MRI Brain Tumor Classification using Deep Learning

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1. Import Required Libraries

```
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import torch
import torchvision
from torchvision import transforms, models
import torch.nn as nn
import torch.optim as optim
from sklearn.metrics import accuracy_score

import numpy as np
import pandas as pd
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        os.path.join(dirname, filename)

import kagglehub
orvile_brain_cancer_mri_dataset_path =
kagglehub.dataset_download('orvile/brain-cancer-mri-dataset')
print('Data source import complete.')
```

```
Data source import complete.
```

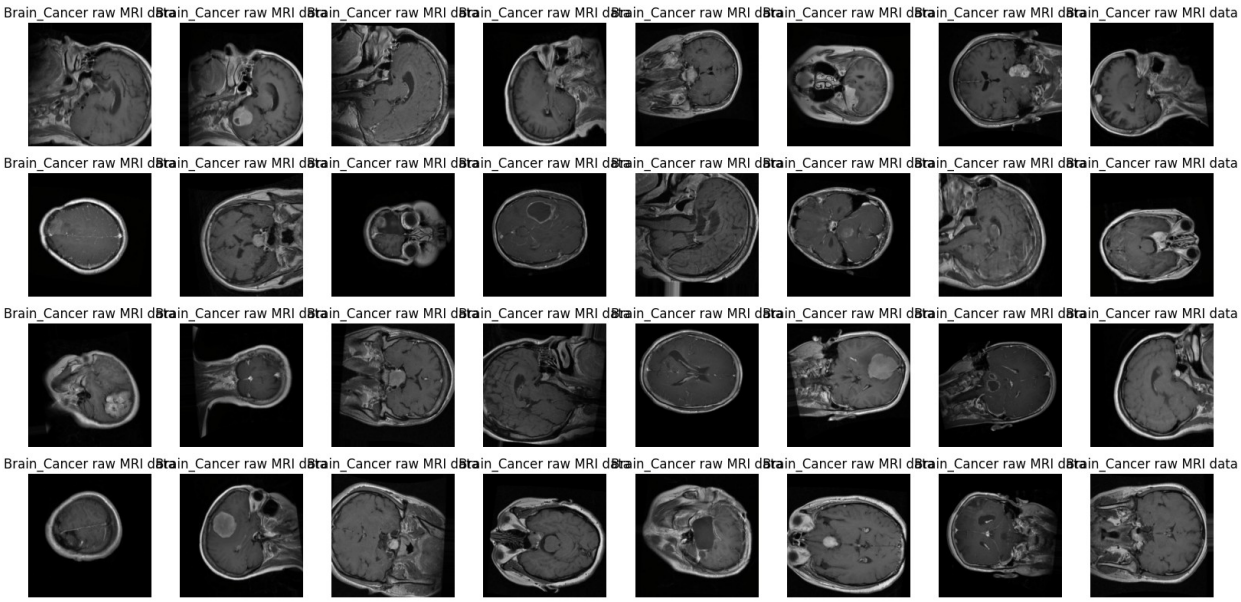
Define Image Transformations and Prepare Dataset

```
import torchvision.transforms as transforms
import torchvision
import torch

LABELS = ['brain_tumor', 'brain_glioma', 'brain_menin']

# Define transformation
transform = transforms.Compose([
    transforms.Resize((256, 256)),
    transforms.ToTensor(),
    transforms.Normalize(mean=[0.485, 0.456, 0.406],
                         std=[0.229, 0.224, 0.225])
```

```
])

# Load dataset
data_dir = orvile_brain_cancer_mri_dataset_path # Use the path from
the previous cell
dataset = torchvision.datasets.ImageFolder(root=data_dir,
transform=transform)

# Split dataset
train_size = int(0.8 * len(dataset))
test_size = len(dataset) - train_size
train_data, test_data = torch.utils.data.random_split(dataset,
[train_size, test_size])

BATCH_SIZE = 32

train_loader = torch.utils.data.DataLoader(train_data,
batch_size=BATCH_SIZE, shuffle=True)
test_loader = torch.utils.data.DataLoader(test_data,
batch_size=BATCH_SIZE, shuffle=False)
```

Visualize Sample Images

```
def img_inv(image):
    image = image.numpy().transpose((1, 2, 0))
    mean = np.array([0.485, 0.456, 0.406])
    std = np.array([0.229, 0.224, 0.225])
    image = image * std + mean
    return np.clip(image, 0, 1)

images, labels = next(iter(train_loader))

fig, axs = plt.subplots(4, 8, figsize=(16, 8))
for i, ax in enumerate(axs.flat):
    ax.imshow(img_inv(images[i]))
    ax.set_title(dataset.classes[labels[i]])
    ax.axis("off")
plt.tight_layout()
plt.show()
```



Model Traing and Testing

```
# Using pretrained ResNet18
model = models.resnet18(pretrained=True)

# Freeze early layers (optional for better generalization)
for param in model.parameters():
    param.requires_grad = False

# Replace final layer
num_ftrs = model.fc.in_features
model.fc = nn.Linear(num_ftrs, len(LABELS))

device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
model = model.to(device)
```

```
/usr/local/lib/python3.11/dist-packages/torchvision/models/
_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated
since 0.13 and may be removed in the future, please use 'weights'
instead.
  warnings.warn(
/usr/local/lib/python3.11/dist-packages/torchvision/models/_utils.py:2
23: UserWarning: Arguments other than a weight enum or `None` for
'weights' are deprecated since 0.13 and may be removed in the future.
The current behavior is equivalent to passing
`weights=ResNet18_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet18_Weights.DEFAULT` to get the most up-to-date weights.
  warnings.warn(msg)
Downloading: "https://download.pytorch.org/models/resnet18-
f37072fd.pth" to /root/.cache/torch/hub/checkpoints/resnet18-
f37072fd.pth
100%|██████████| 44.7M/44.7M [00:00<00:00, 182MB/s]
```

```
criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.fc.parameters(), lr=0.001)

EPOCHS = 10

for epoch in range(EPOCHS):
    model.train()
    total_loss = 0
    for images, labels in train_loader:
        images, labels = images.to(device), labels.to(device)

        optimizer.zero_grad()
        outputs = model(images)
        loss = criterion(outputs, labels)
        loss.backward()
        optimizer.step()

        total_loss += loss.item()

    print(f'Epoch {epoch+1}/{EPOCHS}, Loss:
{total_loss/len(train_loader):.4f}')
```

```
Epoch 1/10, Loss: 0.0122
Epoch 2/10, Loss: 0.0001
Epoch 3/10, Loss: 0.0001
Epoch 4/10, Loss: 0.0001
Epoch 5/10, Loss: 0.0000
Epoch 6/10, Loss: 0.0000
Epoch 7/10, Loss: 0.0000
Epoch 8/10, Loss: 0.0000
Epoch 9/10, Loss: 0.0000
Epoch 10/10, Loss: 0.0000
```

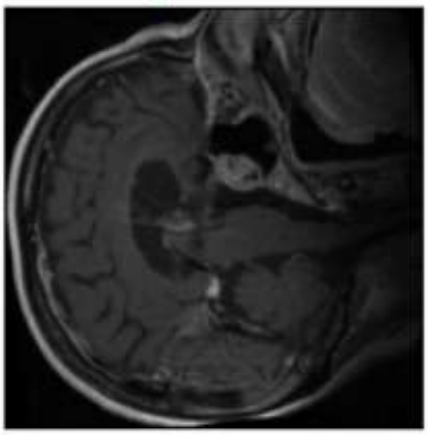
```
model.eval()
y_true = []
y_pred = []

with torch.no_grad():
    for images, labels in test_loader:
        images = images.to(device)
        outputs = model(images)
        _, preds = torch.max(outputs, 1)

        y_true.extend(labels.cpu().numpy())
        y_pred.extend(preds.cpu().numpy())

accuracy = accuracy_score(y_true, y_pred)
print(f'Test Accuracy: {accuracy*100:.2f}%')
```

```
Test Accuracy: 100.00%
```

Visualize Random Predictions

```
# Predict on test_data (single samples)
model.eval()
pred = []
y_test = []

for i in range(len(test_data)):
    image, label = test_data[i]
    image = image.unsqueeze(0).to(device)
    with torch.no_grad():
        output = model(image)
        _, predicted = torch.max(output, 1)
        pred.append(predicted.item())
        y_test.append(label)

# Display random predictions
rand_indices = np.random.choice(len(pred), size=min(15, len(pred)),
replace=False)
plt.figure(figsize=(10, min(30, 2 * len(rand_indices))))

for i, index in enumerate(rand_indices):
    image_tensor = test_data[index][0].to('cpu')
    image = img_inv(image_tensor)
    plt.subplot(len(rand_indices), 1, i + 1)
    plt.imshow(image)
    plt.xticks([]), plt.yticks([])

    predicted_class = dataset.classes[int(pred[index])]
    true_class = dataset.classes[int(y_test[index])]
    color = 'green' if predicted_class == true_class else 'red'
    plt.title(f'True: {true_class} | Predicted: {predicted_class}',
color=color, fontsize=12)

plt.tight_layout()
plt.show()
```

True: Brain_Cancer raw MRI data | Predicted: Brain_Cancer raw MRI data



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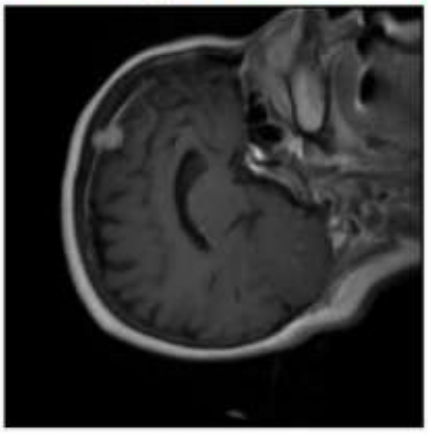

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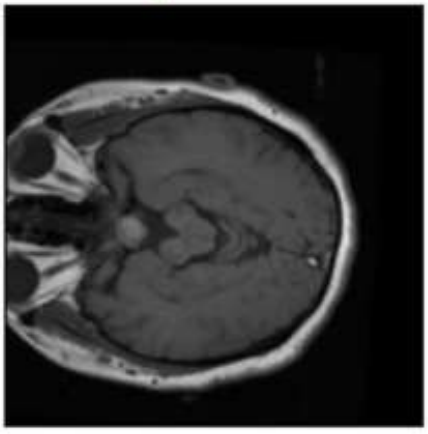

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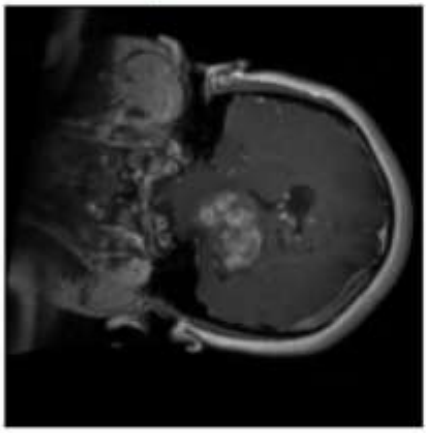

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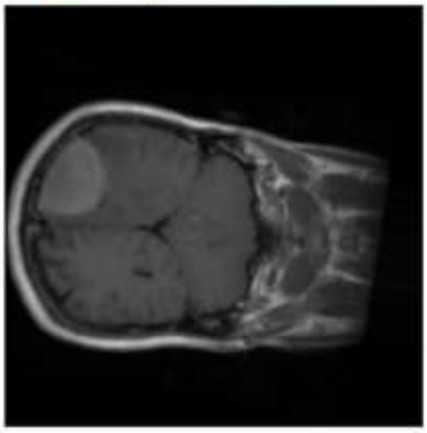

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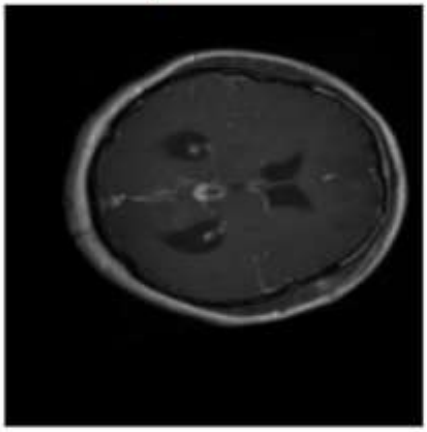

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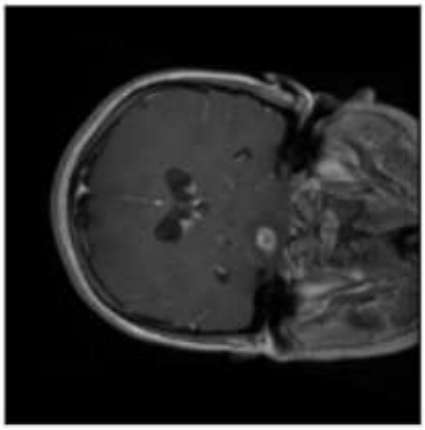

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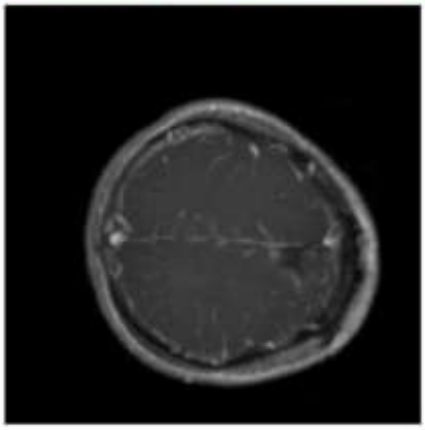

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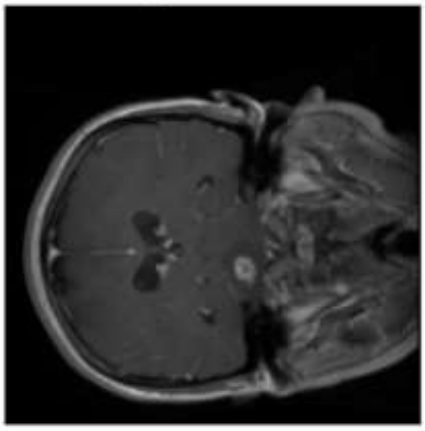

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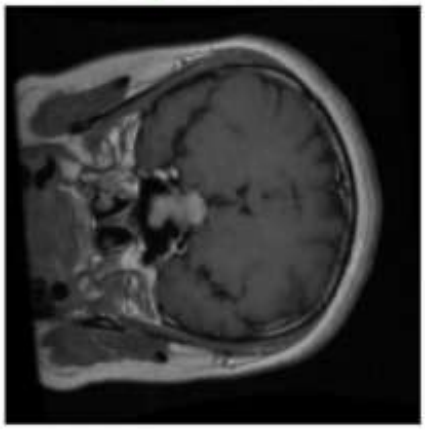

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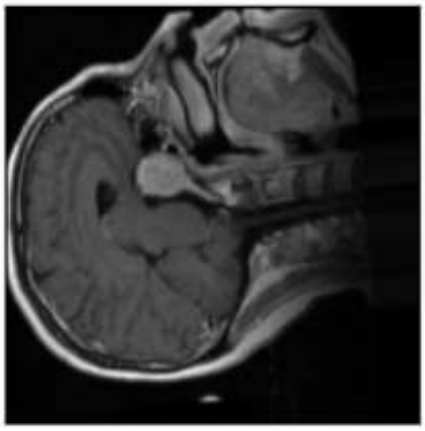

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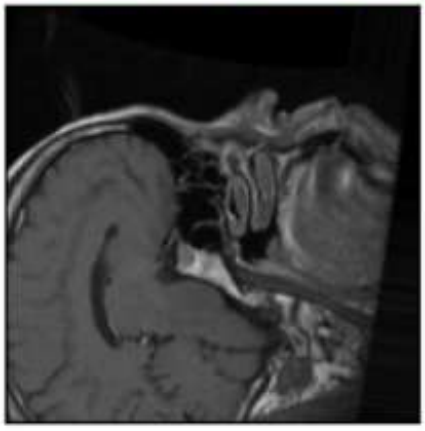

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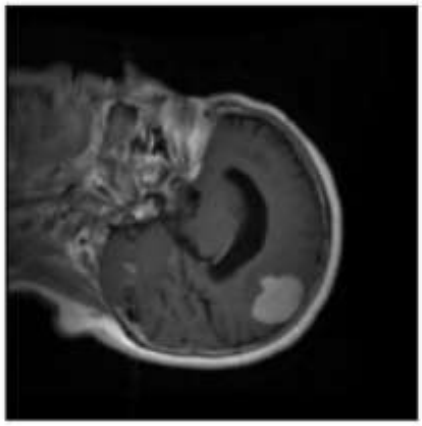

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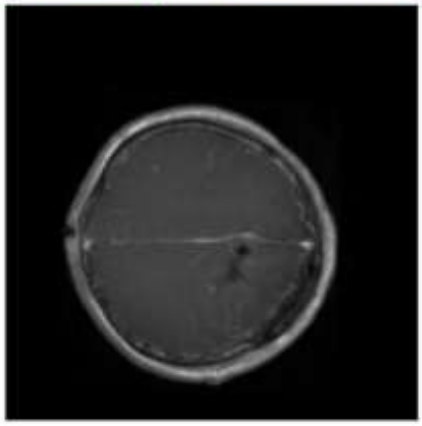

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