

MLOPS ASSIGNMENT - 2

GROUP NO - 45

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GITHUB REPO LINKS

Code Repository :

https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2

Github Actions : https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions

Docker Link : <https://hub.docker.com/repository/docker/cseniteshkumar/mlopsassignment2>

Kubernetes Load Balancer :

https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/blob/main/k8s/service.yaml

Kubernetes / Docker Deployment :

https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/blob/main/k8s/deployment.yaml

Model : https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/tree/main/artifacts

Model Training :

https://github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/blob/main/modelTraining.ipynb

YOUTUBE VIDEO LINK

<https://youtu.be/QaEFgxKoqPQ>

Google Drive LINK

https://drive.google.com/drive/folders/1_I15mlcsOb-yQLkXRd-C0DB1whvUiaA_?usp=sharing

1. Setup and Installation Instructions

Local Environment

Clone the Repository:

Bash

```
git clone <your-repo-link>
```

```
cd bitsMtech_MLOps_Assignment_2
```

Environment Setup:

Bash

```
python3 -m venv .venv
```

```
source .venv/bin/activate # Windows: .venv\Scripts\activate
```

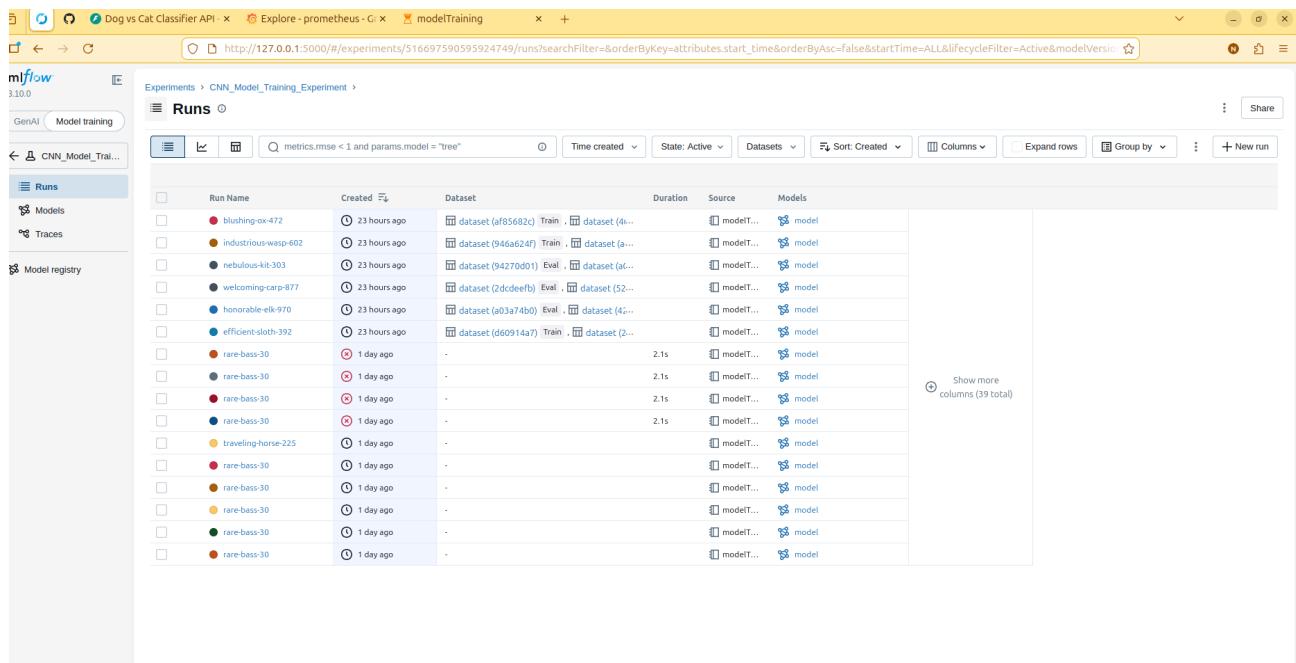
```
pip install -r requirements.txt
```

Docker Execution

```
docker pull cseniteshkumar/mlopsassignment2:latest
```

```
docker run -p 8000:8000 cseniteshkumar/mlopsassignment2:latest
```

2. Experiment Tracking Summary



Screenshot of the miflow interface showing the 'Models' page for the 'CNN_Model_Training_Experiment'. The page displays a table of model attributes, including Model name, Status, Created, Logged from, Source run, Registered models, and Dataset.

Model name	Status	Created	Logged from	Source run	Registered models	Dataset
model	Pending	23 hours ago	modelTraining.ipynb	blushing-ox-472	-	-
model	Pending	23 hours ago	modelTraining.ipynb	industrious-wasp-602	-	-
model	Pending	23 hours ago	modelTraining.ipynb	nebulous-kit-303	-	-
model	Pending	23 hours ago	modelTraining.ipynb	welcoming-carp-877	-	-
model	Pending	23 hours ago	modelTraining.ipynb	honorable-elk-970	-	-
model	Pending	23 hours ago	modelTraining.ipynb	efficient-sloth-392	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-
model	Pending	1 day ago	modelTraining.ipynb	rare-bass-30	-	-

Screenshot of the miflow interface showing the 'Runs' page for the 'CNN_Model_Training_Experiment'. The page displays the details of a specific run named 'blushing-ox-472', including Overview, Model metrics, System metrics, Traces, and Artifacts tabs.

Overview: No metrics recorded.

Parameters (24):

Parameter	Value
opt_clipnorm	None
validation_split	0.0
opt_nesterov	True
opt_weight_decay	None
opt_momentum	0.9
opt_ema_overwrite_frequency	None
opt_gradient_accumulation_steps	None
opt_ema_momentum	0.99
epochs	20
opt_global_clipnorm	None
opt_learning_rate	0.00999999776482582
validation_batch_size	None
shuffle	True
opt_name	SGD

Logged models (1): blushing-ox-472

Source: modelTraining.ipynb

Registered prompts: -

Datasets: dataset (af85682c) Train +1

Tags: Add tags

Registered models: None

3. Training SS

Jupyter modelTraining Last Checkpoint: 9 minutes ago

```
# 3. Clean Enumerated Loop
for i, idx in enumerate(random_indices):
    img = Image.open(train_image_list[idx])
    axes[i].imshow(img)
    axes[i].axis('off') # Turn off axis for each specific subplot
    # Optional: axes[i].set_title(f"Index: {idx}", fontsize=8)

plt.tight_layout() # Automatically adjusts spacing
plt.show()
```

[9]:

```
from pathlib import Path
from sklearn.model_selection import train_test_split
```

Jupyter modelTraining Last Checkpoint: 10 minutes ago

```
out = self.relu(self.fc1(out))
out = self.dropout(out) # Apply dropout during forward pass
out = self.fc2(out)
return out

model = Cnn().to(device)
```

[15]:

```
model = Cnn().to(device)
model.train()

[15]:
```

```
Cnn(
    (layer1): Sequential(
        (0): Conv2d(3, 16, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1))
        (1): BatchNorm2d(16, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
        (2): ReLU()
        (3): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
    )
    (layer2): Sequential(
        (0): Conv2d(16, 32, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1))
        (1): BatchNorm2d(32, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
        (2): ReLU()
        (3): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)
    )
    (layer3): Sequential(
        (0): Conv2d(32, 64, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1))
        (1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_stats=True)
        (2): ReLU()
    )
    (adaptive_pool): AdaptiveAvgPool2d(output_size=(1, 1))
    (fc1): Linear(in_features=64, out_features=10, bias=True)
    (dropout): Dropout(p=0.5, inplace=False)
    (fc2): Linear(in_features=10, out_features=2, bias=True)
    (relu): ReLU()
)
```

[16]:

```
# 1. Modern Optimizer (AdamW is generally preferred over Adam for better weight decay)
optimizer = optim.AdamW(model.parameters(), lr=0.001)

# 2. Loss Function (Standard for classification)
criterion = nn.CrossEntropyLoss()

# 3. Learning Rate Scheduler (Optional but recommended for "latest" performance)
# Reduces the learning rate if the validation loss stops improving
scheduler = optim.lr_scheduler.ReduceLROnPlateau(optimizer, 'min', patience=2)

print(f"Model ready on {device}. Hyperparameters set.")
```

```

# ... EARLY STOPPING ...
if avg_val_loss < best_val_loss - min_delta:
    best_val_loss = avg_val_loss
    early_stop_counter = 0
else:
    early_stop_counter += 1
    if early_stop_counter >= patience:
        print(f"Early stopping at epoch {epoch+1}")
        break
Epoch [1/50]
Train Loss: 0.6666 | Train Acc: 0.5886
Val Loss: 0.6389 | Val Acc: 0.6286

Epoch [2/50]
Train Loss: 0.6355 | Train Acc: 0.6306
Val Loss: 0.6070 | Val Acc: 0.6848

Epoch [3/50]
Train Loss: 0.6103 | Train Acc: 0.6684
Val Loss: 0.6995 | Val Acc: 0.5828

Epoch [4/50]
Train Loss: 0.5945 | Train Acc: 0.6863
Val Loss: 0.5718 | Val Acc: 0.7074

Epoch [5/50]
Train Loss: 0.5850 | Train Acc: 0.6888
Val Loss: 0.5866 | Val Acc: 0.6838

Epoch [6/50]
Train Loss: 0.5802 | Train Acc: 0.6963
Val Loss: 0.5507 | Val Acc: 0.7190

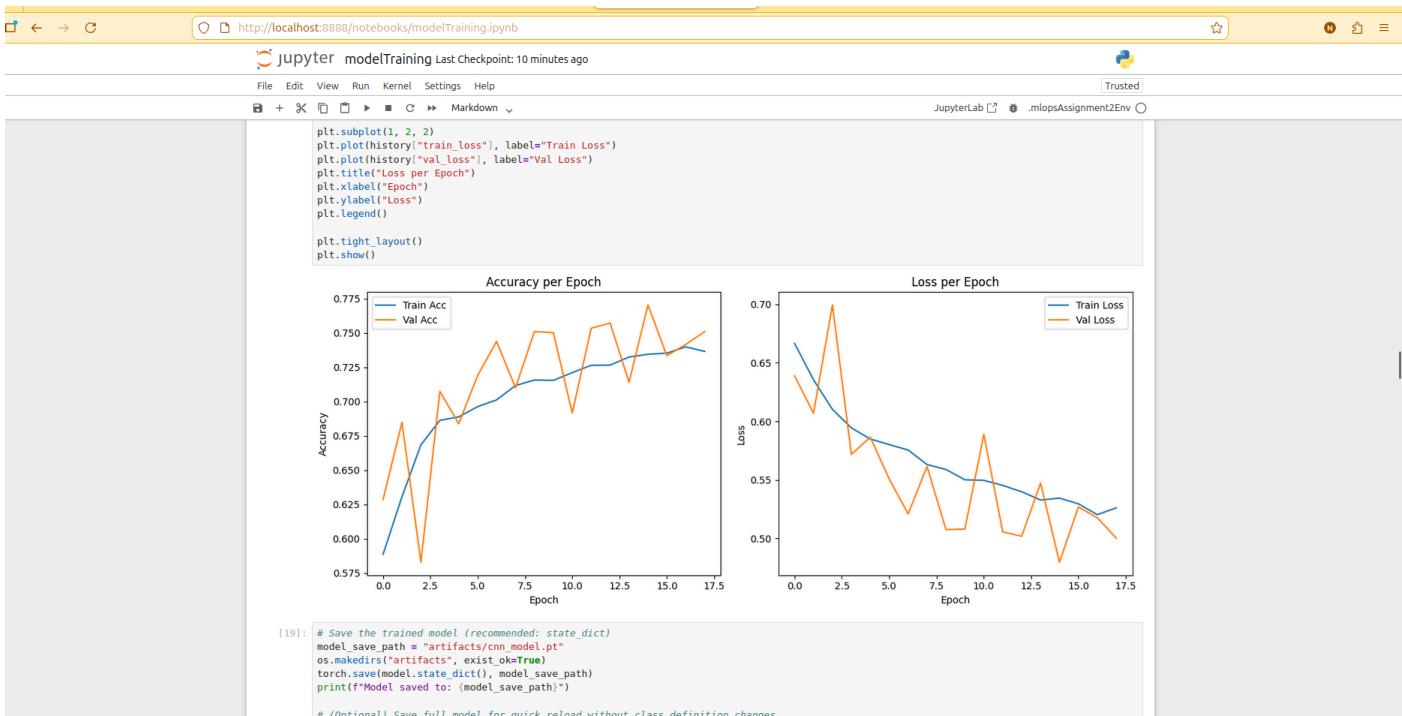
Epoch [7/50]
Train Loss: 0.5756 | Train Acc: 0.7012
Val Loss: 0.5209 | Val Acc: 0.7438

Epoch [8/50]
Train Loss: 0.5631 | Train Acc: 0.7117
Val Loss: 0.5614 | Val Acc: 0.7100

Epoch [9/50]
Train Loss: 0.5589 | Train Acc: 0.7157
Val Loss: 0.5076 | Val Acc: 0.7510

Epoch [10/50]

```



4. CI/CD and Deployment Workflow

CI (Continuous Integration)

```

version: '2'
name: CI Pipeline
on:
  push:
    branches: [ main, develop ]
  pull_request:
    branches: [ main, develop ]

jobs:
  test:
    runs-on: ubuntu-latest
    strategy:
      matrix:
        python-version: ["3.9", "3.10"]
    steps:
      - uses: actions/checkout@v3
      - uses: actions/setup-python@v4
        with:
          python-version: ${{ matrix.python-version }}
          cache: 'pip'
      - run:
          pip install --upgrade pip
          pip install pytest pytest-cov -r requirements_fastapi.txt
      - run: pytest tests/ -v --cov=app --cov-report=xml
      - uses: codecov/codecov-action@v3
        with:
          file: ./coverage.xml
          fail_ci_if_error: false

```

Actions [New workflow](#)

CI Pipeline

Workflow	Last Run	Status	Actor
Train_Log_Generation	now	In progress	...
update Git ignore	14 minutes ago	2m 29s	...
update gitignore	14 minutes ago	2m 30s	...
K8s	26 minutes ago	2m 33s	...
updateReadMeFile	42 minutes ago	2m 35s	...
pro update	Today at 9:46 PM	2m 32s	...
promethes and graphana update	Today at 9:30 PM	2m 37s	...
promethes update	Today at 9:18 PM	2m 26s	...

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281441735

All Bookmarks

cseñiteshkumar / bitsMtech_MLOps_Assignment_2

Code Issues Pull requests Agents Actions Projects Wiki Security Insights Settings

CI Pipeline

update Git Ignore #23

Summary

All jobs

Triggered via push 14 minutes ago

cseñiteshkumar pushed → 947e7ed Main

Status Success Total duration 2m 29s Artifacts

cl.yml on: push

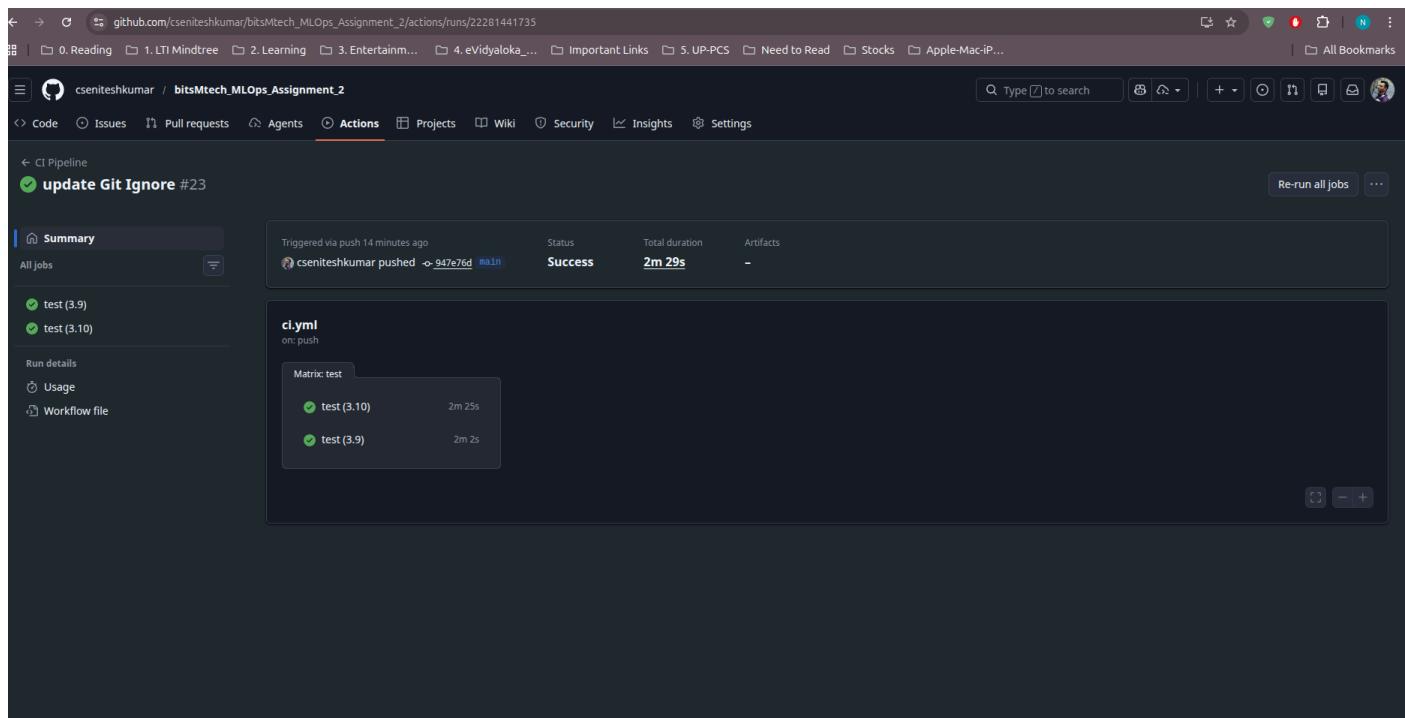
Matrix: test

test (3.10) 2m 25s

test (3.9) 2m 2s

Run details Usage Workflow file

Re-run all jobs



github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281441735/job/64452611656

All Bookmarks

cseñiteshkumar / bitsMtech_MLOps_Assignment_2

Code Issues Pull requests Agents Actions Projects Wiki Security Insights Settings

CI Pipeline

update Git Ignore #23

Summary

All jobs

test (3.9)

test (3.10)

Run details Usage Workflow file

Re-run all jobs

test (3.10)

succeeded 12 minutes ago in 2m 25s

Search logs

Set up job 2s

Run actions/checkout@v3 2s

Run actions/setup-python@v4 1s

Run pip install --upgrade pip 1m 50s

Run pytest tests/-v --cov=app --cov-report=xml 7s

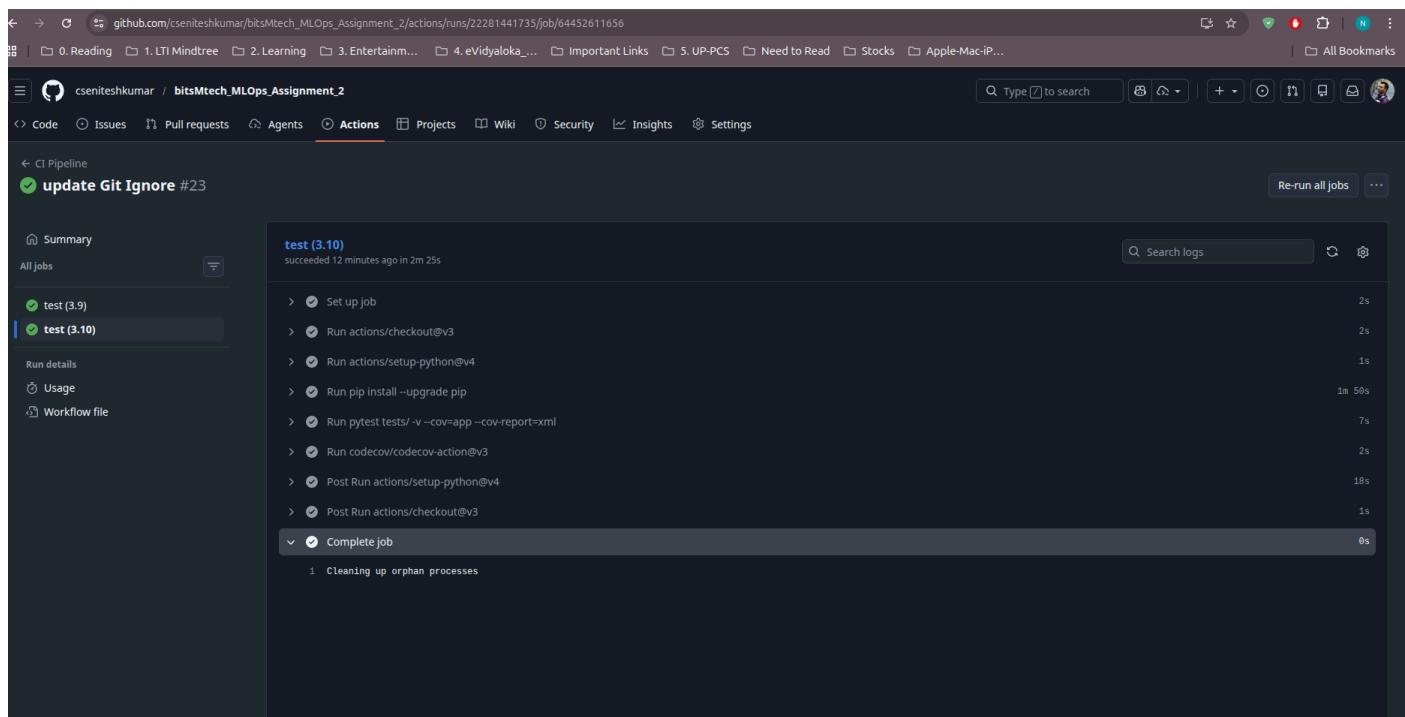
Run codecov/codecov-action@v3 2s

Post Run actions/setup-python@v4 18s

Post Run actions/checkout@v3 1s

Complete job 0s

Cleaning up orphan processes



CI Pipeline

update Git Ignore #23

Re-run all jobs

Summary

All jobs

test (3.9)

succeeded 13 minutes ago in 2m 2s

Search logs

test (3.9)

test (3.10)

Run details

Usage

Workflow file

test (3.9)

Set up job 1s

Run actions/checkout@v3 2s

Run actions/setup-python@v4 3s

Run pip install --upgrade pip 1m 14s

Run pytest tests/-v --cov=app --cov-report=xml 5s

Run codecov/codecov-action@v3 2s

Post Run actions/setup-python@v4 0s

Post Run actions/checkout@v3 0s

Complete job 0s

Summary

All jobs

test (3.9)

succeeded 13 minutes ago in 2m 2s

Search logs

test (3.9)

test (3.10)

Run details

Usage

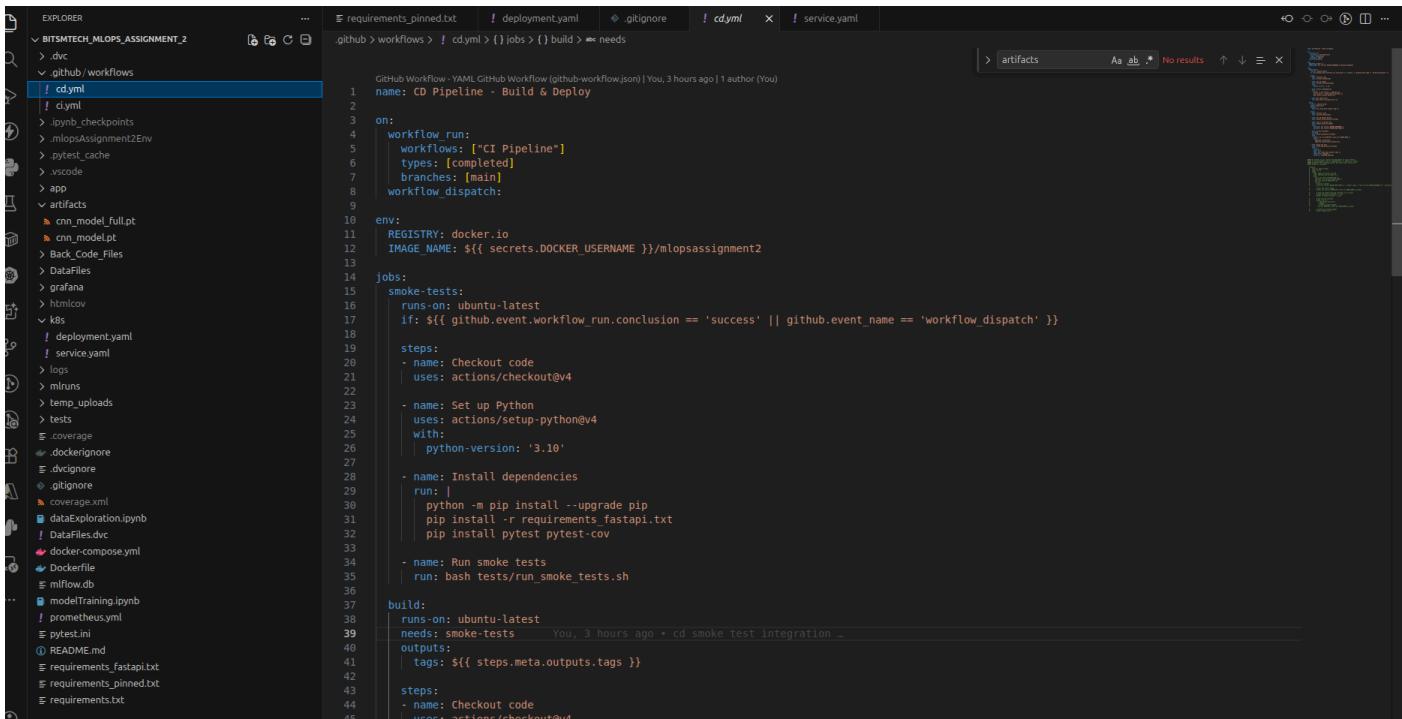
Workflow file

test (3.9)

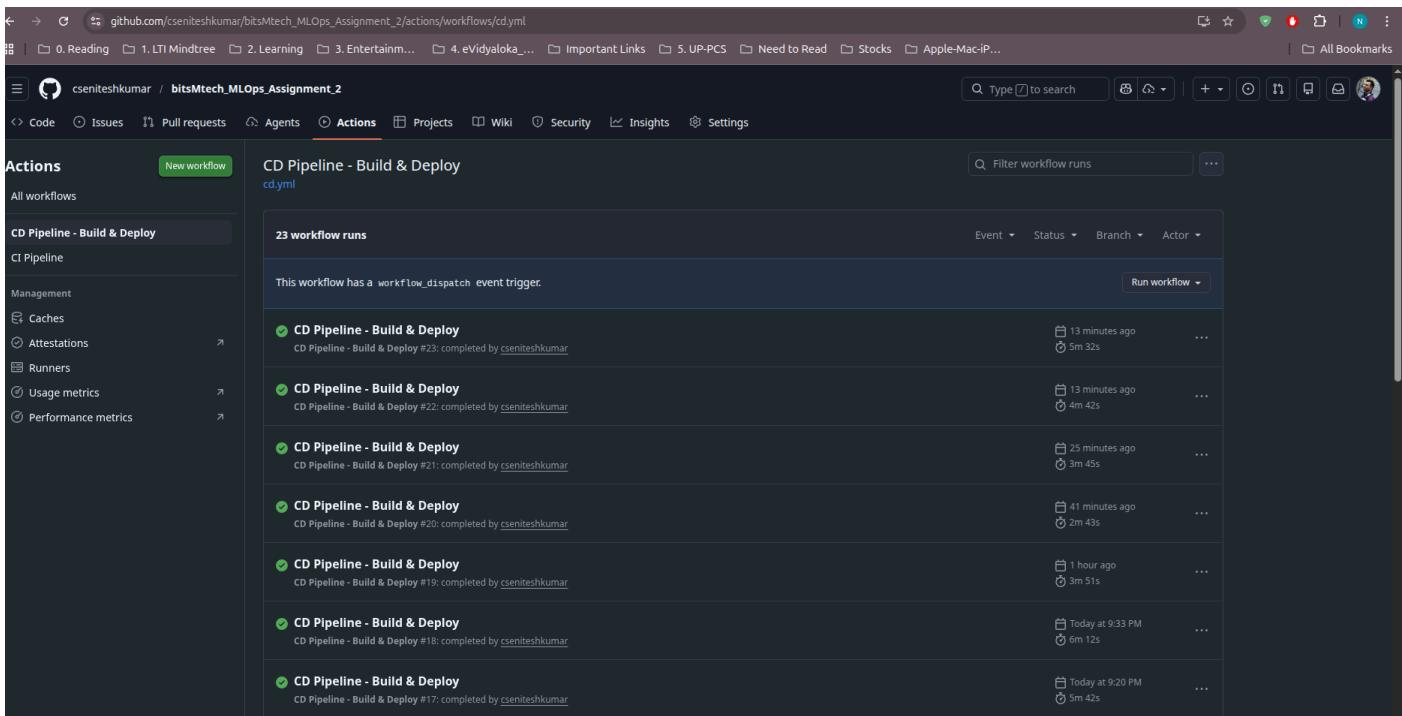
Run pytest tests/-v --cov=app --cov-report=xml

```
13 cacheoir: pytest_cache
14 rootdir: /home/runner/work/bitsMtech_MLOps_Assignment_2/bitsMtech_MLOps_Assignment_2
15 configfile: pytest.ini
16 plugins: cov-7.0.0, anyio-4.12.1
17 collecting ... collected 18 items
18
19 tests/test_deployment.py::TestDeployment::test_app_startup PASSED [ 5%]
20 tests/test_deployment.py::TestDeployment::test_health_check PASSED [ 11%]
21 tests/test_deployment.py::TestDeployment::test_api_routes_exist PASSED [ 16%]
22 tests/test_deployment.py::TestDeployment::test_prediction_endpoint_exists PASSED [ 22%]
23 tests/test_deployment.py::TestDeployment::test_valid_prediction_request PASSED [ 27%]
24 tests/test_deployment.py::TestDeployment::test_invalid_prediction_request PASSED [ 33%]
25 tests/test_deployment.py::TestDeployment::test_empty_request PASSED [ 38%]
26 tests/test_deployment.py::TestDeployment::test_model_inference_consistency PASSED [ 44%]
27 tests/test_deployment.py::TestDeployment::test_response_format PASSED [ 50%]
28 tests/test_deployment.py::TestDeployment::test_concurrent_requests PASSED [ 55%]
29 tests/test_deployment.py::TestDeployment::test_large_input PASSED [ 61%]
30 tests/test_deployment.py::TestDeployment::test_special_values PASSED [ 66%]
31 tests/test_deployment.py::TestDeployment::test_model_loaded PASSED [ 72%]
32 tests/test_deployment.py::TestDeployment::test_config_loaded PASSED [ 77%]
33 tests/test_deployment.py::TestDeployment::test_response_headers PASSED [ 83%]
34 tests/test_deployment.py::TestErrorHandling::test_malformed_json PASSED [ 88%]
35 tests/test_deployment.py::TestErrorHandling::test_wrong_content_type PASSED [ 94%]
36 tests/test_deployment.py::TestErrorHandling::test_missing_required_fields PASSED [100%]
37
38 ===== warnings summary =====
39 tests/test_deployment.py::TestDeployment::test_malformed_json
40 tests/test_deployment.py::TestErrorHandling::test_wrong_content_type
41 /opt/hostedtoolcache/Python/3.9.25/x64/lib/python3.9/site-packages/httpx/_models.py:408: DeprecationWarning: Use 'content=<...>' to upload raw bytes/text content.
42     headers, stream = encode_request()
43
44 -- Docs: https://docs.pytest.org/en/stable/how-to/capture-warnings.html
45 ===== tests coverage =====
46 coverage: platform linux, python 3.9.25-final-0
47
48 Coverage XML written to file coverage.xml
49 ===== 18 passed, 2 warnings in 0.18s =====
```

CD (Continuous Deployment)



```
version: '3.8'
name: CD Pipeline - Build & Deploy
on:
  workflow_dispatch:
  workflow_run:
    types: [completed]
    branches: [main]
  jobs:
    smoke-tests:
      runs-on: ubuntu-latest
      if: ${{ github.event.workflow.run.conclusion == 'success' || github.event_name == 'workflow_dispatch' }}
      steps:
        - name: Checkout code
          uses: actions/checkout@v4
        - name: Set up Python
          uses: actions/setup-python@v4
          with:
            python-version: '3.10'
        - name: Install dependencies
          run:
            python -m pip install --upgrade pip
            pip install -r requirements_fastapi.txt
            pip install pytest pytest-cov
        - name: Run smoke tests
          run: bash tests/run_smoke_tests.sh
      build:
        runs-on: ubuntu-latest
        needs: smoke-tests
        outputs:
          tags: ${{ steps.meta.outputs.tags }}
      steps:
        - name: Checkout code
          uses: actions/checkout@v4
```



The screenshot shows the GitHub Actions interface for the repository 'bitsMtech.MLOps_Assignment_2'. The 'Actions' tab is selected. On the left, there's a sidebar with navigation links like 'Code', 'Issues', 'Pull requests', 'Agents', 'Actions', 'Projects', 'Wiki', 'Security', 'Insights', and 'Settings'. The main area displays the 'CD Pipeline - Build & Deploy' workflow. It shows 23 workflow runs. The first few runs are listed:

Run	Status	Time	Actor
CD Pipeline - Build & Deploy #23	Completed	13 minutes ago	cneniteshkumar
CD Pipeline - Build & Deploy #22	Completed	13 minutes ago	cneniteshkumar
CD Pipeline - Build & Deploy #21	Completed	25 minutes ago	cneniteshkumar
CD Pipeline - Build & Deploy #20	Completed	41 minutes ago	cneniteshkumar
CD Pipeline - Build & Deploy #19	Completed	1 hour ago	cneniteshkumar
CD Pipeline - Build & Deploy #18	Completed	Today at 9:33 PM	cneniteshkumar
CD Pipeline - Build & Deploy #17	Completed	Today at 9:20 PM	cneniteshkumar

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763

All Bookmarks

cseñiteshkumar / bitsMtech_MLOps_Assignment_2

Code Issues Pull requests Agents Actions Projects Wiki Security Insights Settings

CD Pipeline - Build & Deploy

CD Pipeline - Build & Deploy #23

Re-run all jobs ...

Summary

All jobs

smoke-tests build

Run details Usage Workflow file

Triggered via workflow run 13 minutes ago

cseñiteshkumar completed → 947e76d Status Success Total duration 5m 32s Artifacts

cd.yml on: workflow_run

smoke-tests 2m 5s build 3m 20s

Annotations

1 warning

build Skip output 'tags' since it may contain secret.

This screenshot shows the GitHub Actions pipeline summary for a specific run. It displays the status as 'Success' with a total duration of 5m 32s. The pipeline consists of two jobs: 'smoke-tests' (2m 5s) and 'build' (3m 20s). There is one annotation warning about skipping output 'tags' due to potential secrets. The sidebar on the left shows other repository details like '0. Reading' and '1. LTI Mindtree'.

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763/job/64452715499

All Bookmarks

cseñiteshkumar / bitsMtech_MLOps_Assignment_2

Code Issues Pull requests Agents Actions Projects Wiki Security Insights Settings

CD Pipeline - Build & Deploy

CD Pipeline - Build & Deploy #23

Re-run all jobs ...

Summary

All jobs

smoke-tests build

Run details Usage Workflow file

smoke-tests succeeded 11 minutes ago in 2m 5s

Set up job 0s

Checkout code 3s

Set up Python 0s

Install dependencies 1m 49s

Run smoke tests 10s

Post Set up Python 0s

Post Checkout code 1s

Complete job 0s

Search logs

This screenshot shows the detailed log for the 'smoke-tests' job. It lists the following steps and their execution times: 'Set up job' (0s), 'Checkout code' (3s), 'Set up Python' (0s), 'Install dependencies' (1m 49s), 'Run smoke tests' (10s), 'Post Set up Python' (0s), 'Post Checkout code' (1s), and 'Complete job' (0s). The job was successful and completed 11 minutes ago. The sidebar on the left shows other repository details like '0. Reading' and '1. LTI Mindtree'.

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763/job/64452715499

All jobs

smoke-tests

build

Run details

Usage

Workflow file

Summary

smoke-tests succeeded 11 minutes ago in 2m 5s

Run Smoke tests

10s

Search logs

```
tests/test_smoke.py::test_smoke_tests::test_1b_cuda_device_if_available SKIPPED [ 2%]
tests/test_smoke.py::TestSmokeTests::test_16_normalization_parameters PASSED [ 80%]
tests/test_smoke.py::TestSmokeTests::test_17_image_transform_output PASSED [ 85%]
tests/test_smoke.py::TestSmokeTests::test_18_inference_speed PASSED [ 90%]
tests/test_smoke.py::TestSmokeTests::test_19_pytorch_available PASSED [ 95%]
tests/test_smoke.py::TestSmokeTests::test_20_pillow_available PASSED [100%]
=====
===== 19 passed, 1 skipped in 0.15s =====
Step 2: Running with coverage...
=====
===== test session starts =====
platform linux -- Python 3.10.19, pytest-9.0.2, pluggy-1.6.0
rootdir: /home/runner/work/bitsMtech_MLOps_Assignment_2/bitsMtech_MLOps_Assignment_2
configfile: pytest.ini
plugins: cov-7.6.0, anyio-4.12.1
collected 20 items
56
57 tests/test_smoke.py .....[100%]
58
59 ===== tests coverage =====
60 coverage: platform linux, python 3.10.19-final-0
61
62 Name           Stmts Miss Cover   Missing
63 -----
64 app.__init__.py      0    0  100%
65 app/api/routes.py   34   21  38%  13-20, 37-68, 76
66 app/cors/config.py  16    3  81%  29-22
67 app/main.py         15    3  80%  36, 43-44
68 app/models/model.py 58    0  100%
69 app/schemas/_init_.py 2    0  100%
70 app/schemas/prediction.py 16    0  100%
71 app/services/inference.py 43   26  40%  17-22, 35-51, 56-60, 73-87
72 -----
73 TOTAL              184   53  71%
74 ===== 19 passed, 1 skipped in 0.24s =====
75
76 =====
77 Smoke Tests Complete
```

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763/job/64452809008

All jobs

smoke-tests

build

Run details

Usage

Workflow file

Code

Issues

Pull requests

Agents

Actions

Projects

Wiki

Security

Insights

Settings

Type [?] to search

CD Pipeline - Build & Deploy

CD Pipeline - Build & Deploy #23

Re-run all jobs

Annotations 1 warning

Search logs

Summary

build succeeded 8 minutes ago in 3m 20s

Set up job 5s

Checkout code 3s

Set up Docker Buildx 5s

Login to Docker Hub 1s

Extract Metadata 1s

Build and push 2m 59s

Post Build and push 0s

Post Log in to Docker Hub 0s

Post Set up Docker Buildx 3s

Post Checkout code 1s

Complete job 0s

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763/job/64452809008

All jobs

smoke-tests

build

Run details

Usage

Workflow file

Annotations

1 warning

build

succeeded 8 minutes ago in 3m 20s

Search logs

Set up job 5s

Checkout code 3s

Set up Docker Buildx 5s

Log in to Docker Hub 1s

- Run docker/login-action@v3
- Logging into docker.io...
- Login Succeeded!

Extract Metadata 1s

Build and push 2m 59s

Post Build and push 8s

- Post job cleanup.
- Removing temp folder /home/runner/work/_temp/docker-actions-toolkit-R0UNba
- Post cache

Post Log in to Docker Hub 8s

- Post job cleanup.
- Logout from docker.io
- Post cache

Post Set up Docker Buildx 3s

- Post job cleanup.
- Removing builder
- Cleaning up certificates
- Post cache

Post Checkout code 1s

github.com/cseniteshkumar/bitsMtech_MLOps_Assignment_2/actions/runs/22281482763/job/64452809008

All jobs

smoke-tests

build

Run details

Usage

Workflow file

CD Pipeline - Build & Deploy

CD Pipeline - Build & Deploy #23

Re-run all jobs

Annotations

1 warning

build

succeeded 8 minutes ago in 3m 20s

Search logs

Set up job 5s

Checkout code 3s

Set up Docker Buildx 5s

Log in to Docker Hub 1s

Extract Metadata 1s

Build and push 2m 59s

Post Build and push 8s

- Post job cleanup.
- Removing temp folder /home/runner/work/_temp/docker-actions-toolkit-R0UNba
- Post cache

Post Log in to Docker Hub 8s

- Post job cleanup.
- Logout from docker.io
- Post cache

Post Set up Docker Buildx 3s

- Post job cleanup.
- Removing builder
- Cleaning up certificates
- Post cache

Post Checkout code 1s

The screenshot shows the GitHub Actions dashboard for the repository 'bitsMtech_MLOps_Assignment_2'. The left sidebar contains navigation links for Code, Issues, Pull requests, Agents, Actions, Projects, Wiki, Security, Insights, and Settings. The main area displays 'All workflows' and '51 workflow runs'. The runs are listed in descending order of completion time, with the most recent at the top. Each run is represented by a card with a status icon, name, event, status, branch, and duration. A search bar at the top right allows filtering of workflow runs.

5. Smoke Test Log

```

niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum... ✘ niteshkumar@cseniteshkum...
$ cd /media/niteshkumar/SSD_Store_0_nvme/allPythoncodesWithPipEnv/BitsLearning/MLOps_Assignment_2/bitsMtech_MLOps_Assignment_2
$ pytest --cov=bitsMtech_MLOps_Assignment_2 --cov-report=html --cov-branch --log-level=INFO
Selected 38 items

tests/test_deployment.py::TestDeployment::test_app_startup PASSED [ 2%]
tests/test_deployment.py::TestDeployment::test_health_check PASSED [ 5%]
tests/test_deployment.py::TestDeployment::test_api_routes_exist PASSED [ 7%]
tests/test_deployment.py::TestDeployment::test_prediction_endpoint_exists PASSED [ 10%]
tests/test_deployment.py::TestDeployment::test_valid_prediction_request PASSED [ 13%]
tests/test_deployment.py::TestDeployment::test_invalid_prediction_request PASSED [ 15%]
tests/test_deployment.py::TestDeployment::test_empty_request PASSED [ 18%]
tests/test_deployment.py::TestDeployment::test_model_inference_consistency PASSED [ 21%]
tests/test_deployment.py::TestDeployment::test_concurrent_requests PASSED [ 23%]
tests/test_deployment.py::TestDeployment::test_large_input PASSED [ 26%]
tests/test_deployment.py::TestDeployment::test_special_values PASSED [ 28%]
tests/test_deployment.py::TestDeployment::test_model_loaded PASSED [ 31%]
tests/test_deployment.py::TestDeployment::test_config_loaded PASSED [ 34%]
tests/test_deployment.py::TestDeployment::test_response_headers PASSED [ 36%]
tests/test_deployment.py::TestDeployment::test_malformed_json PASSED [ 39%]
tests/test_deployment.py::TestErrorHandling::test_wrong_content_type PASSED [ 42%]
tests/test_deployment.py::TestErrorHandling::test_missing_required_fields PASSED [ 44%]
tests/test_smoke.py::TestSmokeTests::test_01_cnn_model_instantiation PASSED [ 47%]
tests/test_smoke.py::TestSmokeTests::test_02_cnn_model_structure PASSED [ 50%]
tests/test_smoke.py::TestSmokeTests::test_03_cnn_forward_pass PASSED [ 52%]
tests/test_smoke.py::TestSmokeTests::test_04_cnn_batch_inference PASSED [ 55%]
tests/test_smoke.py::TestSmokeTests::test_05_model_checkpoint_exists PASSED [ 57%]
tests/test_smoke.py::TestSmokeTests::test_06_model_checkpoint_loads PASSED [ 60%]
tests/test_smoke.py::TestSmokeTests::test_07_image_classifier_init PASSED [ 63%]
tests/test_smoke.py::TestSmokeTests::test_08_image_classifier_transforms PASSED [ 65%]
tests/test_smoke.py::TestSmokeTests::test_09_image_classifier_invalid_model_path PASSED [ 68%]
tests/test_smoke.py::TestSmokeTests::test_10_inference_with_valid_image PASSED [ 71%]
tests/test_smoke.py::TestSmokeTests::test_11_inference_output_structure PASSED [ 73%]
tests/test_smoke.py::TestSmokeTests::test_12_inference_probability_validity PASSED [ 76%]
tests/test_smoke.py::TestSmokeTests::test_13_inference_with_invalid_image PASSED [ 78%]
tests/test_smoke.py::TestSmokeTests::test_14_cpu_device_placement PASSED [ 81%]
tests/test_smoke.py::TestSmokeTests::test_15_cuda_device_if_available PASSED [ 84%]
tests/test_smoke.py::TestSmokeTests::test_16_normalization_parameters PASSED [ 86%]
tests/test_smoke.py::TestSmokeTests::test_17_image_transform_output PASSED [ 89%]
tests/test_smoke.py::TestSmokeTests::test_18_inference_speed PASSED [ 92%]
tests/test_smoke.py::TestSmokeTests::test_19_pytorch_available PASSED [ 94%]
tests/test_smoke.py::TestSmokeTests::test_20_pillow_available PASSED [ 97%]
tests/test_smoke.py::TestSmokeTests::test_20_pillow_available PASSED [100%]

```

6. Fast API with Docker/Kubernetes Deployment

Runs - Experiment 51669 × Dog vs Cat Classifier API - × Explore - prometheus - × +

http://127.0.0.1:8000/docs#

Dog vs Cat Classifier API 1.0.0 OAS 3.1

/openapi.json

Cat vs Dog Image Classification API

default

GET /metrics Metrics

GET / Read Root

predictions

GET /api/health Health Check

POST /api/predict Predict Image

GET /api/ Root

Schemas

Body_predict_image_api_predict_post > Expand all object

HTTPValidationError > Expand all object

HealthResponse > Expand all object

Runs - Experiment 51669 × Dog vs Cat Classifier API - × Explore - prometheus - × +

http://127.0.0.1:8000/docs#/predictions/health_check_api_health_get

Execute Clear

Responses

Curl

```
curl -X 'GET' \
  'http://127.0.0.1:8000/api/health' \
  -H 'accept: application/json'
```

Request URL

http://127.0.0.1:8000/api/health

Server response

Code Details

Undocumented TypeError: NetworkError when attempting to fetch resource.

Responses

Code	Description	Links
200	Successful Response	No links

Media type

application/json

Controls Accept header.

Example Value | Schema

```
{ "status": "string", "model_loaded": true }
```

POST /api/predict Predict Image

GET /api/ Root

Runs - Experiment 51669 | Dog vs Cat Classifier API - Explore - prometheus - + http://127.0.0.1:8000/docs#/predictions/predict_image_api_predict_post

POST /api/predict Predict Image

Predict if uploaded image is a cat or dog

Args: file (jpg, jpeg, png)

Returns: Prediction result with confidence scores

Parameters

No parameters

Request body required

file required
string(\$binary)

Responses

Code	Description	Links
200	Successful Response	No links

Media type

application/json

Controls Accept header.

Example Value | Schema

```
{ "cat_probability": 0.0124, "confidence": 0.9876, "dog_probability": 0.9876, "prediction": "dog", "success": true }
```

Try it out

multipart/form-data

Runs - Experiment 51669 | Dog vs Cat Classifier API - Explore - prometheus - + http://127.0.0.1:8000/docs#/predictions/predict_image_api_predict_post

Returns: Prediction result with confidence scores

Parameters

No parameters

Request body required

file required
string(\$binary) No file selected.

Responses

Code	Description	Links
200	Successful Response	No links
422	Validation Error	No links

Media type

application/json

Controls Accept header.

Example Value | Schema

```
{ "cat_probability": 0.0124, "confidence": 0.9876, "dog_probability": 0.9876, "prediction": "dog", "success": true }
```

Cancel Reset

File Upload - Dog vs Cat Classifier API - Swagger UI - P... Select

Recent

Home Desktop Documents Downloads Music Pictures Videos Assignments Other Locations

36.jpg 35.jpg 34.jpg

33.jpg 32.jpg 31.jpg

30.jpg 3.jpg 29.jpg

All Files

The screenshot shows the "Explore" feature of an API documentation tool. A POST request is being made to `http://127.0.0.1:8000/api/predict`. The "Responses" section includes a "Curl" command and a "Request URL". Below this, the "Server response" section shows two entries: a successful response (200) and a validation error (422). Each entry includes a "Code" column, a "Description" column, a "Media type" dropdown set to "application/json", and an "Example Value" section with a JSON schema and example.

Code	Description	Links
200	Successful Response	No links
422	Validation Error	No links

7. Docker and Kubernetes

The screenshot shows the Docker Hub interface for the repository `cseniteshkumar/mllopsassignment2`. The repository has 183 stars and was last pushed 1 minute ago. It contains 9 tags. The "General" tab is selected, showing a table of tags with columns: Tag, OS, Type, Pulled, and Pushed. The repository page also features a sidebar with user information and navigation links like Billing, Usage, Pulls, and Storage. A sidebar on the right promotes "buildcloud" and Docker Build Cloud.

Tag	OS	Type	Pulled	Pushed
sha-44d5fd1		Image	less than 1 day	1 minute
latest		Image	less than 1 day	1 minute
sha-947e76d		Image	less than 1 day	16 minutes
sha-b911ed1		Image	less than 1 day	29 minutes
sha-a207b73		Image	less than 1 day	about 1 hour

hub.docker.com/repository/docker/cseniteshkumar/mlopsassignment2/tags

Hardened Images Add a description

Collaborations Add a category

Settings

Default privacy

Notifications

Billing Usage Pulls Storage

General Tags Image Management Collaborators Webhooks Settings

Sort by Newest Filter tags Delete

TAG sha-44d5fd1 Last pushed 6 minutes by cseniteshkumar

Digest OS/ARCH Last pull Compressed size

457a61a2697a linux/amd64 less than 1 day 3.83 GB

TAG latest Last pushed 6 minutes by cseniteshkumar

Digest OS/ARCH Last pull Compressed size

457a61a2697a linux/amd64 less than 1 day 3.83 GB

TAG sha-947e76d Last pushed 21 minutes by cseniteshkumar

Digest OS/ARCH Last pull Compressed size

b1b674188860 linux/amd64 less than 1 day 3.83 GB

hub.docker.com/u/cseniteshkumar

Explore My Hub Search Docker Hub CtrlK

cseniteshkumar Edit profile Community User

Repositories Starred

Search by repository name Displaying 1 to 2 of 2 repositories

IMAGE cseniteshkumar/mlopsassignment2 cseniteshkumar

Pulls 193 Stars 0 Last Updated 7 minutes

IMAGE cseniteshkumar/fastapi_mlopsassignment2 cseniteshkumar

Pulls 17 Stars 0 Last Updated about 4 hours

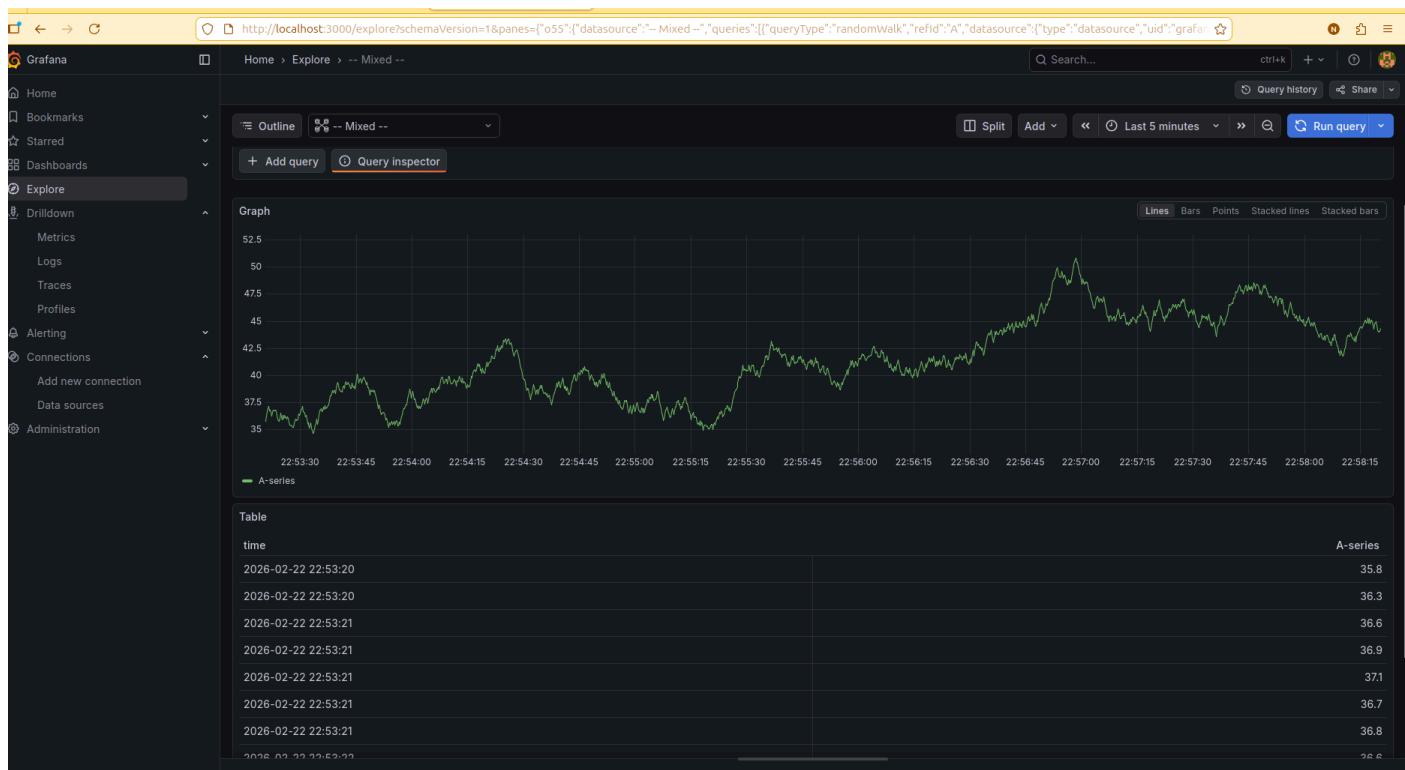
While internal system testing

8. Grafana Tracker

The screenshot shows the Grafana interface with the following details:

- Left Sidebar:** Contains navigation links for Home, Bookmarks, Starred, Dashboards, Explore (selected), Drilldown, Metrics, Logs, Traces, Profiles, Alerting, Connections, and Administration.
- Header:** Shows the URL [http://localhost:3000/explore?schemaVersion=1&panes=\[{"o55": {"datasource": "efe0trsua4n4c", "queries": \[{"refid": "A", "expr": "1", "range": true, "instant": true, "datasource": "prometheus", "type": "prometheus"}\]}\]}](http://localhost:3000/explore?schemaVersion=1&panes=[{), a search bar, and various UI icons.
- Main Content Area:** The "Explore" section for the "prometheus" datasource. It includes:
 - A top bar with "Outline", a dropdown for "prometheus", a "Go queryless" button, and "Split", "Add", and "Last 5 minutes" buttons.
 - A query builder with "Metric" and "Label filters" dropdowns, and a "Select metric" dropdown.
 - An "Operations" button.
 - Query options: Options, Legend: Auto, Format: Time series, Step: auto, Type: Both, Exemplars: false.
 - A "Add query" button and a "Query inspector" tab.
 - A "Stats" tab showing performance metrics:

Total request time	2 ms
Number of queries	0
Total number rows	0



9. Repository Structure

The screenshot shows a GitHub code editor interface. The left sidebar displays a project structure with several files and folders under 'src'. The right panel shows the content of 'dataValidation.py'. The code is a Python script for data validation, including imports for sys, os, pathlib, pandas, and numpy, and a function 'validate_heart_data' that performs logical checks on a DataFrame.

```

1  """Data validation.
2  """
3  import sys
4  import os
5
6  import pathlib
7
8  sys.path.append(os.path.abspath(os.path.join(os.path.dirname(__file__), '..')))
9
10 import pandas as pd
11 import numpy as np
12
13 from src.dataRead import load_dataset
14 from src.dataClean import clean_data
15
16
17 def validate_heart_data(df):
18     """
19         Performs logical checks to ensure data integrity.
20         Returns True if valid, raises an error or prints warnings otherwise.
21     """
22     validation_passed = True
23
24     # Check 1: No missing values
25     if df.isnull().values.any():
26         print("Validation Failed: Missing values detected.")
27         validation_passed = False
28
29     # Check 2: Logical ranges for medical vitals
30     # (e.g., Blood pressure 'restbps' usually between 80 and 200)
31     if not df['restbps'].between(50, 250).all():
32         print("Validation Warning: Outlier detected in Blood Pressure.")
33
34

```

Data Versioning (DVC)

The screenshot shows the VS Code interface with the 'EXPLORER' view open. It lists various files and folders, with 'DataFiles.dvc' highlighted in blue, indicating it is tracked by DVC. The 'DATAFILES.dvc' tab in the editor shows its content, which includes details like 'outs', 'md5', 'size', 'nfiles', and 'hash'.

```

1  You, yesterday | author (You)
2  2 - outs: You, yesterday * Add DVC pointer for DataFiles ...
3  3 - md5: 855d528753b8d0d9da88003a015da934.dir
4  4 - size: 1713465767
5  5 - nfiles: 37625
6  6 - hash: md5
7  7 - path: DataFiles

```

Requirements_Pinned.txt

EXPLORER

BITSMTECH_MLOPS_ASSIGNMENT_2

- .dvc
- .gitignore
- config
- .github
- .ipynb_checkpoints
- .mlopsAssignment2Env
- .pytest_cache
- .vscode
- app
- artifacts
 - cnn_model_full.pt
 - cnn_model.pt
- Back_Code_Files
- Datafiles
- grafana
- htmlcov
- k8s
 - deployment.yaml
 - service.yaml
- logs
- mlruns
- temp_uploads
- tests
- .coverage
- .dockeringore
 - .gitignore
- .coverage.xml
- dataExploration.ipynb
- ! Datafiles.dvc
- docker-compose.yml
- Dockerfile
- milflow.db
- modeTraining.ipynb
- ! prometheus.yml
- pytest.ini
- README.md
- requirements_fastapi.txt
- requirements_pinned.txt
- requirements.txt

OUTLINE

TIMELINE

DVC TRACKED

requirements_pinned.txt

```
1 a2wsgl==1.10.10
2 about-time==4.2.1
3 absl-py==2.4.0
4 addic==2.4.0
5 aiohttpcore==2.26.0
6 aiohappy eyeballs==2.13.3
7 aiohttp==3.13.3
8 aiohttp-asgi-connector==1.1.2
9 aiohttp-retry==2.9.1
10 aioitertools==0.13.0
11 aiosignal==1.4.0
12 aiosqlite==0.22.1
13 alabaster==1.0.0
14 albucore==0.0.24
15 albumen tations==2.0.8
16 alembic==1.18.4
17 alive-progress==3.3.0
18 amqp==5.3.1
19 annotated-doc==0.0.4
20 annotated-types==0.7.0
21 antlr4-python3-runtime==4.9.3
22 anyio==4.12.1
23 appdirs==1.4.4
24 argon2-cffi==25.1.0
25 argon2-cffi-bindings==25.1.0
26 arrow==1.4.0
27 aspiref==3.11.1
28 astroid==4.0.4
29 asttokens==3.8.1
30 astunparse==1.6.3
31 asyncio-lru==2.2.0
32 asynccssh==2.22.0
33 atpublic==7.0.0
34 attrs==25.4.0
35 autograd==1.0
36 autopkg==2.1.2
37 ax-platforme==1.2.3
38 babel==2.18.0
39 beautifulsoup4==4.14.3
40 bentoml==1.4.35
41 billiard==4.2.4
42 black==26.1.0
43 bleach==6.3.0
44 blinker==1.9.0
45 bokeh==3.8.2
46 boto==1.41.5
47 botocore==1.41.5
48 botorch==0.17.0
49 cachetools==7.0.1
50 catboost==1.2.10
51 catfram==23.1.2
```

EXPLORER

BITSMTECH_MLOPS_ASSIGNMENT_2

- .dvc
- .gitignore
- config
- .github
- .ipynb_checkpoints
- .mlopsAssignment2Env
- .pytest_cache
- .vscode
- app
- artifacts
 - cnn_model_full.pt
 - cnn_model.pt
- Back_Code_Files
- Datafiles
- grafana
- htmlcov
- k8s
 - deployment.yaml
 - service.yaml
- logs
- mlruns
- temp_uploads
- tests
- .coverage
- .dockeringore
 - .gitignore
- .coverage.xml
- dataExploration.ipynb
- ! Datafiles.dvc
- docker-compose.yml
- Dockerfile
- milflow.db
- modeTraining.ipynb
- ! prometheus.yml
- pytest.ini
- README.md
- requirements_fastapi.txt
- requirements_pinned.txt
- requirements.txt

OUTLINE

TIMELINE

DVC TRACKED

.gitignore

```
You, 33 minutes ago | 1 author (You)
1 # =====
2 # PYTHON ENVIRONMENT & PACKAGES
3 # =====
4 # Virtual environment directories
5 .mlopsAssignment2Env/
6 .mlopsAssignment2Env/
7 .mlopsAssignment2Env/*
8
9
10 # =====
11 # IDE & EDITOR SPECIFIC
12 # =====
13 # VSCode
14 .vscode/
15 *.code-workspace
16 .vscode-server/
17
18 # =====
19 # Training artifacts / Data Files
20 # =====
21 # *
22 *.jpg
23 *.jpeg
24 *.png
25 *.zip
26
27
28 # =====
29 # JUPYTER NOTEBOOKS
30 # =====
31 # ipynb checkpoints/
32 # *.ipynb
33 desktop.ini
34
35
36 # =====
37 # LOGGING & OUTPUT
38 # =====
39 /logs/
40 /log/
41 *.log
42 *.log.*
43 nohup.out
44 logs.txt
45
46 # # Output and Results
47 # /output/
48 # /outputs/
```

EXPLORER

- BITSMTECH_MLOPS_ASSIGNMENT_2
 - .github
 - .ipynb_checkpoints
 - .mlopsAssignment2Env
 - .pytest_cache
 - .vscode
 - app
 - artifacts
 - cnn_model_full.pt
 - cnn_model.pt
 - Back_Code_Files
 - Datafiles
 - grafana
 - htmlcov
 - kbs
 - logs
 - 20260221-211828 / train
 - events.out.tfevents.177168915.cseniteshkumar1.18973...
 - 20260221-21254 / train
 - events.out.tfevents.1771689360.cseniteshkumar1.19418...
 - 20260221-213033
 - 20260221-213258
 - 20260221-213546
 - mirluns
 - trash
 - S16697590595924749
 - models
 - temp_uploads
 - tests
 - .coverage
 - .dockerrignore
 - .drvignore
 - .gitignore
 - coverage.xml
 - dataExploration.ipynb
 - DataFiles.dvc
 - docker-compose.yml
 - Dockerfile
 - mlflow.db
 - modelTraining.ipynb
- OUTLINE
- TIMELINE
- DVC TRACKED

The file is not displayed in the text editor because it is either binary or uses an unsupported text encoding.

[Open Anyway](#)

EXPLORER

- BITSMTECH_MLOPS_ASSIGNMENT_2
 - .pytest_cache
 - .vscode
 - app
 - artifacts
 - cnn_model_full.pt
 - cnn_model.pt
 - Back_Code_Files
 - Datafiles
 - grafana
 - htmlcov
 - kbs
 - logs
 - mirluns
 - trash
 - S16697590595924749
 - 3a7439b5a77647fea84dd31411da515
 - 3ce8390c0cdf451eb9e30184339439c3
 - 5cc430acbeed4e98bd5edbe524c5a26d
 - artifacts
 - inputs
 - 8d1923f4c3158c168cafd8308ff9b3c
 - a33d0ef3b6a52e5b7915e009744733b7
 - ff7175b465b06b1a69591c8da488efce
 - metrics
 - params
 - tags
 - .yaml
 - 14bdd3bf5084b62b00c94d665e542d3
 - 46caf6b012cd2db3445671a1588d
 - 53e5c6a4879a44659a7b71b057132d5
 - 7113f950c04e4329ab8d0135514b6e
 - 8230a0097cab45c881b24507d773ebce
 - 91252fe0d304a4771a23946cc135bf8e
 - 2455440f02a46e0b0beb3de6f67a2
 - 1725423779e74cd5929c4ed2d2eab3546
 - ce519bf7264b44a9fb9dbd918ef6
 - d4bd34d3b0e4c50af690b0947b2bd9a
 - datasets
 - _af7a1a332222774rrrhv977rlz3wle27f2%
 - OUTLINE
 - TIMELINE
 - DVC TRACKED

EXPLORER

- BITSMTECH_MLOPS_ASSIGNMENT_2
 - mlruns
 - tags
 - meta.yaml
 - params
 - artifacts
 - models
 - temp_uploads
 - tests
 - .coverage
 - .dockeringrone
 - .dvcignore
 - .gitignore
 - coverage.xml
 - dataExploration.ipynb
 - Datafiles.dvc
 - docker-compose.yml
 - Dockerfile
 - mlflow.db
 - modelTraining.ipynb
 - prometheus.yml
 - pytest.ini
 - README.md
 - requirements_fastapi.txt
 - requirements_pinned.txt
 - requirements.txt

! meta.yaml

```

1 conda metadata build recipe - conda's meta.yaml file; https://conda.io/docs/user-guide/tasks/build-packages/define-metadata.html (conda-meta.json) You, yesterday | 1 author (You)
2 artifact_location: file:///media/niteshkumar/SSD_Store_0_nvme/allPythoncodesWithPipEnv/BitsLearning/MLOps_Assignment_2/bitsMtech_MLOps_
3 creation_time: 1771685561004
4 experiment_id: '516697590595924749'
5 lifecycle_stage: active
6 name: CNN_Model_Training_Experiment
7 workspace: default
8

```

artifacts Aa ab No results

EXPLORER

- BITSMTECH_MLOPS_ASSIGNMENT_2
 - .dvc
 - cache
 - tmp
 - .gitignore
 - config
 - ipynb_checkpoints
 - .mlopsAssignment2Env
 - .pytest_cache
 - .vscode
 - app
 - artifacts
 - cnn_model_full.pt
 - cnn_model.pt
 - Back_Code_Files
 - Datafiles
 - grafana
 - htmlcov
 - k8s
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 - tests
 - .coverage
 - .dockeringrone
 - .dvcignore
 - .gitignore
 - coverage.xml
 - dataExploration.ipynb
 - Datafiles.dvc
 - docker-compose.yml
 - Dockerfile
 - mlflow.db
 - modelTraining.ipynb
 - prometheus.yml
 - pytest.ini
 - README.md
 - requirements_fastapi.txt
 - requirements_pinned.txt
 - requirements.txt

! README.md

```

1 You, 9 hours ago | author (You)
2
3 . NITESH KUMAR ----- 2024AA05143 ----- 100%
4 . LAWLESH KUMAR ----- 2024AA05149 ----- 100%
5 . VAIBHAV SAREEN ----- 2024AA050923 ----- 100%
6 . VIVEK TRivedi ----- 2024AA05922 ----- 100%
7 . BINDU MANOJ ----- 2024AA05979 ----- 100%
8
9 You, 9 hours ago + Docker and Readme
10 # MLOps Assignment 2 - Cat vs Dog Image Classifier API
11
12 A production-ready machine learning inference service for classifying cat and dog images, built with FastAPI and PyTorch. The project includes comprehensive MLOps practices including containerization, monitoring, testing, and CI/CD readiness.
13
14 ## 🌐 Overview
15
16 This project implements a complete MLOps pipeline for image classification:
17
18 - **Machine Learning**: CNN model trained on cat vs dog dataset using PyTorch
19 - **API Service**: FastAPI-based REST API for real-time inference
20 - **Monitoring**: Prometheus metrics collection and Grafana visualization
21 - **Containerization**: Docker and Docker Compose for easy deployment
22 - **Testing**: Comprehensive unit and integration tests with pytest
23 - **Experiment Tracking**: MLflow for model versioning and experiment tracking
24 - **Data Versioning**: DVC (Data Version Control) for dataset management
25
26
27
28
29 ## 🏠 Architecture
30
31 ...
32
33
34 Client (Browser) --> FastAPI Service --> PyTorch Model
35
36
37
38
39
40
41
42
43
44
45
46
47

```