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"# \*\*Importing Model building libraries\*\*"

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"import pandas as pd \n",

"import numpy as np\n",

"from sklearn.model\_selection import train\_test\_split\n",

"from sklearn.preprocessing import LabelEncoder\n",

"from keras.models import Model\n",

"from keras.layers import LSTM, Activation, Dense, Dropout, Input, Embedding\n",

"from keras.optimizers import RMSprop\n",

"from keras.preprocessing.text import Tokenizer\n",

"from keras\_preprocessing import sequence\n",

"from keras.utils import to\_categorical\n",

"from keras.models import load\_model"

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"import csv\n",

"import tensorflow as tf\n",

"import pandas as pd\n",

"import numpy as np\n",

"import matplotlib.pyplot as plt\n",

"from tensorflow.keras.preprocessing.text import Tokenizer\n",

"from tensorflow.keras.preprocessing.sequence import pad\_sequences\n",

"import nltk\n",

"nltk.download('stopwords') \n",

"from nltk.corpus import stopwords\n",

"STOPWORDS = set(stopwords.words('english'))"

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{

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"text": [

"[nltk\_data] Downloading package stopwords to /root/nltk\_data...\n",

"[nltk\_data] Package stopwords is already up-to-date!\n"

]

}

]

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"# \*\*Reading dataset and preprocessing\*\*"

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"from google.colab import drive\n",

"drive.mount('/content/drive')"

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"Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount(\"/content/drive\", force\_remount=True).\n"

]

}

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"cd/content/drive/MyDrive/Colab Notebooks"

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"/content/drive/MyDrive/Colab Notebooks\n"

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"df.head()"

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" v1 v2 Unnamed: 2 \\\n",

"0 ham Go until jurong point, crazy.. Available only ... NaN \n",

"1 ham Ok lar... Joking wif u oni... NaN \n",

"2 spam Free entry in 2 a wkly comp to win FA Cup fina... NaN \n;

"3 ham U dun say so early hor... U c already then say... NaN \n",

"4 ham Nah I don't think he goes to usf, he lives aro... NaN \n",

"\n",

" Unnamed: 3 Unnamed: 4 \n",

"0 Nan \n",

"1 NaN NaN \n",

"2 NaN NaN \n",

"3 NaN NaN \n",

"4 NaN NaN "

],

"text/html": [

"\n",

" <div id=\"df-9bf3cfc5-e3d7-40f7-a5eb-4b50ab09a8c4\">\n",

" <div class=\"colab-df-container\">\n",

" <div>\n",

"<style scoped>\n",

" .dataframe tbody tr th:only-of-type {\n",

" vertical-align: middle;\n",

" }\n",

"\n",

" .dataframe tbody tr th {\n",

" vertical-align: top;\n",

" }\n",

"\n",

" .dataframe thead th {\n",

" text-align: right;\n",

" }\n",

"</style>\n",

"<table border=\"1\" class=\"dataframe\">\n",

" <thead>\n",

" <tr style=\"text-align: right;\">\n",

" <th></th>\n",

" <th>v1</th>\n",

" <th>v2</th>\n",

" <th>Unnamed: 2</th>\n",

" <th>Unnamed: 3</th>\n",

" <th>Unnamed: 4</th>\n",

" </tr>\n",

" </thead>\n",

" <tbody>\n",

" <tr>\n",

" <th>0</th>\n",

" <td>ham</td>\n",

" <td>Go until jurong point, crazy.. Available only ...</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" </tr>\n",

" <tr>\n",

" <th>1</th>\n",

" <td>ham</td>\n",

" <td>Ok lar... Joking wif u oni...</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" </tr>\n",

" <tr>\n",

" <th>2</th>\n",

" <td>spam</td>\n",

" <td>Free entry in 2 a wkly comp to win FA Cup fina...</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" </tr>\n",

" <tr>\n",

" <th>3</th>\n",

" <td>ham</td>\n",

" <td>U dun say so early hor... U c already then say...</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" </tr>\n",

" <tr>\n",

" <th>4</th>\n",

" <td>ham</td>\n",

" <td>Nah I don't think he goes to usf, he lives aro...</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" <td>NaN</td>\n",

" </tr>\n",

" </tbody>\n",

"</table>\n",

"</div>\n",

" <button class=\"colab-df-convert\" onclick=\"convertToInteractive('df-9bf3cfc5-e3d7-40f7-a5eb-4b50ab09a8c4')\"\n",

" title=\"Convert this dataframe to an interactive table.\"\n",

" style=\"display:none;\">\n",

" \n",

" <svg xmlns=\"http://www.w3.org/2000/svg\" height=\"24px\"viewBox=\"0 0 24 24\"\n",

" width=\"24px\">\n",

" <path d=\"M0 0h24v24H0V0z\" fill=\"none\"/>\n",

" <path d=\"M18.56 5.44l.94 2.06.94-2.06 2.06-.94-2.06-.94-.94-2.06-.94 2.06-2.06.94zm-11 1L8.5 8.5l.94-2.06 2.06-.94-2.06-.94L8.5 2.5l-.94 2.06-2.06.94zm10 10l.94 2.06.94-2.06 2.06-.94-2.06-.94-.94-2.06-.94 2.06-2.06.94z\"/><path d=\"M17.41 7.96l-1.37-1.37c-.4-.4-.92-.59-1.43-.59-.52 0-1.04.2-1.43.59L10.3 9.45l-7.72 7.72c-.78.78-.78 2.05 0 2.83L4 21.41c.39.39.9.59 1.41.59.51 0 1.02-.2 1.41-.59l7.78-7.78 2.81-2.81c.8-.78.8-2.07 0-2.86zM5.41 20L4 18.59l7.72-7.72 1.47 1.35L5.41 20z\"/>\n",

" </svg>\n",

" </button>\n",

" \n",

" <style>\n",

" .colab-df-container {\n",

" display:flex;\n",

" flex-wrap:wrap;\n",

" gap: 12px;\n",

" }\n",

"\n",

" .colab-df-convert {\n",

" background-color: #E8F0FE;\n",

" border: none;\n",

" border-radius: 50%;\n",

" cursor: pointer;\n",

" display: none;\n",

" fill: #1967D2;\n",

" height: 32px;\n",

" padding: 0 0 0 0;\n",

" width: 32px;\n",

" }\n",

"\n",

" .colab-df-convert:hover {\n",

" background-color: #E2EBFA;\n",

" box-shadow: 0px 1px 2px rgba(60, 64, 67, 0.3), 0px 1px 3px 1px rgba(60, 64, 67, 0.15);\n",

" fill: #174EA6;\n",

" }\n",

"\n",

" [theme=dark] .colab-df-convert {\n",

" background-color: #3B4455;\n",

" fill: #D2E3FC;\n",

" }\n",

"\n",

" [theme=dark] .colab-df-convert:hover {\n",

" background-color: #434B5C;\n",

" box-shadow: 0px 1px 3px 1px rgba(0, 0, 0, 0.15);\n",

" filter: drop-shadow(0px 1px 2px rgba(0, 0, 0, 0.3));\n",

" fill: #FFFFFF;\n",

" }\n",

" </style>\n",

"\n",

" <script>\n",

" const buttonEl =\n",

" document.querySelector('#df-9bf3cfc5-e3d7-40f7-a5eb-4b50ab09a8c4 button.colab-df-convert');\n",

" buttonEl.style.display =\n",

" google.colab.kernel.accessAllowed ? 'block' : 'none';\n",

"\n",

" async function convertToInteractive(key) {\n",

" const element = document.querySelector('#df-9bf3cfc5-e3d7-40f7-a5eb-4b50ab09a8c4');\n",

" const dataTable =\n",

" await google.colab.kernel.invokeFunction('convertToInteractive',\n",

" [key], {});\n",

" if (!dataTable) return;\n",

"\n",

" const docLinkHtml = 'Like what you see? Visit the ' +\n",

" '<a target=\"\_blank\" href=https://colab.research.google.com/notebooks/data\_table.ipynb>data table notebook</a>'\n",

" + ' to learn more about interactive tables.';\n",

" element.innerHTML = '';\n",

" dataTable['output\_type'] = 'display\_data';\n",

" await google.colab.output.renderOutput(dataTable, element);\n",

" const docLink = document.createElement('div');\n",

" docLink.innerHTML = docLinkHtml;\n",

" element.appendChild(docLink);\n",

" }\n",

" </script>\n",

" </div>\n",

" </div>\n",

" "

]

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"execution count": 5

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"df.drop(['Unnamed: 2','Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True) \n",

"df.info()"

],

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"<class 'pandas.core.frame.DataFrame'>\n",

"RangeIndex: 5572 entries, 0 to 5571\n",

"Data columns (total 2 columns):\n",

" # Column Non-Null Count Dtype \n",

"--- ------ -------------- ----- \n",

" 0 v1 5572 non-null object\n",

" 1 v2 5572 non-null object\n",

"dtypes: object(2)\n",

"memory usage: 87.2+ KB\n"

]

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"v1\n",

"ham 4825\n",

"spam 747\n",

"dtype: int64"

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{

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"#Label Encoding Required Column\n",

"X = df.v2\n",

"Y = df.v1\n",

"le = LabelEncoder()\n",

"Y = le.fit\_transform(Y)\n",

"Y = Y.reshape(-1,1)"

],

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"# Test and train data split \n",

"X\_train,X\_test,Y\_train,Y\_test = train\_test\_split(X,Y,test\_size=0.15)"

],

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"# Tokenisation function\n",

"max\_words = 1000\n",

"max\_len = 150\n",

"tok = Tokenizer(num\_words=max\_words)\n",

"tok.fit\_on\_texts(X\_train)\n",

"sequences = tok.texts\_to\_sequences(X\_train)\n",

"sequences\_matrix = sequence.pad\_sequences(sequences,maxlen=max\_len)\n"

],

"metadata": {

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"# \*\*Create Model\*\*\n",

"# \*\*Add layers (LSTM ,Dense-(HiddenLayers),Ouput)\*\*"

],

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"#LSTM model\n",

"inputs = Input(name='InputLayer',shape=[max\_len])\n",

"layer = Embedding(max\_words,50,input\_length=max\_len)(inputs)\n",

"layer = LSTM(64)(layer)\n",

"layer = Dense(256,name='FullyConnectedLayer1')(layer)\n",

"layer = Activation('relu')(layer)\n",

"layer = Dropout(0.5)(layer)\n",

"layer = Dense(1,name='OutputLayer')(layer)\n",

"layer = Activation('sigmoid')(layer)"

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"model = Model(inputs=inputs,outputs=layer)\n",

"model.summary()\n",

"model.compile(loss='binary\_crossentropy',optimizer=RMSprop(),metrics=['accuracy'])"

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"Model: \"model\"\n",

"\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n",

" Layer (type) Output Shape Param # \n",

"=================================================================\n",

" InputLayer (InputLayer) [(None, 150)] 0 \n",

" \n",

" embedding (Embedding) (None, 150, 50) 50000 \n",

" \n",

" lstm (LSTM) (None, 64) 29440 \n",

" \n",

" FullyConnectedLayer1 (Dense (None, 256) 16640 \n",

" ) \n",

" \n",

" activation (Activation) (None, 256) 0 \n",

" \n",

" dropout (Dropout) (None, 256) 0 \n",

" \n",

" OutputLayer (Dense) (None, 1) 257 \n",

" \n",

" activation\_1 (Activation) (None, 1) 0 \n",

" \n",

"=================================================================\n",

"Total params: 96,337\n",

"Trainable params: 96,337\n",

"Non-trainable params: 0\n",

"\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n"

]

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"30/30 [==============================] - 28s 720ms/step - loss: 0.3323 - accuracy: 0.8772 - val\_loss: 0.1085 - val\_accuracy: 0.9715\n",

"Epoch 2/25\n",

"30/30 [==============================] - 18s 588ms/step - loss: 0.0818 - accuracy: 0.9807 - val\_loss: 0.0794 - val\_accuracy: 0.9800\n",

"Epoch 3/25\n",

"30/30 [==============================] - 12s 384ms/step - loss: 0.0421 - accuracy: 0.9884 - val\_loss: 0.0518 - val\_accuracy: 0.9842\n",

"Epoch 4/25\n",

"30/30 [==============================] - 9s 291ms/step - loss: 0.0293 - accuracy: 0.9921 - val\_loss: 0.0461 - val\_accuracy: 0.9884\n",

"Epoch 5/25\n",

"30/30 [==============================] - 9s 288ms/step - loss: 0.0261 - accuracy: 0.9921 - val\_loss: 0.0517 - val\_accuracy: 0.9873\n",

"Epoch 6/25\n",

"30/30 [==============================] - 9s 291ms/step - loss: 0.0161 - accuracy: 0.9952 - val\_loss: 0.0582 - val\_accuracy: 0.9863\n",

"Epoch 7/25\n",

"30/30 [==============================] - 9s 291ms/step - loss: 0.0110 - accuracy: 0.9971 - val\_loss: 0.0660 - val\_accuracy: 0.9895\n",

"Epoch 8/25\n",

"30/30 [==============================] - 11s 369ms/step - loss: 0.0087 - accuracy: 0.9974 - val\_loss: 0.0765 - val\_accuracy: 0.9863\n",

"Epoch 9/25\n",

"30/30 [==============================] - 9s 294ms/step - loss: 0.0059 - accuracy: 0.9982 - val\_loss: 0.0815 - val\_accuracy: 0.9884\n",

"Epoch 10/25\n",

"30/30 [==============================] - 9s 290ms/step - loss: 0.0051 - accuracy: 0.9987 - val\_loss: 0.0902 - val\_accuracy: 0.9852\n",

"Epoch 11/25\n",

"30/30 [==============================] - 9s 318ms/step - loss: 0.0038 - accuracy: 0.9987 - val\_loss: 0.0964 - val\_accuracy: 0.9884\n",

"Epoch 12/25\n",

"30/30 [==============================] - 9s 290ms/step - loss: 0.0039 - accuracy: 0.9984 - val\_loss: 0.1214 - val\_accuracy: 0.9863\n",

"Epoch 13/25\n",

"30/30 [==============================] - 11s 363ms/step - loss: 0.0011 - accuracy: 0.9997 - val\_loss: 0.1153 - val\_accuracy: 0.9895\n",

"Epoch 14/25\n",

"30/30 [==============================] - 9s 294ms/step - loss: 6.9965e-04 - accuracy: 0.9997 - val\_loss: 0.1322 - val\_accuracy: 0.9873\n",

"Epoch 15/25\n",

"30/30 [==============================] - 9s 292ms/step - loss: 0.7710 - accuracy: 0.9739 - val\_loss: 0.1286 - val\_accuracy: 0.9884\n",

"Epoch 16/25\n",

"30/30 [==============================] - 9s 294ms/step - loss: 5.0771e-04 - accuracy: 0.9997 - val\_loss: 0.1294 - val\_accuracy: 0.9895\n",

"Epoch 17/25\n",

"30/30 [==============================] - 9s 296ms/step - loss: 2.4364e-04 - accuracy: 1.0000 - val\_loss: 0.1362 - val\_accuracy: 0.9895\n",

"Epoch 18/25\n",

"30/30 [==============================] - 9s 293ms/step - loss: 7.7019e-05 - accuracy: 1.0000 - val\_loss: 0.1435 - val\_accuracy: 0.9863\n",

"Epoch 19/25\n",

"30/30 [==============================] - 9s 294ms/step - loss: 4.9329e-05 - accuracy: 1.0000 - val\_loss: 0.1585 - val\_accuracy: 0.9863\n",

"Epoch 20/25\n",

"30/30 [==============================] - 9s 310ms/step - loss: 3.0667e-05 - accuracy: 1.0000 - val\_loss: 0.1735 - val\_accuracy: 0.9863\n",

"Epoch 21/25\n",

"30/30 [==============================] - 9s 316ms/step - loss: 1.8201e-05 - accuracy: 1.0000 - val\_loss: 0.1857 - val\_accuracy: 0.9852\n",

"Epoch 22/25\n",

"30/30 [==============================] - 9s 295ms/step - loss: 7.7908e-06 - accuracy: 1.0000 - val\_loss: 0.2049 - val\_accuracy: 0.9884\n",

"Epoch 23/25\n",

"30/30 [==============================] - 9s 295ms/step - loss: 7.4443e-06 - accuracy: 1.0000 - val\_loss: 0.2257 - val\_accuracy: 0.9873\n",

"Epoch 24/25\n",

"30/30 [==============================] - 9s 298ms/step - loss: 1.8775e-04 - accuracy: 1.0000 - val\_loss: 0.2443 - val\_accuracy: 0.9810\n",

"Epoch 25/25\n",

"30/30 [==============================] - 9s 292ms/step - loss: 1.6095e-06 - accuracy: 1.0000 - val\_loss: 0.2496 - val\_accuracy: 0.9810\n"

]

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"<Keras.callbacks.History at 0x7f0dc2ac8190>"

]

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"execution count": 13

}

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},

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},

"id": "YHIM235qC4wt",

"outputId": "b07591db-78ae-4d44-e5fe-535ca42ba663"

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"name": "stderr",

"text": [

"WARNING:absl:Function `\_wrapped\_model` contains input name(s) InputLayer with unsupported characters which will be renamed to inputlayer in the SavedModel.\n",

"WARNING:absl:Found untraced functions such as lstm\_cell\_layer\_call\_fn, lstm\_cell\_layer\_call\_and\_return\_conditional\_losses while saving (showing 2 of 2). These functions will not be directly callable after loading.\n"

]

}

]

},

{

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"test\_sequences = tok.texts\_to\_sequences(X\_test)\n",

"test\_sequences\_matrix = sequence.pad\_sequences(test\_sequences,maxlen=max\_len)"

],

"metadata": {

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},

"execution count": 15,

"outputs": []

},

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"source": [

"accuracy = model.evaluate(test\_sequences\_matrix,Y\_test)\n",

"print('Accuracy: {:0.3f}'.format(accuracy[1]))"

],

"metadata": {

"colab": {

"base\_uri": "https://localhost:8080/"

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"id": "YYfPeJHoC7r8",

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"27/27 [==============================] - 1s 27ms/step - loss: 0.3614 - accuracy: 0.9833\n",

"Accuracy: 0.983\n"

]

}

]

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{

"cell type": "code",

"source": [

"y\_pred = model.predict(test\_sequences\_matrix)\n",

"print(y\_pred[25:40].round(3))"

],

"metadata": {

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" [0.]\n",

" [0.]\n",

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]

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{

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"source": [

"print(Y\_test[25:40])"

],

"metadata": {

"colab": {

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