

# **API with CodeIgniter4 and Containerization with Docker**

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# Understanding RESTful APIs

## Introduction to RESTful architecture

REST (Representational State Transfer) is an architectural style for designing networked applications. It relies on a stateless, client-server communication model, often over HTTP. Key aspects include:

- **Stateless Communication:** Each request from a client to a server must contain all the information needed to understand and complete the request. The server doesn't store client state.
- **Resource-Oriented:** RESTful services focus on resources, identifiable by URIs (Uniform Resource Identifiers).
- **Uniform Interface:** RESTful APIs use consistent conventions and methods across the API, making them easier to understand and work with.

## HTTP methods (GET, POST, PUT, PATCH, DELETE)

HTTP methods define the operations you can perform on a resource. Here's how each is typically used:

- **GET:** Retrieve data from the server. It's safe and idempotent (repeated calls don't change the resource).
- **POST:** Create a new resource. This method is not idempotent, as calling it multiple times can create multiple resources.
- **PUT:** Update a resource by replacing it entirely. It's idempotent.
- **PATCH:** Partially update a resource, only changing the specified fields.
- **DELETE:** Remove a resource from the server.

## RESTful API design principles

RESTful APIs are based on certain design principles to ensure consistency and usability:

- ✓ **Statelessness:** Ensures that each request is independent and does not rely on previous requests.
- ✓ **Client-Server Architecture:** Separates user interface from data storage, allowing each to evolve independently.
- ✓ **Cacheability:** Responses must explicitly indicate if they're cacheable or not to improve performance.
- ✓ **Layered System:** Clients cannot tell if they're directly connected to the end server, allowing for intermediary servers to improve scalability.

## Common API design patterns

To enhance the functionality and usability of RESTful APIs, these design patterns are commonly used:

- ✓ **Noun-based URIs:** Resources are defined as nouns (e.g., /users, /orders) rather than verbs.
- ✓ **Hierarchical URIs:** Resource relationships are shown in URIs, like /users/{user\_id}/orders/{order\_id}.
- ✓ **Versioning:** API versions should be explicitly included in the URI (e.g., /v1/users).
- ✓ **Error Handling:** Use standard HTTP status codes (e.g., 404 for "Not Found", 500 for server errors) with detailed messages.

# Introduction to CodeIgniter 4

## Overview of CodeIgniter 4

CodeIgniter 4 is a PHP-based MVC framework known for its lightweight and straightforward approach. It's designed to simplify the development of web applications by providing a clear structure and efficient tools. Key features include:

- ✓ MVC Architecture: Separation of logic, presentation, and data in applications.
- ✓ Lightweight: Suitable for small-to-medium applications with low server overhead.
- ✓ Extensive Libraries: CodeIgniter provides libraries to handle tasks like sessions, file uploads, and form validation.

## Installation and setup

### Step-by-Step Installation

1. System Requirements: Ensure you have PHP 7.2 (or higher) and Composer installed.
2. Download CodeIgniter: Open your terminal and navigate to the folder where you want to set up the project. Use Composer to install CodeIgniter 4 by running:

```
composer create-project codeigniter4/appstarter myproject
```

\*This will create a folder named myproject with all CodeIgniter files.

3. Configuration:

Go to the myproject directory:

```
cd myproject
```

Open the .env file and rename it from env to .env.

```
Set CI_ENVIRONMENT = development in .env to enable development mode for better debugging.
```

Run the Application: Start the server to ensure everything is set up properly:

```
php spark serve
```

\*Access the project at <http://localhost:8080> to see the default CodeIgniter welcome page.

## Project structure and MVC architecture

CodeIgniter's folder structure and how it fits into the MVC (Model-View-Controller) framework:

- app: Contains all application code.
  - Controllers: Code for request handling logic.
  - Models: Handles data logic, typically communicating with the database.
  - Views: Contains the HTML, CSS, and JavaScript for presenting data to users.
- public: Contains assets like images, JavaScript, and CSS files.
- writable: Stores cache, session data, and logs.

In CodeIgniter's MVC:

- Controllers manage incoming requests and communicate with Models.
- Models retrieve data from the database.
- Views display data and the user interface.

# Routing in CodeIgniter 4

Routing defines how URLs map to controllers and actions.

## Step-by-Step Demonstration of Routing

1. Open app/Config/Routes.php.
2. Define a new route to point to a controller and a method:

```
$routes->get('hello', 'HelloController::index');
```

\*This means when users access <http://localhost:8080/hello>, it will route to the index method of HelloController.

3. Custom Route: You can create routes with parameters as well:

```
$routes->get('user/(:num)', 'UserController::profile/$1');
```

\*Here, (:num) allows only numbers in the URL, and \$1 passes this number to the profile method of UserController. Other route parameters we can use are :any, :alphanumeric, :segment, :num, :any?

## Controllers and views

1. Create a Controller:  
In the app/Controllers folder, create a file named HelloController.php with the following content:

### ***HelloController.php***

```
<?php

namespace App\Controllers;

class HelloController extends BaseController
{
    public function index()
    {
        return view('hello');
    }
}
```

\*This controller has an index method that loads a view named hello.

2. Create a View:  
In the app/Views folder, create a file named hello.php.

### ***hello.php***

```
<h1>Hello, CodeIgniter 4!</h1>
<p>Welcome to your first view.</p>
```

Access the View:

```
http://localhost:8080/hello
```

# Using Spark CLI

## Display All Make Commands

```
php spark help make:controller
```

## Basic Controller Generation

```
php spark make:controller ControllerName
```

## Generate a RESTful Controller

If you want to create a controller for a RESTful API, you can use the `--restful` option. This will generate a controller with REST methods (index, show, create, update, and delete).

```
php spark make:controller ApiController --restful
```

## Generate a Resource Controller

A resource controller is similar to a RESTful controller but is designed for CRUD operations in a more specific way, including standard naming conventions for methods. Use the `--resource` option to generate this type:

```
php spark make:controller ProductController --resource
```

## Generate Controller with Namespace

If you want your controller to be placed in a custom namespace, use the `--namespace` option:

```
php spark make:controller Admin/Dashboard --namespace App\Controllers\Admin
```

## Basic Model Generation

```
php spark make:model ModelName
```

## Generate a Model with Database Table Name

If you want to specify the table name for your model right away, you can use the `-table` option. This is particularly useful when your table name does not match the model name.

```
php spark make:model Product -table products
```

## Generate a Model with Timestamps and Soft Deletes

To create a model that includes timestamps (`created_at`, `updated_at`) and soft deletes (`deleted_at`), you can use the `-suffix` and `--softDeletes` options.

```
php spark make:model Product -suffix -softDeletes
```

This will:

- Suffix the class name with Model (e.g., `ProductModel`).
- Enable soft deletes within the model by setting the `useSoftDeletes` property to true.

## Generate a Model with Namespace

If you want to organize your model into a specific namespace, you can specify it with the `--namespace` option:

```
php spark make:model Admin/Product --namespace App\Models\Admin
```

## Generate a Model with Multiple Options

Here's a more comprehensive example combining several options:

```
php spark make:model User -table users -suffix -softDeletes --namespace App\Models\Admin
```

This command will:

- Create a UserModel.php file in the app/Models/Admin directory.
- Set the \$table property to users.
- Enable soft deletes.

### Example 1: Static Pages

1. Goal: Set up routes to serve static pages like "About" and "Contact."
2. Routing

Open app/Config/Routes.php.

```
$routes->get('about', 'PagesController::about');  
$routes->get('contact', 'PagesController::contact');
```

3. Controller

In app/Controllers, create a new file called PagesController.php.

```
<?php  
namespace App\Controllers;  
  
class PagesController extends BaseController  
{  
    public function about()  
    {  
        return view('about');  
    }  
  
    public function contact()  
    {  
        return view('contact');  
    }  
}
```

4. Views

In app/Views, create two files: about.php and contact.php.

#### **about.php:**

```
<h1>About Us</h1>  
<p>This is the about page.</p>
```

#### **contact.php:**

```
<h1>Contact Us</h1>  
<p>This is the contact page.</p>
```

\*Access these pages via <http://localhost:8080/about> and <http://localhost:8080/contact>.



### Example 2: Passing Parameters to Controllers

1. Goal: Display a user profile by ID.

2. Routing

In app/Config/Routes.php, add:

```
$routes->get('user/(:num)', 'UserController::profile/$1');
```

3. Controller

In app/Controllers, create UserController.php.

Define the profile method to receive the user ID:

```
<?php
namespace App\Controllers;

class UserController extends BaseController
{
    public function profile($id)
    {
        return view('user_profile', ['id' => $id]);
    }
}
```

4. View

In app/Views, create user\_profile.php.

Add content to display the user ID:

```
<h1>User Profile</h1>
<p>User ID: <?= esc($id) ?></p>
```

\*Access this page with <http://localhost:8080/user/1> (or any other ID).

### Example 3: Multiple Parameters in Routes

1. Goal: Show a blog post by category and post ID.

2. Routing

In app/Config/Routes.php, add:

```
$routes->get('blog/(:any)/(:num)', 'BlogController::post/$1/$2');
```

3. Controller

In app/Controllers, create BlogController.php.

Define the post method to handle the category and ID:

```
<?php
namespace App\Controllers;

class BlogController extends BaseController
{
    public function post($category, $id)
    {
        return view('blog_post', ['category' => $category, 'id' => $id]);
    }
}
```

#### 4. View

In app/Views, create blog\_post.php.

Add content to display the category and post ID:

```
<h1>Blog Post</h1>
<p>Category: <?= esc($category) ?></p>
<p>Post ID: <?= esc($id) ?></p>
```

\*Access this page with <http://localhost:8080/blog/technology/1>.

### Example 4: POST Request Handling

#### 1. Goal: Process a contact form submission.

#### 2. Routing

In app/Config/Routes.php, add:

```
$routes->get('contact', 'ContactController::form');
$routes->post('contact', 'ContactController::submit');
```

#### 3. Controller

In app/Controllers, create ContactController.php.

Define form to show the form and submit to handle form data:

```
<?php
namespace App\Controllers;

class ContactController extends BaseController
{
    public function form()
    {
        return view('contact_form');
    }

    public function submit()
    {
        $name = $this->request->getPost('name');
        $email = $this->request->getPost('email');
        return view('contact_success', ['name' => $name, 'email' => $email]);
    }
}
```

#### 4. Views

In app/Views, create contact\_form.php:

```
<form method="post" action="/contact">
    <input type="text" name="name" placeholder="Your Name">
    <input type="email" name="email" placeholder="Your Email">
    <button type="submit">Submit</button>
</form>
```

Create contact\_success.php to display the submitted data:

```
<h1>Thank You!</h1>
<p>Name: <?= esc($name) ?></p>
<p>Email: <?= esc($email) ?></p>
```

\*Access the form at <http://localhost:8080/contact> and submit it to see the success page.

### Example 5: Redirecting Routes

1. Goal: Redirect the user from an old URL to a new one.
2. Routing

In app/Config/Routes.php, use:

```
$routes->get('old-page', 'RedirectController::oldPage');  
$routes->get('new-page', 'RedirectController::newPage');
```

3. Controller

In app/Controllers, create RedirectController.php.

Define the methods:

```
<?php  
namespace App\Controllers;  
  
class RedirectController extends BaseController  
{  
    public function oldPage()  
    {  
        return redirect()->to('/new-page');  
    }  
  
    public function newPage()  
    {  
        return view('new_page');  
    }  
}
```

4. View

In app/Views, create new\_page.php:

```
<h1>New Page</h1>  
<p>Welcome to the new page!</p>
```

\*Access <http://localhost:8080/old-page>, and you will be redirected to /new-page.

### Example 6: Route Grouping

1. Goal: Group related routes under a common prefix, such as for an admin dashboard.
2. Routing. In app/Config/Routes.php, define a route group with a prefix:

```
$routes->group('admin', function($routes) {  
    $routes->get('dashboard', 'AdminController::dashboard');  
    $routes->get('users', 'AdminController::users');  
    $routes->get('settings', 'AdminController::settings');  
});
```

3. Controller

In app/Controllers, create AdminController.php. Define methods for each route:

```
<?php  
namespace App\Controllers;  
  
class AdminController extends BaseController
```

```
{
    public function dashboard()
    {
        return view('admin/dashboard');
    }

    public function users()
    {
        return view('admin/users');
    }

    public function settings()
    {
        return view('admin/settings');
    }
}
```

#### 4. Views

In app/Views, create an admin folder and add three files: dashboard.php, users.php, and settings.php.

##### **dashboard.php:**

```
<h1>Admin Dashboard</h1>
<p>Welcome to the dashboard.</p>
```

##### **users.php:**

```
<h1>User Management</h1>
<p>Manage your users here.</p>
```

##### **settings.php:**

```
<h1>Settings</h1>
<p>Manage application settings here.</p>
```

\*Access these pages at <http://localhost:8080/admin/dashboard>, <http://localhost:8080/admin/users>, and <http://localhost:8080/admin/settings>.

### **Example 7: Custom Error Page**

1. Goal: Define a custom 404 error page for undefined routes.
2. Routing

In app/Config/Routes.php, add a custom 404 override:

```
$routes->set404Override('ErrorController::show404');
```

3. Controller

In app/Controllers, create ErrorController.php. Define the show404 method:

```
<?php
namespace App\Controllers;

class ErrorController extends BaseController
{
    public function show404()
    {
```

```
        return view('errors/custom_404');
    }
}
```

#### 4. View

In app/Views/errors, create custom\_404.php:

```
<h1>404 - Page Not Found</h1>
<p>Sorry, the page you are looking for does not exist.</p>
```

\*Now, if a user visits an undefined route like <http://localhost:8080/nonexistent>, they will see your custom 404 page.

### Example 8: RESTful Controller for CRUD Operations

1. Goal: Set up a RESTful controller to handle basic CRUD operations for a "Product" resource.
2. Routing

In app/Config/Routes.php, define RESTful routes:

```
$routes->resource('product');
```

\*This will automatically create routes for index, show, create, update, and delete methods.

#### 3. Controller

In app/Controllers, create ProductController.php and extend ResourceController:

```
<?php
namespace App\Controllers;

use CodeIgniter\RESTful\ResourceController;

class ProductController extends ResourceController
{
    public function index()
    {
        return view('product/index');
    }

    public function show($id = null)
    {
        return view('product/show', ['id' => $id]);
    }

    public function create()
    {
        return view('product/create');
    }

    public function update($id = null)
    {
        return view('product/edit', ['id' => $id]);
    }

    public function delete($id = null)
    {

```

```
        return redirect()->to('/product');
    }
}
```

#### 4. Views

In app/Views/product, create four views: index.php, show.php, create.php, and edit.php.

##### ***index.php:***

```
<h1>All Products</h1>
```

##### ***show.php:***

```
<h1>Product Details</h1>
<p>Product ID: <?= esc($id) ?></p>
```

##### ***create.php:***

```
<h1>Create New Product</h1>
```

##### ***edit.php:***

```
<h1>Edit Product</h1>
<p>Product ID: <?= esc($id) ?></p>
```

\*Access <http://localhost:8080/product> to view these CRUD operations in action.

### **Example 9: Optional Route Parameters**

1. Goal: Set up a route with an optional parameter.
2. Routing

In app/Config/Routes.php, define a route with an optional id parameter:

```
$routes->get('post/(:num)?', 'PostController::view/$1');
```

#### 3. Controller

In app/Controllers, create PostController.php.

Define the view method to handle cases with and without an ID:

```
<?php
namespace App\Controllers;

class PostController extends BaseController
{
    public function view($id = null)
    {
        if ($id) {
            return view('post/single', ['id' => $id]);
        }
        return view('post/all');
    }
}
```

#### 4. Views

In app/Views/post, create all.php and single.php.

##### ***all.php:***

```
<h1>All Posts</h1>
<p>Listing all blog posts here.</p>
```

##### ***single.php:***

```
<h1>Post Details</h1>
<p>Post ID: <?= esc($id) ?></p>
```

\*Access <http://localhost:8080/post> to see all posts, or <http://localhost:8080/post/1> to view a specific post.

### **Example 10: Route Constraints**

1. Goal: Set up a route with constraints to allow only numeric IDs.

2. Routing

In app/Config/Routes.php, define a route with constraints:

```
$routes->get('article/(:num)', 'ArticleController::view/$1', ['as' => 'article_view']);
```

3. Controller

In app/Controllers, create ArticleController.php. Define the view method:

```
<?php
namespace App\Controllers;

class ArticleController extends BaseController
{
    public function view($id)
    {
        return view('article/view', ['id' => $id]);
    }
}
```

4. View

In app/Views/article, create view.php:

```
<h1>Article Details</h1>
<p>Article ID: <?= esc($id) ?></p>
```

\*Access this with a numeric ID, e.g., <http://localhost:8080/article/10>.

## **Building Basic RESTful APIs with CodeIgniter 4**

### **Creating basic CRUD (Create, Read, Update, Delete) operations**

We'll create CRUD operations for a "Product" resource.

#### **Step 1: Setting up the Database**

Create a products table in your database with the following SQL:

```
CREATE TABLE products (
    id INT AUTO_INCREMENT PRIMARY KEY,
    name VARCHAR(100),
    description TEXT,
```

```
price DECIMAL(10,2)
);
```

### Step 2: Configure Database Connection

Open app/Config/Database.php and set your database credentials.

### Step 3: Create a Model

In app/Models, create ProductModel.php:

```
<?php
namespace App\Models;

use CodeIgniter\Model;

class ProductModel extends Model
{
    protected $table = 'products';
    protected $allowedFields = ['name', 'description', 'price'];
}
```

### Step 4: Create a Controller

In app/Controllers, create ProductController.php:

```
<?php
namespace App\Controllers;

use App\Models\ProductModel;

class ProductController extends BaseController
{
    public function index()
    {
        $model = new ProductModel();
        $data['products'] = $model->findAll();
        return view('product/index', $data);
    }

    public function create()
    {
        return view('product/create');
    }

    public function store()
    {
        $model = new ProductModel();
        $model->save($this->request->getPost());
        return redirect()->to('/product');
    }
}
```



```

public function edit($id)
{
    $model = new ProductModel();
    $data['product'] = $model->find($id);
    return view('product/edit', $data);
}

public function update($id)
{
    $model = new ProductModel();
    $model->update($id, $this->request->getPost());
    return redirect()->to('/product');
}

public function delete($id)
{
    $model = new ProductModel();
    $model->delete($id);
    return redirect()->to('/product');
}
}

```

### Step 5: Create Views

In app/Views/product, create:

- index.php for listing products.
- create.php for adding a product.
- edit.php for editing a product.

You can now access CRUD functionality by navigating to routes like /product, /product/create, and /product/edit/{id}.

## Handling HTTP requests and responses

### Example 1: Retrieving Data with GET

Define a route:

```
$routes->get('product', 'ProductController::index');
```

Use GET to retrieve data:

```
$data = $this->request->getGet();
```

### Example 2: Submitting Data with POST

Define a route:

```
$routes->post('product/store', 'ProductController::store');
```

Access POST data:

```
$name = $this->request->getPost('name');
```

### Example 3: JSON Response

```
return $this->response->setJSON(['message' => 'Success']);
```

### Example 4: Redirect

```
return redirect()->to('/product');
```

### Example 5: Sending HTTP Status Codes

```
return $this->response->setStatusCode(404, 'Product Not Found');
```

### Example 6: Handling Query Parameters in GET Requests

In CodeIgniter, you can capture query parameters from a URL, such as `?page=1&category=tech`.

Define a Route:

```
$routes->get('articles', 'ArticleController::index');
```

Controller Method: In `app/Controllers/ArticleController.php`, capture the query parameters using `$this->request->getGet()`:

```
<?php
namespace App\Controllers;

class ArticleController extends BaseController
{
    public function index()
    {
        $page = $this->request->getGet('page'); // e.g., 1
        $category = $this->request->getGet('category'); // e.g., tech

        return view('articles/index', ['page' => $page, 'category' => $category]);
    }
}
```

View: Display the parameters in `app/Views/articles/index.php`:

```
<h1>Articles</h1>
<p>Page: <?= esc($page) ?></p>
<p>Category: <?= esc($category) ?></p>
```

\*Access it with `http://localhost:8080/articles?page=1&category=tech`.

### Example 7: Handling File Uploads in POST Requests

Define a Route:

```
$routes->post('upload', 'FileController::upload');
```

Controller Method: In `app/Controllers/FileController.php`, handle file upload using `$this->request->getFile()`:

```
<?php
namespace App\Controllers;

class FileController extends BaseController
{
```

```

public function upload()
{
    $file = $this->request->getFile('userfile');

    if ($file->isValid() && !$file->hasMoved()) {
        $file->move(WRITEPATH . 'uploads');
        return $this->response->setJSON(['message' => 'File uploaded successfully']);
    } else {
        return $this->response->setStatusCode(400, 'Failed to upload file');
    }
}
}

```

HTML Form: In a view (e.g., app/Views/upload.php), add a form to upload files:

```

<form method="post" action="/upload" enctype="multipart/form-data">
    <input type="file" name="userfile">
    <button type="submit">Upload</button>
</form>

```

\*Access the form at <http://localhost:8080/upload>.

### Example 8: Handling PUT Requests for Resource Updates

To handle a PUT request (often used for updates), use CodeIgniter's put() method.

Define a Route:

```

$routes->put('product/update/(:num)', 'ProductController::update/$1');

```

Controller Method: In app/Controllers/ProductController.php, use \$this->request->getRawInput() for data in the PUT request:

```

<?php
namespace App\Controllers;

use App\Models\ProductModel;

class ProductController extends BaseController
{
    public function update($id)
    {
        $model = new ProductModel();
        $data = $this->request->getRawInput();

        if ($model->update($id, $data)) {
            return $this->response->setJSON(['message' => 'Product updated successfully']);
        } else {
            return $this->response->setStatusCode(400, 'Failed to update product');
        }
    }
}

```

\*This handles JSON data sent with a PUT request for updating a product.

### Example 9: Custom HTTP Headers

You can handle and send custom headers in the response to control caching, security, and content type.

Define a Route:

```
$routes->get('custom-headers', 'HeaderController::index');
```

Controller Method: In app/Controllers/HeaderController.php, add custom headers to the response:

```
<?php
namespace App\Controllers;

class HeaderController extends BaseController
{
    public function index()
    {
        $this->response->setHeader('Cache-Control', 'no-store, no-cache, must-revalidate');
        $this->response->setHeader('X-Content-Type-Options', 'nosniff');
        $this->response->setHeader('X-Frame-Options', 'DENY');
        return $this->response->setJSON(['message' => 'Custom headers added']);
    }
}
```

\*Access this at <http://localhost:8080/custom-headers> and inspect the headers in your browser's network tools.

### Example 10: Handling JSON Requests and Responses

CodeIgniter allows handling JSON data in requests, often used with REST APIs.

Define a Route:

```
$routes->post('api/product', 'ApiController::createProduct');
```

Controller Method: In app/Controllers/ApiController.php, capture JSON input with `$this->request->getJSON()`:

```
<?php
namespace App\Controllers;

use App\Models\ProductModel;

class ApiController extends BaseController
{
    public function createProduct()
    {
        $model = new ProductModel();
        $json = $this->request->getJSON();

        $data = [
            'name' => $json->name,
            'description' => $json->description,
            'price' => $json->price,
        ];

        if ($model->save($data)) {
```

```

        return $this->response->setStatusCode(201)->setJSON(['message' => 'Product created']);
    } else {
        return $this->response->setStatusCode(400)->setJSON(['message' => 'Failed to create product']);
    }
}
}
}

```

\*This allows for handling JSON data in the request and sending JSON responses.

## Implementing data validation and error handling

### Step 1: Define Validation Rules

In `app/Controllers/ProductController.php`, use:

```

$rules = [
    'name' => 'required|min_length[3]',
    'price' => 'required|decimal',
];

```

### Step 2: Apply Validation

Add to store and update methods:

```

if (!$this->validate($rules)) {
    return view('product/create', [
        'validation' => $this->validator
    ]);
}

```

### Step 3: Display Errors in the View

In `create.php`, show errors:

```

<?php if (isset($validation)): ?>
    <div><?= $validation->listErrors() ?></div>
<?php endif; ?>

```

### Step 4: Custom Error Messages

Customize in `app/Language/en/Validation.php`.

#### List of validation rules and what each does:

##### 1. Basic Validation Rules

- `required`: The field must not be empty.
- `matches[field_name]`: Ensures that the input value matches the value of another field (e.g., `matches[password_confirm]`).
- `differs[field_name]`: Ensures that the input value differs from the value of another field.
- `is_unique[table.field]`: Ensures the value is unique in a specified database table and field (e.g., `is_unique[users.email]`).
- `min_length[length]`: Ensures the field is at least a specified number of characters long.
- `max_length[length]`: Ensures the field does not exceed a specified number of characters.
- `exact_length[length]`: Ensures the field is exactly a specified number of characters.
- `in_list[item1,item2,...]`: Ensures the value is one of the items in a specified list.
- `alpha`: Allows only alphabetic characters (a–z, A–Z).
- `alpha_numeric`: Allows only alphabetic and numeric characters.
- `alpha_numeric_space`: Allows only alphabetic, numeric, and space characters.

- `alpha_dash`: Allows only alphabetic characters, underscores, and dashes.
- `alpha_numeric_punct`: Allows alphanumeric characters and commonly used punctuation (e.g., `~!#$%&*-_+=|:|.).`
- `alpha_space`: Allows only alphabetic characters and spaces.

## 2. Numeric Validation Rules

- `numeric`: Ensures the field contains only numeric characters.
- `integer`: Ensures the field contains only integers.
- `decimal`: Ensures the field is a decimal number.
- `is_natural`: Ensures the field contains only natural numbers (0, 1, 2, ...).
- `is_natural_no_zero`: Ensures the field contains only natural numbers greater than zero (1, 2, 3, ...).
- `greater_than[value]`: Ensures the field contains a number greater than the specified value.
- `greater_than_equal_to[value]`: Ensures the field contains a number greater than or equal to the specified value.
- `less_than[value]`: Ensures the field contains a number less than the specified value.
- `less_than_equal_to[value]`: Ensures the field contains a number less than or equal to the specified value.

## 3. Date Validation Rules

- `valid_date[format]`: Ensures the field contains a valid date, optionally checking against a format (e.g., `valid_date[Y-m-d]`).
- `valid_date[Y-m-d]`: Checks for a valid date in YYYY-MM-DD format.
- `valid_date_format[format]`: Checks that the date is in a specified format (e.g., Y-m-d for YYYY-MM-DD).
- **String Validation Rules**
- `regex_match[pattern]`: Ensures the field matches the specified regular expression pattern.
- `valid_email`: Ensures the field contains a valid email address.
- `valid_emails`: Ensures the field contains a comma-separated list of valid email addresses.
- `valid_ip[ip_version]`: Ensures the field contains a valid IP address, optionally specifying IPv4 or IPv6.
- `valid_base64`: Ensures the field contains a valid Base64-encoded string.
- `valid_url`: Ensures the field contains a valid URL.

## 5. File Upload Validation Rules

These rules are used to validate files when uploading.

- `uploaded[file_field]`: Ensures that a file was uploaded.
- `max_size[file_field, size]`: Ensures the uploaded file does not exceed a certain size (in kilobytes).
- `max_dims[file_field, width, height]`: Ensures the uploaded image file dimensions do not exceed the specified width and height.
- `is_image[file_field]`: Ensures the uploaded file is an image.
- `mime_in[file_field, mime1, mime2, ...]`: Ensures the uploaded file has one of the allowed MIME types (e.g., `mime_in[userfile, image/jpg, image/png]`).
- `ext_in[file_field, ext1, ext2, ...]`: Ensures the uploaded file has one of the specified extensions (e.g., `ext_in[userfile, jpg, png]`).

# Using CodeIgniter's built-in libraries (e.g., Database, Security, Validation)

## Database Library

The Database library helps interact with your database, allowing you to perform queries and manipulate data.

### 1. Configure Database:

Open app/Config/Database.php and add your database credentials:

```
public $default = [  
    'DSN' => "",  
    'hostname' => 'localhost',  
    'username' => 'your_username',  
    'password' => 'your_password',  
    'database' => 'your_database',  
    'DBDriver' => 'MySQLi',  
];
```

### 2. Using the Database in a Controller:

In app/Controllers, create a new file named DatabaseController.php:

```
<?php  
namespace App\Controllers;  
  
use CodeIgniter\Controller;  
use Config\Database;  
  
class DatabaseController extends Controller  
{  
    public function getProducts()  
    {  
        $db = Database::connect();  
        $query = $db->query("SELECT * FROM products");  
        $data['products'] = $query->getResult();  
  
        return view('products', $data);  
    }  
}
```

### 3. Create a View:

In app/Views, create products.php to display the data:

```
<h1>Products</h1>  
<?php foreach ($products as $product): ?>  
    <p><?= esc($product->name) ?>: $<?= esc($product->price) ?></p>  
<?php endforeach; ?>
```

### 4. Define Route:

In app/Config/Routes.php, add a route:

```
$routes->get('products', 'DatabaseController::getProducts');
```

\*Access <http://localhost:8080/products> to view the list of products.

## Security Library

The Security library provides functions for data sanitization and CSRF protection.

### 1. Escaping Output:

Escaping prevents Cross-Site Scripting (XSS) attacks by sanitizing output.

In app/Views/products.php, use:

```
<p><?= esc($product->name) ?></p>
```

### 2. CSRF Protection:

Enable CSRF protection in app/Config/Filters.php by setting csrfProtection to true.

Add CSRF protection to forms:

```
<form action="/submit" method="post">
    <?= csrf_field() ?>
    <input type="text" name="name" placeholder="Product Name">
    <button type="submit">Submit</button>
</form>
```

### 3. Sanitizing Data:

Use to sanitize filenames:

```
$this->security->sanitizeFilename($filename).
```

## Validation Library

The Validation library allows defining rules to validate form inputs.

### 1. Define Validation Rules:

In app/Controllers, create a file called ValidationController.php:

```
<?php
namespace App\Controllers;

use CodeIgniter\Controller;

class ValidationController extends Controller
{
    public function submit()
    {
        $validation = \Config\Services::validation();

        $rules = [
            'name' => 'required|min_length[3]',
            'email' => 'required|valid_email'
        ];

        if (!$this->validate($rules)) {
            return view('form', [
                'validation' => $this->validator
            ]);
        }

        // Process valid data here
    }
}
```



## 2. Create a Form View:

In app/Views, create form.php:

```
<form action="/submit" method="post">
  <input type="text" name="name" placeholder="Name">
  <input type="email" name="email" placeholder="Email">
  <button type="submit">Submit</button>

  <?php if (isset($validation)): ?>
    <div><?= $validation->listErrors() ?></div>
  <?php endif; ?>
</form>
```

## 3. Define Route:

```
$routes->post('submit', 'ValidationController::submit');
```

\*Access the form at <http://localhost:8080/form>.

## Session Library

The Session library helps manage user sessions and store temporary data.

### 1. Start a Session:

In app/Controllers, create SessionController.php:

```
<?php
namespace App\Controllers;

use CodeIgniter\Controller;

class SessionController extends Controller
{
    public function setSession()
    {
        session()->set('username', 'JohnDoe');
        return redirect()->to('/session-check');
    }

    public function checkSession()
    {
        $username = session()->get('username');
        return view('session', ['username' => $username]);
    }
}
```

### 2. Create a View:

In app/Views, create session.php:

```
<h1>Welcome, <?= esc($username) ?></h1>
```

### 3. Define Routes:

```
$routes->get('session-set', 'SessionController::setSession');
$routes->get('session-check', 'SessionController::checkSession');
```

\*Navigate to <http://localhost:8080/session-set> to set the session and then to <http://localhost:8080/session-check> to view it.

## Email Library

The Email library helps send emails from within your application.

### 1. Configure Email:

Open app/Config/Email.php and set up your email provider (SMTP or other):

```
public $protocol = 'smtp';
public $SMTPHost = 'smtp.example.com';
public $SMTPUser = 'your_email@example.com';
public $SMTPPass = 'your_password';
public $SMTPPort = 587;
```

### 2. Create Email Sending Controller:

In app/Controllers, create EmailController.php:

```
<?php
namespace App\Controllers;

use CodeIgniter\Controller;

class EmailController extends Controller
{
    public function sendEmail()
    {
        $email = \Config\Services::email();

        $email->setFrom('your_email@example.com', 'Your Name');
        $email->setTo('recipient@example.com');
        $email->setSubject('Test Email');
        $email->setMessage('This is a test email from CodeIgniter.');
```

```
        if ($email->send()) {
            echo "Email sent successfully";
        } else {
            echo "Failed to send email";
            print_r($email->printDebugger(['headers']));
        }
    }
}
```

### 3. Define Route:

```
$routes->get('send-email', 'EmailController::sendEmail');
```

\*Access <http://localhost:8080/send-email> to trigger the email.

# Model-View-Controller (MVC) Pattern

## Understanding the roles of models, views, and controllers

In CodeIgniter, Models, Views, and Controllers (MVC) each play a distinct role in separating the logic, data handling, and presentation of a web application.

### Example 1: Setting Up a Basic MVC Structure

Create a Controller:

In app/Controllers, create ProductController.php:

```
<?php
namespace App\Controllers;

use App\Models\ProductModel;

class ProductController extends BaseController
{
    public function index()
    {
        $model = new ProductModel();
        $data['products'] = $model->findAll();
        return view('product/index', $data);
    }
}
```

Create a Model:

In app/Models, create ProductModel.php:

```
<?php
namespace App\Models;

use CodeIgniter\Model;

class ProductModel extends Model
{
    protected $table = 'products';
    protected $allowedFields = ['name', 'price', 'description'];
}
```

Create a View:

In app/Views/product, create index.php:

```
<h1>Product List</h1>
<?php foreach ($products as $product): ?>
    <p><?= esc($product['name']) ?>: $<?= esc($product['price']) ?></p>
<?php endforeach; ?>
```

Define a Route:

In app/Config/Routes.php, add:

```
$routes->get('products', 'ProductController::index');
```

\*Access <http://localhost:8080/products> to see the product list.

### Example 2: Adding a Create Method in the Controller

```
public function create()
{
    return view('product/create');
}
```

### Example 3: Adding a Store Method in the Controller

```
public function store()
{
    $model = new ProductModel();
    $model->save($this->request->getPost());
    return redirect()->to('/products');
}
```

## Creating database models and performing database operations

Models represent database tables and allow for database operations.

### Example 1: Creating a Model for CRUD Operations

Create Product Model (if not created above):

```
protected $table = 'products';
```

### Example 2: Fetching All Records

```
$products = $model->findAll();
```

### Example 3: Fetching a Single Record by ID

Controller Method:

In ProductController, add a show method:

```
public function show($id)
{
    $model = new \App\Models\ProductModel();
    $data['product'] = $model->find($id);

    return view('product/show', $data);
}
```

Define a Route:

In app/Config/Routes.php, add:

```
$routes->get('product/(:num)', 'ProductController::show/$1');
```

Create a View:

In app/Views/product, create show.php:

```
<h1>Product Details</h1>
<p>Name: <?= esc($product['name']) ?></p>
<p>Price: $<?= esc($product['price']) ?></p>
<p>Description: <?= esc($product['description']) ?></p>
```

\*Access <http://localhost:8080/product/1> to view a specific product by ID.

#### Example 4: Updating a Record

Controller Method:

In ProductController, add edit and update methods:

```
public function edit($id)
{
    $model = new \App\Models\ProductModel();
    $data['product'] = $model->find($id);

    return view('product/edit', $data);
}

public function update($id)
{
    $model = new \App\Models\ProductModel();
    $model->update($id, $this->request->getPost());

    return redirect()->to('/products');
}
```

Define Routes:

In app/Config/Routes.php, add:

```
$routes->get('product/edit/{:num}', 'ProductController::edit/$1');
$routes->post('product/update/{:num}', 'ProductController::update/$1');
```

Create the Edit View:

In app/Views/product, create edit.php:

```
<h1>Edit Product</h1>
<form action="/product/update/<?= esc($product['id']) ?>" method="post">
    <input type="text" name="name" value="<?= esc($product['name']) ?>">
    <input type="text" name="price" value="<?= esc($product['price']) ?>">
    <textarea name="description"><?= esc($product['description']) ?></textarea>
    <button type="submit">Update Product</button>
</form>
```

#### Example 5: Deleting a Record

Controller Method:

In ProductController, add a delete method:

```
public function delete($id)
{
    $model = new \App\Models\ProductModel();
    $model->delete($id);

    return redirect()->to('/products');
}
```

Define Route:

In app/Config/Routes.php, add:

```
$routes->get('product/delete/{:num}', 'ProductController::delete/$1');
```

## Using view templates and layouts

Using layouts allows us to define a base template and extend it in individual views.

### Example 1: Creating a Layout Template

Create a Layout File: In app/Views/layouts, create main.php:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <title><?= esc($title ?? 'My App') ?></title>
</head>
<body>
  <header>
    <h1>My App</h1>
  </header>
  <main>
    <?= $this->renderSection('content') ?>
  </main>
</body>
</html>
```

### Example 2: Extending the Layout in Views

Use the Layout in a View: In app/Views/product/index.php, use:

```
<?= $this->extend('layouts/main') ?>
<?= $this->section('content') ?>
<h1>Product List</h1>
<!-- product list code here -->
<?= $this->endSection() ?>
```

### Example 3: Passing Data to the Layout

In Controller: Pass a title to the view:

```
return view('product/index', ['title' => 'Products']);
```

### Example 4: Adding a Navbar in Layout

Edit main.php Layout: Add a simple navbar:

```
<nav>
  <a href="/">Home</a> | <a href="/products">Products</a>
</nav>
```

### Example 5: Adding a Footer Section

In main.php Layout: Add a footer:

```
<footer>
  <p>My App &copy; <?= date('Y') ?></p>
</footer>
```

## Implementing custom filters and callbacks

Filters allow us to apply actions to requests, such as authentication or logging.

### Example 1: Creating a Custom Filter

In app/Filters, create AuthFilter.php:

```
<?php
namespace App\Filters;

use CodeIgniter\HTTP\RequestInterface;
use CodeIgniter\HTTP\ResponseInterface;
use CodeIgniter\Filters\FilterInterface;

class AuthFilter implements FilterInterface
{
    public function before(RequestInterface $request, $arguments = null)
    {
        if (! session()->get('isLoggedIn')) {
            return redirect()->to('/login');
        }
    }

    public function after(RequestInterface $request, ResponseInterface $response, $arguments = null)
    {
        // Do something here
    }
}
```

Register the Filter:

Open app/Config/Filters.php and register it:

```
public $aliases = [
    'auth' => \App\Filters\AuthFilter::class,
];
```

### Example 2: Applying the Filter to Routes

In app/Config/Routes.php, apply the filter to specific routes:

```
$routes->get('dashboard', 'DashboardController::index', ['filter' => 'auth']);
```

### Example 3: Using Callbacks in Models

Create Callbacks for a Model: In ProductModel, define callbacks:

```
protected $beforeInsert = ['beforeInsert'];
protected $afterInsert = ['afterInsert'];

protected function beforeInsert(array $data)
{
    $data['data']['name'] = strtoupper($data['data']['name']);
    return $data;
}
```

```
protected function afterInsert(array $data)
{
    log_message('info', 'Product added with ID: ' . $data['id']);
}
```

#### Example 4: Creating a Custom Callback

Define Custom Callback: Add a custom callback to sanitize inputs:

```
protected function sanitizeInput(array $data)
{
    $data['data'] = array_map('htmlspecialchars', $data['data']);
    return $data;
}
```

Add to Callbacks:

```
protected $beforeInsert = ['sanitizeInput'];
```

#### Example 5: Logging Actions with Filters and Callbacks

Create Logging in Filter: Add log messages in AuthFilter:

```
public function before(RequestInterface $request, $arguments = null)
{
    log_message('info', 'User attempting to access: ' . current_url());
}
```

## Authentication and Authorization

Implementing user authentication (e.g., password hashing, session management)

#### Example 1: Setting Up the User Database Table

Create a Users Table:

Use the following SQL to set up a basic users table with role and password\_hash fields:

```
CREATE TABLE users (
    id INT AUTO_INCREMENT PRIMARY KEY,
    username VARCHAR(50) NOT NULL UNIQUE,
    password_hash VARCHAR(255) NOT NULL,
    role VARCHAR(20) NOT NULL
);
```

#### Example 2: Registering Users with Password Hashing

Create a Registration Form:

In app/Views/user/register.php, create a form:

```
<form action="/register" method="post">
    <input type="text" name="username" placeholder="Username" required>
    <input type="password" name="password" placeholder="Password" required>
    <button type="submit">Register</button>
</form>
```



Hash the Password and Store the User:

In app/Controllers/AuthController.php, create a method for registration:

```
public function register()
{
    $password = $this->request->getPost('password');
    $hashedPassword = password_hash($password, PASSWORD_BCRYPT);

    $data = [
        'username' => $this->request->getPost('username'),
        'password_hash' => $hashedPassword,
        'role' => 'user' // Default role
    ];

    $model = new \App\Models\UserModel();
    $model->insert($data);

    return redirect()->to('/login');
}
```

### Example 3: Logging In with Password Verification

Create a Login Form:

In app/Views/user/login.php, create a form:

```
<form action="/login" method="post">
    <input type="text" name="username" placeholder="Username" required>
    <input type="password" name="password" placeholder="Password" required>
    <button type="submit">Login</button>
</form>
```

Verify the Password and Set the Session:

In AuthController, add a login method:

```
public function login()
{
    $username = $this->request->getPost('username');
    $password = $this->request->getPost('password');

    $model = new \App\Models\UserModel();
    $user = $model->where('username', $username)->first();

    if ($user && password_verify($password, $user['password_hash'])) {
        session()->set('isLoggedIn', true);
        session()->set('user_id', $user['id']);
        session()->set('role', $user['role']);
        return redirect()->to('/dashboard');
    } else {
        return redirect()->to('/login')->with('error', 'Invalid credentials');
    }
}
```

#### Example 4: Protecting Routes with Session Management

Create a Filter for Authentication:

In app/Filters, create AuthFilter.php:

```
<?php
namespace App\Filters;

use CodeIgniter\HTTP\RequestInterface;
use CodeIgniter\HTTP\ResponseInterface;
use CodeIgniter\Filters\FilterInterface;

class AuthFilter implements FilterInterface
{
    public function before(RequestInterface $request, $arguments = null)
    {
        if (! session()->get('isLoggedIn')) {
            return redirect()->to('/login');
        }
    }

    public function after(RequestInterface $request, ResponseInterface $response, $arguments = null)
    {
        // Do nothing
    }
}
```

Register and Apply the Filter:

In app/Config/Filters.php, add the filter:

```
public $aliases = [
    'auth' => \App\Filters\AuthFilter::class,
];
```

Protect routes in app/Config/Routes.php:

```
$routes->get('dashboard', 'DashboardController::index', ['filter' => 'auth']);
```

#### Example 5: Logging Out and Clearing the Session

Create a Logout Method:

In AuthController, add:

```
public function logout()
{
    session()->destroy();
    return redirect()->to('/login');
}
```

Add a Logout Link:

In your main layout or navigation, add a link to /logout.

## Implementing role-based access control (RBAC)

RBAC allows restricting access based on user roles (e.g., admin, user).

### Example 1: Adding a Role Field in the Users Table

Ensure the users table has a role column (e.g., user or admin).

### Example 2: Adding Role-Based Restrictions in Controllers

Check User Role in Controller:

In DashboardController, add a method to restrict access:

```
public function adminDashboard()
{
    if (session()->get('role') !== 'admin') {
        return redirect()->to('/dashboard')->with('error', 'Access Denied');
    }

    // Load admin-specific view
    return view('admin/dashboard');
}
```

Define Route for Admin Dashboard:

Add in Routes.php:

```
$routes->get('admin/dashboard', 'DashboardController::adminDashboard', ['filter' => 'auth']);
```

### Example 3: Role-Based Menu Links in Views

Show Links Based on Role:

In the main navigation, conditionally display links:

```
<?php if (session()->get('role') === 'admin'): ?>
    <a href="/admin/dashboard">Admin Dashboard</a>
<?php endif; ?>
```

### Example 4: Role-Based Access Control Filter

Create a Custom Filter for Role Access:

In app/Filters, create AdminFilter.php:

```
public function before(RequestInterface $request, $arguments = null)
{
    if (session()->get('role') !== 'admin') {
        return redirect()->to('/dashboard')->with('error', 'Access Denied');
    }
}
```

### Example 5: Applying Role-Based Filters in Routes

Apply the Filter in Routes:

Protect routes using admin filter:

```
$routes->get('admin-only', 'AdminController::index', ['filter' => 'admin']);
```

## Using Single-Sign On (SSO)

SSO allows users to authenticate once and gain access to multiple applications. Here we'll use OAuth2 as a sample SSO.

### Example 1: Install OAuth2 Client Library

Install OAuth2 Client Library:

```
composer require league/oauth2-client
```

### Example 2: Configure OAuth2 Provider

Create OAuth2 Provider Configuration:

In app/Config/OAuth.php:

```
public $providers = [  
    'google' => [  
        'clientId' => 'YOUR_GOOGLE_CLIENT_ID',  
        'clientSecret' => 'YOUR_GOOGLE_CLIENT_SECRET',  
        'redirectUri' => 'YOUR_REDIRECT_URI',  
        'hostedDomain' => 'YOUR_DOMAIN.com',  
    ]  
];
```

### Example 3: Redirecting User to OAuth Provider

Controller Method:

In AuthController, add:

```
public function redirectToProvider()  
{  
    $provider = new \League\OAuth2\Client\Provider\Google($config->providers['google']);  
    $authUrl = $provider->getAuthorizationUrl();  
    session()->set('oauth2state', $provider->getState());  
    return redirect()->to($authUrl);  
}
```

### Example 4: Handling OAuth2 Callback

OAuth Callback Handling:

Capture the token and user details in AuthController:

```
public function handleProviderCallback()  
{  
    $provider = new \League\OAuth2\Client\Provider\Google($config->providers['google']);  
    $token = $provider->getAccessToken('authorization_code', ['code' => $_GET['code']]);  
    $user = $provider->getResourceOwner($token);  
    session()->set('user', $user->toArray());  
    return redirect()->to('/dashboard');  
}
```

### Example 5: Displaying User Information Post-Login

Display User Data in Dashboard:

In the dashboard view, show user info:

```
<?php $user = session()->get('user'); ?>  
<p>Welcome, <?= esc($user['name']) ?></p>
```

# Introduction to Docker and Containerization

## Introduction to containers and containerization

Containers are lightweight, standalone packages that include an application and all its dependencies, ensuring that the application runs consistently in any environment.

### Key Concepts

- ✓ **Isolation:** Containers run independently from each other, allowing multiple applications to run on the same system without conflict.
- ✓ **Portability:** Containerized applications can run on any machine that supports container runtime, like Docker.
- ✓ **Efficiency:** Containers share the host OS kernel, which makes them lightweight compared to virtual machines.

## Benefits of using Docker for development and deployment

Using Docker for development and deployment offers several advantages:

- ✓ **Consistency:** Docker ensures that the application runs the same way across different environments (local, staging, production).
- ✓ **Scalability:** Docker containers can be easily scaled up or down to handle varying loads.
- ✓ **Resource Efficiency:** Containers are lightweight and consume fewer resources compared to virtual machines.
- ✓ **Rapid Deployment:** Docker simplifies the process of setting up and deploying applications.

## Docker architecture and components

Docker consists of several key components:

- **Docker Engine:** The core of Docker, responsible for creating, running, and managing containers.
- **Docker Images:** The templates that contain all necessary files and dependencies for a container.
- **Docker Containers:** Instances of Docker images that run applications in isolated environments.
- **Dockerfile:** A file with instructions to build Docker images.
- **Docker Hub:** A cloud-based repository where Docker images can be stored and shared.

## Installing Docker on Windows

1. **Download Docker Desktop:**

Go to Docker Desktop for Windows and download the installer

<https://docs.docker.com/desktop/install/windows-install/>

2. **Install Docker Desktop:**

Run the downloaded installer and follow the installation wizard.

Select the option to enable WSL 2 integration (if available). Windows Subsystem for Linux (WSL 2) allows Docker to run in a Linux environment on Windows.

3. **Start Docker Desktop:**

Launch Docker Desktop from the Start Menu.

4. **Verify Installation:**

Open Command Prompt or PowerShell and type:

```
docker --version
```

You should see the Docker version installed on your machine.

5. Run a Test Container:

Run a simple container to verify Docker is working:

```
docker run hello-world
```

\*This will pull the hello-world image from Docker Hub and run it, displaying a message confirming Docker is working.

## Creating Docker images

Install CodeIgniter 4 Locally:

1. Create a new CodeIgniter 4 application locally.

Open your Command Prompt or PowerShell and navigate to the directory where you want to create the project:

```
composer create-project codeigniter4/appstarter my-codeigniter-app
```

This will create a new folder named my-codeigniter-app with all CodeIgniter files.

2. Test the Application Locally:

Enter the project directory and start the local server:

```
cd my-codeigniter-app
php spark serve
```

\*Go to <http://localhost:8080> in your browser to ensure that the application is running.

A Dockerfile is a script containing commands to build a Docker image.

1. Create a Dockerfile:

In the root directory of your CodeIgniter project (my-codeigniter-app), create a file named Dockerfile (without any file extension).

2. Write Dockerfile Instructions:

Open the Dockerfile and add the following instructions:

```
# Use an official PHP image with Apache
FROM php:8.0-apache

# Install required PHP extensions
RUN docker-php-ext-install mysqli pdo pdo_mysql

# Set the working directory
WORKDIR /var/www/html

# Copy the current directory contents into the container
COPY . /var/www/html

# Set permissions for the storage and writable directories
RUN chown -R www-data:www-data /var/www/html/writable /var/www/html/cache
RUN chmod -R 775 /var/www/html/writable /var/www/html/cache

# Expose port 80
EXPOSE 80
```

#### Explanation of Dockerfile Instructions:

FROM php:8.0-apache	:Starts with a PHP image that has Apache installed.
RUN docker-php-ext-install mysqli pdo pdo_mysql	:Installs PHP extensions needed for CodeIgniter.
WORKDIR /var/www/html	:Sets the working directory in the container.
COPY . /var/www/html	:Copies all application files to the container's /var/www/html directory.
RUN chown... and chmod...	:Sets permissions for writable directories to avoid permission issues.
EXPOSE 80	:Exposes port 80 to access the application.

### 3. Create a docker-compose.yml File (Optional)

Using Docker Compose can simplify the setup, especially if you plan to add more services like a database.

#### Create a docker-compose.yml file:

In the project root (my-codeigniter-app), create a file named docker-compose.yml.

#### Add the Docker Compose Configuration:

```
version: '3.8'

services:
  app:
    build: .
    ports:
      - "8080:80"
    volumes:
      - ./var/www/html
    environment:
      - CI_ENVIRONMENT=development
  db:
    image: mysql:8.0
    environment:
      MYSQL_ROOT_PASSWORD: rootpassword
      MYSQL_DATABASE: codeigniter
      MYSQL_USER: user
      MYSQL_PASSWORD: password
    ports:
      - "3306:3306"
```

#### Explanation of docker-compose.yml:

App	: Defines the CodeIgniter application service.
Build	: Builds the image using the Dockerfile in the current directory.
Ports	: Maps port 8080 on the host to port 80 in the container.
Volumes	: Maps the current directory to /var/www/html in the container, allowing live updates.
Db	: Sets up a MySQL database service with a default database and user.

### 4. Build the Docker Image

Open PowerShell or Command Prompt, navigate to the my-codeigniter-app directory.

```
docker-compose build
```

\*This command reads the Dockerfile and docker-compose.yml, and builds the application and database images.

## Running containers

1. Use Docker Compose to start both the application and the database containers:

```
docker-compose up
```

\*You should see output indicating that the containers are running.

2. Open a web browser and go to <http://localhost:8080>. You should see your CodeIgniter application running inside the Docker container.

## Managing containers and images

Here are some useful commands for managing your Docker containers and images.

Stop the Containers:

```
docker-compose down
```

\*This stops and removes the containers defined in docker-compose.yml.

View Running Containers:

```
docker ps
```

\*Shows all currently running containers.

Remove Unused Images:

```
docker image prune
```

\*Removes unused Docker images to free up disk space.

Restart Containers:

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

\*Adds -d to run containers in detached mode (in the background).

Check Logs:

```
docker-compose logs
```

\*Displays logs for all services in docker-compose.yml.

### Troubleshooting Tips

- **Permission Issues:** If you encounter permission issues, double-check the permissions set for writable and cache directories in the Dockerfile.
- If you see “Whoops....We encountered a snag”, your environment is still set to production. Make sure you have a (.env) file (not just the (env) file and it should be set to use “development” not “production” (set as default).
- **Database Connection:** Update CodeIgniter’s .env file with database connection settings to use the db service (as defined in docker-compose.yml).



# Docker vs Docker-Compose

## 1. **docker** Command

The docker command is the primary CLI tool for interacting with Docker. It's mainly used to manage individual containers, images, networks, and volumes. docker commands are lower-level and more granular, focusing on single containers or images at a time.

### Common docker Commands

#### **Images:**

- |                              |  |
|------------------------------|--|
| docker build -t image_name . | – Build an image from a Dockerfile.                  |
| docker pull image_name       | – Download an image from Docker Hub or a repository. |
| docker images                | – List all local images.                             |

#### **Containers:**

- |  |                               |
|--|-------------------------------|
| docker run -d -p host_port:container_port image_name | – Run a container.            |
| docker ps  | – List running containers.    |
| docker stop container_id                             | – Stop a container.           |
| docker rm container_id                               | – Remove a stopped container. |

#### **Networks and Volumes:**

- |                                  |                           |
|----------------------------------|---------------------------|
| docker network ls                | – List Docker networks.   |
| docker volume create volume_name | – Create a Docker volume. |

## 2. **docker-compose** Command

The docker-compose command is a higher-level tool used to define and manage multi-container Docker applications. It reads configurations from a docker-compose.yml file, where you can specify multiple services (containers), networks, and volumes in a single configuration.

### Common docker-compose Commands

#### **Starting Services:**

- |                      |   |
|----------------------|---|
| docker-compose up    | – Build, (re)create, start, and attach to containers for all services defined in the docker-compose.yml file. |
| docker-compose up -d | – Start containers in detached mode (background).   |
| docker-compose build | – Build or rebuild services.  |

#### **Stopping Services:**

- |                     |  |
|---------------------|--|
| docker-compose down | – Stop and remove containers, networks, and volumes created by up. |
| docker-compose stop | – Stop running containers without removing them.                   |

#### **Viewing Status:**

- docker-compose ps – List containers related to the docker-compose.yml file.

#### **Logs and Debugging:**

- |  |  |
|--|--|
| docker-compose logs                      | – View output from services.                         |
| docker-compose exec service_name command | – Run a command inside a specific service container. |

# Containerizing CodeIgniter 4 Applications with Docker

## Defining the base image for your CodeIgniter 4 application

The base image is the starting point for building your Docker image. Since CodeIgniter is a PHP application, we'll use an official PHP image with Apache.

1. Create a Dockerfile:

Inside your CodeIgniter project root directory (e.g., my-codeigniter-app), create a file named Dockerfile (no file extension).

2. Set the Base Image in the Dockerfile:

Add the following line to define the base image:

dockerfile

```
# Use PHP 8.1 as the base image
FROM php:8.1-apache
```

Note(s):

- ✓ php:8.1-apache is an official PHP image with Apache pre-installed. CodeIgniter 4.5.x requires PHP 8.1+.

## Copying application files

Copy the CodeIgniter application files into the Docker image.

1. Set the Working Directory:

Set the directory inside the container where the files will be copied:

dockerfile

```
# Set the working directory
WORKDIR /var/www/html
```

2. Copy Files:

Add a command to copy all project files into the container:

dockerfile

```
# Copy application files to the working directory
COPY . /var/www/html
```

Note(s):

- ✓ WORKDIR sets the directory within the container where all following commands will run.
- ✓ COPY . /var/www/html copies all files from the current directory (CodeIgniter app) to /var/www/html in the container, which is the default location for Apache's root directory.

## Installing dependencies

CodeIgniter might require PHP extensions, such as pdo\_mysql for MySQL. We can install these in the Dockerfile.

### 1. Install Dependencies:

Add the following line to install any necessary PHP extensions:

dockerfile

```
# Install necessary PHP extensions, including intl
RUN apt-get update && \
    apt-get install -y libicu-dev && \
    docker-php-ext-install intl pdo pdo_mysql

# Enable Apache mod_rewrite for CodeIgniter
RUN a2enmod rewrite
```

## Set Permissions

Set permissions for the folders and files that will be stored in the docker image

```
# Set the necessary permissions
RUN chown -R www-data:www-data /var/www/html \
    && chmod -R 755 /var/www/html
```

## Exposing ports

To make the application accessible, we need to expose a port on which the container will listen.

### 1. Expose Port 80:

dockerfile

```
# Expose port 80 for Apache
EXPOSE 80
```

## Setting environment variables

Environment variables allow us to configure our application's behavior. You can define variables within the Dockerfile or in a docker-compose.yml file.

### 1. Set Environment Variable for Development:

dockerfile

```
# Set the environment for CodeIgniter
ENV CI_ENVIRONMENT=development
```

Note(s):

- ✓ ENV defines environment variables inside the Docker container. Here, we're setting CI\_ENVIRONMENT to development for debugging and testing purposes in CodeIgniter.

## Create Environment File

Copy **env** file to **.env**

.env

```
...
CI_ENVIRONMENT = development
...
```

## Create .dockerignore

Create .dockerignore in project root. This file indicates the other files that will not be included in docker.

.dockerignore

```
.git
vendor
.env
.gitignore
```

## Create docker-compose.yml

This file contains configuration for the docker container

docker-compose.yml

```
version: '3.8'

services:
  app:
    build:
      context: .
      dockerfile: Dockerfile
    container_name: codeigniter-app
    ports:
      - '8080:80'
    volumes:
      - ../var/www/html
    environment:
      - APP_ENV=local
      - APP_DEBUG=true
```

## Building and Running a CodeIgniter 4 Docker Image

Let's build the image and run it as a container.

### 1. Build the Docker Image:

Open Command Prompt or PowerShell in your project directory (my-codeigniter-app) and run the following

```
docker build -t codeigniter-app .
# or
docker-compose build
```

\*This command tells Docker to build an image from the Dockerfile in the current directory (.) and tag it as codeigniter-app.

## 2. Run the Docker Container:

Run the container, mapping port 8080 on your host to port 80 in the container:

```
docker-compose up -d
# or
docker run -d -p 8080:80 --name my-codeigniter-app codeigniter-app
```

***-d runs the container in detached mode (in the background).***

***-p 8080:80 maps port 80 in the container to port 8080 on the host machine.***

***--name my-codeigniter-app names the container instance my-codeigniter-app.***

## 3. Verify the Container is Running:

To check if the container is running, use:

```
docker ps
```

\*You should see my-codeigniter-app listed with port 8080 mapped.

## 4. Access the Application:

Open a web browser and navigate to <http://localhost:8080>. You should see your CodeIgniter 4 application running inside the Docker container.

## 5. Stopping and Removing the Container (Optional):

To stop the container, use:

```
docker stop my-codeigniter-app
```

To remove the container:

```
docker rm my-codeigniter-app
```

## Full Dockerfile for CodeIgniter 4

Here's the complete Dockerfile after all steps:

dockerfile

```
# Use PHP 8.1 as the base image
FROM php:8.1-apache

# Install necessary PHP extensions, including intl
RUN apt-get update && \
    apt-get install -y libicu-dev && \
    docker-php-ext-install intl pdo pdo_mysql

# Enable Apache mod_rewrite for CodeIgniter
RUN a2enmod rewrite

# Copy the app files to the working directory
COPY . /var/www/html

# Set the working directory
WORKDIR /var/www/html
```

```
# Set the necessary permissions
RUN chown -R www-data:www-data /var/www/html \
    && chmod -R 755 /var/www/html

# Expose the necessary port
EXPOSE 80
```

## Additional Section

### Sample CI4 API + SQLite Database + ReactJS

#### Setting Up the CodeIgniter 4 API

##### 1. Install CodeIgniter 4

In your project directory, create a CodeIgniter project:

```
composer create-project codeigniter4/appstarter ci4_crud_api
cd ci4_crud_api
```

Start the development server to check if the installation works:

```
php spark serve
```

Visit <http://localhost:8080> to verify.

##### 2. Configure SQLite Database

Open .env file (copy .env.example if it doesn't exist):

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

Configure the SQLite database in the .env file: (OR edit the app/config/database.php for the sqlite config!)

```
database.default.DBDriver = SQLite3
database.default.database = writable/database.db
```

Create an empty SQLite database file in writable/:

```
touch writable/database.db
```

##### 3. Create the Migration for the Items Table

Run the command to create a migration:

```
php spark make:migration CreateItemsTable
```

Open the migration file in app/Database/Migrations/XXXX-XX-XX-XXXX\_CreateItemsTable.php and define the table schema:

```
public function up()
{
    $this->forge->addField([
        'id' => [
            'type' => 'INTEGER',
```

```

        'constraint' => 5,
        'unsigned' => true,
        'auto_increment' => true
    ],
    'name' => [
        'type' => 'VARCHAR',
        'constraint' => '100',
    ],
    'description' => [
        'type' => 'TEXT',
    ],
    'created_at' => [
        'type' => 'DATETIME',
        'null' => true,
    ],
    'updated_at' => [
        'type' => 'DATETIME',
        'null' => true,
    ],
    ]);
$this->forge->addKey('id', true);
$this->forge->createTable('items');
}

public function down()
{
    $this->forge->dropTable('items');
}

```

Make sure the extensions are enabled(uncommented) in php.ini

```

extension=pdo_sqlite
extension=sqlite3

```

Run the migration to create the table:

```
php spark migrate
```

#### 4. Create the Model

Run the command to create a model:

```
php spark make:model ItemModel
```

Open app/Models/ItemModel.php and configure it:

```

namespace App\Models;

use CodeIgniter\Model;

class ItemModel extends Model
{
    protected $table = 'items';
}

```

```
protected $primaryKey = 'id';
protected $allowedFields = ['name', 'description'];
protected $useTimestamps = true;
}
```

## 5. Create the Controller

Run the command to create a controller:

```
php spark make:controller Item --restful
```

Open app/Controllers/Item.php and implement CRUD methods:

```
namespace App\Controllers;

use App\Models\ItemModel;
use CodeIgniter\RESTful\ResourceController;

class Item extends ResourceController
{
    protected $modelName = 'App\Models\ItemModel';
    protected $format = 'json';

    // GET /items
    public function index()
    {
        return $this->respond($this->model->findAll());
    }

    // GET /items/{id}
    public function show($id = null)
    {
        $data = $this->model->find($id);
        return $data ? $this->respond($data) : $this->failNotFound('Item not found');
    }

    // POST /items
    public function create()
    {
        $data = $this->request->getPost();
        if ($this->model->insert($data)) {
            return $this->respondCreated($data);
        }
        return $this->failValidationErrors($this->model->errors());
    }

    // PUT /items/{id}
    public function update($id = null)
    {
        $data = $this->request->getRawInput();
        if ($this->model->update($id, $data)) {
            return $this->respond($data);
        }
    }
}
```



```

    }
    return $this->failNotFound('Item not found');
}

// DELETE /items/{id}
public function delete($id = null)
{
    if ($this->model->delete($id)) {
        return $this->respondDeleted(['id' => $id, 'message' => 'Deleted']);
    }
    return $this->failNotFound('Item not found');
}
}

```

Add routes for the API in app/Config/Routes.php:

```
$routes->resource('item');
```

## Setting Up the ReactJS Frontend

Initialize a new React app:

```

npx create-react-app react-crud
cd react-crud

```

Install Axios for making HTTP requests:

```
npm install axios
```

Create a new file src/api.js to set up Axios:

```

import axios from 'axios';

const API_URL = 'http://localhost:8080/item';

export const fetchItems = () => axios.get(API_URL);
export const fetchItem = (id) => axios.get(`${API_URL}/${id}`);
export const createItem = (data) => axios.post(API_URL, data);
export const updateItem = (id, data) => axios.put(`${API_URL}/${id}`, data);
export const deleteItem = (id) => axios.delete(`${API_URL}/${id}`);

```

Create a component for managing CRUD operations (e.g., src/App.js):

```

import React, { useState, useEffect } from 'react';
import * as API from './api';

function App() {
    const [items, setItems] = useState([]);
    const [name, setName] = useState("");
    const [description, setDescription] = useState("");

    useEffect(() => {
        loadItems();
    }, []);

```

```

const loadItems = async () => {
  const response = await API.fetchItems();
  setItems(response.data);
};

const addItem = async () => {
  await API.createItem({ name, description });
  setName("");
  setDescription("");
  loadItems();
};

const deleteItem = async (id) => {
  await API.deleteItem(id);
  loadItems();
};

return (
  <div>
    <h1>Items</h1>
    <ul>
      {items.map(item => (
        <li key={item.id}>
          {item.name} - {item.description}
          <button onClick={() => deleteItem(item.id)}>Delete</button>
        </li>
      ))}
    </ul>
    <input
      type="text"
      placeholder="Name"
      value={name}
      onChange={(e) => setName(e.target.value)}
    />
    <input
      type="text"
      placeholder="Description"
      value={description}
      onChange={(e) => setDescription(e.target.value)}
    />
    <button onClick={addItem}>Add Item</button>
  </div>
);
}

export default App;

```

Start the React application:

```
npm start
```