# APPENDIX A

**PROJECT CODE**

# A.1Model training and testing

*# ! / u s r / b i n / e n v p y t h o n # c o d i n g : u t f −8*

**i m p o r t** math

**i m p o r t** numpy a s np

**i m p o r t** p a n d a s a s pd

**i m p o r t** m a t p l o t l i b . p y p l o t a s p l t

g e t \_ i p y t h o n ( ) . r u n \_ l i n e \_ m a g i c ( ’ m a t p l o t l i b ’ , ’ i n l i n e ’ )

d f = pd . r e a d \_ c s v ( ’ i n p u t / t r a i n \_ p o s t \_ c o m p e t i t i o n . c s v ’ ) d f . h e a d ( )

**from** I P y t h o n . d i s p l a y **i m p o r t** Audio

**f i l e** = ’ 786 e e 8 8 3 . wav ’

p a t h = ’ i n p u t / a u d i o \_ t r a i n / ’ Audio ( f i l e n a m e = p a t h + **f i l e** )

**i m p o r t** wave

**d e f** g e t \_ l e n g t h ( **f i l e** ) :

a u d i o = wave . **open** ( p a t h + **f i l e** )

**r e t u r n** a u d i o . g e t n f r a m e s ( ) / a u d i o . g e t f r a m e r a t e ( )

g e t \_ l e n g t h ( **f i l e** )

**from** j o b l i b **i m p o r t** P a r a l l e l , d e l a y e d

w i t h P a r a l l e l ( n \_ j o b s = 1 0 , p r e f e r = ’ t h r e a d s ’ , v e r b o s e = 1 ) a s ex : l e n g t h s = ex ( d e l a y e d ( g e t \_ l e n g t h ) ( e ) **f o r** e **i n** d f . fname )

d f [ ’ l e n g t h ’ ] = l e n g t h s d f . h e a d ( )

d f = d f . q u e r y ( ’ l e n g t h <= 6 ’ ) . r e s e t \_ i n d e x ( d r o p = T r u e )

**p r i n t** ( d f . s h a p e ) d f . h e a d ( )

**i m p o r t** l i b r o s a

y , s r = l i b r o s a . l o a d ( p a t h + **f i l e** )

*# y : a u d i o d a t a # s r : s a m p l e r a t e*

p l t . p l o t ( y )

p l t . t i t l e ( f ’ Sample r a t e = { s r } ’ , s i z e = 1 8 ) ;

mfcc = l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = 4 0 )

**p r i n t** ( mfcc . s h a p e )

p l t . f i g u r e ( f i g s i z e = ( 1 0 , 5 ) )

p l t . imshow ( mfcc , cmap= ’ h o t ’ ) ;

**d e f** o b t a i n \_ m f c c ( **f i l e** , f e a t u r e s = 4 0 ) :

y , s r = l i b r o s a . l o a d ( p a t h + **f i l e** , r e s \_ t y p e = ’ k a i s e r \_ f a s t ’ )

**r e t u r n** l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = f e a t u r e s )

o b t a i n \_ m f c c ( **f i l e** ) . s h a p e

mfcc . s h a p e

**d e f** g e t \_ m f c c ( **f i l e** , n\_ mfcc = 4 0 , p a d d i n g =None ) :

y , s r = l i b r o s a . l o a d ( p a t h + **f i l e** , r e s \_ t y p e = ’ k a i s e r \_ f a s t ’ ) mfcc = l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = n\_ mfcc )

**i f** p a d d i n g : mfcc = np . pad ( mfcc , ( ( 0 , 0 ) , ( 0 , **max** ( 0 , p a d d i n g *−*mfcc . s h a p e [ 1 ] ) ) ) , ’ c o n s t a n t ’ )

**r e t u r n** mfcc . a s t y p e ( np . f l o a t 3 2 )

mfcc = g e t \_ m f c c ( **f i l e** , p a d d i n g = 2 0 0 )

**p r i n t** ( mfcc . s h a p e )

p l t . f i g u r e ( f i g s i z e = ( 1 2 , 5 ) )

p l t . imshow ( mfcc , cmap= ’ h o t ’ ) ;

**p r i n t** ( g e t \_ m f c c ( d f . s o r t \_ v a l u e s ( ’ l e n g t h ’ ) . fname . i l o c [ *−* 1 ] ) . s h a p e )

**from** f u n c t o o l s **i m p o r t** p a r t i a l

n\_ mfcc = 40

p a d d i n g = 259

f u n = p a r t i a l ( g e t \_ m f c c , n\_ mfcc = n\_mfcc , p a d d i n g = p a d d i n g )

w i t h P a r a l l e l ( n \_ j o b s = 1 0 , p r e f e r = ’ t h r e a d s ’ , v e r b o s e = 1 ) a s ex :

m f c c \_ d a t a = ex ( d e l a y e d ( p a r t i a l ( f u n ) ) ( e ) **f o r** e **i n** d f . fname )

m f c c \_ d a t a = np . s t a c k ( m f c c \_ d a t a ) [ . . . , None ] m f c c \_ d a t a . s h a p e

l b l 2 i d x = { l b l : i d x **f o r** i d x , l b l **i n enumerate** ( d f . l a b e l . u n i q u e ( ) ) } i d x 2 l b l = { i d x : l b l **f o r** l b l , i d x **i n** l b l 2 i d x . i t e m s ( ) }

n \_ c a t e g o r i e s = **l e n** ( l b l 2 i d x )

n \_ c a t e g o r i e s = **l e n** ( l b l 2 i d x )

d f [ ’ y ’ ] = d f . l a b e l . **map** ( l b l 2 i d x ) d f . h e a d ( )

**from** s k l e a r n . m o d e l \_ s e l e c t i o n **i m p o r t** t r a i n \_ t e s t \_ s p l i t

x \_ t r a i n , x \_ v a l , y \_ t r a i n , y \_ v a l = t r a i n \_ t e s t \_ s p l i t ( m f c c \_ d a t a , d f . y , t e s t \_ s i z e = 0 . 2 , r a n d o m \_ s t a t e = 4 2 )

x \_ t r a i n . s h a p e , x \_ v a l . s h a p e

**from** k e r a s . m o d e l s **i m p o r t** Model

**from** k e r a s . l a y e r s **i m p o r t** Dense , Conv2D ,

B a t c h N o r m a l i z a t i o n , D r o p o u t , I n p u t , Global Avg Pool2D ,

GlobalMaxPool2D , c o n c a t e n a t e

**from** k e r a s . o p t i m i z e r s **i m p o r t** Adam , SGD

**i m p o r t** k e r a s . b a c k e n d a s K

b s = 128

l r = 0 . 0 0 3

m\_in = I n p u t ( [ n\_mfcc , p a d d i n g , 1 ] ) x = B a t c h N o r m a l i z a t i o n ( ) ( m\_in )

l a y e r s = [ 1 0 , 2 0 , 5 0 , 1 0 0 ]

**f o r** i , l **i n enumerate** ( l a y e r s ) :

s t r i d e s = 1 **i f** i == 0 **e l s e** ( 2 , 2 )

x = Conv2D ( l , 3 , s t r i d e s = s t r i d e s , a c t i v a t i o n = ’ r e l u ’ , p a d d i n g = ’ same ’ ,

u s e \_ b i a s = F a l s e ,

k e r n e l \_ i n i t i a l i z e r = ’ h e \_ u n i f o r m ’ ) ( x ) x = B a t c h N o r m a l i z a t i o n ( ) ( x )

x = D r o p o u t ( 0 . 0 2 ) ( x )

x \_ a v g = G l o b a l A v g P o o l 2 D ( ) ( x ) x\_max = Global Max Pool2D ( ) ( x )

x = c o n c a t e n a t e ( [ x\_avg , x\_max ] )

x = Dense ( 1 0 0 0 , a c t i v a t i o n = ’ r e l u ’ , u s e \_ b i a s = F a l s e , k e r n e l \_ i n i t i a l i z e r = ’ h e \_ u n i f o r m ’ ) ( x )

x = D r o p o u t ( 0 . 2 ) ( x )

m\_out = Dense ( n \_ c a t e g o r i e s , a c t i v a t i o n = ’ s o f t m a x ’ ) ( x )

model = Model ( m\_in , m\_out ) model . **c o m p i l e** ( Adam ( l r ) ,

l o s s = ’ s p a r s e \_ c a t e g o r i c a l \_ c r o s s e n t r o p y ’ , m e t r i c s = [ ’ a c c u r a c y ’ ] )

model . summary ( )

l o g 1 = model . f i t ( x \_ t r a i n , y \_ t r a i n , bs , 1 5 , v a l i d a t i o n \_ d a t a = [ x \_ v a l , y \_ v a l ] )

K . **e v a l** ( model . o p t i m i z e r . l r . a s s i g n ( l r / 1 0 ) )

l o g 2 = model . f i t ( x \_ t r a i n , y \_ t r a i n , bs , 1 0 , v a l i d a t i o n \_ d a t a = [ x \_ v a l , y \_ v a l ] )

**d e f** s h o w \_ r e s u l t s ( \* l o g s ) :

t r n \_ l o s s , v a l \_ l o s s , t r n \_ a c c , v a l \_ a c c = [ ] , [ ] , [ ] , [ ]

**f o r** l o g **i n** l o g s :

t r n \_ l o s s += l o g . h i s t o r y [ ’ l o s s ’ ]

v a l \_ l o s s += l o g . h i s t o r y [ ’ v a l \_ l o s s ’ ] t r n \_ a c c += l o g . h i s t o r y [ ’ a c c ’ ]

v a l \_ a c c += l o g . h i s t o r y [ ’ v a l \_ a c c ’ ]

f i g , a x e s = p l t . s u b p l o t s ( 1 , 2 , f i g s i z e = ( 1 4 , 4 ) ) ax1 , ax2 = a x e s

ax1 . p l o t ( t r n \_ l o s s , l a b e l = ’ t r a i n ’ )

ax1 . p l o t ( v a l \_ l o s s , l a b e l = ’ v a l i d a t i o n ’ )

ax1 . s e t \_ x l a b e l ( ’ e p o c h ’ ) ; ax1 . s e t \_ y l a b e l ( ’ l o s s ’ ) ax2 . p l o t ( t r n \_ a c c , l a b e l = ’ t r a i n ’ )

ax2 . p l o t ( v a l \_ a c c , l a b e l = ’ v a l i d a t i o n ’ )

ax2 . s e t \_ x l a b e l ( ’ e p o c h ’ ) ; ax2 . s e t \_ y l a b e l ( ’ a c c u r a c y ’ )

**f o r** ax , t i t l e **i n z i p** ( a x e s , [ ’ T r a i n ’ , ’ A c c u r a c y ’ ] ) : ax . s e t \_ t i t l e ( t i t l e , s i z e = 1 4 )

ax . l e g e n d ( )

s h o w \_ r e s u l t s ( l o g 1 , l o g 2 )

s a m p l e = d f . s a m p l e ( )

s a m p l e \_ f i l e = s a m p l e . fname . i l o c [ 0 ] s a m p l e \_ l a b e l = s a m p l e . l a b e l . i l o c [ 0 ]

mfcc = g e t \_ m f c c ( s a m p l e \_ f i l e , n\_mfcc , p a d d i n g ) [ None , . . . , None ] y\_ = model . p r e d i c t ( mfcc )

p r e d = i d x 2 l b l [ np . argmax ( y\_ ) ]

**p r i n t** ( f ’ T r u e = { s a m p l e \_ l a b e l } ’ )

**p r i n t** ( f ’ P r e d i c t i o n = { p r e d } ’ ) Audio ( p a t h + s a m p l e \_ f i l e )

**d e f** g e t \_ m f c c 2 ( **f i l e** , n\_ mfcc = 4 0 , p a d d i n g =None ) :

y , s r = l i b r o s a . l o a d ( **f i l e** , r e s \_ t y p e = ’ k a i s e r \_ f a s t ’ ) mfcc = l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = n\_ mfcc )

**i f** p a d d i n g : mfcc = np . pad ( mfcc , ( ( 0 , 0 ) , ( 0 , **max** ( 0 , p a d d i n g *−*mfcc . s h a p e [ 1 ] ) ) ) , ’ c o n s t a n t ’ )

**r e t u r n** mfcc . a s t y p e ( np . f l o a t 3 2 )

mfcc = g e t \_ m f c c 2 ( " t e s t \_ a u d i o . wav " , n\_mfcc , p a d d i n g ) [ None ,

. . . , None ]

y\_ = model . p r e d i c t ( mfcc )

p r e d = i d x 2 l b l [ np . argmax ( y\_ ) ]

**p r i n t** ( p r e d )

model . s a v e ( ’ b e s t \_ m o d e l . h5 ’ )

**from** k e r a s . m o d e l s **i m p o r t** l o a d \_ m o d e l model = l o a d \_ m o d e l ( ’ b e s t \_ m o d e l . h5 ’ )

**i m p o r t** l i b r o s a n\_ mfcc = 40

p a d d i n g = 259

mfcc = g e t \_ m f c c ( " 047 b3d34 . wav " , n\_mfcc , p a d d i n g ) [ None ,

. . . , None ]

y\_ = model . p r e d i c t ( mfcc )

p r e d = i d x 2 l b l [ np . argmax ( y\_ ) ]

**p r i n t** ( p r e d )

# A.2Audio classification web classification

**from** f l a s k **i m p o r t** F l a s k , r e n d e r \_ t e m p l a t e ,

f l a s h , u r l \_ f o r , r e q u e s t , r e d i r e c t , B l u e p r i n t

**from** f l a s k **i m p o r t** R e s p o n s e , m a k e \_ r e s p o n s e

**i m p o r t** r e q u e s t s

**i m p o r t** j s o n

**i m p o r t** s y s , o s

**i m p o r t** math

**i m p o r t** numpy a s np

**i m p o r t** p a n d a s a s pd

**i m p o r t** wave

**i m p o r t** l i b r o s a

**from** k e r a s . m o d e l s **i m p o r t** Model

**from** k e r a s . l a y e r s **i m p o r t** Dense , Conv2D , B a t c h N o r m a l i z a t i o n , D r o p o u t , I n p u

**from** k e r a s . o p t i m i z e r s **i m p o r t** Adam , SGD

**i m p o r t** k e r a s . b a c k e n d a s K

**from** k e r a s . m o d e l s **i m p o r t** l o a d \_ m o d e l

**i m p o r t** pymongo

**from** pymongo **i m p o r t** M o n g o C l i e n t

m o n g o C l i e n t = M o n g o C l i e n t ( ’ l o c a l h o s t ’ , 2 7 0 1 7 ) db= m o n g o C l i e n t [ ’ c o u g h T r a c k e r ’ ]

u s e r \_ c o l l e c t i o n =db . u s e r s

|  |  |  |
| --- | --- | --- |
| b s | = | 128 |
| l r | = | 0 . 0 0 3 |
| d f | = | pd . r e a d \_ c s v ( ’ i n p u t / |

t r a i n \_ p o s t \_ c o m p e t i t i o n . c s v ’ )

**d e f** o b t a i n \_ m f c c ( **f i l e** , f e a t u r e s = 4 0 ) :

y , s r = l i b r o s a . l o a d ( p a t h + **f i l e** , r e s \_ t y p e = ’ k a i s e r \_ f a s t ’ )

**r e t u r n** l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = f e a t u r e s )

**d e f** g e t \_ m f c c ( **f i l e** , n\_ mfcc = 4 0 , p a d d i n g =None ) :

y , s r = l i b r o s a . l o a d ( **f i l e** , r e s \_ t y p e = ’ k a i s e r \_ f a s t ’ ) mfcc = l i b r o s a . f e a t u r e . mfcc ( y , s r , n\_ mfcc = n\_ mfcc )

**i f** p a d d i n g : mfcc = np . pad ( mfcc , ( ( 0 , 0 ) , ( 0 , **max** ( 0 , p a d d i n g *−*mfcc . s h a p

**r e t u r n** mfcc . a s t y p e ( np . f l o a t 3 2 )

app = F l a s k ( \_\_name\_\_ )

app . s e c r e t \_ k e y = ’ a s d a s d ^%$%^&a s d j h %^$ f ^ ’ @app . r o u t e ( ’ / l o g i n ’ )

**d e f** l o g i n ( ) :

**r e t u r n** r e n d e r \_ t e m p l a t e ( " l o g i n . h t m l " )

@app . r o u t e ( ’ / l o g o u t ’ )

**d e f** l o g o u t ( ) :

r e s p = m a k e \_ r e s p o n s e ( r e d i r e c t ( u r l \_ f o r ( ’ l o g i n ’ ) ) ) r e s p . s e t \_ c o o k i e ( ’ c l i e n t I d ’ , ’ ’ , e x p i r e s = 0 )

**r e t u r n** r e s p

@app . r o u t e ( ’ / l o g i n V e r i f y ’ , m e t h o d s = [ ’GET ’ , ’POST ’ ] )

**d e f** l o g i n V e r i f y ( ) :

c l i e n t I d = r e q u e s t . f o r m [ ’ c l i e n t I d ’ ]

r e s p = m a k e \_ r e s p o n s e ( r e d i r e c t ( u r l \_ f o r ( ’ i n d e x ’ ) ) )

r e s p . s e t \_ c o o k i e ( ’ c l i e n t I d ’ , c l i e n t I d , max\_age = 6 0 \* 6 0 \* 1 2 )

**r e t u r n** r e s p

@app . r o u t e ( ’ / i n d e x ’ )

**d e f** i n d e x ( ) :

**i f** r e q u e s t . c o o k i e s . g e t ( ’ c l i e n t I d ’ ) **i s n o t** None : c l i e n t I d = r e q u e s t . c o o k i e s . g e t ( ’ c l i e n t I d ’ ) **p r i n t** ( " I n s i d e i n d e x " )

**p r i n t** ( c l i e n t I d )

**i f** u s e r \_ c o l l e c t i o n . f i n d \_ o n e ( { " c l i e n t I d " : c l i e n t I d } ) **i s n o t** None :

c o u g h C o u n t = u s e r \_ c o l l e c t i o n . f i n d \_ o n e ( { " c l i e n t I d " : c l i e n t I d } ) [

**p r i n t** ( " i n s i d e i f o f i n d e x " )

**p r i n t** ( c o u g h C o u n t )

**i f** c o u g h C o u n t > 3 :

**r e t u r n** r e n d e r \_ t e m p l a t e ( ’ i n d e x . h t m l ’ , c l i e n t I d = c l i e n t I d , c

## e l s e :

**r e t u r n** r e n d e r \_ t e m p l a t e ( ’ i n d e x . h t m l ’ , c l i e n t I d = c l i e n t I d , c

## e l s e :

d a t a = { " c l i e n t I d " : c l i e n t I d , " c o u g h C o u n t " : 0 } u s e r \_ c o l l e c t i o n . i n s e r t \_ o n e ( d a t a )

**p r i n t** ( "New c l i e n t c r e a t e d " )

**r e t u r n** r e n d e r \_ t e m p l a t e ( ’ i n d e x . h t m l ’ , c l i e n t I d = c l i e n t I d , c o u g h

## e l s e :

**r e t u r n** r e d i r e c t ( u r l \_ f o r ( ’ l o g i n ’ ) )

@app . r o u t e ( ’ / s a v e S o u n d ’ , m e t h o d s = [ ’GET ’ , ’POST ’ ] )

**d e f** s a v e S o u n d ( ) :

d a t a = r e q u e s t . d a t a

**p r i n t** ( " h e l l o " )

*# p r i n t ( d a t a )*

w i t h **open** ( " t e s t \_ a u d i o . wav " , " wb" ) a s f o : f o . w r i t e ( d a t a )

**p r i n t** ( r e q u e s t )

**r e t u r n** R e s p o n s e ( " { ’ a ’ : ’ b ’ } " , s t a t u s = 2 0 1 , mimetype = ’ a p p l i c a t i o n / j s o n ’ )

@app . r o u t e ( ’ / a u d i o C l a s s i f y ’ , m e t h o d s = [ ’GET ’ , ’POST ’ ] )

**d e f** a u d i o C l a s s i f y ( ) :

model = l o a d \_ m o d e l ( ’ b e s t \_ m o d e l . h5 ’ ) model . \_ m a k e \_ p r e d i c t \_ f u n c t i o n ( )

n\_ mfcc = 40

p a d d i n g = 259

mfcc = g e t \_ m f c c ( " t e s t \_ a u d i o . wav " , n\_mfcc , p a d d i n g ) [ None , . . . , None ] y\_ = model . p r e d i c t ( mfcc )

p r e d = i d x 2 l b l [ np . argmax ( y\_ ) ]

**p r i n t** ( p r e d )

c l i e n t I d = r e q u e s t . c o o k i e s . g e t ( ’ c l i e n t I d ’ )

**p r i n t** ( " I n s i d e a u d i o C l a s s i f y " )

**p r i n t** ( c l i e n t I d )

**i f** p r e d == " Cough " :

c o u g h C o u n t = u s e r \_ c o l l e c t i o n . f i n d \_ o n e ( { " c l i e n t I d " : c l i e n t I d } ) [ " c o u

**p r i n t** ( " c u r r e n t c o u g h C o u n t " )

**p r i n t** ( c o u g h C o u n t )

**p r i n t** ( " c o u g h C o u n t +1 " )

c o u g h C o u n t = c o u g h C o u n t +1 **p r i n t** ( "New c o u g h C o u n t : " ) **p r i n t** ( c o u g h C o u n t )

u s e r \_ c o l l e c t i o n . u p d a t e \_ o n e ( { " c l i e n t I d " : c l i e n t I d } , { " $ s e t " : { " c o u g

f l a s h ( " Sound i s : " + p r e d ) K . c l e a r \_ s e s s i o n ( )

o s . s y s t e m ( " rm *−*r v f t e s t \_ a u d i o . wav " )

*# r e t u r n r e n d e r \_ t e m p l a t e ( ’ i n d e x . h t m l ’ )*

**r e t u r n** r e d i r e c t ( u r l \_ f o r ( ’ i n d e x ’ ) )

**i f** \_\_name\_\_ == ’ \_\_ main\_\_ ’ :

c o n t e x t = ( ’ s s l . c e r t ’ , ’ s s l . key ’ )

app . r u n ( h o s t = ’ 0 . 0 . 0 . 0 ’ , p o r t = 8 1 2 4 , s s l \_ c o n t e x t = c o n t e x t )