CS655 GENI Mini Project: Image Recognition Application

Implement an image-recognition service which has a web interface, where a user should be able to submit an image query and the service should use any of image recognition techniques, e.g., Squeeze Net, Google Net or any deep learning neural network which classifies the image and returns the answer to the user. You don't need to worry about training the neural network and can use pre-trained weights. The web interface and the recognition systems should be on separate nodes, and you should connect them using socket programming or rest API

Demo

Web: http://204.102.244.71:9999/
(for demo, add/delete worker: 10.10.1.1:8888) add worker: http://204.102.244.71:9999/add/IP:PORT
delete worker: http://204.102.244.71:9999/del/IP:PORT

Video: https://drive.google.com/file/d/1zmoaPUUsQC0rRz1UK-pe7A-Fd0267xXb/view?usp=share_link

Design

1. Define message format

> < Protocol Type > [< SPACE >< Data >< SPACE >< Checksum >]

Protocol Type:

- 'D': Data message, include < Data > and < Checksum >
- 'A': ACK message, exclude < Data > and < Checksum >
- 'N': NACK message, exclude < Data > and < Checksum >

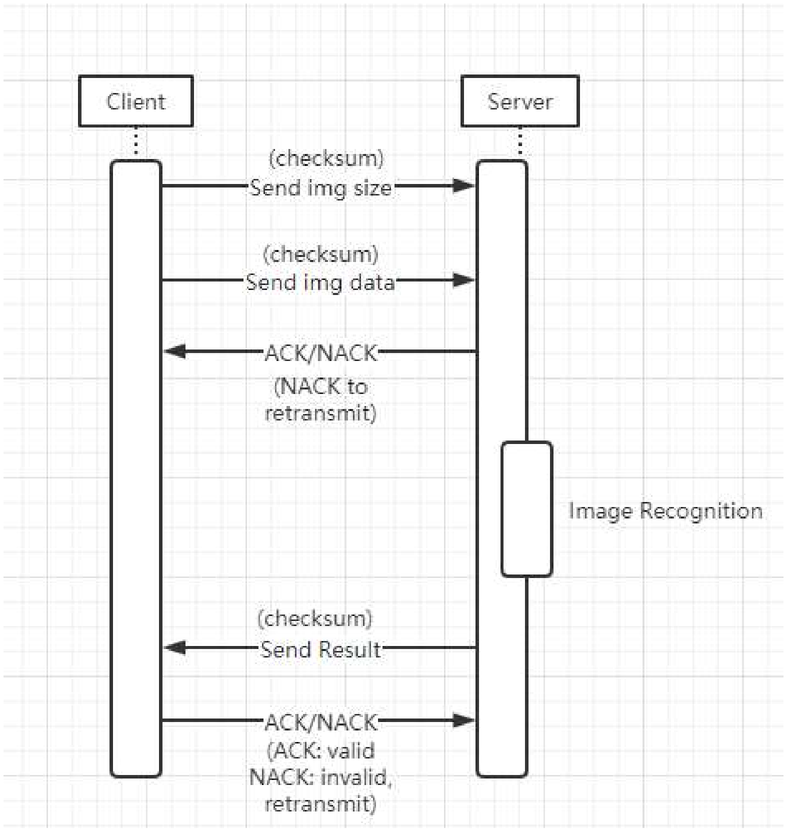
Data:

- Payload to send md5 hash or cracked password

Checksum: (5 bytes: 4 bytes checksum + 1 byte sign)

- Checksum of data

2. Define socket protocol to transfer image data and result.



3. Image recognition model

Used Squeeze Net to do image recognition. The pretrained model is part of pytorch.
Reference: SQUEEZENET

3. Implement socket code for server and client

Python socket program.
`clientsocket.py`
Read image, send image size and data to server

`serversocket.py`
Use multi-thread to handle connection. Receive image, image recognize and return result.

4. Update worker list on the fly

Basic concept

Maintain a worker list and current index in ClientSocket.
Add/delete worker will update worker list.
Whenever client need to use worker, it will choose one worker according to worker index. Then increase index by one.
Client has error worker detection. When worker can't respond correctly, client will delete error worker automatically.

Multi-thread concurrent

Use mutex lock to control concurrent code.
In particular, use mutex lock when client detect error worker, which need to update list and index, or increase index

5. Deploy GUI with Flask

Use Flask to implement simply web ui.
Html templates: `templates/index.html` and `templates/info.html`
Flask code: `client.py`

Requirement

server

```
# install pip3 first
sudo apt update
sudo apt install python3-pip

# prerequisite for Pillow
sudo apt install libjpeg-dev zlib1g-dev
# install python package
sudo pip3 install torch torchvision torchaudio --extra-index-url https://download.pytorch.org
```

client

```
# install pip3 first
sudo apt update
sudo apt install python3-pip

# install python package
sudo pip3 install Flask
```

Run

server

Replace SERVERIP, PORT with your setting

```
# run code in terminal
python3 serversocket.py SERVERIP PORT
# or run code at background
nohup python3 serversocket.py SERVERIP PORT > /dev/null 2>&1 &
```

client

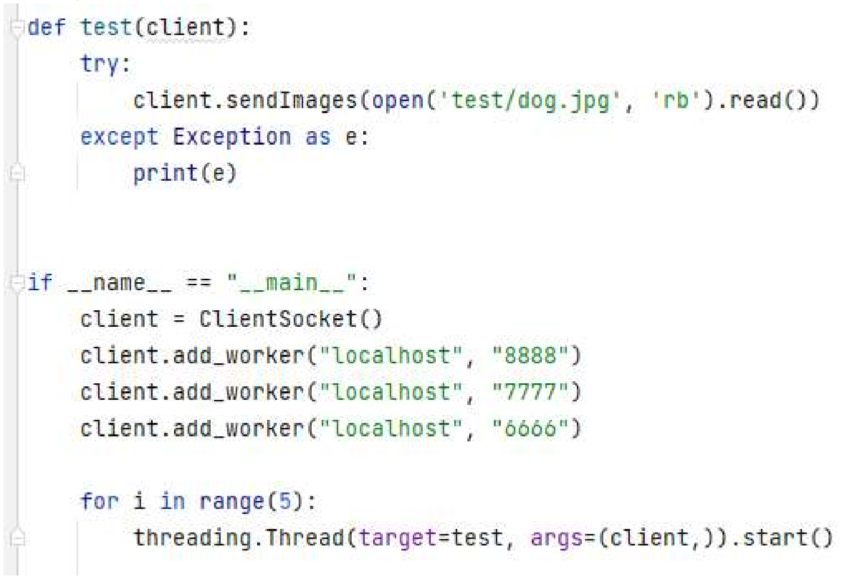
Replace SERVERIP, PORT with your setting

```
# run code in terminal
python3 client.py
# or run code at background
nohup python3 client.py > /dev/null 2>&1 &
```

Analysis

Multi-worker cooperation

Setting: 5 client thread, 3 worker: Worker list [localhost:8888, localhost:7777, localhost:6666]

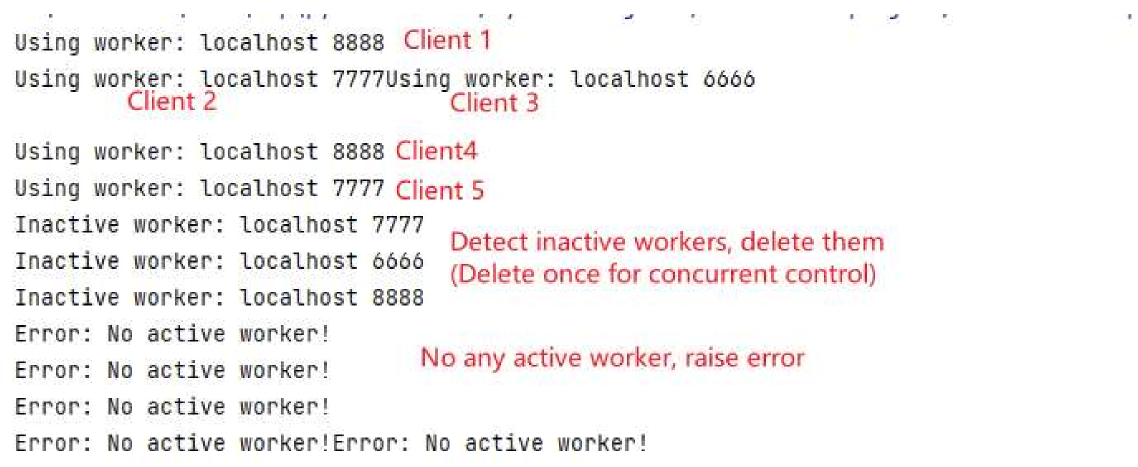


```python
def test(client):
    try:
        client.sendImages(open('test/dog.jpg', 'rb').read())
    except Exception as e:
        print(e)


if __name__ == "__main__":
    client = ClientSocket()
    client.add_worker("localhost", "8888")
    client.add_worker("localhost", "7777")
    client.add_worker("localhost", "6666")

    for i in range(5):
        threading.Thread(target=test, args=(client,)).start()
```

1. 5 client thread with 3 inactive worker

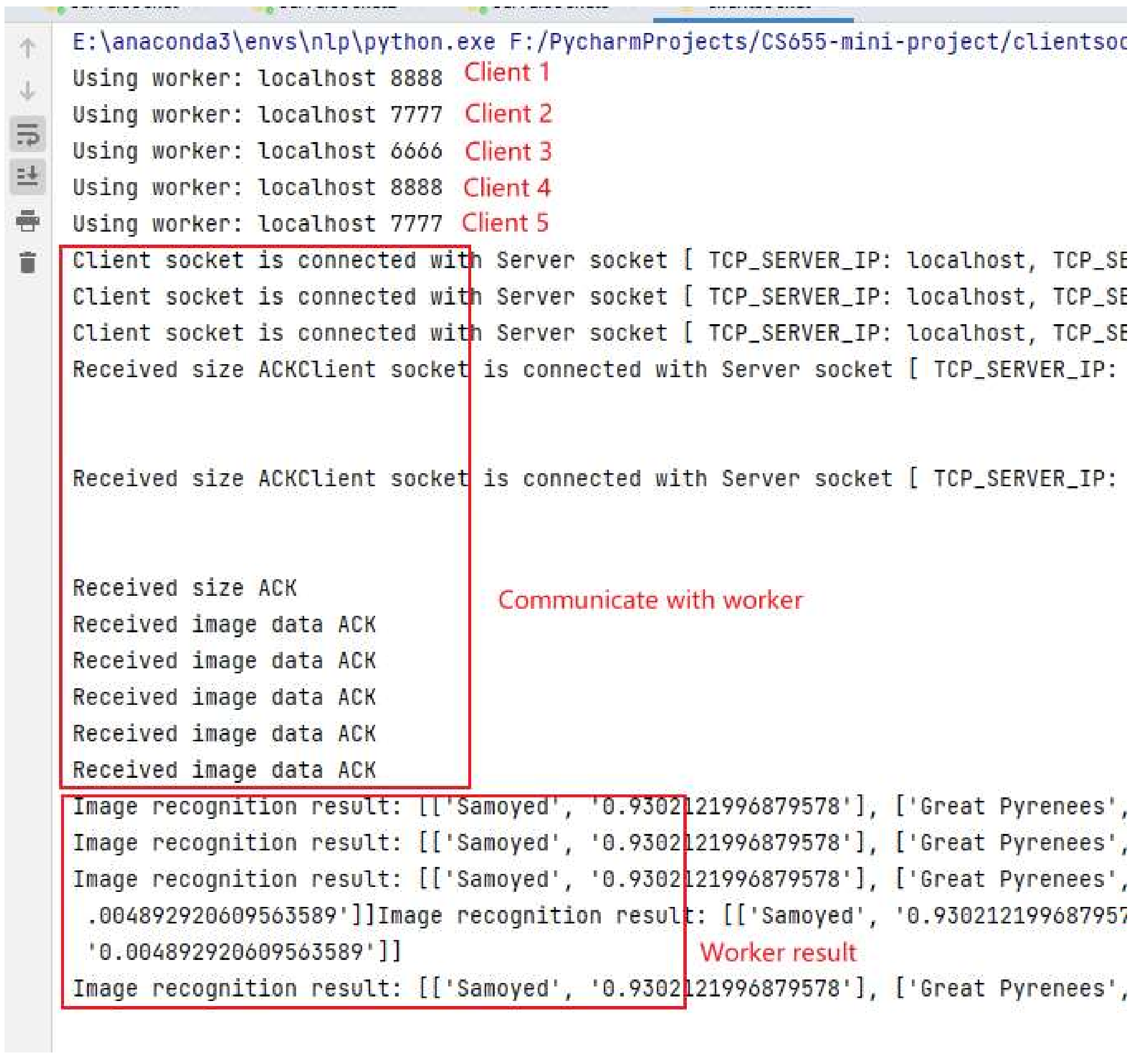


```
Using worker: localhost 8888
Using worker: localhost 7777Using worker: localhost 6666

Using worker: localhost 8888
Using worker: localhost 7777
Inactive worker: localhost 7777
Inactive worker: localhost 6666
Inactive worker: localhost 8888
Error: No active worker!
Error: No active worker!
Error: No active worker!
Error: No active worker!Error: No active worker!
```

Client 1
Client 2
Client 3
Client4
Client 5
Detect inactive workers, delete them
(Delete once for concurrent control)
No any active worker, raise error

2. 5 client thread with 3 active worker



```
E:\anaconda3\envs\nlp\python.exe F:/PycharmProjects/CS655-mini-project/clientsoc
Using worker: localhost 8888  Client 1
Using worker: localhost 7777  Client 2
Using worker: localhost 6666  Client 3
Using worker: localhost 8888  Client 4
Using worker: localhost 7777  Client 5
Client socket is connected with Server socket [ TCP_SERVER_IP: localhost, TCP_SE
Client socket is connected with Server socket [ TCP_SERVER_IP: localhost, TCP_SE
Client socket is connected with Server socket [ TCP_SERVER_IP: localhost, TCP_SE
Received size ACKClient socket is connected with Server socket [ TCP_SERVER_IP:


Received size ACKClient socket is connected with Server socket [ TCP_SERVER_IP:


Received size ACK
Received image data ACK                Communicate with worker
Received image data ACK
Received image data ACK
Received image data ACK
Received image data ACK
Image recognition result: [['Samoyed', '0.930212199687957８'], ['Great Pyrenees',
Image recognition result: [['Samoyed', '0.9302121996879578'], ['Great Pyrenees',
Image recognition result: [['Samoyed', '0.9302121996879578'], ['Great Pyrenees',
 .004892920609563589']]Image recognition result: [['Samoyed', '0.930212199687957
 '0.004892920609563589']]               Worker result
Image recognition result: [['Samoyed', '0.9302121996879578'], ['Great Pyrenees',
```