In [1]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?cli
ent_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.apps.googleuserconten
t.com&redirect_uri=urn%3aietf%3awg%3aoauth%3a2.0%3aoob&response_type=code&
scope=email%20https%3a%2f%2fwww.googleapis.com%2fauth%2fdocs.test%20https%
3a%2f%2fwww.googleapis.com%2fauth%2fdrive%20https%3a%2f%2fwww.googleapis.c
om%2fauth%2fdrive.photos.readonly%20https%3a%2f%2fwww.googleapis.com%2faut
h%2fpeopleapi.readonly

Enter your authorization code:
..........
Mounted at /content/drive
```

In [2]:

```
# Importing Libraries.
from datetime import datetime
start_real = datetime.now()
import numpy as np
import pandas as pd
import math
import pickle
from nltk.corpus import stopwords
from tqdm import tqdm

from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import Ridge
from sklearn.linear_model import RidgeCV
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from sklearn.linear_model import RidgeCV
from sklearn.pipeline import FeatureUnion

from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
from keras.layers import Input, Dropout, Dense, concatenate
from keras.layers import GRU, Embedding, Flatten, Activation
from keras.models import Model

from sklearn.linear_model import Ridge, LogisticRegression
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
from sklearn.ensemble import RandomForestClassifier
from sklearn.pipeline import Pipeline
from sklearn.model_selection import GridSearchCV
from sklearn.ensemble import RandomForestRegressor
from sklearn.model_selection import RandomizedSearchCV
from scipy.stats import randint as sp_randint
from sklearn.tree import DecisionTreeRegressor
from sklearn.svm import SVR

from keras.layers import Input, Dense, Embedding, Dense, Dropout, Flatten, Conv1D, Glob
alMaxPooling1D, BatchNormalization, LSTM, GRU
from keras.models import Model
from keras import optimizers
```

```
Using TensorFlow backend.
```

In [0]:

```
# Defining Utility Functions :

# 1. RMSLE Function
def rmsle(y, y_pred): # return Rmsle value.
    return np.sqrt(np.mean(np.square(y_pred - y )))

#--------------------------------------------------------------------

# 2. Word Count Function.
def word_count(text):
    try:
        if text == 'No description yet':
            return 0 # for the data point with string "No description yet" returns word
count 0.
        else:
            text = text.lower()
            words = []
            for w in text.split(" "):
              words.append(w)
            return len(words)
    except:
        return 0

#--------------------------------------------------------------------


# 3.Splitting category into sub categories.
def cat_split(column, sub_cat):
    category = []
    for i in range(len(train)):
        try:
            category.append(train[column].values[i].split("/")[sub_cat])
        except:
            category.append("No Label") # If there is no sub category it repalces No La
bel.

    return category

def cat_split_test(column, sub_cat):
    category = []
    for i in range(len(test)):
        try:
            category.append(test[column].values[i].split("/")[sub_cat])
        except:
            category.append("No Label") # If there is no sub category it repalces No La
bel.
    return category

#--------------------------------------------------------------------


# 4. finding missing brands.
#https://www.kaggle.com/valkling/mercari-rnn-2ridge-models-with-notes-0-42755
# The Brand Name has 600,000 Missing Values. This Function will replace the data.
def finding_brand(row_n):
    brand_row = row_n[0]
    name = row_n[1]
    namesplit = name.split(' ') # for missing brand we check every word in the name col
umn
```

```
    if brand_row == 'missing':
        for x in namesplit: # Then we check for every word in brand vocabulary.if exist
s retur name
            if x in brand_vocab:
                return name
    if name in brand_vocab:
        return name
    return brand_row

#-----------------------------------------------------------------

# 5. Filling Missing values. Filling Columns names, category_name, item_description, br
and_name
def fill_missing_values(df):
    df.category_name.fillna(value="missing", inplace=True)
    df.brand_name.fillna(value="missing", inplace=True)
    df.item_description.fillna(value="missing", inplace=True)
    df.item_description.replace('No description yet',"missing", inplace=True)
    return df
```

Machine Learning Models

In [0]:

```
# Import Train Data.
print("Importing Train Data:")
train = pd.read_table('/content/drive/My Drive/train.tsv')
print("Shape of Train Data:", train.shape)
print("Checking For NaN in the data...")
print(train.isnull().any())
print("Removing rows which has price value less than 5")
# Removing Lower Prices which are less than 5. As Majority of the prices range above 5
train = train.drop(train[(train.price < 5.0)].index)
print("Computing Word Count of item_description")
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
print("Computing Word Count of name")
train['name_len'] = train['name'].apply(lambda x: word_count(x))
print("Splitting category_name to sub categories")
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
print("Performing Feature Engineering and preprocessing :")
# Filling All the NAN rows of brand name with text "missing"
# Get all the vocabulary of all the words in the column Brand.
print("Filling Missing values in the Brand name...")
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
# Total Count with rows "missing"
missing = len(train.loc[train["brand_name"] == 'missing'])
print("Total Missing Values:", missing)
# Filling Missing values in the brand_name.
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
# Checking number of detected brand names from name column.
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print("Total Detected brand names :",detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
print("Verifying Null Values in the data :", train.isnull().any())
print("Converting Columns to Strings : ")
# We Convert all the data columns in the form of strings.
train['category_name'] = train['category_name'].fillna('missing').astype(str)
train['subcat_0'] = train['subcat_0'].astype(str)
train['subcat_1'] = train['subcat_1'].astype(str)
train['subcat_2'] = train['subcat_2'].astype(str)
train['brand_name'] = train['brand_name'].fillna('missing').astype(str)
train['shipping'] = train['shipping'].astype(str)
train['item_condition_id'] = train['item_condition_id'].astype(str)
train['desc_len'] = train['desc_len'].astype(str)
train['name_len'] = train['name_len'].astype(str)
train['item_description'] = train['item_description'].fillna('No description yet').asty
pe(str)
print("Natural Logarithm on Price...")
train["target"] = np.log1p(train.price)
```

```
Importing Train Data:
Shape of Train Data: (1482535, 8)
Checking For NaN in the data...
train_id             False
name                 False
item_condition_id    False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Removing rows which has price value less than 5
Computing Word Count of item_description
Computing Word Count of name
Splitting category_name to sub categories
Performing Feature Engineering and preprocessing :
Filling Missing values in the Brand name...
Total Missing Values: 607593
Total Detected brand names : 125239
Electronics/Computers & Tablets/Components & Parts
Verifying Null Values in the data : train_id             False
name                 False
item_condition_id    False
category_name        False
brand_name           False
price                False
shipping             False
item_description     False
desc_len             False
name_len             False
subcat_0             False
subcat_1             False
subcat_2             False
dtype: bool
Converting Columns to Strings :
Natural Logarithm on Price...
```

In [0]:

```
# Train and Test Split:
x_train, x_test = train_test_split(train, random_state=123, train_size=0.99)
print(x_train.shape)
print(x_test.shape)
Y_train = x_train.target.values.reshape(-1, 1)
Y_test = x_test.target.values.reshape(-1,1)
```

```
(1432350, 14)
(14469, 14)
```

In [0]:

```
# Vectorizing Data.
# https://towardsdatascience.com/hacking-scikit-learns-vectorizers-9ef26a7170af
#https://www.kaggle.com/valkling/mercari-rnn-2ridge-models-with-notes-0-42755
# https://blog.usejournal.com/featureunion-a-time-saver-when-building-a-machine-learning-model-d0ad7a90f215

default_preprocessor = CountVectorizer().build_preprocessor() # a callable function that preprocesses the text data.

def build_preprocessor(colum, ):
  # We are preprocessing each columns
    column_index = list(train.columns).index(colum) # Returns the Index of a specific Column.
    return lambda x: default_preprocessor(x[column_index])

# stack tfidf and count vectorize for all the columns.
vectorizer = FeatureUnion([
    ('name', CountVectorizer(ngram_range=(1, 3),max_features=10000,preprocessor = build_preprocessor('name'))),

    ('subcat_0', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_0'))),

    ('subcat_1', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_1'))),

    ('subcat_2', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_2'))),

    ('brand_name', CountVectorizer(token_pattern ='.+',preprocessor = build_preprocessor('brand_name'))),

    ('shipping', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('shipping'))),

    ('item_condition_id', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('item_condition_id'))),

    ('desc_len', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('desc_len'))),

    ('name_len', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('name_len'))),

    ('item_description', TfidfVectorizer(ngram_range = (1, 3),max_features = 100000,preprocessor = build_preprocessor('item_description'))),
])
```

In [0]:

```
# Fitting Vectorizer.
vectorizer.fit(x_train.values)
# Transforming Train and Test.
x = vectorizer.transform(x_train.values)
x_t = vectorizer.transform(x_test.values)
print(x.shape,x_t.shape)
X_train = x
X_test = x_t
```

```
(1432350, 222408) (14469, 222408)
```

SVR

In [0]:

```
# SVR
Y_train = np.ravel(Y_train)
from sklearn.svm import SVR
params = [0.0001,0.001,0.01,0.1]
for i in params:

    svr = SVR(C = i, epsilon = 0.01)
    svr.fit(X_train, Y_train)
    y_pred = svr.predict(X_test)
    svr_rmsle = np.sqrt(mean_squared_error(Y_test, y_pred))
    print(i)
    print(svr_rmsle)
```

```
0.0001
0.5990894557275435
0.001
0.5868092755412005
0.01
0.5404932373507542
0.1
0.4755534110778424
```

DecisionTreeReg

In [0]:

```
from sklearn.tree import DecisionTreeRegressor

parameters = [(2,2),(4,5), (6,6),(9,8), ]

for i,j in tqdm(parameters):
    dt_reg = DecisionTreeRegressor(max_depth = i, min_samples_split = j)
    dt_reg.fit(X_train, Y_train)

    y_pred = dt_reg.predict(X_test)
    # Calculating RMSLE
    dt_rmsle = np.sqrt(mean_squared_error(Y_test, y_pred))
    print("For Depth:",i)
    print("For Min_sample_split : ", j)
    print("RMSLE : ", dt_rmsle)
```

```
 25%|██▌       | 1/4 [00:54<02:43, 54.47s/it]
For Depth: 2
For Min_sample_split :  2
RMSLE :  0.7092153254274274
 50%|█████     | 2/4 [02:35<02:16, 68.37s/it]
For Depth: 4
For Min_sample_split :  5
RMSLE :  0.6802232886209346
 75%|███████▌  | 3/4 [05:20<01:37, 97.37s/it]
For Depth: 6
For Min_sample_split :  6
RMSLE :  0.6628085974892538
100%|██████████| 4/4 [10:54<00:00, 163.70s/it]
For Depth: 9
For Min_sample_split :  8
RMSLE :  0.6353326424231599
```

In [0]:

```
from sklearn.tree import DecisionTreeRegressor

parameters = [(10,15),(15,20), (30,50),(50,100), ]

for i,j in tqdm(parameters):
    dt_reg = DecisionTreeRegressor(max_depth = i, min_samples_split = j)
    dt_reg.fit(X_train, Y_train)

    y_pred = dt_reg.predict(X_test)
    # Calculating RMSLE
    dt_rmsle = np.sqrt(mean_squared_error(Y_test, y_pred))
    print("For Depth:",i)
    print("For Min_sample_split : ", j)
    print("RMSLE : ", dt_rmsle)
```

```
 25%|██▌       | 1/4 [06:50<20:32, 410.86s/it]
For Depth: 10
For Min_sample_split :  15
RMSLE :  0.6292677048629349

 50%|█████     | 2/4 [24:15<20:02, 601.11s/it]
For Depth: 15
For Min_sample_split :  20
RMSLE :  0.6048510105794948

 75%|███████▌  | 3/4 [1:31:31<27:11, 1631.60s/it]
For Depth: 30
For Min_sample_split :  50
RMSLE :  0.5672880245885058
```

max_depth = 30, min Sample Split = 50

SgdReg

In [0]:

```
from sklearn.linear_model import SGDRegressor
Y_train = np.ravel(Y_train)

parameters = [0.00001, 0.0001,0.001,0.01,0.1,0,1,10]

for i in parameters:
    sgd_reg = SGDRegressor(alpha = i, loss = 'squared_loss', penalty = 'l2', learning_r
ate = 'constant')
    sgd_reg.fit(X_train, Y_train)
    y_pred = sgd_reg.predict(X_test)
    y_pred =  y_pred.reshape(-1, 1)
    sgd_rmsle = np.sqrt(mean_squared_error(Y_test, y_pred))
    print("For Alpha:",i)
    print("RMSLE ridgecv:", sgd_rmsle)
```

```
For Alpha: 1e-05
RMSLE ridgecv: 0.45376929969734825
For Alpha: 0.0001
RMSLE ridgecv: 0.4760848688908972
For Alpha: 0.001
RMSLE ridgecv: 0.5297605865265459
For Alpha: 0.01
RMSLE ridgecv: 0.5980632891841436
For Alpha: 0.1
RMSLE ridgecv: 0.669138478237479
For Alpha: 0
RMSLE ridgecv: 0.45449834341396417
For Alpha: 1
RMSLE ridgecv: 0.72085375442452
For Alpha: 10
RMSLE ridgecv: 0.7359748471151365
```

alpha = 0.00001

RidgeReg

In [0]:

```
# Ridge Regression.
ridge_reg = Ridge(solver='auto', fit_intercept=True, alpha=1.0,max_iter=100, normalize=
False, tol=0.05, random_state = 1,)
ridge_reg.fit(X_train, Y_train)
```

Out[0]:

```
Ridge(alpha=1.0, copy_X=True, fit_intercept=True, max_iter=100, normalize=
False,
      random_state=1, solver='auto', tol=0.05)
```

In [0]:

```
y_pred = ridge_reg.predict(X_test)
y_pred = y_pred.reshape(-1, 1)
print("RMSLE Ridge:", rmsle(Y_test, y_pred))
```

```
RMSLE Ridge: 0.47499265313099626
```

In [0]:

```
ridge_cv = RidgeCV(alphas=[10.0], fit_intercept= True,normalize=False, cv = 3, scoring=
'neg_mean_squared_error',)
ridge_cv.fit(X_train, Y_train)
y_pred = ridge_cv.predict(X_test)
y_pred = y_pred.reshape(-1, 1)
print("RMSLE ridgecv:", rmsle(Y_test, y_pred))
```

```
RMSLE ridgecv: 0.4432021951114149
```

Ensembles

In [0]:

```
# SVR, RIDGE, SGD.
from sklearn.svm import SVR
from sklearn.linear_model import SGDRegressor
from sklearn.ensemble import VotingRegressor

model_1 = SVR(C = 0.1, epsilon = 0.01)
model_2 = RidgeCV(fit_intercept=True, alphas=[10.0],normalize=False, cv = 3, scoring='n
eg_mean_squared_error',)
model_3 = SGDRegressor(alpha = 0.00001, loss = 'squared_loss', penalty = 'l2', learning
_rate = 'constant')

reg = VotingRegressor([("svr", model_1), ("r", model_2), ("sgd", model_3)], n_jobs = -1
)
reg.fit(X_train, Y_train)
```

```
/opt/conda/lib/python3.7/site-packages/sklearn/ensemble/_voting.py:406: Da
taConversionWarning: A column-vector y was passed when a 1d array was expe
cted. Please change the shape of y to (n_samples, ), for example using rav
el().
  y = column_or_1d(y, warn=True)
```

Out[0]:

```
VotingRegressor(estimators=[('svr',
                             SVR(C=0.1, cache_size=200, coef0=0.0, degree=
3,
                                 epsilon=0.01, gamma='scale', kernel='rb
f',
                                 max_iter=-1, shrinking=True, tol=0.001,
                                 verbose=False)),
                            ('r',
                             RidgeCV(alphas=array([5.]), cv=2,
                                     fit_intercept=True, gcv_mode=None,
                                     normalize=False,
                                     scoring='neg_mean_squared_error',
                                     store_cv_values=False)),
                            ('sgd',
                             SGDRegressor(alpha=1e-05, average=False,
                                          early_stopping=False, epsilon=0.
1,
                                          eta0=0.01, fit_intercept=True,
                                          l1_ratio=0.15,
                                          learning_rate='constant',
                                          loss='squared_loss', max_iter=10
00,
                                          n_iter_no_change=5, penalty='l
2',
                                          power_t=0.25, random_state=None,
                                          shuffle=True, tol=0.001,
                                          validation_fraction=0.1, verbose
=0,
                                          warm_start=False))],
                n_jobs=None, weights=None)
```

In [0]:

```
y_pred = reg.predict(X_test)
y_pred = y_pred.reshape(-1,1)
print("Ensemble Rmsle error:", rmsle(Y_test, y_pred))
```

```
Ensemble Rmsle error: 0.4451476373350806
```

PrettyTable.

In [0]:

```
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model", "Alpha", "Rmsle Error"]
x.add_row(["SVR", 0.1, 0.47])
x.add_row(["Decision Tree Reg", 30, 0.56])
x.add_row(["RidgeReg Cv",5, 0.44])
x.add_row(["SGD Reg", 0.00001, 0.45])
x.add_row(["RRidgeReg",1,  0.48])
x.add_row(["Ensemble Voting Reg", "sgd, Rf, svr", 0.44])
print(x)
```

```
+---------------------+--------------+-------------+
|        Model        |    Alpha     | Rmsle Error |
+---------------------+--------------+-------------+
|         SVR         |     0.1      |     0.47    |
|  Decision Tree Reg  |      30      |     0.56    |
|     RidgeReg Cv     |      5       |     0.44    |
|       SGD Reg       |    1e-05     |     0.45    |
|      RRidgeReg      |      1       |     0.48    |
| Ensemble Voting Reg | sgd, Rf, svr |     0.44    |
+---------------------+--------------+-------------+
```

Ensemble Performed Well with rmsle score of 0.44, and also ridge cv scored good with 0.44

Implementing Deep learning Models.

In [0]:

```
# Importing train data.
print("Importing Train Data...")
train = pd.read_table('/content/drive/My Drive/train.tsv')
print("Shape of Train data :",train.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(train.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 3.
train = train.drop(train[(train.price < 5.0)].index)
train.shape
# Getting Length of each text in name and item_description.
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
train['name_len'] = train['name'].apply(lambda x: word_count(x))
train.head()
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(train.loc[train["brand_name"] == 'missing'])
#premissing
print(missing)
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print(detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
train["target"] = np.log1p(train.price)
```

```
Importing Train Data...
Shape of Train data : (1482535, 8)
Checking for any null values..
train_id             False
name                 False
item_condition_id     False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Performing Preprocessing and Feature engineering...
607593
125239
Electronics/Computers & Tablets/Components & Parts
```

In [0]:

```
from sklearn.preprocessing import LabelEncoder
import numpy as np


class LabelEncoderExt(object):
    def __init__(self):
        """
        It differs from LabelEncoder by handling new classes and providing a value for
 it [Unknown]
        Unknown will be added in fit and transform will take care of new item. It gives
unknown class id
        """
        self.label_encoder = LabelEncoder()
        # self.classes_ = self.label_encoder.classes_

    def fit(self, data_list):
        """
        This will fit the encoder for all the unique values and introduce unknown value
        :param data_list: A list of string
        :return: self
        """
        self.label_encoder = self.label_encoder.fit(list(data_list) + ['Unknown'])
        self.classes_ = self.label_encoder.classes_

        return self

    def transform(self, data_list):
        """
        This will transform the data_list to id list where the new values get assigned
 to Unknown class
        :param data_list:
        :return:
        """
        new_data_list = list(data_list)
        for unique_item in np.unique(data_list):
            if unique_item not in self.label_encoder.classes_:
                new_data_list = ['Unknown' if x==unique_item else x for x in new_data_l
ist]

        return self.label_encoder.transform(new_data_list)
```

In [0]:

```
# Encoding Categorical Features.
label = LabelEncoderExt()
label.fit(train.category_name) # categories united
train['category'] = label.transform(train.category_name)

label.fit(train.brand_name) # brand name
train.brand_name = label.transform(train.brand_name)

label.fit(train.subcat_0) # sub_cat0
train.subcat_0 = label.transform(train.subcat_0)

label.fit(train.subcat_1) # sub_cat_1
train.subcat_1 = label.transform(train.subcat_1)

label.fit(train.subcat_2) # sub_cat2
train.subcat_2 = label.transform(train.subcat_2)

del label
```

In [0]:

```
# Text to Sequence Data.
# Combining columns, item_description, name, category_name.
full_text = np.hstack([train.item_description.str.lower(), train.name.str.lower(), trai
n.category_name.str.lower()])

# Tokenizing on combined columns.
tokenizer = Tokenizer()
tokenizer.fit_on_texts(full_text)

train['seq_desc'] = tokenizer.texts_to_sequences(train.item_description.str.lower())
train['seq_name'] = tokenizer.texts_to_sequences(train.name.str.lower())
```

In [0]:

```
# finding out max len of all the text data combined.
max_len = np.max([np.max(train.seq_name.max()),np.max(train.seq_desc.max()),])
# max length for Categorical Data.
#max_len_cat = np.max(train.category.max()) + 1 # category
max_len_brand = np.max(train.brand_name.max())    # brand
max_len_condition = np.max(int(max(train.item_condition_id)))  # item_cond
max_len_desc = np.max(int(train.desc_len.max()))  # item_desc_len
max_len_name = np.max(int(train.name_len.max()))  # name_len
max_len_sub0 = np.max(int(train.subcat_0.max()))  # Sub_0
max_len_sub1 = np.max(int(train.subcat_1.max()))  # Sub_1
max_len_sub2 = np.max(train.subcat_2.max())  # Sub_2
# Defining max length for Padding Text Data.
name_padding = 15
description_padding = 80
```

In [0]:

```
# Train and Test Split.
x_tr, x_te = train_test_split(train, random_state=123, train_size=0.99)
Y_train = x_tr.target.values.reshape(-1, 1)
Y_test = x_te.target.values.reshape(-1, 1)
```

In [0]:

```
# Padding Name :
x_train_padded = {
"name" : pad_sequences(x_tr.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_tr.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_tr.brand_name),
"category" :np.array(x_tr.category),
"item_condition" : np.array(x_tr.item_condition_id),
"shipping" : np.array(x_tr[["shipping"]]),
"desc_len" : np.array(x_tr[["desc_len"]]),
"name_len" : np.array(x_tr[["name_len"]]),
"subcat_0" : np.array(x_tr.subcat_0),
"subcat_1"  : np.array(x_tr.subcat_1),
"subcat_2" : np.array(x_tr.subcat_2),
}
x_test_padded = {
"name" : pad_sequences(x_te.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_te.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_te.brand_name),
"category" : np.array(x_te.category),
"item_condition" : np.array(x_te.item_condition_id),
"shipping" : np.array(x_te[["shipping"]]),
"desc_len" : np.array(x_te[["desc_len"]]),
"name_len" : np.array(x_te[["name_len"]]),
"subcat_0" : np.array(x_te.subcat_0),
"subcat_1" : np.array(x_te.subcat_1),
"subcat_2" : np.array(x_te.subcat_2),
}
```

In [0]:

```
x_tr = x_train_padded
x_te = x_test_padded
```

In [0]:

```
# defining Model :
# inputs
from keras.layers import LSTM, GRU
from keras.layers import Conv1D, GlobalMaxPooling1D
from keras.layers import concatenate, BatchNormalization
from keras import optimizers

name = Input(shape=[x_tr["name"].shape[1]], name="name")
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc")
brand_name =Input(shape=[1], name="brand_name")
item_condition =Input(shape=[1], name="item_condition")
num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
# Embedding Layers
name_emb = Embedding(max_len, 15)(name)
item_desc_emb = Embedding(max_len, 80)(item_desc)
brand_emb = Embedding(max_len_brand, 10)(brand_name)
item_cond_emb = Embedding(max_len_condition, 5)(item_condition)
desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

lstm_layer1 = GRU(16) (item_desc_emb)
lstm_layer2 = LSTM(8) (name_emb)
#Flattening
flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_3 = Flatten() (desc_len_emb)
flat_4 = Flatten() (name_len_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)

# Concat
main_l = concatenate([flat_1,flat_2,flat_3,flat_4,flat_5,flat_6,flat_7,lstm_layer1,lstm
_layer2, num_vars])
#Dense Layers
main_l = Dropout(0.1)(Dense(256,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))
#Compile
output = Dense(1, activation="linear") (main_l)
model_2 = Model([name, item_desc, brand_name , item_condition, num_vars, desc_len, name
_len, subcat_0, subcat_1, subcat_2], output)
optimizer = optimizers.Adam(lr= 0.005)
model_2.compile(loss = 'mse', optimizer = optimizer)
model_2.summary()
```

```
Model: "model_2"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
desc_len (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
name_len (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 80)           0
__________________________________________________________________________________________________
name (InputLayer)               (None, 15)           0
__________________________________________________________________________________________________
embedding_12 (Embedding)        (None, 1, 10)        1155760     brand_name[0][0]
__________________________________________________________________________________________________
embedding_13 (Embedding)        (None, 1, 5)         25          item_condition[0][0]
__________________________________________________________________________________________________
embedding_14 (Embedding)        (None, 1, 5)         1225        desc_len[0][0]
__________________________________________________________________________________________________
embedding_15 (Embedding)        (None, 1, 5)         85          name_len[0][0]
__________________________________________________________________________________________________
embedding_16 (Embedding)        (None, 1, 10)        110         subcat_0[0][0]
__________________________________________________________________________________________________
embedding_17 (Embedding)        (None, 1, 10)        1140        subcat_1[0][0]
__________________________________________________________________________________________________
embedding_18 (Embedding)        (None, 1, 10)        8710        subcat_2[0][0]
__________________________________________________________________________________________________
```

```
__________________________
embedding_11 (Embedding)        (None, 80, 80)       20435360    item_desc
[0][0]
__________________________________________________________________________
__________________________
embedding_10 (Embedding)        (None, 15, 15)       3831630     name[0]
[0]
__________________________________________________________________________
__________________________
flatten_8 (Flatten)             (None, 10)           0           embedding
_12[0][0]
__________________________________________________________________________
__________________________
flatten_9 (Flatten)             (None, 5)            0           embedding
_13[0][0]
__________________________________________________________________________
__________________________
flatten_10 (Flatten)            (None, 5)            0           embedding
_14[0][0]
__________________________________________________________________________
__________________________
flatten_11 (Flatten)            (None, 5)            0           embedding
_15[0][0]
__________________________________________________________________________
__________________________
flatten_12 (Flatten)            (None, 10)           0           embedding
_16[0][0]
__________________________________________________________________________
__________________________
flatten_13 (Flatten)            (None, 10)           0           embedding
_17[0][0]
__________________________________________________________________________
__________________________
flatten_14 (Flatten)            (None, 10)           0           embedding
_18[0][0]
__________________________________________________________________________
__________________________
gru_2 (GRU)                     (None, 16)           4656        embedding
_11[0][0]
__________________________________________________________________________
__________________________
lstm_2 (LSTM)                   (None, 8)            768         embedding
_10[0][0]
__________________________________________________________________________
__________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________
__________________________
concatenate_2 (Concatenate)     (None, 80)           0           flatten_8
[0][0]
                                                                 flatten_9
[0][0]
                                                                 flatten_1
0[0][0]
                                                                 flatten_1
1[0][0]
                                                                 flatten_1
2[0][0]
                                                                 flatten_1
3[0][0]
                                                                 flatten_1
```

```
4[0][0]
                                                                 gru_2[0]
[0]
                                                                 lstm_2[0]
[0]
                                                                 shipping
[0][0]
__________________________________________________________________________
_____________________________
dense_6 (Dense)                 (None, 256)          20736       concatena
te_2[0][0]
__________________________________________________________________________
_____________________________
dropout_3 (Dropout)             (None, 256)          0           dense_6
[0][0]
__________________________________________________________________________
_____________________________
dense_7 (Dense)                 (None, 128)          32896       dropout_3
[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_3 (BatchNor (None, 128)          512         dense_7
[0][0]
__________________________________________________________________________
_____________________________
dense_8 (Dense)                 (None, 64)           8256        batch_nor
malization_3[0][0]
__________________________________________________________________________
_____________________________
dropout_4 (Dropout)             (None, 64)           0           dense_8
[0][0]
__________________________________________________________________________
_____________________________
dense_9 (Dense)                 (None, 32)           2080        dropout_4
[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_4 (BatchNor (None, 32)           128         dense_9
[0][0]
__________________________________________________________________________
_____________________________
dense_10 (Dense)                (None, 1)            33          batch_nor
malization_4[0][0]
==========================================================================
========================
Total params: 25,504,110
Trainable params: 25,503,790
Non-trainable params: 320
__________________________________________________________________________
_____________________________
```

In [0]:

```
epochs = 3
# Create model and fit it with training dataset.
model_2.fit(x_tr, Y_train, epochs = epochs, batch_size = 512 * 3)
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "


Epoch 1/3
1432350/1432350 [==============================] - 168s 117us/step - loss:
0.4629
Epoch 2/3
1432350/1432350 [==============================] - 164s 115us/step - loss:
0.1556
Epoch 3/3
1432350/1432350 [==============================] - 164s 114us/step - loss:
0.1291
```

Out[0]:

```
<keras.callbacks.callbacks.History at 0x7f4ef092e160>
```

In [0]:

```
y_pred = model_2.predict(x_te, batch_size=batch_size)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.4249679056655569
```

Experimenting With Cnn's

In [0]:

```
# Importing train data.
print("Importing Train Data...")
train = pd.read_table('/content/drive/My Drive/train.tsv')
print("Shape of Train data :",train.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(train.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 5.
train = train.drop(train[(train.price < 5.0)].index)
train.shape
# Getting Length of each text in name and item_description.
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
train['name_len'] = train['name'].apply(lambda x: word_count(x))
train.head()
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(train.loc[train["brand_name"] == 'missing'])
#premissing
print(missing)
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print(detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
train["target"] = np.log1p(train.price)
```

```
Importing Train Data...
Shape of Train data : (1482535, 8)
Checking for any null values..
train_id             False
name                 False
item_condition_id    False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Performing Preprocessing and Feature engineering...
607593
125239
Electronics/Computers & Tablets/Components & Parts
```

In [0]:

```
from sklearn.preprocessing import LabelEncoder
import numpy as np


class LabelEncoderExt(object):
    def __init__(self):
        """
        It differs from LabelEncoder by handling new classes and providing a value for
 it [Unknown]
        Unknown will be added in fit and transform will take care of new item. It gives
unknown class id
        """
        self.label_encoder = LabelEncoder()
        # self.classes_ = self.label_encoder.classes_

    def fit(self, data_list):
        """
        This will fit the encoder for all the unique values and introduce unknown value
        :param data_list: A list of string
        :return: self
        """
        self.label_encoder = self.label_encoder.fit(list(data_list) + ['Unknown'])
        self.classes_ = self.label_encoder.classes_

        return self

    def transform(self, data_list):
        """
        This will transform the data_list to id list where the new values get assigned
 to Unknown class
        :param data_list:
        :return:
        """
        new_data_list = list(data_list)
        for unique_item in np.unique(data_list):
            if unique_item not in self.label_encoder.classes_:
                new_data_list = ['Unknown' if x==unique_item else x for x in new_data_l
ist]

        return self.label_encoder.transform(new_data_list)
```

In [0]:

```
# Encoding Categorical Features.
label = LabelEncoderExt()
label.fit(train.category_name) # categories united
train['category'] = label.transform(train.category_name)

label.fit(train.brand_name) # brand name
train.brand_name = label.transform(train.brand_name)

label.fit(train.subcat_0) # sub_cat0
train.subcat_0 = label.transform(train.subcat_0)

label.fit(train.subcat_1) # sub_cat_1
train.subcat_1 = label.transform(train.subcat_1)

label.fit(train.subcat_2) # sub_cat2
train.subcat_2 = label.transform(train.subcat_2)

del label
```

In [0]:

```
# Text to Sequence Data.
# Combining columns, item_description, name, category_name.
full_text = np.hstack([train.item_description.str.lower(), train.name.str.lower(), trai
n.category_name.str.lower()])

# Tokenizing on combined columns.
tokenizer = Tokenizer()
tokenizer.fit_on_texts(full_text)

train['seq_desc'] = tokenizer.texts_to_sequences(train.item_description.str.lower())
train['seq_name'] = tokenizer.texts_to_sequences(train.name.str.lower())
```

In [0]:

```
max_len_brand = np.max(train.brand_name.max())    # brand
max_len_condition = np.max(int(max(train.item_condition_id)))  # item_cond
max_len_desc = np.max(int(train.desc_len.max()))  # item_desc_len
max_len_name = np.max(int(train.name_len.max()))  # name_len
max_len_sub0 = np.max(int(train.subcat_0.max()))  # Sub_0
max_len_sub1 = np.max(int(train.subcat_1.max()))  # Sub_1
max_len_sub2 = np.max(train.subcat_2.max())  # Sub_2
# Defining max length for Padding Text Data.
name_padding = 15
description_padding = 80
max_len = np.max([np.max(train.seq_name.max()),np.max(train.seq_desc.max()),])
```

In [0]:

```
# Train and Test Split.
x_tr, x_te = train_test_split(train, random_state=123, train_size=0.99)
Y_train = x_tr.target.values.reshape(-1, 1)
Y_test = x_te.target.values.reshape(-1, 1)
```

In [0]:

```
# Padding Name :
x_train_padded = {
"name" : pad_sequences(x_tr.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_tr.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_tr.brand_name),
"category" :np.array(x_tr.category),
"item_condition" : np.array(x_tr.item_condition_id),
"shipping" : np.array(x_tr[["shipping"]]),
"desc_len" : np.array(x_tr[["desc_len"]]),
"name_len" : np.array(x_tr[["name_len"]]),
"subcat_0" : np.array(x_tr.subcat_0),
"subcat_1"  : np.array(x_tr.subcat_1),
"subcat_2" : np.array(x_tr.subcat_2),
}
x_test_padded = {
"name" : pad_sequences(x_te.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_te.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_te.brand_name),
"category" : np.array(x_te.category),
"item_condition" : np.array(x_te.item_condition_id),
"shipping" : np.array(x_te[["shipping"]]),
"desc_len" : np.array(x_te[["desc_len"]]),
"name_len" : np.array(x_te[["name_len"]]),
"subcat_0" : np.array(x_te.subcat_0),
"subcat_1" : np.array(x_te.subcat_1),
"subcat_2" : np.array(x_te.subcat_2),
}
```

In [0]:

```
x_tr = x_train_padded
x_te = x_test_padded
```

In [0]:

```
batch_size = 512 * 3
epochs = 2
exp_decay = lambda init, fin, steps: (init/fin)**(1/(steps-1)) - 1
steps = int(len(x_tr['name']) / batch_size) * epochs
lr_init, lr_fin = 0.005, 0.001
lr_decay = exp_decay(lr_init, lr_fin, steps)
```

In [0]:

```
len(x_tr['name'])/batch_size* 2
```

Out[0]:

```
1865.0390625
```

In [0]:

```
lr_decay
```

Out[0]:

```
0.0008642690853521984
```

In [0]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name = Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]
```

In [0]:

```
sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 15)(name)
item_desc_emb = Embedding(max_len, 80)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
```

In [0]:

```
convs1 = []
convs2 = []
for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)
```

In [0]:

```
convs1 = concatenate(convs1)
convs2 = concatenate(convs2)
```

In [0]:

```
flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)
```

In [0]:

```
main_l = concatenate([flat_1,flat_2,flat_5,flat_6,flat_7,convs1,convs2, num_vars ])
```

In [0]:

```
main_l = Dropout(0.1)(Dense(256,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))
```

In [0]:

```
output = Dense(1, activation="linear") (main_l)

model_2 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, subca
t_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005)
model_2.compile(loss = 'mse', optimizer = optimizer)

model_2.summary()
```

```
Model: "model_2"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 15)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 80)           0
__________________________________________________________________________________________________
embedding_6 (Embedding)         (None, 15, 15)       3831630     name[0][0]
__________________________________________________________________________________________________
embedding_7 (Embedding)         (None, 80, 80)       20435360    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
conv1d_3 (Conv1D)               (None, 15, 50)       800         embedding_6[0][0]
__________________________________________________________________________________________________
conv1d_5 (Conv1D)               (None, 15, 50)       1550        embedding_6[0][0]
__________________________________________________________________________________________________
conv1d_4 (Conv1D)               (None, 80, 50)       4050        embedding_7[0][0]
__________________________________________________________________________________________________
conv1d_6 (Conv1D)               (None, 80, 50)       8050        embedding_7[0][0]
__________________________________________________________________________________________________
embedding_4 (Embedding)         (None, 1, 10)        1155760     brand_name[0][0]
__________________________________________________________________________________________________
embedding_5 (Embedding)         (None, 1, 5)         25          item_condition[0][0]
__________________________________________________________________________________________________
embedding_1 (Embedding)         (None, 1, 10)        110         subcat_0
```

```
[0][0]
__________________________________________________________________________________________________
__________________________
embedding_2 (Embedding)         (None, 1, 10)        1140        subcat_1
[0][0]
__________________________________________________________________________________________________
__________________________
embedding_3 (Embedding)         (None, 1, 10)        8710        subcat_2
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_1 (GlobalM (None, 50)           0           conv1d_3
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_3 (GlobalM (None, 50)           0           conv1d_5
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_2 (GlobalM (None, 50)           0           conv1d_4
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_4 (GlobalM (None, 50)           0           conv1d_6
[0][0]
__________________________________________________________________________________________________
__________________________
flatten_1 (Flatten)             (None, 10)           0           embedding
_4[0][0]
__________________________________________________________________________________________________
__________________________
flatten_2 (Flatten)             (None, 5)            0           embedding
_5[0][0]
__________________________________________________________________________________________________
__________________________
flatten_3 (Flatten)             (None, 10)           0           embedding
_1[0][0]
__________________________________________________________________________________________________
__________________________
flatten_4 (Flatten)             (None, 10)           0           embedding
_2[0][0]
__________________________________________________________________________________________________
__________________________
flatten_5 (Flatten)             (None, 10)           0           embedding
_3[0][0]
__________________________________________________________________________________________________
__________________________
concatenate_1 (Concatenate)     (None, 100)          0           global_ma
x_pooling1d_1[0][0]
                                                                 global_ma
x_pooling1d_3[0][0]
__________________________________________________________________________________________________
__________________________
concatenate_2 (Concatenate)     (None, 100)          0           global_ma
x_pooling1d_2[0][0]
                                                                 global_ma
x_pooling1d_4[0][0]
__________________________________________________________________________________________________
__________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
```

```
__________________________
concatenate_3 (Concatenate)     (None, 246)          0           flatten_1
[0][0]
                                                                 flatten_2
[0][0]
                                                                 flatten_3
[0][0]
                                                                 flatten_4
[0][0]
                                                                 flatten_5
[0][0]
                                                                 concatena
te_1[0][0]
                                                                 concatena
te_2[0][0]
                                                                 shipping
[0][0]
__________________________________________________________________________
__________________________
dense_1 (Dense)                 (None, 256)          63232       concatena
te_3[0][0]
__________________________________________________________________________
__________________________
dropout_1 (Dropout)             (None, 256)          0           dense_1
[0][0]
__________________________________________________________________________
__________________________
dense_2 (Dense)                 (None, 256)          65792       dropout_1
[0][0]
__________________________________________________________________________
__________________________
dropout_2 (Dropout)             (None, 256)          0           dense_2
[0][0]
__________________________________________________________________________
__________________________
dense_3 (Dense)                 (None, 128)          32896       dropout_2
[0][0]
__________________________________________________________________________
__________________________
batch_normalization_1 (BatchNor (None, 128)          512         dense_3
[0][0]
__________________________________________________________________________
__________________________
dense_4 (Dense)                 (None, 64)           8256        batch_nor
malization_1[0][0]
__________________________________________________________________________
__________________________
dropout_3 (Dropout)             (None, 64)           0           dense_4
[0][0]
__________________________________________________________________________
__________________________
dense_5 (Dense)                 (None, 32)           2080        dropout_3
[0][0]
__________________________________________________________________________
__________________________
batch_normalization_2 (BatchNor (None, 32)           128         dense_5
[0][0]
__________________________________________________________________________
__________________________
dense_7 (Dense)                 (None, 1)            33          batch_nor
malization_2[0][0]
```

```
=================================================================
=======================
Total params: 25,620,114
Trainable params: 25,619,794
Non-trainable params: 320
_________________________________________________________________
_________________________
```

In [0]:

```
model_2.fit(x_tr, Y_train, epochs= 2 , batch_size= 512 * 3)
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "

Epoch 1/2
1432350/1432350 [==============================] - 80s 56us/step - loss:
0.4585
Epoch 2/2
1432350/1432350 [==============================] - 73s 51us/step - loss:
0.1629
```

Out[0]:

```
<keras.callbacks.callbacks.History at 0x7fe86c4f6c18>
```

In [0]:

```
y_pred = model_2.predict(x_te, batch_size=batch_size)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.42633457644517353
```

TESTING ON TEST DATA:

In [0]:

```
# Importing train data.
print("Importing Train Data...")
train = pd.read_table('/content/drive/My Drive/train.tsv')
print("Shape of Train data :",train.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(train.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 3.
train = train.drop(train[(train.price < 5.0)].index)
train.shape
# Getting Length of each text in name and item_description.
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
train['name_len'] = train['name'].apply(lambda x: word_count(x))
train.head()
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(train.loc[train["brand_name"] == 'missing'])
#premissing
print(missing)
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print(detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
train["target"] = np.log1p(train.price)
```

```
Importing Train Data...
Shape of Train data : (1482535, 8)
Checking for any null values..
train_id             False
name                 False
item_condition_id    False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Performing Preprocessing and Feature engineering...
607593
125239
Electronics/Computers & Tablets/Components & Parts
```

In [0]:

```
# Importing Test data.
print("Importing Test Data...")
test = pd.read_table('/content/drive/My Drive/test.tsv')
print("Shape of Train data :",test.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(test.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 3.
test.shape
# Getting Length of each text in name and item_description.
test['desc_len'] = test['item_description'].apply(lambda x: word_count(x))
test['name_len'] = test['name'].apply(lambda x: word_count(x))
test.head()
# Subdiving category.
test["subcat_0"] = cat_split_test("category_name",0)
test["subcat_1"] = cat_split_test("category_name",1)
test["subcat_2"] = cat_split_test("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(test['brand_name'].values) # Get all the brands.
test.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(test.loc[test["brand_name"] == 'missing'])
#premissing
print(missing)
test['brand_name'] = test[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(test.loc[test['brand_name'] == 'missing'])
print(detected_brands)
test = fill_missing_values(test)
print(test.category_name[1])
```

```
Importing Test Data...
Shape of Train data : (693359, 7)
Checking for any null values..
test_id              False
name                 False
item_condition_id    False
category_name         True
brand_name            True
shipping             False
item_description     False
dtype: bool
Performing Preprocessing and Feature engineering...
295525
59695
Other/Office supplies/Shipping Supplies
```

In [0]:

```
# https://stackoverflow.com/a/56876351
from sklearn.preprocessing import LabelEncoder
import numpy as np


class LabelEncoderExt(object):
    def __init__(self):
        """
        It differs from LabelEncoder by handling new classes and providing a value for
 it [Unknown]
        Unknown will be added in fit and transform will take care of new item. It gives
unknown class id
        """
        self.label_encoder = LabelEncoder()
        # self.classes_ = self.label_encoder.classes_

    def fit(self, data_list):
        """
        This will fit the encoder for all the unique values and introduce unknown value
        :param data_list: A list of string
        :return: self
        """
        self.label_encoder = self.label_encoder.fit(list(data_list) + ['Unknown'])
        self.classes_ = self.label_encoder.classes_

        return self

    def transform(self, data_list):
        """
        This will transform the data_list to id list where the new values get assigned
 to Unknown class
        :param data_list:
        :return:
        """
        new_data_list = list(data_list)
        for unique_item in np.unique(data_list):
            if unique_item not in self.label_encoder.classes_:
                new_data_list = ['Unknown' if x==unique_item else x for x in new_data_l
ist]

        return self.label_encoder.transform(new_data_list)
```

In [0]:

```
# We Convert all the data columns in the form of strings.
train['brand_name'] = train['brand_name'].fillna('missing').astype(str)
test['brand_name'] = test['brand_name'].fillna('missing').astype(str)


label = LabelEncoderExt()
label.fit(np.hstack([train.brand_name, test.brand_name]))
train['brand_name'] = label.transform(train.brand_name)
test['brand_name'] = label.transform(test.brand_name)
del label
```

In [0]:

```
# Encoding Categorical Features.
label = LabelEncoderExt()
label.fit(np.hstack([train.category_name, test.category_name])) # categories united

train['category'] = label.transform(train.category_name)
test['category'] = label.transform(test.category_name)

label.fit(np.hstack([train.subcat_0, test.subcat_0])) # sub_cat0
train.subcat_0 = label.transform(train.subcat_0)
test.subcat_0 = label.transform(test.subcat_0)

label.fit(np.hstack([train.subcat_1, test.subcat_1])) # sub_cat_1
train.subcat_1 = label.transform(train.subcat_1)
test.subcat_1 = label.transform(test.subcat_1)

label.fit(np.hstack([train.subcat_2, test.subcat_2])) # sub_cat2
train.subcat_2 = label.transform(train.subcat_2)
test.subcat_2 = label.transform(test.subcat_2)
del label
```

In [0]:

```
# Text to Sequence Data.
# Combining columns, item_description, name, category_name.
full_text = np.hstack([train.item_description.str.lower(), train.name.str.lower(), trai
n.category_name.str.lower()])

# Tokenizing on combined columns.
tokenizer = Tokenizer()
tokenizer.fit_on_texts(full_text)

train['seq_desc'] = tokenizer.texts_to_sequences(train.item_description.str.lower())
test['seq_desc'] = tokenizer.texts_to_sequences(test.item_description.str.lower())

train['seq_name'] = tokenizer.texts_to_sequences(train.name.str.lower())
test['seq_name'] = tokenizer.texts_to_sequences(test.name.str.lower())
```

In [0]:

```
# max length for Categorical Data.
max_len_brand =  np.max([train.brand_name.max(), test.brand_name.max()])  # brand # bra
nd
max_len_condition = np.max([max(train.item_condition_id), max(test.item_condition_id)])
# item_cond
max_len_desc = np.max([int(train.desc_len.max()), int(test.desc_len.max())])  # item_de
sc_len
max_len_name = np.max([int(train.name_len.max()), int(test.name_len.max())])  # name_le
n
max_len_sub0 = np.max([int(train.subcat_0.max()), int(train.subcat_0.max())])  # Sub_0
max_len_sub1 = np.max([int(train.subcat_1.max()), int(train.subcat_1.max())])  # Sub_1
max_len_sub2 = np.max([train.subcat_2.max(), train.subcat_2.max()])  # Sub_2
# Defining max length for Padding Text Data.
name_padding = 15
description_padding = 80
max_len = np.max([np.max(train.seq_name.max()),np.max(train.seq_desc.max()),np.max(test
.seq_name.max()),np.max(test.seq_desc.max())])
```

In [0]:

```
# Train and Test Split.
x_tr, x_te = train_test_split(train, random_state=123, train_size=0.99)
Y_train = x_tr.target.values.reshape(-1, 1)
Y_test = x_te.target.values.reshape(-1, 1)
```

In [0]:

```
# Padding Name :
x_train_padded = {
"name" : pad_sequences(x_tr.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_tr.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_tr.brand_name),
"category" :np.array(x_tr.category),
"item_condition" : np.array(x_tr.item_condition_id),
"shipping" : np.array(x_tr[["shipping"]]),
"desc_len" : np.array(x_tr[["desc_len"]]),
"name_len" : np.array(x_tr[["name_len"]]),
"subcat_0" : np.array(x_tr.subcat_0),
"subcat_1"  : np.array(x_tr.subcat_1),
"subcat_2" : np.array(x_tr.subcat_2),
}

x_test_padded = {
"name" : pad_sequences(x_te.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_te.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_te.brand_name),
"category" : np.array(x_te.category),
"item_condition" : np.array(x_te.item_condition_id),
"shipping" : np.array(x_te[["shipping"]]),
"desc_len" : np.array(x_te[["desc_len"]]),
"name_len" : np.array(x_te[["name_len"]]),
"subcat_0" : np.array(x_te.subcat_0),
"subcat_1" : np.array(x_te.subcat_1),
"subcat_2" : np.array(x_te.subcat_2),
}


te_data = {
"name" : pad_sequences(test.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(test.seq_desc, maxlen= description_padding),
"brand_name" : np.array(test.brand_name),
"category" : np.array(test.category),
"item_condition" : np.array(test.item_condition_id),
"shipping" : np.array(test[["shipping"]]),
"desc_len" : np.array(test[["desc_len"]]),
"name_len" : np.array(test[["name_len"]]),
"subcat_0" : np.array(test.subcat_0),
"subcat_1" : np.array(test.subcat_1),
"subcat_2" : np.array(test.subcat_2),
}
```

In [0]:

```
x_tr = x_train_padded
x_te = x_test_padded
X_test = te_data
```

In [0]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name =Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]

sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 15)(name)
item_desc_emb = Embedding(max_len, 80)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)



convs1 = []
convs2 = []
for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)

convs1 = concatenate(convs1)
convs2 = concatenate(convs2)

flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)

main_l = concatenate([flat_1,flat_2,flat_5,flat_6,flat_7,convs1,convs2, num_vars ])

main_l = Dropout(0.1)(Dense(256,kernel_initializer='normal',activation='relu') (main_l
))
```

```
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))


output = Dense(1, activation="linear") (main_l)

model_2 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, subca
t_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005 )
model_2.compile(loss = 'mse', optimizer = optimizer)

model_2.summary()
```

```
Model: "model_8"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 15)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 80)           0
__________________________________________________________________________________________________
embedding_71 (Embedding)        (None, 15, 15)       3831630     name[0][0]
__________________________________________________________________________________________________
embedding_72 (Embedding)        (None, 80, 80)       20435360    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
conv1d_29 (Conv1D)              (None, 15, 50)       800         embedding_71[0][0]
__________________________________________________________________________________________________
conv1d_31 (Conv1D)              (None, 15, 50)       1550        embedding_71[0][0]
__________________________________________________________________________________________________
conv1d_30 (Conv1D)              (None, 80, 50)       4050        embedding_72[0][0]
__________________________________________________________________________________________________
conv1d_32 (Conv1D)              (None, 80, 50)       8050        embedding_72[0][0]
__________________________________________________________________________________________________
embedding_69 (Embedding)        (None, 1, 10)        1654600     brand_name[0][0]
__________________________________________________________________________________________________
embedding_70 (Embedding)        (None, 1, 5)         25          item_condition[0][0]
__________________________________________________________________________________________________
embedding_66 (Embedding)        (None, 1, 10)        110         subcat_0
```

```
[0][0]
__________________________________________________________________________________________________
__________________________
embedding_67 (Embedding)        (None, 1, 10)        1140        subcat_1
[0][0]
__________________________________________________________________________________________________
__________________________
embedding_68 (Embedding)        (None, 1, 10)        8830        subcat_2
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_29 (Global (None, 50)           0           conv1d_29
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_31 (Global (None, 50)           0           conv1d_31
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_30 (Global (None, 50)           0           conv1d_30
[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_32 (Global (None, 50)           0           conv1d_32
[0][0]
__________________________________________________________________________________________________
__________________________
flatten_36 (Flatten)            (None, 10)           0           embedding
_69[0][0]
__________________________________________________________________________________________________
__________________________
flatten_37 (Flatten)            (None, 5)            0           embedding
_70[0][0]
__________________________________________________________________________________________________
__________________________
flatten_38 (Flatten)            (None, 10)           0           embedding
_66[0][0]
__________________________________________________________________________________________________
__________________________
flatten_39 (Flatten)            (None, 10)           0           embedding
_67[0][0]
__________________________________________________________________________________________________
__________________________
flatten_40 (Flatten)            (None, 10)           0           embedding
_68[0][0]
__________________________________________________________________________________________________
__________________________
concatenate_22 (Concatenate)    (None, 100)          0           global_ma
x_pooling1d_29[0][0]
                                                                 global_ma
x_pooling1d_31[0][0]
__________________________________________________________________________________________________
__________________________
concatenate_23 (Concatenate)    (None, 100)          0           global_ma
x_pooling1d_30[0][0]
                                                                 global_ma
x_pooling1d_32[0][0]
__________________________________________________________________________________________________
__________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
```

```
__________________________
concatenate_24 (Concatenate)    (None, 246)          0           flatten_3
6[0][0]
                                                                 flatten_3
7[0][0]
                                                                 flatten_3
8[0][0]
                                                                 flatten_3
9[0][0]
                                                                 flatten_4
0[0][0]
                                                                 concatena
te_22[0][0]
                                                                 concatena
te_23[0][0]
                                                                 shipping
[0][0]
__________________________________________________________________________
__________________________
dense_36 (Dense)                (None, 256)          63232       concatena
te_24[0][0]
__________________________________________________________________________
__________________________
dropout_15 (Dropout)            (None, 256)          0           dense_36
[0][0]
__________________________________________________________________________
__________________________
dense_37 (Dense)                (None, 128)          32896       dropout_1
5[0][0]
__________________________________________________________________________
__________________________
batch_normalization_15 (BatchNo (None, 128)          512         dense_37
[0][0]
__________________________________________________________________________
__________________________
dense_38 (Dense)                (None, 64)           8256        batch_nor
malization_15[0][0]
__________________________________________________________________________
__________________________
dropout_16 (Dropout)            (None, 64)           0           dense_38
[0][0]
__________________________________________________________________________
__________________________
dense_39 (Dense)                (None, 32)           2080        dropout_1
6[0][0]
__________________________________________________________________________
__________________________
batch_normalization_16 (BatchNo (None, 32)           128         dense_39
[0][0]
__________________________________________________________________________
__________________________
dense_40 (Dense)                (None, 1)            33          batch_nor
malization_16[0][0]
==========================================================================
========================
Total params: 26,053,282
Trainable params: 26,052,962
Non-trainable params: 320
__________________________________________________________________________
__________________________
```

In [0]:

```
# Create model and fit it with training dataset.
model_2.fit(x_tr, Y_train, epochs= 2 , batch_size= 512 * 3, validation_data = (x_te, Y_
test), verbose=1)
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "

Train on 1432350 samples, validate on 14469 samples
Epoch 1/2
1432350/1432350 [==============================] - 76s 53us/step - loss:
0.4525 - val_loss: 0.1941
Epoch 2/2
1432350/1432350 [==============================] - 73s 51us/step - loss:
0.1627 - val_loss: 0.1894
```

Out[0]:

```
<keras.callbacks.callbacks.History at 0x7f8cbf593fd0>
```

In [0]:

```
y_pred = model_2.predict(x_te, batch_size=512*3)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.43519362249805893
```

In [0]:

```
#CREATE PREDICTIONS
preds = model_2.predict(X_test, batch_size = 512*3)

test_pred = np.expm1(preds)

submission = pd.DataFrame(test[["test_id"]])
submission["price"] = test_pred
```

In [0]:

```
submission.head()
```

Out[0]:

	test_id	price
0	0	7.189877
1	1	11.437581
2	2	42.248737
3	3	12.605415
4	4	8.467966

Ensembles With Stacking

1. Ridge Cv
2. SVR
3. XGBOOST REG
4. RF REG
5. SGD REG
6. LIGHT GBM REG

In [0]:

```
# Import Train Data.
print("Importing Train Data:")
train = pd.read_table('train.tsv')
print("Shape of Train Data:", train.shape)
print("Checking For NaN in the data...")
print(train.isnull().any())
print("Removing rows which has price value less than 5")
# Removing Lower Prices which are less than 5. As Majority of the prices range above 5
train = train.drop(train[(train.price < 5.0)].index)
print("Computing Word Count of item_description")
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
print("Computing Word Count of name")
train['name_len'] = train['name'].apply(lambda x: word_count(x))
print("Splitting category_name to sub categories")
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
print("Performing Feature Engineering and preprocessing :")
# Filling All the NAN rows of brand name with text "missing"
# Get all the vocabulary of all the words in the column Brand.
print("Filling Missing values in the Brand name...")
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
# Total Count with rows "missing"
missing = len(train.loc[train["brand_name"] == 'missing'])
print("Total Missing Values:", missing)
# Filling Missing values in the brand_name.
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
# Checking number of detected brand names from name column.
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print("Total Detected brand names :",detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
print("Verifying Null Values in the data :", train.isnull().any())
print("Converting Columns to Strings : ")
# We Convert all the data columns in the form of strings.
train['category_name'] = train['category_name'].fillna('missing').astype(str)
train['subcat_0'] = train['subcat_0'].astype(str)
train['subcat_1'] = train['subcat_1'].astype(str)
train['subcat_2'] = train['subcat_2'].astype(str)
train['brand_name'] = train['brand_name'].fillna('missing').astype(str)
train['shipping'] = train['shipping'].astype(str)
train['item_condition_id'] = train['item_condition_id'].astype(str)
train['desc_len'] = train['desc_len'].astype(str)
train['name_len'] = train['name_len'].astype(str)
train['item_description'] = train['item_description'].fillna('No description yet').asty
pe(str)
print("Natural Logarithm on Price...")
train["target"] = np.log1p(train.price)
```

```
Importing Train Data:
Shape of Train Data: (1482535, 8)
Checking For NaN in the data...
train_id             False
name                 False
item_condition_id    False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Removing rows which has price value less than 5
Computing Word Count of item_description
Computing Word Count of name
Splitting category_name to sub categories
Performing Feature Engineering and preprocessing :
Filling Missing values in the Brand name...
Total Missing Values: 607593
Total Detected brand names : 125239
Electronics/Computers & Tablets/Components & Parts
Verifying Null Values in the data : train_id             False
name                 False
item_condition_id    False
category_name        False
brand_name           False
price                False
shipping             False
item_description     False
desc_len             False
name_len             False
subcat_0             False
subcat_1             False
subcat_2             False
dtype: bool
Converting Columns to Strings :
Natural Logarithm on Price...
```

In [0]:

```
# Train and Test Split:
x_train, x_test = train_test_split(train, random_state=123, train_size=0.99)
print(x_train.shape)
print(x_test.shape)
Y_train = x_train.target.values.reshape(-1, 1)
Y_test = x_test.target.values.reshape(-1,1)
```

```
(1432350, 14)
(14469, 14)
```

In [0]:

```
# Vectorizing Data.
# https://towardsdatascience.com/hacking-scikit-learns-vectorizers-9ef26a7170af
#https://www.kaggle.com/valkling/mercari-rnn-2ridge-models-with-notes-0-42755
# https://blog.usejournal.com/featureunion-a-time-saver-when-building-a-machine-learning-model-d0ad7a90f215

default_preprocessor = CountVectorizer().build_preprocessor() # a callable function that preprocesses the text data.

def build_preprocessor(colum, ):
  # We are preprocessing each columns
    column_index = list(train.columns).index(colum) # Returns the Index of a specific Column.
    return lambda x: default_preprocessor(x[column_index])

# stack tfidf and count vectorize for all the columns.
vectorizer = FeatureUnion([
    ('name', CountVectorizer(ngram_range=(1, 2),max_features=5000,preprocessor = build_preprocessor('name'))),

    ('subcat_0', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_0'))),

    ('subcat_1', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_1'))),

    ('subcat_2', CountVectorizer(token_pattern = '.+',preprocessor = build_preprocessor('subcat_2'))),

    ('brand_name', CountVectorizer(token_pattern ='.+',preprocessor = build_preprocessor('brand_name'))),

    ('shipping', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('shipping'))),

    ('item_condition_id', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('item_condition_id'))),

    ('desc_len', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('desc_len'))),

    ('name_len', CountVectorizer(token_pattern = '\d+',preprocessor = build_preprocessor('name_len'))),

    ('item_description', TfidfVectorizer(ngram_range = (1, 3),max_features = 10000,preprocessor = build_preprocessor('item_description'))),
])
```

In [0]:

```
# Fitting Vectorizer.
vectorizer.fit(x_train.values)
# Transforming Train and Test.
x = vectorizer.transform(x_train.values)
x_t = vectorizer.transform(x_test.values)
print(x.shape,x_t.shape)
X_train = x
X_test = x_t
```

```
(1432350, 127408) (14469, 127408)
```

Ensemble :Stacking

In [0]:

```
pip install xgboost
```

```
Requirement already satisfied: xgboost in /opt/conda/lib/python3.7/site-pa
ckages (1.0.2)
Requirement already satisfied: scipy in /opt/conda/lib/python3.7/site-pack
ages (from xgboost) (1.4.1)
Requirement already satisfied: numpy in /opt/conda/lib/python3.7/site-pack
ages (from xgboost) (1.18.1)
Note: you may need to restart the kernel to use updated packages.
```

In [0]:

```
pip install mlxtend
```

```
Requirement already satisfied: mlxtend in /opt/conda/lib/python3.7/site-pa
ckages (0.17.2)
Requirement already satisfied: scikit-learn>=0.20.3 in /opt/conda/lib/pyth
on3.7/site-packages (from mlxtend) (0.22.2.post1)
Requirement already satisfied: scipy>=1.2.1 in /opt/conda/lib/python3.7/si
te-packages (from mlxtend) (1.4.1)
Requirement already satisfied: joblib>=0.13.2 in /opt/conda/lib/python3.7/
site-packages (from mlxtend) (0.14.1)
Requirement already satisfied: matplotlib>=3.0.0 in /opt/conda/lib/python
3.7/site-packages (from mlxtend) (3.2.0)
Requirement already satisfied: setuptools in /opt/conda/lib/python3.7/site
-packages (from mlxtend) (46.0.0.post20200311)
Requirement already satisfied: numpy>=1.16.2 in /opt/conda/lib/python3.7/s
ite-packages (from mlxtend) (1.18.1)
Requirement already satisfied: pandas>=0.24.2 in /opt/conda/lib/python3.7/
site-packages (from mlxtend) (1.0.1)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
/opt/conda/lib/python3.7/site-packages (from matplotlib>=3.0.0->mlxtend)
(2.4.6)
Requirement already satisfied: kiwisolver>=1.0.1 in /opt/conda/lib/python
3.7/site-packages (from matplotlib>=3.0.0->mlxtend) (1.1.0)
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.7/si
te-packages (from matplotlib>=3.0.0->mlxtend) (0.10.0)
Requirement already satisfied: python-dateutil>=2.1 in /opt/conda/lib/pyth
on3.7/site-packages (from matplotlib>=3.0.0->mlxtend) (2.8.1)
Requirement already satisfied: pytz>=2017.2 in /opt/conda/lib/python3.7/si
te-packages (from pandas>=0.24.2->mlxtend) (2019.3)
Requirement already satisfied: six in /opt/conda/lib/python3.7/site-packag
es (from cycler>=0.10->matplotlib>=3.0.0->mlxtend) (1.14.0)
Note: you may need to restart the kernel to use updated packages.
```

In [0]:

```
# Ridge Cv, XGBOOST REG, RF REG, SGD REG,LIGHT GBM REG.

# Model 1 ridge reg cv
import xgboost as xgb
import lightgbm as lgb
from mlxtend.regressor import StackingRegressor
from sklearn import linear_model

model_1 = RidgeCV()
model_2 = RandomForestRegressor()
model_3 = linear_model.SGDRegressor()
model_4 = xgb.XGBRegressor()
model_5 = lgb.LGBMRegressor()

stregr = StackingRegressor(regressors=[model_1, model_2, model_3, model_4, model_5], me
ta_regressor = model_1)
stregr.fit(X_train, Y_train)
```

```
/opt/conda/lib/python3.7/site-packages/mlxtend/regressor/stacking_regressi
on.py:148: DataConversionWarning: A column-vector y was passed when a 1d a
rray was expected. Please change the shape of y to (n_samples,), for examp
le using ravel().
  regr.fit(X, y)
/opt/conda/lib/python3.7/site-packages/sklearn/utils/validation.py:760: Da
taConversionWarning: A column-vector y was passed when a 1d array was expe
cted. Please change the shape of y to (n_samples, ), for example using rav
el().
  y = column_or_1d(y, warn=True)
```

Out[0]:

```
StackingRegressor(meta_regressor=RidgeCV(alphas=array([ 0.1,  1. , 10. ]),
                                         cv=None, fit_intercept=True,
                                         gcv_mode=None, normalize=False,
                                         scoring=None, store_cv_values=Fal
se),
                  refit=True,
                  regressors=[RidgeCV(alphas=array([ 0.1,  1. , 10. ]), cv
=None,
                                      fit_intercept=True, gcv_mode=None,
                                      normalize=False, scoring=None,
                                      store_cv_values=False),
                              RandomForestRegressor(bootstrap=True,
                                                    c...
                                                 importance_type='split',
                                                 learning_rate=0.1, max_depth=-
1,
                                                 min_child_samples=20,
                                                 min_child_weight=0.001,
                                                 min_split_gain=0.0,
                                                 n_estimators=100, n_jobs=-1,
                                                 num_leaves=31, objective=None,
                                                 random_state=None, reg_alpha=
0.0,
                                                 reg_lambda=0.0, silent=True,
                                                 subsample=1.0,
                                                 subsample_for_bin=200000,
                                                 subsample_freq=0)],
                  store_train_meta_features=False,
                  use_features_in_secondary=False, verbose=0)
```

In [0]:

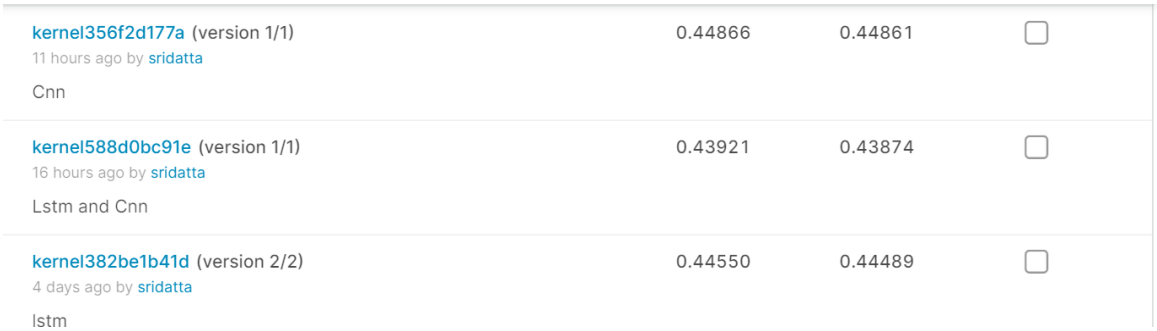
```
y_pred = stregr.predict(X_test)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.5250966580972255
```

In [0]:

```
from PIL import Image
jpgfile = Image.open("/content/all_scores.PNG")
jpgfile
```

Out[0]:



Implement CNN and LSTM:

In [4]:

```
# Importing train data.
print("Importing Train Data...")
train = pd.read_table('/content/drive/My Drive/train.tsv')
print("Shape of Train data :",train.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(train.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 3.
train = train.drop(train[(train.price < 5.0)].index)
train.shape
# Getting Length of each text in name and item_description.
train['desc_len'] = train['item_description'].apply(lambda x: word_count(x))
train['name_len'] = train['name'].apply(lambda x: word_count(x))
train.head()
# Subdiving category.
train["subcat_0"] = cat_split("category_name",0)
train["subcat_1"] = cat_split("category_name",1)
train["subcat_2"] = cat_split("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(train['brand_name'].values) # Get all the brands.
train.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(train.loc[train["brand_name"] == 'missing'])
#premissing
print(missing)
train['brand_name'] = train[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(train.loc[train['brand_name'] == 'missing'])
print(detected_brands)
train = fill_missing_values(train)
print(train.category_name[1])
train["target"] = np.log1p(train.price)
train["combined_text"] = train["item_description"] + " " + train["name"]
```

```
Importing Train Data...
Shape of Train data : (1482535, 8)
Checking for any null values..
train_id             False
name                 False
item_condition_id     False
category_name         True
brand_name            True
price                False
shipping             False
item_description      True
dtype: bool
Performing Preprocessing and Feature engineering...
607593
125239
Electronics/Computers & Tablets/Components & Parts
```

In [5]:

```
# Importing Test data.
print("Importing Test Data...")
test = pd.read_table('/content/drive/My Drive/test.tsv')
print("Shape of Train data :",test.shape)
# Checking for NaN in the data.
print("Checking for any null values..")
print(test.isnull().any())
print("Performing Preprocessing and Feature engineering...")
# Removing Lower Prices which are less than 3.
test.shape
# Getting Length of each text in name and item_description.
test['desc_len'] = test['item_description'].apply(lambda x: word_count(x))
test['name_len'] = test['name'].apply(lambda x: word_count(x))
test.head()
# Subdiving category.
test["subcat_0"] = cat_split_test("category_name",0)
test["subcat_1"] = cat_split_test("category_name",1)
test["subcat_2"] = cat_split_test("category_name",2)
# Filling All the NAN rows of brand name with text "missing"
brand_vocab = set(test['brand_name'].values) # Get all the brands.
test.brand_name.fillna(value = "missing", inplace = True)
#all_brands
missing = len(test.loc[test["brand_name"] == 'missing'])
#premissing
print(missing)
test['brand_name'] = test[['brand_name','name']].apply(finding_brand, axis = 1)
detected_brands = missing-len(test.loc[test['brand_name'] == 'missing'])
print(detected_brands)
test = fill_missing_values(test)
print(test.category_name[1])
test["combined_text"] = test["item_description"] + " " + test["name"]
```

```
Importing Test Data...
Shape of Train data : (693359, 7)
Checking for any null values..
test_id              False
name                 False
item_condition_id    False
category_name         True
brand_name            True
shipping             False
item_description     False
dtype: bool
Performing Preprocessing and Feature engineering...
295525
59695
Other/Office supplies/Shipping Supplies
```

In [0]:

```
# https://stackoverflow.com/a/56876351
from sklearn.preprocessing import LabelEncoder
import numpy as np


class LabelEncoderExt(object):
    def __init__(self):
        """
        It differs from LabelEncoder by handling new classes and providing a value for
 it [Unknown]
        Unknown will be added in fit and transform will take care of new item. It gives
unknown class id
        """
        self.label_encoder = LabelEncoder()
        # self.classes_ = self.label_encoder.classes_

    def fit(self, data_list):
        """
        This will fit the encoder for all the unique values and introduce unknown value
        :param data_list: A list of string
        :return: self
        """
        self.label_encoder = self.label_encoder.fit(list(data_list) + ['Unknown'])
        self.classes_ = self.label_encoder.classes_

        return self

    def transform(self, data_list):
        """
        This will transform the data_list to id list where the new values get assigned
 to Unknown class
        :param data_list:
        :return:
        """
        new_data_list = list(data_list)
        for unique_item in np.unique(data_list):
            if unique_item not in self.label_encoder.classes_:
                new_data_list = ['Unknown' if x==unique_item else x for x in new_data_l
ist]

        return self.label_encoder.transform(new_data_list)
```

In [0]:

```
# We Convert all the data columns in the form of strings.
train['brand_name'] = train['brand_name'].fillna('missing').astype(str)
test['brand_name'] = test['brand_name'].fillna('missing').astype(str)


label = LabelEncoderExt()
label.fit(np.hstack([train.brand_name, test.brand_name]))
train['brand_name'] = label.transform(train.brand_name)
test['brand_name'] = label.transform(test.brand_name)
del label
```

In [0]:

```
# Encoding Categorical Features.
label = LabelEncoderExt()
label.fit(np.hstack([train.category_name, test.category_name])) # categories united

train['category'] = label.transform(train.category_name)
test['category'] = label.transform(test.category_name)

label.fit(np.hstack([train.subcat_0, test.subcat_0])) # sub_cat0
train.subcat_0 = label.transform(train.subcat_0)
test.subcat_0 = label.transform(test.subcat_0)

label.fit(np.hstack([train.subcat_1, test.subcat_1])) # sub_cat_1
train.subcat_1 = label.transform(train.subcat_1)
test.subcat_1 = label.transform(test.subcat_1)

label.fit(np.hstack([train.subcat_2, test.subcat_2])) # sub_cat2
train.subcat_2 = label.transform(train.subcat_2)
test.subcat_2 = label.transform(test.subcat_2)
del label
```

In [0]:

```
# Text to Sequence Data.
# Combining columns, item_description, name, category_name.
full_text = np.hstack([train.item_description.str.lower(), train.name.str.lower(), trai
n.category_name.str.lower()])

# Tokenizing on combined columns.
tokenizer = Tokenizer()
tokenizer.fit_on_texts(full_text)

train["seq_combined"] = tokenizer.texts_to_sequences(train.combined_text.str.lower())
test["seq_combined"] = tokenizer.texts_to_sequences(test.combined_text.str.lower())

train['seq_desc'] = tokenizer.texts_to_sequences(train.item_description.str.lower())
test['seq_desc'] = tokenizer.texts_to_sequences(test.item_description.str.lower())

train['seq_name'] = tokenizer.texts_to_sequences(train.name.str.lower())
test['seq_name'] = tokenizer.texts_to_sequences(test.name.str.lower())
```

In [0]:

```
# max length for Categorical Data.
#max_len_cat = np.max(train.category.max()) + 1 # category
max_len_combined = np.max([max(train.seq_combined.max()), max(test.seq_combined.max
())]) + 1
max_len_brand =  np.max([train.brand_name.max(), test.brand_name.max()]) + 1   # brand
 # brand
max_len_condition = np.max([max(train.item_condition_id), max(test.item_condition_id)])
+ 1  # item_cond
max_len_desc = np.max([int(train.desc_len.max()), int(test.desc_len.max())]) + 1  # ite
m_desc_len
max_len_name = np.max([int(train.name_len.max()), int(test.name_len.max())]) + 1 # name
_len
max_len_sub0 = np.max([int(train.subcat_0.max()), int(train.subcat_0.max())])  + 1# Sub
_0
max_len_sub1 = np.max([int(train.subcat_1.max()), int(train.subcat_1.max())]) + 1 # Sub
_1
max_len_sub2 = np.max([train.subcat_2.max(), train.subcat_2.max()]) + 1  # Sub_2
# Defining max length for Padding Text Data.
name_padding = 10
description_padding = 70
combined_padding  =  70
max_len = np.max([np.max(train.seq_name.max()),np.max(train.seq_desc.max()),np.max(test
.seq_name.max()),np.max(test.seq_desc.max())]) + 1
```

In [0]:

```
# Train and Test Split.
x_tr, x_te = train_test_split(train, random_state=123, train_size=0.99)
Y_train = x_tr.target.values.reshape(-1, 1)
Y_test = x_te.target.values.reshape(-1, 1)
```

In [0]:

```
# Padding Name :
x_train_padded = {
"name" : pad_sequences(x_tr.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_tr.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_tr.brand_name),
"category" :np.array(x_tr.category),
"item_condition" : np.array(x_tr.item_condition_id),
"shipping" : np.array(x_tr[["shipping"]]),
"desc_len" : np.array(x_tr[["desc_len"]]),
"name_len" : np.array(x_tr[["name_len"]]),
"subcat_0" : np.array(x_tr.subcat_0),
"subcat_1"  : np.array(x_tr.subcat_1),
"subcat_2" : np.array(x_tr.subcat_2),
"combined_text" : pad_sequences(x_tr.seq_combined, maxlen= combined_padding)
}

x_test_padded = {
"name" : pad_sequences(x_te.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(x_te.seq_desc, maxlen= description_padding),
"brand_name" : np.array(x_te.brand_name),
"category" : np.array(x_te.category),
"item_condition" : np.array(x_te.item_condition_id),
"shipping" : np.array(x_te[["shipping"]]),
"desc_len" : np.array(x_te[["desc_len"]]),
"name_len" : np.array(x_te[["name_len"]]),
"subcat_0" : np.array(x_te.subcat_0),
"subcat_1" : np.array(x_te.subcat_1),
"subcat_2" : np.array(x_te.subcat_2),
"combined_text" : pad_sequences(x_te.seq_combined, maxlen= combined_padding)
}


te_data = {
"name" : pad_sequences(test.seq_name, maxlen= name_padding),
"item_desc" : pad_sequences(test.seq_desc, maxlen= description_padding),
"brand_name" : np.array(test.brand_name),
"category" : np.array(test.category),
"item_condition" : np.array(test.item_condition_id),
"shipping" : np.array(test[["shipping"]]),
"desc_len" : np.array(test[["desc_len"]]),
"name_len" : np.array(test[["name_len"]]),
"subcat_0" : np.array(test.subcat_0),
"subcat_1" : np.array(test.subcat_1),
"subcat_2" : np.array(test.subcat_2),
"combined_text" : pad_sequences(test.seq_combined, maxlen= combined_padding)
}
```

In [0]:

```
x_tr = x_train_padded
x_te = x_test_padded
X_test = te_data
```

MODEL:1 CNN, LSTM

In [0]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name =Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]
combined_text = Input(shape=[x_tr["combined_text"].shape[1]], name="combined_text")

sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 10)(name)
item_desc_emb = Embedding(max_len, 70)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
combined_len_emb  = Embedding(max_len_combined, 80)(combined_text)

# Defining Lstm Layer for combined Text Data.
gru_layer = GRU(64) (combined_len_emb)
lstm_layer = LSTM(16) (brand_emb)

convs1 = []
convs2 = []

for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)

convs1 = concatenate(convs1)
convs2 = concatenate(convs2)

#flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)
```

```
main_l = concatenate([lstm_layer, flat_2, flat_5, flat_6, flat_7,gru_layer, convs1, con
vs2,num_vars])

main_l = Dropout(0.1)(Dense(192,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))

# Set hyper parameters for the model.
BATCH_SIZE = 512 * 3
epochs = 2

output = Dense(1, activation="linear") (main_l)

model_1 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, combi
ned_text,  subcat_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005 )
model_1.compile(loss = 'mse', optimizer = optimizer)

model_1.summary()
```

```
Model: "model_2"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 10)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 70)           0
__________________________________________________________________________________________________
embedding_16 (Embedding)        (None, 10, 10)       2554430     name[0][0]
__________________________________________________________________________________________________
embedding_17 (Embedding)        (None, 70, 70)       17881010    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
combined_text (InputLayer)      (None, 70)           0
__________________________________________________________________________________________________
conv1d_5 (Conv1D)               (None, 10, 50)       550         embedding_16[0][0]
__________________________________________________________________________________________________
conv1d_7 (Conv1D)               (None, 10, 50)       1050        embedding_16[0][0]
__________________________________________________________________________________________________
conv1d_6 (Conv1D)               (None, 70, 50)       3550        embedding_17[0][0]
__________________________________________________________________________________________________
conv1d_8 (Conv1D)               (None, 70, 50)       7050        embedding_17[0][0]
__________________________________________________________________________________________________
embedding_14 (Embedding)        (None, 1, 10)        1654610     brand_name[0][0]
__________________________________________________________________________________________________
embedding_15 (Embedding)        (None, 1, 5)         30          item_condition[0][0]
```

```
__________________________________________________________________________________________________
_____________________________
embedding_11 (Embedding)        (None, 1, 10)        120         subcat_
0[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_12 (Embedding)        (None, 1, 10)        1150        subcat_
1[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_13 (Embedding)        (None, 1, 10)        8840        subcat_
2[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_20 (Embedding)        (None, 70, 80)       20420000    combine
d_text[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_5 (GlobalM (None, 50)           0           conv1d_
5[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_7 (GlobalM (None, 50)           0           conv1d_
7[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_6 (GlobalM (None, 50)           0           conv1d_
6[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_8 (GlobalM (None, 50)           0           conv1d_
8[0][0]
__________________________________________________________________________________________________
_____________________________
lstm_2 (LSTM)                   (None, 16)           1728        embeddi
ng_14[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_5 (Flatten)             (None, 5)            0           embeddi
ng_15[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_6 (Flatten)             (None, 10)           0           embeddi
ng_11[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_7 (Flatten)             (None, 10)           0           embeddi
ng_12[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_8 (Flatten)             (None, 10)           0           embeddi
ng_13[0][0]
__________________________________________________________________________________________________
_____________________________
gru_2 (GRU)                     (None, 64)           27840       embeddi
ng_20[0][0]
__________________________________________________________________________________________________
_____________________________
concatenate_4 (Concatenate)     (None, 100)          0           global_
max_pooling1d_5[0][0]
                                                                 global_
```

```
max_pooling1d_7[0][0]
__________________________________________________________________________________________________
concatenate_5 (Concatenate)     (None, 100)          0           global_
max_pooling1d_6[0][0]
                                                                 global_
max_pooling1d_8[0][0]
__________________________________________________________________________________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
concatenate_6 (Concatenate)     (None, 316)          0           lstm_2
[0][0]
                                                                 flatten
_5[0][0]
                                                                 flatten
_6[0][0]
                                                                 flatten
_7[0][0]
                                                                 flatten
_8[0][0]
                                                                 gru_2
[0][0]
                                                                 concate
nate_4[0][0]
                                                                 concate
nate_5[0][0]
                                                                 shippin
g[0][0]
__________________________________________________________________________________________________
dense_6 (Dense)                 (None, 192)          60864       concate
nate_6[0][0]
__________________________________________________________________________________________________
dropout_3 (Dropout)             (None, 192)          0           dense_6
[0][0]
__________________________________________________________________________________________________
dense_7 (Dense)                 (None, 128)          24704       dropout
_3[0][0]
__________________________________________________________________________________________________
batch_normalization_3 (BatchNor (None, 128)          512         dense_7
[0][0]
__________________________________________________________________________________________________
dense_8 (Dense)                 (None, 64)           8256        batch_n
ormalization_3[0][0]
__________________________________________________________________________________________________
dropout_4 (Dropout)             (None, 64)           0           dense_8
[0][0]
__________________________________________________________________________________________________
dense_9 (Dense)                 (None, 32)           2080        dropout
_4[0][0]
__________________________________________________________________________________________________
batch_normalization_4 (BatchNor (None, 32)           128         dense_9
```

```
[0][0]
__________________________________________________________________________
__________________________
dense_10 (Dense)                (None, 1)            33          batch_n
ormalization_4[0][0]
==========================================================================
==========================
Total params: 42,658,535
Trainable params: 42,658,215
Non-trainable params: 320
__________________________________________________________________________
__________________________
```

In [0]:

```
# Create model and fit it with training dataset.
model_1.fit(x_tr, Y_train, epochs= 2 , batch_size= 512 * 3, validation_data = (x_te, Y_
test), verbose=1)
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "

Train on 1432350 samples, validate on 14469 samples
Epoch 1/2
1432350/1432350 [==============================] - 308s 215us/step - loss:
0.4426 - val_loss: 0.1814
Epoch 2/2
1432350/1432350 [==============================] - 306s 214us/step - loss:
0.1506 - val_loss: 0.1756
```

Out[0]:

```
<keras.callbacks.callbacks.History at 0x7f8dbe630e80>
```

In [0]:

```
y_pred = model_2.predict(x_te, batch_size=512 * 3)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.4190950766502912
```

In [0]:

```
#CREATE PREDICTIONS
preds = model_2.predict(X_test, batch_size = 512*3)

test_pred = np.expm1(preds)

submission = pd.DataFrame(test[["test_id"]])
submission["price"] = test_pred
```

In [0]:

```
submission.head()
```

Out[0]:

	test_id	price
0	0	8.729796
1	1	9.420729
2	2	60.822071
3	3	13.915297
4	4	8.166396

Model 2: CNN, LSTM with Early Stopping (Patience = 3)

In [14]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name =Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]
combined_text = Input(shape=[x_tr["combined_text"].shape[1]], name="combined_text")

sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 10)(name)
item_desc_emb = Embedding(max_len, 70)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
combined_len_emb  = Embedding(max_len_combined, 80)(combined_text)

# Defining Lstm Layer for combined Text Data.
gru_layer = GRU(64) (combined_len_emb)
lstm_layer = LSTM(16) (brand_emb)

convs1 = []
convs2 = []

for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)

convs1 = concatenate(convs1)
convs2 = concatenate(convs2)

#flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)
```

```
main_l = concatenate([lstm_layer, flat_2, flat_5, flat_6, flat_7,gru_layer, convs1, con
vs2,num_vars])

main_l = Dropout(0.1)(Dense(192,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))

# Set hyper parameters for the model.
BATCH_SIZE = 512 * 3
epochs = 2

output = Dense(1, activation="linear") (main_l)

model_2 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, combi
ned_text,  subcat_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005 )
model_2.compile(loss = 'mse', optimizer = optimizer)

model_2.summary()
```

```
Model: "model_1"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 10)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 70)           0
__________________________________________________________________________________________________
embedding_6 (Embedding)         (None, 10, 10)       2554430     name[0][0]
__________________________________________________________________________________________________
embedding_7 (Embedding)         (None, 70, 70)       17881010    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
combined_text (InputLayer)      (None, 70)           0
__________________________________________________________________________________________________
conv1d_1 (Conv1D)               (None, 10, 50)       550         embedding_6[0][0]
__________________________________________________________________________________________________
conv1d_3 (Conv1D)               (None, 10, 50)       1050        embedding_6[0][0]
__________________________________________________________________________________________________
conv1d_2 (Conv1D)               (None, 70, 50)       3550        embedding_7[0][0]
__________________________________________________________________________________________________
conv1d_4 (Conv1D)               (None, 70, 50)       7050        embedding_7[0][0]
__________________________________________________________________________________________________
embedding_4 (Embedding)         (None, 1, 10)        1654610     brand_name[0][0]
__________________________________________________________________________________________________
embedding_5 (Embedding)         (None, 1, 5)         30          item_condition[0][0]
```

```
__________________________________________________________________________________________________
__________________________
embedding_1 (Embedding)         (None, 1, 10)        120         subcat_
0[0][0]
__________________________________________________________________________________________________
__________________________
embedding_2 (Embedding)         (None, 1, 10)        1150        subcat_
1[0][0]
__________________________________________________________________________________________________
__________________________
embedding_3 (Embedding)         (None, 1, 10)        8840        subcat_
2[0][0]
__________________________________________________________________________________________________
__________________________
embedding_10 (Embedding)        (None, 70, 80)       20420000    combine
d_text[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_1 (GlobalM (None, 50)           0           conv1d_
1[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_3 (GlobalM (None, 50)           0           conv1d_
3[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_2 (GlobalM (None, 50)           0           conv1d_
2[0][0]
__________________________________________________________________________________________________
__________________________
global_max_pooling1d_4 (GlobalM (None, 50)           0           conv1d_
4[0][0]
__________________________________________________________________________________________________
__________________________
lstm_1 (LSTM)                   (None, 16)           1728        embeddi
ng_4[0][0]
__________________________________________________________________________________________________
__________________________
flatten_1 (Flatten)             (None, 5)            0           embeddi
ng_5[0][0]
__________________________________________________________________________________________________
__________________________
flatten_2 (Flatten)             (None, 10)           0           embeddi
ng_1[0][0]
__________________________________________________________________________________________________
__________________________
flatten_3 (Flatten)             (None, 10)           0           embeddi
ng_2[0][0]
__________________________________________________________________________________________________
__________________________
flatten_4 (Flatten)             (None, 10)           0           embeddi
ng_3[0][0]
__________________________________________________________________________________________________
__________________________
gru_1 (GRU)                     (None, 64)           27840       embeddi
ng_10[0][0]
__________________________________________________________________________________________________
__________________________
concatenate_1 (Concatenate)     (None, 100)          0           global_
max_pooling1d_1[0][0]
                                                                 global_
```

```
max_pooling1d_3[0][0]
__________________________________________________________________________________________________
concatenate_2 (Concatenate)     (None, 100)          0           global_
max_pooling1d_2[0][0]
                                                                 global_
max_pooling1d_4[0][0]
__________________________________________________________________________________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
concatenate_3 (Concatenate)     (None, 316)          0           lstm_1
[0][0]
                                                                 flatten
_1[0][0]
                                                                 flatten
_2[0][0]
                                                                 flatten
_3[0][0]
                                                                 flatten
_4[0][0]
                                                                 gru_1
[0][0]
                                                                 concate
nate_1[0][0]
                                                                 concate
nate_2[0][0]
                                                                 shippin
g[0][0]
__________________________________________________________________________________________________
dense_1 (Dense)                 (None, 192)          60864       concate
nate_3[0][0]
__________________________________________________________________________________________________
dropout_1 (Dropout)             (None, 192)          0           dense_1
[0][0]
__________________________________________________________________________________________________
dense_2 (Dense)                 (None, 128)          24704       dropout
_1[0][0]
__________________________________________________________________________________________________
batch_normalization_1 (BatchNor (None, 128)          512         dense_2
[0][0]
__________________________________________________________________________________________________
dense_3 (Dense)                 (None, 64)           8256        batch_n
ormalization_1[0][0]
__________________________________________________________________________________________________
dropout_2 (Dropout)             (None, 64)           0           dense_3
[0][0]
__________________________________________________________________________________________________
dense_4 (Dense)                 (None, 32)           2080        dropout
_2[0][0]
__________________________________________________________________________________________________
batch_normalization_2 (BatchNor (None, 32)           128         dense_4
```

```
[0][0]
__________________________________________________________________________________
_____________________________
dense_5 (Dense)                 (None, 1)            33          batch_n
ormalization_2[0][0]
==================================================================================
==========================
Total params: 42,658,535
Trainable params: 42,658,215
Non-trainable params: 320
__________________________________________________________________________________
_____________________________
```

In [0]:

```
# Create model and fit it with training dataset.
from keras.callbacks import EarlyStopping
earlyStop=EarlyStopping(monitor="val_loss",verbose=1, mode='min', patience = 3)
model_2.fit(x_tr, Y_train, epochs= 60 , batch_size= 512 * 3, validation_data = (x_te, Y
_test), verbose=1, callbacks = [earlyStop])
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "

Train on 1432350 samples, validate on 14469 samples
Epoch 1/60
1432350/1432350 [==============================] - 264s 184us/step - loss:
0.4421 - val_loss: 0.1803
Epoch 2/60
1432350/1432350 [==============================] - 261s 182us/step - loss:
0.1513 - val_loss: 0.1722
Epoch 3/60
1432350/1432350 [==============================] - 261s 182us/step - loss:
0.1194 - val_loss: 0.1733
Epoch 4/60
1432350/1432350 [==============================] - 257s 179us/step - loss:
0.0997 - val_loss: 0.1702
Epoch 5/60
1432350/1432350 [==============================] - 257s 179us/step - loss:
0.0862 - val_loss: 0.1739
Epoch 6/60
1432350/1432350 [==============================] - 259s 181us/step - loss:
0.0766 - val_loss: 0.1753
Epoch 7/60
1432350/1432350 [==============================] - 260s 182us/step - loss:
0.0692 - val_loss: 0.1819
Epoch 00007: early stopping
```

Out[0]:

```
<keras.callbacks.callbacks.History at 0x7f972048b5f8>
```

In [0]:

```
y_pred = model_2.predict(x_te, batch_size=512 * 3)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.426543858000284
```

Model 3: CNN, LSTM, Early Stopping (Patience = 5)

In [15]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name =Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]
combined_text = Input(shape=[x_tr["combined_text"].shape[1]], name="combined_text")

sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 10)(name)
item_desc_emb = Embedding(max_len, 70)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
combined_len_emb  = Embedding(max_len_combined, 80)(combined_text)

# Defining Lstm Layer for combined Text Data.
gru_layer = GRU(64) (combined_len_emb)
lstm_layer = LSTM(16) (brand_emb)

convs1 = []
convs2 = []

for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)

convs1 = concatenate(convs1)
convs2 = concatenate(convs2)

#flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)
```

```
main_l = concatenate([lstm_layer, flat_2, flat_5, flat_6, flat_7,gru_layer, convs1, con
vs2,num_vars])

main_l = Dropout(0.1)(Dense(192,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))

# Set hyper parameters for the model.
BATCH_SIZE = 512 * 3
epochs = 2

output = Dense(1, activation="linear") (main_l)

model_3 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, combi
ned_text,  subcat_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005 )
model_3.compile(loss = 'mse', optimizer = optimizer)

model_3.summary()
```

```
Model: "model_2"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 10)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 70)           0
__________________________________________________________________________________________________
embedding_16 (Embedding)        (None, 10, 10)       2554430     name[0][0]
__________________________________________________________________________________________________
embedding_17 (Embedding)        (None, 70, 70)       17881010    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
combined_text (InputLayer)      (None, 70)           0
__________________________________________________________________________________________________
conv1d_5 (Conv1D)               (None, 10, 50)       550         embedding_16[0][0]
__________________________________________________________________________________________________
conv1d_7 (Conv1D)               (None, 10, 50)       1050        embedding_16[0][0]
__________________________________________________________________________________________________
conv1d_6 (Conv1D)               (None, 70, 50)       3550        embedding_17[0][0]
__________________________________________________________________________________________________
conv1d_8 (Conv1D)               (None, 70, 50)       7050        embedding_17[0][0]
__________________________________________________________________________________________________
embedding_14 (Embedding)        (None, 1, 10)        1654610     brand_name[0][0]
__________________________________________________________________________________________________
embedding_15 (Embedding)        (None, 1, 5)         30          item_condition[0][0]
```

```
__________________________________________________________________________________________________
_____________________________
embedding_11 (Embedding)        (None, 1, 10)        120         subcat_
0[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_12 (Embedding)        (None, 1, 10)        1150        subcat_
1[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_13 (Embedding)        (None, 1, 10)        8840        subcat_
2[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_20 (Embedding)        (None, 70, 80)       20420000    combine
d_text[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_5 (GlobalM (None, 50)           0           conv1d_
5[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_7 (GlobalM (None, 50)           0           conv1d_
7[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_6 (GlobalM (None, 50)           0           conv1d_
6[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_8 (GlobalM (None, 50)           0           conv1d_
8[0][0]
__________________________________________________________________________________________________
_____________________________
lstm_2 (LSTM)                   (None, 16)           1728        embeddi
ng_14[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_5 (Flatten)             (None, 5)            0           embeddi
ng_15[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_6 (Flatten)             (None, 10)           0           embeddi
ng_11[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_7 (Flatten)             (None, 10)           0           embeddi
ng_12[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_8 (Flatten)             (None, 10)           0           embeddi
ng_13[0][0]
__________________________________________________________________________________________________
_____________________________
gru_2 (GRU)                     (None, 64)           27840       embeddi
ng_20[0][0]
__________________________________________________________________________________________________
_____________________________
concatenate_4 (Concatenate)     (None, 100)          0           global_
max_pooling1d_5[0][0]
                                                                 global_
```

```
max_pooling1d_7[0][0]
__________________________________________________________________________________________________
concatenate_5 (Concatenate)     (None, 100)          0           global_
max_pooling1d_6[0][0]
                                                                 global_
max_pooling1d_8[0][0]
__________________________________________________________________________________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
concatenate_6 (Concatenate)     (None, 316)          0           lstm_2
[0][0]
                                                                 flatten
_5[0][0]
                                                                 flatten
_6[0][0]
                                                                 flatten
_7[0][0]
                                                                 flatten
_8[0][0]
                                                                 gru_2
[0][0]
                                                                 concate
nate_4[0][0]
                                                                 concate
nate_5[0][0]
                                                                 shippin
g[0][0]
__________________________________________________________________________________________________
dense_6 (Dense)                 (None, 192)          60864       concate
nate_6[0][0]
__________________________________________________________________________________________________
dropout_3 (Dropout)             (None, 192)          0           dense_6
[0][0]
__________________________________________________________________________________________________
dense_7 (Dense)                 (None, 128)          24704       dropout
_3[0][0]
__________________________________________________________________________________________________
batch_normalization_3 (BatchNor (None, 128)          512         dense_7
[0][0]
__________________________________________________________________________________________________
dense_8 (Dense)                 (None, 64)           8256        batch_n
ormalization_3[0][0]
__________________________________________________________________________________________________
dropout_4 (Dropout)             (None, 64)           0           dense_8
[0][0]
__________________________________________________________________________________________________
dense_9 (Dense)                 (None, 32)           2080        dropout
_4[0][0]
__________________________________________________________________________________________________
batch_normalization_4 (BatchNor (None, 32)           128         dense_9
```

```
[0][0]
__________________________________________________________________________________
_________________________
dense_10 (Dense)                (None, 1)            33          batch_n
ormalization_4[0][0]
==================================================================================
==========================
Total params: 42,658,535
Trainable params: 42,658,215
Non-trainable params: 320
__________________________________________________________________________________
_________________________
```

In [16]:

```
# Create model and fit it with training dataset.
from keras.callbacks import EarlyStopping
earlyStop=EarlyStopping(monitor="val_loss",verbose=1, mode='min', patience = 5)
model_3.fit(x_tr, Y_train, epochs= 60 , batch_size= 512 * 3, validation_data = (x_te, Y
_test), verbose=1, callbacks = [earlyStop])
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "

Train on 1432350 samples, validate on 14469 samples
Epoch 1/60
1432350/1432350 [==============================] - 260s 182us/step - loss:
0.4368 - val_loss: 0.1841
Epoch 2/60
1432350/1432350 [==============================] - 251s 175us/step - loss:
0.1519 - val_loss: 0.1774
Epoch 3/60
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.1236 - val_loss: 0.1757
Epoch 4/60
1432350/1432350 [==============================] - 250s 174us/step - loss:
0.1063 - val_loss: 0.1790
Epoch 5/60
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0944 - val_loss: 0.1740
Epoch 6/60
1432350/1432350 [==============================] - 247s 173us/step - loss:
0.0854 - val_loss: 0.1746
Epoch 7/60
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0782 - val_loss: 0.1772
Epoch 8/60
1432350/1432350 [==============================] - 249s 174us/step - loss:
0.0721 - val_loss: 0.1757
Epoch 9/60
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.0677 - val_loss: 0.1818
Epoch 10/60
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.0630 - val_loss: 0.1784
Epoch 00010: early stopping
```

Out[16]:

```
<keras.callbacks.callbacks.History at 0x7f945de00f98>
```

In [17]:

```
y_pred = model_3.predict(x_te, batch_size=512 * 3)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.4223680902635731
```

Model 4: CNN, LSTM Running for 20 Epochs

In [18]:

```
# Definign Inputs.
subcat_0 = Input(shape=[1], name="subcat_0")
subcat_1 = Input(shape=[1], name="subcat_1")
subcat_2 = Input(shape=[1], name="subcat_2")
desc_len = Input(shape=[1], name="desc_len")
name_len = Input(shape=[1], name="name_len")

brand_name =Input(shape=[1], name="brand_name")

num_vars = Input(shape=[x_tr["shipping"].shape[1]], name="shipping")

item_condition = Input(shape=[1], name="item_condition")

name = Input(shape=[x_tr["name"].shape[1]], name="name") # 15 shape = [15]
item_desc = Input(shape=[x_tr["item_desc"].shape[1]], name="item_desc") # 80 shape = [8
0]
combined_text = Input(shape=[x_tr["combined_text"].shape[1]], name="combined_text")

sub0_emb = Embedding(max_len_sub0, 10)(subcat_0)
sub1_emb = Embedding(max_len_sub1, 10)(subcat_1)
sub2_emb = Embedding(max_len_sub2, 10)(subcat_2)

brand_emb = Embedding(max_len_brand, 10)(brand_name)

item_cond_emb = Embedding(max_len_condition, 5)(item_condition)

name_emb = Embedding(max_len, 10)(name)
item_desc_emb = Embedding(max_len, 70)(item_desc)

desc_len_emb = Embedding(max_len_desc, 5)(desc_len)
name_len_emb = Embedding(max_len_name, 5)(name_len)
combined_len_emb  = Embedding(max_len_combined, 80)(combined_text)

# Defining Lstm Layer for combined Text Data.
gru_layer = GRU(64) (combined_len_emb)
lstm_layer = LSTM(16) (brand_emb)

convs1 = []
convs2 = []

for filter_length in [1,2]:
  cnn_layer1 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (name_emb)
  cnn_layer2 = Conv1D(filters=50, kernel_size=filter_length, padding='same', activation
='relu', strides=1) (item_desc_emb)
  maxpool1 = GlobalMaxPooling1D() (cnn_layer1)
  maxpool2 = GlobalMaxPooling1D() (cnn_layer2)
  convs1.append(maxpool1)
  convs2.append(maxpool2)

convs1 = concatenate(convs1)
convs2 = concatenate(convs2)

#flat_1 = Flatten() (brand_emb)
flat_2 = Flatten() (item_cond_emb)
flat_5 = Flatten() (sub0_emb)
flat_6 = Flatten() (sub1_emb)
flat_7 = Flatten() (sub2_emb)
```

```
main_l = concatenate([lstm_layer, flat_2, flat_5, flat_6, flat_7,gru_layer, convs1, con
vs2,num_vars])

main_l = Dropout(0.1)(Dense(192,kernel_initializer='normal',activation='relu') (main_l
))
main_l = BatchNormalization()(Dense(128,kernel_initializer='normal',activation='relu')
(main_l))
main_l = Dropout(0.1)(Dense(64,kernel_initializer='normal',activation='relu') (main_l))
main_l = BatchNormalization()(Dense(32,kernel_initializer='normal',activation='relu') (
main_l))

# Set hyper parameters for the model.
BATCH_SIZE = 512 * 3
epochs = 2

output = Dense(1, activation="linear") (main_l)

model_4 = Model([name, item_desc, brand_name , desc_len,name_len, item_condition, combi
ned_text,  subcat_0, subcat_1, subcat_2, num_vars ], output)

optimizer = optimizers.Adam(lr = 0.005 )
model_4.compile(loss = 'mse', optimizer = optimizer)

model_4.summary()
```

```
Model: "model_3"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
name (InputLayer)               (None, 10)           0
__________________________________________________________________________________________________
item_desc (InputLayer)          (None, 70)           0
__________________________________________________________________________________________________
embedding_26 (Embedding)        (None, 10, 10)       2554430     name[0][0]
__________________________________________________________________________________________________
embedding_27 (Embedding)        (None, 70, 70)       17881010    item_desc[0][0]
__________________________________________________________________________________________________
brand_name (InputLayer)         (None, 1)            0
__________________________________________________________________________________________________
item_condition (InputLayer)     (None, 1)            0
__________________________________________________________________________________________________
subcat_0 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_1 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
subcat_2 (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
combined_text (InputLayer)      (None, 70)           0
__________________________________________________________________________________________________
conv1d_9 (Conv1D)               (None, 10, 50)       550         embedding_26[0][0]
__________________________________________________________________________________________________
conv1d_11 (Conv1D)              (None, 10, 50)       1050        embedding_26[0][0]
__________________________________________________________________________________________________
conv1d_10 (Conv1D)              (None, 70, 50)       3550        embedding_27[0][0]
__________________________________________________________________________________________________
conv1d_12 (Conv1D)              (None, 70, 50)       7050        embedding_27[0][0]
__________________________________________________________________________________________________
embedding_24 (Embedding)        (None, 1, 10)        1654610     brand_name[0][0]
__________________________________________________________________________________________________
embedding_25 (Embedding)        (None, 1, 5)         30          item_condition[0][0]
```

```
__________________________________________________________________________________________________
_____________________________
embedding_21 (Embedding)        (None, 1, 10)        120         subcat_
0[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_22 (Embedding)        (None, 1, 10)        1150        subcat_
1[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_23 (Embedding)        (None, 1, 10)        8840        subcat_
2[0][0]
__________________________________________________________________________________________________
_____________________________
embedding_30 (Embedding)        (None, 70, 80)       20420000    combine
d_text[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_9 (GlobalM (None, 50)           0           conv1d_
9[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_11 (Global (None, 50)           0           conv1d_
11[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_10 (Global (None, 50)           0           conv1d_
10[0][0]
__________________________________________________________________________________________________
_____________________________
global_max_pooling1d_12 (Global (None, 50)           0           conv1d_
12[0][0]
__________________________________________________________________________________________________
_____________________________
lstm_3 (LSTM)                   (None, 16)           1728        embeddi
ng_24[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_9 (Flatten)             (None, 5)            0           embeddi
ng_25[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_10 (Flatten)            (None, 10)           0           embeddi
ng_21[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_11 (Flatten)            (None, 10)           0           embeddi
ng_22[0][0]
__________________________________________________________________________________________________
_____________________________
flatten_12 (Flatten)            (None, 10)           0           embeddi
ng_23[0][0]
__________________________________________________________________________________________________
_____________________________
gru_3 (GRU)                     (None, 64)           27840       embeddi
ng_30[0][0]
__________________________________________________________________________________________________
_____________________________
concatenate_7 (Concatenate)     (None, 100)          0           global_
max_pooling1d_9[0][0]
                                                                 global_
```

```
max_pooling1d_11[0][0]
__________________________________________________________________________________________________
_____________________________
concatenate_8 (Concatenate)     (None, 100)          0           global_
max_pooling1d_10[0][0]
                                                                 global_
max_pooling1d_12[0][0]
__________________________________________________________________________________________________
_____________________________
shipping (InputLayer)           (None, 1)            0
__________________________________________________________________________________________________
_____________________________
concatenate_9 (Concatenate)     (None, 316)          0           lstm_3
[0][0]
                                                                 flatten
_9[0][0]
                                                                 flatten
_10[0][0]
                                                                 flatten
_11[0][0]
                                                                 flatten
_12[0][0]
                                                                 gru_3
[0][0]
                                                                 concate
nate_7[0][0]
                                                                 concate
nate_8[0][0]
                                                                 shippin
g[0][0]
__________________________________________________________________________________________________
_____________________________
dense_11 (Dense)                (None, 192)          60864       concate
nate_9[0][0]
__________________________________________________________________________________________________
_____________________________
dropout_5 (Dropout)             (None, 192)          0           dense_1
1[0][0]
__________________________________________________________________________________________________
_____________________________
dense_12 (Dense)                (None, 128)          24704       dropout
_5[0][0]
__________________________________________________________________________________________________
_____________________________
batch_normalization_5 (BatchNor (None, 128)          512         dense_1
2[0][0]
__________________________________________________________________________________________________
_____________________________
dense_13 (Dense)                (None, 64)           8256        batch_n
ormalization_5[0][0]
__________________________________________________________________________________________________
_____________________________
dropout_6 (Dropout)             (None, 64)           0           dense_1
3[0][0]
__________________________________________________________________________________________________
_____________________________
dense_14 (Dense)                (None, 32)           2080        dropout
_6[0][0]
__________________________________________________________________________________________________
_____________________________
batch_normalization_6 (BatchNor (None, 32)           128         dense_1
```

```
4[0][0]
__________________________________________________________________________________
_________________________
dense_15 (Dense)                (None, 1)            33          batch_n
ormalization_6[0][0]
==================================================================================
==========================
Total params: 42,658,535
Trainable params: 42,658,215
Non-trainable params: 320
__________________________________________________________________________________
_________________________
```

In [19]:

```
# Create model and fit it with training dataset.
model_4.fit(x_tr, Y_train, epochs= 20 , batch_size= 512 * 3, validation_data = (x_te, Y
_test), verbose=1)
```

```
/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/indexed
_slices.py:434: UserWarning: Converting sparse IndexedSlices to a dense Te
nsor of unknown shape. This may consume a large amount of memory.
  "Converting sparse IndexedSlices to a dense Tensor of unknown shape. "
```

```
Train on 1432350 samples, validate on 14469 samples
Epoch 1/20
1432350/1432350 [==============================] - 252s 176us/step - loss:
0.4582 - val_loss: 0.1889
Epoch 2/20
1432350/1432350 [==============================] - 252s 176us/step - loss:
0.1579 - val_loss: 0.1791
Epoch 3/20
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.1287 - val_loss: 0.1744
Epoch 4/20
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.1108 - val_loss: 0.1752
Epoch 5/20
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0983 - val_loss: 0.1745
Epoch 6/20
1432350/1432350 [==============================] - 251s 175us/step - loss:
0.0889 - val_loss: 0.1831
Epoch 7/20
1432350/1432350 [==============================] - 250s 174us/step - loss:
0.0814 - val_loss: 0.1736
Epoch 8/20
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0756 - val_loss: 0.1753
Epoch 9/20
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0703 - val_loss: 0.1785
Epoch 10/20
1432350/1432350 [==============================] - 251s 175us/step - loss:
0.0655 - val_loss: 0.1795
Epoch 11/20
1432350/1432350 [==============================] - 250s 174us/step - loss:
0.0615 - val_loss: 0.1830
Epoch 12/20
1432350/1432350 [==============================] - 248s 173us/step - loss:
0.0581 - val_loss: 0.1828
Epoch 13/20
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.0554 - val_loss: 0.1809
Epoch 14/20
1432350/1432350 [==============================] - 254s 177us/step - loss:
0.0525 - val_loss: 0.1858
Epoch 15/20
1432350/1432350 [==============================] - 252s 176us/step - loss:
0.0502 - val_loss: 0.1826
Epoch 16/20
1432350/1432350 [==============================] - 250s 174us/step - loss:
0.0479 - val_loss: 0.1864
Epoch 17/20
1432350/1432350 [==============================] - 250s 175us/step - loss:
0.0461 - val_loss: 0.1894
Epoch 18/20
1432350/1432350 [==============================] - 253s 177us/step - loss:
0.0443 - val_loss: 0.1909
Epoch 19/20
1432350/1432350 [==============================] - 253s 177us/step - loss:
0.0429 - val_loss: 0.1895
Epoch 20/20
1432350/1432350 [==============================] - 252s 176us/step - loss:
0.0417 - val_loss: 0.1888
```

Out[19]:

```
<keras.callbacks.callbacks.History at 0x7f945c568f60>
```

In [20]:

```
y_pred = model_4.predict(x_te, batch_size=512 * 3)
print(" RMSLE error:", rmsle(Y_test, y_pred))
```

```
 RMSLE error: 0.4344567272750884
```

Running for the model with early stopping with patience = 5 and also with 20 epochs didn't imporve the Rmsle score.

In [0]:

```
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model", "Rmsle Error"]
x.add_row(["LSTM", 0.42])
x.add_row(["CNN'S", 0.42])
x.add_row(["LSTM,CNN'S with Test", 0.41])
x.add_row(["LSTM, CNN Early Stop", 0.42])

print(x)
```

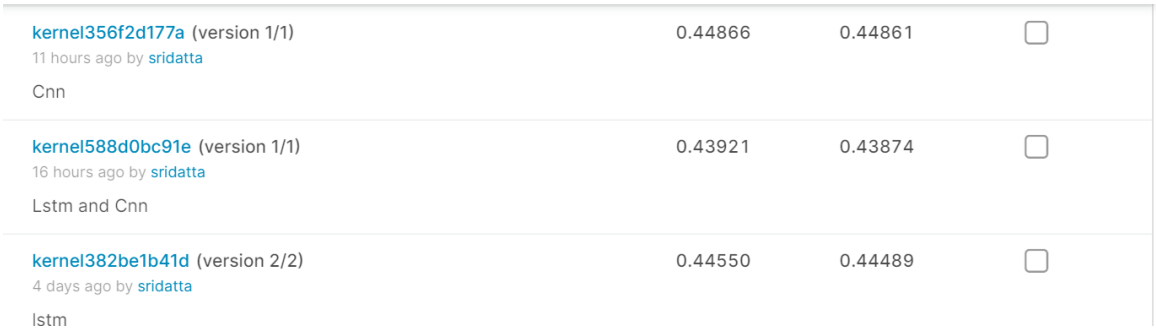
```
+----------------------+-------------+
|        Model         | Rmsle Error |
+----------------------+-------------+
|         LSTM         |     0.42    |
|        CNN'S         |     0.42    |
| LSTM,CNN'S with Test |     0.41    |
| LSTM, CNN Early Stop |     0.42    |
+----------------------+-------------+
```

Kaggle ScreenShots

In [0]:

```
from PIL import Image
jpgfile = Image.open("/content/all_scores.PNG")
jpgfile
```

Out[0]:

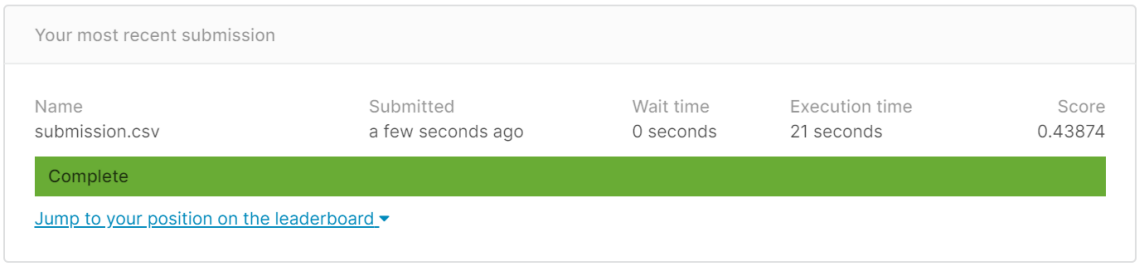


CNN WITH LSTM

In [0]:

```
from PIL import Image
jpgfile = Image.open("/content/cnnlstm.PNG")
jpgfile
```

Out[0]:



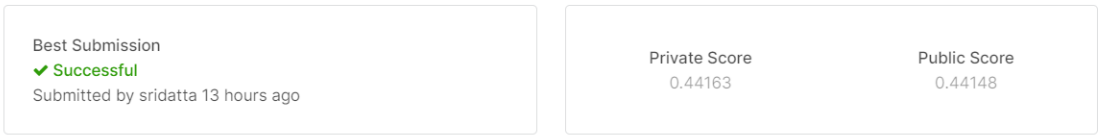
Cnn combined with Lstm Improved score from 0.44 to 0.43

CNN, LSTM Implemting :Early Stopping

In [0]:

```
# CNN, LSTM with Early Stopping.
from PIL import Image
jpgfile = Image.open("/content/lstm_cnn_early_stop.PNG")
jpgfile
```

Out[0]:



In [0]:

```
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model", "Rmsle Error"]
x.add_row(["SVR", 0.47])
x.add_row(["Decision Tree Reg", 0.56])
x.add_row(["SGD Reg", 0.47])
x.add_row(["Ridge Reg", 0.47])
x.add_row(["Ridge Reg Cv", 0.44])
x.add_row(["Ensemble : Voting Reg", 0.44])
x.add_row(["Ensemble : Stacking Reg", 0.52])
x.add_row(["2x LSTM", 0.42])
x.add_row(["2x CNN", 0.42])
x.add_row(["1x LSTM 2x CNN", 0.41])
print(x)
```

```
+-------------------------+-------------+
|          Model          | Rmsle Error |
+-------------------------+-------------+
|           SVR           |     0.47    |
|    Decision Tree Reg    |     0.56    |
|         SGD Reg         |     0.47    |
|        Ridge Reg        |     0.47    |
|       Ridge Reg Cv      |     0.44    |
|  Ensemble : Voting Reg  |     0.44    |
| Ensemble : Stacking Reg |     0.52    |
|         2x LSTM         |     0.42    |
|          2x CNN         |     0.42    |
|      1x LSTM 2x CNN     |     0.41    |
+-------------------------+-------------+
```

Observation:

On Implementing Early Stopping the Model Didn't improve any better.
Running the model with early stopping with patience = 5 and also with 20 epochs didn't imporve the Rmsle score.
With 20 epochs the RMSLE score is 0.43 and with Early Stopping patience = 5, Rmsle = 0.42