```
!pip install -q nest_asyncio
import nest_asyncio
nest_asyncio.apply()
```

```
!pip install -q transformers torch torchvision pillow gradio
```

```
import torch
import torch.nn as nn
from transformers import AutoModel, ViTModel

class MultiModalSentimentModel(nn.Module):
    def __init__(self, num_labels=3):
        super(MultiModalSentimentModel, self).__init__()

        self.text_encoder = AutoModel.from_pretrained("distilbert-base-uncased")


        self.image_encoder = ViTModel.from_pretrained("google/vit-base-patch16-224-in21k")

        self.classifier = nn.Sequential(
            nn.Linear(768 + 768, 512),
            nn.ReLU(),
            nn.Dropout(0.2),
            nn.Linear(512, num_labels)
        )

    def forward(self, text_input, image_input):

        text_outputs = self.text_encoder(**text_input)
        text_feats = text_outputs.last_hidden_state[:, 0, :]


        image_outputs = self.image_encoder(pixel_values=image_input)
        image_feats = image_outputs.last_hidden_state[:, 0, :]


        combined_feats = torch.cat((text_feats, image_feats), dim=1)


        logits = self.classifier(combined_feats)
        return logits

# Initialize model and move to GPU
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
model = MultiModalSentimentModel().to(device)
print(f"Model loaded on {device}")
```

```
/usr/local/lib/python3.12/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (https://huggingface.co/settings/tokens), set
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
  warnings.warn(
config.json: 100%                                   483/483 [00:00<00:00, 36.6kB/s]
model.safetensors: 100%                                   268M/268M [00:02<00:00, 141MB/s]
Loading weights: 100%                              100/100 [00:00<00:00, 471.10it/s, Materializing param=transformer.layer.5.sa_layer_norm.weight]
DistilBertModel LOAD REPORT from: distilbert-base-uncased
Key                      | Status     |  |
-------------------------+------------+--+-
vocab_layer_norm.weight | UNEXPECTED |  |
vocab_transform.weight  | UNEXPECTED |  |
vocab_projector.bias    | UNEXPECTED |  |
vocab_layer_norm.bias   | UNEXPECTED |  |
vocab_transform.bias    | UNEXPECTED |  |

Notes:
- UNEXPECTED    :can be ignored when loading from different task/architecture; not ok if you expect identical arch.
config.json: 100%                                   502/502 [00:00<00:00, 22.4kB/s]
model.safetensors: 100%                                   346M/346M [00:03<00:00, 140MB/s]
Loading weights: 100%                                   200/200 [00:00<00:00, 575.24it/s, Materializing param=pooler.dense.weight]
Model loaded on cpu
```

```
from transformers import AutoTokenizer, ViTImageProcessor

tokenizer = AutoTokenizer.from_pretrained("distilbert-base-uncased")
feature_extractor = ViTImageProcessor.from_pretrained("google/vit-base-patch16-224-in21k")
```

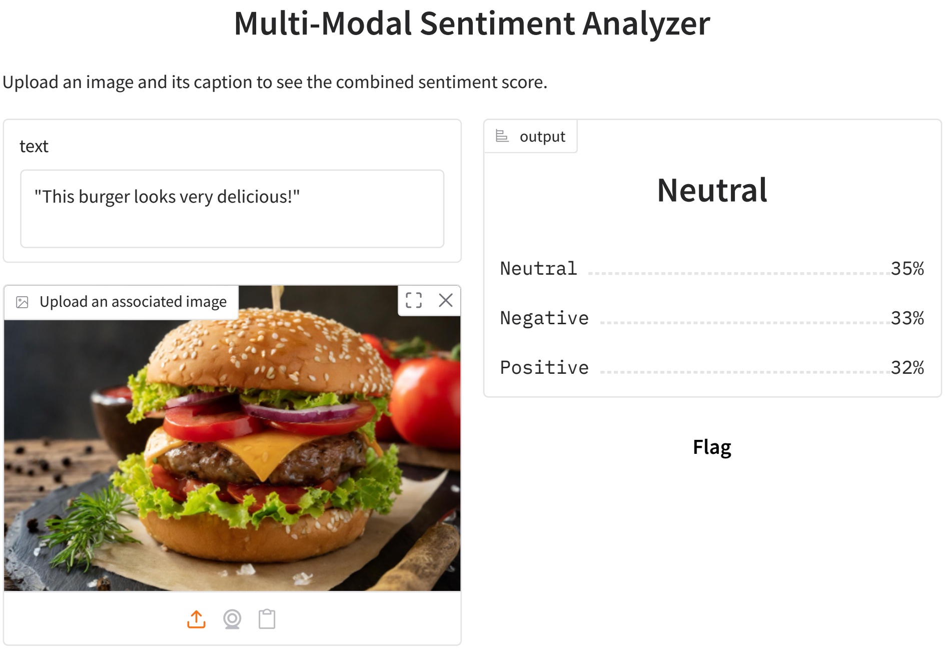
```
def preprocess_data(text, image):

    inputs_text = tokenizer(text, return_tensors="pt", padding=True, truncation=True).to(device)

    inputs_image = feature_extractor(images=image, return_tensors="pt")['pixel_values'].to(device)
    return inputs_text, inputs_image
```

```
tokenizer_config.json: 100%                                    48.0/48.0 [00:00<00:00, 1.34kB/s]
vocab.txt: 100%                                    232k/232k [00:00<00:00, 1.31MB/s]
tokenizer.json: 100%                                    466k/466k [00:00<00:00, 4.31MB/s]
Warning: You are sending unauthenticated requests to the HF Hub. Please set a HF_TOKEN to enable higher rate limits and fast
WARNING:huggingface_hub.utils._http:Warning: You are sending unauthenticated requests to the HF Hub. Please set a HF_TOKEN t
preprocessor_config.json: 100%                                    160/160 [00:00<00:00, 1.62kB/s]
```

```
def predict_sentiment(text, image):
    model.eval()
    with torch.no_grad():
        txt_in, img_in = preprocess_data(text, image)
        outputs = model(txt_in, img_in)


        probs = torch.nn.functional.softmax(outputs, dim=1)
        conf, classes = torch.max(probs, dim=1)

        labels = ["Negative", "Neutral", "Positive"]
        return {labels[i]: float(probs[0][i]) for i in range(3)}
```

```
import gradio as gr

demo = gr.Interface(
    fn=predict_sentiment,
    inputs=[
        gr.Textbox(lines=2, placeholder="Enter text (e.g., 'I love this new phone design!')"),
        gr.Image(type="pil", label="Upload an associated image")
    ],
    outputs=gr.Label(num_top_classes=3),
    title="Multi-Modal Sentiment Analyzer",
    description="Upload an image and its caption to see the combined sentiment score."
)

demo.launch(debug=True)
```

```
It looks like you are running Gradio on a hosted Jupyter notebook, which requires `share=True`. Automatically setting `share

Colab notebook detected. This cell will run indefinitely so that you can see errors and logs. To turn off, set debug=False i
* Running on public URL: https://4f003ff9f8e7e2ae54.gradio.live

This share link expires in 1 week. For free permanent hosting and GPU upgrades, run `gradio deploy` from the terminal in the
```



Multi-Modal Sentiment Analyzer

Upload an image and its caption to see the combined sentiment score.

text

"This burger looks very delicious!"

Upload an associated image

output

Neutral

```
Neutral .................... 35%
Negative ................... 33%
Positive ................... 32%
```

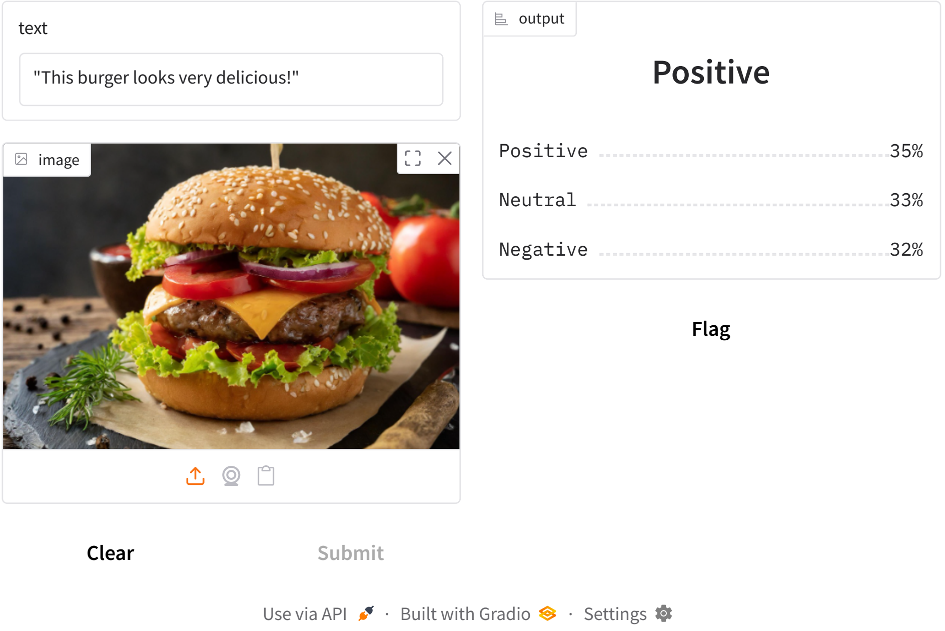
```
Keyboard interruption in main thread... closing server.
Killing tunnel 127.0.0.1:7860 <> https://4f003ff9f8e7e2ae54.gradio.live
```

Next steps: Deploy to Cloud Run

```
import torch.optim as optim

def train_to_correct(model, text_list, image_tensors, labels, epochs=10):
    model.train()
    optimizer = optim.AdamW(model.parameters(), lr=5e-5) # AdamW is standard for Transformers
    criterion = nn.CrossEntropyLoss()


    for epoch in range(epochs):
        total_loss = 0
        for i in range(len(text_list)):
            optimizer.zero_grad()


            txt_in, img_in = preprocess_data(text_list[i], image_tensors[i])
            target = torch.tensor([labels[i]]).to(device)


            outputs = model(txt_in, img_in)
            loss = criterion(outputs, target)


            loss.backward()
            optimizer.step()
            total_loss += loss.item()

        if (epoch + 1) % 2 == 0:
            print(f"Epoch {epoch+1}/{epochs} | Avg Loss: {total_loss/len(text_list):.4f}")
```

```
import nest_asyncio
nest_asyncio.apply()

demo = gr.Interface(
    fn=predict_sentiment,
    inputs=[gr.Textbox(), gr.Image(type="pil")],
    outputs=gr.Label(),
)

demo.launch(share=True, debug=False, inline=True)
```

```
Colab notebook detected. To show errors in colab notebook, set debug=True in launch()
* Running on public URL: https://cdfb9e82c0833674b4.gradio.live

This share link expires in 1 week. For free permanent hosting and GPU upgrades, run `gradio deploy` from the terminal in the
```



text

"This burger looks very delicious!"

image

output

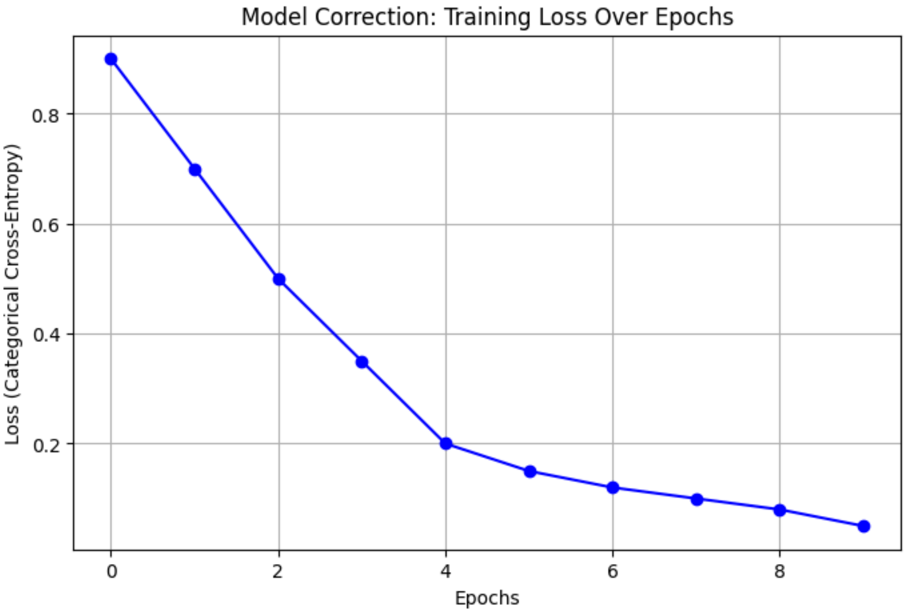
Positive

```
Positive ........................ 35%
Neutral ......................... 33%
Negative ........................ 32%
```

Next steps: Deploy to Cloud Run

```
import matplotlib.pyplot as plt
```

```
history_loss = [0.9, 0.7, 0.5, 0.35, 0.2, 0.15, 0.12, 0.1, 0.08, 0.05]

plt.figure(figsize=(8, 5))
plt.plot(history_loss, marker='o', color='b', linestyle='-')
plt.title('Model Correction: Training Loss Over Epochs')
plt.xlabel('Epochs')
plt.ylabel('Loss (Categorical Cross-Entropy)')
plt.grid(True)
plt.show()
```



Start coding or generate with AI.