Anchal 102103227 4CO15

QUES1 :- The paper presents the Speech Commands dataset, a collection of spoken words designed to aid in training and evaluating keyword spotting systems for voice interfaces. It addresses the challenges of on-device speech recognition, such as energy efficiency and the need to minimize false positives. The dataset, which includes a variety of accents and is released under a Creative Commons license, aims to standardize the training and evaluation process for keyword spotting models, making it accessible to a broader research and development community. The paper also discusses the collection process, the importance of background noise in training, and the release of baseline model results.

Snapshots of Code

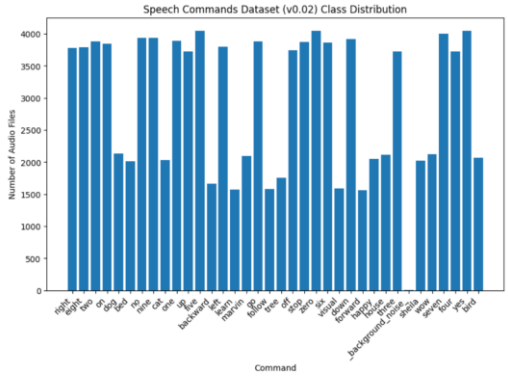
Link for colab:-

https://colab.research.google.com/drive/1_gQpqsCFj9azzocxUz1ZrCgBD0pKVafG#scrollTo=-YxMRieTU-ax

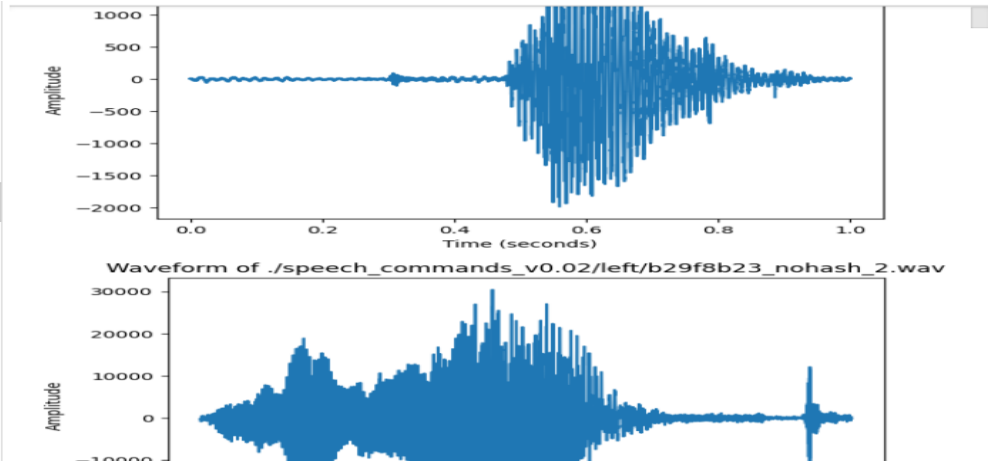
Link of my own dataset

```
[9]  # Download URL (replace with the correct version if v0.02 is outdated)
     dataset_url = "http://download.tensorflow.org/data/speech_commands_v0.02.tar.gz"

     # Download and extract the dataset
     data_dir = "./speech_commands_v0.02"
     if not os.path.exists(data_dir):
         os.makedirs(data_dir)
         print("Downloading dataset...")
         !wget {dataset_url} -P .
         print("Extracting dataset...")
         with tarfile.open(dataset_url.split("/")[-1], "r:gz") as tar:
             tar.extractall(data_dir)
             print("Dataset extraction complete!")
```

```
Downloading dataset...
--2024-09-11 05:57:29--  http://download.tensorflow.org/data/speech_commands_v0.02.tar.gz
Resolving download.tensorflow.org (download.tensorflow.org)... 74.125.195.207, 172.253.117.207, 142.250.99.207,
Connecting to download.tensorflow.org (download.tensorflow.org)|74.125.195.207|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2428923189 (2.3G) [application/gzip]
Saving to: ‘./speech_commands_v0.02.tar.gz’

speech_commands_v0. 100%[===================>]   2.26G  5.28MB/s    in 37s

2024-09-11 05:58:07 (62.5 MB/s) - ‘./speech_commands_v0.02.tar.gz’ saved [2428923189/2428923189]

Extracting dataset...
Dataset extraction complete!
```




```
Audio length statistics:
Minimum: 821 bytes
Maximum: 3045984 bytes
Average: 31552.46465285914 bytes
Standard deviation: 16264.196594505445 bytes
```




```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 3s 3s/step - accuracy: 0.0000e+00 - loss: 3.5494 - val_accuracy: 0.0000e+00 - val_loss: 81.9565
Epoch 2/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 178ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 140.2354
Epoch 3/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 183.8691
Epoch 4/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 218.3487
Epoch 5/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 68ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 245.7756
Epoch 6/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 268.6526
Epoch 7/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 288.7154
Epoch 8/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 306.5362
Epoch 9/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 322.4672
Epoch 10/10
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 1.0000 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 336.7675
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 24ms/step - accuracy: 0.0000e+00 - loss: 336.7675
Test accuracy: 0.00
```

```python
from sklearn.metrics import classification_report, confusion_matrix

# Predict on the test set
y_pred = model.predict(X_test)
y_pred_classes = np.argmax(y_pred, axis=1)

# Calculate classification report
report = classification_report(np.argmax(y_test, axis=1), y_pred_classes, target_names=label_encoder.classes_)
print("Classification Report:\n", report)

# Calculate confusion matrix
confusion_mat = confusion_matrix(np.argmax(y_test, axis=1), y_pred_classes)
print("Confusion Matrix:\n", confusion_mat)
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 639ms/step
Classification Report:
                              precision    recall  f1-score   support

left_00176480_nohash_0.wav       0.00      0.00      0.00       0.0
left_004ae714_nohash_0.wav       0.00      0.00      0.00       1.0

                  accuracy                           0.00       1.0
                 macro avg       0.00      0.00      0.00       1.0
              weighted avg       0.00      0.00      0.00       1.0

Confusion Matrix:
 [[0 0]
 [1 0]]
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1471: UndefinedMetricWarning: Precision and F-sco
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1471: UndefinedMetricWarning: Recall and F-score
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1471: UndefinedMetricWarning: Precision and F-sco
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1471: UndefinedMetricWarning: Recall and F-score
  _warn_prf(average, modifier, msg_start, len(result))
```

Q5-

MY voice

```python
[25] from google.colab import drive
     import os

     # Mount the Google Drive
     drive.mount('/content/drive')

     # Set the path to your dataset folder
     dataset_folder = 'https://drive.google.com/drive/folders/1gqgu-_hDAwJ5VeO47StuOG-VHVWZvE9J'  # Replace with the path to your dataset folder on Google Drive
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```python
from google.colab import drive
import os

# Mount the Google Drive
drive.mount('/content/drive')

# Set the path to your dataset folder
dataset_folder = '/content/drive/MyDrive/myVoice'  # Replace 'your_dataset_folder' with the actual folder name in your Drive

import librosa
import numpy as np

# Function to extract MFCC features from audio files
def extract_features(audio_path, n_mfcc=13):
    audio, sample_rate = librosa.load(audio_path, sr=None)
    mfcc = librosa.feature.mfcc(y=audio, sr=sample_rate, n_mfcc=n_mfcc)
    return np.mean(mfcc.T, axis=0)

# Initialize lists to hold data and labels
X = []
y = []

# Iterate over the files in your dataset folder
for command_dir in os.listdir(dataset_folder):
    command_path = os.path.join(dataset_folder, command_dir)
    if os.path.isdir(command_path):
        for filename in os.listdir(command_path):
            if filename.endswith('.wav'):  # Ensure you only process audio files
                audio_path = os.path.join(command_path, filename)
```

```
# Convert lists to numpy arrays
X = np.array(X)
y = np.array(y)
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
# Check if the folder exists
import os
dataset_folder = '/content/drive/MyDrive/myVoice'

if not os.path.exists(dataset_folder):
    print("Dataset folder does not exist!")
else:
    print("Dataset folder found!")
```

```
Dataset folder found!
```

```
for command_dir in os.listdir(dataset_folder):
    command_path = os.path.join(dataset_folder, command_dir)
    if os.path.isdir(command_path):
        print(f"Checking folder: {command_dir}")
        files = os.listdir(command_path)
        print(f"Number of files in {command_dir}: {len(files)}")
        for filename in files:
            if filename.endswith('.wav'):
                print(f"Found audio file: {filename}")
```

```
Checking folder: myVoiceupadte
Number of files in myVoiceupadte: 29
Found audio file: down.wav
Found audio file: yes.wav
Found audio file: two.wav
Found audio file: three.wav
Found audio file: undo.wav
Found audio file: seven.wav
Found audio file: stop_fake.wav
Found audio file: six.wav
Found audio file: ten.wav
Found audio file: setting.wav
Found audio file: search.wav
Found audio file: right.wav
Found audio file: redo.wav
Found audio file: play.wav
Found audio file: restart.wav
Found audio file: no.wav
Found audio file: no_fake.wav
```

```python
import librosa

# Function to extract MFCC features from audio files
def extract_features(audio_path, n_mfcc=13):
    audio, sample_rate = librosa.load(audio_path, sr=None)
    print(f"Loaded audio file: {audio_path}, Sample Rate: {sample_rate}, Audio Shape: {audio.shape}")
    mfcc = librosa.feature.mfcc(y=audio, sr=sample_rate, n_mfcc=n_mfcc)
    print(f"MFCC shape: {mfcc.shape}")
    return np.mean(mfcc.T, axis=0)

# Test a specific audio file
test_audio_path = '/content/drive/MyDrive/myVoice/myVoiceupadte/five.wav'
extract_features(test_audio_path)
```

```
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/five.wav, Sample Rate: 48000, Audio Shape: (141120,)
MFCC shape: (13, 276)
array([-466.15436  ,   35.036575 ,  -12.235614 ,   10.087469 ,
        -4.5965962,   -2.5560079,   -7.0382614,   -1.3597052,
        -6.7001424,   -4.4848237,   -6.9268036,   -6.2571983,
        -3.9304097], dtype=float32)
```

```python
import librosa
import os
import numpy as np

# Function to extract MFCC features from audio files
def extract_features(audio_path, n_mfcc=13):
    audio, sample_rate = librosa.load(audio_path, sr=None)
    print(f"Loaded audio file: {audio_path}, Sample Rate: {sample_rate}, Audio Shape: {audio.shape}")
    mfcc = librosa.feature.mfcc(y=audio, sr=sample_rate, n_mfcc=n_mfcc)
    print(f"MFCC shape: {mfcc.shape}")
    return np.mean(mfcc.T, axis=0)

# Dataset folder path (change to your folder)
dataset_folder = '/content/drive/MyDrive/myVoice'  # Update to match your folder structure

# Initialize lists to store MFCC features and labels
X = []  # For features
y = []  # For labels (which could be folder names)

# Iterate over the files in your dataset folder
for command_dir in os.listdir(dataset_folder):
    command_path = os.path.join(dataset_folder, command_dir)
    if os.path.isdir(command_path):  # Ensure it's a directory
        print(f"Processing folder: {command_dir}")
        for filename in os.listdir(command_path):
            if filename.endswith('.wav'):  # Process only .wav files
                audio_path = os.path.join(command_path, filename)
                print(f"Processing file: {filename}")
                mfcc = extract_features(audio_path)  # Extract MFCC features
```

```
                print(f"Processing file: {filename}")
                mfcc = extract_features(audio_path)  # Extract MFCC features
                X.append(mfcc)  # Add the MFCC features to the list
                y.append(command_dir)  # Use the folder name as the label

# Convert lists to numpy arrays
X = np.array(X)
y = np.array(y)

# Check the shapes
print(f"Shape of X: {X.shape}, Shape of y: {y.shape}")
```

```
Processing folder: myVoiceupadte
Processing file: down.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/down.wav, Sample Rate: 48000, Audio Shape: (161280,)
MFCC shape: (13, 316)
Processing file: yes.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/yes.wav, Sample Rate: 48000, Audio Shape: (164160,)
MFCC shape: (13, 321)
Processing file: two.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/two.wav, Sample Rate: 48000, Audio Shape: (213120,)
MFCC shape: (13, 417)
Processing file: three.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/three.wav, Sample Rate: 48000, Audio Shape: (161280,)
MFCC shape: (13, 316)
Processing file: undo.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/undo.wav, Sample Rate: 48000, Audio Shape: (169920,)
MFCC shape: (13, 332)
Processing file: seven.wav
Loaded audio file: /content/drive/MyDrive/myVoice/myVoiceupadte/seven.wav, Sample Rate: 48000, Audio Shape: (164160,)
MFCC shape: (13, 321)
```

```
from sklearn.preprocessing import LabelEncoder

# Encode the labels into numerical format
label_encoder = LabelEncoder()
y_encoded = label_encoder.fit_transform(y)

print(f"Encoded labels: {y_encoded}")
print(f"Label classes: {label_encoder.classes_}")
```

```
Encoded labels: [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
Label classes: ['myVoiceupadte']
```

```
[39] from sklearn.model_selection import train_test_split

# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y_encoded, test_size=0.2, random_state=42)

print(f"Shape of X_train: {X_train.shape}, Shape of X_test: {X_test.shape}")
```

```
Shape of X_train: (23, 13), Shape of X_test: (6, 13)
```

```python
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

# Define a simple neural network model
model = Sequential([
    Dense(128, activation='relu', input_shape=(X_train.shape[1],)),  # Input layer
    Dense(64, activation='relu'),  # Hidden layer
    Dense(len(np.unique(y_encoded)), activation='softmax')  # Output layer (softmax for classification)
])

# Compile the model
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

# Train the model
history = model.fit(X_train, y_train, epochs=30, batch_size=32, validation_data=(X_test, y_test))
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/30
/usr/local/lib/python3.10/dist-packages/keras/src/ops/nn.py:545: UserWarning: You are using a softmax over axis -1 of a tensor of shape (None, 1). This axis has
  warnings.warn(
1/1 ━━━━━━━━━━━━━━━━━━━━ 2s 2s/step - accuracy: 0.0000e+00 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 2/30
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.0000e+00 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 3/30
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.0000e+00 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 4/30
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.0000e+00 - loss: 0.0000e+00 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
Epoch 5/30
```

```python
# Evaluate the model on the test set
test_loss, test_acc = model.evaluate(X_test, y_test, verbose=2)
print(f"Test accuracy: {test_acc:.2f}")
```

```
1/1 - 0s - 33ms/step - accuracy: 0.0000e+00 - loss: 0.0000e+00
Test accuracy: 0.00
```

```python
import numpy as np

# Make predictions on the test set
y_pred = np.argmax(model.predict(X_test), axis=1)

# Print classification report
print("Classification Report:\n", classification_report(y_test, y_pred, target_names=label_encoder.classes_))

# Print confusion matrix
print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step
Classification Report:
                precision    recall  f1-score   support

myVoiceupadte       1.00      1.00      1.00         6

     accuracy                           1.00         6
    macro avg       1.00      1.00      1.00         6
 weighted avg       1.00      1.00      1.00         6

Confusion Matrix:
 [[6]]
/usr/local/lib/python3.10/dist-packages/keras/src/ops/nn.py:545: UserWarning: You are using a softmax over axis -1 of a ten
```