Machine Learning Final Project train the deep learning model and traditional Machine Learning Models. Compare the performance of Deep learning Algorithm and three traditional Machine Learning Models.

Imported numpy, pandas, matplot libraries, seaborn, tensorflow and all other required libraries to the project.

An excellent tool for image processing and computer vision work is OpenCV. It is a free library that may be used to carry out operations like face recognition, object tracking, landmark recognition, and many other things. A complete open source machine learning platform is called TensorFlow. The class concentrates on using a specific TensorFlow API to create and train machine learning models, despite the fact that TensorFlow is a robust system for managing all parts of a machine learning system.

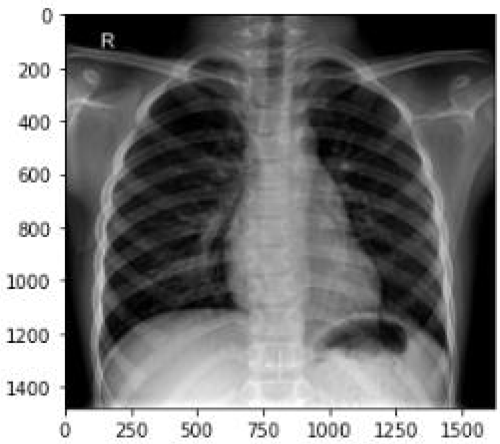
```
In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import seaborn as sns
        import tensorflow as tf
        import os
        import cv2
        import warnings
        warnings.filterwarnings('ignore')
        from sklearn.metrics import classification_report,confusion_matrix
```

```
In [2]: from tensorflow.keras.models import Sequential
        from tensorflow.keras.activations import softmax,sigmoid,relu
        from tensorflow.keras.optimizers import SGD,Adam
        from tensorflow.keras.layers import Conv2D,MaxPool2D,AvgPool2D,Flatten,Dropout,Dense,MaxPooling2D
        from sklearn.metrics import classification_report,confusion_matrix
```

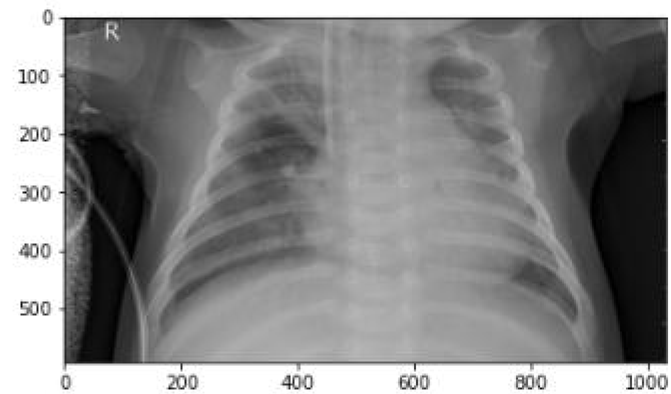
Collected the chest_xray dataset of pneumonia effect persons and normal persons, below shown images are samples.

```
img1 =r"C:\Users\LAHARI\Downloads\chest_xray\train\Normal\IM-0764-0001.jpeg"
print("Undiseased lungs")
im = cv2.imread(img1)
plt.imshow(cv2.cvtColor(im,cv2.COLOR_BGR2RGB))
plt.show()
img2 =r"C:\Users\LAHARI\Downloads\chest_xray\train\PNEUMONIA\person253_bacteria_1155.jpeg"
print("PNEUMONIA effected lungs")
im = cv2.imread(img2)
plt.imshow(cv2.cvtColor(im,cv2.COLOR_BGR2RGB))
plt.show()
```

Undiseased lungs



PNEUMONIA effected lungs



In deep learning, a convolutional neural network (CNN) is a class of artificial neural network most commonly applied to analyze visual imagery.

```
from PIL import Image
import os
import shutil
from skimage.io import imread
from PIL import Image
training_path=r'C:\Users\LAHARI\Downloads\chest_xray\train'
testing_path =r'C:\Users\LAHARI\Downloads\chest_xray\test'
```

The original data inputs are used to feed the Keras ImageDataGenerator, which transforms the data randomly and outputs a result that only contains the newly altered data. The data are not included. In order to broaden the model's applicability, additional data is added using the Keras ImageDataGenerator module. Data augmentation uses an image data generator to conduct random operations on data, including translations, rotations, scale modifications, and vertical flips.

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.50)
```

```
batch_size = 20
input_shape=(150,150,3)
```

```
train_datagen = datagen.flow_from_directory(
    training_path,
    target_size=input_shape[:2],
    class_mode='binary')
```

```
Found 1174 images belonging to 2 classes.
```

```
valid_datagen = datagen.flow_from_directory(
    testing_path,
    target_size=input_shape[:2],
    class_mode='binary')
```

```
Found 624 images belonging to 2 classes.
```

```
model =  Sequential()
model.add(Conv2D(filters=64,kernel_size=(3,3),padding = 'same',activation = 'relu',input_shape=(150,150,3)))
model.add(MaxPool2D(pool_size = (2,2),strides = 2, padding='valid'))
model.add(Conv2D(64,(5,5),padding='SAME',activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())
model.add(Dense(units = 128, activation = 'relu'))
model.add(Dropout(0.3))
model.add(Dense(1,activation='sigmoid'))
model.summary()
```

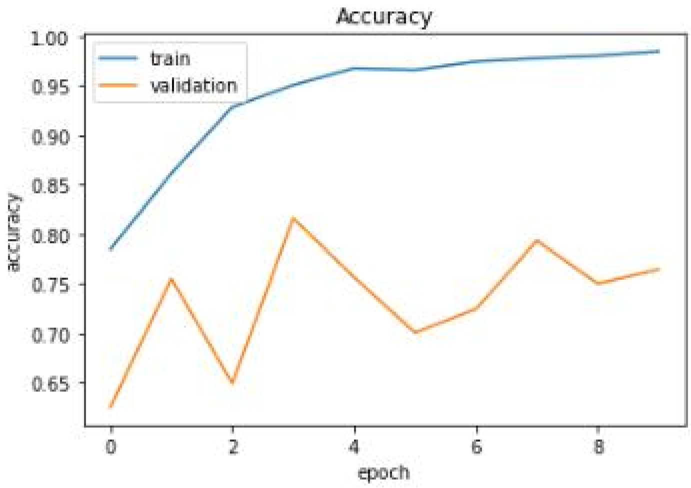
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 150, 150, 64)      1792

 max_pooling2d (MaxPooling2D  (None, 75, 75, 64)       0
 )

 conv2d_1 (Conv2D)           (None, 75, 75, 64)        102464

 max_pooling2d_1 (MaxPooling  (None, 37, 37, 64)       0
 2D)

 flatten (Flatten)           (None, 87616)             0

 dense (Dense)               (None, 128)               11214976

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 1)                 129

=================================================================
Total params: 11,319,361
Trainable params: 11,319,361
Non-trainable params: 0
_________________________________________________________________
```

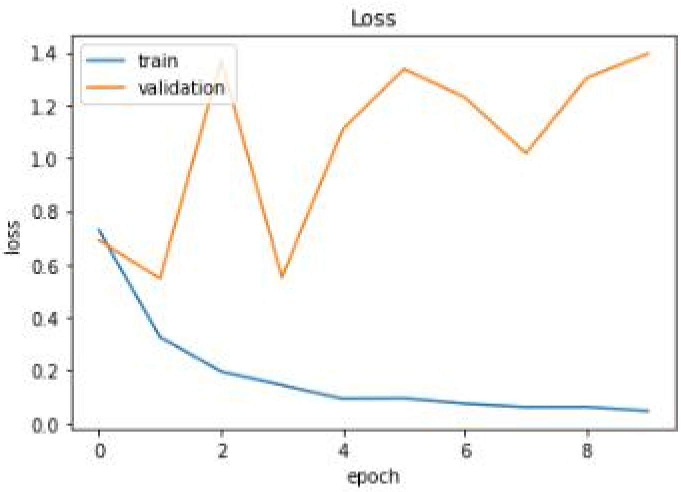
```
model.compile(optimizer ='adam',loss='binary_crossentropy',metrics = ['accuracy'])
```

```
#Epoch is crucial in machine learning modeling because it helps identify the model that most accurately represents the data.
hist = model.fit(
         train_datagen,
        validation_data = valid_datagen,
        epochs = 10)
```

```
Epoch 1/10
37/37 [==============================] - 146s 4s/step - loss: 0.7269 - accuracy: 0.7845 - val_loss: 0.6901 - val_accuracy: 0.62
50
Epoch 2/10
37/37 [==============================] - 157s 4s/step - loss: 0.3262 - accuracy: 0.8612 - val_loss: 0.5480 - val_accuracy: 0.75
48
Epoch 3/10
37/37 [==============================] - 149s 4s/step - loss: 0.1962 - accuracy: 0.9284 - val_loss: 1.3682 - val_accuracy: 0.64
90
Epoch 4/10
37/37 [==============================] - 149s 4s/step - loss: 0.1443 - accuracy: 0.9506 - val_loss: 0.5522 - val_accuracy: 0.81
57
Epoch 5/10
37/37 [==============================] - 148s 4s/step - loss: 0.0925 - accuracy: 0.9676 - val_loss: 1.1096 - val_accuracy: 0.75
64
Epoch 6/10
37/37 [==============================] - 147s 4s/step - loss: 0.0941 - accuracy: 0.9659 - val_loss: 1.3367 - val_accuracy: 0.70
03
Epoch 7/10
37/37 [==============================] - 149s 4s/step - loss: 0.0745 - accuracy: 0.9744 - val_loss: 1.2287 - val_accuracy: 0.72
44
Epoch 8/10
37/37 [==============================] - 146s 4s/step - loss: 0.0613 - accuracy: 0.9779 - val_loss: 1.0182 - val_accuracy: 0.79
33
Epoch 9/10
37/37 [==============================] - 152s 4s/step - loss: 0.0617 - accuracy: 0.9804 - val_loss: 1.3038 - val_accuracy: 0.75
00
Epoch 10/10
37/37 [==============================] - 148s 4s/step - loss: 0.0472 - accuracy: 0.9847 - val_loss: 1.3949 - val_accuracy: 0.76
44
```

```
hist
plt.title('Accuracy')
plt.plot(hist.history['accuracy'])
plt.plot(hist.history['val_accuracy'])
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()

plt.title('Loss')
plt.plot(hist.history['loss'])
plt.plot(hist.history['val_loss'])
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```





```
from sklearn import metrics
from sklearn.metrics import classification_report
y_pred = (model.predict(valid_datagen) > 0.505).astype(int)
y_test = valid_datagen.classes
print(classification_report(y_test, y_pred))
```

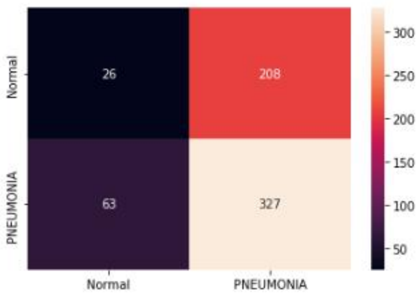
```
20/20 [==============================] - 24s 1s/step
              precision    recall  f1-score   support

           0       0.29      0.11      0.16       234
           1       0.61      0.84      0.71       390

    accuracy                           0.57       624
   macro avg       0.45      0.47      0.43       624
weighted avg       0.49      0.57      0.50       624
```

```
train_datagen.class_indices
```

```
{'NORMAL': 0, 'PNEUMONIA': 1}
```

```
sns.heatmap(metrics.confusion_matrix(y_test,y_pred),annot=True,xticklabels=['Normal','PNEUMONIA'],yticklabels=['Normal','PNEUMONI
```

```
<AxesSubplot:>
```



Conclusion for CNN model: Accuracy is 60%.

Traditional Machine learning models:

```
import pandas as pd
from sklearn import svm
import os
import matplotlib.pyplot as plt
from skimage.transform import resize
from skimage.io import imread
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report,accuracy_score,confusion_matrix
import pickle
Efftype = ['Normal','Pneumonia']
training_path=r'C:\Users\LAHARI\Downloads\chest_xray\train'
testing_path =r'C:\Users\LAHARI\Downloads\chest_xray\test'
```

```python
flat_data_arr=[]
target_arr=[]
# Loading training data of NORMAL and PNEUMONIA LUNGS chestx-ray
datadir=training_path
for i in Efftype:
    print(f'lungs type: {i}')
    path=os.path.join(datadir,i)
    for img in os.listdir(path):
        img_array=imread(os.path.join(path,img))
        img_resized=resize(img_array,(150,150,3))
        flat_data_arr.append(img_resized.flatten())
        target_arr.append(Efftype.index(i))
    print(f'lungs type:{i} lungs data loaded successfully')
flat_data=np.array(flat_data_arr)
target=np.array(target_arr)
df=pd.DataFrame(flat_data)
df['Target']=target
df
```

```
lungs type: Normal
lungs type:Normal lungs data loaded successfully
lungs type: Pneumonia
lungs type:Pneumonia lungs data loaded successfully
```

:

	0	1	2	3	4	5	6	7	8	9	...	67491	67492	67493	674
0	0.000624	0.000624	0.000624	1.554703e-02	1.554703e-02	1.554703e-02	0.046477	0.046477	0.046477	0.092571	...	0.000000	0.000000	0.000000	0.0000
1	0.224595	0.224595	0.224595	2.220384e-01	2.220384e-01	2.220384e-01	0.201172	0.201172	0.201172	0.192875	...	0.265450	0.265450	0.265450	0.2466
2	0.576460	0.576460	0.576460	5.711765e-01	5.711765e-01	5.711765e-01	0.476906	0.476906	0.476906	0.462792	...	0.100622	0.100622	0.100622	0.0987
3	0.000000	0.000000	0.000000	2.798602e-07	2.798602e-07	2.798602e-07	0.000330	0.000330	0.000330	0.009659	...	0.000000	0.000000	0.000000	0.0000
4	0.000000	0.000000	0.000000	0.000000e+00	0.000000e+00	0.000000e+00	0.000001	0.000001	0.000001	0.001085	...	0.000007	0.000007	0.000007	0.0000
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1169	0.069326	0.069326	0.069326	1.102778e-01	1.102778e-01	1.102778e-01	0.143043	0.143043	0.143043	0.166732	...	0.368588	0.368588	0.368588	0.2460
1170	0.367269	0.367269	0.367269	3.845874e-01	3.845874e-01	3.845874e-01	0.387758	0.387758	0.387758	0.390509	...	0.407631	0.407631	0.407631	0.4616
1171	0.186600	0.186600	0.186600	1.958581e-01	1.958581e-01	1.958581e-01	0.203598	0.203598	0.203598	0.210261	...	0.061562	0.061562	0.061562	0.0686
1172	0.174943	0.174943	0.174943	1.746081e-01	1.746081e-01	1.746081e-01	0.179924	0.179924	0.179924	0.178424	...	0.137259	0.137259	0.137259	0.1381
1173	0.733773	0.733773	0.733773	7.208144e-01	7.208144e-01	7.208144e-01	0.722602	0.722602	0.722602	0.691281	...	0.172024	0.172024	0.172024	0.1745

1174 rows × 67501 columns

```python
flat_data_arr=[]
target_arr=[]
# Loading testing data of NORMAL and PNEUMONIA LUNGS chestx-ray
datadir=testing_path
for i in Efftype:
    print(f'lungs type : {i}')
    path=os.path.join(datadir,i)
    for img in os.listdir(path):
        img_array=imread(os.path.join(path,img))
        img_resized=resize(img_array,(150,150,3))
        flat_data_arr.append(img_resized.flatten())
        target_arr.append(Efftype.index(i))
    print(f'lungs type:{i} lungs data loaded successfully')
flat_data=np.array(flat_data_arr)
target=np.array(target_arr)
df2=pd.DataFrame(flat_data)
df2['Target']=target
df2.head()
```

```
lungs type : Normal
lungs type:Normal lungs data loaded successfully
lungs type : Pneumonia
lungs type:Pneumonia lungs data loaded successfully
```

	0	1	2	3	4	5	6	7	8	9	...	67491	67492	67493	67494	67495	
0	0.122207	0.122207	0.122207	0.125258	0.125258	0.125258	0.123472	0.123472	0.123472	0.120515	...	0.130572	0.130572	0.130572	0.130024	0.130024	0.
1	0.105979	0.105979	0.105979	0.124858	0.124858	0.124858	0.109188	0.109188	0.109188	0.166194	...	0.129098	0.129098	0.129098	0.128679	0.128679	0.
2	0.142660	0.142660	0.142660	0.143883	0.143883	0.143883	0.142252	0.142252	0.142252	0.136136	...	0.135853	0.135853	0.135853	0.136796	0.136796	0.
3	0.275154	0.275154	0.275154	0.294058	0.294058	0.294058	0.296596	0.296596	0.296596	0.303661	...	0.521303	0.521303	0.521303	0.526744	0.526744	0.
4	0.153259	0.153259	0.153259	0.155322	0.155322	0.155322	0.152600	0.152600	0.152600	0.148415	...	0.170456	0.170456	0.170456	0.173259	0.173259	0.

5 rows × 67501 columns

1)SVC model

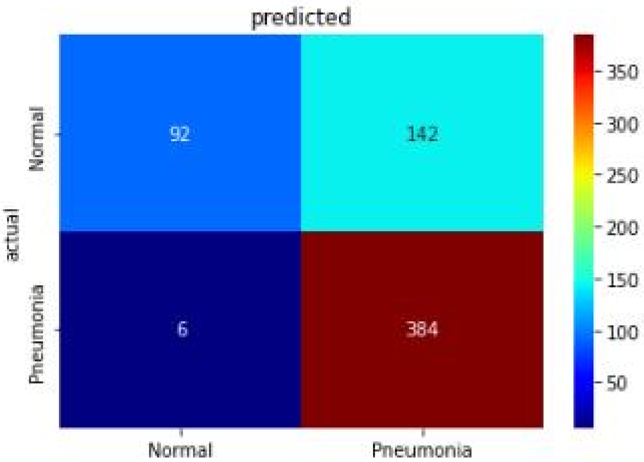
Support Vector Classification (SVC), which is a supervised machine learning algorithm used for classification tasks. It belongs to the family of linear and nonlinear classifiers, and it works by finding the best hyperplane that separates the data into different classes.

```python
from sklearn.svm import SVC
svm_model = SVC()
svm_model.fit(x_train,y_train)
```

```
SVC()
```

```python
y_pred_svm=svm_model.predict(x_test)
print(classification_report(y_test,y_pred_svm))
cm = confusion_matrix(y_test,y_pred_svm)
sns.heatmap(cm,annot=True,cmap='jet',fmt="1",xticklabels={'Normal': 0, 'Pneumonia': 1},yticklabels={'Normal': 0, 'Pneumonia': 1}
plt.title("predicted")
plt.ylabel('actual')
plt.show()
```

```
              precision    recall  f1-score   support

           0       0.94      0.39      0.55       234
           1       0.73      0.98      0.84       390

    accuracy                           0.76       624
   macro avg       0.83      0.69      0.70       624
weighted avg       0.81      0.76      0.73       624
```



Conclusion for SVC model: Accuracy is 76%.

2)Decision tree classifier

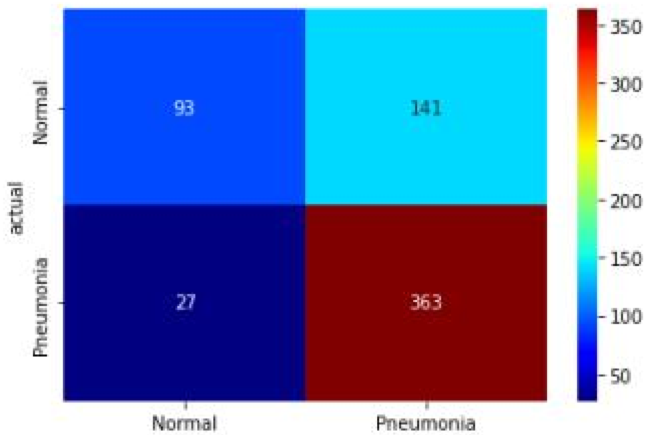
Decision Tree Classifier models are known for their interpretability, as the decision tree structure can be visualized and analyzed to understand how the model is making its predictions. However, decision trees can be prone to overfitting, particularly if the tree is allowed to grow to its full depth. Techniques such as pruning and setting a maximum depth can help to prevent overfitting. Decision trees can also be sensitive to the choice of splitting criterion and can struggle with complex datasets with many features.

```
from sklearn.tree import DecisionTreeClassifier
dct_model = DecisionTreeClassifier()
dct_model.fit(x_train,y_train)
```

```
DecisionTreeClassifier()
```

```
y_pred_dct=dct_model.predict(x_test)
print(classification_report(y_test,y_pred_dct))
cm = confusion_matrix(y_test,y_pred_dct)
sns.heatmap(cm,annot=True,cmap='jet',fmt="1",xticklabels={'Normal': 0, 'Pneumonia': 1},yticklabels={'Normal': 0, 'Pneumonia': 1})
plt.ylabel('actual')
plt.show()
```

	precision	recall	f1-score	support
0	0.78	0.40	0.53	234
1	0.72	0.93	0.81	390
accuracy			0.73	624
macro avg	0.75	0.66	0.67	624
weighted avg	0.74	0.73	0.70	624



Conclusion for DTC model: Accuracy is 73%.

3) k-Nearest Neighbors (k-NN)

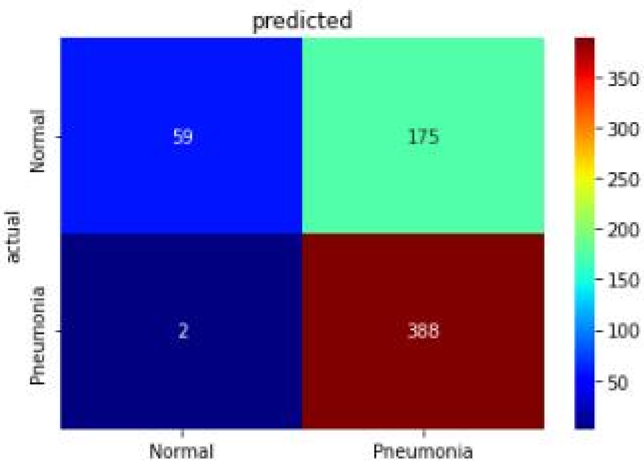
The k-NN algorithm is a type of lazy learning algorithm that is used for both classification and regression tasks. It works by finding the k data points in the training set that are closest to a new data point and using their labels to make a prediction.

```
from sklearn.neighbors import KNeighborsClassifier
knn_model = KNeighborsClassifier()
knn_model.fit(x_train,y_train)
```

```
KNeighborsClassifier()
```

```
y_pred_knn=knn_model.predict(x_test)
print(classification_report(y_test,y_pred_knn))
cm = confusion_matrix(y_test,y_pred_knn)
sns.heatmap(cm,annot=True,cmap='jet',fmt="1",xticklabels={'Normal': 0, 'Pneumonia': 1},yticklabels={'Normal': 0, 'Pneumonia': 1}
plt.title("predicted")
plt.ylabel('actual')
plt.show()
```

	precision	recall	f1-score	support
0	0.97	0.25	0.40	234
1	0.69	0.99	0.81	390
accuracy			0.72	624
macro avg	0.83	0.62	0.61	624
weighted avg	0.79	0.72	0.66	624



Conclusion for K-NN model: Accuracy is 72%.

Conclusion:

The process for conclusion of traditional machine learning models is similar to that of deep learning models, but the difference lies in the algorithms used and the complexity of the models. Deep learning models can handle more complex tasks and larger datasets, while traditional machine learning models are simpler and can handle smaller datasets.