HUMBER COLLEGE

AWS Cloud Computing

Project – Sentiment Analysis using AWS Comprehend

22 – 03 – 2024

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Project Description:

Show the sentiment score of the text that is posted in the text field, i.e., the "positive," "negative," and "neutral" scores together.

In order to integrate AWS Comprehend into a Flask-developed web application, communication between the frontend and backend levels must be established. In this design, HTTP requests are used to transfer user input from the frontend to the Flask backend. The text data is then processed within the Flask application and sent via the AWS SDK for Python (Boto3) to the AWS Comprehend service. The data is formatted and sent back to the frontend by the Flask backend when it receives the analysis results from AWS Comprehend. The sentiment analysis results are shown dynamically in the user interface via the frontend, which is created with HTML, CSS, and JavaScript. Here, I am going to use a simple HTML file to create a front-end website.

Steps for our project:

- Develop HTML Templates: Create HTML files for the frontend interface, including a form to capture text input.
- Create Flask App File: Write a Python script (e.g., app.py) to define the Flask application.
- Import Flask: Import Flask module in your app.py script.
- Define Route for Homepage: Define a route in your Flask app to render the homepage HTML template.
- Run Flask App: Add code to run the Flask app (if __name__ == '__main__': app.run()) at the end of the script.
- Access Cloud9 Preview: Access the Flask app preview in your Cloud9 environment to verify functionality.
- Integrate AWS Comprehend: Install Boto3 library and use it to interact with AWS Comprehend within your Cloud9 environment.
- Implement Sentiment Analysis Route, create an instance, create a web server: Define a route in your Flask app to handle sentiment analysis requests. Here we use Nginx and Gunicorn.
- Process Text Input: Extract text input from HTTP requests and pass it to your sentiment analysis function.
- Return Analysis Results: Return the sentiment analysis results as JSON or HTML response.
- Update HTML Template: Update the HTML template to display the sentiment analysis results.

- Test Integration: Test the integration by entering text in the frontend form and submitting it.
- Deploy: Once satisfied with the functionality, you can deploy the Flask app to a production server.

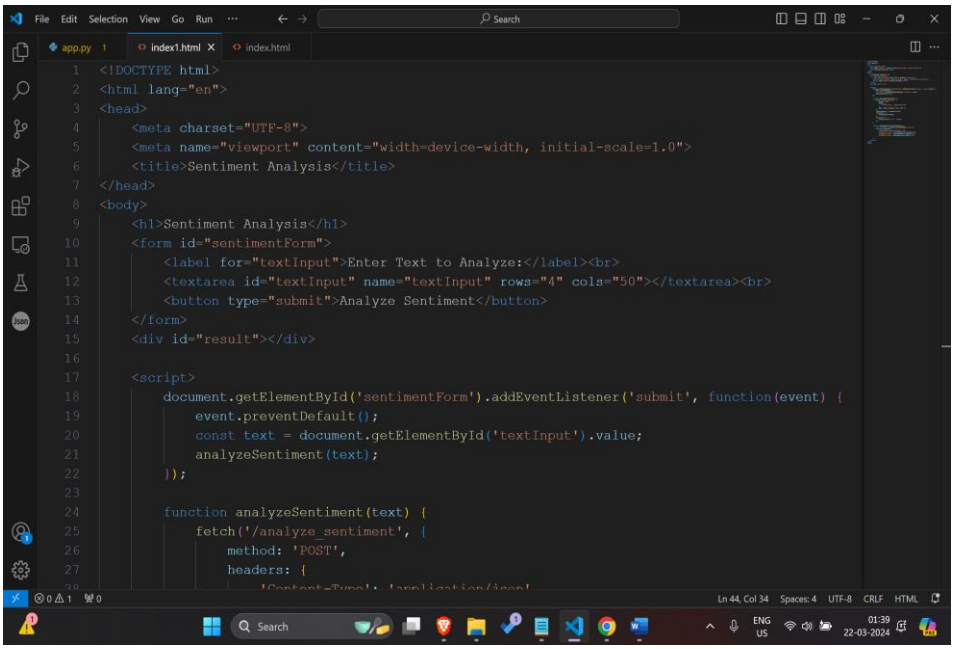
For this project, I have used two files: index1.html and app.py (codes mentioned below).

Creating a Front – end Web Application:

For our project, we need to create a simple front-end application where we input the text, and the output is displayed on that website.

For this we use html language and create a simple front-end website.

Below is the screenshot of the code file and before loading it to AWS we need to make sure we don't have any errors in the code, so we use VSCode to run the file.




```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Sentiment Analysis</title>
</head>
<body>
  <h1>Sentiment Analysis</h1>
```

```
    <form id="sentimentForm">
        <label for="textInput">Enter Text to Analyze:</label><br>
        <textarea id="textInput" name="textInput" rows="4" cols="50"></textarea><br>
        <button type="submit">Analyze Sentiment</button>
    </form>
    <div id="result"></div>

    <script>
        document.getElementById('sentimentForm').addEventListener('submit',
function(event) {
            event.preventDefault();
            const text = document.getElementById('textInput').value;
            analyzeSentiment(text);
        });

        function analyzeSentiment(text) {
            fetch('/analyze_sentiment', {
                method: 'POST',
                headers: {
                    'Content-Type': 'application/json'
                },
                body: JSON.stringify({ text: text })
            })
            .then(response => response.json())
            .then(data => {
                displayResults(data);
            })
            .catch(error => {
                console.error('Error:', error);
            });
        }

        function displayResults(sentimentScores) {
            const resultDiv = document.getElementById('result');
            resultDiv.innerHTML = `
                <h2>Sentiment Analysis Results:</h2>
```

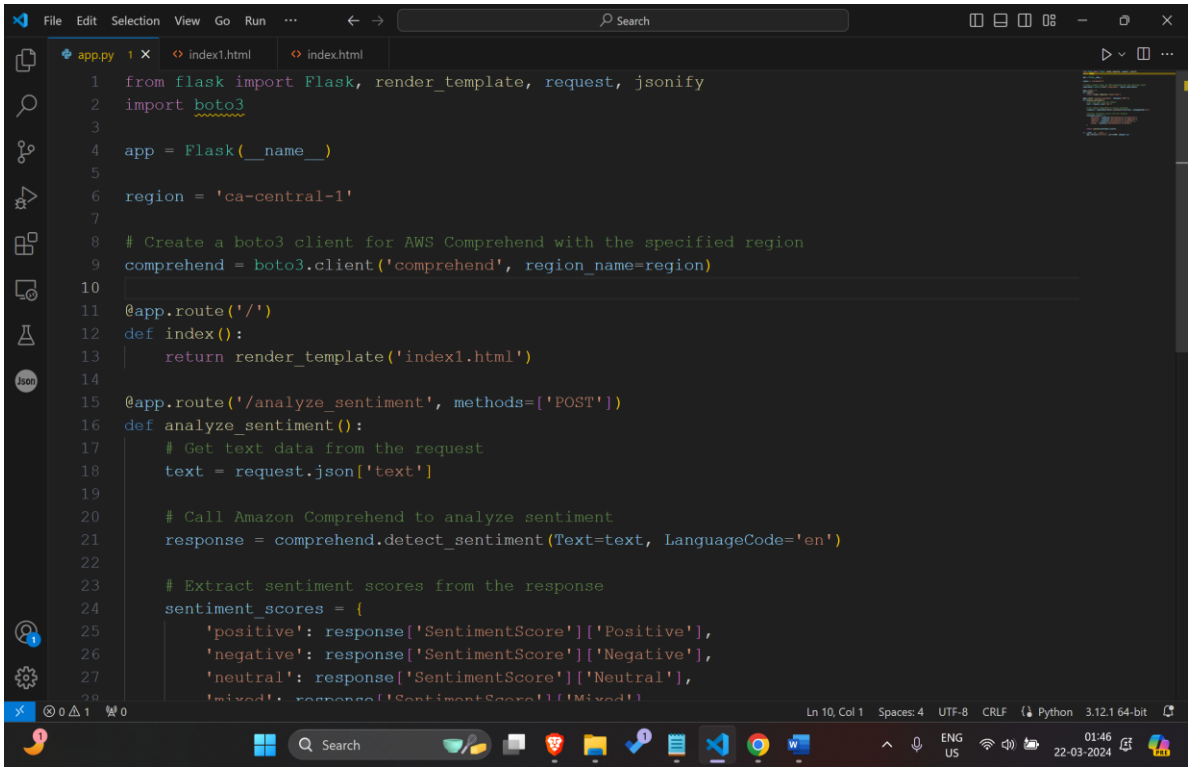
```
            <p>Positive Score: ${sentimentScores.positive}</p>
            <p>Negative Score: ${sentimentScores.negative}</p>
            <p>Neutral Score: ${sentimentScores.neutral}</p>
        `;
    }
  </script>
</body>
</html>
```

Similarly, we create a flask application, which calls the amazon AWS comprehend and the sentiment detect method.

This directly uses Amazon AWS comprehend methods to analyze the texts. This is a fully managed AWS NLP service that offers text detection, key phrases, entities, parts of speech.

It basically provides us the pre – trained models with APIs that are easier to use for text analyzation.

Below is the flask code:



```python
from flask import Flask, render_template, request, jsonify
import boto3

app = Flask(__name__)

region = 'ca-central-1'

# Create a boto3 client for AWS Comprehend with the specified region
comprehend = boto3.client('comprehend', region_name=region)

@app.route('/')
def index():
    return render_template('index1.html')

@app.route('/analyze_sentiment', methods=['POST'])
def analyze_sentiment():
    # Get text data from the request
    text = request.json['text']

    # Call Amazon Comprehend to analyze sentiment
    response = comprehend.detect_sentiment(Text=text, LanguageCode='en')

    # Extract sentiment scores from the response
    sentiment_scores = {
        'positive': response['SentimentScore']['Positive'],
        'negative': response['SentimentScore']['Negative'],
        'neutral': response['SentimentScore']['Neutral'],
        'mixed': response['SentimentScore']['Mixed']
    }

    return jsonify(sentiment_scores)

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000, debug=True)
```

This code includes a route that is basically used for analyzing sentiment using amazon AWS comprehend.

from flask import Flask, render_template, request, jsonify: This line imports necessary modules from the Flask library. Here, we import Flask (the main Flask class), render_template (for ren-- dering HTML templates), request (for accessing request data), and jsonify (for creating JSON responses).

import boto3: We use boto3 to interact with AWS services.

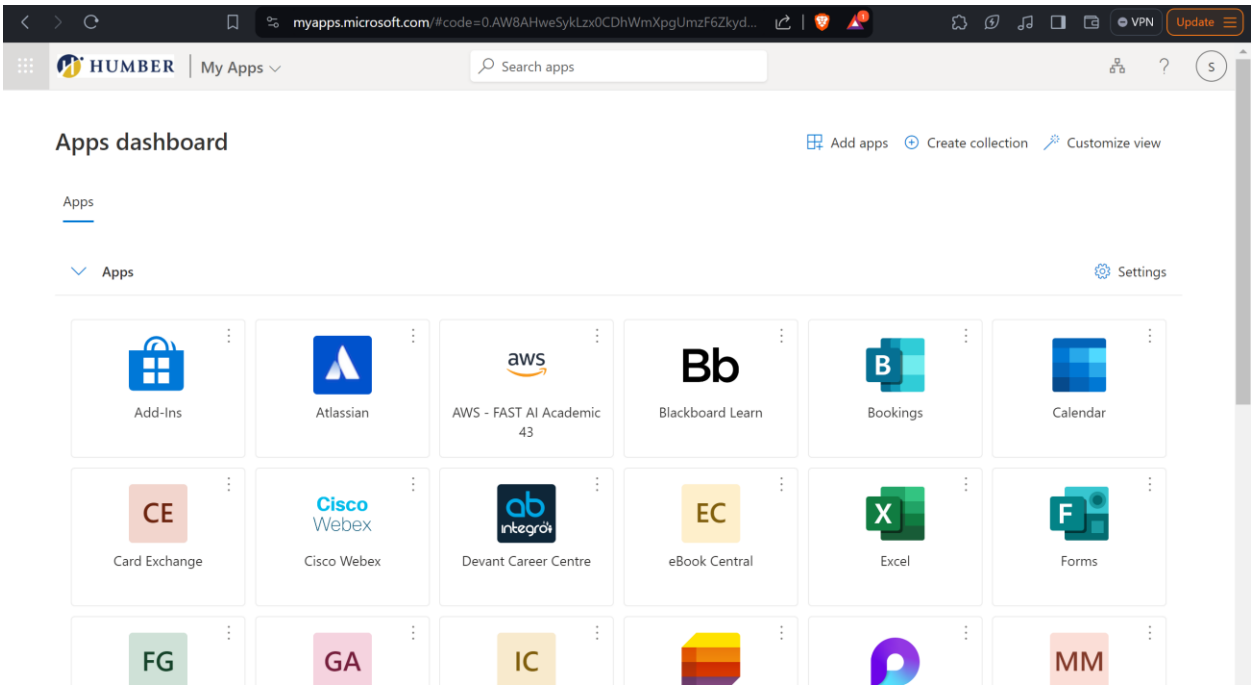
app = Flask(__name__): This line creates a Flask application instance named app. In this case, it represents the name of the script (__main__ when executed directly).

region = 'ca-central-1': This line of code defines the AWS region (ca-central-1) where the AWS Comprehend service is located.

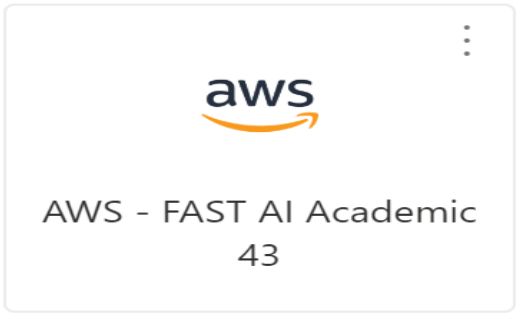
comprehend = boto3.client('comprehend', region_name=region): This line creates a boto3 client for the AWS Comprehend service. This client object will allow us to call methods on the AWS Comprehend service.

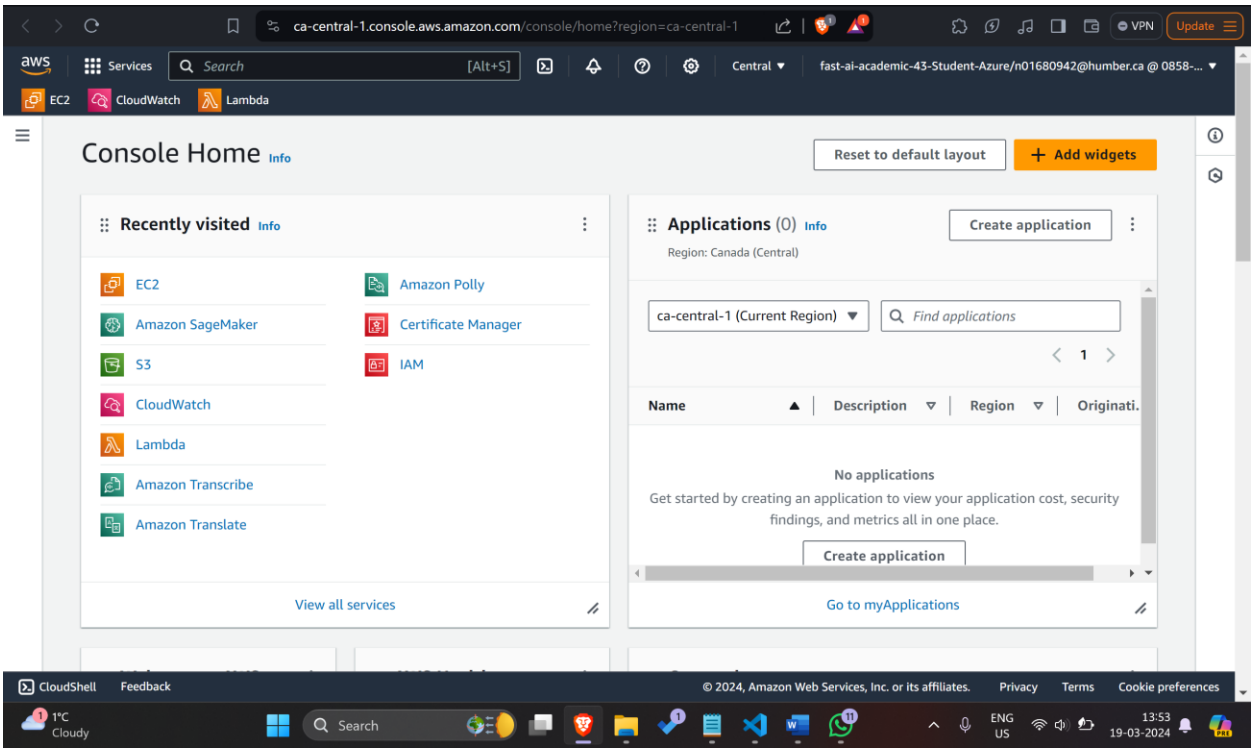
Setting up Amazon instance

Firstly we will login to our Microsoft.myapps.com and login with our student id. You will see a page like this:



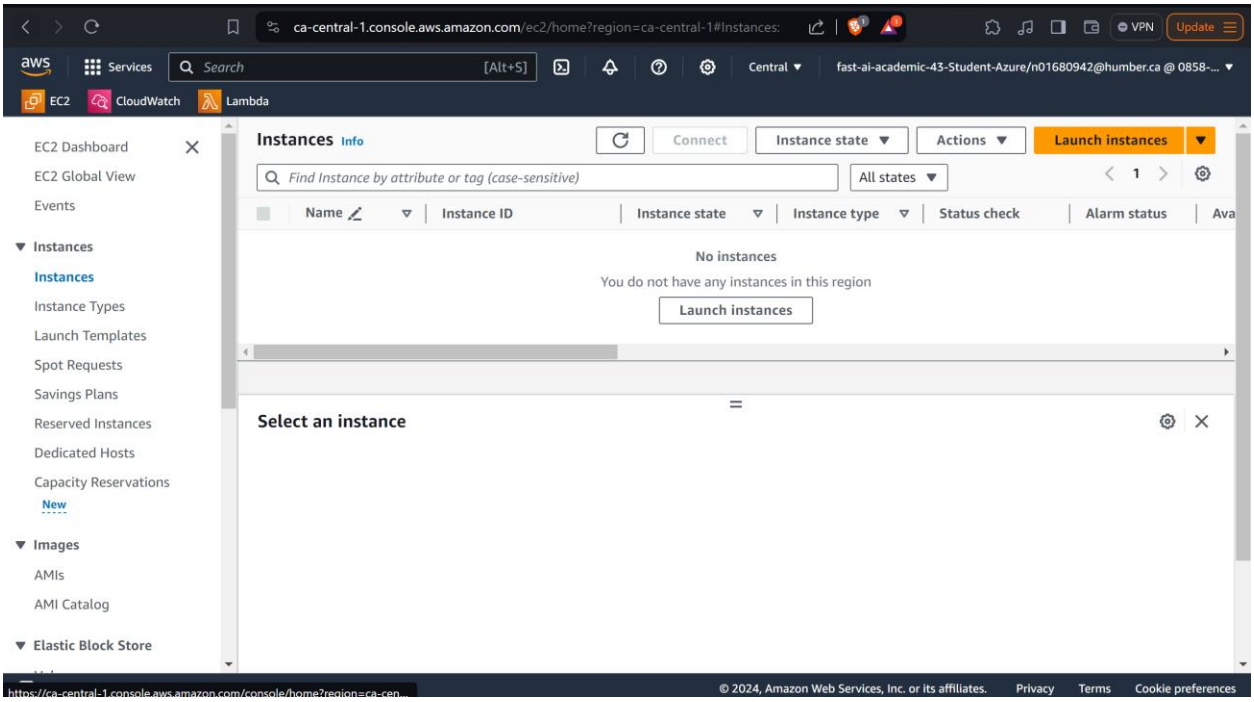
Click on AWS- FAST AI Academic and you will see a page similar to AWS learner's lab.

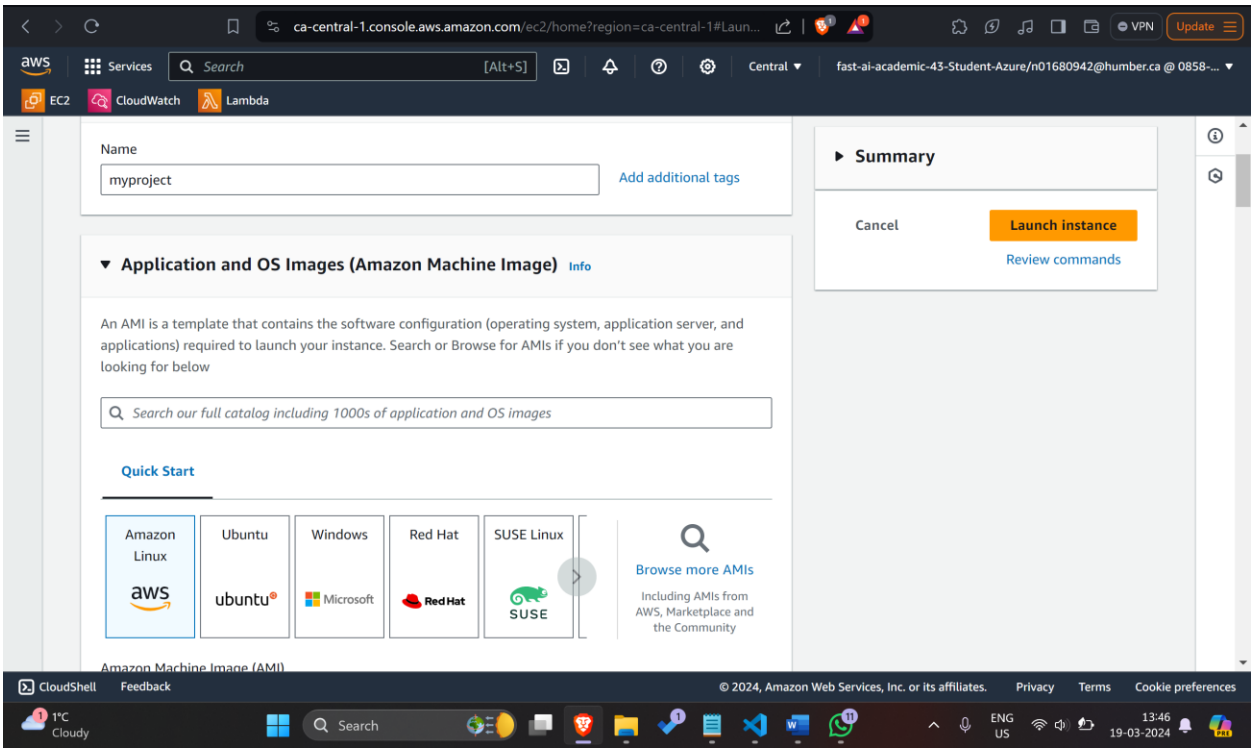




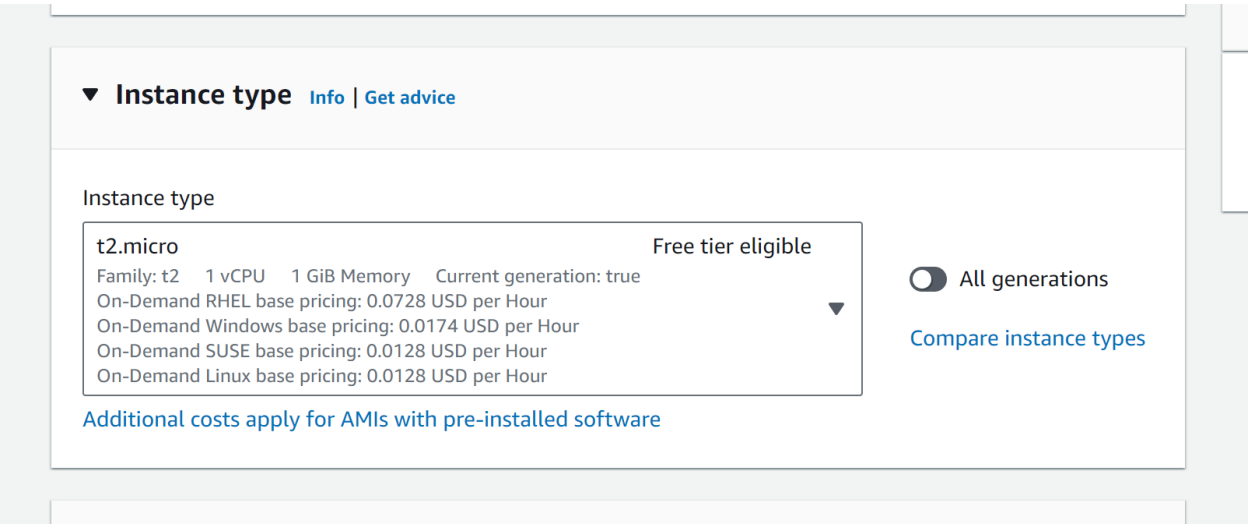
Now once we set ourselves up, Make sure we are in the ‘Central’ Region and click on EC2 instance to create our instance.

Below is the page you will see to create an instance.

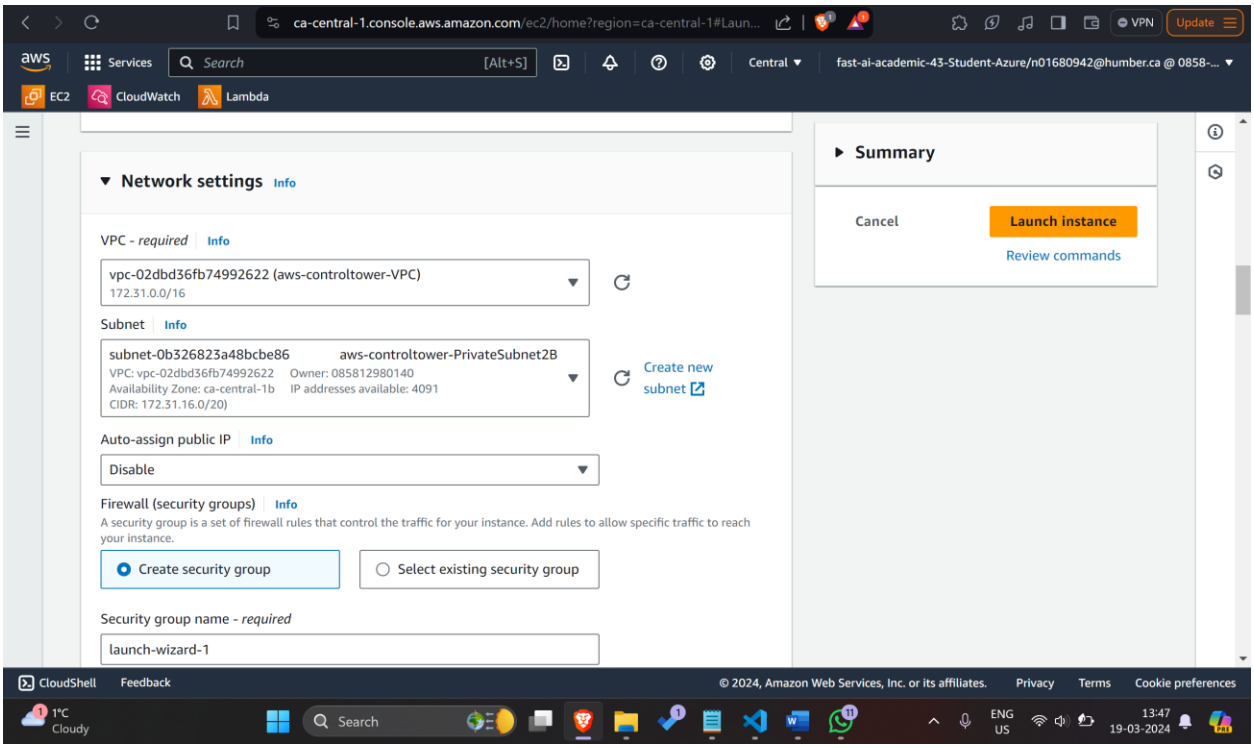




Instance type:

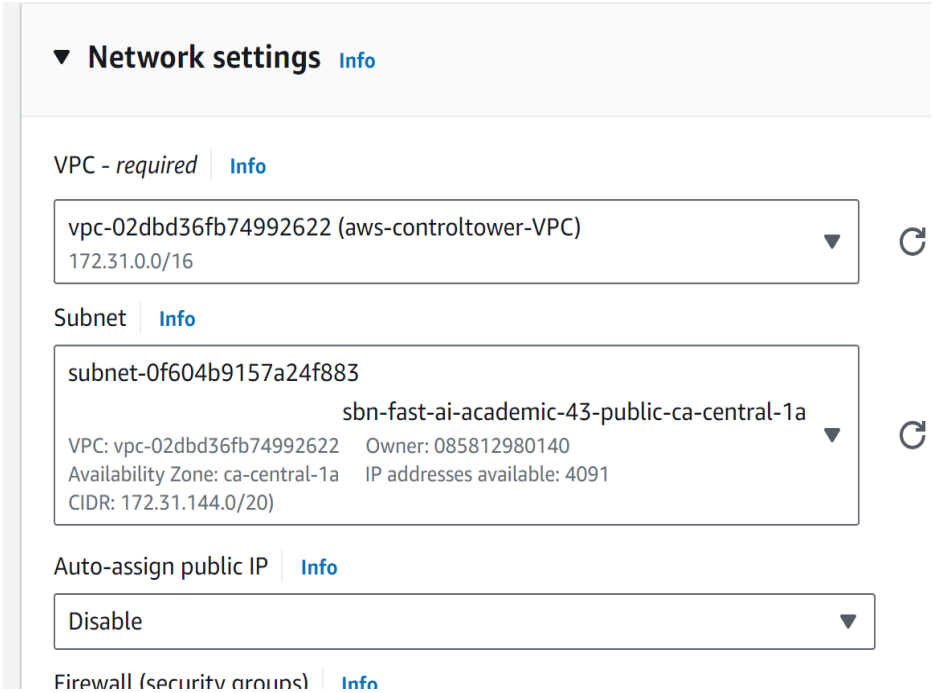


In the network settings change the subnet type to public. By default it will be privatesubnet.



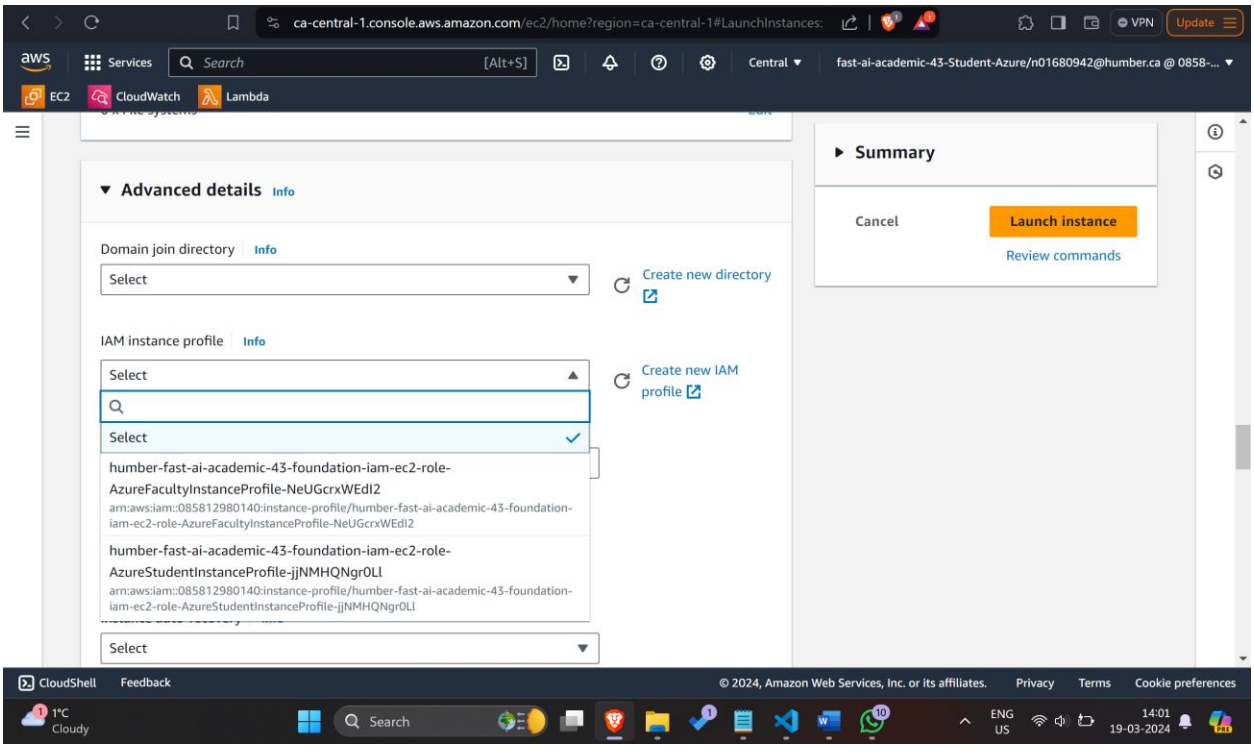
Click on edit network settings and you will see a dropdown where you can find different subnets.

Make sure we have to set it to public subnet: sbn-fast-ai-academic-1-public-ca-central-1a

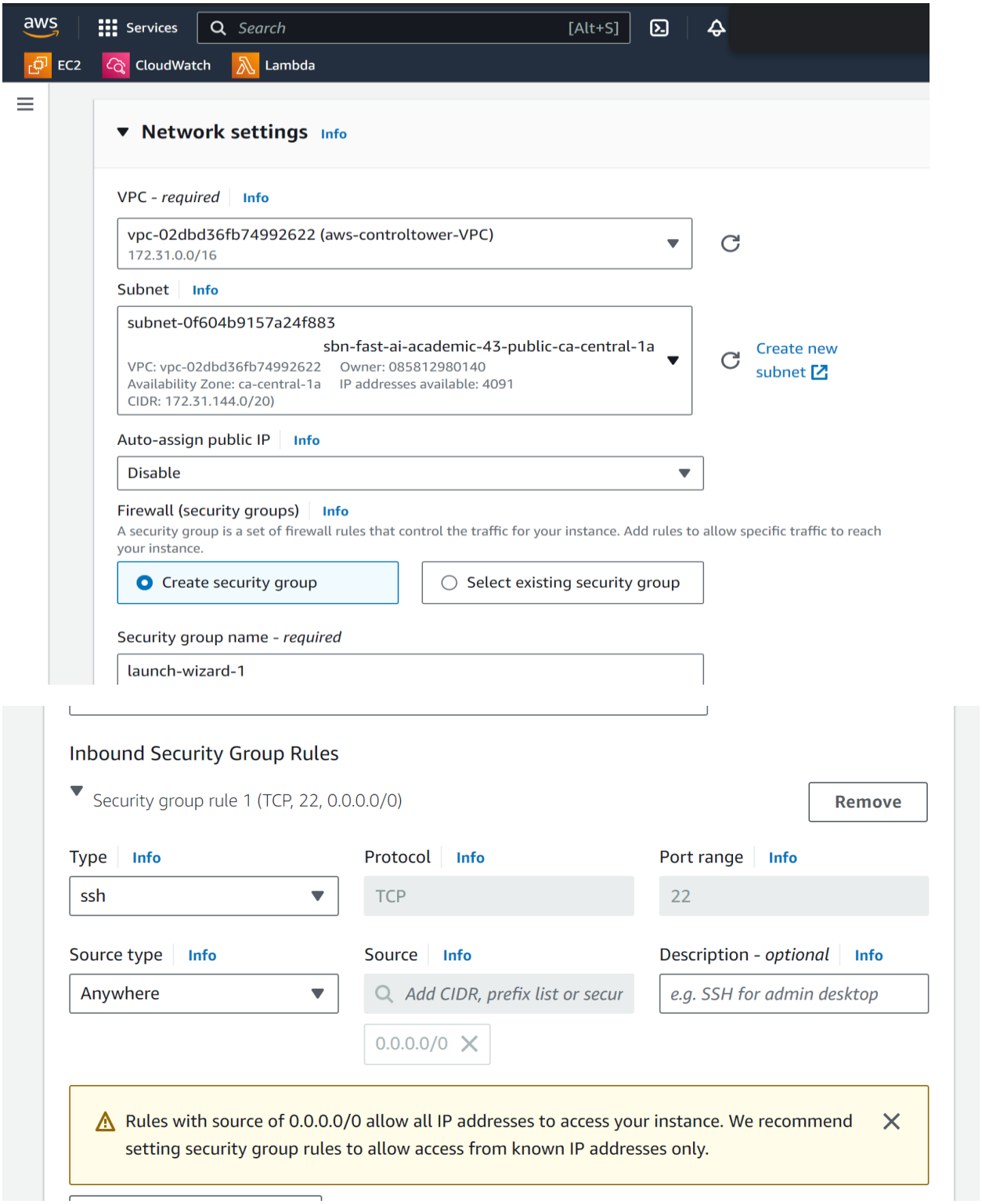


Assign EC2 role: fast-ai-academic-1-Student-EC2

As we scroll down, we will find IAM instance profile, make sure we have it in student

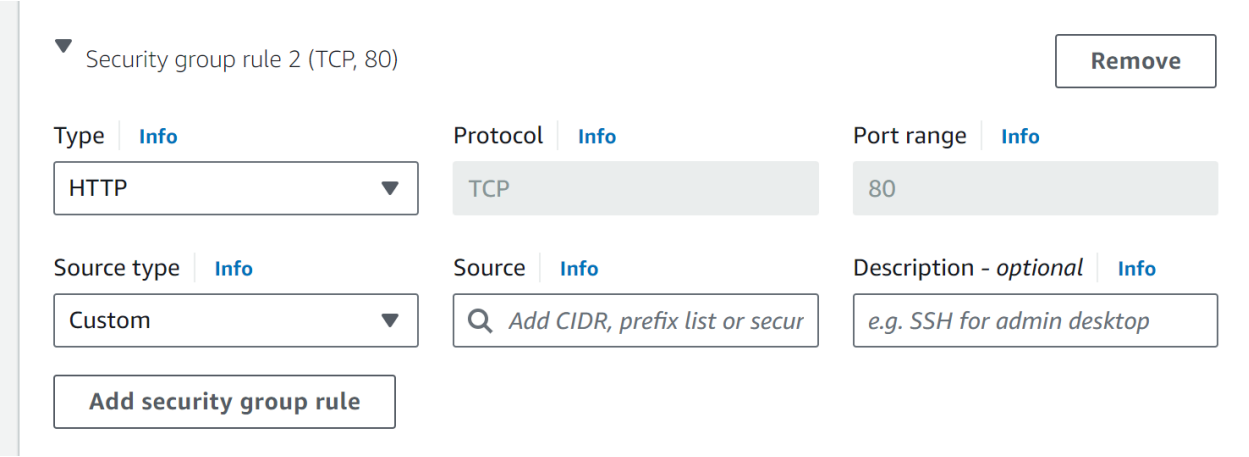


Once, we set these settings, we scroll to the instance network settings -> inbound security group rules

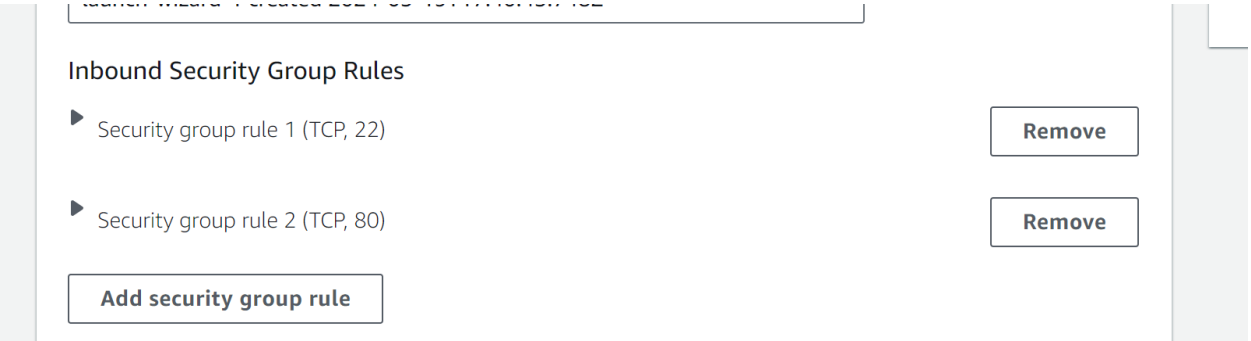


Once you land in the screen shown In the screenshot above, click below on the source type and click on HTTP. Once you click on HTTP the source will be created that is port 80.

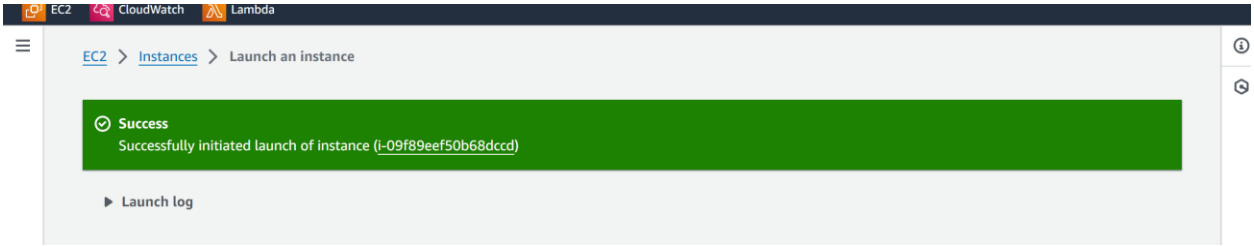
We can also do this later after creating the instance, but to make things easier, we will create our port here itself to connect it with our web application.



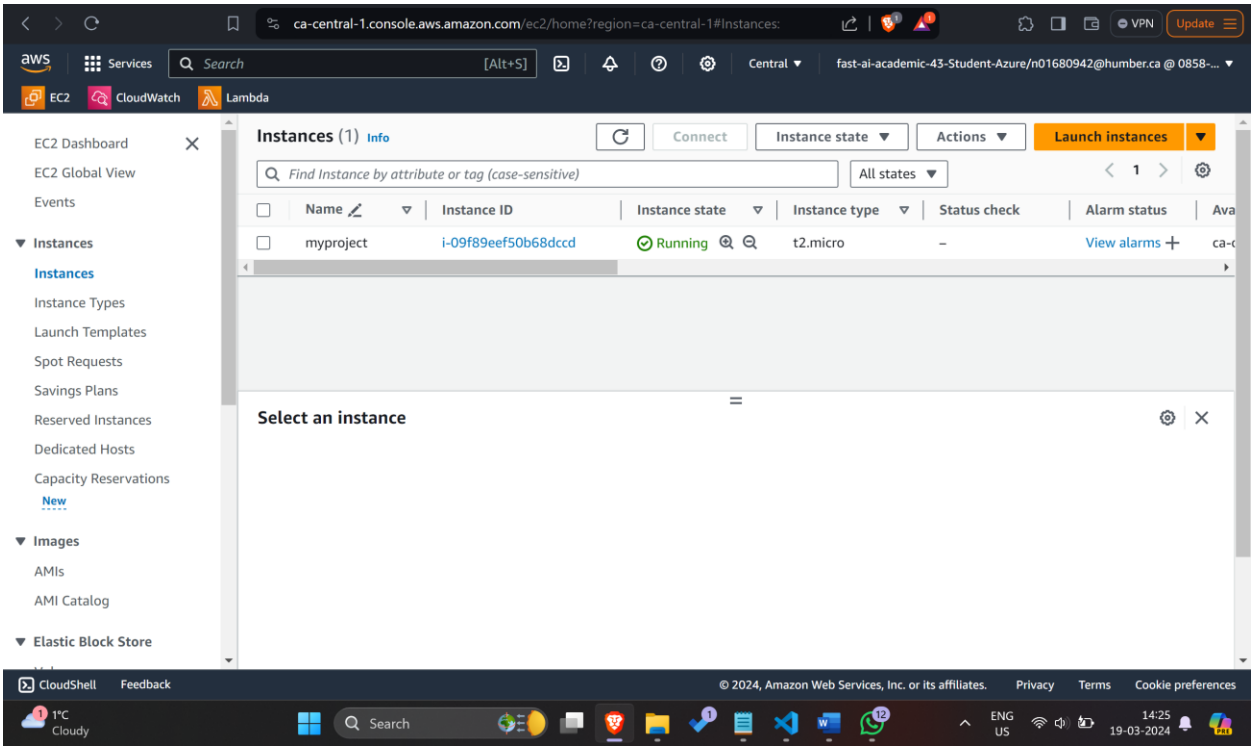
Here we need to have both the ports, one which is SSH that is connected to our terminal and another one which will be connected to our web application.



Once all the set-up is done, click on launch the instance.

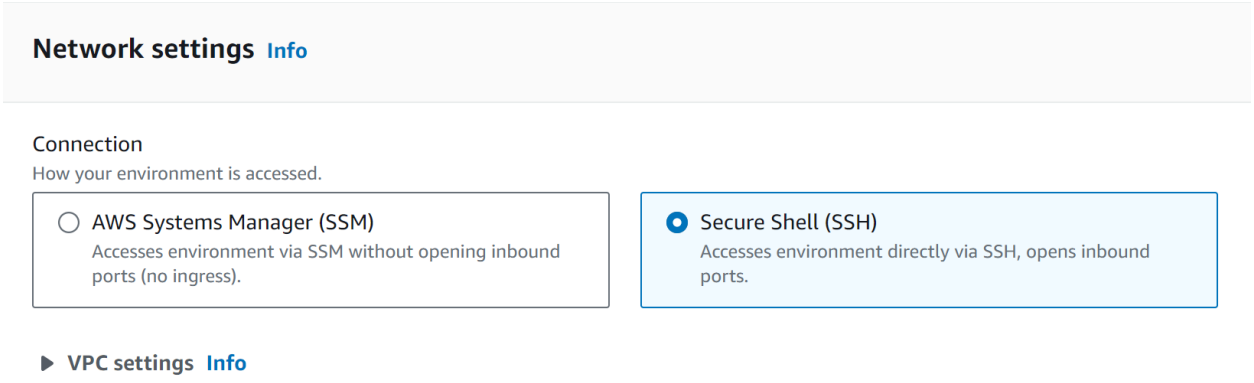


You wont be able to see the instance immediately as it takes time. But once you refresh the page, you should see the screen like below:

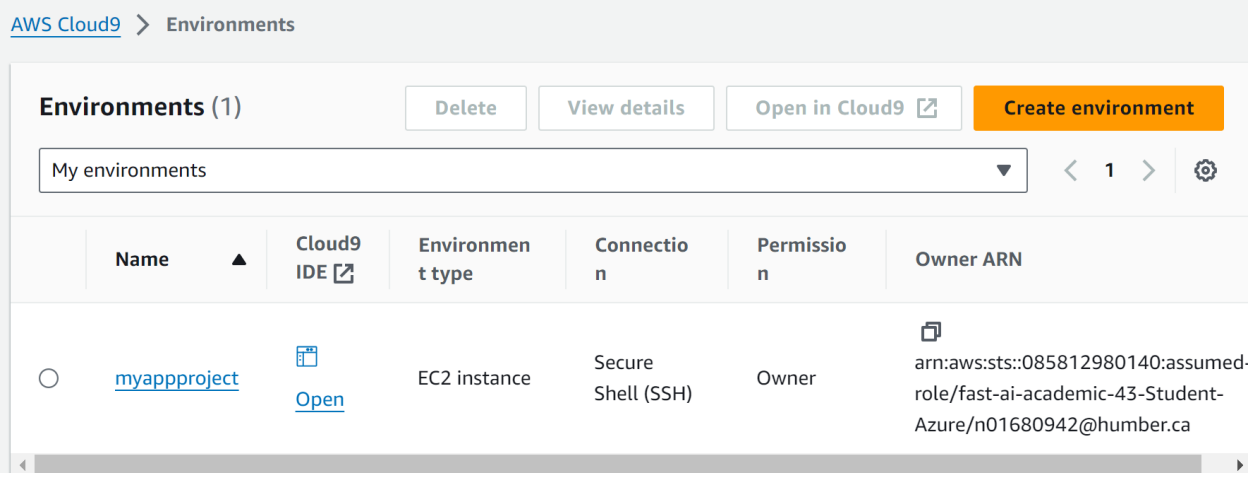


Setting Up Cloud9:

Open the clou9 environment and you create an environment with new ec2 instance. Make sure you are again in ca-central and in the network settings you have to choose SSH connection. We can also do this through putty or SSH.



Make sure the ARN is in student.



Once you set the environment ready, open the ide. This is the OS of the server.

Libraries Installed:

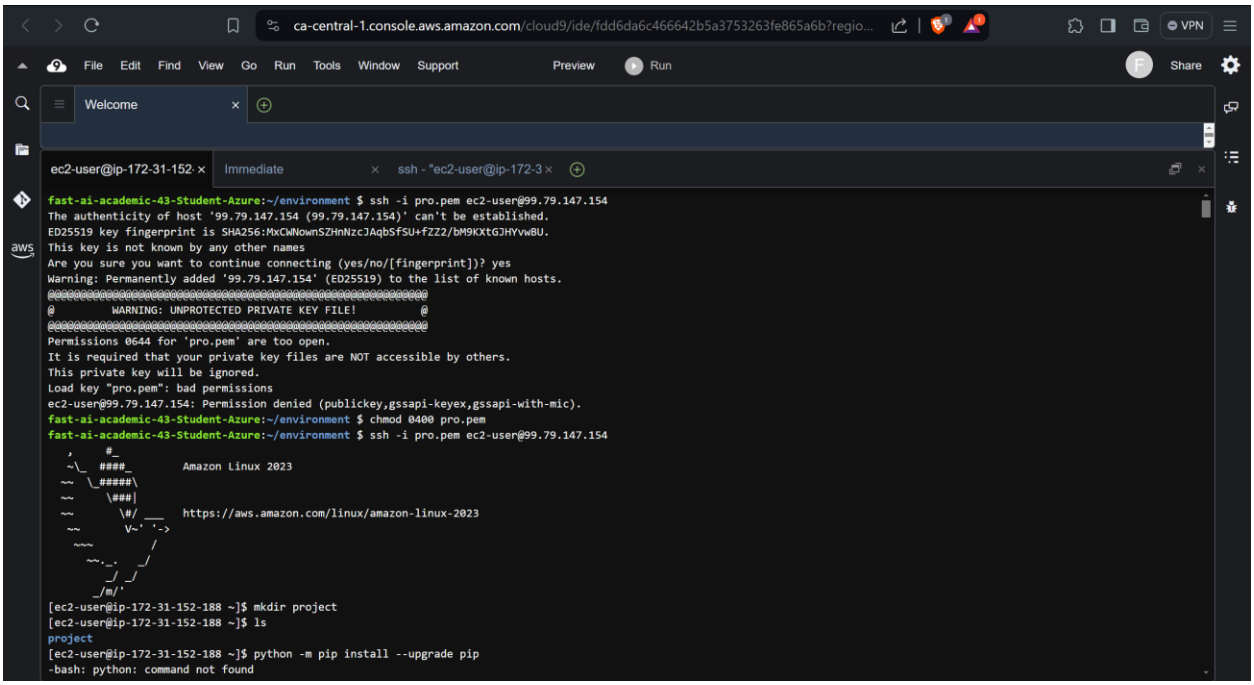
Python3

Flask

Boto3

Web servers:Nginx and Gunicorn for handling requests.

Firstly, You will be landed in a page shown below:



You will be seeing amazon Linux. This is where our backend, proxy and the rest half of the project Is done.

Click on the folder icon in the top left corner and upload the .pem file. We need to remember that for SSH .pem file works and for putty we need to download .ppk file.

Once you are in this page, type in a ssh command to connect to your ec2 instance.

Command: ssh -I filename.pem username@IP address

You will be prompted with a permission denied and warning message.

Just type in ‘chmod 0400 filename.pem. This is a way to give used to set permissions on a file in Unix-like operating systems, such as Amazon Linux.

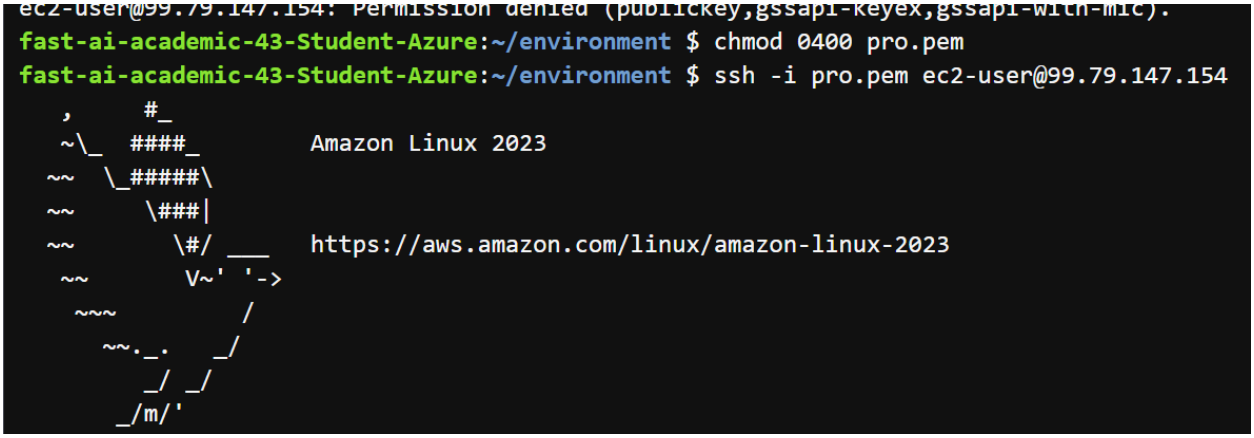
In the case of chmod 0400, it sets the following permissions:

0 for the owner: No permissions.

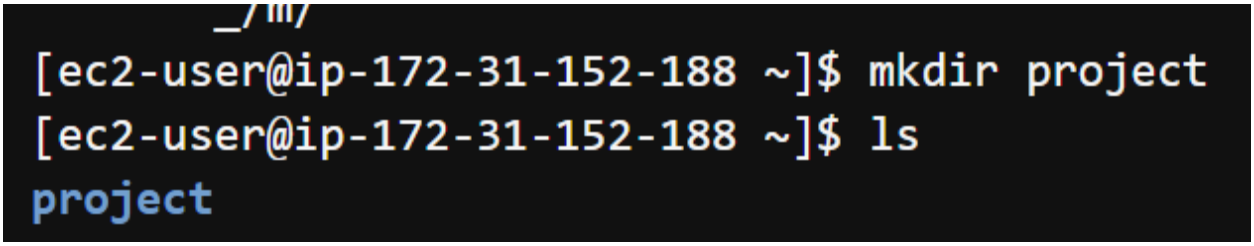
4 for the group: Read permission.

0 for others: No permissions.

Again run the SSH command mentioned above and it will open up Amazon linux connected to our instance.



Now we create a directory with mkdir command:



This directory is to store and run our python application.

Now before uploading our python file, we need to make sure that we install all the libraries we are using: boto3, flask and python3.

Using curl command to install pip

```
[ec2-user@ip-172-31-152-188 ~]$ curl https://bootstrap.pypa.io/get-pip.py -o get-pip.py
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 2574k  100 2574k    0     0  6363k      0 --:--:-- --:--:-- --:--:-- 6355k
[ec2-user@ip-172-31-152-188 ~]$ python3 get-pip.py
Defaulting to user installation because normal site-packages is not writeable
Collecting pip
  Downloading pip-24.0-py3-none-any.whl.metadata (3.6 kB)
Collecting wheel
  Downloading wheel-0.43.0-py3-none-any.whl.metadata (2.2 kB)
Downloading pip-24.0-py3-none-any.whl (2.1 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2.1/2.1 MB 10.5 MB/s eta 0:00:00
Downloading wheel-0.43.0-py3-none-any.whl (65 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 65.8/65.8 kB 9.8 MB/s eta 0:00:00
Installing collected packages: wheel, pip
```

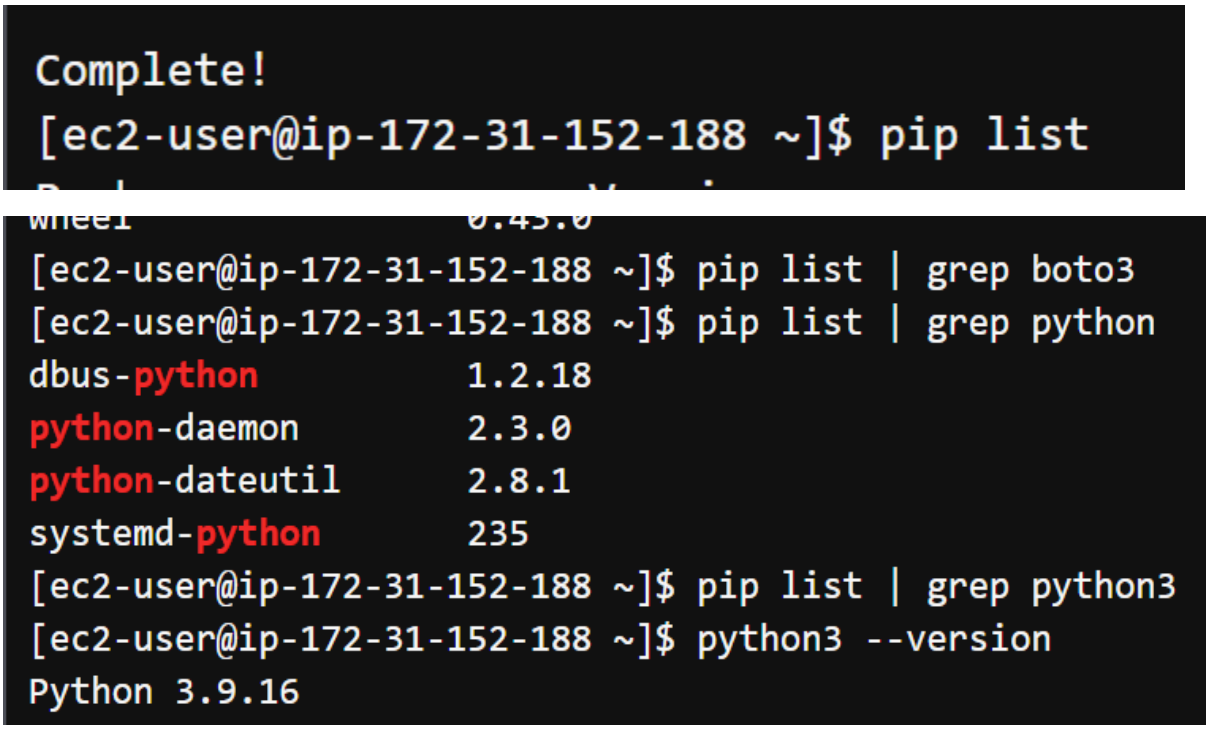
Once installation is done, install python. For SSH the commands are slightly different as it's a red hat Enterprise linux.

```
[ec2-user@ip-172-31-152-188 ~]$ python3 -m pip --version
pip 24.0 from /home/ec2-user/.local/lib/python3.9/site-packages/pip (python 3.9)
[ec2-user@ip-172-31-152-188 ~]$ sudo yum install python3
Last metadata expiration check: 0:24:37 ago on Thu Mar 21 22:35:45 2024.
Package python3-3.9.16-1.amzn2023.0.6.x86_64 is already installed.
Dependencies resolved.
```

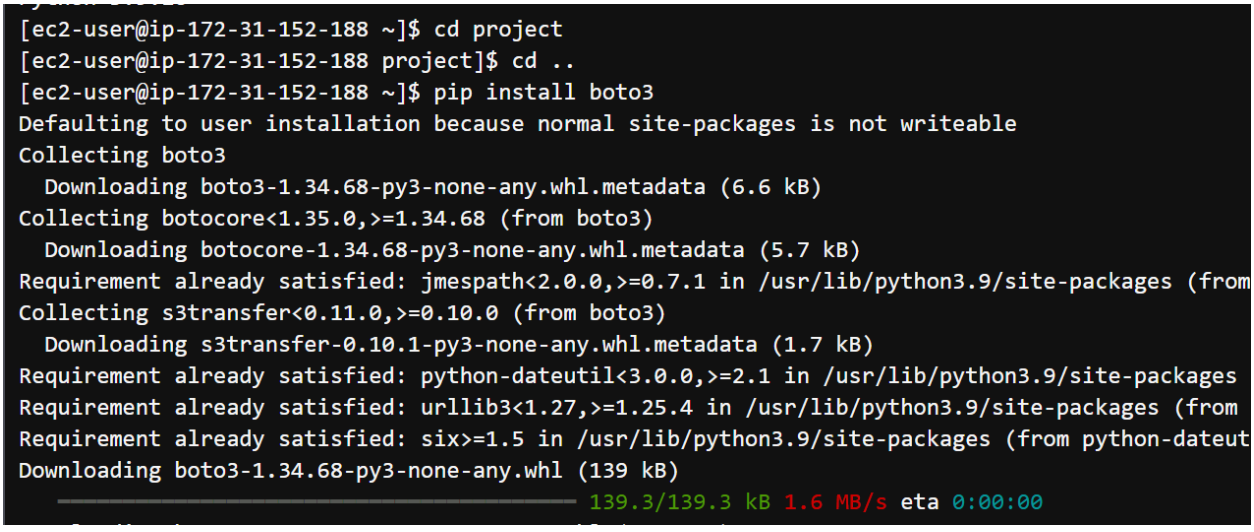
You will see the downloading dependencies.

```
[ec2-user@ip-172-31-152-188 ~]$ sudo yum install python3-pip
Last metadata expiration check: 0:24:48 ago on Thu Mar 21 22:35:45 2024.
Dependencies resolved.
================================================================================
 Package                Architecture            Version                  Repository                Size
================================================================================
Installing:
 python3-pip            noarch                  21.3.1-2.amzn2023.0.7    amazonlinux               1.8 M
Installing weak dependencies:
 libxcrypt-compat       x86_64                  4.4.33-7.amzn2023        amazonlinux               92 k

Transaction Summary
================================================================================
Install  2 Packages

Total download size: 1.9 M
Installed size: 11 M
Is this ok [y/N]: pip list
Is this ok [y/N]: y
Downloading Packages:
(1/2): libxcrypt-compat-4.4.33-7.amzn2023.x86_64.rpm      921 kB/s |  92 kB     00:00
(2/2): python3-pip-21.3.1-2.amzn2023.0.7.noarch.rpm        15 MB/s | 1.8 MB     00:00
--------------------------------------------------------------------------------
Total                                                      11 MB/s | 1.9 MB     00:00
Running transaction check
```

This is optional but for my reference, I am checking list of pip or installations I have in my system, to check it you type in ‘pip list’.



Now once you install python, we need to install boto3. I have installed it by going to the folder I previously created. But you can also download it anywhere in the IDE since it will be installed globally.



Now once this has been done, install flask for our application.

```
[ec2-user@ip-172-31-152-188 ~]$ pip install flask
Defaulting to user installation because normal site-packages is not writeable
Collecting flask
  Downloading flask-3.0.2-py3-none-any.whl.metadata (3.6 kB)
Collecting Werkzeug>=3.0.0 (from flask)
  Downloading werkzeug-3.0.1-py3-none-any.whl.metadata (4.1 kB)
Collecting Jinja2>=3.1.2 (from flask)
  Downloading Jinja2-3.1.3-py3-none-any.whl.metadata (3.3 kB)
Collecting itsdangerous>=2.1.2 (from flask)
  Downloading itsdangerous-2.1.2-py3-none-any.whl.metadata (2.9 kB)
Collecting click>=8.1.3 (from flask)
  Downloading click-8.1.7-py3-none-any.whl.metadata (3.0 kB)
Collecting blinker>=1.6.2 (from flask)
  Downloading blinker-1.7.0-py3-none-any.whl.metadata (1.9 kB)
Collecting importlib-metadata>=3.6.0 (from flask)
  Downloading importlib_metadata-7.1.0-py3-none-any.whl.metadata (4.7 kB)
Collecting zipp>=0.5 (from importlib-metadata>=3.6.0->flask)
  Downloading zipp-3.18.1-py3-none-any.whl.metadata (3.5 kB)
Collecting MarkupSafe>=2.0 (from Jinja2>=3.1.2->flask)
  Downloading MarkupSafe-2.1.5-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.met
Downloading flask-3.0.2-py3-none-any.whl (101 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 101.3/101.3 kB 1.9 MB/s eta 0:00:00
Downloading blinker-1.7.0-py3-none-any.whl (13 kB)
Downloading click-8.1.7-py3-none-any.whl (97 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 kB 3.7 MB/s eta 0:00:00
Downloading importlib_metadata-7.1.0-py3-none-any.whl (24 kB)
Downloading itsdangerous-2.1.2-py3-none-any.whl (15 kB)
Downloading Jinja2-3.1.3-py3-none-any.whl (133 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 133.2/133.2 kB 5.0 MB/s eta 0:00:00
```

Now once we install all the libraries, create a file, in my case its app.py and copy the flask code into this folder and save it. You can use the commands as mentioned in the below picture:

```
[ec2-user@ip-172-31-152-188 ~]$ cd project
[ec2-user@ip-172-31-152-188 project]$ sudo nano app.py
[ec2-user@ip-172-31-152-188 project]$ cat app.py
```

The cat command shows you what's actually in the file.

```
from flask import Flask, render_template, request, jsonify
import boto3

app = Flask(__name__)

region = 'ca-central-1'

# Create a boto3 client for AWS Comprehend with the specified region
comprehend = boto3.client('comprehend', region_name=region)

@app.route('/')
def index():
    return render_template('index1.html')

@app.route('/analyze_sentiment', methods=['POST'])
def analyze_sentiment():
    # Get text data from the request
    text = request.json['text']

    # Call Amazon Comprehend to analyze sentiment
    response = comprehend.detect_sentiment(Text=text, LanguageCode='en')

    # Extract sentiment scores from the response
    sentiment_scores = {
        'positive': response['SentimentScore']['Positive'],
        'negative': response['SentimentScore']['Negative'],
        'neutral': response['SentimentScore']['Neutral'],
    }
```

```
    return jsonify(sentiment_scores)

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000, debug=True)

[ec2-user@ip-172-31-152-188 project]$ sudo nano app.py
[ec2-user@ip-172-31-152-188 project]$ python3 app.py
 * Serving Flask app 'app'
```

Once your code is shown or printed on the screen, save the nano file and exit by pressing ctrl + x.

Now run the python file(app.py)

This will connect to our flask application and we will see the below screen.

```
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it i
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://172.31.152.188:5000
Press CTRL+C to quit
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 632-901-806
```

Here we can see that its running on the addresses its running.

We choose a web browser of our own choice to check if the application is running or not.

For that, copy the public IP address of your ec2 instance with the port number(in our case its 5000 since it's the standard port number for flask).

'IP address:5000'. This is how we need to check if our application has been connected or not.

Now we might not be seeing the application as we still did not connect our front end. For this, within the project folder create another folder named templates and then save the html file in it.

```
[ec2-user@ip-172-31-152-188 project]$ cd ..
[ec2-user@ip-172-31-152-188 ~]$ cd project
[ec2-user@ip-172-31-152-188 project]$ mkdir templates
[ec2-user@ip-172-31-152-188 project]$ ls
app.py  templates
```

Since flask looks for files only in templates we are explicitly creating this folder and putting our html file to run through it.

Run the command sudo nano… to create an empty file in the templates folder and copy paste the html code we have in our system.

```
[ec2-user@ip-172-31-152-188 project]$ cd templates
[ec2-user@ip-172-31-152-188 templates]$ sudo nano index1.html
[ec2-user@ip-172-31-152-188 templates]$ cat index1.html
<!DOCTYPE html>
```

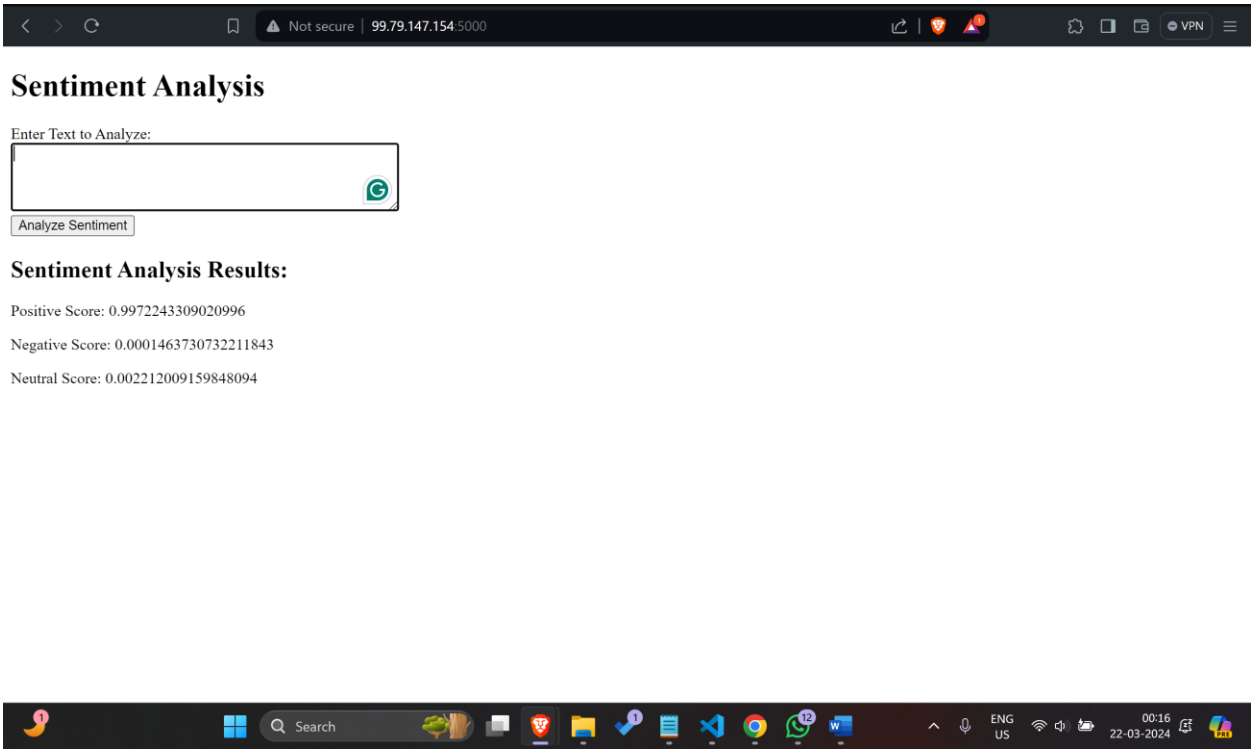
Once you perform cat command, we should be able to see the html code in the ide.

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Sentiment Analysis</title>
</head>
<body>
    <h1>Sentiment Analysis</h1>
    <form id="sentimentForm">
        <label for="textInput">Enter Text to Analyze:</label><br>
        <textarea id="textInput" name="textInput" rows="4" cols="50"></textarea><br>
        <button type="submit">Analyze Sentiment</button>
    </form>
    <div id="result"></div>

    <script>
        document.getElementById('sentimentForm').addEventListener('submit', function(event) {
            event.preventDefault();
            const text = document.getElementById('textInput').value;
            analyzeSentiment(text);
        });
```

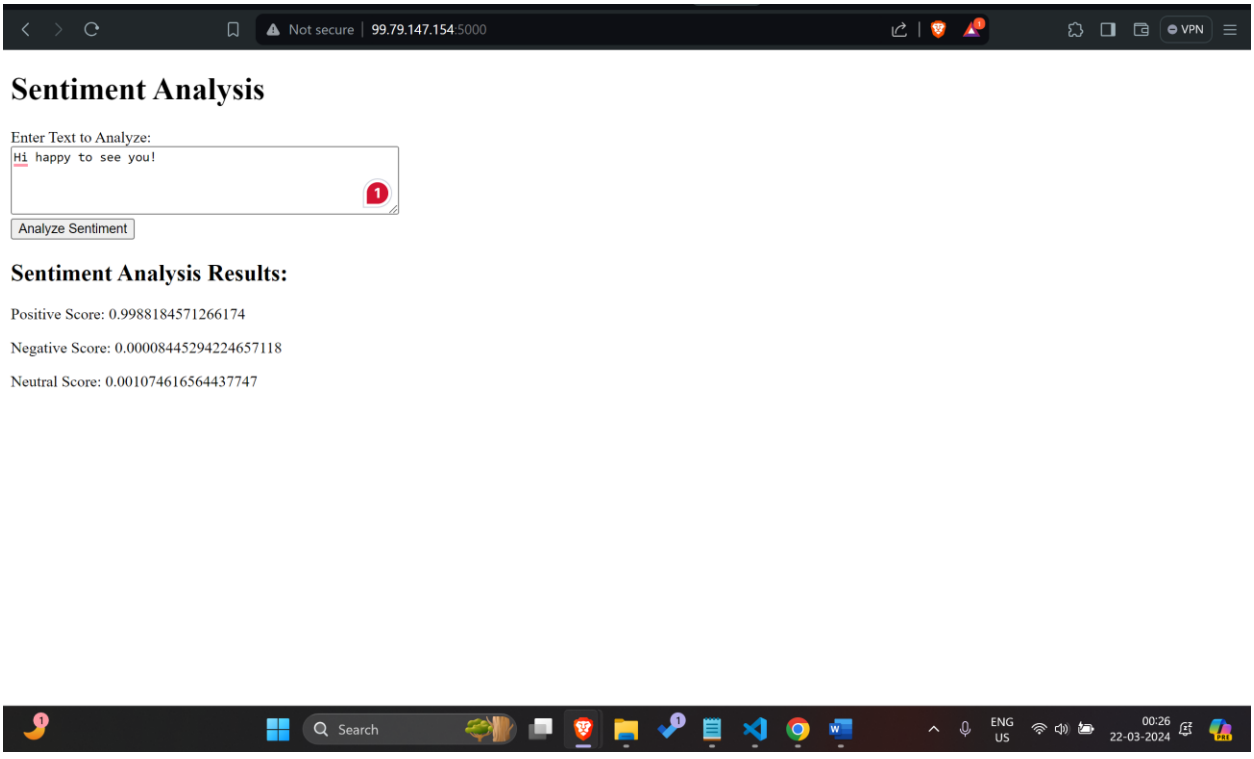
```
        function analyzeSentiment(text) {
            fetch('/analyze_sentiment', {
                method: 'POST',
                headers: {
                    'Content-Type': 'application/json'
                },
                body: JSON.stringify({ text: text })
            })
            .then(response => response.json())
            .then(data => {
                displayResults(data);
            })
            .catch(error => {
                console.error('Error:', error);
            });
        }

        function displayResults(sentimentScores) {
            const resultDiv = document.getElementById('result');
            resultDiv.innerHTML = `
                <h2>Sentiment Analysis Results:</h2>
                <p>Positive Score: ${sentimentScores.positive}</p>
                <p>Negative Score: ${sentimentScores.negative}</p>
                <p>Neutral Score: ${sentimentScores.neutral}</p>
            `;
        }
    </script>
</body>
</html>
```

Now you Run the python file and reload your web browser page, you should be able to see the html format in it.

```
app.py  templates
[ec2-user@ip-172-31-152-188 project]$ python3 app.py
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deploy
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://172.31.152.188:5000
Press CTRL+C to quit
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 632-901-806
```



The above is my simple html format where I am showing the sentiment results along with its scores.



As you can see we are able to see the sentiment score of how much percentage is sentence is.

Since it is a positive statement, the positive score is 0.99 which is 99% accurate.

Setting Up web server and running the application:

Now once we are done with checking the backend, we now set up a web server and proxy server for our web applications to run.

Nginx: It is a web server that is used as a reverse proxy. It is used to handle the HTTP requests.

Gunicorn is a WSGI server which is used to serve python, flask web applications. It is an application server to handle the execution of the flask application files and handle multiple worker request processes. To be precise it is used to handle dynamic application content.

```
[ec2-user@ip-172-31-152-188 project]$ pip install gunicorn
Defaulting to user installation because normal site-packages is not writeable
Collecting gunicorn
  Downloading gunicorn-21.2.0-py3-none-any.whl.metadata (4.1 kB)
Collecting packaging (from gunicorn)
  Downloading packaging-24.0-py3-none-any.whl.metadata (3.2 kB)
Downloading gunicorn-21.2.0-py3-none-any.whl (80 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 80.2/80.2 kB 1.7 MB/s eta 0:00:00
Downloading packaging-24.0-py3-none-any.whl (53 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 53.5/53.5 kB 5.5 MB/s eta 0:00:00
Installing collected packages: packaging, gunicorn
Successfully installed gunicorn-21.2.0 packaging-24.0
[ec2-user@ip-172-31-152-188 project]$ cd ..
[ec2-user@ip-172-31-152-188 ~]$ ls
get-pip.py  project
```

Once you install Gunicorn install Nginx as well.

```
[ec2-user@ip-172-31-152-188 ~]$ pip install nginx
Defaulting to user installation because normal site-packages is not writeable
ERROR: Could not find a version that satisfies the requirement nginx (from versions: n
ERROR: No matching distribution found for nginx
[ec2-user@ip-172-31-152-188 ~]$ sudo yum install nginx
Last metadata expiration check: 1:42:23 ago on Thu Mar 21 22:35:45 2024.
Dependencies resolved.
================================================================================
 Package               Arch     Version                     Repository     Size
================================================================================
Installing:
 nginx                 x86_64   1:1.24.0-1.amzn2023.0.2     amazonlinux    32 k
Installing dependencies:
 generic-logos-httpd   noarch   18.0.0-12.amzn2023.0.3      amazonlinux    19 k
 gperftools-libs       x86_64   2.9.1-1.amzn2023.0.3        amazonlinux   308 k
 libunwind             x86_64   1.4.0-5.amzn2023.0.2        amazonlinux    66 k
 nginx-core            x86_64   1:1.24.0-1.amzn2023.0.2     amazonlinux   586 k
 nginx-filesystem      noarch   1:1.24.0-1.amzn2023.0.2     amazonlinux   9.1 k
 nginx-mimetypes       noarch   2.1.49-3.amzn2023.0.3       amazonlinux    21 k

Transaction Summary
================================================================================
Install  7 Packages

Total download size: 1.0 M
Installed size: 3.4 M
Is this ok [y/N]: y
Downloading Packages:
(1/7): nginx-1.24.0-1.amzn2023.0.2.x86_64.rpm    532 kB/s |  32 kB     00:00
(2/7): gperftools-libs-2.9.1-1.amzn2023.0.3.x86_ 4.6 MB/s | 308 kB     00:00
(3/7): nginx-core-1.24.0-1.amzn2023.0.2.x86_64.r 7.8 MB/s | 586 kB     00:00
```

Once you installed the web server, we now have to start the Gunicorn application to see if the flask application is running on the web browser.

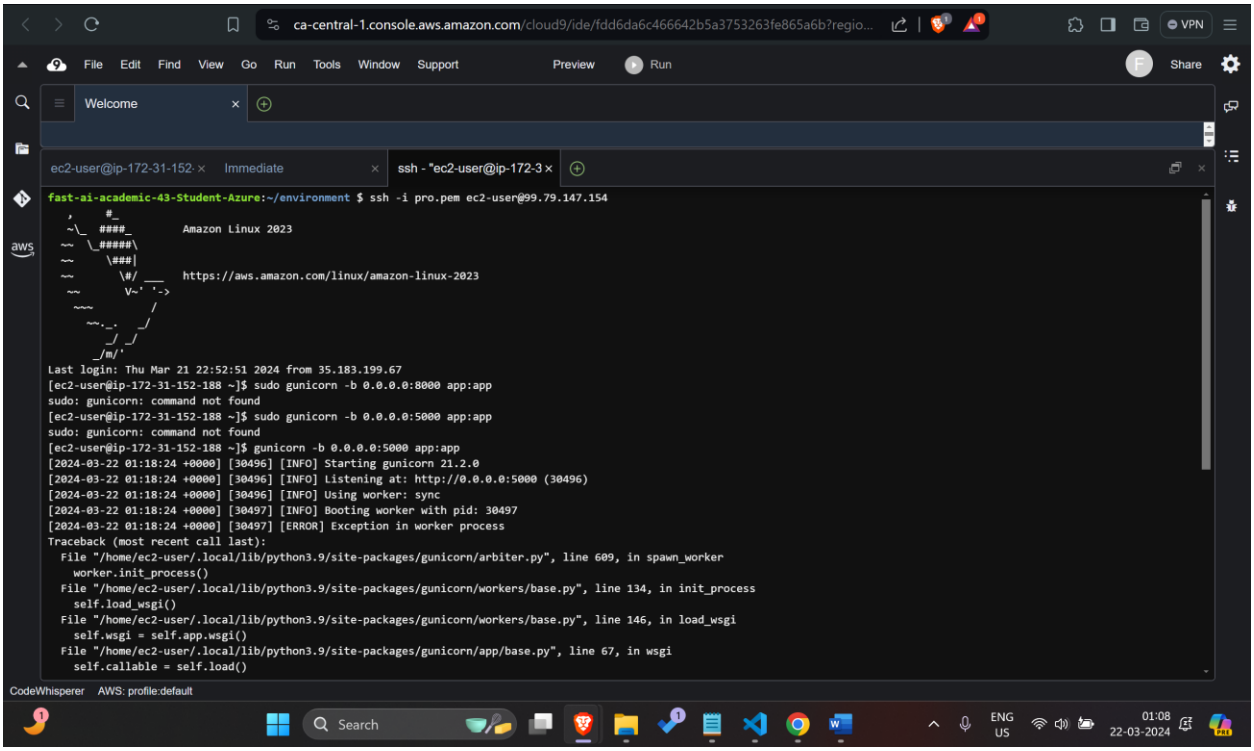
```
-bash: cd: project: No such file or directory
[ec2-user@ip-172-31-152-188 ~]$ cd project
[ec2-user@ip-172-31-152-188 project]$ ls
app.py  templates
[ec2-user@ip-172-31-152-188 project]$ gunicorn -b 0.0.0.0:5000 app:app
[2024-03-22 00:24:03 +0000] [28703] [INFO] Starting gunicorn 21.2.0
[2024-03-22 00:24:03 +0000] [28703] [INFO] Listening at: http://0.0.0.0:5000 (28703)
[2024-03-22 00:24:03 +0000] [28703] [INFO] Using worker: sync
[2024-03-22 00:24:03 +0000] [28704] [INFO] Booting worker with pid: 28704
^C[2024-03-22 00:24:43 +0000] [28703] [INFO] Handling signal: int
[2024-03-22 00:24:43 +0000] [28704] [INFO] Worker exiting (pid: 28704)
[2024-03-22 00:24:43 +0000] [28703] [INFO] Shutting down: Master
[ec2-user@ip-172-31-152-188 project]$ gunicorn -b 0.0.0.0:5000 app:app
[2024-03-22 00:24:56 +0000] [28753] [INFO] Starting gunicorn 21.2.0
[2024-03-22 00:24:56 +0000] [28753] [INFO] Listening at: http://0.0.0.0:5000 (28753)
[2024-03-22 00:24:56 +0000] [28753] [INFO] Using worker: sync
[2024-03-22 00:24:56 +0000] [28754] [INFO] Booting worker with pid: 28754
```

Run the sudo command and you will see the workers with PID. PID is nothing but a process ID who are listening(means waiting for the request) to perform the task. Now to make this work, we need someone to actually handle our requests. This is where Nginx comes into work.

Before starting it, we create a systemd: It is a tool that is called as a system service manager that allows for strict process management. Below we are creating a socket for incoming Gunicorn requests. Systemd will listen on this socket and start gunicorn automatically.

```
[2024-03-22 00:28:21 +0000] [28755] [INFO] Shutting down: Master
[ec2-user@ip-172-31-152-188 project]$ sudo nano /etc/systemd/system/project.service
[ec2-user@ip-172-31-152-188 project]$ pwd
/home/ec2-user/project
[ec2-user@ip-172-31-152-188 project]$ ls
__pycache__  app.py  templates
```

To make the Gunicorn running for the rest of the process, we open another terminal, connect our ec2 instance and run the gunicorn start command. Since this is used for our incoming requests, we keep this running in one terminal and run other parts in different terminal.




```
[2024-03-22 01:18:24 +0000] [30497] [INFO] Worker exiting (pid: 30497)
[2024-03-22 01:18:24 +0000] [30496] [ERROR] Worker (pid:30497) exited with code 3
[2024-03-22 01:18:24 +0000] [30496] [ERROR] Shutting down: Master
[2024-03-22 01:18:24 +0000] [30496] [ERROR] Reason: Worker failed to boot.
[ec2-user@ip-172-31-152-188 ~]$ cd project
[ec2-user@ip-172-31-152-188 project]$ gunicorn -b 0.0.0.0:5000 app:app
[2024-03-22 01:19:24 +0000] [30546] [INFO] Starting gunicorn 21.2.0
[2024-03-22 01:19:24 +0000] [30546] [INFO] Listening at: http://0.0.0.0:5000 (30546)
[2024-03-22 01:19:24 +0000] [30546] [INFO] Using worker: sync
[2024-03-22 01:19:24 +0000] [30547] [INFO] Booting worker with pid: 30547
```

Now we get back to our terminal 1 and type in the below commands where we are creating a unit file named project.service. Here, we define in the file that how the systemd should manage a process, in our case its flask or Nginx server.

```
[ec2-user@ip-172-31-152-188 project]$ sudo nano /etc/systemd/system/project.service
[ec2-user@ip-172-31-152-188 project]$ sudo systemctl daemon-reload
[ec2-user@ip-172-31-152-188 project]$ sudo systemctl daemon-reload
[ec2-user@ip-172-31-152-188 project]$ sudo systemctl start project
[ec2-user@ip-172-31-152-188 project]$ sudo systemctl enable project
```

In the file where we use the nano command, there are few things we need to learn about the code.

Unit Description: A brief description of the service.

Service Section: Defines the service-specific configuration, including the executable path (ExecStart), working directory (WorkingDirectory), user and group under which the service should run (User and Group), and other settings.

Dependencies: Specifies any dependencies that must be satisfied before the service can start (After, Requires, etc.).

Installation Section: Defines how the service should be installed and started automatically at boot (WantedBy, RequiredBy, etc.).

The .service extension indicates that the file is a systemd service unit file.

Furthermore, The command daemon - refers to a type of background process that runs continuously, providing specific services or functionality to the operating system or other programs.

Daemons typically do not have a user interface and operate without direct user interaction.

Now that we have set, run the port using curl command: curl 0.0.0.0:5000

```
[ec2-user@ip-172-31-152-188 project]$ curl 0.0.0.0:5000
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Sentiment Analysis</title>
</head>
<body>
    <h1>Sentiment Analysis</h1>
    <form id="sentimentForm">
        <label for="textInput">Enter Text to Analyze:</label><br>
        <textarea id="textInput" name="textInput" rows="4" cols="50"></textarea><br>
        <button type="submit">Analyze Sentiment</button>
    </form>
    <div id="result"></div>

    <script>
        document.getElementById('sentimentForm').addEventListener('submit', function(event) {
            event.preventDefault();
            const text = document.getElementById('textInput').value;
            analyzeSentiment(text);
        });
```

By entering the curl command, it will open the html file ensuring that our files are connected to the server successfully.

Now we create a configuration file using sudo nano command. This is a configuration file for the Nginx server.

This file contains how the Nginx should run, its behaviour, security etc.

```
[ec2-user@ip-172-31-152-188 project]$ sudo nano /etc/nginx/conf.d/app.conf
[ec2-user@ip-172-31-152-188 project]$ sudo nano /etc/nginx/conf.d/app.conf
[ec2-user@ip-172-31-152-188 project]$ sudo nginx -t
```

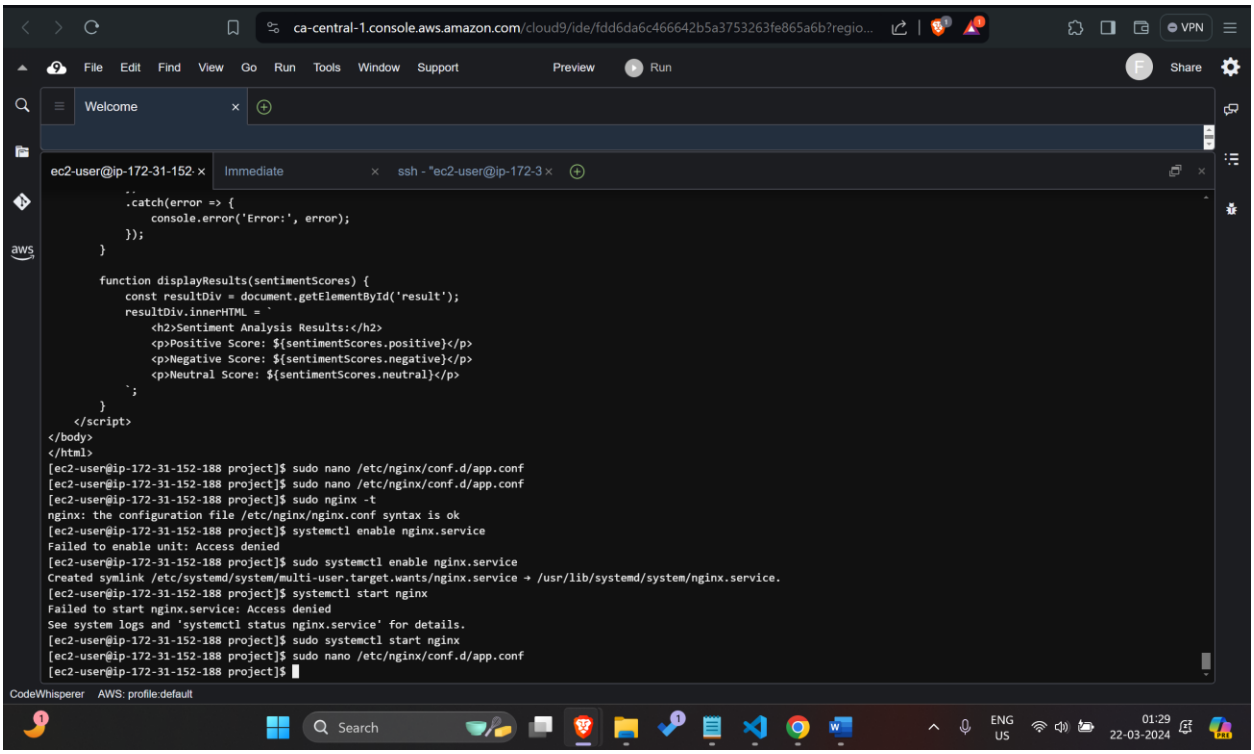
The code:

```
server {
    listen 80;
    server_name 99.79.147.154;


    location / {
        proxy_pass http://0.0.0.0:5000;
        proxy_set_header Host $host;
```

```
        proxy_set_header X-Real-IP $remote_addr;
        proxy_set_header X-Forwarded-For $proxy_add_x_forwarded_for;
        proxy_set_header X-Forwarded-Proto $scheme;
    }
}
```

The listen and server name are used to configure a local machine. Once we save the file, we have to make sure that we enable and start the Nginx server.

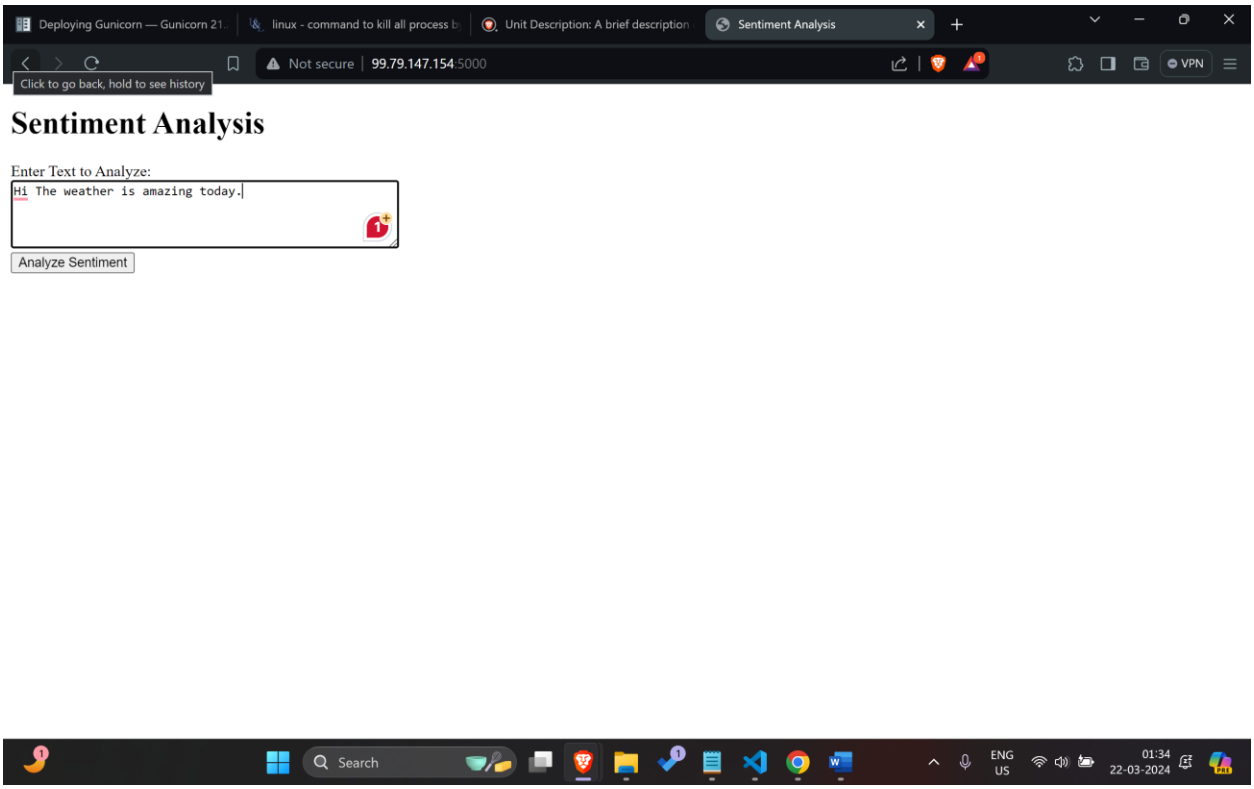
By this, our server is connected to the website and can be opened on any web browser.

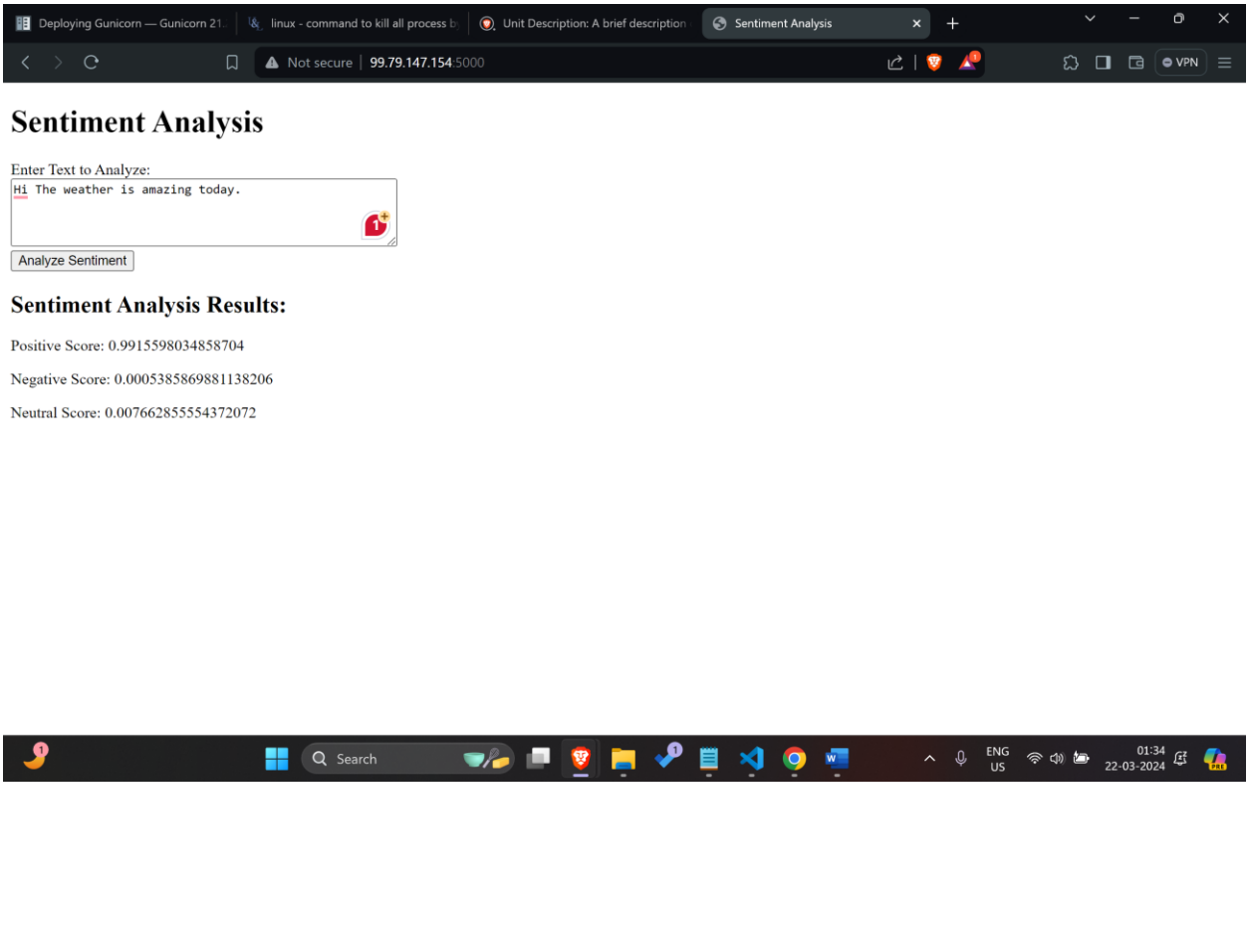


Now to see our results, copy the IP address and the port number(IP address:5000) and run it on the browser.

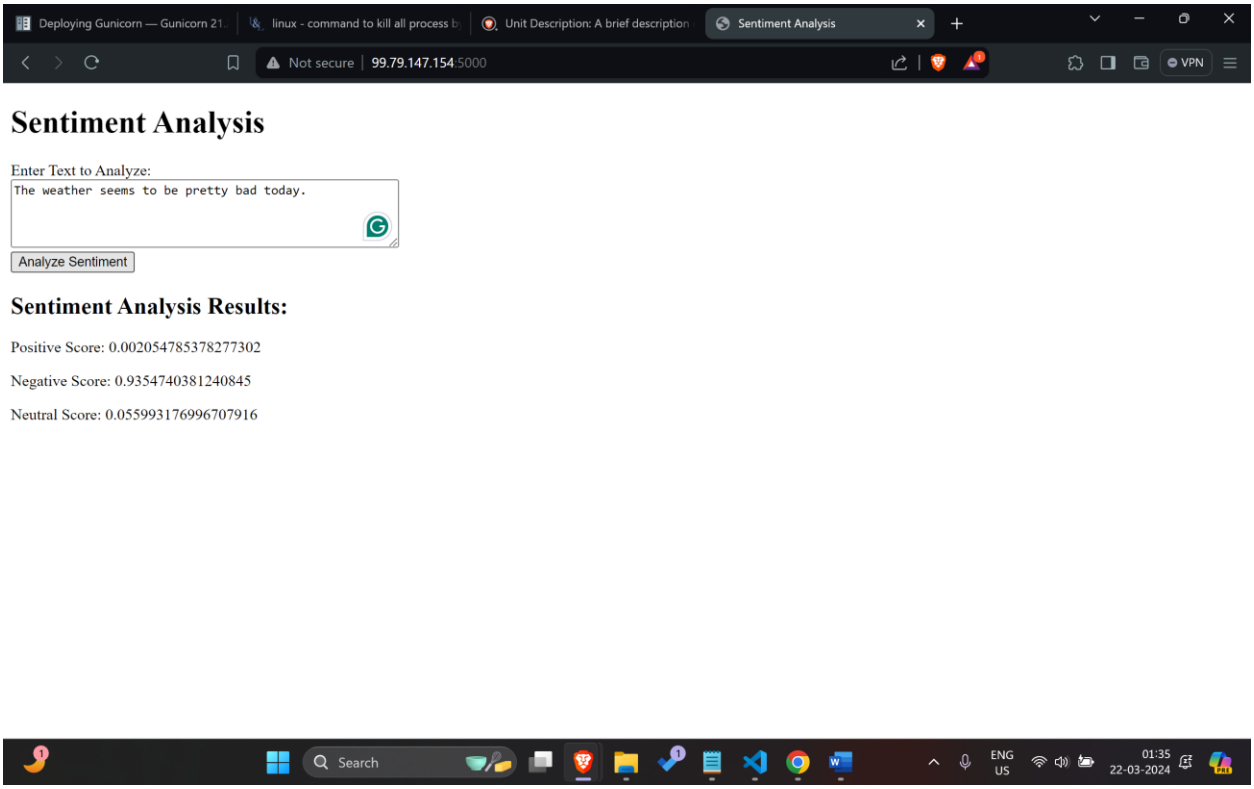
Below are the results of each type of sentiment analysis of a statement and the scores showing what percentage of scores.

So if our statement is positive, the highest sentiment score will be positive else negative or else neutral.

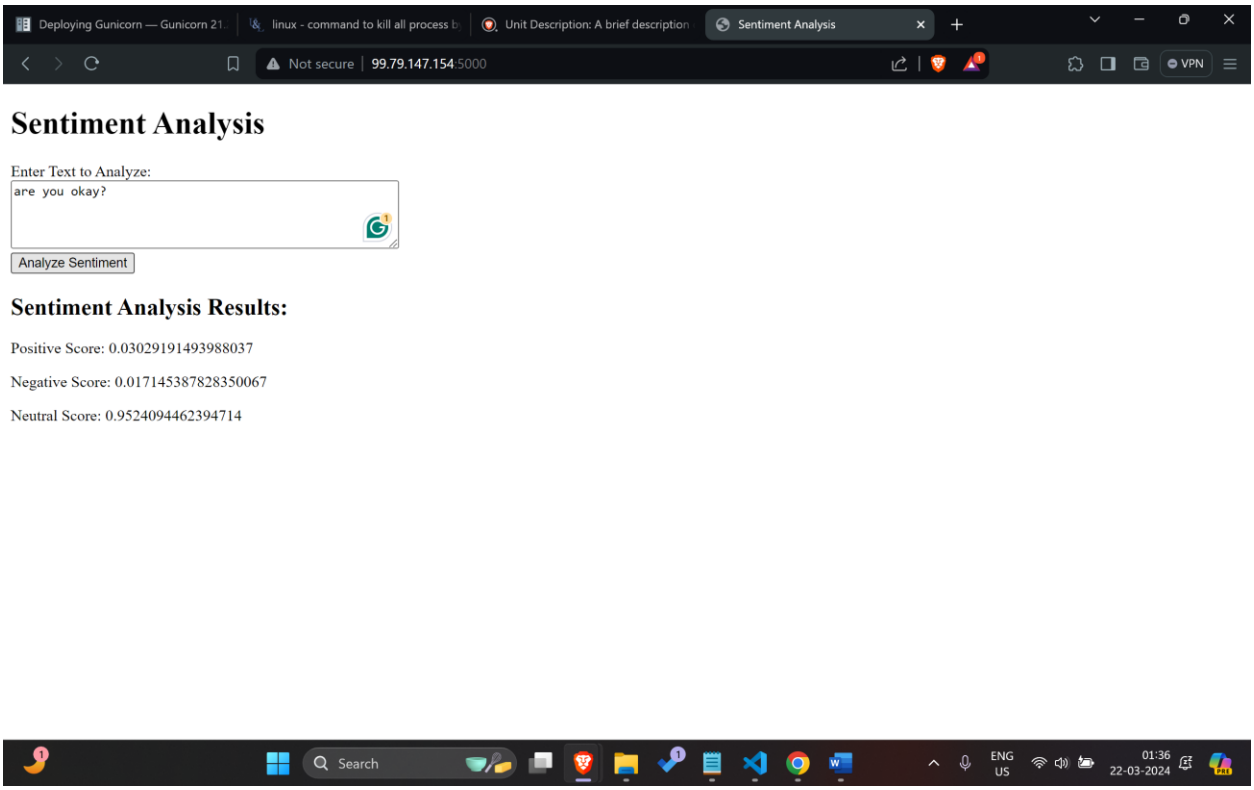

Deploying Gunicorn — Gunicorn 21
linux - command to kill all process b
Unit Description: A brief description
Sentiment Analysis
Not secure | 99.79.147.154:5000
Click to go back, hold to see history
VPN
Sentiment Analysis
Enter Text to Analyze:
Hi The weather is amazing today.
Analyze Sentiment


Deploying Gunicorn — Gunicorn 21
linux - command to kill all process b
Unit Description: A brief description
Sentiment Analysis
Not secure | 99.79.147.154:5000
VPN
Sentiment Analysis
Enter Text to Analyze:
Hi The weather is amazing today.
Analyze Sentiment
Sentiment Analysis Results:
Positive Score: 0.9915598034858704
Negative Score: 0.0005385869881138206
Neutral Score: 0.007662855554372072

If the given statement is negative:



Now lets check for the neutral statement:



References:

https://docs.gunicorn.org/en/stable/deploy.html

https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/system_administrators_guide/chap-managing_services_with_systemd

Thank You.