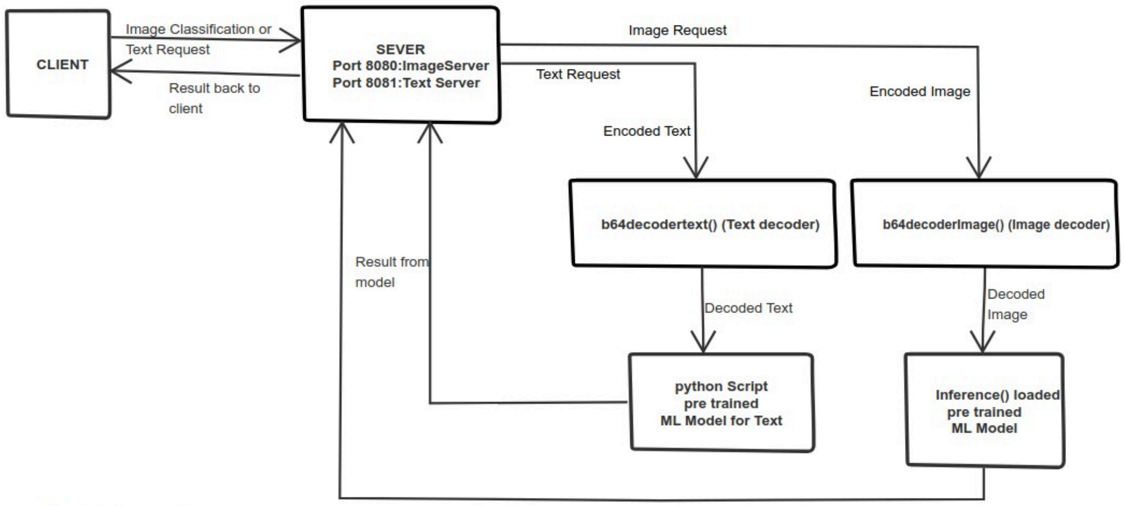
Project Overview:

The project offers a toolkit featuring multiple pre-trained machine learning models, each trained for specific tasks. Users can perform tasks such as classification and text prediction easily with this toolkit.

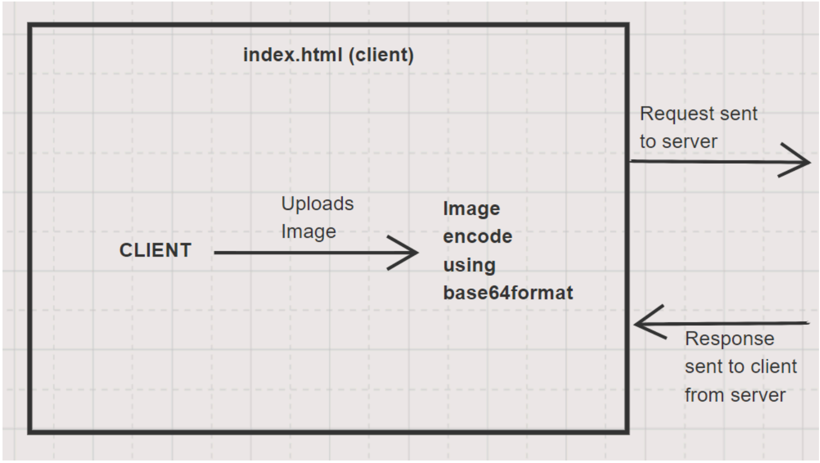
Design:

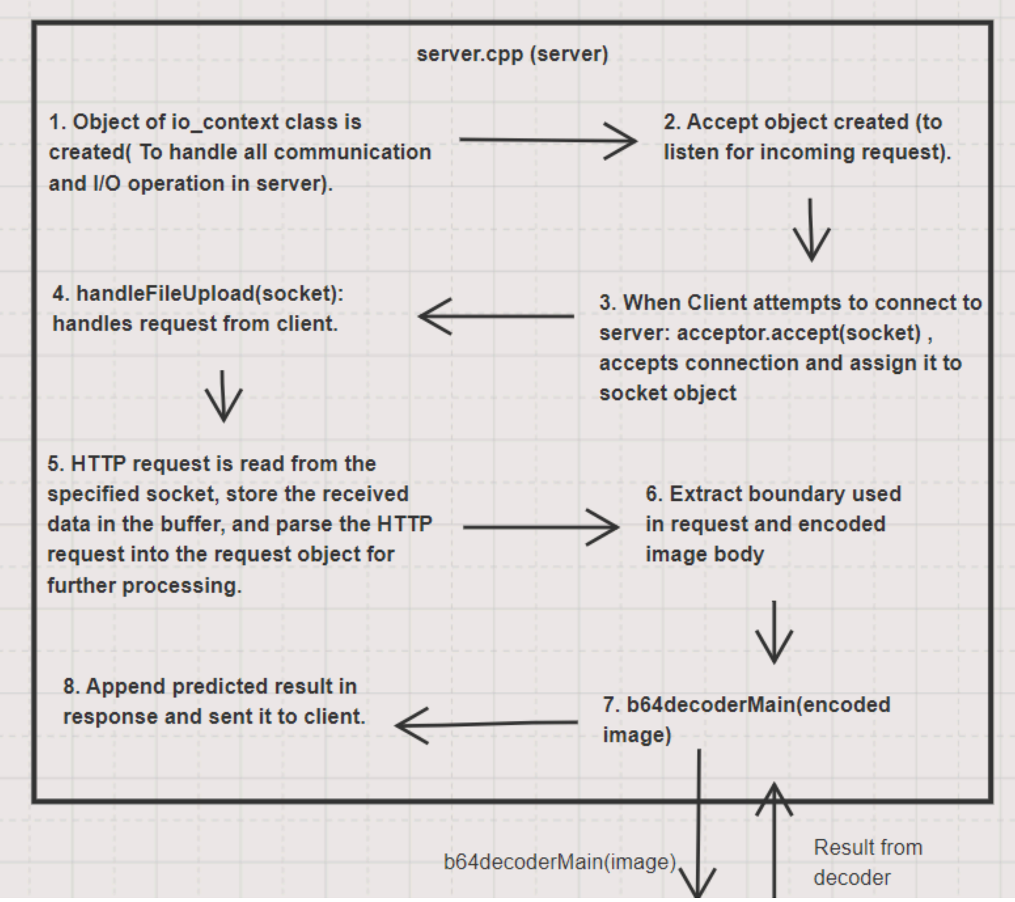
(breakup into processes/threads/classes/functions)



Modular Functionality:

1. **Image**


index.html (client)
CLIENT
Uploads Image
Image encode using base64format
Request sent to server
Response sent to client from server



server.cpp (server)

1. Object of io_context class is created(To handle all communication and I/O operation in server).

2. Accept object created (to listen for incoming request).

3. When Client attempts to connect to server: acceptor.accept(socket) , accepts connection and assign it to socket object

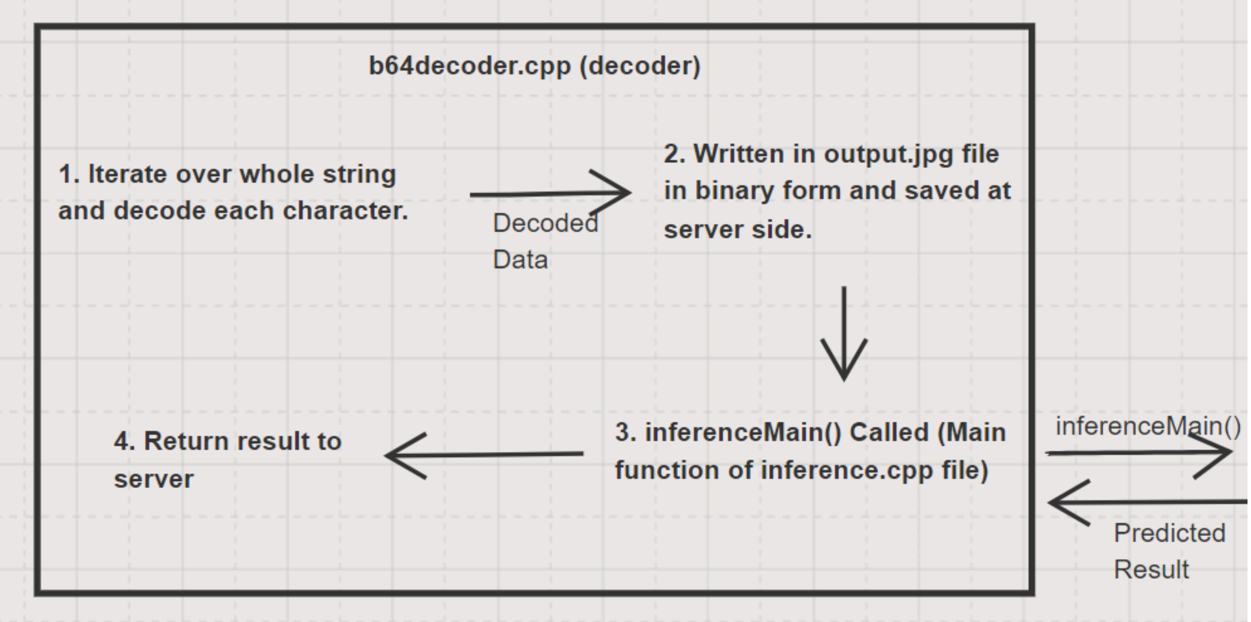
4. handleFileUpload(socket): handles request from client.

5. HTTP request is read from the specified socket, store the received data in the buffer, and parse the HTTP request into the request object for further processing.

6. Extract boundary used in request and encoded image body

7. b64decoderMain(encoded image)

8. Append predicted result in response and sent it to client.



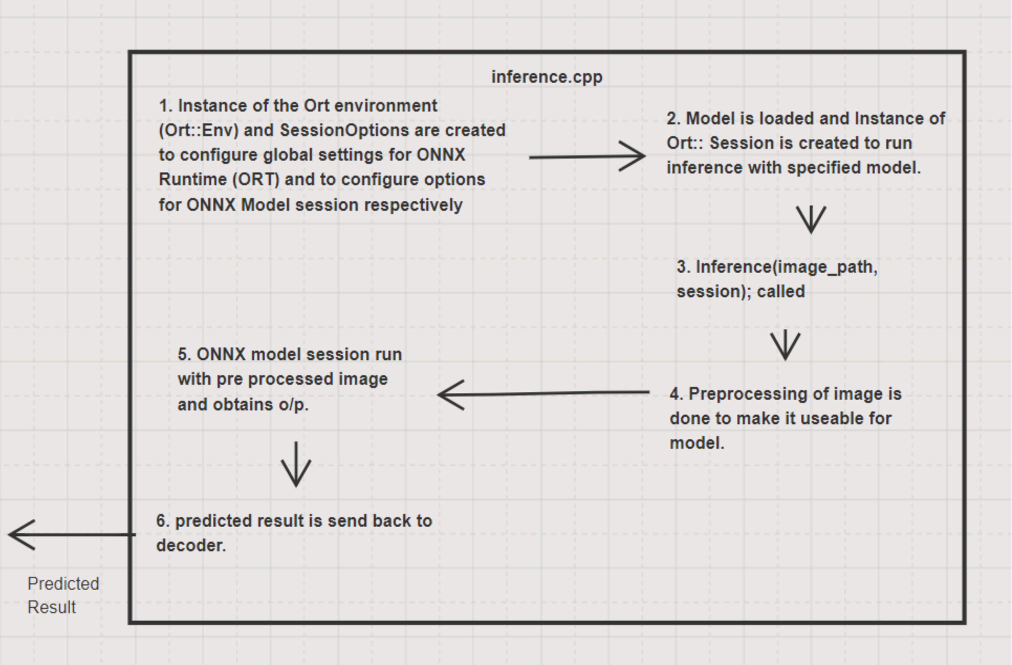
b64decoder.cpp (decoder)

1. Iterate over whole string and decode each character.

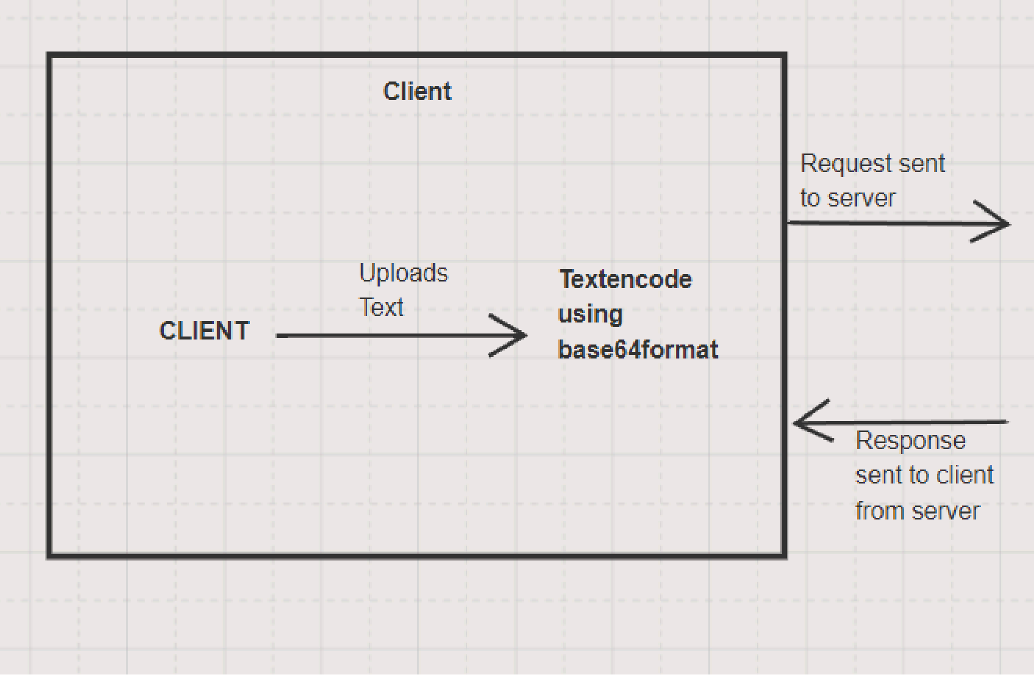
2. Written in output.jpg file in binary form and saved at server side.

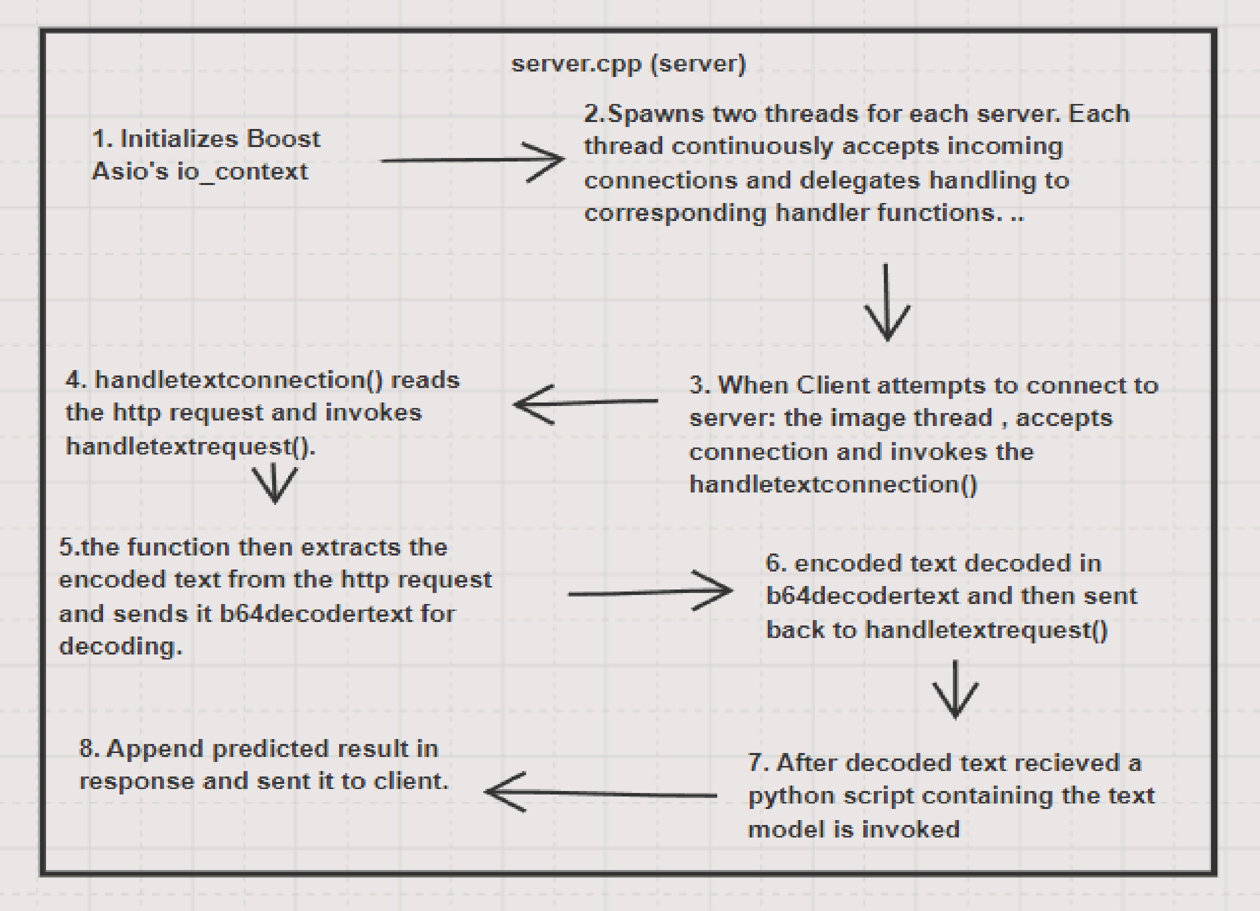
3. inferenceMain() Called (Main function of inference.cpp file)

4. Return result to server


inference.cpp
1. Instance of the Ort environment (Ort::Env) and SessionOptions are created to configure global settings for ONNX Runtime (ORT) and to configure options for ONNX Model session respectively
2. Model is loaded and Instance of Ort:: Session is created to run inference with specified model.
3. Inference(image_path, session); called
4. Preprocessing of image is done to make it useable for model.
5. ONNX model session run with pre processed image and obtains o/p.
6. predicted result is send back to decoder.
Predicted Result

For Text:


Client
CLIENT
Uploads Text
Textencode using base64format
Request sent to server
Response sent to client from server



server.cpp (server)

1. Initializes Boost Asio's io_context

2.Spawns two threads for each server. Each thread continuously accepts incoming connections and delegates handling to corresponding handler functions. ..

3. When Client attempts to connect to server: the image thread , accepts connection and invokes the handletextconnection()

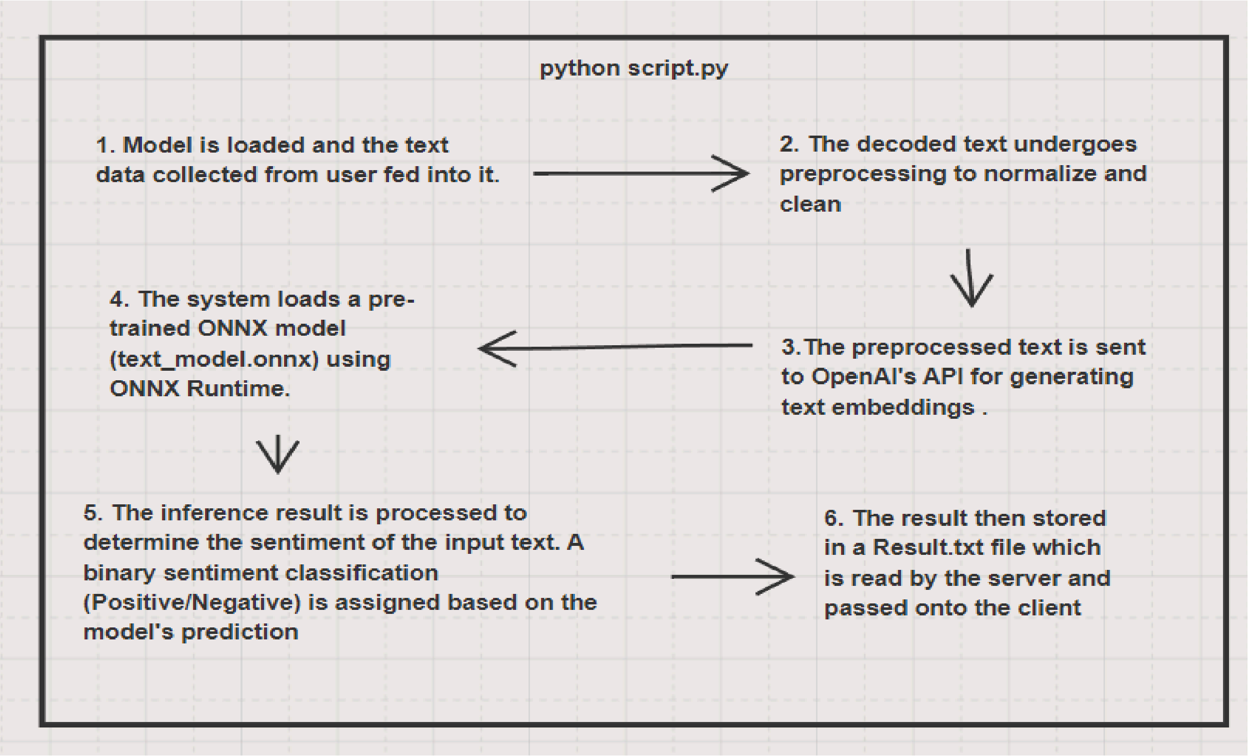
4. handletextconnection() reads the http request and invokes handletextrequest().

5.the function then extracts the encoded text from the http request and sends it b64decodertext for decoding.

6. encoded text decoded in b64decodertext and then sent back to handletextrequest()

7. After decoded text recieved a python script containing the text model is invoked

8. Append predicted result in response and sent it to client.



python script.py

1. Model is loaded and the text data collected from user fed into it.

2. The decoded text undergoes preprocessing to normalize and clean

3.The preprocessed text is sent to OpenAI's API for generating text embeddings .

4. The system loads a pre-trained ONNX model (text_model.onnx) using ONNX Runtime.

5. The inference result is processed to determine the sentiment of the input text. A binary sentiment classification (Positive/Negative) is assigned based on the model's prediction

6. The result then stored in a Result.txt file which is read by the server and passed onto the client

For Image Classification

1. Client sends request to server through a HTML form.
   Input: Image
   Request is **encoded to base64 format** before sending to the server. Then send it to the server.
2. Server stores request and performs parsing of request to extract request body. In case of Image Classification, the extracted request body is sent to the decoder file, to decode the image encoded using base64.
   Server is already listening to a port and the request is read and stored in a buffer. Next request body is extracted and sent to the decoder using **b64decoderMain()**.
   Server is built using the **boost** library.
3. Image is decoded using **base64_decode().** and the result is written in 'output.jpg' file in binary format. After decoding image **inferenceMain()** is called for further processing.
4. Inference module **openCV** is used to perform image processing on decoded images and **ONNX Runtime** is used to perform inferencing. This loads a pre-trained model and uses decoded images to perform prediction.

External Dependancies:

1. ONNXRuntime (version)
2. OpenCV
3. Boost

For Text Model

1. **Data Collection:**
   Input text data is collected through an HTTP form, where users input text for sentiment analysis.
2. **Data Encoding:**
   The collected text data is encoded into Base64 format before being transmitted to the server.
3. **Server Processing:**
   Upon receiving the encoded text data, the server parses the request and decodes the text using a corresponding decoder, b64decodertext.cpp.
4. **Text Preprocessing:**

The decoded text undergoes preprocessing to normalize and clean it for further analysis.
Non-alphanumeric characters are removed, and the text is converted to lowercase.

5. **Embedding Generation:**
   The preprocessed text is sent to OpenAI's API for generating text embeddings.
   OpenAI's text embedding model is utilized for generating embeddings from the input text.
6. **ONNX Model Loading:**
   The system loads a pre-trained ONNX model (text_model.onnx) using ONNX Runtime.
   This model is responsible for performing sentiment analysis on the text embeddings.
7. **Inference Execution:**
   The text embeddings are fed into the loaded ONNX model for inference.
   The model predicts the sentiment of the input text.
8. **Sentiment Analysis:**
   The inference result is processed to determine the sentiment of the input text.
   A binary sentiment classification (Positive/Negative) is assigned based on the model's prediction.
   Confidence scores are computed to indicate the strength of the sentiment prediction.
9. **Result Output:**
   The sentiment classification along with confidence scores are printed to the console.

Dependencies:

1. **onnxruntime**: Python API for ONNX Runtime.
2. **numpy**: Library for numerical computing.
3. **openai:** Python client for OpenAI's API.
4. **Boost**: Server built on boost

ML Model Used:

1. Image Classification

Dataset: Lumpy Skin Disease Detection Classification Dataset

Size of Train and Test Data: 730 , 82 (404 positive , 408 negative)

Accuracy: train: 94.11, test : 98.78

2. Text

Dataset: Sentiment Analysis Dataset | Kaggle

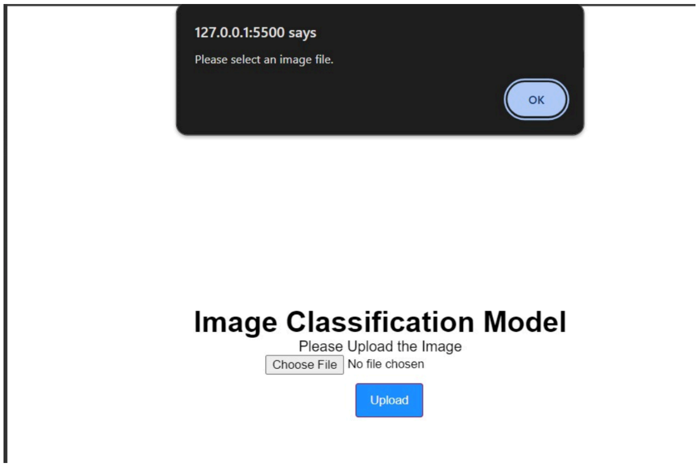
Size of Train and Test Data: 27482,3535

Accuracy: 94,91.5

Test Cases (Image Model)

1) Frontend

1.1) Empty Image



127.0.0.1:5500 says

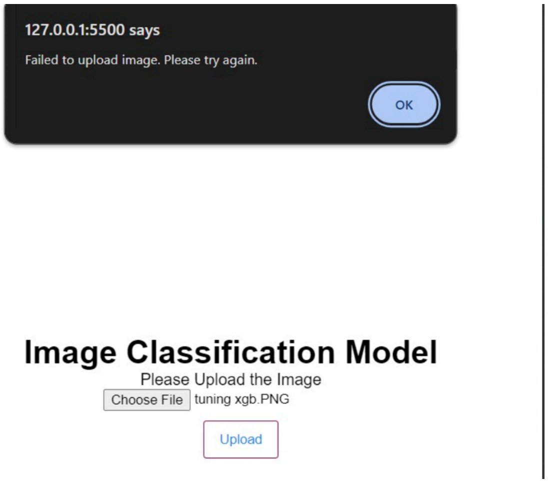
Please select an image file.

Image Classification Model

Please Upload the Image

No file chosen

1.2) Wrong format (not jpg)



127.0.0.1:5500 says

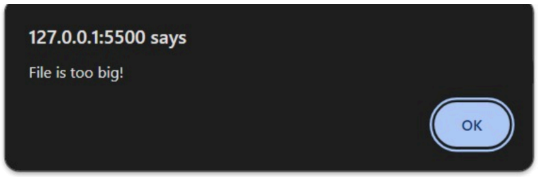
Failed to upload image. Please try again.

Image Classification Model

Please Upload the Image

tuning xgb.PNG

1.3) Image size Too large (Image size>1mb)



127.0.0.1:5500 says

File is too big!

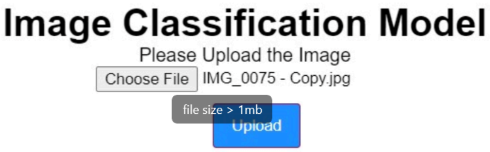


Image Classification Model

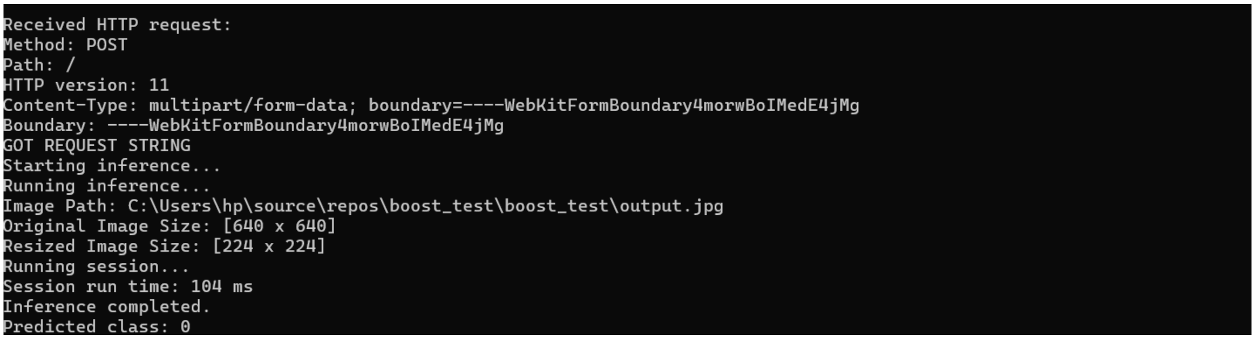
Please Upload the Image

Result: Negative on all of the above

2) Server

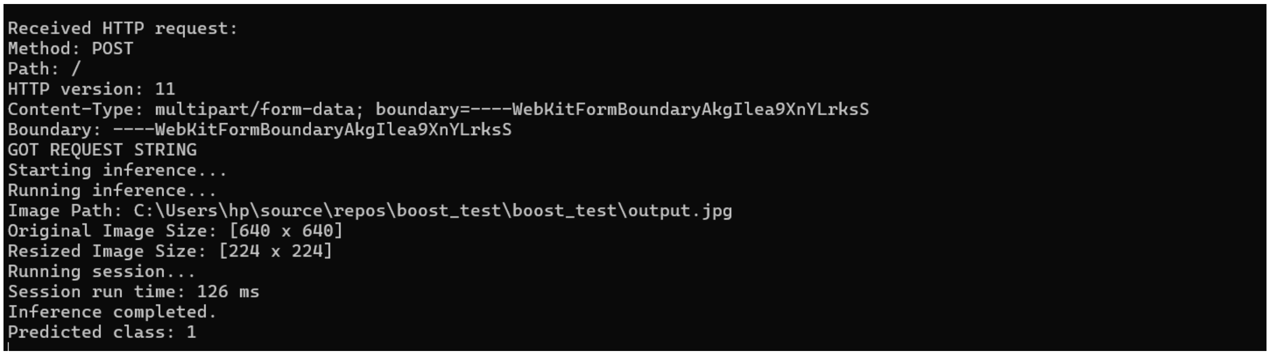
2.1) Empty request -> Blocked by Javascript

2.2) positive class request



```
Received HTTP request:
Method: POST
Path: /
HTTP version: 11
Content-Type: multipart/form-data; boundary=----WebKitFormBoundary4morwBoIMedE4jMg
Boundary: ----WebKitFormBoundary4morwBoIMedE4jMg
GOT REQUEST STRING
Starting inference...
Running inference...
Image Path: C:\Users\hp\source\repos\boost_test\boost_test\output.jpg
Original Image Size: [640 x 640]
Resized Image Size: [224 x 224]
Running session...
Session run time: 104 ms
Inference completed.
Predicted class: 0
```

2.3) Negative class request

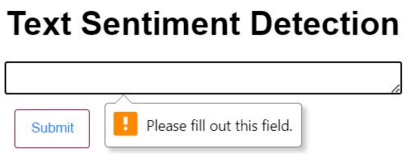


```
Received HTTP request:
Method: POST
Path: /
HTTP version: 11
Content-Type: multipart/form-data; boundary=----WebKitFormBoundaryAkgIlea9XnYLrksS
Boundary: ----WebKitFormBoundaryAkgIlea9XnYLrksS
GOT REQUEST STRING
Starting inference...
Running inference...
Image Path: C:\Users\hp\source\repos\boost_test\boost_test\output.jpg
Original Image Size: [640 x 640]
Resized Image Size: [224 x 224]
Running session...
Session run time: 126 ms
Inference completed.
Predicted class: 1
```

Test Cases (Text Model)

1) Frontend

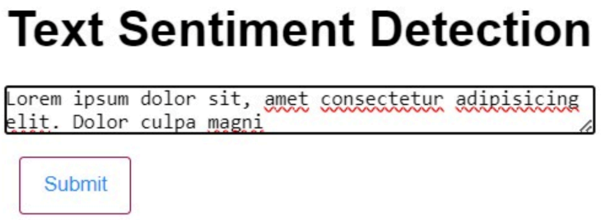
   1.1) Empty Text Field



Text Sentiment Detection

Please fill out this field.

   1.2) Text length too long



Text Sentiment Detection

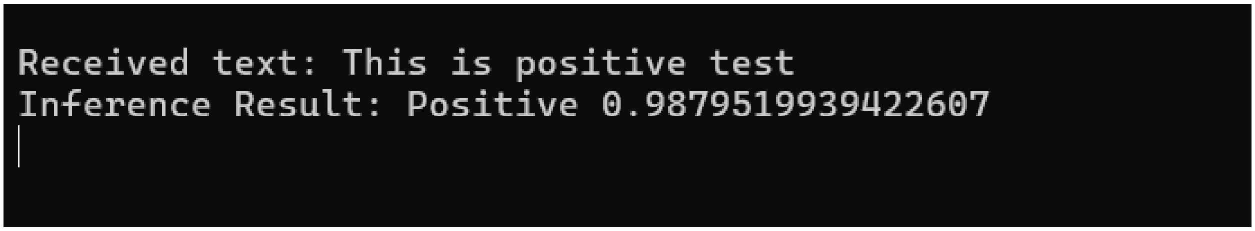
Lorem ipsum dolor sit, amet consectetur adipisicing elit. Dolor culpa magni

   Result: Negative on all of the above

2) Server

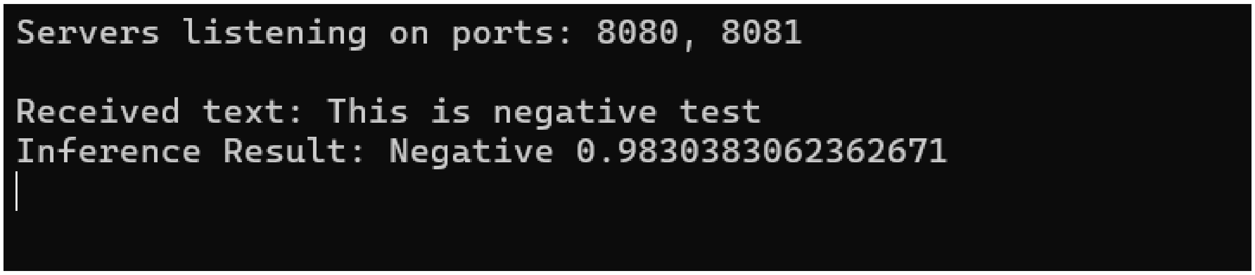
   2.1) Empty request -> Rejected at frontend

 2.2) positive class request



```
Received text: This is positive test
Inference Result: Positive 0.9879519939422607
```

2.3) Negative class request



```
Servers listening on ports: 8080, 8081

Received text: This is negative test
Inference Result: Negative 0.9830383062362671
```