the `docker-compose` file, you can configure the PHP service to act as a PHP processor for incoming requests from Nginx.

To configure PHP, you will create the `local.ini` file inside the `php` folder. This is the file that you bind-mounted to `/usr/local/etc/php/conf.d/local.ini` inside the container in Step 2. Creating this file will allow you to override the default `php.ini` file that

PHP reads when it starts.

Create the `php` directory:

```
• mkdir ~/laravel-app/php
```

Next, open the `local.ini` file:

```
• nano ~/laravel-app/php/local.ini
```

To demonstrate how to configure PHP, we'll add the following code to set size limitations for uploaded files:

~/laravel-app/php/local.ini

```
upload_max_filesize=40M
post_max_size=40M
```

The `upload_max_filesize` and `post_max_size` directives set the maximum allowed size for uploaded files, and demonstrate how you can set `php.ini` configurations from your `local.ini` file. You can put any PHP-specific configuration that you want to override in the `local.ini` file.

Save the file and exit your editor.

With your PHP `local.ini` file in place, you can move on to configuring Nginx.

Step 6 — Configuring Nginx

With the PHP service configured, you can modify the Nginx service to use PHP-FPM as the FastCGI server to serve dynamic content. The

FastCGI server is based on a binary protocol for interfacing interactive programs with a web server. For more information, please refer to this article on Understanding and Implementing FastCGI Proxying in Nginx.

To configure Nginx, you will create an `app.conf` file with the service configuration in the `~/laravel-app/nginx/conf.d/` folder.

First, create the `nginx/conf.d/` directory:

```
• mkdir -p ~/laravel-app/nginx/conf.d
```

Next, create the `app.conf` configuration file:

```
• nano ~/laravel-app/nginx/conf.d/app.conf
```

Add the following code to the file to specify your Nginx configuration:

~/laravel-app/nginx/conf.d/app.conf

```
server {
    listen 80;
    index index.php index.html;
    error_log  /var/log/nginx/error.log;
    access_log /var/log/nginx/access.log;
    root /var/www/public;
    location ~ \.php$ {
        try_files $uri =404;
        fastcgi_split_path_info ^(.+\.php)(/.+)$;
        fastcgi_pass app:9000;
        fastcgi_index index.php;
        include fastcgi_params;
        fastcgi_param SCRIPT_FILENAME $document_root$fastcgi_script_name;
        fastcgi_param PATH_INFO $fastcgi_path_info;
    }
    location / {
        try_files $uri $uri/ /index.php?$query_string;
        gzip_static on;
    }
}
```

The server block defines the configuration for the Nginx web server with the following directives:

- `listen`: This directive defines the port on which the server will listen to incoming requests.
- `error_log` and `access_log`: These directives define the files for writing logs.
- `root`: This directive sets the root folder path, forming the complete path to any requested file on the local file system.

In the `php` location block, the `fastcgi_pass` directive specifies that the `app` service is listening on a TCP socket on port `9000`. This makes the PHP-FPM server listen over the network rather than on a Unix socket. Though a Unix socket has a slight advantage in speed over a TCP socket, it does not have a network protocol and thus skips the network stack. For cases where hosts are located on one machine, a Unix socket may make sense, but in cases where you have services running on different hosts, a TCP socket offers the advantage of allowing you to connect to distributed services. Because our `app` container is running on a different host from our `webserver` container, a TCP socket makes the most sense for our configuration.

Save the file and exit your editor when you are finished making changes.

Thanks to the bind mount you created in Step 2, any changes you make inside the `nginx/conf.d/` folder will be directly reflected inside the `webserver` container.

Next, let's look at our MySQL settings.

Step 7 — Configuring MySQL

With PHP and Nginx configured, you can enable MySQL to act as the database for your application.

To configure MySQL, you will create the `my.cnf` file in the `mysql` folder. This is the file that you bind-mounted to `/etc/mysql/my.cnf` inside the container in Step 2. This bind mount allows you to override the `my.cnf` settings as and when required.

To demonstrate how this works, we'll add settings to the `my.cnf` file that enable the general query log and specify the log file.

First, create the `mysql` directory:

```
mkdir ~/laravel-app/mysql
```

Next, make the `my.cnf` file:

```
nano ~/laravel-app/mysql/my.cnf
```

In the file, add the following code to enable the query log and set the log file location:

~/laravel-app/mysql/my.cnf

```
[mysqld]
general_log = 1
general_log_file = /var/lib/mysql/general.log
```

This `my.cnf` file enables logs, defining the `general_log` setting as `1` to allow general logs. The `general_log_file` setting specifies where the logs will be stored.

Save the file and exit your editor.

Our next step will be to start the containers.

Step 8 — Running the Containers and Modifying Environment Settings

Now that you have defined all of your services in your `docker-compose` file and created the configuration files for these services, you can start the containers. As a final step, though, we will make a copy of the `.env.example` file that Laravel includes by default and name the copy `.env`, which is the file Laravel expects to define its environment:

```
cp .env.example .env
```

We will configure the specific details of our setup in this file once we have started the containers.

With all of your services defined in your `docker-compose` file, you just need to issue a single command to start all of the containers, create the volumes, and set up and connect the networks:

```
docker-compose up -d
```

When you run `docker-compose up` for the first time, it will download all of the necessary Docker images, which might take a while. Once the images are downloaded and stored in your local machine, Compose will create your containers. The `-d` flag daemonizes the process, running your containers in the background.

Once the process is complete, use the following command to list all of the running containers:

```
• docker ps
```

You will see the following output with details about your `app`, `webserver`, and `db` containers:

```
Output

CONTAINER ID        NAMES               IMAGE                             S
c31b7b3251e0        db                  mysql:5.7.22                      U
ed5a69704580        app                 digitalocean.com/php              U
5ce4ee31d7c0        webserver           nginx:alpine                      U
```

The `CONTAINER ID` in this output is a unique identifier for each container, while `NAMES` lists the service name associated with each. You can use both of these identifiers to access the containers. `IMAGE` defines the image name for each container, while `STATUS` provides information about the container's state: whether it's running, restarting, or stopped.

You can now modify the `.env` file on the `app` container to include specific details about your setup.

Open the file using `docker-compose exec`, which allows you to run specific commands in containers. In this case, you are opening the file for editing:

```
• docker-compose exec app nano .env
```

Find the block that specifies `DB_CONNECTION` and update it to reflect the specifics of your setup. You will modify the following fields:

- `DB_HOST` will be your `db` database container.
- `DB_DATABASE` will be the `laravel` database.
- `DB_USERNAME` will be the username you will use for your database. In this case, we will use `laraveluser`.
- `DB_PASSWORD` will be the secure password you would like to use for this user account.

/var/www/.env

```
DB_CONNECTION=mysql
DB_HOST=db
DB_PORT=3306
DB_DATABASE=laravel
DB_USERNAME=laraveluser
DB_PASSWORD=your_laravel_db_password
```

Save your changes and exit your editor.

Next, set the application key for the Laravel application with the `php artisan key:generate` command. This command will generate a key and copy it to your `.env` file, ensuring that your user sessions and encrypted data remain secure:

```
• docker-compose exec app php artisan key:generate
```

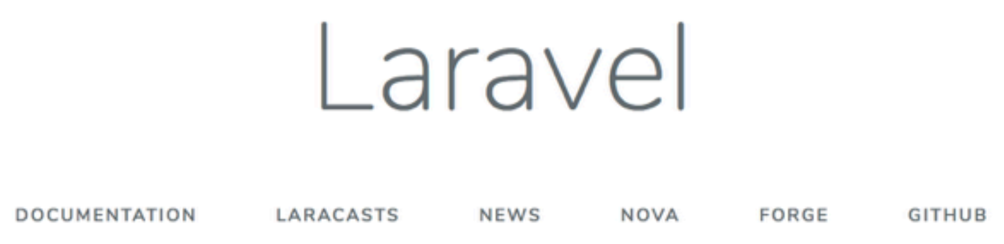
You now have the environment settings required to run your application. To cache these settings into a file, which will boost your application's load speed, run:

```
• docker-compose exec app php artisan config:cache
```

Your configuration settings will be loaded into

`/var/www/bootstrap/cache/config.php` on the container.

As a final step, visit `http://your_server_ip` in the browser. You will see the following home page for your Laravel application:



With your containers running and your configuration information in place, you can move on to configuring your user information for the `laravel` database on the `db` container.

Step 9 — Creating a User for MySQL

The default MySQL installation only creates the **root** administrative account, which has unlimited privileges on the database server. In general, it's better to avoid using the **root** administrative account when interacting with the database. Instead, let's create a dedicated database user for our application's Laravel database.

To create a new user, execute an interactive bash shell on the `db` container with `docker-compose exec`:

```
• docker-compose exec db bash
```

Inside the container, log into the MySQL **root** administrative account:

```
• mysql -u root -p
```

You will be prompted for the password you set for the MySQL **root** account during installation in your `docker-compose` file.

Start by checking for the database called `laravel`, which you defined in your `docker-compose` file. Run the `show databases` command to check for existing databases:

```
• show databases;
```

You will see the `laravel` database listed in the output:

```
Output

+--------------------+
| Database           |
+--------------------+
| information_schema |
| laravel            |
| mysql              |
| performance_schema |
| sys                |
+--------------------+
5 rows in set (0.00 sec)
```

Next, create the user account that will be allowed to access this database. Our username will be `laraveluser`, though you can replace this with another name if you'd prefer. Just be sure that your username and password here match the details you set in your `.env` file in the previous step:

```
• GRANT ALL ON laravel.* TO 'laraveluser'@'%' IDENTIFIED BY 'your_larave
```

Flush the privileges to notify the MySQL server of the changes:

```
• FLUSH PRIVILEGES;
```

Exit MySQL:

```
• EXIT;
```

Finally, exit the container:

```
• exit
```

You have configured the user account for your Laravel application database and are ready to migrate your data and work with the Tinker console.

Step 10 — Migrating Data and Working with the Tinker Console

With your application running, you can migrate your data and experiment with the `tinker` command, which will initiate a *PsySH* console with Laravel preloaded. PsySH is a runtime developer console and interactive debugger for PHP, and Tinker is a REPL specifically for Laravel. Using the `tinker` command will allow you to interact with your Laravel application from the command line in an interactive shell.

First, test the connection to MySQL by running the Laravel `artisan migrate` command, which creates a `migrations` table in the database from inside the container:

```
• docker-compose exec app php artisan migrate
```

This command will migrate the default Laravel tables. The output confirming the migration will look like this:

```
Output

Migration table created successfully.
Migrating: 2014_10_12_000000_create_users_table
Migrated:  2014_10_12_000000_create_users_table
Migrating: 2014_10_12_100000_create_password_resets_table
Migrated:  2014_10_12_100000_create_password_resets_table
```

Once the migration is complete, you can run a query to check if you are properly connected to the database using the `tinker` command:

```
• docker-compose exec app php artisan tinker
```

Test the MySQL connection by getting the data you just migrated:

```
• \DB::table('migrations')->get();
```

You will see output that looks like this:

```
Output

=> Illuminate\Support\Collection {#2856
     all: [
       {#2862
         +"id": 1,
         +"migration": "2014_10_12_000000_create_users_table",
         +"batch": 1,
       },
       {#2865
         +"id": 2,
         +"migration": "2014_10_12_100000_create_password_resets_table",
         +"batch": 1,
       },
     ],
   }
```

You can use `tinker` to interact with your databases and to experiment with services and models.

With your Laravel application in place, you are ready for further development and experimentation.

Conclusion

You now have a LEMP stack application running on your server, which you've tested by accessing the Laravel welcome page and creating MySQL database migrations.

Key to the simplicity of this installation is Docker Compose, which allows you to create a group of Docker containers, defined in a single file, with a single command. If you would like to learn more about how to do CI with Docker Compose, take a look at How To Configure a Continuous Integration Testing Environment with Docker and Docker Compose on Ubuntu 16.04. If you want to streamline your Laravel application deployment process then How to Automatically Deploy Laravel Applications with Deployer on Ubuntu 16.04 will be a relevant resource.