# Goals

- sentiment analysis on twitter thread interactions.
- train a model to be able to predict conversation sentiment.
  - based on the first tweet?
  - proactive measures for dealing with customers.

```
!pip install -q kaggle
from google.colab import files
files.upload()
!mkdir ~/.kaggle
!cp kaggle.json ~/.kaggle/
!chmod 600 ~/.kaggle/kaggle.json
!kaggle datasets download -d thoughtvector/customer-support-on-twitter

#in drive https://drive.google.com/drive/u/1/folders/1Sh4w-8e1p2Yl_9QrAvpgRf4nmeY_KW-z
```

```
Choose Files kaggle.json
- kaggle.json(application/json) - 67 bytes, last modified: 4/26/2021 - 100% done
Saving kaggle.json to kaggle.json
Downloading customer-support-on-twitter.zip to /content
 96% 161M/169M [00:05<00:00, 27.0MB/s]
100% 169M/169M [00:05<00:00, 33.1MB/s]
```

```
!pip install cloudmesh-installer
!pip install cloudmesh-common
```

```
Requirement already satisfied: pyyaml in /usr/local/lib/python3.7/dist-packages (fr
Collecting mccabe<0.7.0,>=0.6.0
  Downloading https://files.pythonhosted.org/packages/87/89/479dc97e18549e21354893e
Requirement already satisfied: importlib-metadata; python_version < "3.8" in /usr/l
Collecting pycodestyle<2.8.0,>=2.7.0
  Downloading https://files.pythonhosted.org/packages/de/cc/227251b1471f129bc35e966
     |████████████████████████████████| 51kB 4.5MB/s
Collecting pyflakes<2.4.0,>=2.3.0
  Downloading https://files.pythonhosted.org/packages/6c/11/2a745612f1d3cbbd9c69ba1
     |████████████████████████████████| 71kB 4.3MB/s
Requirement already satisfied: pathlib in /usr/local/lib/python3.7/dist-packages (f
Collecting simplejson
  Downloading https://files.pythonhosted.org/packages/a8/04/377418ac1e530ce2a196b54
     |████████████████████████████████| 133kB 5.9MB/s
Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.7/dist-pac
Collecting pyfiglet
  Downloading https://files.pythonhosted.org/packages/33/07/fcfdd7a2872f5b348953de3
     |████████████████████████████████| 870kB 6.9MB/s
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: click>=7 in /usr/local/lib/python3.7/dist-packages (
```

```
Requirement already satisfied: pip>=6.0.0 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: typing-extensions>=3.6.4; python_version < "3.8" in
Building wheels for collected packages: python-hostlist, ordered-set
  Building wheel for python-hostlist (setup.py) ... done
  Created wheel for python-hostlist: filename=python_hostlist-1.21-cp37-none-any.wh
  Stored in directory: /root/.cache/pip/wheels/0b/5b/55/ddcf52288f0b10f4564ca1b2531
  Building wheel for ordered-set (setup.py) ... done
  Created wheel for ordered-set: filename=ordered_set-4.0.2-py2.py3-none-any.whl si
  Stored in directory: /root/.cache/pip/wheels/e1/c6/9b/651d8a21d59b51a75ab9c070838
Successfully built python-hostlist ordered-set
ERROR: pytest-cov 2.11.1 has requirement coverage>=5.2.1, but you'll have coverage
ERROR: pytest-cov 2.11.1 has requirement pytest>=4.6, but you'll have pytest 3.6.4
Installing collected packages: python-hostlist, ordered-set, oyaml, mccabe, pycodes
Successfully installed bump2version-1.0.0 cloudmesh-common-4.3.66 cloudmesh-install

Requirement already satisfied: cloudmesh-common in /usr/local/lib/python3.7/dist-pa
Requirement already satisfied: humanize in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: colorama in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.7/dist-pac
Requirement already satisfied: pathlib in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: tabulate in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: psutil in /usr/local/lib/python3.7/dist-packages (fr
Requirement already satisfied: simplejson in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: pyfiglet in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: oyaml in /usr/local/lib/python3.7/dist-packages (fro
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: python-hostlist in /usr/local/lib/python3.7/dist-pac
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packag
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/loca
Requirement already satisfied: pyyaml in /usr/local/lib/python3.7/dist-packages (fr
```

# Import libraries

```
import time
from cloudmesh.common.StopWatch import StopWatch
from cloudmesh.common.Benchmark import Benchmark
from cloudmesh.common.Shell import Shell

import zipfile

#dealing with data
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import tensorflow as tf
import keras
```

```
import keras
from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence
import sklearn
from sklearn.model_selection import train_test_split

#nl libraries
import string
import nltk #natural language tool kit
from nltk.sentiment.vader import SentimentIntensityAnalyzer
nltk.download("vader_lexicon")
nltk.download('punkt')
```

```
/usr/local/lib/python3.7/dist-packages/nltk/twitter/__init__.py:20: UserWarning: The twy
  warnings.warn("The twython library has not been installed. "
[nltk_data] Downloading package vader_lexicon to /root/nltk_data...
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
True
```

## Download and reduce the data working with

```
StopWatch.start("get_data")

zfile=zipfile.ZipFile('/content/customer-support-on-twitter.zip')
data=pd.read_csv(zfile.open('twcs/twcs.csv'))

StopWatch.stop("get_data")

print(data.shape)
data.head()

StopWatch.start("manageability")

df=data.drop(['inbound','created_at'],axis=1)
df["text"]=df["text"].astype(str)
df.sample(frac=1)
df=df.head(650)
StopWatch.stop("manageability")
```

```
(2811774, 7)
```

```
StopWatch.start("removing_companies")

#companies are not anon so they have actual letters
```

```
#companies are not anon so they have actual letters
def companies(df):
  idx=[]
  for id in range(len(df["author_id"])):
    #assuming at least one vowel in each company name
      vowels=['a','e','i','o', 'u']
      for vowel in vowels:
        if vowel in df["author_id"][id]:
          idx.append(id)
          break
  return df.drop(idx)

#we only want the consumer side
customers=companies(df)

StopWatch.stop("removing_companies")
```

# Analyze senitment for individual tweets

```
StopWatch.start("sentiment_score")

sent_analyzer=SentimentIntensityAnalyzer()

#analyze the raw tweets
customers["sentiment"]=customers["text"].apply(lambda x: sent_analyzer.polarity_scores(x)["co

StopWatch.stop("sentiment_score")
```

# Build a new dataframe

```
# #show distribution of overall tweets and by customers
cust_average=customers.groupby("author_id")
cust_sent_average=cust_average.sentiment.mean()
cust_sent_average=pd.DataFrame({'author_id':cust_sent_average.index, 'sentiment_average': cus

#getting the first tweet for each author
customers = customers[pd.isnull(df.in_response_to_tweet_id)]

#new dataframe with the essentials
customer_first=pd.DataFrame({'author_id':customers['author_id'],
                             'tweet':customers['text'],
                             'first_sentiment':customers['sentiment'],
                             'classification': 'Na'})

#add the overall sentiment binary for the entire thread
for author in customer_first['author_id']:
```

```
  sentiment=cust_sent_average.loc[cust_sent_average.author_id==author, 'sentiment_average']
  if sentiment.values < 0:
    customer_first.loc[customer_first.author_id==author,'classification'] = 0
  else:
        customer_first.loc[customer_first.author_id==author,'classification'] = 1

#add the sentiment from the first tweet sent by author
for author in customer_first['author_id']:
  sent=customer_first.loc[customer_first.author_id==author, 'first_sentiment']
  if sent.values < 0:
    customer_first.loc[customer_first.author_id==author,'first_sentiment'] = 0
  else:
        customer_first.loc[customer_first.author_id==author,'first_sentiment'] = 1

customer_first.head()
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:7: UserWarning: Boolean Ser
  import sys
```

| | author_id | tweet | first_sentiment | classificat |
|---|---|---|---|---|
| **6** | 115712 | @sprintcare is the worst customer service | 0.0 | |
| **12** | 115713 | @115714 y’all lie about your “great” connectio... | 0.0 | |
| **14** | 115715 | @115714 whenever I contact customer support, t... | 1.0 | |
| **23** | 115716 | actually that's a broken link you sent me and ... | 0.0 | |
| **25** | 115717 | Yo @Ask_Spectrum, your customer service reps a... | 1.0 | |

# show sentiment distribution

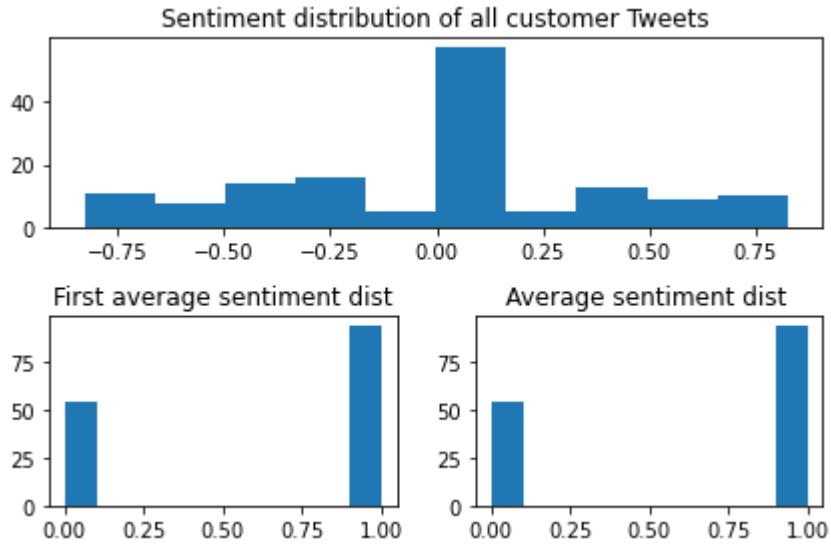
```
fig=plt.figure()

axs0=plt.subplot(211)
axs0.hist(customers["sentiment"])
axs0.set_title("Sentiment distribution of all customer Tweets")

axs1=plt.subplot(223)
axs1.hist(customer_first["first_sentiment"])
axs1.set_title("First average sentiment dist")

axs2=plt.subplot(224)
axs2.hist(customer_first["classification"])
axs2.set_title("Average sentiment dist ")


plt.tight_layout()
fig.savefig("customer_dist.png")
fig.show()
```




```
nltk.download('averaged_perceptron_tagger')

def encode_tweets(df):
  count=0
  encoded=[]
  embedding={}
  for scentence in df.tweet:
    encode=[]
    token=nltk.word_tokenize(scentence.lower())

    token=[ele for word_tuple in nltk.pos_tag(token) for ele in word_tuple ]

    for word in token:
      if word not in embedding:
        embedding[word]=count
        count+=1
      encode.append(embedding[word])
    encoded.append(encode)
  return (encoded)

#endoce the natural text into something the network will be able to read
encoded=encode_tweets(customer_first)

#replace the raw text with the encoded text
customer_first['tweet']=encoded
```

```
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /root/nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
```

```
customer_first['tweet']=np.reshape(customer_first['tweet'].values, (-1,1))
```

# Dividing train and test data

```
#train test split the data should be 80 20 by default
#fit data into the models

#split the data into train and test subsets
train_text, test_text, train_sent, test_sent=train_test_split(customer_first['tweet'],
                                                              customer_first['classification'
num_classes=3

train_text=train_text.values
test_text=test_text.values

#pad the text for uniformity on length
train_text=sequence.pad_sequences(train_text, maxlen=225)
test_text=sequence.pad_sequences(test_text, maxlen=225)

train_sent=train_sent.values
test_sent=test_sent.values
train_sent=keras.utils.to_categorical(train_sent)
test_sent=keras.utils.to_categorical(test_sent)

test_text.shape
```

```
(37, 225)
```

# Cnn model

```
#Cnn libraries
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Activation, Dropout
from keras.layers import Conv1D, MaxPooling1D, Flatten, AveragePooling1D, Embedding
from tensorflow.keras.utils import to_categorical, plot_model
```

# Building the model

```
word_dict=1000000

num_labels=2
input_shape=test_text.shape
```

```
input_shape=test_text.shape
batch_size=50
kernel_size=3
pool_size=2
filters=64
dropout=0.2
epochs=10


StopWatch.start("cnn_model_building")

cnn_model=Sequential()

cnn_model.add(Embedding(word_dict, input_shape[1], input_length=input_shape[1]))

cnn_model.add(Conv1D(filters=filters, kernel_size=kernel_size,
                activation='relu', input_shape=input_shape,
                padding='same'))
cnn_model.add(MaxPooling1D(pool_size))

cnn_model.add(Conv1D(filters=filters, kernel_size=kernel_size,
                activation='relu', input_shape=input_shape,
                padding='same'))
cnn_model.add(MaxPooling1D(pool_size))

cnn_model.add(Conv1D(filters=filters, kernel_size=kernel_size,
                activation='relu', input_shape=input_shape,
                padding='same'))
cnn_model.add(MaxPooling1D(pool_size))

cnn_model.add(Conv1D(filters=filters, kernel_size=kernel_size,
                activation='relu', input_shape=input_shape,
                padding='same'))
cnn_model.add(Flatten())
cnn_model.add(Dropout(dropout))
cnn_model.add(Dense(num_labels))
cnn_model.add(Activation('softmax'))
cnn_model.summary()
plot_model(cnn_model, to_file='cnn_model.png', show_shapes=True)

StopWatch.stop("cnn_model_building")
```

```
Model: "sequential_9"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_5 (Embedding)      (None, 225, 225)          225000000
_________________________________________________________________
conv1d_24 (Conv1D)           (None, 225, 64)           43264
_________________________________________________________________
max_pooling1d_18 (MaxPooling (None, 112, 64)           0
_________________________________________________________________
conv1d_25 (Conv1D)           (None, 112, 64)           12352
```

```
_________________________________________________________________
max_pooling1d_19 (MaxPooling (None, 56, 64)            0         
_________________________________________________________________
conv1d_26 (Conv1D)           (None, 56, 64)            12352     
_________________________________________________________________
max_pooling1d_20 (MaxPooling (None, 28, 64)            0         
_________________________________________________________________
conv1d_27 (Conv1D)           (None, 28, 64)            12352     
_________________________________________________________________
flatten_6 (Flatten)          (None, 1792)              0         
_________________________________________________________________
dropout_6 (Dropout)          (None, 1792)              0         
_________________________________________________________________
dense_6 (Dense)              (None, 2)                 3586      
_________________________________________________________________
activation_6 (Activation)    (None, 2)                 0         
=================================================================
Total params: 225,083,906
Trainable params: 225,083,906
Non-trainable params: 0
_________________________________________________________________
```

## Compile

```
StopWatch.start("cnn_compile")
cnn_model.compile(loss='categorical_crossentropy',
                  optimizer='adam', metrics=['accuracy'])
StopWatch.stop("cnn_compile")
```

## Model Fit

```
StopWatch.start("cnn_train")
cnn_model.fit(train_text, train_sent, batch_size=batch_size,epochs=epochs)
StopWatch.stop("cnn_train")
```

```
Epoch 1/10
3/3 [==============================] - 9s 3s/step - loss: 0.6865 - accuracy: 0.5413
Epoch 2/10
3/3 [==============================] - 7s 2s/step - loss: 0.6583 - accuracy: 0.6333
Epoch 3/10
3/3 [==============================] - 7s 2s/step - loss: 0.6473 - accuracy: 0.6308
Epoch 4/10
3/3 [==============================] - 7s 2s/step - loss: 0.6443 - accuracy: 0.6258
Epoch 5/10
3/3 [==============================] - 7s 2s/step - loss: 0.6234 - accuracy: 0.6608
Epoch 6/10
```

```
3/3 [==============================] - 7s 2s/step - loss: 0.6105 - accuracy: 0.6553
Epoch 7/10
3/3 [==============================] - 7s 2s/step - loss: 0.5949 - accuracy: 0.6478
Epoch 8/10
3/3 [==============================] - 7s 2s/step - loss: 0.5743 - accuracy: 0.6848
Epoch 9/10
3/3 [==============================] - 7s 2s/step - loss: 0.5311 - accuracy: 0.7459
Epoch 10/10
3/3 [==============================] - 7s 2s/step - loss: 0.4616 - accuracy: 0.8159
```

# Predicting

```
StopWatch.start("predict")

predicted=cnn_model.predict(test_text)

StopWatch.stop("predict")
```

# Evaluate

```
StopWatch.start("cnn_evaluate")
cnn_loss, cnn_accuracy=cnn_model.evaluate(predicted, test_sent, batch_size = batch_size)
print("CNN Accuracy: %.1f%%" %(100.0*cnn_accuracy))
StopWatch.stop("cnn_evaluate")
```

```
979                 False

ValueError: in user code:

    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/training.py:1233 test_function  *
        return step_function(self, iterator)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/training.py:1224 step_function  **
        outputs = model.distribute_strategy.run(run_step, args=(data,))
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/distribute/distribute_lib.py:1259 run
        return self._extended.call_for_each_replica(fn, args=args, kwargs=kwargs)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/distribute/distribute_lib.py:2730 call_for_each_replica
        return self._call_for_each_replica(fn, args, kwargs)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/distribute/distribute_lib.py:3417 _call_for_each_replica
        return fn(*args, **kwargs)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/training.py:1217 run_step  **
        outputs = model.test_step(data)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/training.py:1183 test_step
        y_pred = self(x, training=False)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/base_layer.py:1012 __call__
        outputs = call_fn(inputs, *args, **kwargs)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/sequential.py:375 call
        return super(Sequential, self).call(inputs, training=training, mask=mask)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/functional.py:425 call
        inputs, training=training, mask=mask)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/functional.py:560 _run_internal_graph
        outputs = node.layer(*args, **kwargs)
    /usr/local/lib/python3.7/dist-
packages/tensorflow/python/keras/engine/base_layer.py:1012 __call__
        outputs = call_fn(inputs, *args, **kwargs)
    /usr/local/lib/python3.7/dist-packages/tensorflow/python/keras/layers/pooling.py:80
call
        data_format=self.data_format)
    /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/dispatch.py:201
wrapper
        return target(*args, **kwargs)
    /usr/local/lib/python3.7/dist-packages/tensorflow/python/keras/backend.py:5697
pool2d
        x, pool_size, strides, padding=padding, data_format=tf_data_format)
    /usr/local/lib/python3.7/dist-packages/tensorflow/python/util/dispatch.py:201
wrapper
        return target(*args, **kwargs)
```

```
StopWatch.benchmark()
```

```
+---------------------+------------------------------------------------------------
| Attribute           | Value
```

| | |
|---|---|
| BUG_REPORT_URL | "https://bugs.launchpad.net/ubuntu/" |
| DISTRIB_CODENAME | bionic |
| DISTRIB_DESCRIPTION | "Ubuntu 18.04.5 LTS" |
| DISTRIB_ID | Ubuntu |
| DISTRIB_RELEASE | 18.04 |
| HOME_URL | "https://www.ubuntu.com/" |
| ID | ubuntu |
| ID_LIKE | debian |
| NAME | "Ubuntu" |
| PRETTY_NAME | "Ubuntu 18.04.5 LTS" |
| PRIVACY_POLICY_URL | "https://www.ubuntu.com/legal/terms-and-policies/privacy-pc |
| SUPPORT_URL | "https://help.ubuntu.com/" |
| UBUNTU_CODENAME | bionic |
| VERSION | "18.04.5 LTS (Bionic Beaver)" |
| VERSION_CODENAME | bionic |
| VERSION_ID | "18.04" |
| cpu_count | 2 |
| mem.active | 2.5 GiB |
| mem.available | 10.5 GiB |
| mem.free | 1.3 GiB |
| mem.inactive | 8.7 GiB |
| mem.percent | 17.8 % |
| mem.total | 12.7 GiB |
| mem.used | 10.5 GiB |
| platform.version | #1 SMP Thu Jul 23 08:00:38 PDT 2020 |
| python | 3.7.10 (default, May 3 2021, 02:48:31)<br>[GCC 7.5.0] |
| python.pip | 19.3.1 |
| python.version | 3.7.10 |
| sys.platform | linux |
| uname.machine | x86_64 |
| uname.node | 88179830b256 |
| uname.processor | x86_64 |
| uname.release | 4.19.112+ |
| uname.system | Linux |
| uname.version | #1 SMP Thu Jul 23 08:00:38 PDT 2020 |
| user | collab |

| Name | Status | Time | Sum | Start | tag |
|---|---|---|---|---|---|
| get_data | ok | 13.43 | 13.43 | 2021-05-08 17:58:36 | |
| manageability | ok | 2.884 | 2.884 | 2021-05-08 17:58:49 | |
| removing_companies | ok | 0.02 | 0.035 | 2021-05-08 17:59:54 | |
| sentiment_score | ok | 0.095 | 0.202 | 2021-05-08 17:59:54 | |
| cnn_model_building | ok | 2.221 | 7.596 | 2021-05-08 18:43:35 | |
| cnn_compile | ok | 0.017 | 0.105 | 2021-05-08 18:43:37 | |
| cnn_train | ok | 67.861 | 104.324 | 2021-05-08 18:43:37 | |
| predict | ok | 0.144 | 0.366 | 2021-05-08 18:45:09 | |
| cnn_evaluate | failed | | 0 | 2021-05-08 18:42:45 | |

✓ 0s completed at 14:45