MP8 Overview Session

CS 340 - Introduction to Computer Systems

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Goals

In this MP:

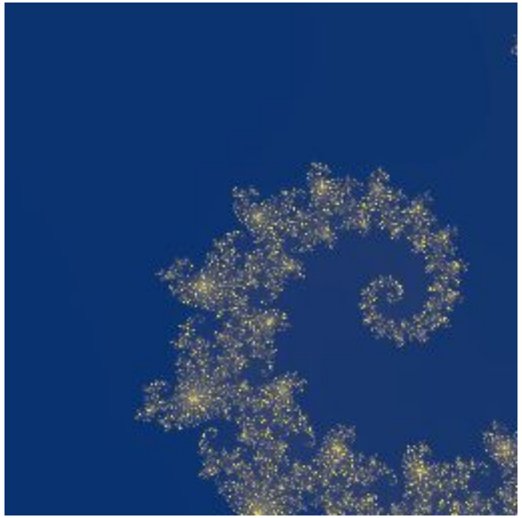
- Build the middleware and backend for a stateful web server to explore the Mandelbrot set
- Use Docker to launch a S3 compatible object storage
- Use AWS boto3 library for accessing your object storage

Mandelbrot Microservice Overview

- /mandelbrot: If there is a GET request on the route /mandelbrot/<colormap>/<real>:<imag>:<height>:<dim>:<iter>, it will return the mandelbrot set generated off those parameters

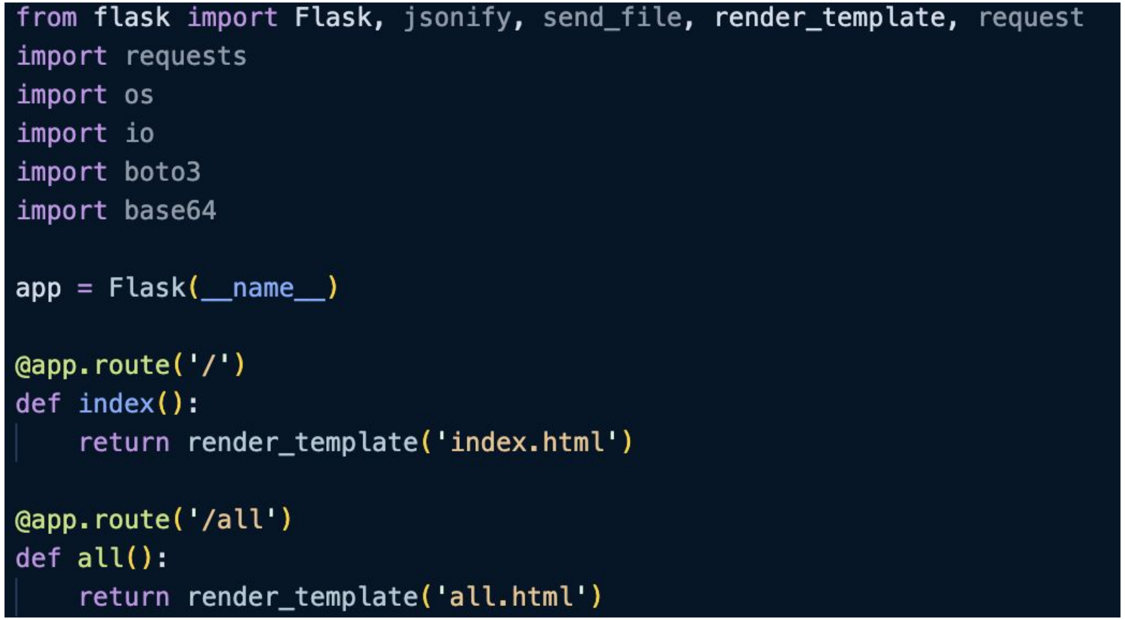
/mandelbrot/cividis/-0.7435:0.126129:0.00018972901232843951:256:1024

$\Longrightarrow$



Flask Overview

- Provided Code: The provided code can be found in app.py and will give you the two routes already defined that will render the frontend



```python
from flask import Flask, jsonify, send_file, render_template, request
import requests
import os
import io
import boto3
import base64

app = Flask(__name__)

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

@app.route('/all')
def all():
    return render_template('all.html')
```

Found the app using python -m flask run

- Set the FLASK_DEBUG environment variable to 1 to run in debug mode

Visit https://127.0.0.1:5000/ to the application

Helpful Functions & Modules

Programming in Python

- boto3.client: Will initialize an s3 client
- boto3.list_objects: Will list all the objects stored in a given bucket
- boto3.download_fileobj: Can be used to retrieve an object out of the storage system
- boto3.upload_fileobj: Can be used to store an object in the s3 storage
- send_file(): Can be used to return the bytes of a file in a response
- how to run MinIO: docker run -it --rm -p 9000:9000 -p 9090:9090 --name minio -e "MINIO_ROOT_USER=ROOTNAME" -e "MINIO_ROOT_PASSWORD=CHANGEME123" quay.io/minio/minio server /data --console-address :9090 (use this command to run a local instance of MinIO before running your stateful server)

MP8 Part 3

Creating a stateful web server

Maintain State in Server

- **Center real:** center point used in the real axis
- **Center Imaginary:** center point used in the imaginary axis
- **Height:** contains the unit height that will be used when generating the mandelbrot set
- **Dimensions:** render dimensions of the image
- **Iterations:** maximum iterations of the mandelbrot set
- **Colormap:** Matplotlib colormap used to generate the image

Modifying Server State

- POST /moveup: moves the center of the image up by 25% of the current height
- POST /moveDown: moves the center of the image down by 25% of the current height
- POST /moveLeft: moves the center of the image to the left by 25% of the current height
- POST /moveRight: moves the center of the image to the right by 25% of the current height
- POST /zoomIn: modifies the height by a factor of 1 / 1.4
- POST /zoomOut: modifies the height by a factor of 1.4

Modifying Server State Cont.

- POST /smallerImage: modifies the dim of the image by a factor of 1 / 1.25
- POST /largerImage: modifies the dim of the image by a factor of 1.25
- POST /moreIterations: modifies the iter of the image by a factor of 2
- POST /lessIterations: modifies the iter of the image by a factor of 1 / 2
- POST /changeColorMap: changes the colormap to be equal to the colormap value in the JSON in the request's body

Generating the Mandelbrot Image

- GET /mandelbrot:
  - Check if a mandelbrot image with the same state values exists in the cache
    - Return the image if it exists in the cache
  - Make a request to the mandelbrot microservice if the image doesn’t exist
    - Store the returned image in the cache
    - Return the generated image
  - Respond with response code **200**

State of the Cache

- GET /storage:
    - Return a JSON of every image stored as a array of entries
        - Each JSON object must contain a key which is the unique name for a given Mandelbrot image stored in the cache
        - Each JSON object must contain an image with base64-encoded PNG image binary data and data:image/png;base64 prefix

MP8 Testing

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- Run the tests by using pytest
    - You can specify a filter with -k flag after pytest to run a specific test
- To test locally, run the docker command to start the MinIO Instance
- Start the Mandelbrot Microservice
- Run your microservice last