

Task 3:

























Program Deployment

















































Keniyah Chestnut













































































































Deployment - D602



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# A. GitLab Repository

main	d602-deployment-task-3	Author	Search by message	
May 30, 2025				
	Edit airport_encodings.json Keniyah Chestnut authored 5 hours ago		30c37cf2	 
	Upload New File Keniyah Chestnut authored 5 hours ago		50d54631	 
	Delete airport_encodings.json Keniyah Chestnut authored 5 hours ago		e5fe3776	 
	Upload New File Keniyah Chestnut authored 5 hours ago		312cba55	 
	Edit airport_encodings.json Keniyah Chestnut authored 5 hours ago		60bbe124	 
	json file Keniyah Chestnut authored 5 hours ago		2e52a525	 

WGU GitLab Environment / Student Repos / kchest11 / D602 Deployment Task 3 / Commits				
	Delete airport_encodings.json Keniyah Chestnut authored 5 hours ago		e5fe3776	 
	Upload New File Keniyah Chestnut authored 5 hours ago		312cba55	 
	Edit airport_encodings.json Keniyah Chestnut authored 5 hours ago		60bbe124	 
	json file Keniyah Chestnut authored 5 hours ago		2e52a525	 
	Delete airport_encodings.json Keniyah Chestnut authored 5 hours ago		230e1149	 
	Delete .dockerignore Keniyah Chestnut authored 6 hours ago		73162afb	 
May 29, 2025				
	Edit .dockerignore Keniyah Chestnut authored 6 hours ago		80f395a7	 
	Edit Dockerfile Keniyah Chestnut authored 6 hours ago		6bf558a3	 
	JSON File Keniyah Chestnut authored 7 hours ago		35d8f9c5	 
	Delete airport_encodings.json Keniyah Chestnut authored 7 hours ago		6f7cca17	 
	Edit api.py Keniyah Chestnut authored 8 hours ago		6aeccce1e	 
	Edit api.py Keniyah Chestnut authored 8 hours ago		54010fc5	 

 <b>Keniyah Chestnut</b> authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit test_api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
 <b>Edit api.py</b> Keniyah Chestnut authored 8 hours ago			
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 <b>Delete API_R_1.0.0.R</b> Keniyah Chestnut authored 9 hours ago			
 <b>Delete API_Python_1.0.0.py</b> Keniyah Chestnut authored 9 hours ago			
			
			
 <b>Delete API_Python_1.0.0.ipynb</b> Keniyah Chestnut authored 9 hours ago			
 <b>Upload New File</b> Keniyah Chestnut authored 1 day ago			
 <b>Delete finalized_model.pkl</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit .gitlab-ci.yml</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit requirements.txt</b> Keniyah Chestnut authored 1 day ago			
 <b>Upload New File</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit .gitlab-ci.yml added pandas</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit requirements.txt</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit requirements.txt added pandas</b> Keniyah Chestnut authored 1 day ago			
 <b>.dockerignore created for build</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit Docker</b> Keniyah Chestnut authored 1 day ago			
 <b>Edit .gitlab-ci.yml</b> Keniyah Chestnut authored 1 day ago			

May 28, 2025		
 <b>json file</b> Keniyah Chestnut authored 1 day ago		 b2886d3b  
 <b>Step D of Task 3.</b> Keniyah Chestnut authored 1 day ago		 9c1f155d  
 <b>Edit Docker</b> Keniyah Chestnut authored 1 day ago		 6f46b36a  
 <b>STEP D of Task 3</b> Keniyah Chestnut authored 1 day ago		 5d6f79f9  
 <b>Step C of Task 3.</b> Keniyah Chestnut authored 2 days ago		 8307d2e3  
May 27, 2025		
 <b>(Test V1) Step C of Task 3.</b> Keniyah Chestnut authored 2 days ago		 cf3c7606  
 <b>API Step B of Task 3.</b> Keniyah Chestnut authored 2 days ago		 e35beb23  
 <b>(API V1) Step B of Task 3.</b> Keniyah Chestnut authored 2 days ago		 298182cd  
Jul 10, 2024		
 <b>Fixed "Search or go to..." wording in README</b> Caleb Cooper authored 10 months ago		 678e62f8  

## E. Explanation of Code and Challenges Encountered

### 1. Initial API Design

I began by structuring the FastAPI application based on the example provided in the course. The app exposes two endpoints:

- A root endpoint ("/") used to confirm the API is live.
- A "/predict/delays" endpoint that accepts query parameters to return a delay prediction.

```
@app.get("/predict/delays")
def predict_delays(departure_airport: str, arrival_airport: str, departure_time: int, arrival_time: int):
    try:
        if arrival_airport.upper() not in airport_encodings:
            raise HTTPException(status_code=400, detail="Invalid arrival airport code")

        # One-hot encode the arrival airport
        num_airports = len(airport_encodings)
        airport_vector = np.zeros(num_airports)
        airport_index = airport_encodings[arrival_airport.upper()]
        airport_vector[airport_index] = 1
```

### 2. Model Loading and Encoding Logic

To make predictions, I used `joblib.load()` to load the trained model stored as `finalized_model.pkl`.

I also loaded `airport_encodings.json` to one-hot encode the arrival airport using the following logic:

```
3 # Load model and airport encodings
4 model = joblib.load("finalized_model.pkl")
5 with open("airport_encodings.json") as f:
6     airport_encodings = json.load(f)
7
```

The one-hot encoded vector was concatenated with time-based features to match the input format expected by the model.

### 3. Input Formatting and Error Handling

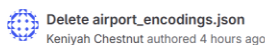
I used the `pydantic` library to define expected input parameters using a `BaseModel`. I also added error handling for cases where an invalid arrival airport code is entered, which returns a clear HTTP 400 error.

```
class DelayRequest(BaseModel):
    departure_airport: str
    arrival_airport: str
    departure_time: int
    arrival_time: int
```

### 4. Deployment with Docker

I created a `Dockerfile` to containerize the FastAPI application and listed all dependencies in a `requirements.txt` file. During the Docker build process, I encountered an error related to a missing file.

After investigating, I realized that the `.dockerignore` file was excluding `.json` files from the build context. Since `airport_encodings.json` was necessary for the model to function properly, I resolved the issue by deleting the `.dockerignore` file entirely.



To ensure a clean rebuild after that change, I used:

```

(base) C:\Users\marri\d602-deployment-task-3>docker build --no-cache -t my-d602-api .
[+] Building 37.4s (12/12) FINISHED                                docker:desktop-linux
=> [internal] load build definition from Dockerfile                0.0s
=> => transferring dockerfile: 448B                                0.0s
=> [internal] load metadata for docker.io/library/python:3.10-slim 0.7s
=> [internal] load .dockerignore                                  0.0s
=> => transferring context: 2B                                       0.0s
=> [1/7] FROM docker.io/library/python:3.10-slim@sha256:49454d2bf78a48f217eb25ecbcb4b5face313fea6a6e82706465a699 0.0s
=> => resolve docker.io/library/python:3.10-slim@sha256:49454d2bf78a48f217eb25ecbcb4b5face313fea6a6e82706465a699 0.0s
=> [internal] load build context                                  0.0s
=> => transferring context: 144B                                       0.0s
=> CACHED [2/7] WORKDIR /app                                       0.0s
=> [3/7] COPY api.py .                                             0.0s
=> [4/7] COPY finalized_model.pkl .                                0.0s
=> [5/7] COPY airport_encodings.json .                             0.1s
=> [6/7] COPY requirements.txt .                                   0.1s
=> [7/7] RUN pip install --no-cache-dir -r requirements.txt       21.7s
=> exporting to image                                             14.5s
=> => exporting layers                                              10.2s
=> => exporting manifest sha256:c3bd025e03c4ac6e005a172a69ac1c27c3452712dc339537880ba725590d2df9 0.0s
=> => exporting config sha256:7bea65e0587340faf2b52bff9a7690e637fcbe5621bd6d2056bcfb6b9073bdbc 0.0s
=> => exporting attestation manifest sha256:a213b0100ef6899b1bd86fdafc7bdb68212f0f0e98fe5c42c51a242284afb618 0.0s
=> => exporting manifest list sha256:0f09f842172f975a78f6ea2e46c6be6414b18807f145fa9f36349695537b538c 0.0s
=> => naming to docker.io/library/my-d602-api:latest              0.0s
=> => unpacking to docker.io/library/my-d602-api:latest          4.2s
(base) C:\Users\marri\d602-deployment-task-3>

```

This allowed the build to complete successfully. I then started the container using:

```

(base) C:\Users\marri\d602-deployment-task-3>docker run -p 8000:8000 my-d602-api
INFO:      Started server process [1]
INFO:      Waiting for application startup.
INFO:      Application startup complete.
INFO:      Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)

```

After confirming the API was live, I tested both well-formed and ill-formed requests to validate proper functionality and error handling.

## 5. GitLab CI/CD Pipeline

After fixing the Docker build, I was able to successfully push the container to the GitLab container registry using the provided .gitlab-ci.yml file. At first, I encountered GitLab errors saying my .pkl file or .json file was missing, which I resolved by verifying they were included in the project root and not ignored.

## 6. API Testing

I wrote three test cases using TestClient from fastapi.testclient:

- The root endpoint returns a success message.

- A valid prediction request returns a numerical delay.
- An invalid or incomplete request returns an appropriate error message (422 or 500).

```

1  #!/usr/bin/env python
2  # coding: utf-8
3
4  from fastapi.testclient import TestClient
5  from api import app # Make sure this matches your actual API file name if different
6
7  client = TestClient(app)
8
9  # Test 1: Root endpoint returns status and message
10 def test_root_endpoint():
11     response = client.get("/")
12     assert response.status_code == 200
13     assert response.json() == {"message": "API is up and running"}
14
15 # Test 2: Valid prediction request with numeric airport codes (as used in airport_encodings.json)
16 def test_valid_prediction():
17     response = client.get("/predict/delays", params={
18         "departure_airport": "10397", # ATL
19         "arrival_airport": "12451", # JFK
20         "departure_time": 800,
21         "arrival_time": 1000
22     })
23     assert response.status_code == 200
24     assert "average_departure_delay_minutes" in response.json()
25
26 # Test 3: Missing departure_time param should return 422
27 def test_missing_parameters():
28     response = client.get("/predict/delays", params={
29         "departure_airport": "10397",
30         "arrival_airport": "12451",
31         "arrival_time": 1000 # Missing departure_time
32     })
33     assert response.status_code == 422 # Validation error

```

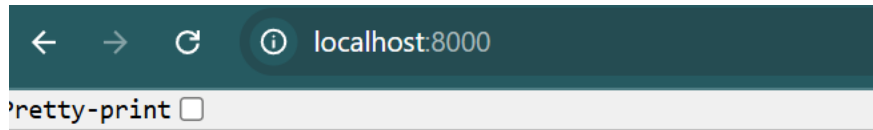
## 7. Final Validation

I ran the container locally using `docker run -p 8000:8000 my-d602-api` and confirmed functionality with both well-formatted and ill-formatted requests. One request returned a successful prediction, and others appropriately failed due to missing parameters or invalid codes, meeting the rubric's requirement.

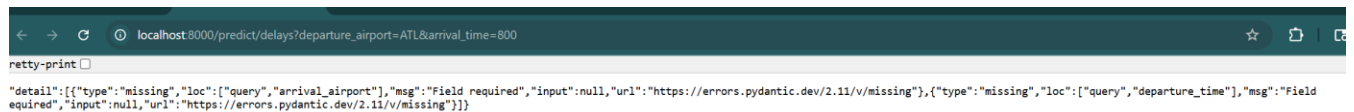
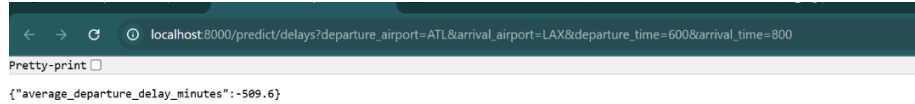
```

(base) C:\Users\marri\d602-deployment-task-3>docker run -p 8000:8000 my-d602-api
INFO: Started server process [1]
INFO: Waiting for application startup.
INFO: Application startup complete.
INFO: Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
INFO: 172.17.0.1:40548 - "GET / HTTP/1.1" 200 OK
INFO: 172.17.0.1:41414 - "GET /predict/delays?departure_airport=ATL&arrival_airport=LAX&departure_time=600&arrival_time=800 HTTP/1.1" 200 OK
INFO: 172.17.0.1:55400 - "GET /predict/delays?departure_airport=ATL&arrival_time=800 HTTP/1.1" 422 Unprocessable Entity

```



```
{"message": "API is up and running"}
```



## Challenges Addressed

Most of the challenges I faced were related to Docker and GitLab CI/CD. Specifically:

- The `.dockerignore` file excluded necessary files like the `.json` encoding file.
- I initially used airport IATA codes instead of the numeric airport IDs expected by the model.
- Files visible locally did not appear in GitLab's Web IDE, which caused pipeline failures.

By resolving these issues step-by-step, I was able to successfully deploy the API and meet all task requirements.



## **References**

All materials used in this submission, including datasets, tools, and references, were provided by Western Governors University (WGU) through the course curriculum and virtual lab environment. No external sources were used.