Amazon Apparel Recommendations

In [1]:
```
from PIL import Image
import requests
from io import BytesIO
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import warnings
from bs4 import BeautifulSoup
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
import nltk
import math
import time
import re
import os
import seaborn as sns
from collections import Counter
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.metrics.pairwise import cosine_similarity
from sklearn.metrics import pairwise_distances
from matplotlib import gridspec
from scipy.sparse import hstack
import plotly
import plotly.figure_factory as ff
from plotly.graph_objs import Scatter, Layout

plotly.offline.init_notebook_mode(connected=True)
warnings.filterwarnings("ignore")
```

Loading data

In [2]:
```
img_data = np.load('16k_data_cnn_features.npy')
asins = np.load('16k_data_cnn_feature_asins.npy')
data = pd.read_pickle('pickels/16k_apperal_data_preprocessed')
df_asins = list(data['asin'])
asins = list(asins)
```

In [3]:
```
import pickle
with open('word2vec_model', 'rb') as handle:
    model = pickle.load(handle)
```

In [4]:
```
data['brand'].fillna(value="Not given", inplace=True )

# replace spaces with hypen
brands = [x.replace(" ", "-") for x in data['brand'].values]
types = [x.replace(" ", "-") for x in data['product_type_name'].values]
colors = [x.replace(" ", "-") for x in data['color'].values]

brand_vectorizer = CountVectorizer()
brand_features = brand_vectorizer.fit_transform(brands)

type_vectorizer = CountVectorizer()
type_features = type_vectorizer.fit_transform(types)

color_vectorizer = CountVectorizer()
color_features = color_vectorizer.fit_transform(colors)

extra_features = hstack((brand_features, type_features, color_features)).tocsr()
```

In [5]:
```
idf_title_vectorizer = CountVectorizer()
idf_title_features = idf_title_vectorizer.fit_transform(data['title'])
```

In [6]:
```
vocab = model.keys()
# this function will add the vectors of each word and returns the avg vector of given sentance
def build_avg_vec(sentence, num_features, doc_id, m_name):
    # sentace: its title of the apparel
    # num_features: the lenght of word2vec vector, its values = 300
    # m_name: model information it will take two values
        # if  m_name == 'avg', we will append the model[i], w2v representation of word i
        # if m_name == 'weighted', we will multiply each w2v[word] with the idf(word)

    featureVec = np.zeros((num_features,), dtype="float32")
    # we will intialize a vector of size 300 with all zeros
    # we add each word2vec(wordi) to this fetureVec
    nwords = 0

    for word in sentence.split():
        nwords += 1
        if word in vocab:
            if m_name == 'weighted' and word in  idf_title_vectorizer.vocabulary_:
                featureVec = np.add(featureVec, idf_title_features[doc_id, idf_title_vectorizer.vocabulary_[word]] * mode
            elif m_name == 'avg':
                featureVec = np.add(featureVec, model[word])
    if(nwords>0):
        featureVec = np.divide(featureVec, nwords)
    # returns the avg vector of given sentance, its of shape (1, 300)
    return featureVec
```

In [7]:
```
doc_id = 0
w2v_title_weight = []
# for every title we build a weighted vector representation
for i in data['title']:
    w2v_title_weight.append(build_avg_vec(i, 300, doc_id,'weighted'))
    doc_id += 1
# w2v_title = np.array(# number of doc in courpus * 300), each row corresponds to a doc
w2v_title_weight = np.array(w2v_title_weight)
#print ("hi")
```

In [8]:
```
def display_img(url,ax,fig):
    # we get the url of the apparel and download it
    response = requests.get(url)
    img = Image.open(BytesIO(response.content))
    # we will display it in notebook
    plt.imshow(img)
```

In [9]:
```
def get_word_vec(sentence, doc_id, m_name):
    # sentence : title of the apparel
    # doc_id: document id in our corpus
    # m_name: model information it will take two values
        # if  m_name == 'avg', we will append the model[i], w2v representation of word i
        # if m_name == 'weighted', we will multiply each w2v[word] with the idf(word)
    vec = []
    for i in sentence.split():
        if i in vocab:
            if m_name == 'weighted' and i in  idf_title_vectorizer.vocabulary_:
                vec.append(idf_title_features[doc_id, idf_title_vectorizer.vocabulary_[i]] * model[i])
            elif m_name == 'avg':
                vec.append(model[i])
        else:
            # if the word in our courpus is not there in the google word2vec corpus, we are just ignoring it
            vec.append(np.zeros(shape=(300,)))
    # we will return a numpy array of shape (#number of words in title * 300 ) 300 = len(w2v_model[word])
    # each row represents the word2vec representation of each word (weighted/avg) in given sentance
    return  np.array(vec)

def get_distance(vec1, vec2):
    # vec1 = np.array(#number_of_words_title1 * 300), each row is a vector of length 300 corresponds to each word in give
    # vec2 = np.array(#number_of_words_title2 * 300), each row is a vector of length 300 corresponds to each word in give

    final_dist = []
    # for each vector in vec1 we caluclate the distance(euclidean) to all vectors in vec2
    for i in vec1:
        dist = []
        for j in vec2:
            # np.linalg.norm(i-j) will result the euclidean distance between vectors i, j
            dist.append(np.linalg.norm(i-j))
        final_dist.append(np.array(dist))
    # final_dist = np.array(#number of words in title1 * #number of words in title2)
    # final_dist[i,j] = euclidean distance between vectors i, j
    return np.array(final_dist)
def heat_map_w2v_brand(sentance1, sentance2, url, doc_id1, doc_id2, df_id1, df_id2, model):

    # sentance1 : title1, input apparel
    # sentance2 : title2, recommended apparel
    # url: apparel image url
    # doc_id1: document id of input apparel
```

```
# doc_id2: document id of recommended apparel
# df_id1: index of document1 in the data frame
# df_id2: index of document2 in the data frame
# model: it can have two values, 1. avg 2. weighted

#s1_vec = np.array(#number_of_words_title1 * 300), each row is a vector(weighted/avg) of length 300 corresponds to ea
s1_vec = get_word_vec(sentance1, doc_id1, model)
#s2_vec = np.array(#number_of_words_title2 * 300), each row is a vector(weighted/avg) of length 300 corresponds to ea
s2_vec = get_word_vec(sentance2, doc_id2, model)

# s1_s2_dist = np.array(#number of words in title1 * #number of words in title2)
# s1_s2_dist[i,j] = euclidean distance between words i, j
s1_s2_dist = get_distance(s1_vec, s2_vec)

data_matrix = [['Asin','Brand', 'Color', 'Product type'],
           [data['asin'].loc[df_id1],brands[doc_id1], colors[doc_id1], types[doc_id1]], # input apparel's features
           [data['asin'].loc[df_id2],brands[doc_id2], colors[doc_id2], types[doc_id2]]] # recommonded apparel's featu

colorscale = [[0, '#1d004d'],[.5, '#f2e5ff'],[1, '#f2e5d1']] # to color the headings of each column

# we create a table with the data_matrix
table = ff.create_table(data_matrix, index=True, colorscale=colorscale)
# plot it with plotly
plotly.offline.iplot(table, filename='simple_table')

# devide whole figure space into 25 * 1:10 grids
gs = gridspec.GridSpec(25, 15)
fig = plt.figure(figsize=(25,5))

# in first 25*10 grids we plot heatmap
ax1 = plt.subplot(gs[:, :-5])
# ploting the heap map based on the pairwise distances
ax1 = sns.heatmap(np.round(s1_s2_dist,6), annot=True)
# set the x axis labels as recommended apparels title
ax1.set_xticklabels(sentance2.split())
# set the y axis labels as input apparels title
ax1.set_yticklabels(sentance1.split())
# set title as recommended apparels title
ax1.set_title(sentance2)

# in last 25 * 10:15 grids we display image
ax2 = plt.subplot(gs[:, 10:16])
```

```
    # we dont display grid lins and axis labels to images
    ax2.grid(False)
    ax2.set_xticks([])
    ax2.set_yticks([])

    # pass the url it display it
    display_img(url, ax2, fig)

    plt.show()
```

Text, brand, color and image features to recommend similar products

In [15]:
```
def idf_w2v_brand(doc_id, w1, w2, w3, num_results):
    # doc_id: apparel's id in given corpus
    # w1: weight for  w2v features
    # w2: weight for brand and color features
    # w3: weight for image

    # pairwise_dist will store the distance from given input apparel to all remaining apparels
    # the metric we used here is cosine, the coside distance is mesured as K(X, Y) = <X, Y> / (||X||*||Y||)
    # http://scikit-learn.org/stable/modules/metrics.html#cosine-similarity
    idf_w2v_dist  = pairwise_distances(w2v_title_weight, w2v_title_weight[doc_id].reshape(1,-1))
    ex_feat_dist = pairwise_distances(extra_features, extra_features[doc_id])
    doc_id = asins.index(df_asins[doc_id])
    img_dist = pairwise_distances(img_data, img_data[doc_id].reshape(1,-1))
    pairwise_dist   = (w1 * idf_w2v_dist +  w2 * ex_feat_dist + w3 * img_dist)/float(w1 + w2 + w3)

    # np.argsort will return indices of 9 smallest distances
    indices = np.argsort(pairwise_dist.flatten())[0:num_results]
    #pdists will store the 9 smallest distances
    pdists  = np.sort(pairwise_dist.flatten())[0:num_results]

    #data frame indices of the 9 smallest distace's
    df_indices = list(data.index[indices])


    for i in range(0, len(indices)):
        heat_map_w2v_brand(data['title'].loc[df_indices[0]],data['title'].loc[df_indices[i]], data['medium_image_url'].lo
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print('Brand :',data['brand'].loc[df_indices[i]])
        print('euclidean distance from input :', pdists[i])
        print('='*125)

idf_w2v_brand(12654, 5, 5, 10, 20)
# in the give heat map, each cell contains the euclidean distance between words i, j
```

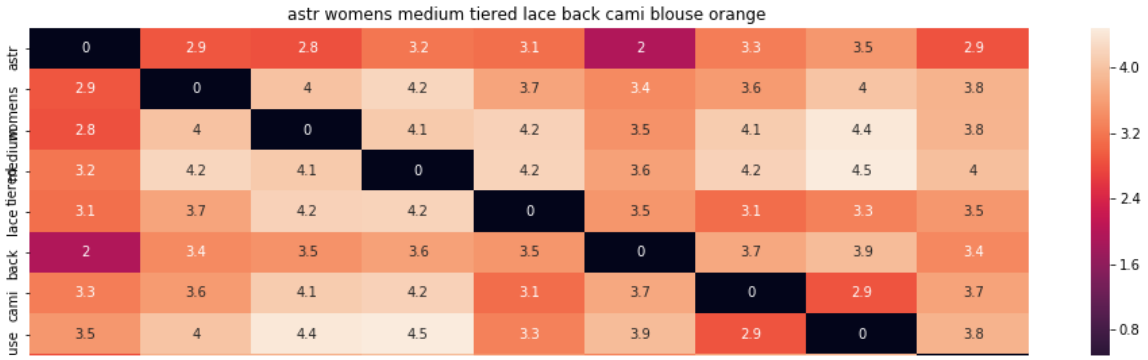
```
euclidean distance from input : 0.752713656425476
=============================================================================================================
========
```

Asin	Brand	Color	Product type

B07354ZQPF	ASTR	Orange	SHIRT
B01H17WYB2	Anboo	Multi-Colored	SHIRT

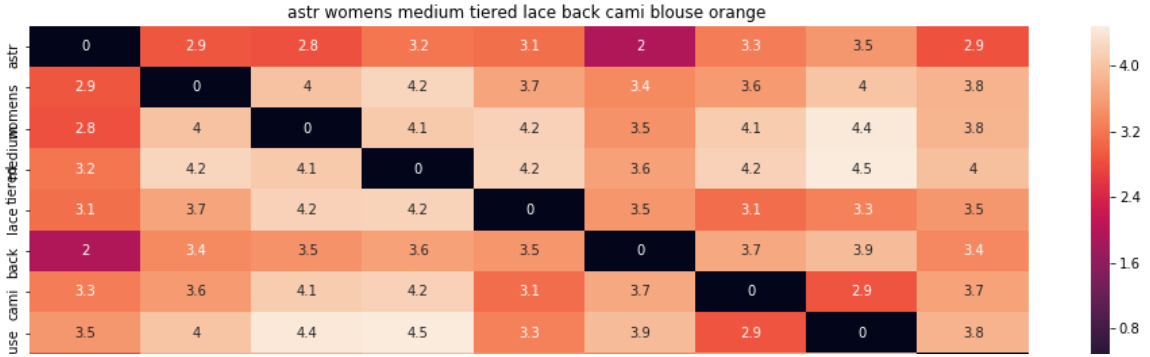
In [18]:
```
idf_w2v_brand(12654, 10, 5, 5, 20)
```

Asin	Brand	Color	Product type
B07354ZQPF	ASTR	Orange	SHIRT
B07354ZQPF	ASTR	Orange	SHIRT



In [19]:
```
idf_w2v_brand(12654, 5, 10, 5, 20)
```

Asin	Brand	Color	Product type
B07354ZQPF	ASTR	Orange	SHIRT
B07354ZQPF	ASTR	Orange	SHIRT



Conclusion :-

1. We used the Text, brand, color and image features to compute the euclidean distance.
2. We tried with different weights for each of the above features.
3. We notice that even with different weights to different feature the initial recommenations are more or less similar but for later recommendations we observe different recommendation with different weights.