

# 连续语音识别实验指导书

## 一、实验目的

1. 掌握、巩固语音识别相关知识点 GMM 和 HMM 的使用，理解 GMM-HMM 连续语音识别算法；
2. 熟悉华为提供的 MindSpore 平台和 Python3；

## 二、实验设备

1. 硬件：PC 机
2. 软件：MindSpore1.1.1，Python3.7，python\_speech\_features

## 三、实验内容

在实验中，学生登录华为云官网，在华为提供的 MindSpore 平台和给定数据集上运行基于 GMM-HMM 的连续词语音识别代码并识别出测试音频中的文字内容。

## 三、实验原理以及操作步骤

### 1. 数据准备

#### 步骤 1 导入所需库

```
import os
import pickle
import numpy as np
import scipy.io.wavfile as wvf
from python_speech_features import mfcc
from hmmlearn.hmm import GMMHMM
import heapq
```

#### 步骤 2 配置路径

```
#训练数据路径
train_data_path =os.path.join(os.getcwd(),"datas/train/speech" )
label_path
= os.path.join(os.getcwd(),"datas/labels/trainprompts_m" )
#测试数据路径
test_data_path =os.path.join(os.getcwd(),"datas/test/speech" )
#模型保存路径
model_path="hmm_gmm_model.pkl"
```

#### 步骤 3 定义特征提取函数

```
def wav2mfcc(labels,data_paths):

    trng_data = {}
    for label,data_path in zip(labels,data_paths):
        # if label in trng_data.keys():
        #     print(label)
        write_pickle = True
        mfccs = []
        rate, sig = wvf.read(data_path)
        mfcc_feat = mfcc(sig, rate)
        mfccs.append(mfcc_feat)
        trng_data[label] = mfccs

    return trng_data
```

#### 步骤 4 定义高斯混合模型的配置信息

```
def obtain_config(labels):
    conf = {}
    for label in labels:
        conf[label] = {}
        conf[label]["n_components"] = 2
        conf[label]["n_mix"] = 2
    return conf
```

### 2. 创建模型并进行训练和测试

#### 步骤 1 创建 GMM-HMM 模型

```
def get_hmm_gmm(trng_datas=None,
GMM_configs=None,model_path
="hmm_gmm_model.pkl",from_file=False):

    hmm_gmm = {}
    if not from_file:
        for label, trng_data in trng_datas.items():
            GMM_config = GMM_configs[label]

            hmm_gmm[label] = GMMHMM(
                n_components=GMM_config["n_components"],
                n_mix=GMM_config["n_mix"])

            if trng_data:
                hmm_gmm[label].fit(np.vstack(trng_data))

        pickle.dump(hmm_gmm, open(model_path, "wb"))
    else:
        hmm_gmm = pickle.load(open(model_path, "rb"))
    return hmm_gmm
```

#### 步骤 5 读取训练数据并训练模型



```

def get_nbest(d, n):

    return heapq.nlargest(n, d, key=lambda k: d[k])

def predict_label(file, hmm_gmm):

    predicted = test_file(file, hmm_gmm)
    return predicted

wave_path = os.path.join(test_data_path, "T0001.wav")
#wave_path = os.path.join(train_data_path, "S0001.wav")
predicted, probs = predict_label(wave_path, hmm_gmm)
print("PREDICTED: %s" % predicted[0])

[14] def test_file(test_file, hmm_gmm):
    rate, sig = wvf.read(test_file)
    mfcc_feat = mfcc(sig, rate)
    pred = {}
    for model in hmm_gmm:
        pred[model] = hmm_gmm[model].score(mfcc_feat)
    return get_nbest(pred, 2), pred

#获取topN的结果
def get_nbest(d, n):

    return heapq.nlargest(n, d, key=lambda k: d[k])

def predict_label(file, hmm_gmm):

    predicted = test_file(file, hmm_gmm)
    return predicted

wave_path = os.path.join(test_data_path, "T0001.wav")
#wave_path = os.path.join(train_data_path, "S0001.wav")
predicted, probs = predict_label(wave_path, hmm_gmm)
print("PREDICTED: %s" % predicted[0])

PREDICTED: 关闭 阀门 六 小时

```

#### 四、实验报告

请在实验报告中详细记录每个步骤的中间结果和最终识别结果，并配以关键图示说明。

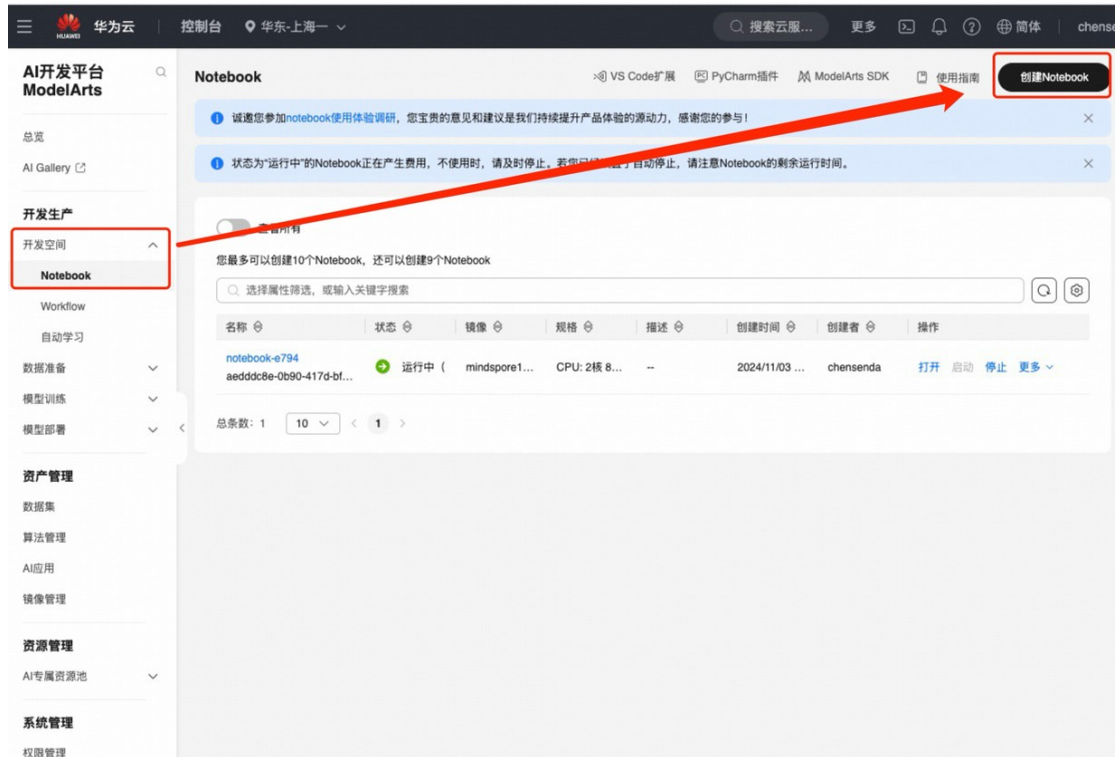
##### 一、线上服务环境搭建

##### 1. 进入华为云 ModelArts 控制台

网址：<https://console.huaweicloud.com/modelarts>

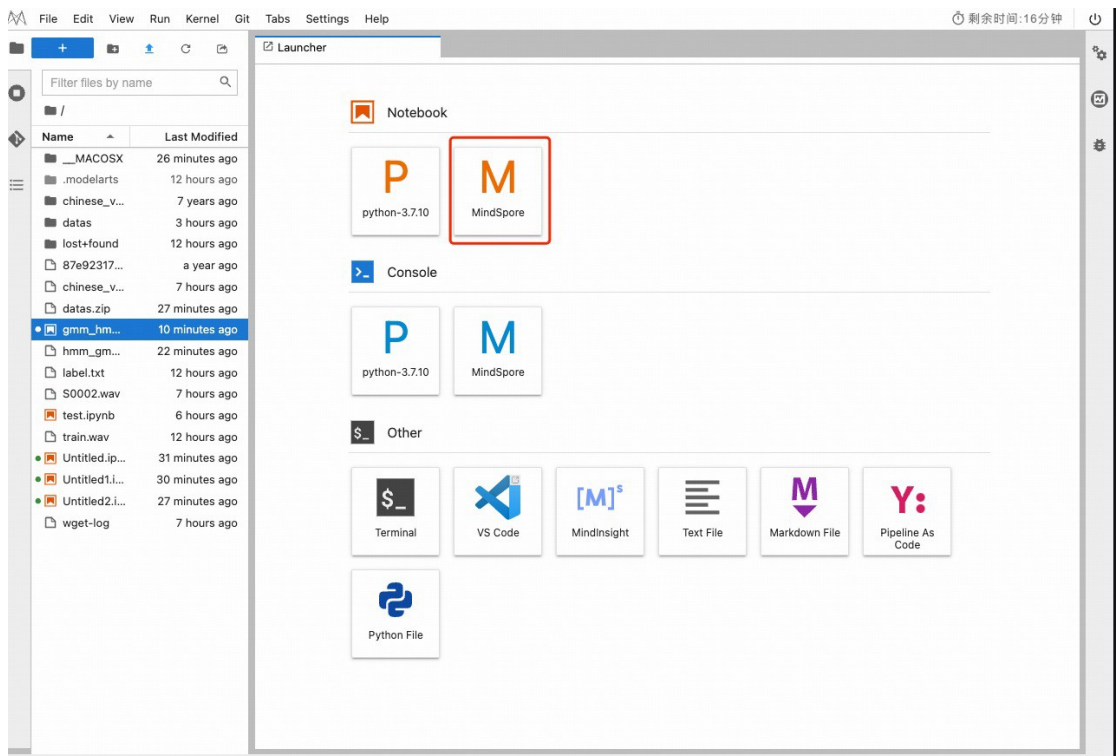
##### 2. 创建 Notebook 训练作业

进入创建界面后选择公共镜像中的“mindspore1.7.0-py3.7-ubuntu18.04”，其余默认即可，点击“立即创建”完成创建 Notebook 训练作业流程



### 3. 启动 Notebook 进入开发环境

#### 点击 MindSpore



## 二、数据准备

## 1. 将数据上传到服务器

(1) zip 数据数据上传到服务器

(2) 打开终端输入：unzip datas.zip

## 三、训练与推理

将代码复制到 ipynb 文件中，进行训练与推理，注意先执行安装 python 库命令

```
pip install python_speech_features
```

```
pip install hmmlearn
```

```
[2] pip install python_speech_features

Looking in indexes: http://repo.myhuaweicloud.com/repository/pypi/simple/
Requirement already satisfied: python_speech_features in /home/ma-user/anaconda3/envs/MindSpore/lib/python3.7/site-packages (0.6)
WARNING: You are using pip version 21.0.1; however, version 24.0 is available.
You should consider upgrading via the '/home/ma-user/anaconda3/envs/MindSpore/bin/python -m pip install --upgrade pip' command.
Note: you may need to restart the kernel to use updated packages.

[3] pip install hmmlearn

Looking in indexes: http://repo.myhuaweicloud.com/repository/pypi/simple/
Collecting hmmlearn
  Downloading http://repo.myhuaweicloud.com/repository/pypi/packages/26/44/8bcd4de875b6df420447f0a5d184dc6256015452abfai3266227c662ce92/hmmlearn-0.3.0-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (162 kB)
    |████████████████████| 162 kB 24.0 MB/s eta 0:00:01
Requirement already satisfied: scipy>=0.19 in /home/ma-user/anaconda3/envs/MindSpore/lib/python3.7/site-packages (from hmmlearn) (1.5.2)
Requirement already satisfied: numpy>=1.10 in /home/ma-user/anaconda3/envs/MindSpore/lib/python3.7/site-packages (from hmmlearn) (1.19.5)
Requirement already satisfied: scikit-learn!=0.22.0,>=0.16 in /home/ma-user/anaconda3/envs/MindSpore/lib/python3.7/site-packages (from hmmlearn) (0.22.1)
Requirement already satisfied: joblib>=0.11 in /home/ma-user/anaconda3/envs/MindSpore/lib/python3.7/site-packages (from scikit-learn!=0.22.0,>=0.16->hmmlearn) (1.2.0)
Installing collected packages: hmmlearn
Successfully installed hmmlearn-0.3.0
WARNING: You are using pip version 21.0.1; however, version 24.0 is available.
You should consider upgrading via the '/home/ma-user/anaconda3/envs/MindSpore/bin/python -m pip install --upgrade pip' command.
Note: you may need to restart the kernel to use updated packages.

[4] import os
import pickle
import numpy as np
import scipy.io.wavfile as wavf
from python_speech_features import mfcc
from hmmlearn.hmm import GMMHMM
import heapq
```