Assignment_3 Smart health

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In [1]:

```
from __future__ import print_function
import tensorflow.compat.v1 as tf
from tensorflow.keras.models import Model
import tensorflow.keras
import pandas as pd
from tensorflow.keras.callbacks import TensorBoard
#from tensorflow import keras
from tensorflow.keras.datasets import cifar100
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Activation, Flatten, Input
from tensorflow.keras.layers import Conv2D, MaxPooling2D, ZeroPadding2D
from tensorflow.keras.optimizers import SGD
from tensorflow.keras.regularizers import l2
from tensorflow.keras.callbacks import Callback, LearningRateScheduler, TensorBoa
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.utils import  to_categorical
from tensorflow.keras import backend as K
import numpy as np
import matplotlib
import json
from matplotlib import pyplot as plt

from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import ModelCheckpoint
from tensorflow.keras.models import load_model
from tensorflow.keras.layers import Lambda, Conv2D, MaxPooling2D, Dropout, Dense,
import sys
import os
#import cv2
from PIL import Image
import numpy as np
from skimage.transform import resize
from skimage import data, io, filters
from skimage.transform import rescale
import time
# from tensorflow.keras.layers.normalization import BatchNormalization
from sklearn.model_selection import StratifiedShuffleSplit
from keras.layers.normalization import BatchNormalization

import keras
from keras.models import load_model
from keras.datasets import cifar10
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation, Flatten
from keras.layers import Conv2D, MaxPooling2D
from keras.callbacks import EarlyStopping, ModelCheckpoint
import os
import pickle
import numpy as np
import os
os.environ["KERAS_BACKEND"] = "tensorflow"
kerasBKED = os.environ["KERAS_BACKEND"]
print(kerasBKED)
```

```
tensorflow
```

In [2]:

```
import glob#---------------------------------------------this helps in reading al
Abdomen = glob.glob('DS_NN/DS/Abdomen_CT*.jpeg')
Chest = glob.glob('DS_NN/DS/Chest_CT*.jpeg')
Head = glob.glob('DS_NN/DS/Head_CT*.jpeg')
```

In [3]:

```
print(len(Abdomen))#------------------ checking the number of files of each class
print(len(Chest))
print(len(Head))
```

```
500
500
500
```

this section will create the training and testing sets (very important) ratio is 60:40

In [4]:

```
data = []
data.clear()
labels = []
labels.clear()
num_classes = 3

for i in Abdomen:   #-----------------------------------------------------------
    image=tf.keras.preprocessing.image.load_img(i, color_mode='grayscale', #-----
    target_size= (32,32))#--------------------------------------------------using
    image=np.array(image)
    data.append(image)
    labels.append(0)#---------------------------------------now this the label fo
for i in Chest:
    image=tf.keras.preprocessing.image.load_img(i, color_mode='grayscale',
    target_size= (32,32))
    image=np.array(image)
    data.append(image)
    labels.append(1)
for i in Head:
    image=tf.keras.preprocessing.image.load_img(i, color_mode='grayscale',
    target_size= (32,32))
    image=np.array(image)
    data.append(image)
    labels.append(2)

data = np.array(data)#----------------------- it contain all the images of abdome
labels = np.array(labels)#-------------------------this contian all the labels

from sklearn.model_selection import train_test_split
X_train, X_test, ytrain, ytest = train_test_split(data, labels, test_size=0.4)#--
```

In [ ]:

In [5]:
```
X_train.shape#-- checking dimension, but our model wont accept this type of dimen
```

Out[5]:
```
(900, 32, 32)
```

In [6]:
```
X_train = np.reshape(X_train,(-1, 32, 32 , 1))#---------so reshaping model
X_test = np.reshape(X_test,(-1, 32, 32 , 1))
```

In [7]:
```
ytrain[1:100]
```

Out[7]:
```
array([2, 1, 0, 2, 0, 2, 1, 1, 1, 2, 2, 2, 0, 0, 1, 2, 1, 1, 0, 0, 0, 1,
       0, 2, 0, 1, 2, 1, 2, 0, 0, 1, 2, 1, 0, 2, 2, 0, 0, 2, 1, 2, 1, 2,
       2, 2, 2, 2, 1, 0, 2, 1, 0, 0, 1, 0, 0, 1, 2, 1, 2, 1, 2, 2, 0, 2,
       1, 1, 2, 2, 1, 1, 0, 0, 2, 1, 1, 2, 0, 1, 0, 2, 1, 0, 2, 2, 2, 1,
       2, 2, 0, 0, 2, 2, 1, 1, 1, 1, 0])
```

In [8]:
```
ytest[1:100]
```

Out[8]:
```
array([0, 0, 0, 0, 0, 2, 1, 2, 1, 1, 2, 2, 0, 1, 1, 1, 2, 0, 1, 2, 0, 2,
       0, 0, 2, 0, 0, 2, 0, 2, 0, 0, 2, 0, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2,
       2, 0, 1, 2, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 2, 0, 0, 2, 2, 2, 1, 0,
       2, 1, 1, 0, 2, 0, 2, 1, 1, 2, 0, 0, 1, 2, 2, 0, 2, 1, 0, 2, 1, 1,
       0, 1, 2, 1, 0, 2, 1, 0, 0, 2, 2])
```

In [9]:
```
X_train.shape#-----------------updated shape
```

Out[9]:
```
(900, 32, 32, 1)
```

In [10]:
```
ytrain_encoded = keras.utils.to_categorical(ytrain, num_classes)#---------------
ytest_encoded = keras.utils.to_categorical(ytest, num_classes)

X_train = X_train.astype(np.float32)#---------------------normalizaing the data
X_test = X_test.astype(np.float32)
X_train = X_train / 255
X_test = X_test / 255
```

In [ ]:
```
```

Convolution neural network starts here:

In [11]:

```
featureLayer1=[Conv2D(64, (3, 3), padding='same',input_shape=X_train.shape[1:]),
               Activation('relu'),
               Conv2D(64, (3, 3), padding='same'),#-------------all the the cov l
               Activation('relu'),
               MaxPooling2D(pool_size=(2, 2)),
               Dropout(0.25)]

featureLayer2=[Conv2D(128, (3, 3), padding='same'),
               Activation('relu'),
               Conv2D(128, (3, 3), padding='same'),
               Activation('relu'),
               MaxPooling2D(pool_size=(2, 2)),
               Dropout(0.25)]

featureLayer3=[Conv2D(256, (3, 3), padding='same'),
               Activation('relu'),
               Conv2D(256, (3, 3), padding='same'),
               Activation('relu'),
               Conv2D(256, (3, 3), padding='same'),
               Activation('relu'),
               MaxPooling2D(pool_size=(2, 2)),
               Dropout(0.25)]

fullConnLayer=[Flatten(),
               Dense(1024),
               Activation('relu'),
               Dropout(0.5),
               Dense(1024),
               Activation('relu'),
               Dropout(0.5)]

classificationLayer=[Dense(num_classes),
                     Activation('softmax')]

model = Sequential(featureLayer1 + featureLayer2 + featureLayer3 + fullConnLayer
```

In [ ]:

In [12]:

```

print('x_train shape:', X_train.shape)
print(X_train.shape[0], 'train samples')#----------checking dimentions
print(X_test.shape[0], 'test samples')
```

```
x_train shape: (900, 32, 32, 1)
900 train samples
600 test samples
```

In [13]:

```

opt = opt = keras.optimizers.Adam()

model.compile(loss='categorical_crossentropy',
              optimizer=opt,#--------------------------------compiling model her
              metrics=['accuracy'])

es_cb = EarlyStopping(monitor='val_loss', patience=10, verbose=1, mode='auto')
```

In [14]:

```
batch_size = 32
epochs = 5#---------------------------------------performance of the model can b
history = model.fit(X_train, ytrain_encoded,
                    batch_size=batch_size,
                    epochs=epochs,
                    verbose=1,#-------------------------------------------------
                    validation_data=(X_test, ytest_encoded),
                    callbacks= [es_cb],
                    shuffle=True)
```

```
Epoch 1/5
29/29 [==============================] - 9s 306ms/step - loss: 0.8101 - accurac
y: 0.5578 - val_loss: 0.4706 - val_accuracy: 0.6450
Epoch 2/5
29/29 [==============================] - 9s 302ms/step - loss: 1.1965 - accurac
y: 0.4900 - val_loss: 1.1069 - val_accuracy: 0.3017
Epoch 3/5
29/29 [==============================] - 9s 307ms/step - loss: 0.7406 - accurac
y: 0.6044 - val_loss: 0.3487 - val_accuracy: 0.8267
Epoch 4/5
29/29 [==============================] - 9s 306ms/step - loss: 0.3233 - accurac
y: 0.8356 - val_loss: 0.0812 - val_accuracy: 0.9733
Epoch 5/5
29/29 [==============================] - 9s 306ms/step - loss: 0.0745 - accurac
y: 0.9678 - val_loss: 0.0101 - val_accuracy: 0.9917
```

In [15]:

```
score = model.evaluate(X_test, ytest_encoded, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

```
Test loss: 0.010113884694874287
Test accuracy: 0.9916666746139526
```

In [16]:

```
# Layers definitions
from keras import backend as K#------------------------this will help to get all
for l in range(len(model.layers)):
    print(l, model.layers[l])
```

```
0 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027507AB
FEF0>
1 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508E906D8>
2 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508E9
0860>
3 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508E90AC8>
4 <tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x0000027508E9
0C18>
5 <tensorflow.python.keras.layers.core.Dropout object at 0x0000027508E90D68>
6 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508E9
0EF0>
7 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EDC198>
8 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508ED
C2E8>
9 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EDC550>
10 <tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x0000027508E
DC6A0>
11 <tensorflow.python.keras.layers.core.Dropout object at 0x0000027508EDC828>
12 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508E
DC978>
13 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EDCBE0
>
14 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508E
DCD30>
15 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EDCF98
>
16 <tensorflow.python.keras.layers.convolutional.Conv2D object at 0x0000027508E
E5128>
17 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EE5390
>
18 <tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x0000027508E
E54E0>
19 <tensorflow.python.keras.layers.core.Dropout object at 0x0000027508EE5668>
20 <tensorflow.python.keras.layers.core.Flatten object at 0x0000027508EDC940>
21 <tensorflow.python.keras.layers.core.Dense object at 0x0000027508EE5908>
22 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EE5B70
>
23 <tensorflow.python.keras.layers.core.Dropout object at 0x0000027508EE5C88>
24 <tensorflow.python.keras.layers.core.Dense object at 0x0000027508EE5DA0>
25 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EE5FD0
>
26 <tensorflow.python.keras.layers.core.Dropout object at 0x0000027508EEE128>
27 <tensorflow.python.keras.layers.core.Dense object at 0x0000027508EE5780>
28 <tensorflow.python.keras.layers.core.Activation object at 0x0000027508EEE4E0
>
```

In [17]:

```
inputs_1=model.layers[0].input#------------selecting initial layer
outputs_1=model.layers[26].output#------------according to question selelcting in
```

In [ ]:

```

```

In [18]:

```
from keras.layers import Input
# # feature extraction layer
getFeature = K.function([inputs_1],
                         [outputs_1])#----------------------------------getting f
```

In [19]:

```
extracted_features_train = getFeature([X_train[:900], 0])[0]#-------------- we ne
extracted_features_test = getFeature([X_test[:600], 0])[0]
```

In [20]:

```
train_labels = ytrain[:900]
test_labels = ytest[:600]
```

In [21]:

```
# output of getFeature function
extracted_features_train[0]#-----------checking values
```

Out[21]:

```
array([0.        , 0.59431756, 0.        , ..., 0.1508846 , 0.        ,
       2.29823   ], dtype=float32)
```

In [22]:

```
print(extracted_features_train.shape, extracted_features_test.shape, train_labels
```

```
(900, 1024) (600, 1024) (900,) (600,)
```

KNN starts below

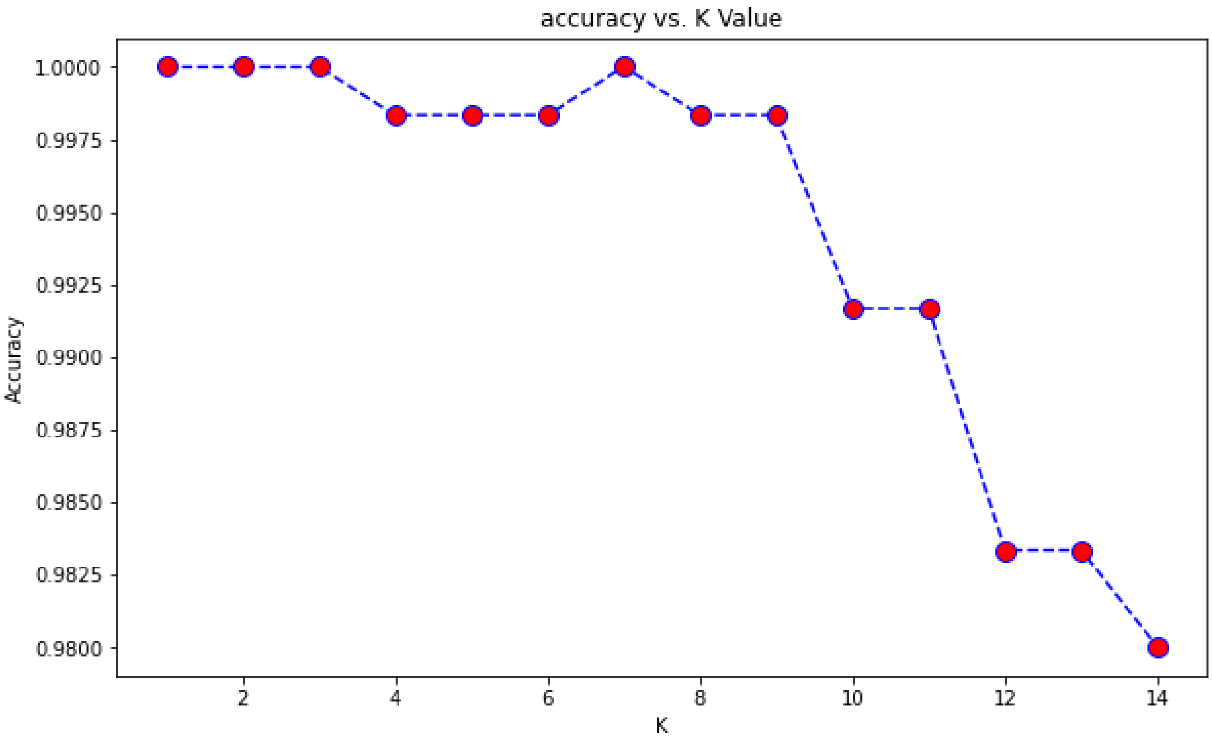
In [23]:

```
#-------------------------------------------------------K nearest neighbour starts
from multiprocessing import Queue
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import GridSearchCV
X_train = extracted_features_train
y_train = train_labels
X_test = extracted_features_test
y_test = test_labels


acc = []
acc.clear()
# Will take some time
from sklearn import metrics
for i in range(1,15):#--------------------------value of k = 1, 3 ,5, 7 included
    KNN_model = KNeighborsClassifier(n_neighbors = i).fit(X_train,y_train)
    knn_prediction = KNN_model.predict(X_test)
    acc.append(metrics.accuracy_score(y_test, knn_prediction))

plt.figure(figsize=(10,6))#---------------------------------------used to plot gr
plt.plot(range(1,15),acc,color = 'blue',linestyle='dashed',
         marker='o',markerfacecolor='red', markersize=10)
plt.title('accuracy vs. K Value')
plt.xlabel('K')
plt.ylabel('Accuracy')
print("Maximum accuracy:-",max(acc),"at K =",acc.index(max(acc))+1)#------------
```

```
Maximum accuracy:- 1.0 at K = 1
```



In [24]:

```

KNN_filename = '1115290_KNN.pkl'
# Open the file to save as pkl file#------------------saving model for KNN
saved = open(KNN_filename, 'wb')
pickle.dump(KNN_model, saved)
# Close the pickle instances
saved.close()
```

In [ ]:

Random forest starts below

In [25]:

```
################_--------------------------------Random forest starts here-------
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV

parameters = {
              "max_features": [1, 3, 10],
              "bootstrap": [True, False],
              "n_estimators": [10, 20, 50]}
rclf = RandomForestClassifier()
rgclf = GridSearchCV(rclf, param_grid=parameters)
rgclf.fit(extracted_features_train, train_labels)
```

Out[25]:

```
GridSearchCV(estimator=RandomForestClassifier(),
             param_grid={'bootstrap': [True, False], 'max_features': [1, 3, 1
0],
                         'n_estimators': [10, 20, 50]})
```

In [26]:

```

rclf = rgclf.best_estimator_
rclf.fit(extracted_features_train, train_labels)
```

Out[26]:

```
RandomForestClassifier(max_features=1, n_estimators=10)
```

In [27]:

```

predicted_RandomForest = rclf.predict(extracted_features_test)

from sklearn.metrics import confusion_matrix, classification_report, accuracy_sco
print("+++++++++++++Printing Confusion matrix below+++++++++++++++")
print(classification_report(test_labels, predicted_RandomForest))
a = rgclf.best_estimator_
print("Optimal parameteres  -------------->"  , a)
print("Accuracy: {0}".format(accuracy_score(test_labels, predicted_RandomForest))
```

```
+++++++++++++Printing Confusion matrix below+++++++++++++++
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       213
           1       0.99      1.00      1.00       181
           2       1.00      1.00      1.00       206

    accuracy                           1.00       600
   macro avg       1.00      1.00      1.00       600
weighted avg       1.00      1.00      1.00       600

Optimal parameteres  --------------> RandomForestClassifier(max_features=1, n_e
stimators=10)
Accuracy: 0.9983333333333333
```

In [28]:

```

RF_filename = '1115290_RandomForest.pkl'#------------------------saving random fo
# Open the file to save as pkl file
saved = open(RF_filename, 'wb')
pickle.dump(rclf, saved)
# Close the pickle instances
saved.close()
```

In [29]:

```
#--------------------------LOading models here-----------------------------------
```

Models can be loaded from below sections

In [30]:

```
KNN_m = open(KNN_filename, 'rb')
Knn_load = pickle.load(KNN_m)
print ("Loaded KNN model:: ", Knn_load)
```

```
Loaded KNN model::  KNeighborsClassifier(n_neighbors=14)
```

In [31]:

```
RF_m = open(RF_filename, 'rb')
RF_load = pickle.load(RF_m)
print ("Loaded RF model:: ", RF_load)
```

```
Loaded RF model::  RandomForestClassifier(max_features=1, n_estimators=10)
```

In [ ]:

In [ ]:

In [ ]:

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In [ ]:

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In [ ]: