Amazon Apparel Recommendations

[4.2] Data and Code:

https://drive.google.com/open?id=0BwNkduBnePt2VWhCYXhMV3p4dTg

[4.3] Overview of the data

In [1]:

```
#import all the necessary packages.

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")
import os
os.chdir('C:/Users/kingsubham27091995/Desktop/AppliedAiCouse/CASE STUDIES/AmazonFashionDiscoveryEngine/
Applied_AI_Workshop_Code_Data')
```

In [0]:

```
# we have give a json file which consists of all information about
# the products
# loading the data using pandas' read_json file.
data = pd.read_json('tops_fashion.json')
```

In [0]:

```
print ('Number of data points : ', data.shape[0], \
       'Number of features/variables:', data.shape[1])
```

```
Number of data points :  183138 Number of features/variables: 19
```

Terminology:

What is a dataset?
Rows and columns
Data-point
Feature/variable

In [0]:

```
# each product/item has 19 features in the raw dataset.
data.columns # prints column-names or feature-names.
```

Out[0]:

```
Index(['asin', 'author', 'availability', 'availability_type', 'brand', 'color',
       'editorial_reivew', 'editorial_review', 'formatted_price',
       'large_image_url', 'manufacturer', 'medium_image_url', 'model',
       'product_type_name', 'publisher', 'reviews', 'sku', 'small_image_url',
       'title'],
      dtype='object')
```

Of these 19 features, we will be using only 6 features in this workshop.

1. asin (Amazon standard identification number)
2. brand (brand to which the product belongs to)
3. color (Color information of apparel, it can contain many colors as a value ex: red and black stripes)
4. product_type_name (type of the apperal, ex: SHIRT/TSHIRT)
5. medium_image_url (url of the image)
6. title (title of the product.)
7. formatted_price (price of the product)

In [0]:

```
data = data[['asin', 'brand', 'color', 'medium_image_url', 'product_type_name', 'title', 'formatted_price']]
```

In [0]:

```
print ('Number of data points : ', data.shape[0], \
       'Number of features:', data.shape[1])
data.head() # prints the top rows in the table.
```

```
Number of data points :  183138 Number of features: 7
```

Out[0]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
0	B016I2TS4W	FNC7C	None	https://images-na.ssl-images-amazon.com/images...	SHIRT	Minions Como Superheroes Ironman Long Sleeve R...	None
1	B01N49AI08	FIG Clothing	None	https://images-na.ssl-images-amazon.com/images...	SHIRT	FIG Clothing Womens Izo Tunic	None
2	B01JDPCOHO	FIG Clothing	None	https://images-na.ssl-images-amazon.com/images...	SHIRT	FIG Clothing Womens Won Top	None
3	B01N19U5H5	Focal18	None	https://images-na.ssl-images-amazon.com/images...	SHIRT	Focal18 Sailor Collar Bubble Sleeve Blouse Shi...	None
4	B004GSI2OS	FeatherLite	Onyx Black/ Stone	https://images-na.ssl-images-amazon.com/images...	SHIRT	Featherlite Ladies' Long Sleeve Stain Resistan...	$26.26

[5.1] Missing data for various features.

Basic stats for the feature: product_type_name

In [0]:

```
# We have total 72 unique type of product_type_names
print(data['product_type_name'].describe())
```

```
# 91.62% (167794/183138) of the products are shirts,
```

```
count     183138
unique        72
top         SHIRT
freq      167794
Name: product_type_name, dtype: object
```

In [0]:

```
# names of different product types
print(data['product_type_name'].unique())
```

```
['SHIRT' 'SWEATER' 'APPAREL' 'OUTDOOR_RECREATION_PRODUCT'
 'BOOKS_1973_AND_LATER' 'PANTS' 'HAT' 'SPORTING_GOODS' 'DRESS' 'UNDERWEAR'
 'SKIRT' 'OUTERWEAR' 'BRA' 'ACCESSORY' 'ART_SUPPLIES' 'SLEEPWEAR'
 'ORCA_SHIRT' 'HANDBAG' 'PET_SUPPLIES' 'SHOES' 'KITCHEN' 'ADULT_COSTUME'
 'HOME_BED_AND_BATH' 'MISC_OTHER' 'BLAZER' 'HEALTH_PERSONAL_CARE'
 'TOYS_AND_GAMES' 'SWIMWEAR' 'CONSUMER_ELECTRONICS' 'SHORTS' 'HOME'
 'AUTO_PART' 'OFFICE_PRODUCTS' 'ETHNIC_WEAR' 'BEAUTY'
 'INSTRUMENT_PARTS_AND_ACCESSORIES' 'POWERSPORTS_PROTECTIVE_GEAR' 'SHIRTS'
 'ABIS_APPAREL' 'AUTO_ACCESSORY' 'NONAPPARELMISC' 'TOOLS' 'BABY_PRODUCT'
 'SOCKSHOSIERY' 'POWERSPORTS_RIDING_SHIRT' 'EYEWEAR' 'SUIT'
 'OUTDOOR_LIVING' 'POWERSPORTS_RIDING_JACKET' 'HARDWARE' 'SAFETY_SUPPLY'
 'ABIS_DVD' 'VIDEO_DVD' 'GOLF_CLUB' 'MUSIC_POPULAR_VINYL'
 'HOME_FURNITURE_AND_DECOR' 'TABLET_COMPUTER' 'GUILD_ACCESSORIES'
 'ABIS_SPORTS' 'ART_AND_CRAFT_SUPPLY' 'BAG' 'MECHANICAL_COMPONENTS'
 'SOUND_AND_RECORDING_EQUIPMENT' 'COMPUTER_COMPONENT' 'JEWELRY'
 'BUILDING_MATERIAL' 'LUGGAGE' 'BABY_COSTUME' 'POWERSPORTS_VEHICLE_PART'
 'PROFESSIONAL_HEALTHCARE' 'SEEDS_AND_PLANTS' 'WIRELESS_ACCESSORY']
```

In [0]:

```
# find the 10 most frequent product_type_names.
product_type_count = Counter(list(data['product_type_name']))
product_type_count.most_common(10)
```

Out[0]:

```
[('SHIRT', 167794),
 ('APPAREL', 3549),
 ('BOOKS_1973_AND_LATER', 3336),
 ('DRESS', 1584),
 ('SPORTING_GOODS', 1281),
 ('SWEATER', 837),
 ('OUTERWEAR', 796),
 ('OUTDOOR_RECREATION_PRODUCT', 729),
 ('ACCESSORY', 636),
 ('UNDERWEAR', 425)]
```

Basic stats for the feature: brand

In [0]:

```
# there are 10577 unique brands
print(data['brand'].describe())

# 183138 - 182987 = 151 missing values.
```

```
count     182987
unique     10577
top         Zago
freq         223
Name: brand, dtype: object
```

In [0]:

```
brand_count = Counter(list(data['brand']))
brand_count.most_common(10)
```

Out[0]:

```
[('Zago', 223),
 ('XQS', 222),
 ('Yayun', 215),
 ('YUNY', 198),
 ('XiaoTianXin-women clothes', 193),
 ('Generic', 192),
```

```
 ('Boohoo', 190),
 ('Alion', 188),
 ('Abetteric', 187),
 ('TheMogan', 187)]
```

Basic stats for the feature: color

In [0]:

```
print(data['color'].describe())


# we have 7380 unique colors
# 7.2% of products are black in color
# 64956 of 183138 products have color information. That's approx 35.4%.
```

```
count     64956
unique     7380
top       Black
freq      13207
Name: color, dtype: object
```

In [0]:

```
color_count = Counter(list(data['color']))
color_count.most_common(10)
```

Out[0]:

```
[(None, 118182),
 ('Black', 13207),
 ('White', 8616),
 ('Blue', 3570),
 ('Red', 2289),
 ('Pink', 1842),
 ('Grey', 1499),
 ('*', 1388),
 ('Green', 1258),
 ('Multi', 1203)]
```

Basic stats for the feature: formatted_price

In [0]:

```

print(data['formatted_price'].describe())

# Only 28,395 (15.5% of whole data) products with price information
```

```
count      28395
unique      3135
top       $19.99
freq          945
Name: formatted_price, dtype: object
```

In [0]:

```
price_count = Counter(list(data['formatted_price']))
price_count.most_common(10)
# Only 15.5% of whole products with price information, others are 'None'
```

Out[0]:

```
[(None, 154743),
 ('$19.99', 945),
 ('$9.99', 749),
 ('$9.50', 601),
 ('$14.99', 472),
 ('$7.50', 463),
 ('$24.99', 414),
 ('$29.99', 370),
 ('$8.99', 343),
 ('$9.01', 336)]
```

Basic stats for the feature: title

In [0]:

```
print(data['title'].describe())

# All of the products have a title.
# Titles are fairly descriptive of what the product is.
# We use titles extensively in this workshop
# as they are short and informative.
# By watching the 'count', we can say that 'title' feature is available for most items. This makes it m
ost important feature too
```

```
count                                                183138
unique                                               175985
top       Nakoda Cotton Self Print Straight Kurti For Women
freq                                                     77
Name: title, dtype: object
```

In [0]:

```
data.to_pickle('pickels/180k_apparel_data')
```

We save data files at every major step in our processing in "pickle" files. If you are stuck anywhere (or) if some code takes too long to run on your laptop, you may use the pickle files we give you to speed things up.

In [0]:

```
# consider products which have price information
# data['formatted_price'].isnull() => gives the information
#about the dataframe row's which have null values price == None|Null
data = data.loc[~data['formatted_price'].isnull()]
#This will store those values whose 'formatted_price' is not null
print('Number of data points After eliminating price=NULL :', data.shape[0])
```

```
Number of data points After eliminating price=NULL : 28395
```

In [0]:

```
# consider products which have color information
# data['color'].isnull() => gives the information about the dataframe row's which have null values pric
e == None|Null
data =data.loc[~data['color'].isnull()]
print('Number of data points After eliminating color=NULL :', data.shape[0])
```

```
Number of data points After eliminating color=NULL : 28385
```

We brought down the number of data points from 183K to 28K.

We are processing only 28K points so that most of the workshop participants can run this code on thier laptops in a reasonable amount of time.

For those of you who have powerful computers and some time to spare, you are recommended to use all of the 183K images.

In [0]:

```
data.to_pickle('pickels/28k_apparel_data')
```

In [0]:

```
# You can download all these 28k images using this code below.
# You do NOT need to run this code and hence it is commented.


'''
from PIL import Image
import requests
from io import BytesIO

for index, row in images.iterrows():
        url = row['large_image_url']
        response = requests.get(url)
        img = Image.open(BytesIO(response.content))
        img.save('images/28k_images/'+row['asin']+'.jpeg')


'''
```

Out[0]:

```
"\nfrom PIL import Image\nimport requests\nfrom io import BytesIO\n\nfor index, row in images.iterrows
():\n        url = row['large_image_url']\n        response = requests.get(url)\n        img = Image.op
en(BytesIO(response.content))\n        img.save('workshop/images/28k_images/'+row['asin']+'.jpeg')\n\n
\n"
```

[5.2] Remove near duplicate items

[5.2.1] Understand about duplicates.

In [0]:

```
# read data from pickle file from previous stage
data = pd.read_pickle('pickels/28k_apparel_data')

# find number of products that have duplicate titles.
print(sum(data.duplicated('title')))
# we have 2325 products which have same title but different color
```

2325

These shirts are exactly same except in size (S, M,L,XL)

:B00AQ4GMCK	:B00AQ4GMTS
:B00AQ4GMLQ	:B00AQ4GN3I

These shirts exactly same except in color

:B00G278GZ6	:B00G278W6O
:B00G278Z2A	:B00G2786X8

In our data there are many duplicate products like the above examples, we need to de-dupe them for better results.

[5.2.2] Remove duplicates : Part 1

In [0]:

```
# read data from pickle file from previous stage
data = pd.read_pickle('pickels/28k_apparel_data')
```

In [0]:

```
data.head()
```

Out[0]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
4	B004GSI2OS	FeatherLite	Onyx Black/ Stone	https://images-na.ssl-images-amazon.com/images...	SHIRT	Featherlite Ladies' Long Sleeve Stain Resistan...	$26.26
6	B012YX2ZPI	HX-Kingdom Fashion T-shirts	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	Women's Unique 100% Cotton T - Special Olympic...	$9.99
11	B001LOUGE4	Fitness Etc.	Black	https://images-na.ssl-images-amazon.com/images...	SHIRT	Ladies Cotton Tank 2x1 Ribbed Tank Top	$11.99
						FeatherLite	

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
15	B003BSRPB0	FeatherLite	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	Ladies' Moisture Free Mesh Sport S...	$20.54
21	B014ICEDNA	FNC7C	Purple	https://images-na.ssl-images-amazon.com/images...	SHIRT	Supernatural Chibis Sam Dean And Castiel Short...	$7.50

In [0]:

```
# Remove All products with very few words in title
data_sorted = data[data['title'].apply(lambda x: len(x.split())>4)]
print("After removal of products with short description:", data_sorted.shape[0])
```

```
After removal of products with short description: 27949
```

In [0]:

```
# Sort the whole data based on title (alphabetical order of title)
data_sorted.sort_values('title',inplace=True, ascending=False)
data_sorted.head()
```

Out[0]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
61973	B06Y1KZ2WB	Éclair	Black/Pink	https://images-na.ssl-images-amazon.com/images...	SHIRT	Éclair Women's Printed Thin Strap Blouse Black...	$24.99
133820	B010RV33VE	xiaoming	Pink	https://images-na.ssl-images-amazon.com/images...	SHIRT	xiaoming Womens Sleeveless Loose Long T-shirts...	$18.19
81461	B01DDSDLNS	xiaoming	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	xiaoming Women's White Long Sleeve Single Brea...	$21.58
75995	B00X5LYO9Y	xiaoming	Red Anchors	https://images-na.ssl-images-amazon.com/images...	SHIRT	xiaoming Stripes Tank Patch/Bear Sleeve Anchor...	$15.91
151570	B00WPJG35K	xiaoming	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	xiaoming Sleeve Sheer Loose Tassel Kimono Woma...	$14.32

Some examples of dupliacte titles that differ only in the last few words.

```
Titles 1:
16. woman's place is in the house and the senate shirts for Womens XXL White
17. woman's place is in the house and the senate shirts for Womens M Grey

Title 2:
25. tokidoki The Queen of Diamonds Women's Shirt X-Large
26. tokidoki The Queen of Diamonds Women's Shirt Small
27. tokidoki The Queen of Diamonds Women's Shirt Large

Title 3:
```

```
61. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head Shirt fo
r woman Neon Wolf t-shirt
62. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head Shirt fo
r woman Neon Wolf t-shirt
63. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head Shirt fo
r woman Neon Wolf t-shirt
64. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head Shirt fo
r woman Neon Wolf t-shirt
```

This Code removes consequent titles which are mostly similar

In [0]:

```
indices = []
for i,row in data_sorted.iterrows():
    indices.append(i)
```

In [0]:

```
import itertools
stage1_dedupe_asins = []
i = 0
j = 0
num_data_points = data_sorted.shape[0]
while i < num_data_points and j < num_data_points:

    previous_i = i

    # store the list of words of ith string in a, ex: a = ['tokidoki', 'The', 'Queen', 'of', 'Diamonds'
, 'Women's', 'Shirt', 'X-Large']
    a = data['title'].loc[indices[i]].split()

    # search for the similar products sequentially
    j = i+1
    while j < num_data_points:

        # store the list of words of jth string in b, ex: b = ['tokidoki', 'The', 'Queen', 'of', 'Diamo
nds', 'Women's', 'Shirt', 'Small']
        b = data['title'].loc[indices[j]].split()

        # store the maximum length of two strings
        length = max(len(a), len(b))

        # count is used to store the number of words that are matched in both strings
        count  = 0

        # itertools.zip_longest(a,b): will map the corresponding words in both strings, it will appened
None in case of unequal strings
        # example: a =['a', 'b', 'c', 'd']
        # b = ['a', 'b', 'd']
        # itertools.zip_longest(a,b): will give [('a','a'), ('b','b'), ('c','d'), ('d', None)]
        for k in itertools.zip_longest(a,b):
            if (k[0] == k[1]):
                count += 1

        # if the number of words in which both strings differ are > 2 , we are considering it as those
two apperals are different
        # if the number of words in which both strings differ are < 2 , we are considering it as those
two apperals are same, hence we are ignoring them
        if (length - count) > 2: # number of words in which both sensences differ
            # if both strings are differ by more than 2 words we include the 1st string index
            stage1_dedupe_asins.append(data_sorted['asin'].loc[indices[i]])

            # if the comaprision between is between num_data_points, num_data_points-1 strings and they
differ in more than 2 words we include both
            if j == num_data_points-1: stage1_dedupe_asins.append(data_sorted['asin'].loc[indices[j]])

            # start searching for similar apperals corresponds 2nd string
            i = j
            break
        else:
            j += 1
    if previous_i == i:
```

```
        break
```

Take only those 'asins' which have not similar Titles(After removing titles that differ only in last few words)

In [0]:

```
data = data.loc[data['asin'].isin(stage1_dedupe_asins)]
```

We removed the dupliactes which differ only at the end.

In [0]:

```
print('Number of data points : ', data.shape[0])
```

```
Number of data points :  17593
```

In [0]:

```
data.to_pickle('pickels/17k_apperal_data')
```

[5.2.3] Remove duplicates : Part 2

In the previous cell, we sorted whole data in alphabetical order of titles.Then, we removed tit les which are adjacent and very similar title

But there are some products whose titles are not adjacent but very similar.

Examples:

Titles-1
86261. UltraClub Women's Classic Wrinkle-Free Long Sleeve Oxford Shirt, Pink, XX-Large
115042. UltraClub Ladies Classic Wrinkle-Free Long-Sleeve Oxford Light Blue XXL

TItles-2
75004. EVALY Women's Cool University Of UTAH 3/4 Sleeve Raglan Tee
109225. EVALY Women's Unique University Of UTAH 3/4 Sleeve Raglan Tees
120832. EVALY Women's New University Of UTAH 3/4-Sleeve Raglan Tshirt

In [0]:

```
data = pd.read_pickle('pickels/17k_apperal_data')
```

In [0]:

```
# This code snippet takes significant amount of time.
# O(n^2) time.
# Takes about an hour to run on a decent computer.

indices = []
for i,row in data.iterrows():
    indices.append(i)

stage2_dedupe_asins = []
while len(indices)!=0:
    i = indices.pop()
    stage2_dedupe_asins.append(data['asin'].loc[i])
    # consider the first apperal's title
    a = data['title'].loc[i].split()
    # store the list of words of ith string in a, ex: a = ['tokidoki', 'The', 'Queen', 'of', 'Diamonds'
, 'Women's', 'Shirt', 'X-Large']
    for j in indices:

        b = data['title'].loc[j].split()
        # store the list of words of jth string in b, ex: b = ['tokidoki', 'The', 'Queen', 'of', 'Diamo
nds', 'Women's', 'Shirt', 'X-Large']
```

```
        length = max(len(a),len(b))

        # count is used to store the number of words that are matched in both strings
        count  = 0

        # itertools.zip_longest(a,b): will map the corresponding words in both strings, it will appened
None in case of unequal strings
        # example: a =['a', 'b', 'c', 'd']
        # b = ['a', 'b', 'd']
        # itertools.zip_longest(a,b): will give [('a','a'), ('b','b'), ('c','d'), ('d', None)]
        for k in itertools.zip_longest(a,b):
            if (k[0]==k[1]):
                count += 1

        # if the number of words in which both strings differ are < 3 , we are considering it as those
two apperals are same, hence we are ignoring them
        if (length - count) < 3:
            indices.remove(j)
```

In [0]:

```
# from whole previous products we will consider only
# the products that are found in previous cell
data = data.loc[data['asin'].isin(stage2_dedupe_asins)]
```

In [0]:

```
print('Number of data points after stage two of dedupe: ',data.shape[0])
# from 17k apperals we reduced to 16k apperals
```

```
Number of data points after stage two of dedupe:  16042
```

In [0]:

```
data.to_pickle('pickels/16k_apperal_data')
# Storing these products in a pickle file
# candidates who wants to download these files instead
# of 180K they can download and use them from the Google Drive folder.
```

6. Text pre-processing

In [0]:

```
data = pd.read_pickle('pickels/16k_apperal_data')

# NLTK download stop words. [RUN ONLY ONCE]
# goto Terminal (Linux/Mac) or Command-Prompt (Window)
# In the temrinal, type these commands
# $python3
# $import nltk
# $nltk.download()
```

In [0]:

```
# we use the list of stop words that are downloaded from nltk lib.
stop_words = set(stopwords.words('english'))
print ('list of stop words:', stop_words)

def nlp_preprocessing(total_text, index, column):
    if type(total_text) is not int:
        string = ""
        for words in total_text.split():
            # remove the special chars in review like '"#$@!%^&*()_+-~?>< etc.
            word = ("".join(e for e in words if e.isalnum()))
            # Conver all letters to lower-case
            word = word.lower()
            # stop-word removal
            if not word in stop_words:
                string += word + " "
        data[column][index] = string
```

```
list of stop words: {'such', 'and', 'hers', 'up', 'she', 'd', 'further', 'all', 'than', 'under', 'is',
'off', 'both', 'most', 'few', 'should', 're', 'very', 'just', 'then', 'didn', 'myself', 'in', 'too', 's
', 'shouldn', 'herself', 'because', 'how', 'itself', 'what', 'shan', 'weren', 'doing', 'them', 'couldn'
```

```
, 'their', 'so', 'ain', 'haven', 'yourself', 'now', 'll', 'isn', 'about', 'over', 'into', 'before', 'du
ring', 'on', 'as', 'aren', 'against', 'above', 'down', 'they', 'below', 'me', 'again', 'for', 'why', 'b
een', 'yourselves', 'more', 'her', 'that', 'can', 'am', 'was', 'themselves', 'mightn', 'does', 'those',
'only', 'hasn', 'any', 'ma', 'are', 'nor', 'out', 'you', 'ourselves', 'the', 'an', 'has', 'where', 'i',
'while', 'ours', 'its', 'your', 'had', 'were', 'being', 'no', 'or', 'needn', 've', 'y', 'a', 'each', 'h
ave', 'through', 'when', 'mustn', 'by', 'won', 'from', 'own', 'will', 'there', 't', 'him', 'these', 'do
esn', 'theirs', 'my', 'did', 'of', 'who', 'until', 'wouldn', 'we', 'do', 'having', 'yours', 'other', 'w
asn', 'it', 'with', 'once', 'here', 'don', 'o', 'whom', 'this', 'if', 'but', 'hadn', 'our', 'some', 'm'
, 'not', 'between', 'himself', 'same', 'at', 'be', 'he', 'after', 'which', 'to', 'his'}
```

In [0]:

```
start_time = time.clock()
# we take each title and we text-preprocess it.
for index, row in data.iterrows():
    nlp_preprocessing(row['title'], index, 'title')
# we print the time it took to preprocess whole titles
print(time.clock() - start_time, "seconds")
```

```
3.5727220000000006 seconds
```

In [0]:

```
data.head()
```

Out[0]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
4	B004GSI2OS	FeatherLite	Onyx Black/ Stone	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies long sleeve stain resistant...	$26.26
6	B012YX2ZPI	HX-Kingdom Fashion T-shirts	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	womens unique 100 cotton special olympics wor...	$9.99
15	B003BSRPB0	FeatherLite	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies moisture free mesh sport sh...	$20.54
27	B014ICEJ1Q	FNC7C	Purple	https://images-na.ssl-images-amazon.com/images...	SHIRT	supernatural chibis sam dean castiel neck tshi...	$7.39
46	B01NACPBG2	Fifth Degree	Black	https://images-na.ssl-images-amazon.com/images...	SHIRT	fifth degree womens gold foil graphic tees jun...	$6.95

In [0]:

```
data.to_pickle('pickels/16k_apperal_data_preprocessed')
```

Stemming

In [0]:

```
from nltk.stem.porter import *
stemmer = PorterStemmer()
print(stemmer.stem('arguing'))
print(stemmer.stem('fishing'))


# We tried using stemming on our titles and it didnot work very well.
```

```
argu
fish
```

[8] Text based product similarity

In [0]:

```
data = pd.read_pickle('pickels/16k_apperal_data_preprocessed')
data.head()
```

Out[0]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
4	B004GSI2OS	FeatherLite	Onyx Black/ Stone	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies long sleeve stain resistant...	$26.26
6	B012YX2ZPI	HX-Kingdom Fashion T-shirts	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	womens unique 100 cotton special olympics wor...	$9.99
15	B003BSRPB0	FeatherLite	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies moisture free mesh sport sh...	$20.54
27	B014ICEJ1Q	FNC7C	Purple	https://images-na.ssl-images-amazon.com/images...	SHIRT	supernatural chibis sam dean castiel neck tshi...	$7.39
46	B01NACPBG2	Fifth Degree	Black	https://images-na.ssl-images-amazon.com/images...	SHIRT	fifth degree womens gold foil graphic tees jun...	$6.95

In [0]:

```
# Utility Functions which we will use through the rest of the workshop.


#Display an image
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)

#plotting code to understand the algorithm's decision.
def plot_heatmap(keys, values, labels, url, text):
        # keys: list of words of recommended title
        # values: len(values) ==  len(keys), values(i) represents the occurence of the word keys(i)
        # labels: len(labels) == len(keys), the values of labels depends on the model we are using
                # if model == 'bag of words': labels(i) = values(i)
                # if model == 'tfidf weighted bag of words':labels(i) = tfidf(keys(i))
                # if model == 'idf weighted bag of words':labels(i) = idf(keys(i))
        # url : apparel's url

        # we will devide the whole figure into two parts
        gs = gridspec.GridSpec(2, 2, width_ratios=[4,1], height_ratios=[4,1])
        fig = plt.figure(figsize=(25,3))

        # 1st, ploting heat map that represents the count of commonly ocurred words in title2
        ax = plt.subplot(gs[0])
        # it displays a cell in white color if the word is intersection(lis of words of title1 and list
of words of title2), in black if not
        ax = sns.heatmap(np.array([values]), annot=np.array([labels]))
        ax.set_xticklabels(keys) # set that axis labels as the words of title
        ax.set_title(text) # apparel title

        # 2nd, plotting image of the the apparel
        ax = plt.subplot(gs[1])
        # we don't want any grid lines for image and no labels on x-axis and y-axis
        ax.grid(False)
```

```
        ax.grid(False)
        ax.set_xticks([])
        ax.set_yticks([])

        # we call dispaly_img based with paramete url
        display_img(url, ax, fig)

        # displays combine figure ( heat map and image together)
        plt.show()

def plot_heatmap_image(doc_id, vec1, vec2, url, text, model):

    # doc_id : index of the title1
    # vec1 : input apparels's vector, it is of a dict type {word:count}
    # vec2 : recommended apparels's vector, it is of a dict type {word:count}
    # url : apparels image url
    # text: title of recomonded apparel (used to keep title of image)
    # model, it can be any of the models,
        # 1. bag_of_words
        # 2. tfidf
        # 3. idf

    # we find the common words in both titles, because these only words contribute to the distance betw
een two title vec's
    intersection = set(vec1.keys()) & set(vec2.keys())

    # we set the values of non intersecting words to zero, this is just to show the difference in heatm
ap
    for i in vec2:
        if i not in intersection:
            vec2[i]=0

    # for labeling heatmap, keys contains list of all words in title2
    keys = list(vec2.keys())
    #  if ith word in intersection(lis of words of title1 and list of words of title2): values(i)=count
of that word in title2 else values(i)=0
    values = [vec2[x] for x in vec2.keys()]

    # labels: len(labels) == len(keys), the values of labels depends on the model we are using
        # if model == 'bag of words': labels(i) = values(i)
        # if model == 'tfidf weighted bag of words':labels(i) = tfidf(keys(i))
        # if model == 'idf weighted bag of words':labels(i) = idf(keys(i))

    if model == 'bag_of_words':
        labels = values
    elif model == 'tfidf':
        labels = []
        for x in vec2.keys():
            # tfidf_title_vectorizer.vocabulary_ it contains all the words in the corpus
            # tfidf_title_features[doc_id, index_of_word_in_corpus] will give the tfidf value of word i
n given document (doc_id)
            if x in  tfidf_title_vectorizer.vocabulary_:
                labels.append(tfidf_title_features[doc_id, tfidf_title_vectorizer.vocabulary_[x]])
            else:
                labels.append(0)
    elif model == 'idf':
        labels = []
        for x in vec2.keys():
            # idf_title_vectorizer.vocabulary_ it contains all the words in the corpus
            # idf_title_features[doc_id, index_of_word_in_corpus] will give the idf value of word in gi
ven document (doc_id)
            if x in  idf_title_vectorizer.vocabulary_:
                labels.append(idf_title_features[doc_id, idf_title_vectorizer.vocabulary_[x]])
            else:
                labels.append(0)

    plot_heatmap(keys, values, labels, url, text)


# this function gets a list of wrods along with the frequency of each
# word given "text"
def text_to_vector(text):
    word = re.compile(r'\w+')
    words = word.findall(text)
    # words stores list of all words in given string, you can try 'words = text.split()' this will also
gives same result
    return Counter(words) # Counter counts the occurence of each word in list, it returns dict type obj
```

```
ect {word1:count}



def get_result(doc_id, content_a, content_b, url, model):
    text1 = content_a
    text2 = content_b

    # vector1 = dict{word11:#count, word12:#count, etc.}
    vector1 = text_to_vector(text1)

    # vector1 = dict{word21:#count, word22:#count, etc.}
    vector2 = text_to_vector(text2)

    plot_heatmap_image(doc_id, vector1, vector2, url, text2, model)
```

[8.2] Bag of Words (BoW) on product titles.

In [0]:

```
from sklearn.feature_extraction.text import CountVectorizer
title_vectorizer = CountVectorizer()
title_features   = title_vectorizer.fit_transform(data['title'])
title_features.get_shape() # get number of rows and columns in feature matrix.
# title_features.shape = #data_points * #words_in_corpus
# CountVectorizer().fit_transform(corpus) returns
# the a sparase matrix of dimensions #data_points * #words_in_corpus

# What is a sparse vector?

# title_features[doc_id, index_of_word_in_corpus] = number of times the word occured in that doc
```

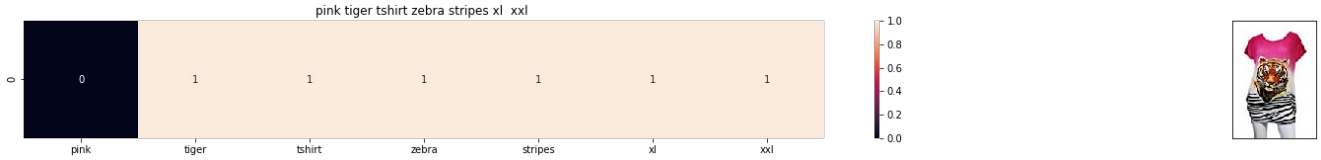
Out[0]:

```
(16042, 12609)
```

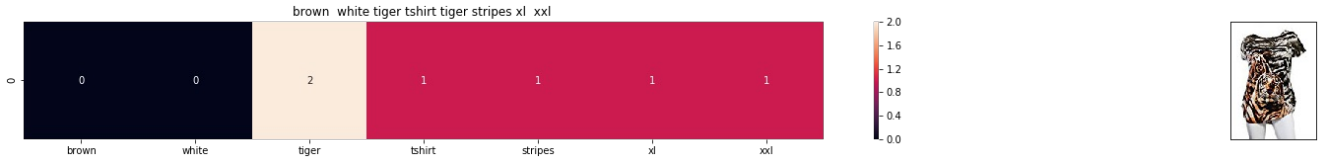
In [0]:

```
def bag_of_words_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # pairwise_dist will store the distance from given input apparel to all remaining apparels
    # the metric we used here is cosine, the cosine distance is mesured as K(X, Y) = <X, Y> / (||X||*||
Y||)
    # http://scikit-learn.org/stable/modules/metrics.html#cosine-similarity
    pairwise_dist = pairwise_distances(title_features,title_features[doc_id])

    # np.argsort will return indices of the smallest distances
    indices = np.argsort(pairwise_dist.flatten())[0:num_results]
    #pdists will store the 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)):
        # we will pass 1. doc_id, 2. title1, 3. title2, url, model
        get_result(indices[i],data['title'].loc[df_indices[0]], data['title'].loc[df_indices[i]], data[
'medium_image_url'].loc[df_indices[i]], 'bag_of_words')
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print ('Brand:', data['brand'].loc[df_indices[i]])
        print ('Title:', data['title'].loc[df_indices[i]])
        print ('Euclidean similarity with the query image :', pdists[i])
        print('='*60)

#call the bag-of-words model for a product to get similar products.
bag_of_words_model(12566, 20) # change the index if you want to.
# In the output heat map each value represents the count value
# of the label word, the color represents the intersection
# with inputs title.
# 12566 is the index of the "Query title"
#try 12566
#try 931
```

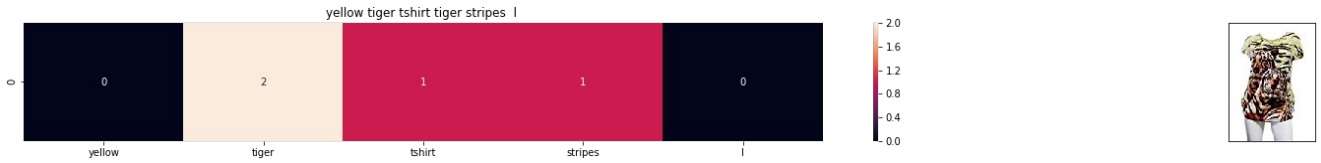
ASIN : B00JXQB5FQ
Brand: Si Row
Title: burnt umber tiger tshirt zebra stripes xl xxl
Euclidean similarity with the query image : 0.0
==========



ASIN : B00JXQASS6
Brand: Si Row
Title: pink tiger tshirt zebra stripes xl xxl
Euclidean similarity with the query image : 1.73205080757
==========

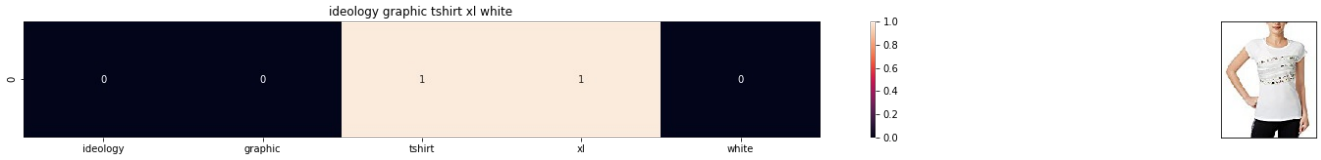


ASIN : B00JXQCWTO
Brand: Si Row
Title: brown white tiger tshirt tiger stripes xl xxl
Euclidean similarity with the query image : 2.44948974278
==========

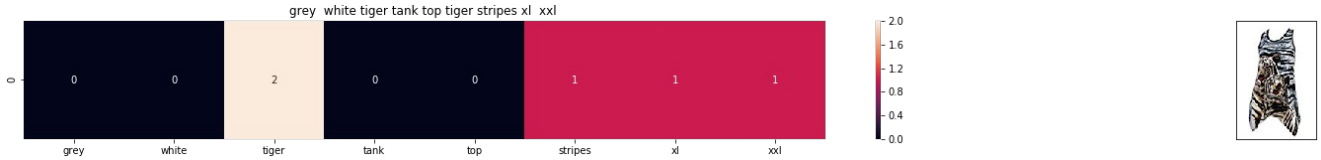


ASIN : B00JXQCUIC
Brand: Si Row
Title: yellow tiger tshirt tiger stripes l
Euclidean similarity with the query image : 2.64575131106
==========

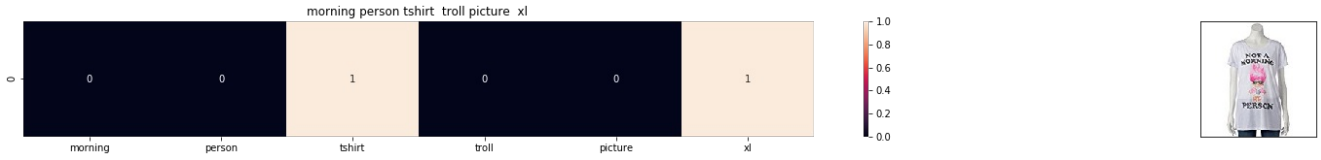
ASIN : B07568NZX4
Brand: Rustic Grace
Title: believed could tshirt
Euclidean similarity with the query image : 3.0
==========



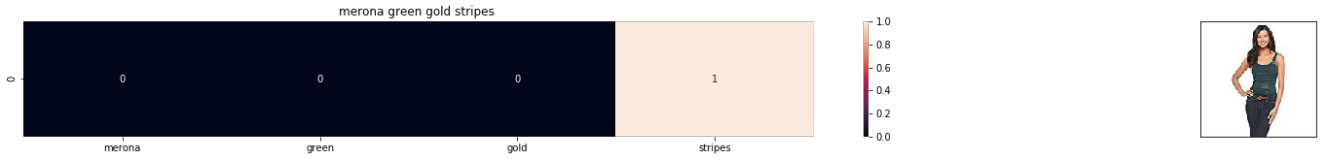
ASIN : B01NB0NKRO
Brand: Ideology
Title: ideology graphic tshirt xl white
Euclidean similarity with the query image : 3.0
==========



ASIN : B00JXQAFZ2
Brand: Si Row
Title: grey white tiger tank top tiger stripes xl xxl
Euclidean similarity with the query image : 3.0
==========

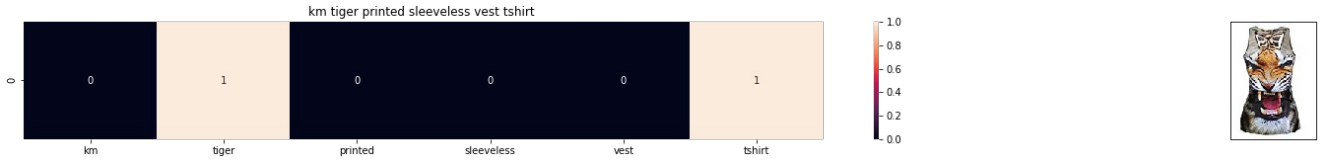


ASIN : B01CLS8LMW
Brand: Awake
Title: morning person tshirt troll picture xl
Euclidean similarity with the query image : 3.16227766017
==========



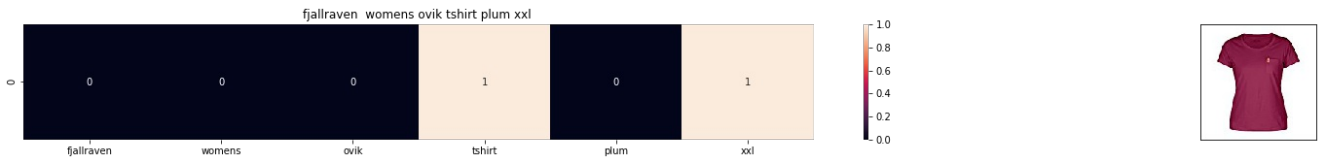
ASIN : B01KVZUB6G
Brand: Merona
Title: merona green gold stripes
Euclidean similarity with the query image : 3.16227766017
==========

ASIN : B0733R2CJK
Brand: BLVD
Title: blvd womens graphic tshirt l
Euclidean similarity with the query image : 3.16227766017
==========



ASIN : B012VQLT6Y
Brand: KM T-shirt
Title: km tiger printed sleeveless vest tshirt
Euclidean similarity with the query image : 3.16227766017
==========

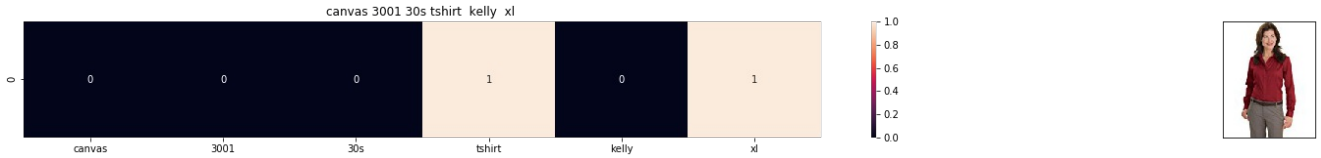
ASIN : B00JXQC8L6
Brand: Si Row
Title: blue peacock print tshirt l
Euclidean similarity with the query image : 3.16227766017
==========



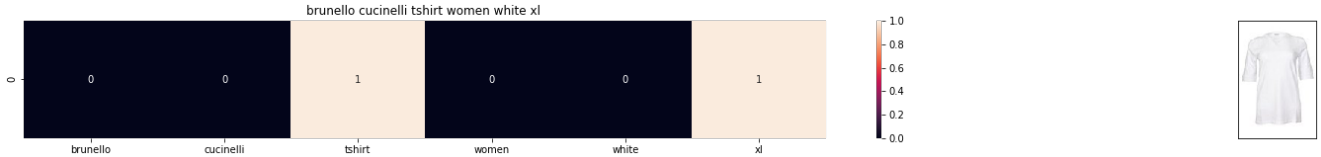
ASIN : B06XC3CZF6
Brand: Fjallraven
Title: fjallraven womens ovik tshirt plum xxl
Euclidean similarity with the query image : 3.16227766017
==========

==

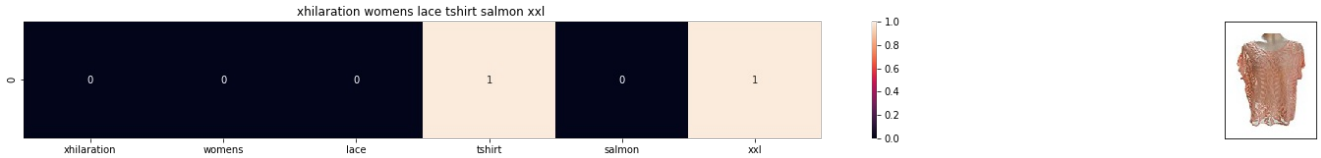
ASIN : B005IT8OBA
Brand: Hetalia
Title: hetalia us girl tshirt
Euclidean similarity with the query image : 3.16227766017
==



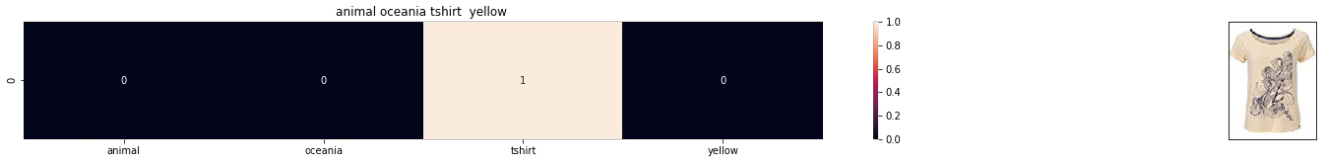
ASIN : B0088PN0LA
Brand: Red House
Title: canvas 3001 30s tshirt kelly xl
Euclidean similarity with the query image : 3.16227766017
==



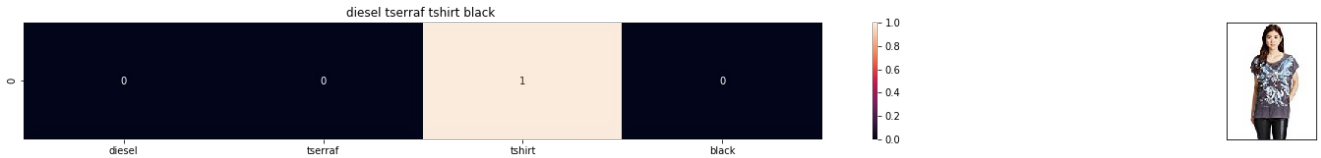
ASIN : B06X99V6WC
Brand: Brunello Cucinelli
Title: brunello cucinelli tshirt women white xl
Euclidean similarity with the query image : 3.16227766017
==



ASIN : B06Y1JPW1Q
Brand: Xhilaration
Title: xhilaration womens lace tshirt salmon xxl
Euclidean similarity with the query image : 3.16227766017
==



ASIN : B06X6GX6WG
Brand: Animal
Title: animal oceania tshirt yellow
Euclidean similarity with the query image : 3.16227766017
==



ASIN : B017X8PW9U
Brand: Diesel
Title: diesel tserraf tshirt black
Euclidean similarity with the query image : 3.16227766017
==

ASIN : B00IAA4JIQ
Brand: I Love Lucy
Title: juniors love lucywaaaaahhhh tshirt size xl
Euclidean similarity with the query image : 3.16227766017
==

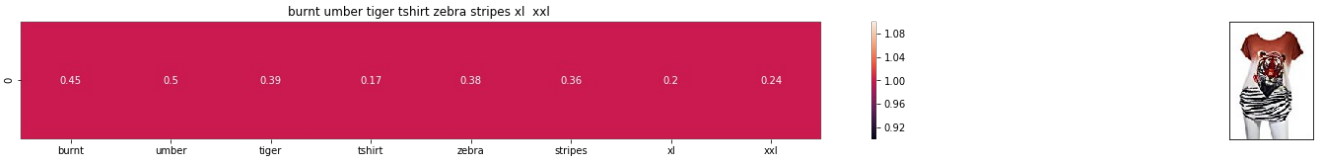
[8.5] TF-IDF based product similarity

In [0]:

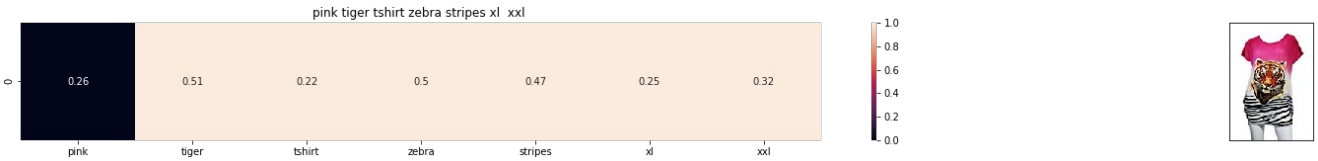
```
tfidf_title_vectorizer = TfidfVectorizer(min_df = 0)
tfidf_title_features = tfidf_title_vectorizer.fit_transform(data['title'])
# tfidf_title_features.shape = #data_points * #words_in_corpus
# CountVectorizer().fit_transform(courpus) returns the a sparase matrix of dimensions #data_points * #w
ords_in_corpus
# tfidf_title_features[doc_id, index_of_word_in_corpus] = tfidf values of the word in given doc
```

In [0]:

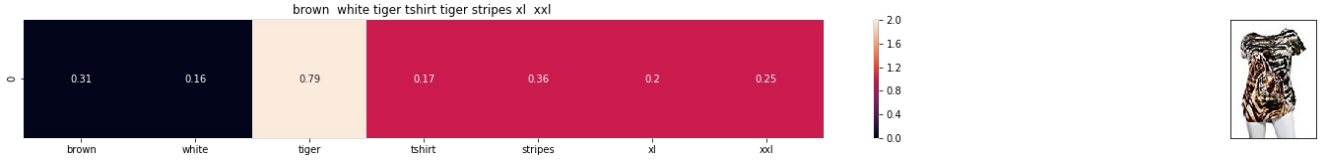
```
def tfidf_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # 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
    pairwise_dist = pairwise_distances(tfidf_title_features,tfidf_title_features[doc_id])

    # 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)):
        # we will pass 1. doc_id, 2. title1, 3. title2, url, model
        get_result(indices[i], data['title'].loc[df_indices[0]], data['title'].loc[df_indices[i]], data
['medium_image_url'].loc[df_indices[i]], 'tfidf')
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print('BRAND :',data['brand'].loc[df_indices[i]])
        print ('Eucliden distance from the given image :', pdists[i])
        print('='*125)
tfidf_model(12566, 20)
# in the output heat map each value represents the tfidf values of the label word, the color represents
the intersection with inputs title
```



ASIN : B00JXQB5FQ
BRAND : Si Row
Eucliden distance from the given image : 0.0
==



ASIN : B00JXQASS6
BRAND : Si Row
Eucliden distance from the given image : 0.753633191245
==

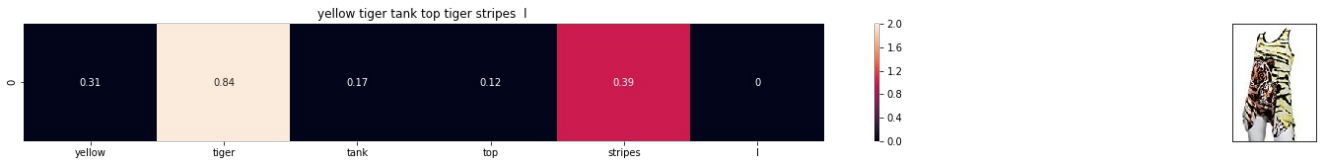


ASIN : B00JXQCWTO
BRAND : Si Row
Eucliden distance from the given image : 0.935764394377
==========

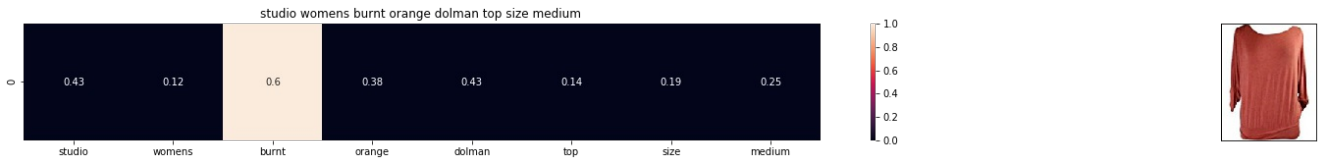
ASIN : B00JXQAFZ2
BRAND : Si Row
Eucliden distance from the given image : 0.95861535242
==========

ASIN : B00JXQCUIC
BRAND : Si Row
Eucliden distance from the given image : 1.00007496145
==========

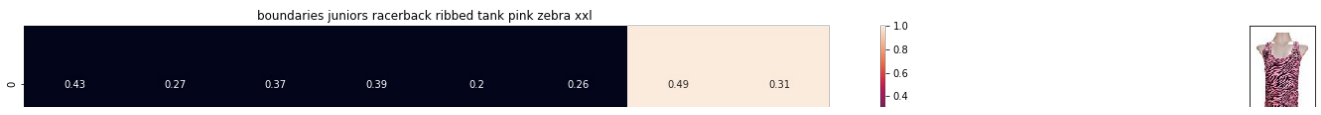
ASIN : B00JXQAO94
BRAND : Si Row
Eucliden distance from the given image : 1.02321555246
==========

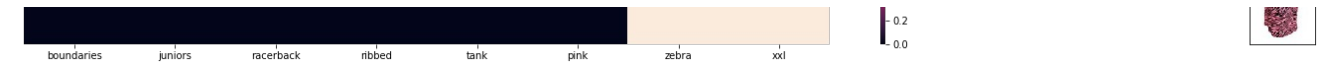


ASIN : B00JXQAUWA
BRAND : Si Row
Eucliden distance from the given image : 1.0319918463
==========

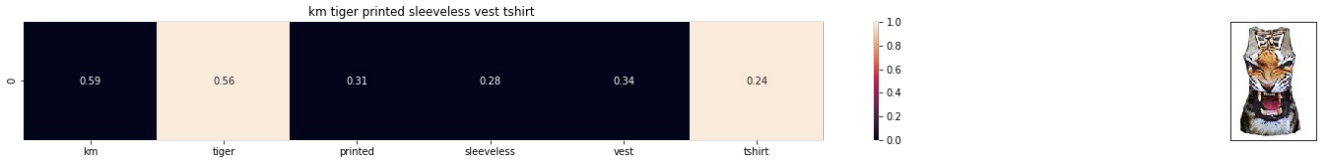


ASIN : B06XSCVFT5
BRAND : Studio M
Eucliden distance from the given image : 1.21068436704
==========



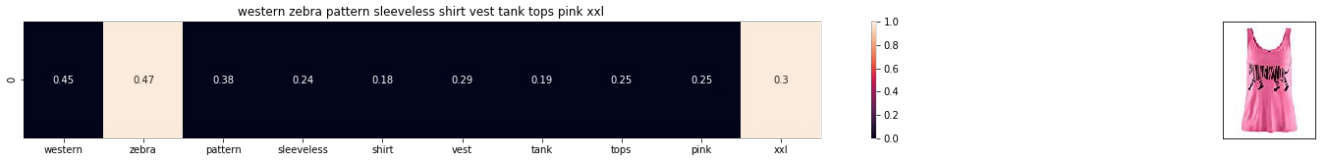


ASIN : B06Y2GTYPM
BRAND : No Boundaries
Eucliden distance from the given image : 1.21216838107
==========

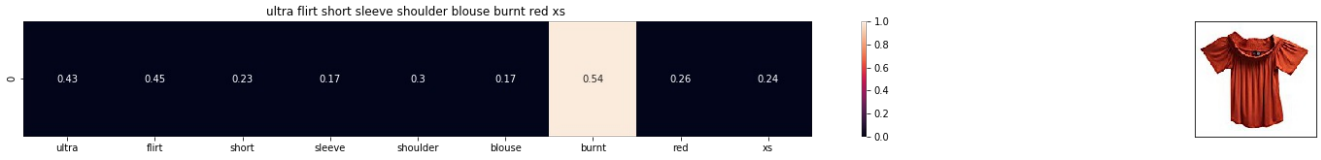


ASIN : B012VQLT6Y
BRAND : KM T-shirt
Eucliden distance from the given image : 1.21979064028
==========

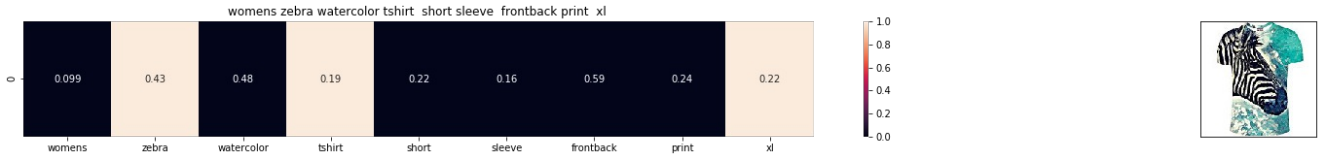
ASIN : B06Y1VN8WQ
BRAND : Black Swan
Eucliden distance from the given image : 1.220684966
==========



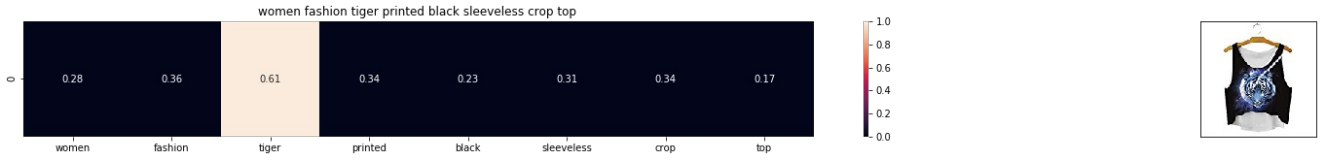
ASIN : B00Z6HEXWI
BRAND : Black Temptation
Eucliden distance from the given image : 1.22128139212
==========



ASIN : B074TR12BH
BRAND : Ultra Flirt
Eucliden distance from the given image : 1.23133640946
==========

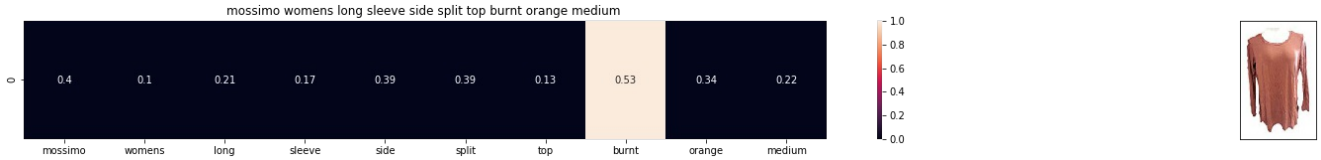


ASIN : B072R2JXKW
BRAND : WHAT ON EARTH
Eucliden distance from the given image : 1.23184519726
==========

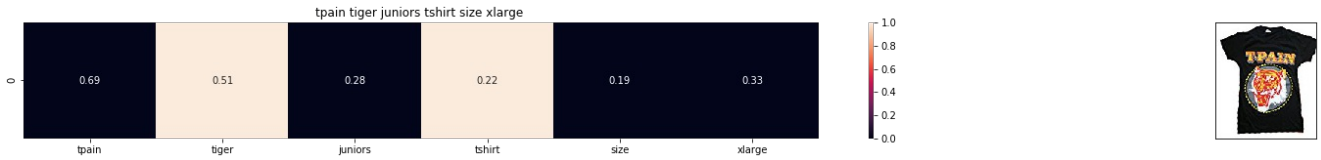


ASIN : B074T8ZYGX
BRAND : MKP Crop Top

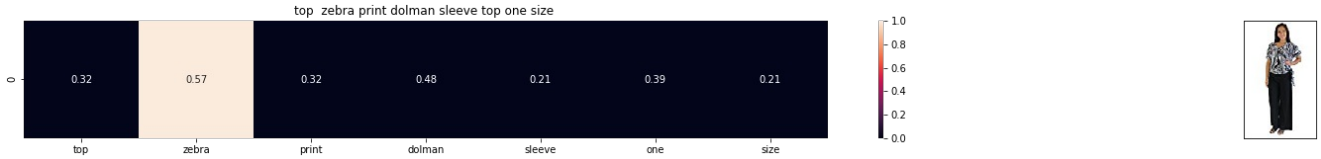
BRAND : TRL Crop Top
Eucliden distance from the given image : 1.23406074574
==========



ASIN : B071ZDF6T2
BRAND : Mossimo
Eucliden distance from the given image : 1.23527855777
==========

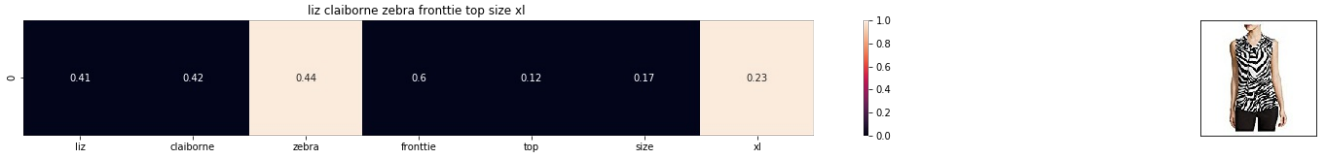


ASIN : B01K0H02OG
BRAND : Tultex
Eucliden distance from the given image : 1.23645729881
==========



ASIN : B00H8A6ZLI
BRAND : Vivian's Fashions
Eucliden distance from the given image : 1.24996155053
==========

ASIN : B010NN9RXO
BRAND : YICHUN
Eucliden distance from the given image : 1.25354614209
==========



ASIN : B06XBY5QXL
BRAND : Liz Claiborne
Eucliden distance from the given image : 1.25388329384
==========

[8.5] IDF based product similarity

In [0]:

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

# idf_title_features.shape = #data_points * #words_in_corpus
# CountVectorizer().fit_transform(courpus) returns the a sparase matrix of dimensions #data_points * #w
ords_in_corpus
```

```
# idf_title_features[doc_id, index_of_word_in_corpus] = number of times the word occured in that doc
```

In [0]:

```
def n_containing(word):
    # return the number of documents which had the given word
    return sum(1 for blob in data['title'] if word in blob.split())

def idf(word):
    # idf = log(#number of docs / #number of docs which had the given word)
    return math.log(data.shape[0] / (n_containing(word)))
```

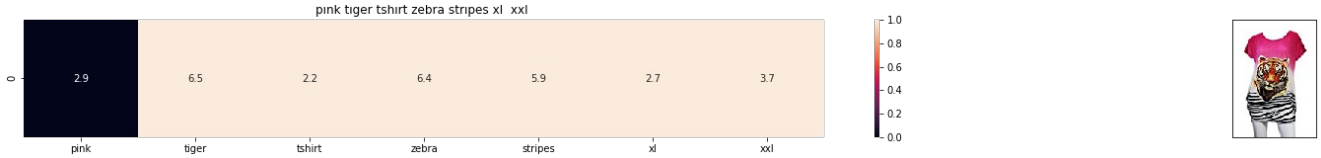
In [0]:

```
# we need to convert the values into float
idf_title_features  = idf_title_features.astype(np.float)

for i in idf_title_vectorizer.vocabulary_.keys():
    # for every word in whole corpus we will find its idf value
    idf_val = idf(i)

    # to calculate idf_title_features we need to replace the count values with the idf values of the wo
rd
    # idf_title_features[:, idf_title_vectorizer.vocabulary_[i]].nonzero()[0] will return all documents
in which the word i present
    for j in idf_title_features[:, idf_title_vectorizer.vocabulary_[i]].nonzero()[0]:

        # we replace the count values of word i in document j with  idf_value of word i
        # idf_title_features[doc_id, index_of_word_in_courpus] = idf value of word
        idf_title_features[j,idf_title_vectorizer.vocabulary_[i]] = idf_val
```

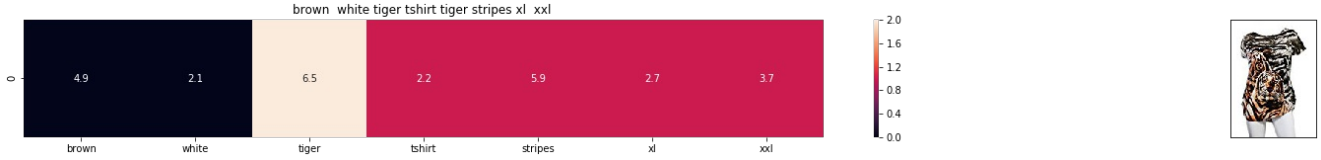
In [0]:

```
def idf_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # 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
    pairwise_dist = pairwise_distances(idf_title_features,idf_title_features[doc_id])

    # 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)):
        get_result(indices[i],data['title'].loc[df_indices[0]], data['title'].loc[df_indices[i]], data[
'medium_image_url'].loc[df_indices[i]], 'idf')
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print('Brand :',data['brand'].loc[df_indices[i]])
        print ('euclidean distance from the given image :', pdists[i])
        print('='*125)



idf_model(12566,20)
# in the output heat map each value represents the idf values of the label word, the color represents t
he intersection with inputs title
```


```
ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from the given image : 0.0
=============================================================================================================
=======================
```



ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from the given image : 12.2050713112

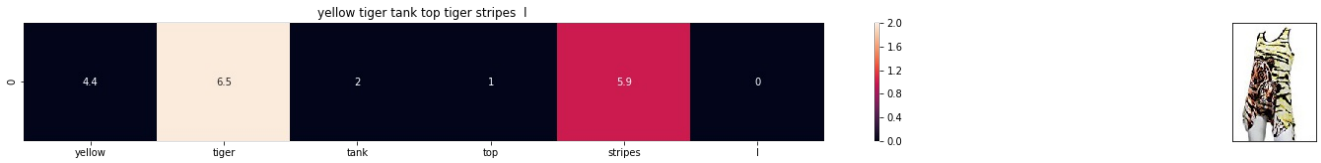


ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from the given image : 14.4683626856

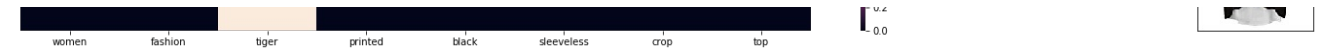
ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from the given image : 14.4868329248

ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from the given image : 14.8333929667

ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from the given image : 14.8987445167

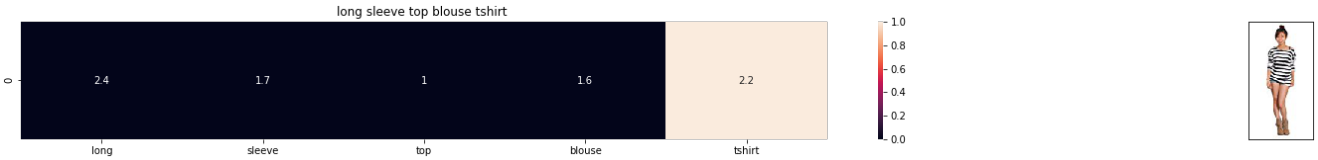


ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from the given image : 15.2244582873



ASIN : B074T8ZYGX
Brand : MKP Crop Top
euclidean distance from the given image : 17.0808129556

==========

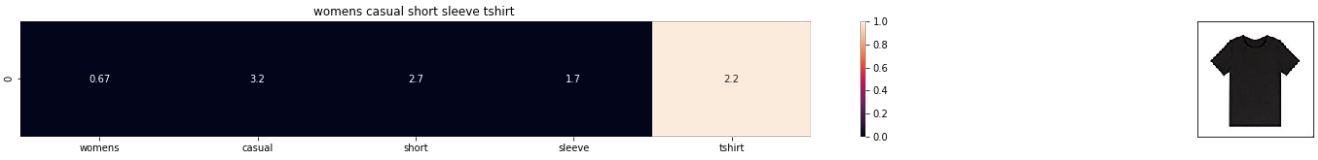


ASIN : B00KF2N5PU
Brand : Vietsbay
euclidean distance from the given image : 17.0901681256

==========

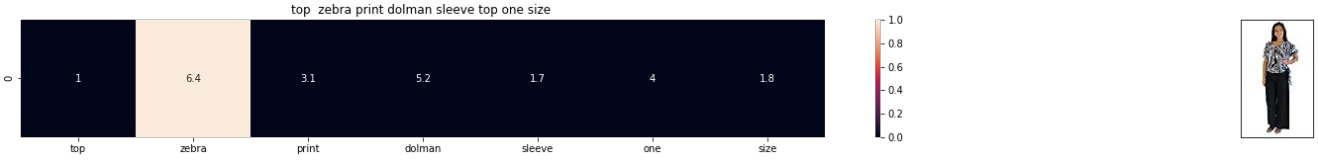
ASIN : B00JPOZ9GM
Brand : Sofra
euclidean distance from the given image : 17.1532153376

==========



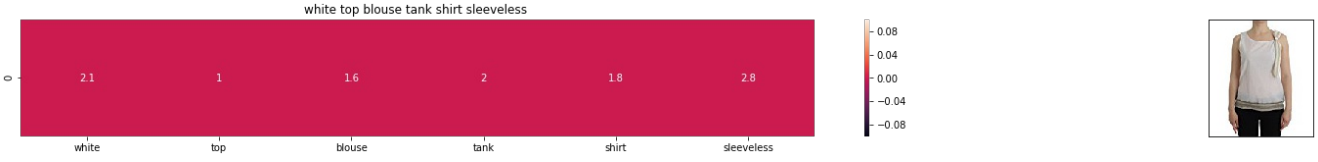
ASIN : B074T9KG9Q
Brand : Rain
euclidean distance from the given image : 17.3367152387

==========



ASIN : B00H8A6ZLI
Brand : Vivian's Fashions
euclidean distance from the given image : 17.410075941

==========

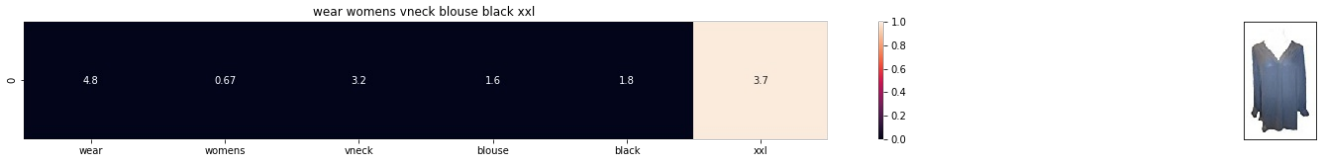


ASIN : B074G5G5RK
Brand : ERMANNO SCERVINO
euclidean distance from the given image : 17.5399213355

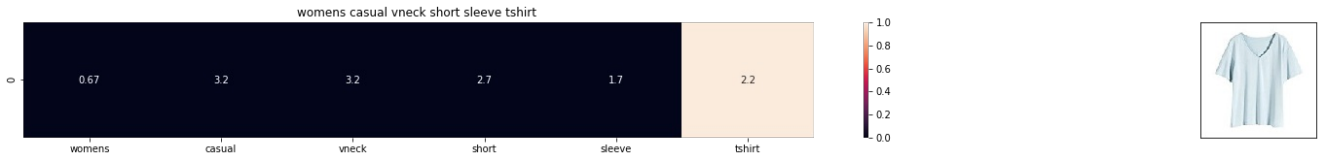
==========

ASIN : B06XSCVFT5
Brand : Studio M

euclidean distance from the given image : 17.6127585437
==========



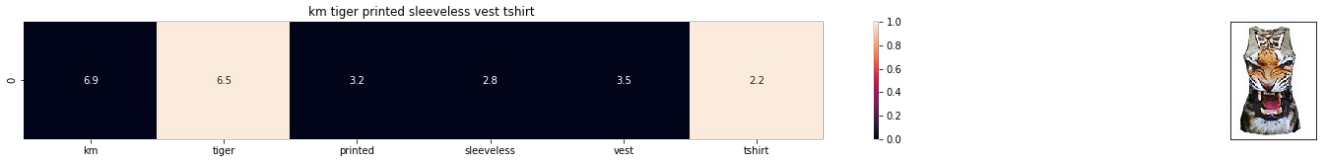
ASIN : B06Y6FH453
Brand : Who What Wear
euclidean distance from the given image : 17.6237452825
==========



ASIN : B074V45DCX
Brand : Rain
euclidean distance from the given image : 17.6343424968
==========

ASIN : B07583CQFT
Brand : Very J
euclidean distance from the given image : 17.6375371274
==========

ASIN : B073GJGVBN
Brand : Ivan Levi
euclidean distance from the given image : 17.7230738913
==========



ASIN : B012VQLT6Y
Brand : KM T-shirt
euclidean distance from the given image : 17.7625885612
==========

ASIN : B00ZZMYBRG
Brand : HP-LEISURE
euclidean distance from the given image : 17.7795368647
==========

[9] Text Semantics based product similarity

In [0]:

```
# credits: https://www.kaggle.com/c/word2vec-nlp-tutorial#part-2-word-vectors
# Custom Word2Vec using your own text data.
# Do NOT RUN this code.
# It is meant as a reference to build your own Word2Vec when you have
# lots of data.

'''
# Set values for various parameters
num_features = 300    # Word vector dimensionality
min_word_count = 1    # Minimum word count
num_workers = 4       # Number of threads to run in parallel
context = 10          # Context window size

downsampling = 1e-3   # Downsample setting for frequent words

# Initialize and train the model (this will take some time)
from gensim.models import word2vec
print ("Training model...")
model = word2vec.Word2Vec(sen_corpus, workers=num_workers, \
            size=num_features, min_count = min_word_count, \
            window = context)

'''
```

In [0]:

```
from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

# in this project we are using a pretrained model by google
# its 3.3G file, once you load this into your memory
# it occupies ~9Gb, so please do this step only if you have >12G of ram
# we will provide a pickle file wich contains a dict ,
# and it contains all our courpus words as keys and  model[word] as values
# To use this code-snippet, download "GoogleNews-vectors-negative300.bin"
# from https://drive.google.com/file/d/0B7XkCwpI5KDYNlNUTTlSS21pQmM/edit
# it's 1.9GB in size.

'''
model = KeyedVectors.load_word2vec_format('GoogleNews-vectors-negative300.bin', binary=True)
'''

#if you do NOT have RAM >= 12GB, use the code below.
# Thw 'word2vec_model' file has W2V for 12609 unique words in our data
with open('word2vec_model', 'rb') as handle:
    model = pickle.load(handle)
```

In [0]:

```
# Utility functions

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 ignori
ng 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 title
    # vec2 = np.array(#number_of_words_title2 * 300), each row is a vector of length 300 corresponds to
each word in give title

    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(sentence1, sentence2, url, doc_id1, doc_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
    # 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 each word in give title
    s1_vec = get_word_vec(sentence1, doc_id1, model)
    #s2_vec = np.array(#number_of_words_title1 * 300), each row is a vector(weighted/avg) of length 300
corresponds to each word in give title
    s2_vec = get_word_vec(sentence2, 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)



    # devide whole figure into 2 parts 1st part displays heatmap 2nd part displays image of apparel
    gs = gridspec.GridSpec(2, 2, width_ratios=[4,1],height_ratios=[2,1])
    fig = plt.figure(figsize=(15,15))

    ax = plt.subplot(gs[0])
    # ploting the heap map based on the pairwise distances
    ax = sns.heatmap(np.round(s1_s2_dist,4), annot=True)
    # set the x axis labels as recommended apparels title
    ax.set_xticklabels(sentence2.split())
    # set the y axis labels as input apparels title
    ax.set_yticklabels(sentence1.split())
    # set title as recommended apparels title
    ax.set_title(sentence2)

    ax = plt.subplot(gs[1])
    # we remove all grids and axis labels for image
    ax.grid(False)
    ax.set_xticks([])
    ax.set_yticks([])
    display_img(url, ax, fig)

    plt.show()
```

In [0]:

```
# vocab = stores all the words that are there in google w2v model
# vocab = model.wv.vocab.keys() # if you are using Google word2Vec

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.vocabul
ary_[word]] * model[word])
            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
```

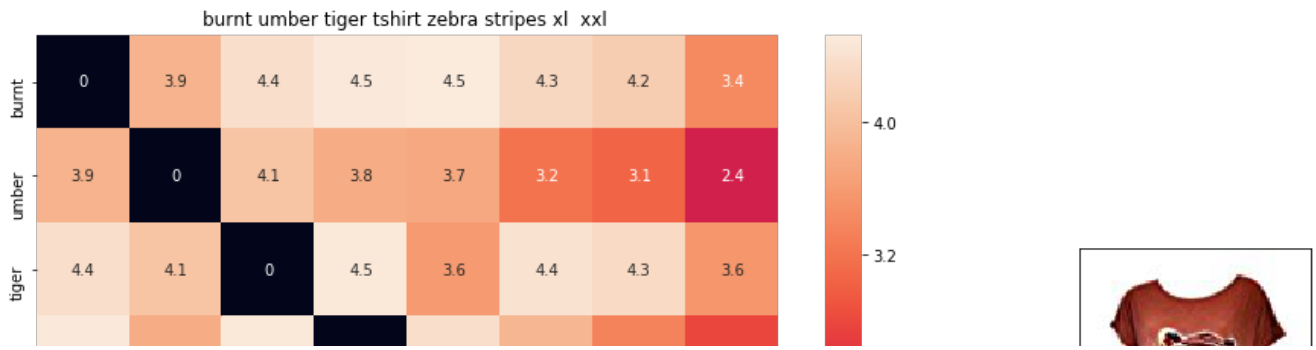
[9.2] Average Word2Vec product similarity.

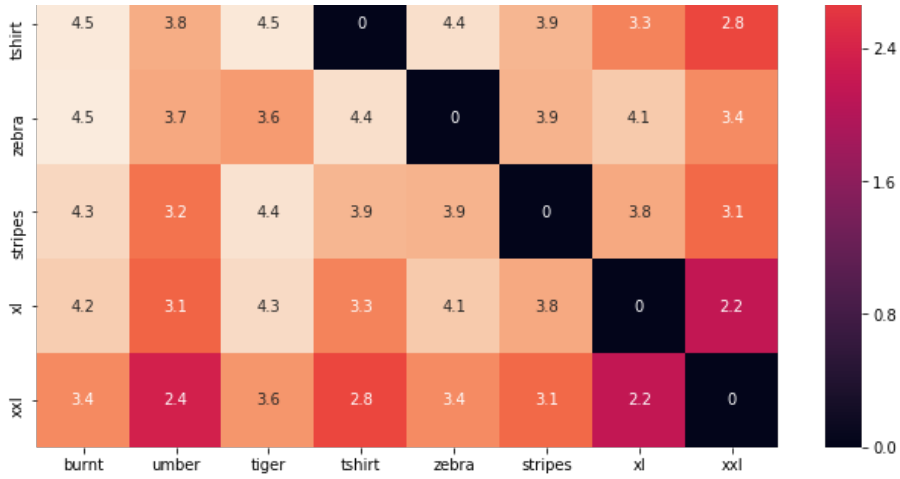
In [0]:

```
doc_id = 0
w2v_title = []
# for every title we build a avg vector representation
for i in data['title']:
    w2v_title.append(build_avg_vec(i, 300, doc_id,'avg'))
    doc_id += 1

# w2v_title = np.array(# number of doc in courpus * 300), each row corresponds to a doc
w2v_title = np.array(w2v_title)
```

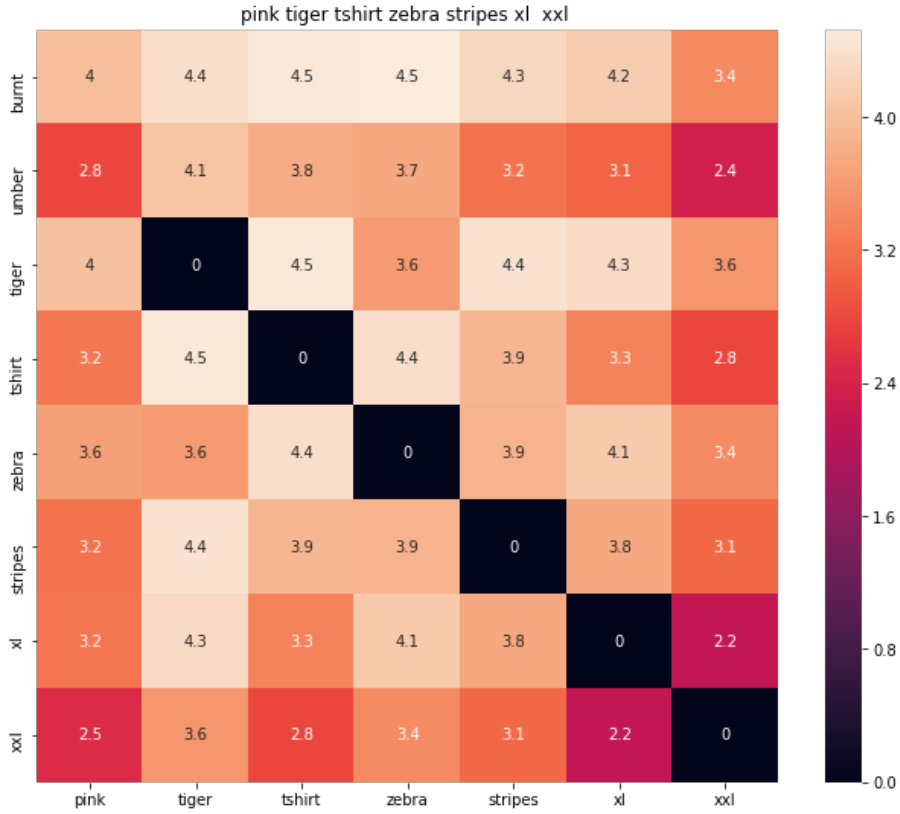
In [0]:

```
def avg_w2v_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # dist(x, y) = sqrt(dot(x, x) - 2 * dot(x, y) + dot(y, y))
    pairwise_dist = pairwise_distances(w2v_title, w2v_title[doc_id].reshape(1,-1))

    # 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(data['title'].loc[df_indices[0]],data['title'].loc[df_indices[i]], data['medium_im
age_url'].loc[df_indices[i]], indices[0], indices[i], 'avg')
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print('BRAND :',data['brand'].loc[df_indices[i]])
        print ('euclidean distance from given input image :', pdists[i])
        print('='*125)


avg_w2v_model(12566, 20)
# in the give heat map, each cell contains the euclidean distance between words i, j
```

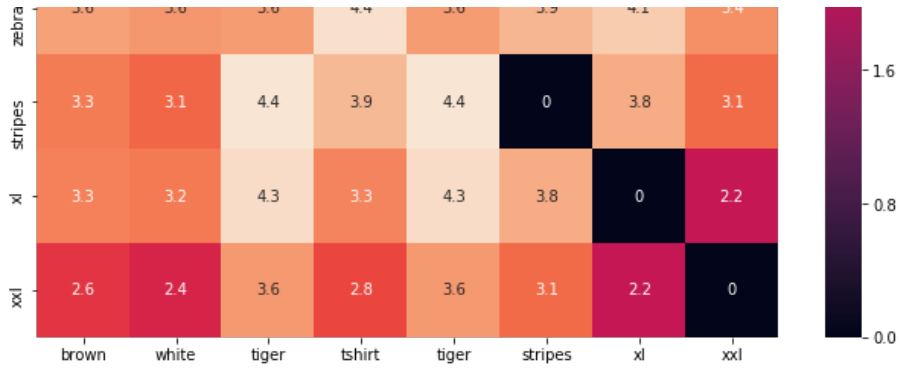




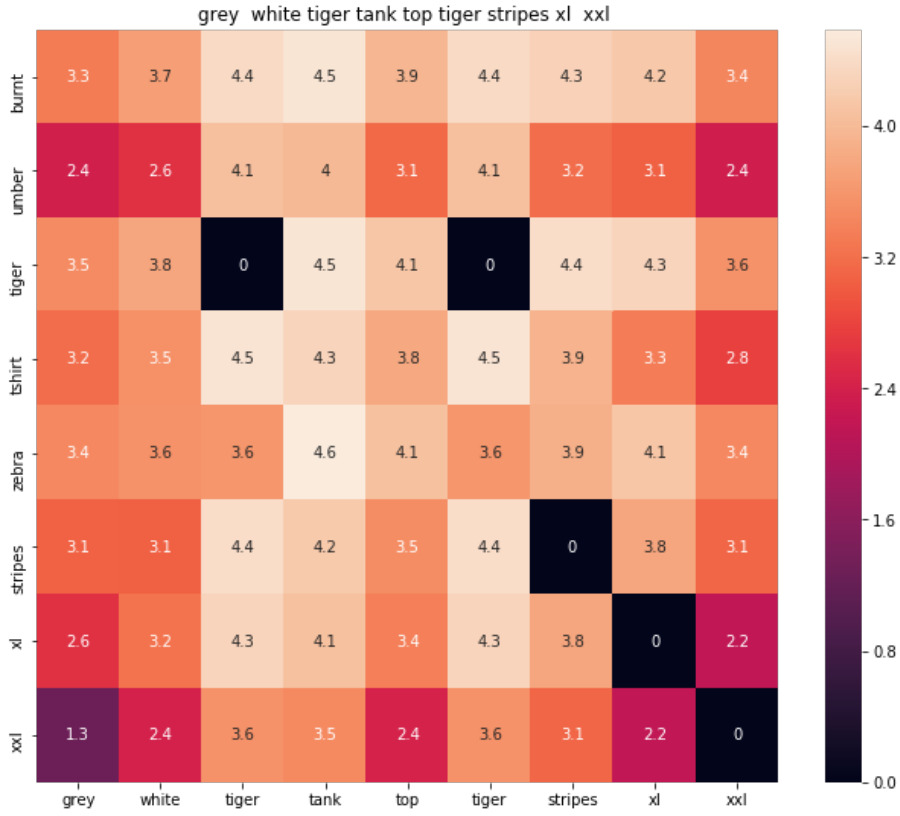
ASIN : B00JXQB5FQ
BRAND : Si Row
euclidean distance from given input image : 0.000690534



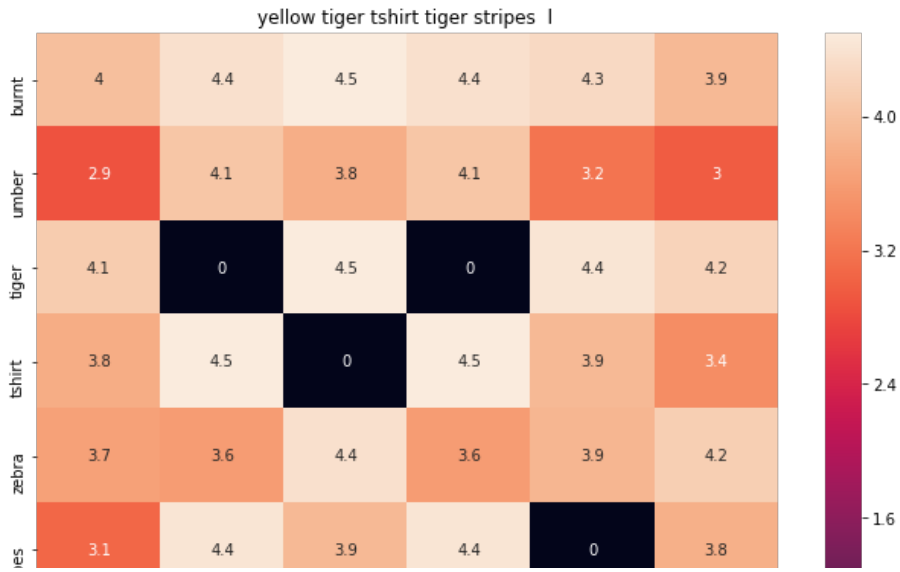
ASIN : B00JXQASS6
BRAND : Si Row
euclidean distance from given input image : 0.589193

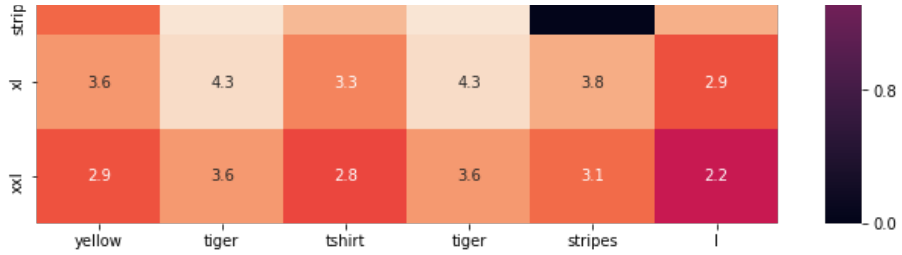


ASIN : B00JXQCWTO
BRAND : Si Row
euclidean distance from given input image : 0.700344

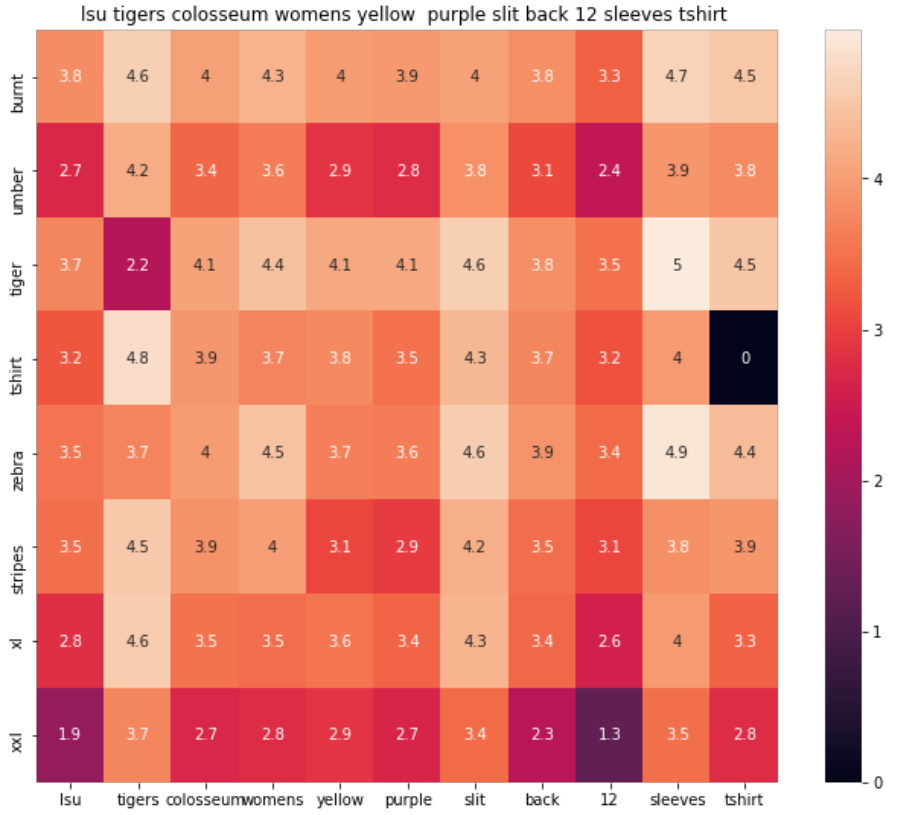


ASIN : B00JXQAFZ2
BRAND : Si Row
euclidean distance from given input image : 0.89284

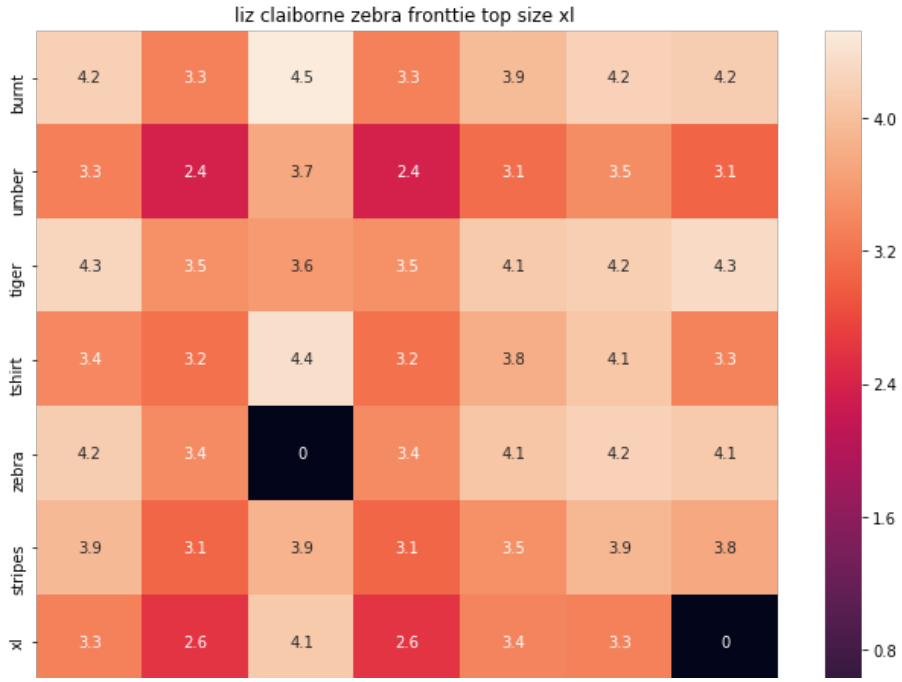


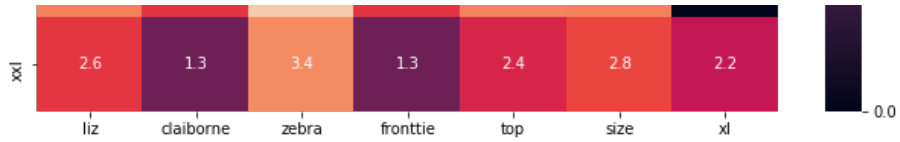


ASIN : B00JXQCUIC
BRAND : Si Row
euclidean distance from given input image : 0.956013

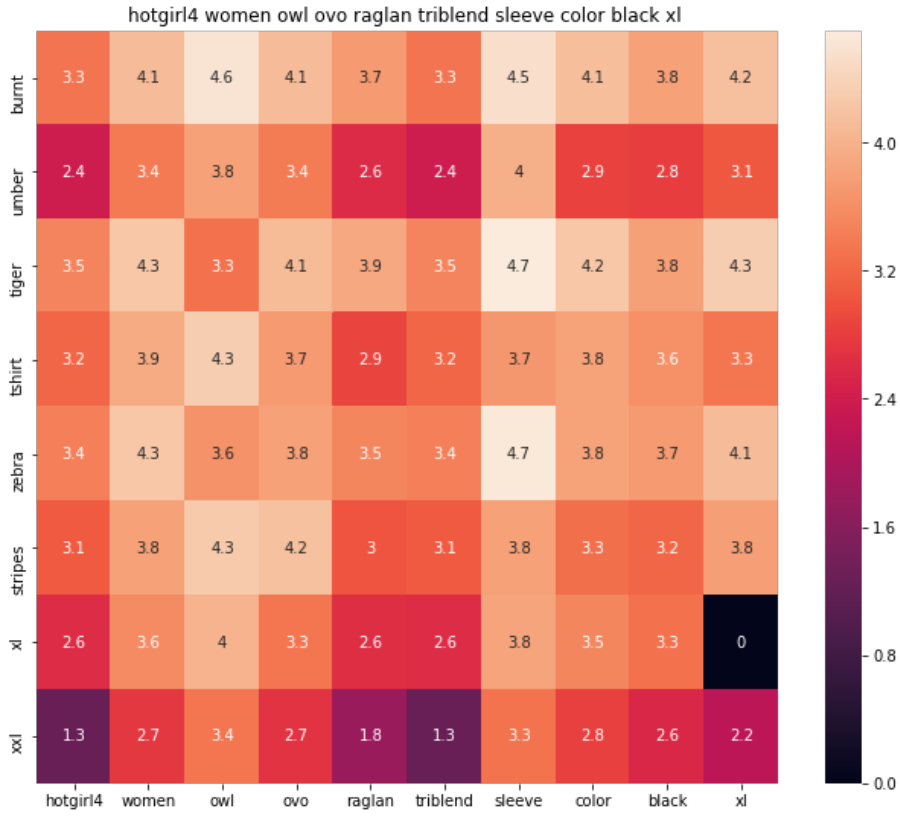


ASIN : B073R5Q8HD
BRAND : Colosseum
euclidean distance from given input image : 1.02297

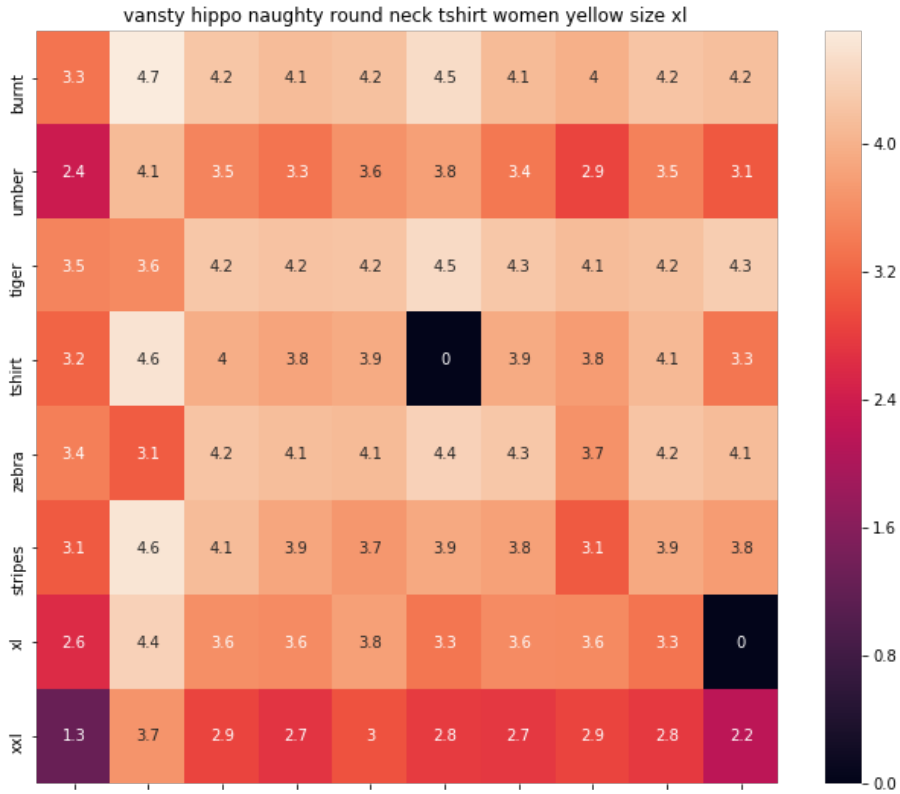




ASIN : B06XBY5QXL
BRAND : Liz Claiborne
euclidean distance from given input image : 1.06693
==========

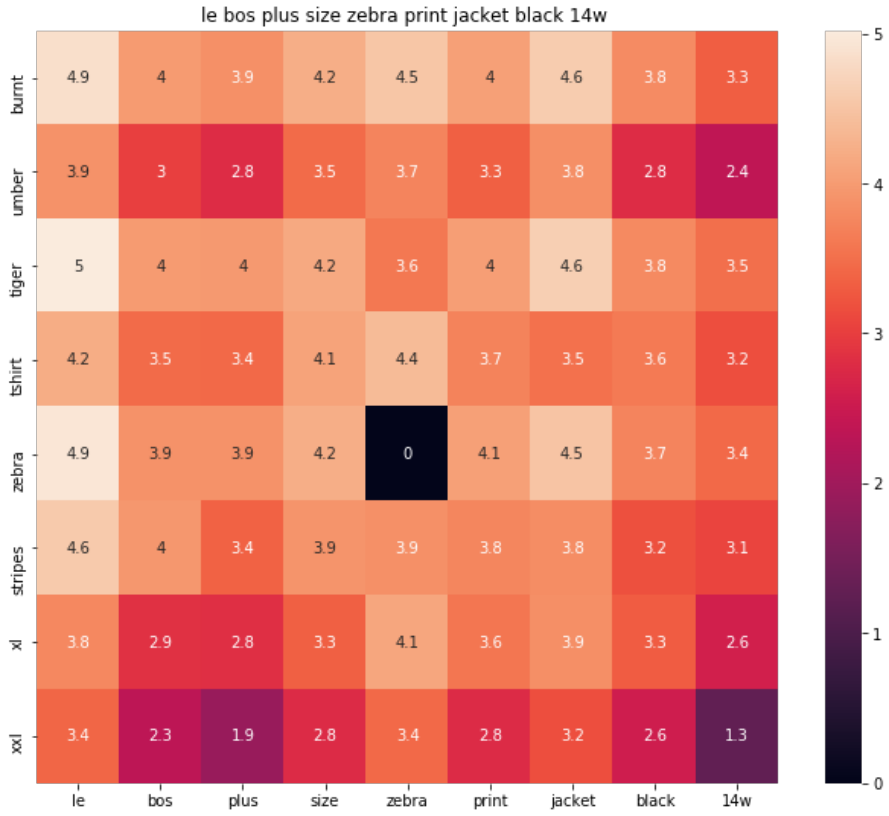


ASIN : B01L8L73M2
BRAND : Hotgirl4 Raglan Design
euclidean distance from given input image : 1.07314
==========

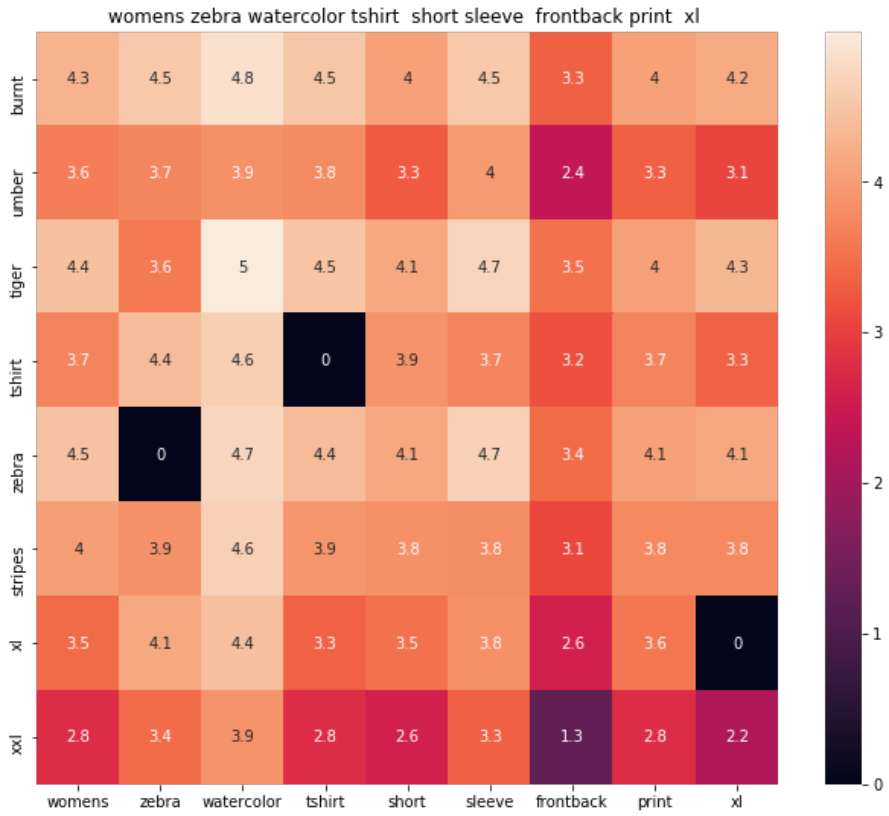


vansty hippo naughty round neck tshirt women yellow size xl

ASIN : B01EJS5H06
BRAND : Vansty
euclidean distance from given input image : 1.07572
==========



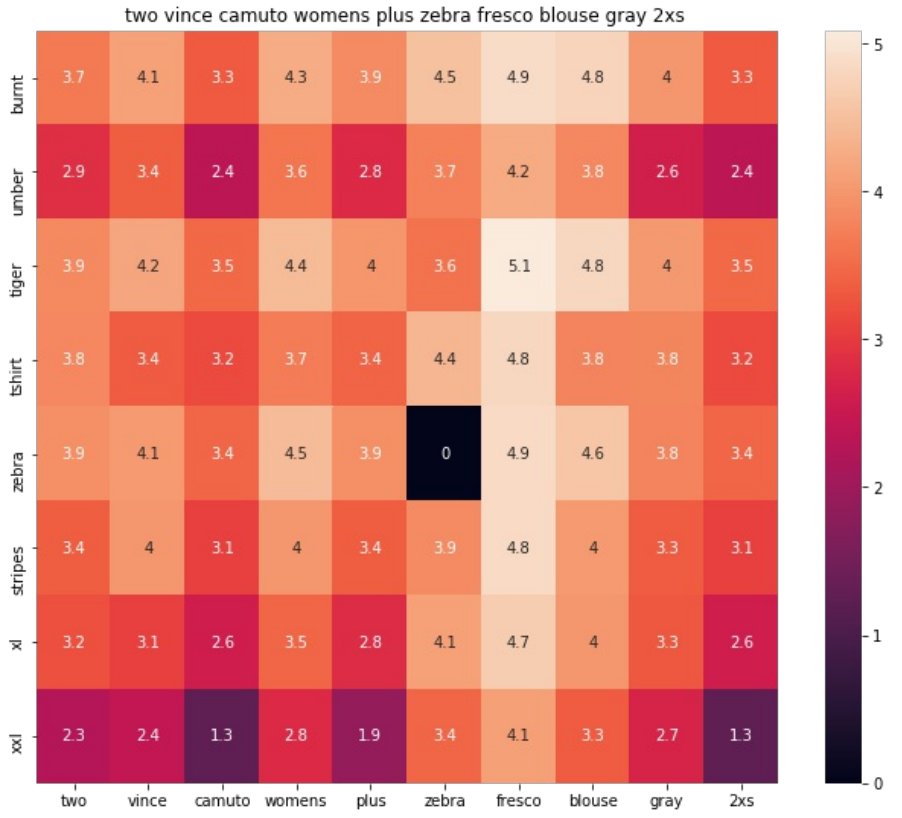
ASIN : B01BO1XRK8
BRAND : Le Bos
euclidean distance from given input image : 1.084
==========



ASIN : B072R2JXKW
BRAND : WHAT ON EARTH
euclidean distance from given input image : 1.08422

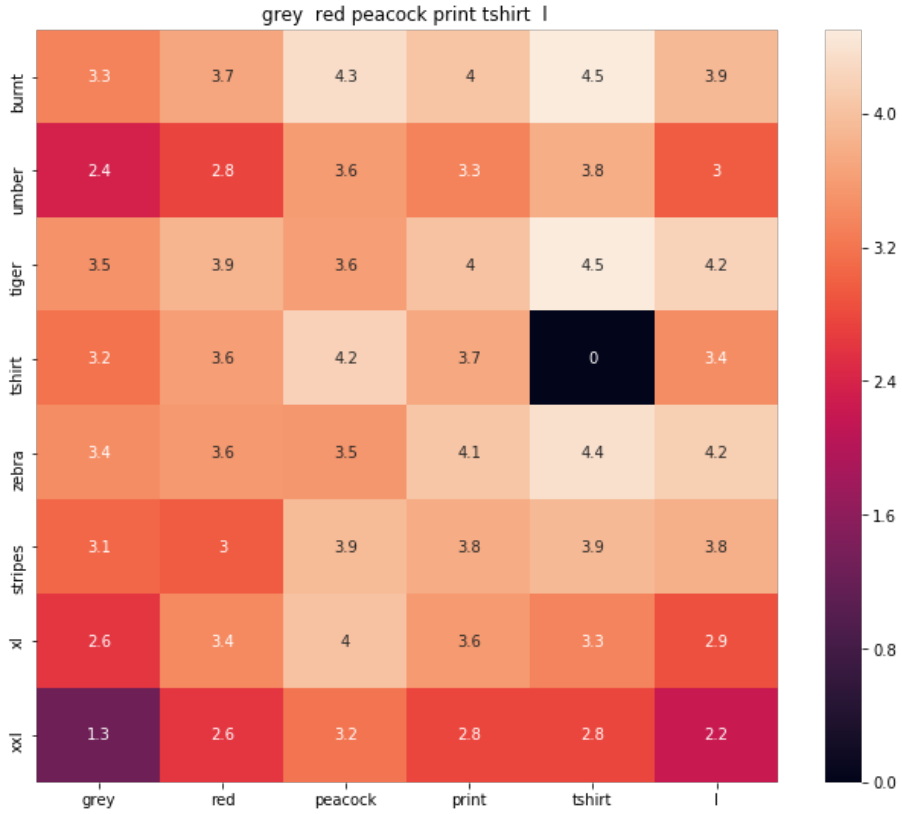
euclidean distance from given input image : 1.06422

==========



ASIN : B074MJRGW6
BRAND : Two by Vince Camuto
euclidean distance from given input image : 1.0895

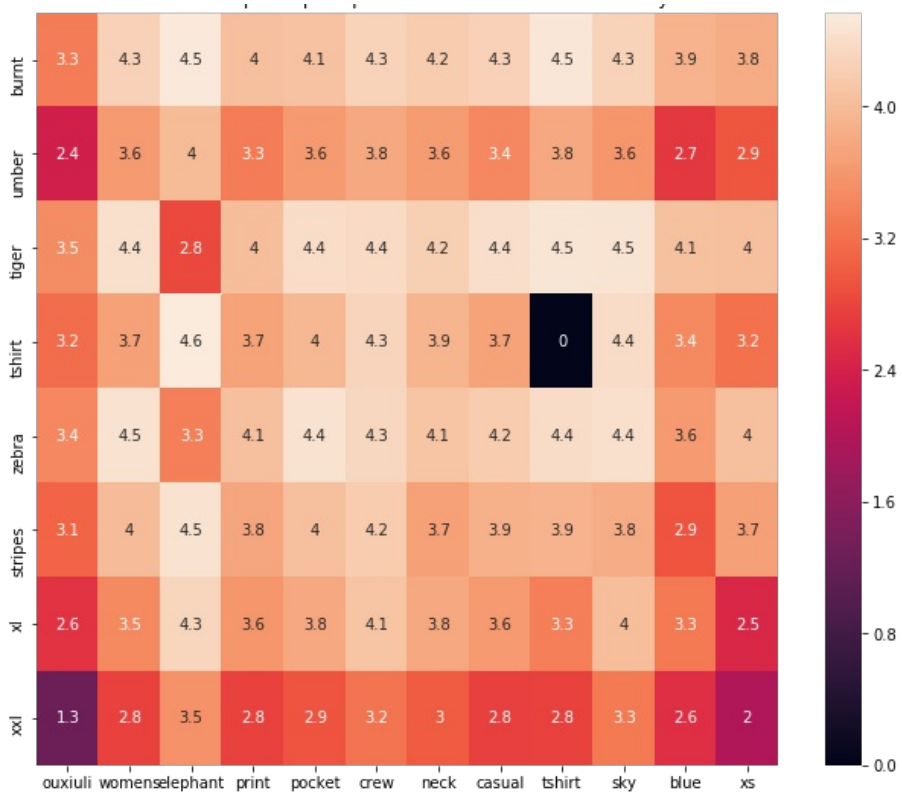
==========



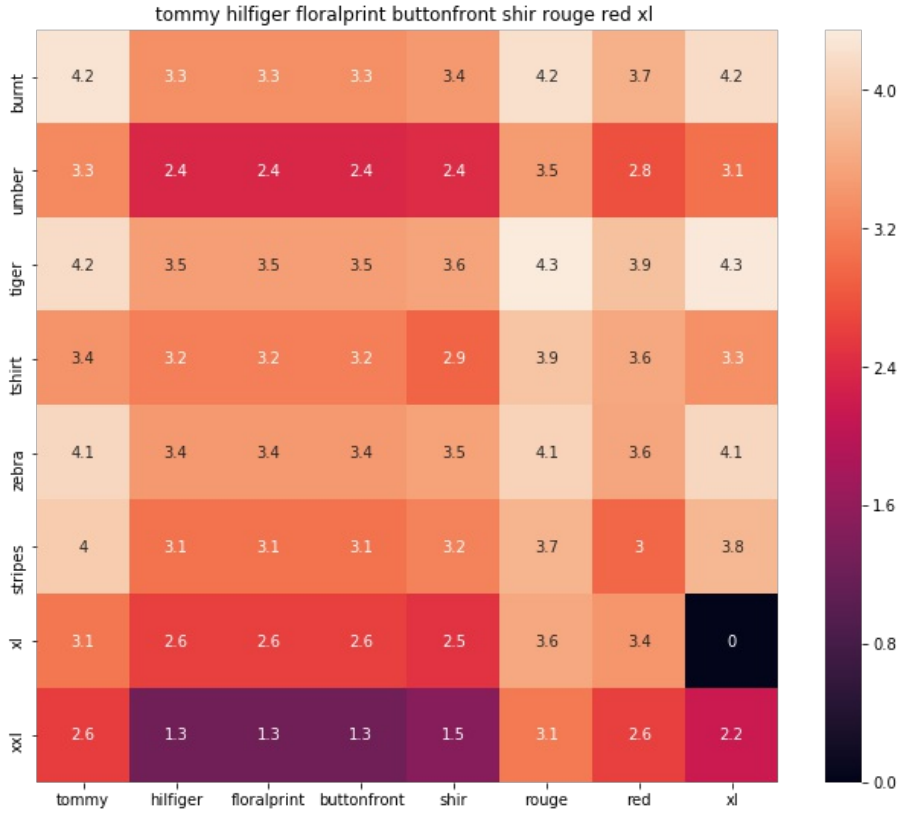
ASIN : B00JXQCFRS
BRAND : Si Row
euclidean distance from given input image : 1.09006

==========

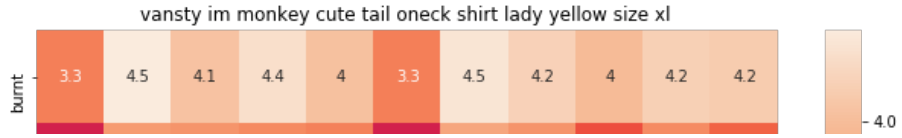
ouxiuli womens elephant print pocket crew neck casual tshirt sky blue xs

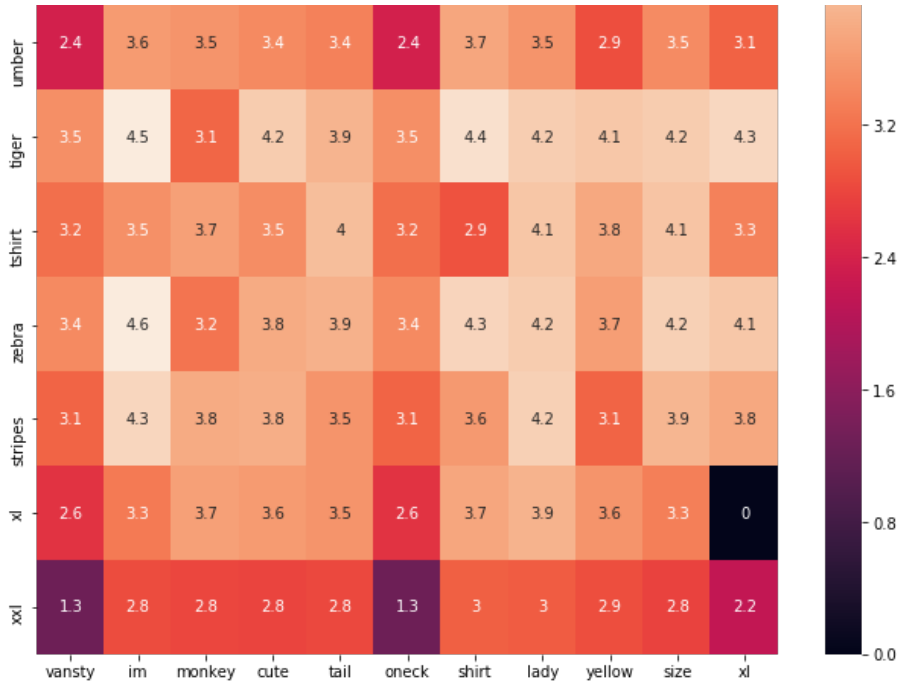


ASIN : B01I53HU6K
BRAND : ouxiuli
euclidean distance from given input image : 1.09201
==========

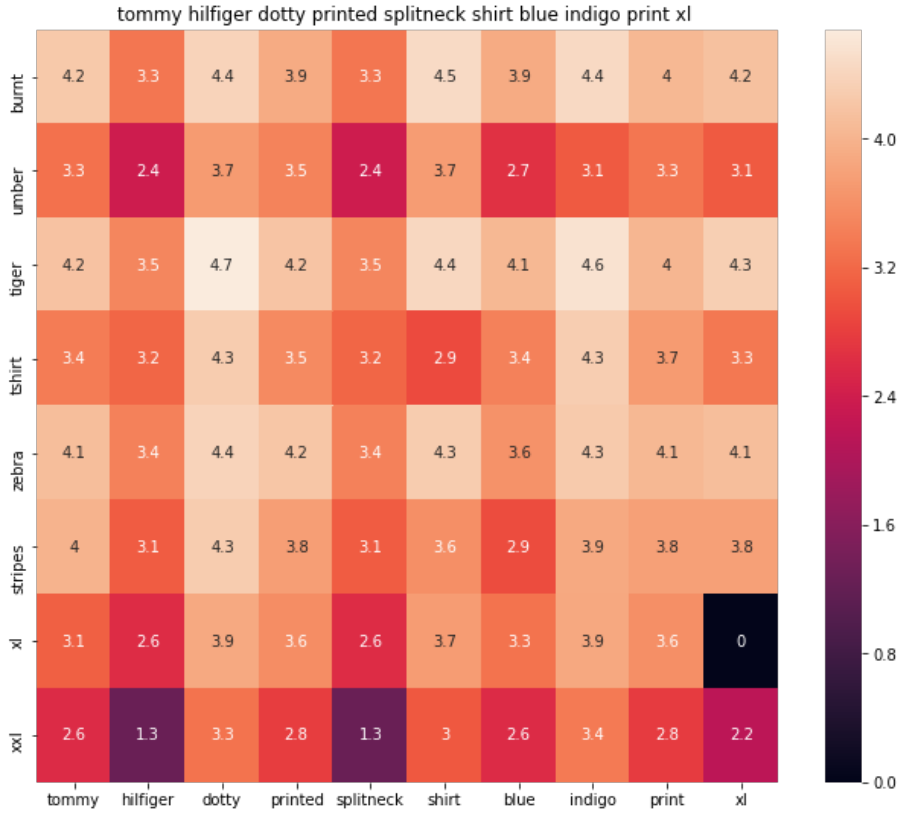


ASIN : B0711NGTQM
BRAND : THILFIGER RTW
euclidean distance from given input image : 1.09234
==========

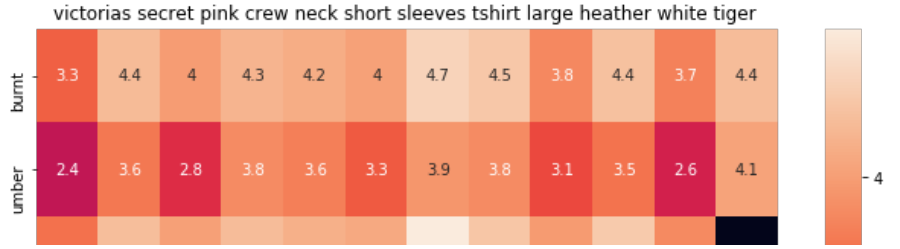


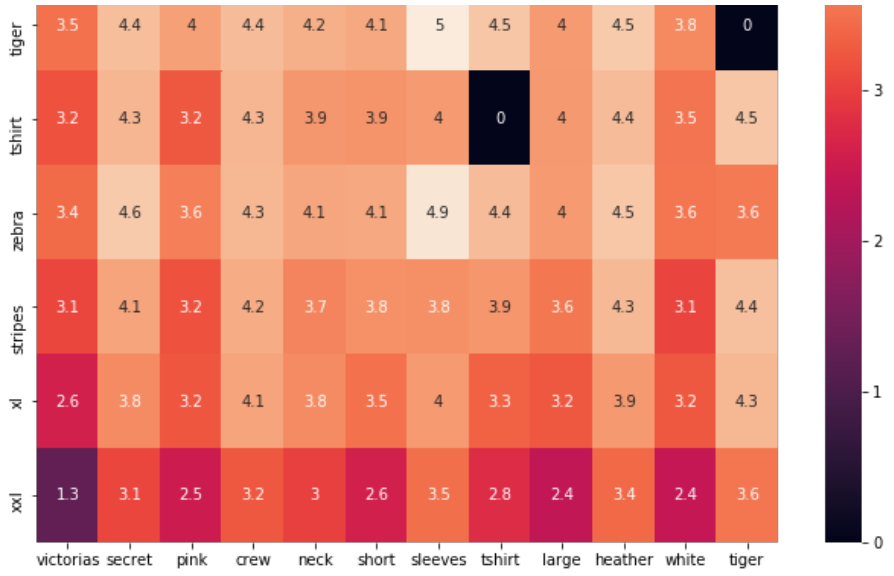


ASIN : B01EFSLO8Y
BRAND : Vansty
euclidean distance from given input image : 1.0934
==========

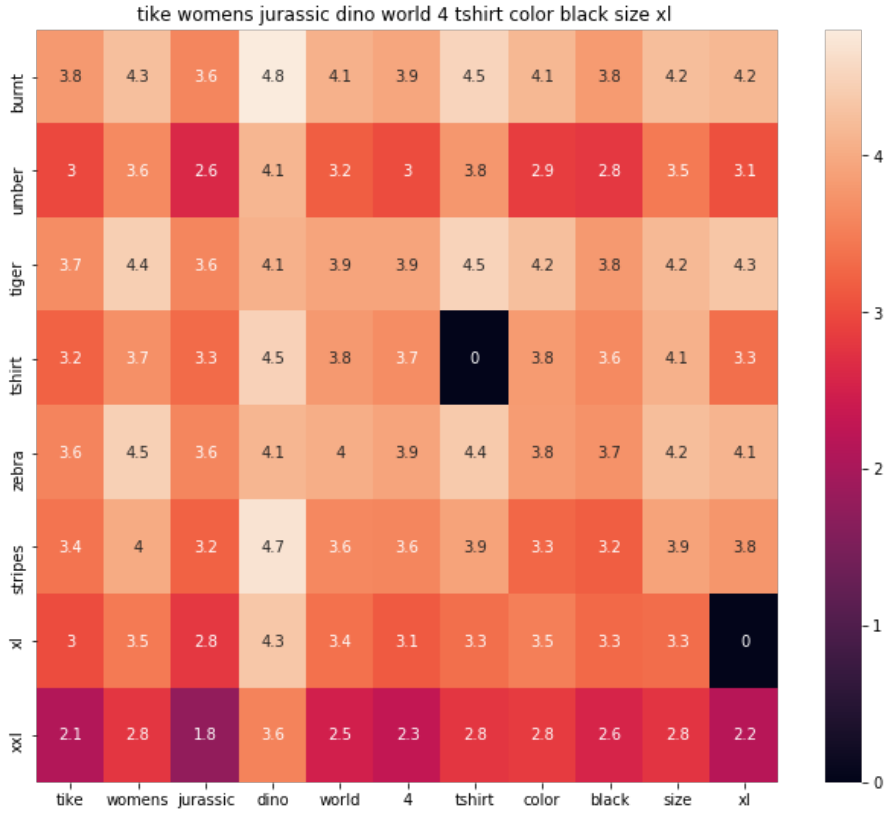


ASIN : B0716TVWQ4
BRAND : THILFIGER RTW
euclidean distance from given input image : 1.0942
==========

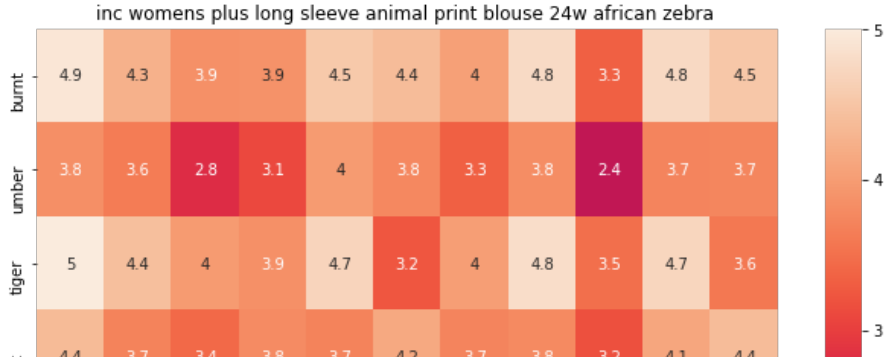


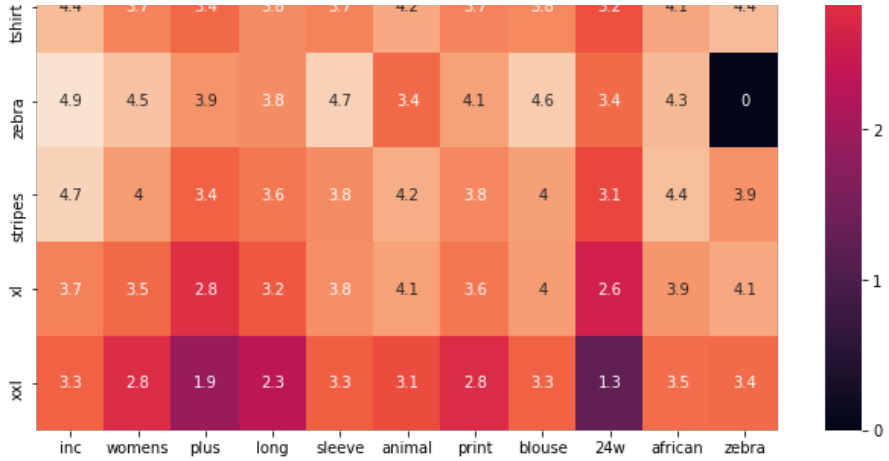


ASIN : B0716MVPGV
BRAND : V.Secret
euclidean distance from given input image : 1.09483
==========



ASIN : B016OPN4OI
BRAND : TIKE Fashions
euclidean distance from given input image : 1.09513
==========





```
ASIN : B018WDJCUA
BRAND : INC - International Concepts Woman
euclidean distance from given input image : 1.09669
================================================================================================================================
======================
```

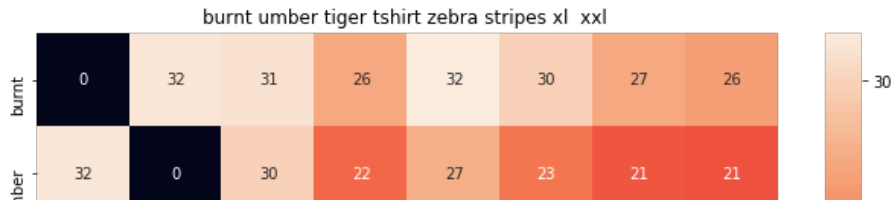
[9.4] IDF weighted Word2Vec for product similarity

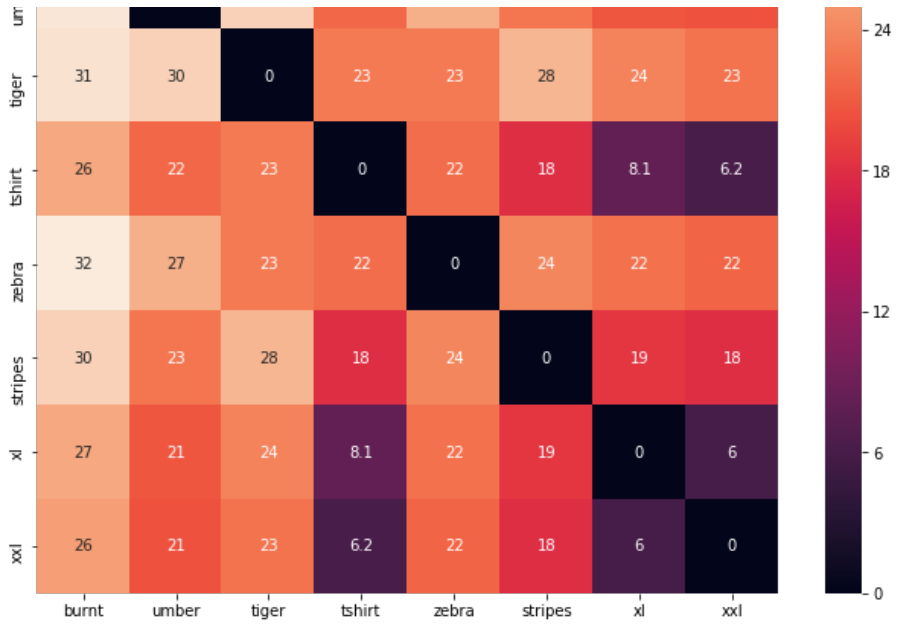
In [0]:

```
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)
```

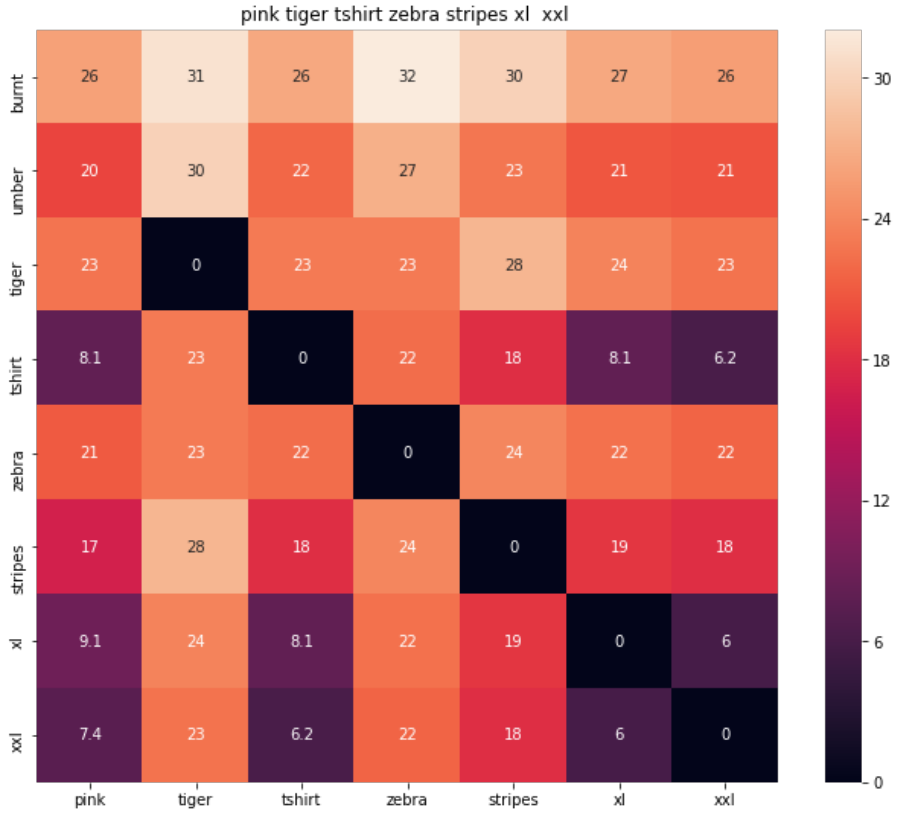
In [0]:

```
def weighted_w2v_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # 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
    pairwise_dist = pairwise_distances(w2v_title_weight, w2v_title_weight[doc_id].reshape(1,-1))

    # 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(data['title'].loc[df_indices[0]],data['title'].loc[df_indices[i]], data['medium_im
age_url'].loc[df_indices[i]], indices[0], indices[i], 'weighted')
        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)

weighted_w2v_model(12566, 20)
#931
#12566
# in the give heat map, each cell contains the euclidean distance between words i, j
```

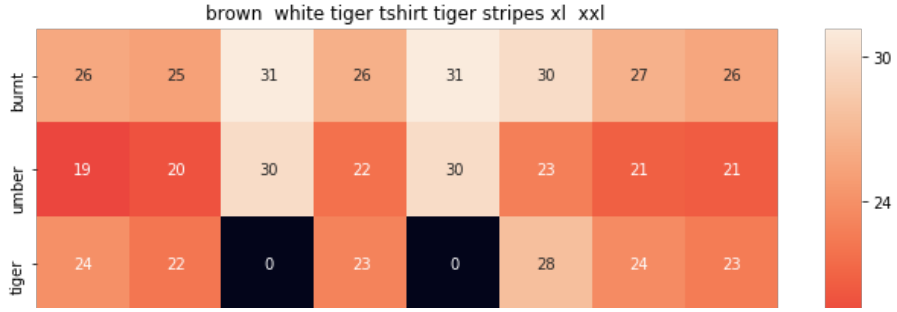


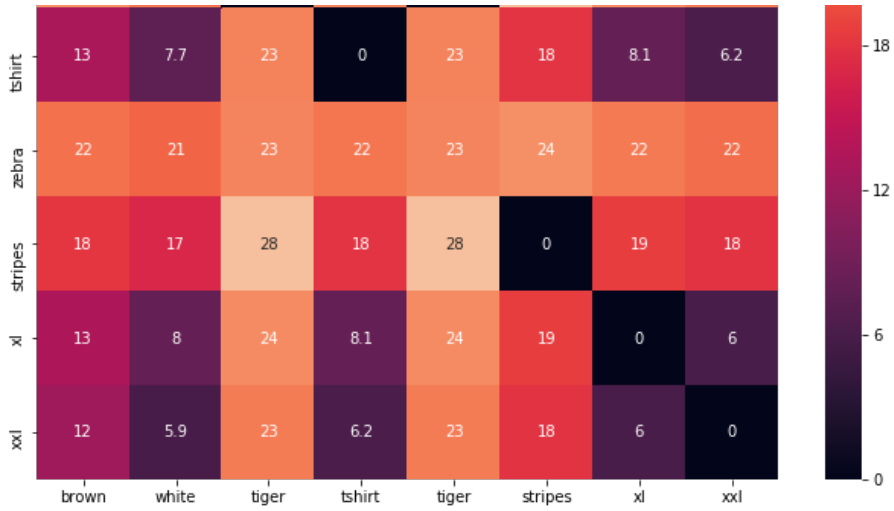


ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.00390625



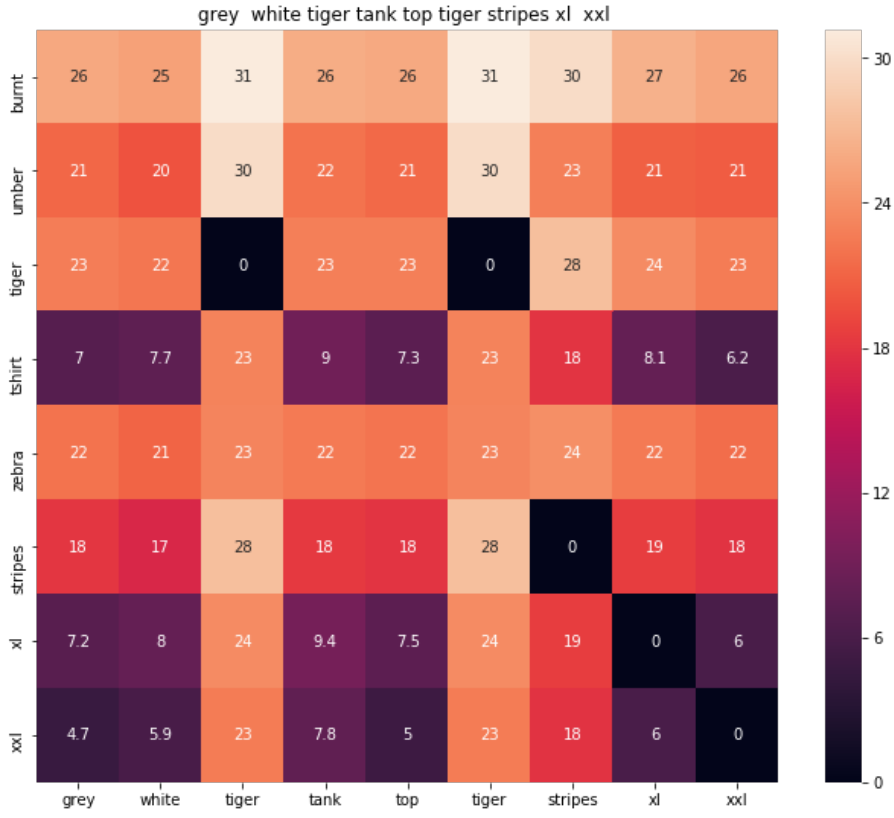
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 4.06389





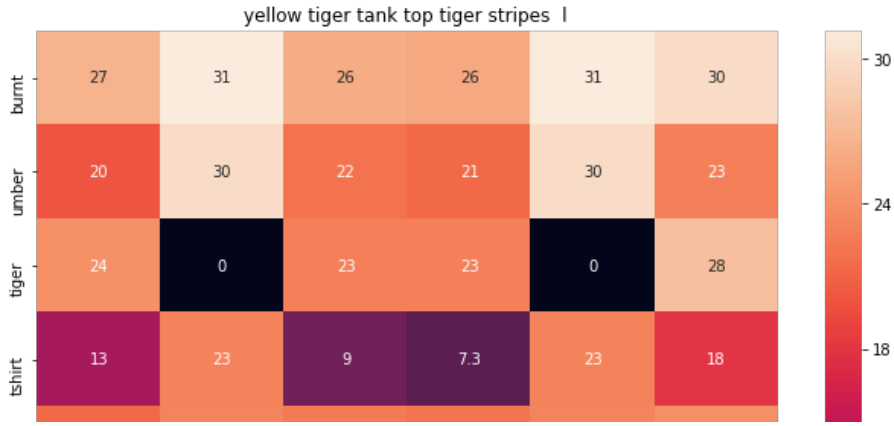
ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 4.77094

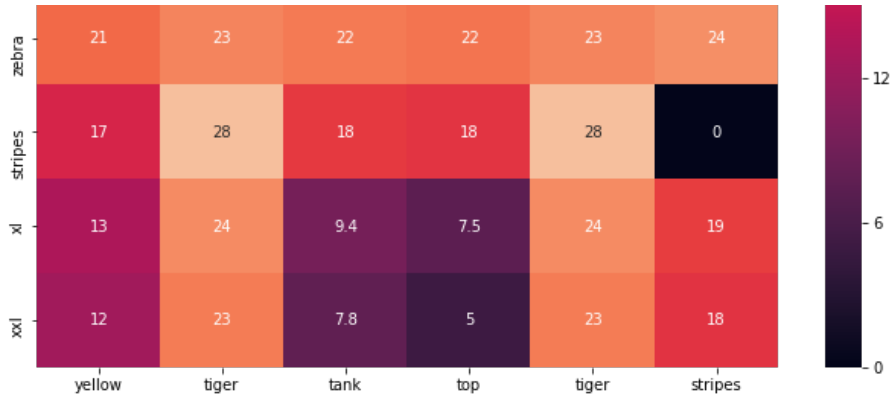
==========



ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 5.36016

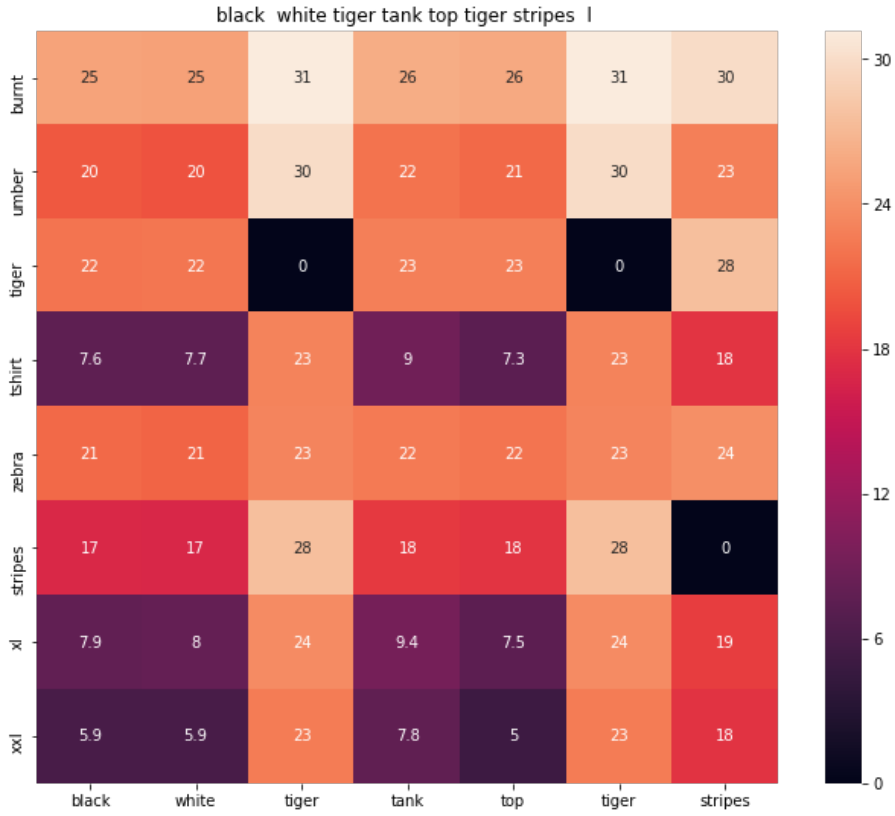
==========





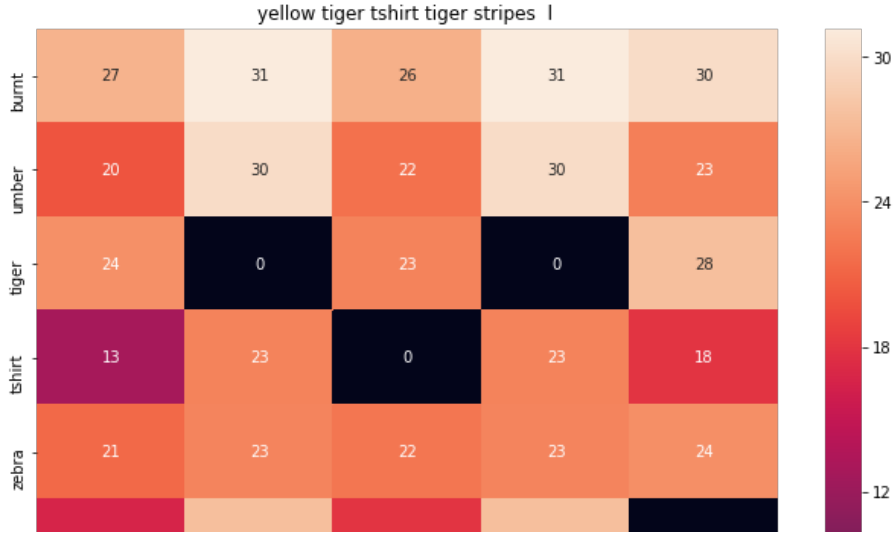
ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 5.68952

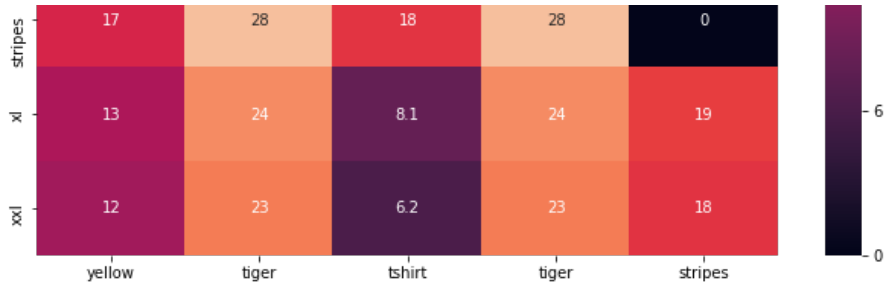
==========



ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 5.69302

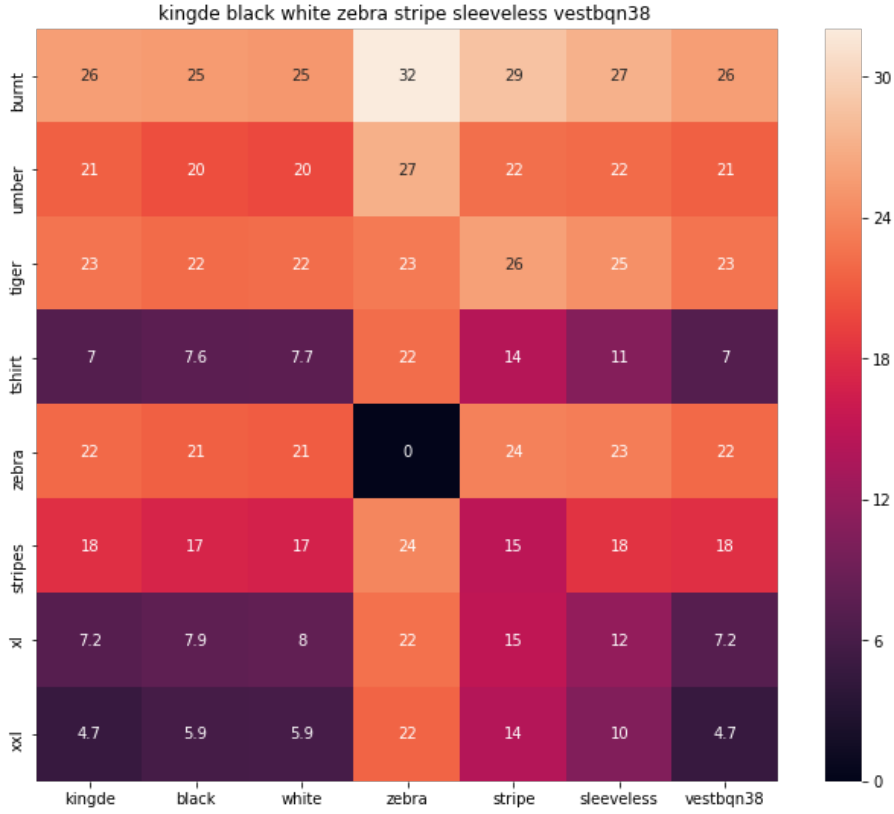
==========





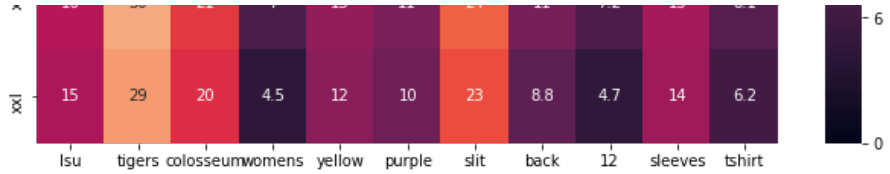
ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 5.89344

==========



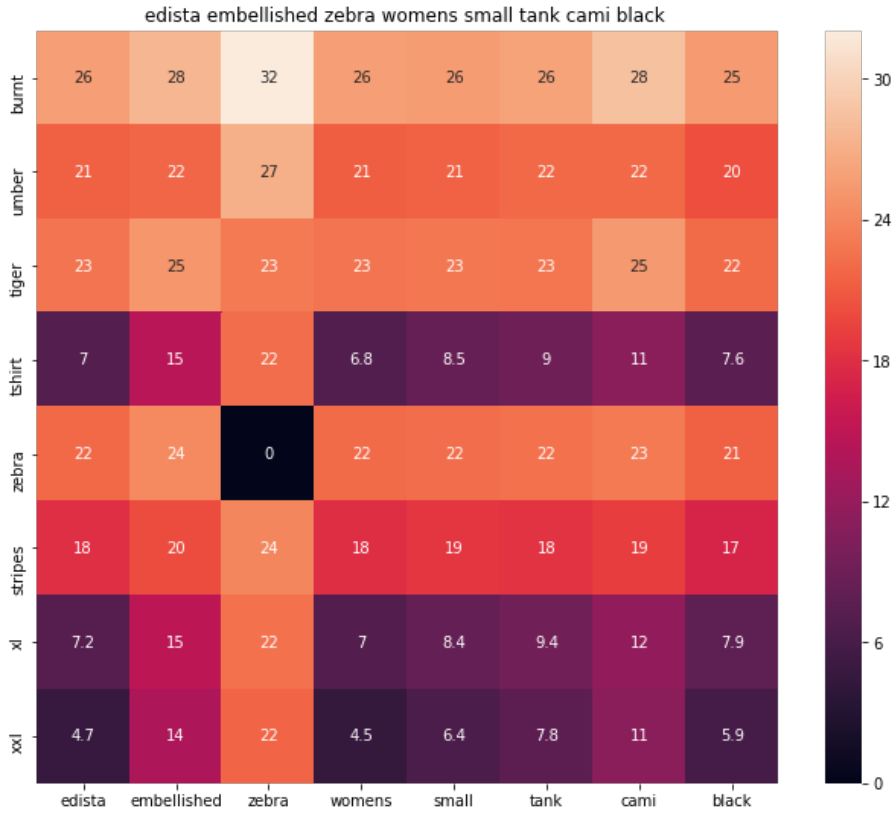
ASIN : B015H41F6G
Brand : KINGDE
euclidean distance from input : 6.13299

==========



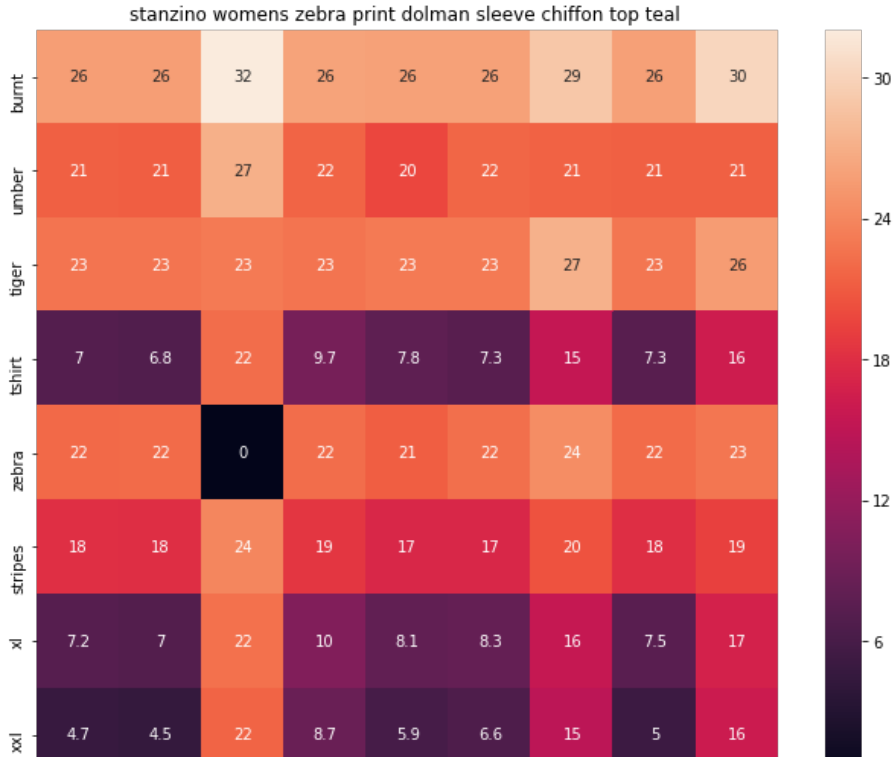
ASIN : B073R5Q8HD
Brand : Colosseum
euclidean distance from input : 6.25671

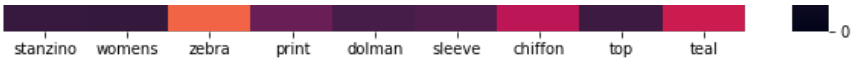
==========



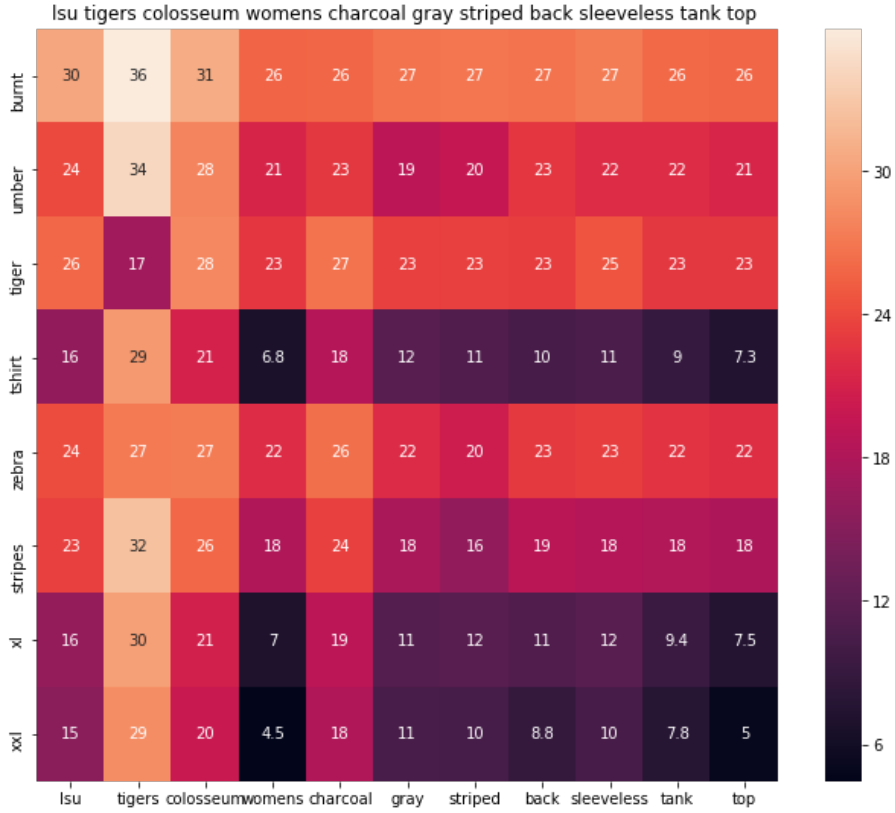
ASIN : B074P8MD22
Brand : Edista
euclidean distance from input : 6.3922

==========

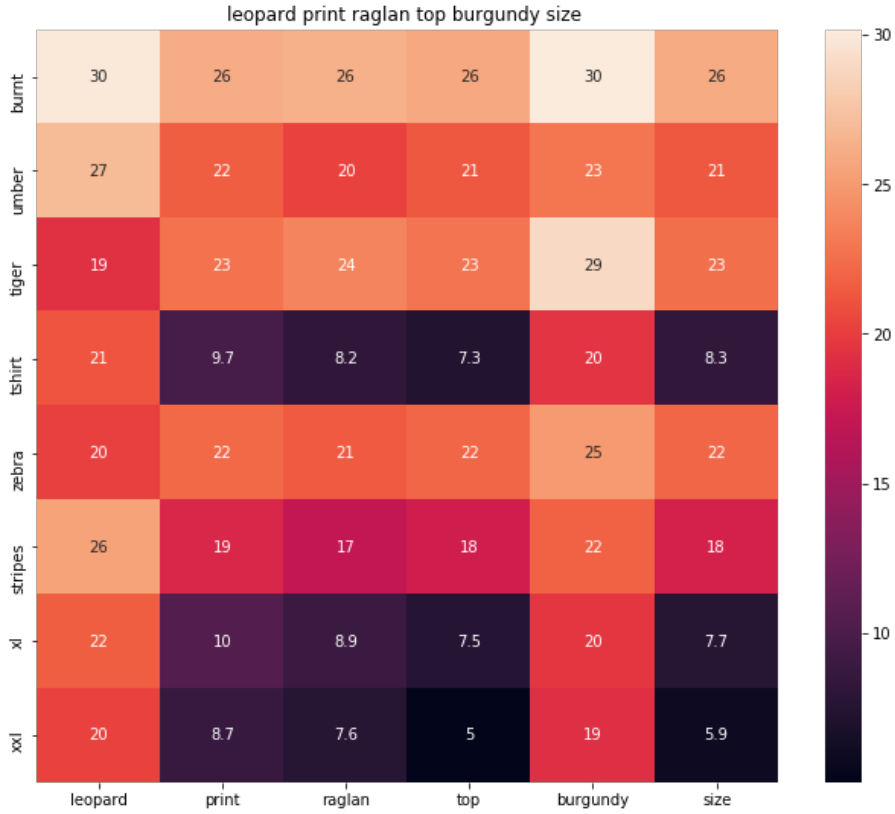




ASIN : B00C0I3U3E
Brand : Stanzino
euclidean distance from input : 6.4149

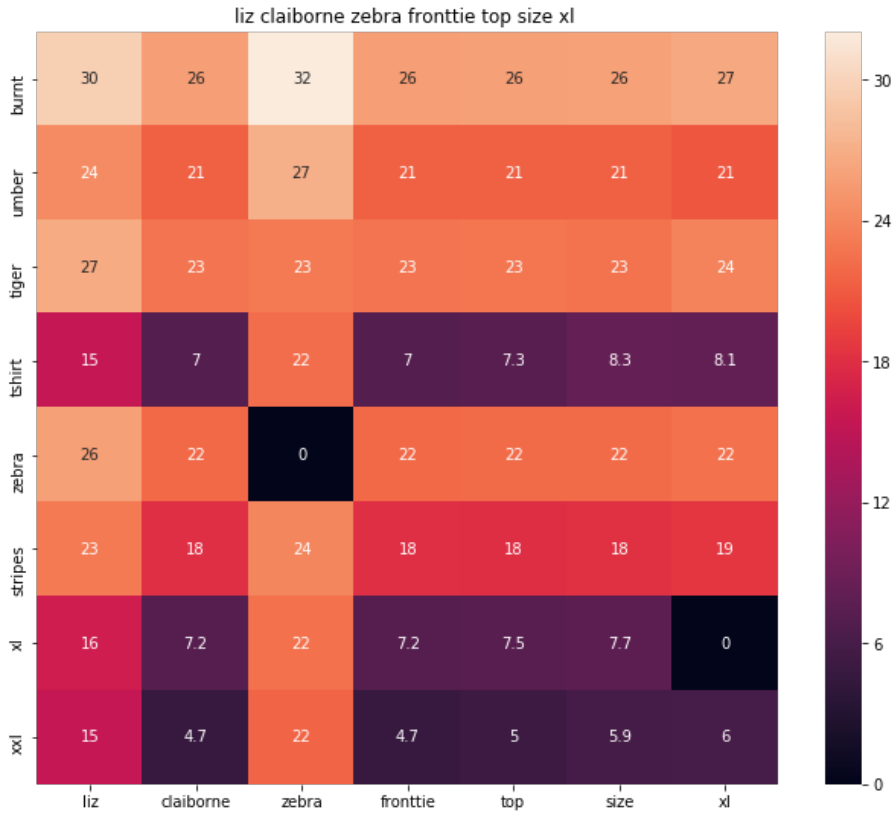


ASIN : B073R4ZM7Y
Brand : Colosseum
euclidean distance from input : 6.45096

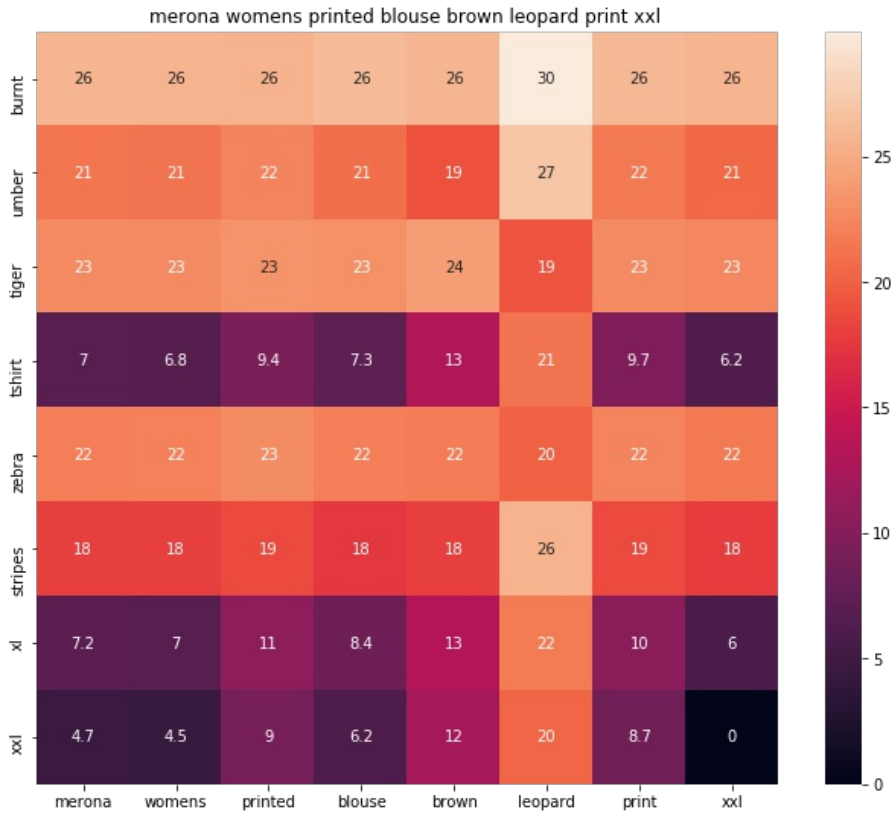


ASIN : B01C6ORLDQ

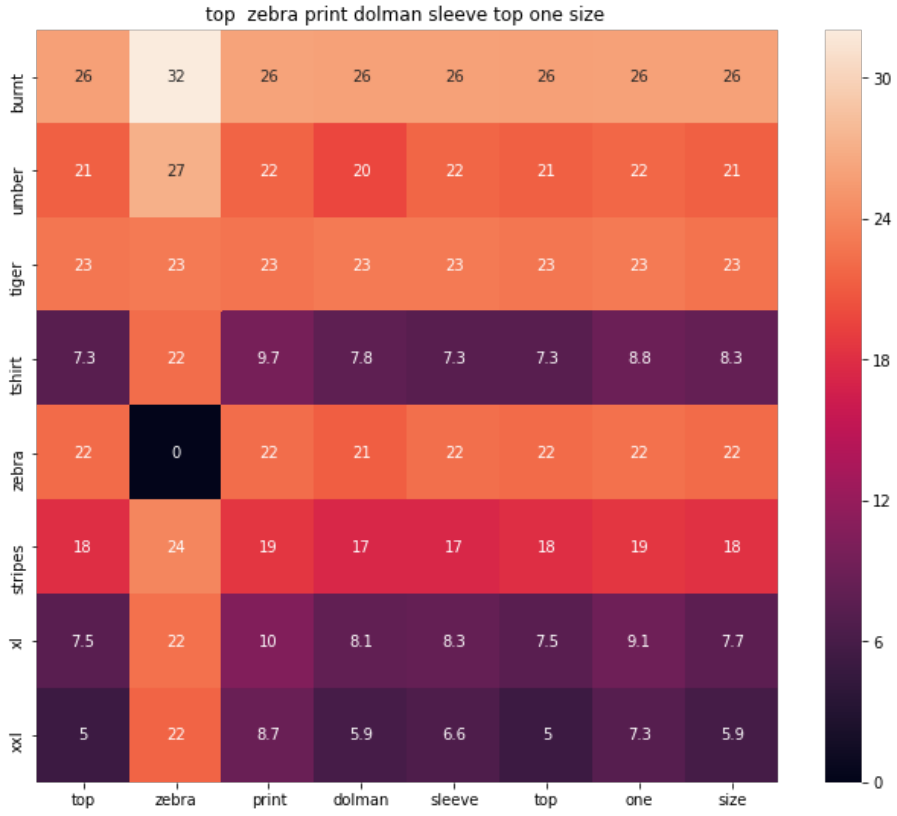
Brand : 1 Mad Fit
euclidean distance from input : 6.46341
==========



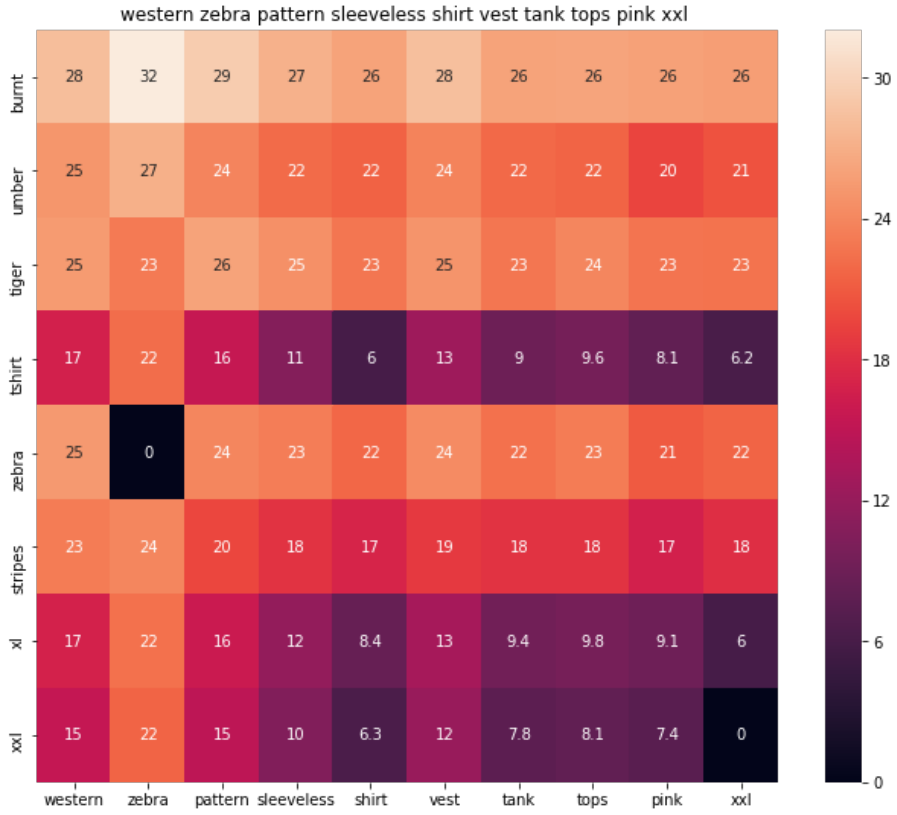
ASIN : B06XBY5QXL
Brand : Liz Claiborne
euclidean distance from input : 6.53922
==========



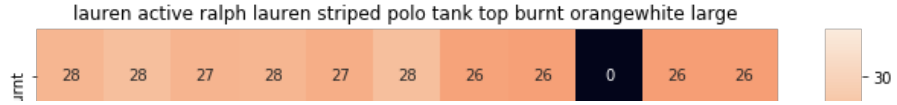
ASIN : B071YF3WDD
Brand : Merona
euclidean distance from input : 6.5755
==========

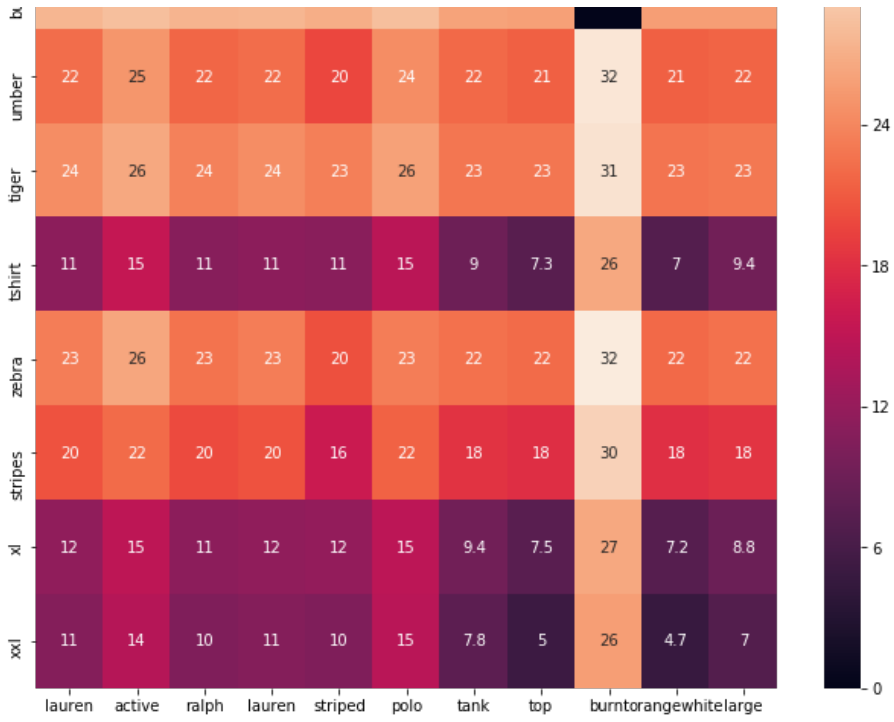


ASIN : B00H8A6ZLI
Brand : Vivian's Fashions
euclidean distance from input : 6.63821

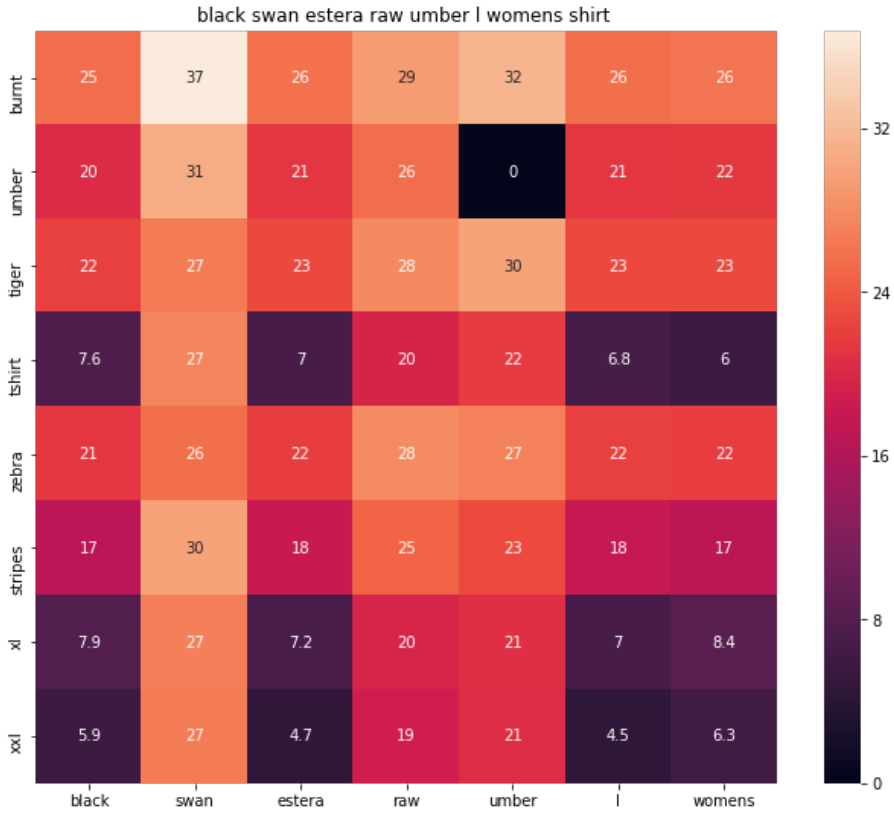


ASIN : B00Z6HEXWI
Brand : Black Temptation
euclidean distance from input : 6.66074

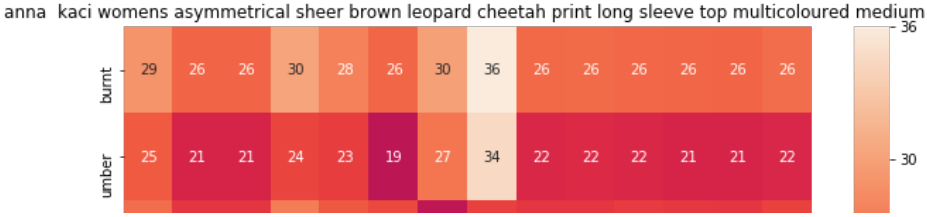


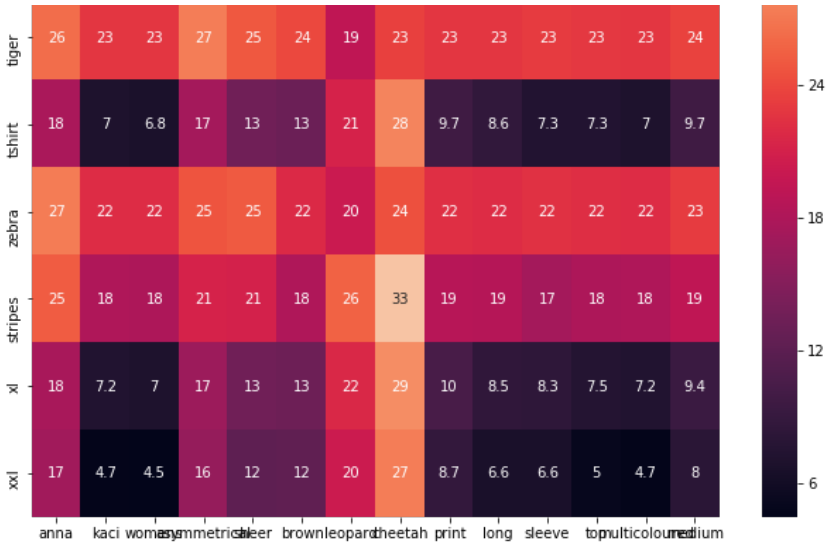


ASIN : B00ILGH5OY
Brand : Ralph Lauren Active
euclidean distance from input : 6.68391



ASIN : B06Y1VN8WQ
Brand : Black Swan
euclidean distance from input : 6.70576





ASIN : B00KSNTY7Y
Brand : Anna-Kaci
euclidean distance from input : 6.70612
==========

[9.6] Weighted similarity using brand and color.

In [0]:

```
# some of the brand values are empty.
# Need to replace Null with string "NULL"
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]

# One Hot Encoding the Brand , Color and Type features

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 [0]:

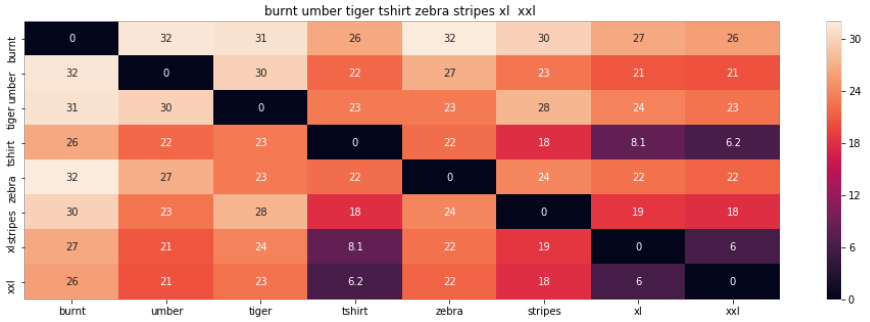
```
def heat_map_w2v_brand(sentance1, sentance2, url, doc_id1, doc_id2, df_id1, df_id2, model):

    # 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 each word in give title
    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 each word in give title
    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 app
arel's features
                   [data['asin'].loc[df_id2],brands[doc_id2], colors[doc_id2], types[doc_id2]]] # recommend
ed apparel's features

    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()
```

In [0]:

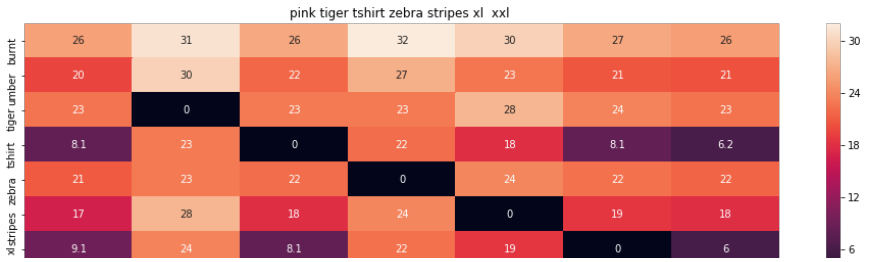
```
# Performing Weighted Eucledean Distances for giving more preference to the Feature we want(eg. Brand o
r Color etc)
def idf_w2v_brand(doc_id, w1, w2, num_results):
    # doc_id: apparel's id in given corpus
    # w1: weight for  w2v features
    # w2: weight for brand and color features

    # 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])
    # Performing Weighted Euclidean Distances
    pairwise_dist   = (w1 * idf_w2v_dist +  w2 * ex_feat_dist)/float(w1 + w2)

    # 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['med
ium_image_url'].loc[df_indices[i]], indices[0], indices[i],df_indices[0], df_indices[i], 'weighted')
        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)
```

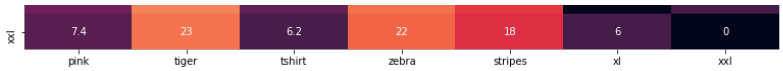
```
idf_w2v_brand(12566, 5, 5, 20)
# idf_w2v_brand(index_of_query_point, weight to Title feature, weight to Brand and Color Feature, No. o
f Similar Products to recommend)
# in the give heat map, each cell contains the euclidean distance between words i, j
```



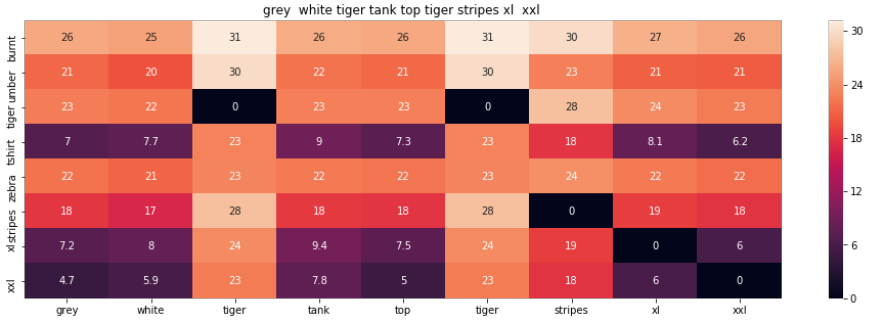
ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.001953125
==========

ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 2.38547115326
==========

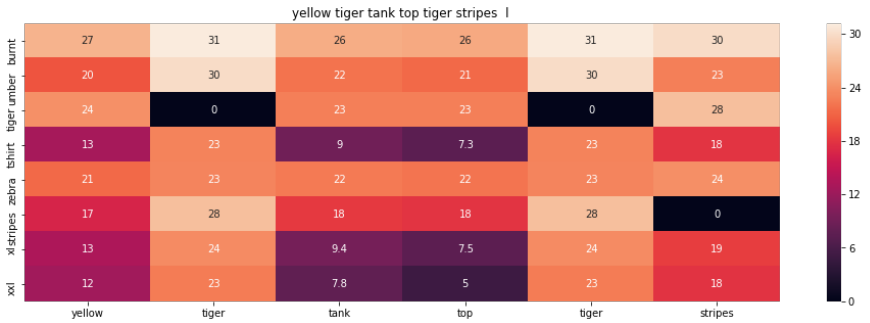




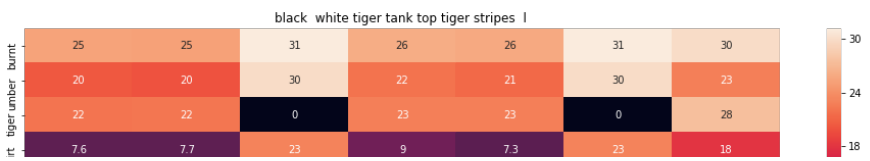
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 2.73905105609

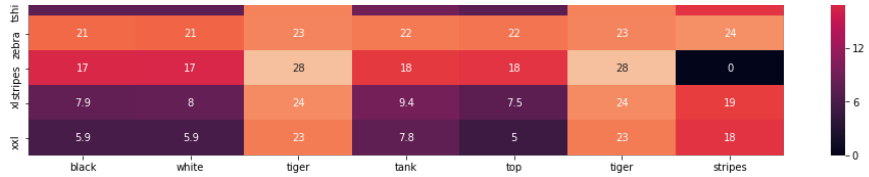


ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 3.387187195



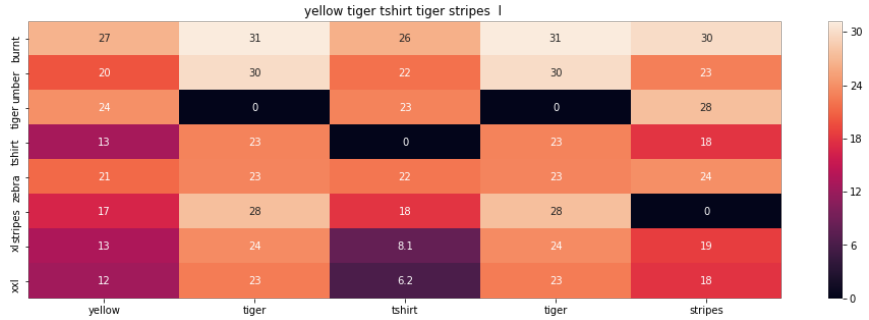
ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 3.5518684389





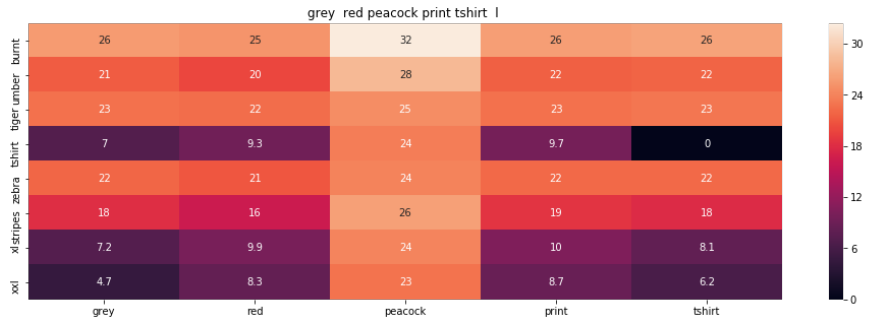
ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 3.5536174776

==========



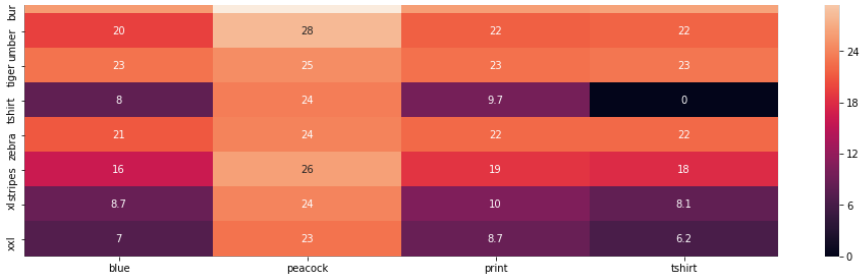
ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 3.65382804889

==========

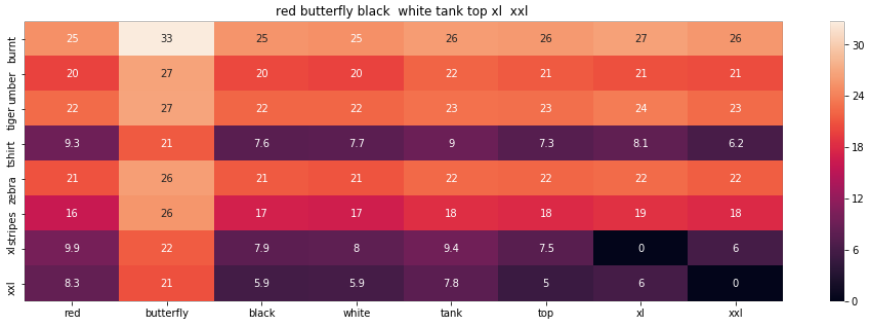


ASIN : B00JXQCFRS
Brand : Si Row
euclidean distance from input : 4.12881164569

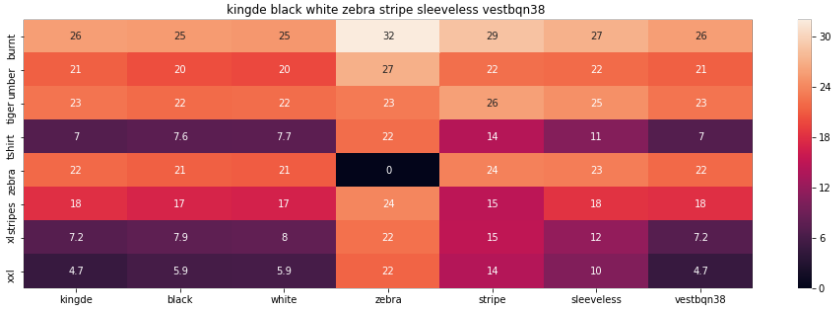
==========



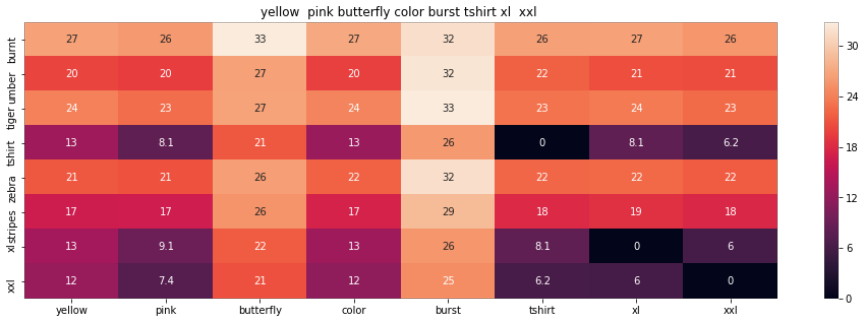
ASIN : B00JXQC8L6
Brand : Si Row
euclidean distance from input : 4.20390052813
==========



ASIN : B00JV63CW2
Brand : Si Row
euclidean distance from input : 4.28658676166
==========

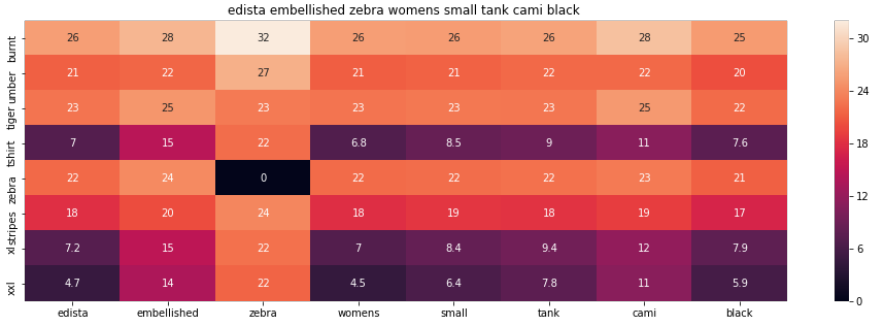


ASIN : B015H41F6G
Brand : KINGDE
euclidean distance from input : 4.38937078798
==========

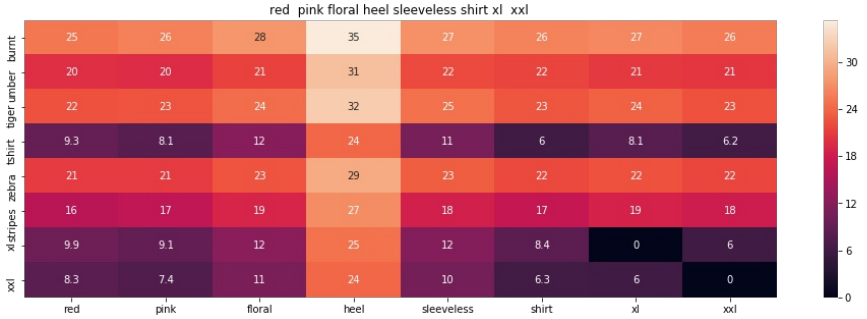


ASIN : B00JXQBBMI
Brand : Si Row
euclidean distance from input : 4.39790992755
==========

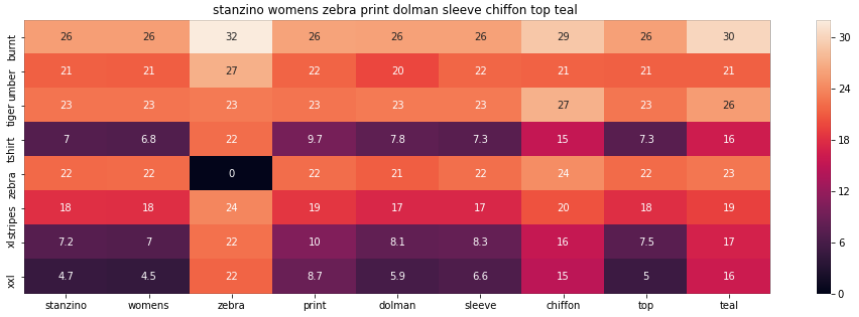
ASIN : B073R5Q8HD
Brand : Colosseum
euclidean distance from input : 4.45122858369
==========



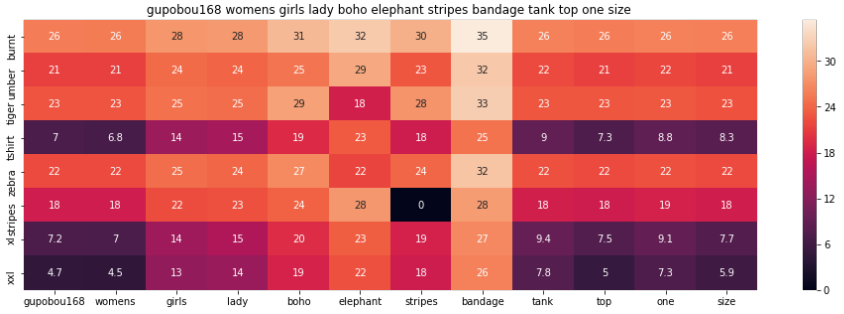
ASIN : B074P8MD22
Brand : Edista
euclidean distance from input : 4.51897779787
==========



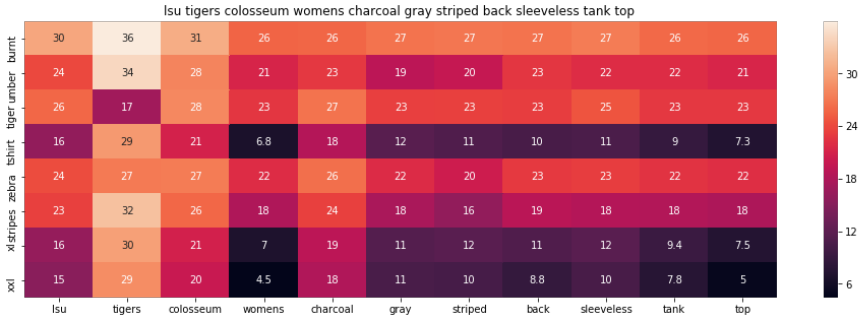
ASIN : B00JV63QQE
Brand : Si Row
euclidean distance from input : 4.52937545794
==========
==========



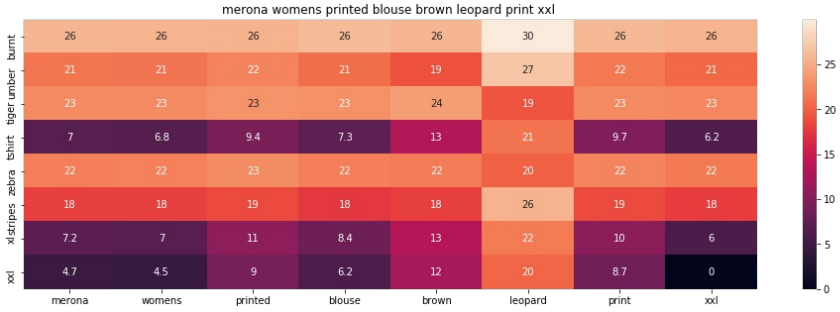
ASIN : B00C0I3U3E
Brand : Stanzino
euclidean distance from input : 4.53032614076
==========
==========



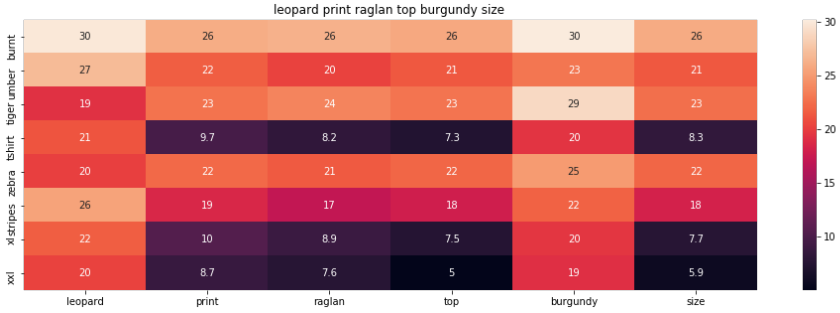
ASIN : B01ER184O6
Brand : GuPoBoU168
euclidean distance from input : 4.54681702403
==========
==========



ASIN : B073R4ZM7Y
Brand : Colosseum
euclidean distance from input : 4.54835554445
==========



ASIN : B071YF3WDD
Brand : Merona
euclidean distance from input : 4.61062742555
==========

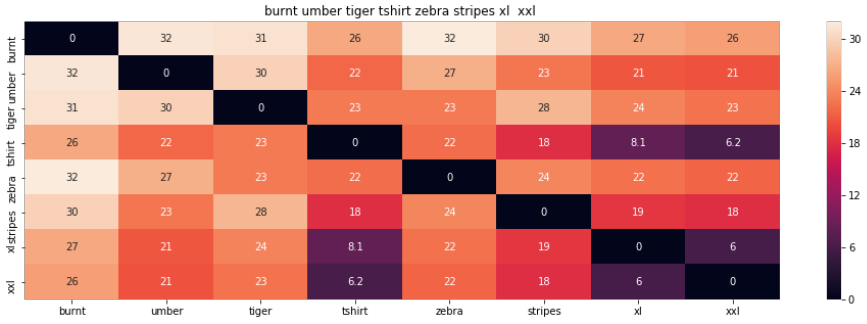


ASIN : B01C6ORLDQ
Brand : 1 Mad Fit
euclidean distance from input : 4.64591789282

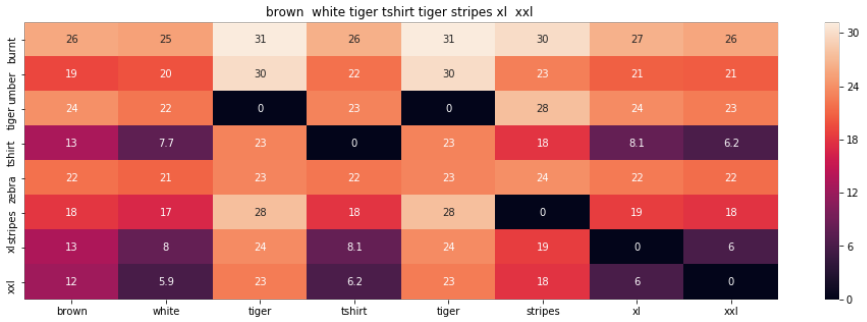
==========

In [0]:

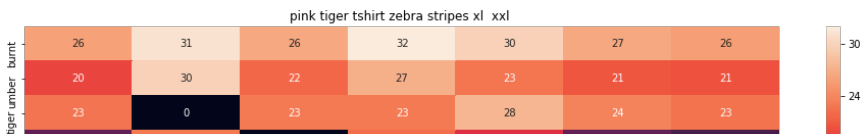
```
# brand and color weight =50
# title vector weight = 5

idf_w2v_brand(12566, 5, 50, 20)
```

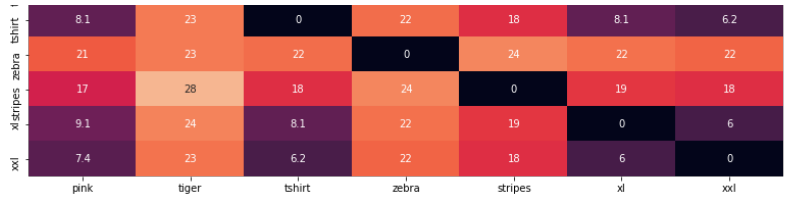


ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.000355113636364
==========

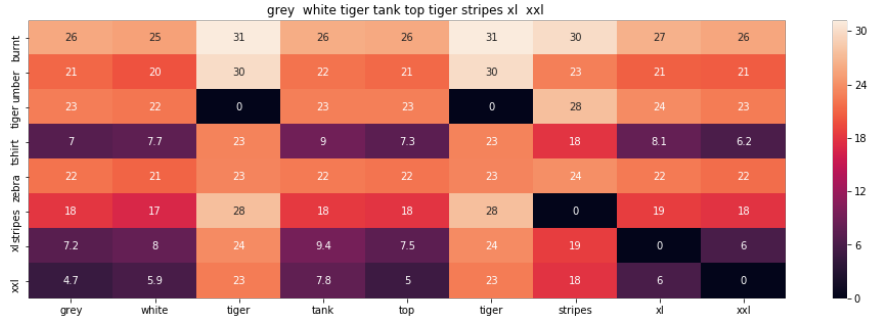


ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 0.433722027865
==========

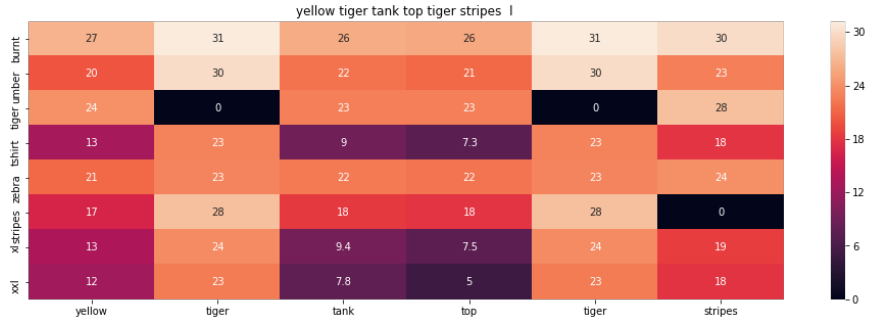




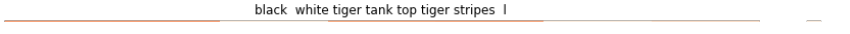
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 1.65509310669

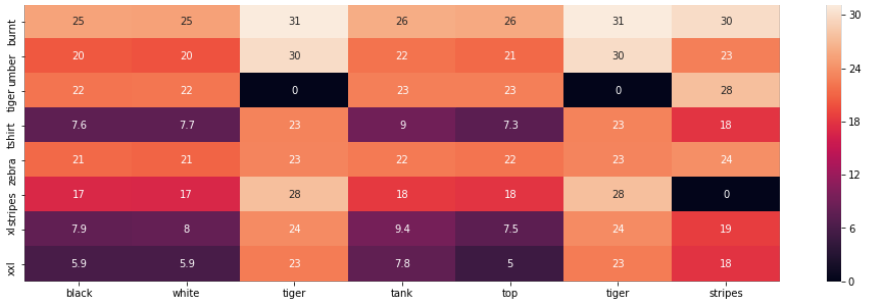


ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 1.77293604103

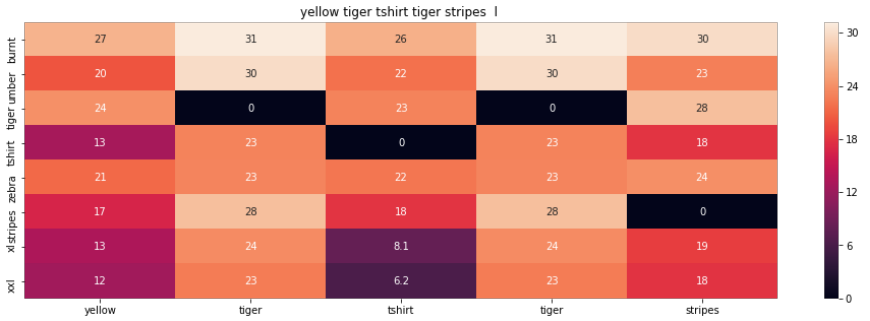


ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 1.80287808538

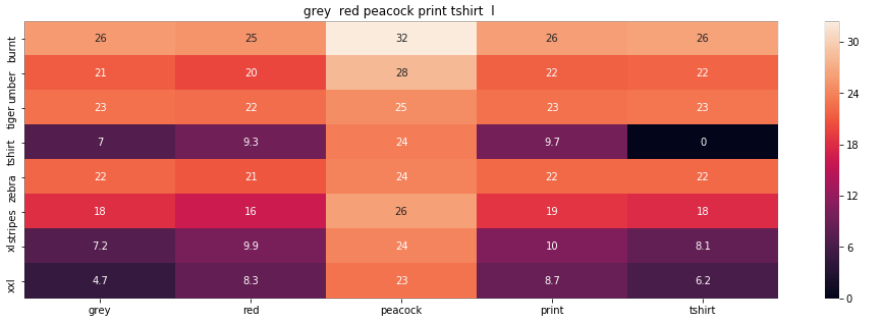




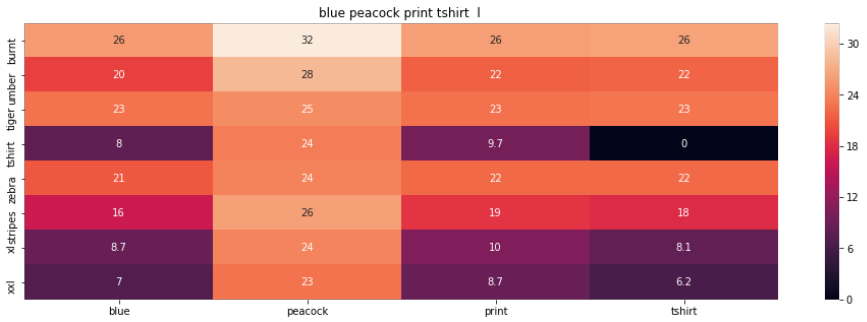
ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 1.80319609241
==========



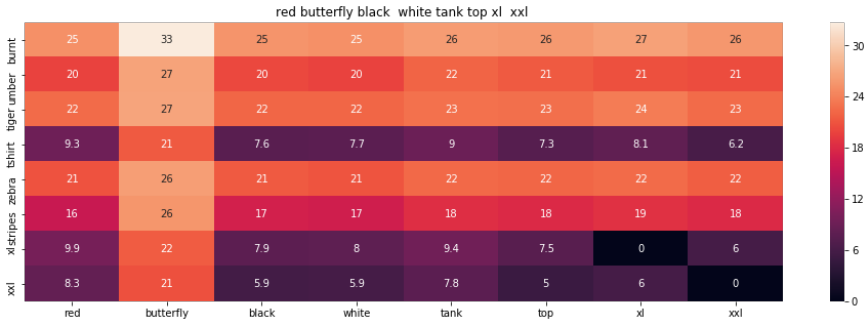
ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 1.82141619628
==========



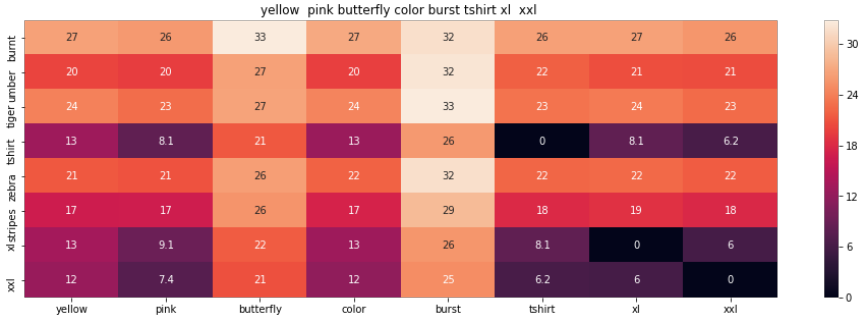
ASIN : B00JXQCFRS
Brand : Si Row
euclidean distance from input : 1.90777685025
==========



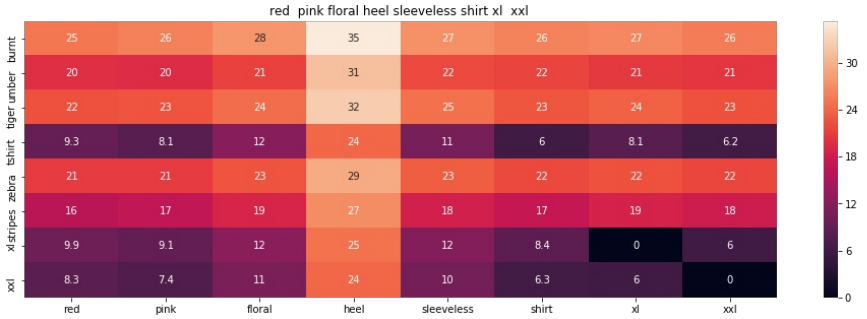
ASIN : B00JXQC8L6
Brand : Si Row
euclidean distance from input : 1.92142937433



ASIN : B00JV63CW2
Brand : Si Row
euclidean distance from input : 1.93646323497

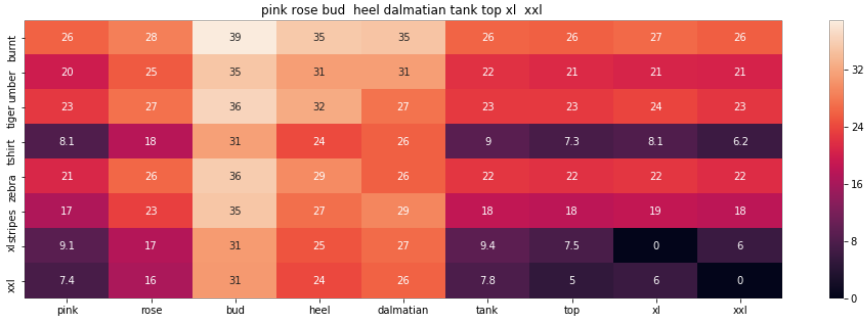


ASIN : B00JXQBBMI
Brand : Si Row
euclidean distance from input : 1.95670381059



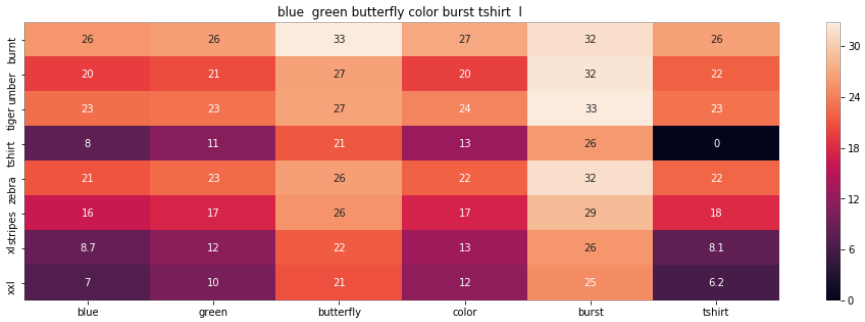
ASIN : B00JV63QQE
Brand : Si Row
euclidean distance from input : 1.9806066343
==========
==========

ASIN : B00JV63VC8
Brand : Si Row
euclidean distance from input : 2.01218559992
==========
==========



ASIN : B00JXQAX2C
Brand : Si Row
euclidean distance from input : 2.01335178755
==========

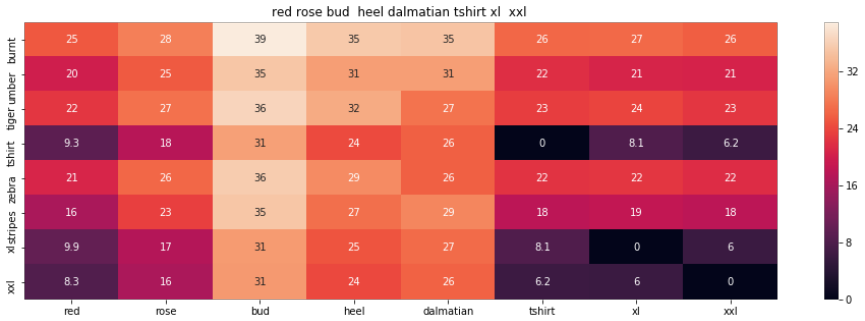
==========



ASIN : B00JXQC0C8
Brand : Si Row
euclidean distance from input : 2.01388334827

==========

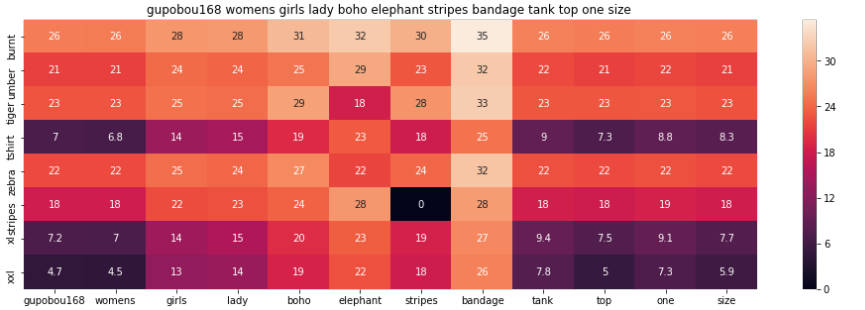
==========



ASIN : B00JXQABB0
Brand : Si Row
euclidean distance from input : 2.0367257555

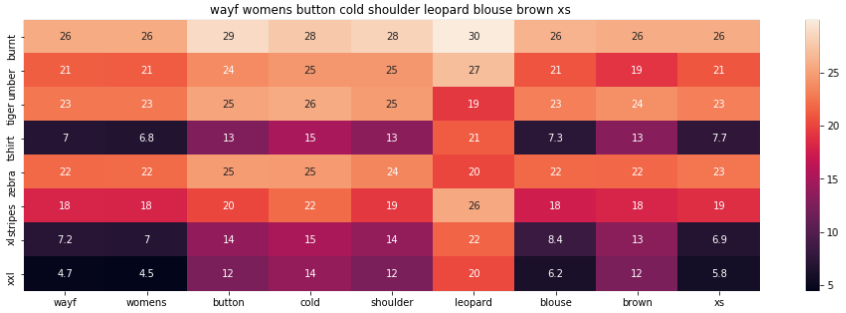
==========

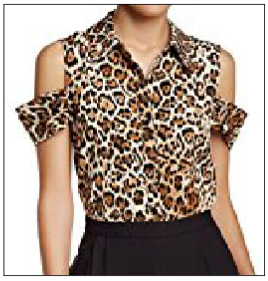
==========



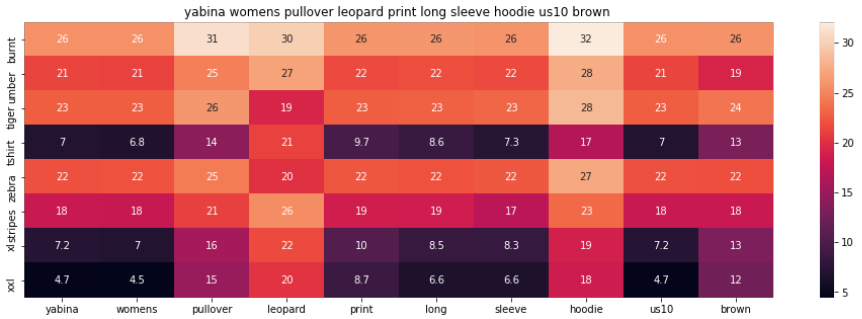
ASIN : B01EP184O6

ASIN : B01ER18406
Brand : GuPoBoU168
euclidean distance from input : 2.65620416778
==========

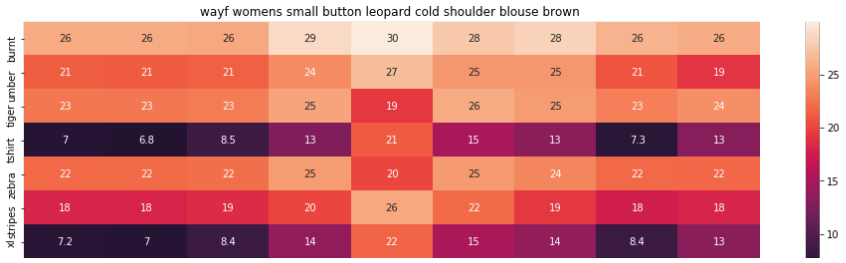


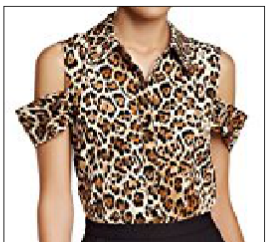


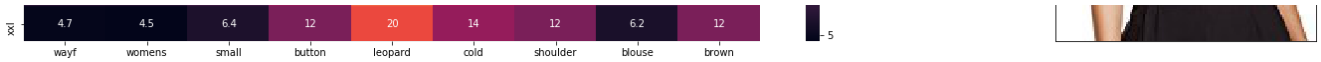
ASIN : B01LZ7BQ4H
Brand : WAYF
euclidean distance from input : 2.6849067823
==========



ASIN : B01KJUM6JI
Brand : YABINA
euclidean distance from input : 2.68583819266
==========








```
ASIN : B01M06V4X1
Brand : WAYF
euclidean distance from input : 2.69476194865
================================================================================================================
======================
```

[10.2] Keras and Tensorflow to extract features

In [0]:

```
import numpy as np
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Dropout, Flatten, Dense
from keras import applications
from sklearn.metrics import pairwise_distances
import matplotlib.pyplot as plt
import requests
from PIL import Image
import pandas as pd
import pickle
```

```
Using TensorFlow backend.
```

In [0]:

```
# https://gist.github.com/fchollet/f35fbc80e066a49d65f1688a7e99f069
# Code reference: https://blog.keras.io/building-powerful-image-classification-models-using-very-little
-data.html



# This code takes 40 minutes to run on a modern GPU (graphics card)
# like Nvidia  1050.
# GPU (NVidia 1050): 0.175 seconds per image

# This codse takes 160 minutes to run on a high end i7 CPU
# CPU (i7): 0.615 seconds per image.

#Do NOT run this code unless you want to wait a few hours for it to generate output

# each image is converted into 25088 length dense-vector


'''
# dimensions of our images.
img_width, img_height = 224, 224

top_model_weights_path = 'bottleneck_fc_model.h5'
train_data_dir = 'images2/'
nb_train_samples = 16042
epochs = 50
batch_size = 1


def save_bottlebeck_features():

    #Function to compute VGG-16 CNN for image feature extraction.

    asins = []
    datagen = ImageDataGenerator(rescale=1. / 255)

    # build the VGG16 network
    model = applications.VGG16(include_top=False, weights='imagenet')
    generator = datagen.flow_from_directory(
        train_data_dir,
        target_size=(img_width, img_height),
        batch_size=batch_size,
        class_mode=None,
        shuffle=False)

    for i in generator.filenames:
        asins.append(i[2:-5])
```

```
    bottleneck_features_train = model.predict_generator(generator, nb_train_samples // batch_size)
    bottleneck_features_train = bottleneck_features_train.reshape((16042,25088))

    np.save(open('16k_data_cnn_features.npy', 'wb'), bottleneck_features_train)
    np.save(open('16k_data_cnn_feature_asins.npy', 'wb'), np.array(asins))


save_bottlebeck_features()

'''
```

[10.3] Visual features based product similarity.

In [0]:

```
#load the features and corresponding ASINS info.
bottleneck_features_train = np.load('16k_data_cnn_features.npy') # Loading all Images data
asins = np.load('16k_data_cnn_feature_asins.npy') # Loading corresponding ASINS for each Images
asins = list(asins)

# load the original 16K dataset
data = pd.read_pickle('pickels/16k_apperal_data_preprocessed')
df_asins = list(data['asin'])


from IPython.display import display, Image, SVG, Math, YouTubeVideo


#get similar products using CNN features (VGG-16) using Eucledean Distances
def get_similar_products_cnn(doc_id, num_results):
    doc_id = asins.index(df_asins[doc_id])
    pairwise_dist = pairwise_distances(bottleneck_features_train, bottleneck_features_train[doc_id].res
hape(1,-1))

    indices = np.argsort(pairwise_dist.flatten())[0:num_results]
    pdists  = np.sort(pairwise_dist.flatten())[0:num_results]

    for i in range(len(indices)):
        rows = data[['medium_image_url','title']].loc[data['asin']==asins[indices[i]]]
        for indx, row in rows.iterrows():
            display(Image(url=row['medium_image_url'], embed=True))
            print('Product Title: ', row['title'])
            print('Euclidean Distance from input image:', pdists[i])
            print('Amazon Url: www.amzon.com/dp/'+ asins[indices[i]])

get_similar_products_cnn(12566, 20)
```

```
Product Title:  burnt umber tiger tshirt zebra stripes xl  xxl
Euclidean Distance from input image: 0.0
Amazon Url: www.amzon.com/dp/B00JXQB5FQ
```

```
Product Title:  pink tiger tshirt zebra stripes xl  xxl
Euclidean Distance from input image: 30.0501
Amazon Url: www.amzon.com/dp/B00JXQASS6
```

Product Title: yellow tiger tshirt tiger stripes l
Euclidean Distance from input image: 41.2611
Amazon Url: www.amzon.com/dp/B00JXQCUIC

Product Title: brown white tiger tshirt tiger stripes xl xxl
Euclidean Distance from input image: 44.0002
Amazon Url: www.amzon.com/dp/B00JXQCWTO

Product Title: kawaii pastel tops tees pink flower design
Euclidean Distance from input image: 47.3825
Amazon Url: www.amzon.com/dp/B071FCWD97

Product Title: womens thin style tops tees pastel watermelon print
Euclidean Distance from input image: 47.7184
Amazon Url: www.amzon.com/dp/B01JUNHBRM

Product Title: kawaii pastel tops tees baby blue flower design
Euclidean Distance from input image: 47.9021
Amazon Url: www.amzon.com/dp/B071SBCY9W

Product Title: edv cheetah run purple multi xl
Euclidean Distance from input image: 48.0465
Amazon Url: www.amzon.com/dp/B01CUPYBM0

Product Title: danskin womens vneck loose performance tee xsmall pink ombre
Euclidean Distance from input image: 48.1019
Amazon Url: www.amzon.com/dp/B01F7PHXY8

Product Title: summer alpaca 3d pastel casual loose tops tee design
Euclidean Distance from input image: 48.1189
Amazon Url: www.amzon.com/dp/B01I80A93G

Product Title: miss chievous juniors striped peplum tank top medium shadowpeach
Euclidean Distance from input image: 48.1313
Amazon Url: www.amzon.com/dp/B0177DM70S

Product Title: red pink floral heel sleeveless shirt xl xxl
Euclidean Distance from input image: 48.1695
Amazon Url: www.amzon.com/dp/B00JV63QQE

Product Title: moana logo adults hot v neck shirt black xxl
Euclidean Distance from input image: 48.2568
Amazon Url: www.amzon.com/dp/B01LX6H43D

Product Title: abaday multicolor cartoon cat print short sleeve longline shirt large
Euclidean Distance from input image: 48.2657
Amazon Url: www.amzon.com/dp/B01CR57YY0

Product Title: kawaii cotton pastel tops tees peach pink cactus design
Euclidean Distance from input image: 48.3626
Amazon Url: www.amzon.com/dp/B071WYLBZS

Product Title: chicago chicago 18 shirt women pink
Euclidean Distance from input image: 48.3836
Amazon Url: www.amzon.com/dp/B01GXAZTRY

Product Title: yichun womens tiger printed summer tshirts tops
Euclidean Distance from input image: 48.4493
Amazon Url: www.amzon.com/dp/B010NN9RXO

Product Title: nancy lopez whimsy short sleeve whiteblacklemon drop xs
Euclidean Distance from input image: 48.4788
Amazon Url: www.amzon.com/dp/B01MPX6IDX

Product Title: womens tops tees pastel peach ice cream cone print
Euclidean Distance from input image: 48.558
Amazon Url: www.amzon.com/dp/B0734GRKZL

```
Product Title:  uswomens mary j blige without tshirts shirt
Euclidean Distance from input image: 48.6144
Amazon Url: www.amzon.com/dp/B01M0XXFKK
```

Assignment

Loading Data

In [19]:

```
#load the features and corresponding ASINS info.
bottleneck_features_train = np.load('16k_data_cnn_features.npy') #shape = (16042, 25088)
asins = np.load('16k_data_cnn_feature_asins.npy')
asins = list(asins)
data = pd.read_pickle('pickels/16k_apperal_data_preprocessed')
data.head()
```

Out[19]:

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
4	B004GSI2OS	FeatherLite	Onyx Black/ Stone	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies long sleeve stain resistant...	$26.26
6	B012YX2ZPI	HX-Kingdom Fashion T-shirts	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	womens unique 100 cotton special olympics wor...	$9.99
15	B003BSRPB0	FeatherLite	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	featherlite ladies moisture free mesh sport sh...	$20.54
27	B014ICEJ1Q	FNC7C	Purple	https://images-na.ssl-images-amazon.com/images...	SHIRT	supernatural chibis sam dean castiel neck tshi...	$7.39
46	B01NACPBG2	Fifth Degree	Black	https://images-na.ssl-images-amazon.com/images...	SHIRT	fifth degree womens gold foil graphic tees jun...	$6.95

TFIDF Vectorisation

In [20]:

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

# idf_title_features.shape = #data_points * #words_in_corpus
# CountVectorizer().fit_transform(courpus) returns the a sparase matrix of dimensions #data_points * #w
ords_in_corpus
# idf_title_features[doc_id, index_of_word_in_corpus] = number of times the word occured in that doc
```

In [21]:

```
def n_containing(word):
    # return the number of documents which has the given word
    return sum(1 for blob in data['title'] if word in blob.split())

def idf(word):
    # idf = log(#number of docs / #number of docs which had the given word)
    return math.log(data.shape[0] / (n_containing(word)))
```

In [22]:

```
# we need to convert the values into float
idf_title_features  = idf_title_features.astype(np.float)

for i in idf_title_vectorizer.vocabulary_.keys():
    # for every word in whole corpus we will find its idf value
    idf_val = idf(i)

    # to calculate idf_title_features we need to replace the count values with the idf values of the wo
rd
    # idf_title_features[:, idf_title_vectorizer.vocabulary_[i]].nonzero()[0] will return all documents
in which the word i present
    for j in idf_title_features[:, idf_title_vectorizer.vocabulary_[i]].nonzero()[0]:

        # we replace the count values of word i in document j with  idf_value of word i
        # idf_title_features[doc_id, index_of_word_in_courpus] = idf value of word
        idf_title_features[j,idf_title_vectorizer.vocabulary_[i]] = idf_val #idf_title_features.shape =
(16042, 12609)
```

Using IDF Weighted W2V

In [23]:

```
#if you do NOT have RAM >= 12GB, use the code below.

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

In [24]:

```
# vocab = stores all the words that are there in google w2v model
# vocab = model.wv.vocab.keys() # if you are using Google word2Vec

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.vocabul
ary_[word]] * model[word])
            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 [25]:

```
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) #w2v_title_weight.shape = (16042,300)
```

OneHotEncoding the Color and Brand Features

Take Color and Brand Feature separeately without merging them

In [26]:

```
# some of the brand values are empty.
# Need to replace Null with string "NULL"
data['brand'].fillna(value="Not given", inplace=True )

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

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

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

Utility Function

In [28]:

```
from IPython.display import display, SVG, Math, YouTubeVideo

#Display an image
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)

# Utility functions

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 ignori
ng 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 title
    # vec2 = np.array(#number_of_words_title2 * 300), each row is a vector of length 300 corresponds to
each word in give title

    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 create_table(df_id1, df_id2, doc_id1,doc_id2):
    import plotly
    import plotly.figure_factory as ff
    from plotly.graph_objs import Scatter, Layout
    plotly.offline.init_notebook_mode(connected=False)

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

    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')


def heat_map_idf_brand_col_img(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 each word in give title
    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 each word in give title
    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)

    #Create a table
    #create_table(df_id1, df_id2, doc_id1,doc_id2)
    '''Extremely high ram consumption. Try to avoid running the above line'''


    # 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()
```

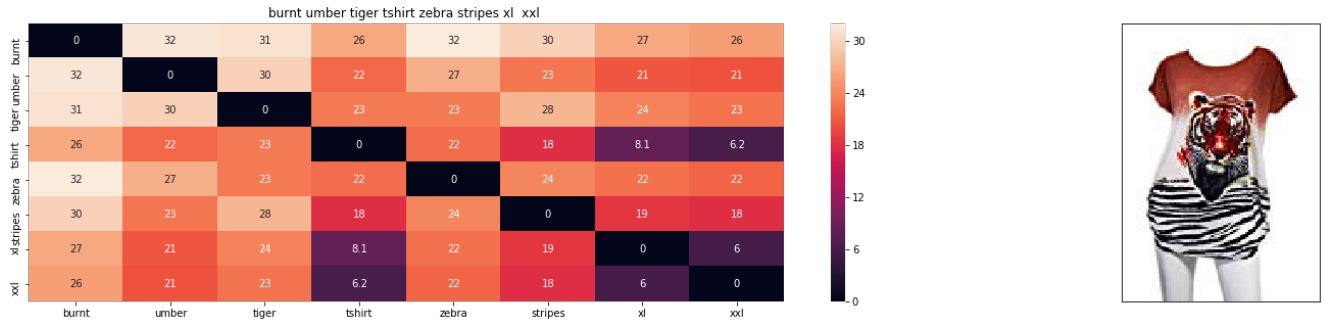
In [29]:

```
def idf_w2v_brand_col_visual(doc_id, w1, w2, w3, w4, num_results):
    # doc_id: apparel's id in given corpus
    # w1: weight for  w2v features
    # w2: weight for brand features
    # w3: weight for color features
    # w4: weight for cnn features

    # 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
    # For Title
    idf_w2v_dist  = pairwise_distances(w2v_title_weight, w2v_title_weight[doc_id].reshape(1,-1))
    # For Brand
    brand_feat_dist = pairwise_distances(brand_features, brand_features[doc_id].reshape(1,-1))
    # For Color
    col_feat_dist = pairwise_distances(color_features, color_features[doc_id].reshape(1,-1))
    # For Image
    cnn_feat_dist = pairwise_distances(bottleneck_features_train, bottleneck_features_train[doc_id].reshape(1,-1))
    # Weighted Eucledean Distance
    pairwise_dist  = (w1*idf_w2v_dist +  w2*brand_feat_dist + w3*col_feat_dist + w4*cnn_feat_dist)/float(w1 + w2 + w3 +w4)

    # np.argsort will return indices of 20 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_idf_brand_col_img(data['title'].loc[df_indices[0]],data['title'].loc[df_indices[i]], data['medium_image_url'].loc[df_indices[i]], indices[0], indices[i],df_indices[0], df_indices[i], 'weighted')
        print('ASIN :',data['asin'].loc[df_indices[i]])
        print('Brand :',data['brand'].loc[df_indices[i]])
        print('Color :',data['color'].loc[df_indices[i]])
        print('Product Type : ',data['product_type_name'].loc[df_indices[i]])
        print('Euclidean distance from input :', pdists[i])

        print('='*125)
```

Giving preference to Title

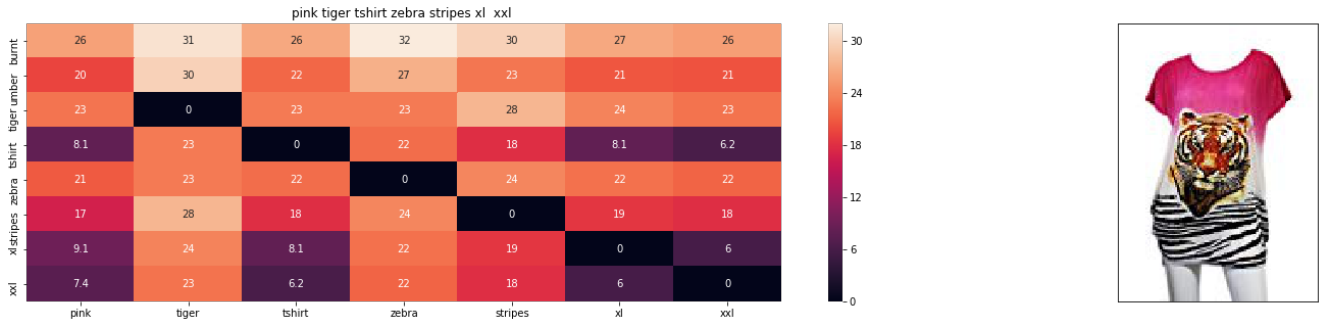
In [31]:

```
idf_w2v_brand_col_visual(12566, 50, 5, 5, 5, 20)
```

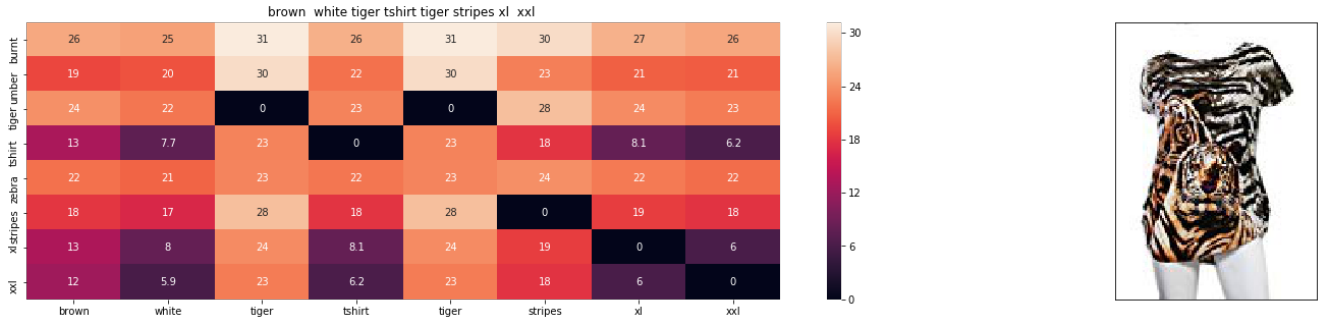



```
ASIN : B00JXQB5FQ
Brand : Si Row
Color : Brown
```

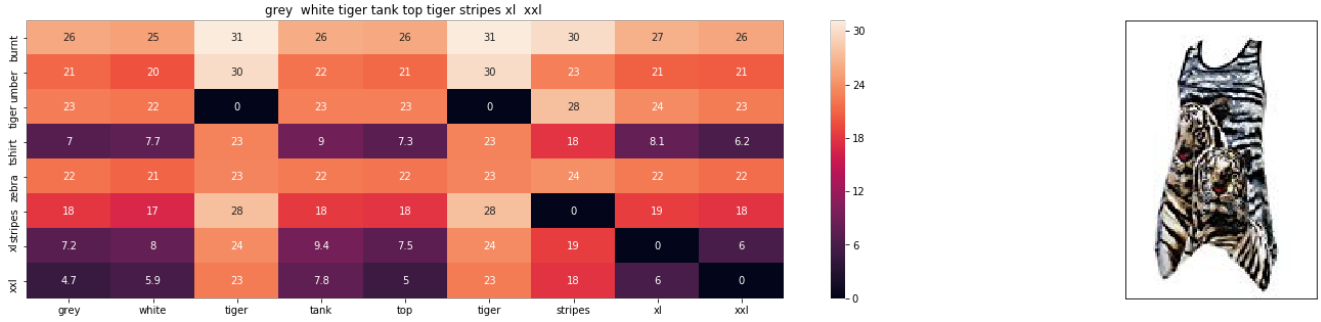
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 0.0030048076923076925
==========



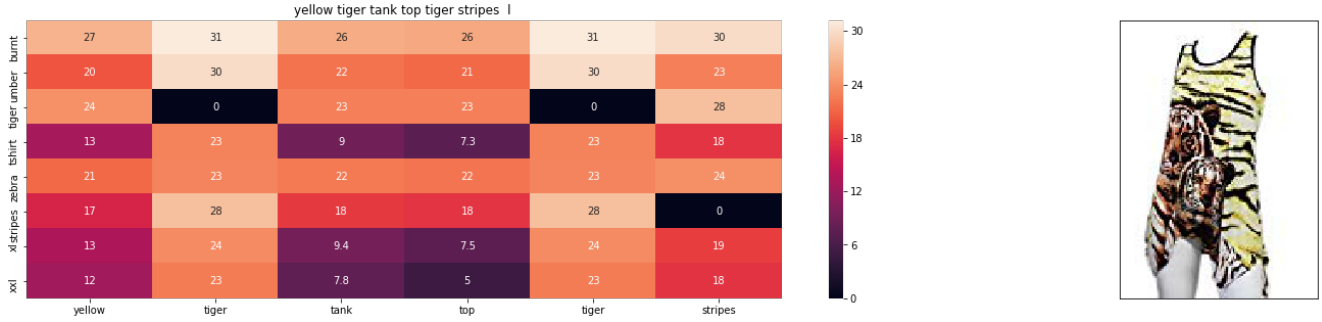
ASIN : B00JXQASS6
Brand : Si Row
Color : Pink
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 6.9663796058345895
==========



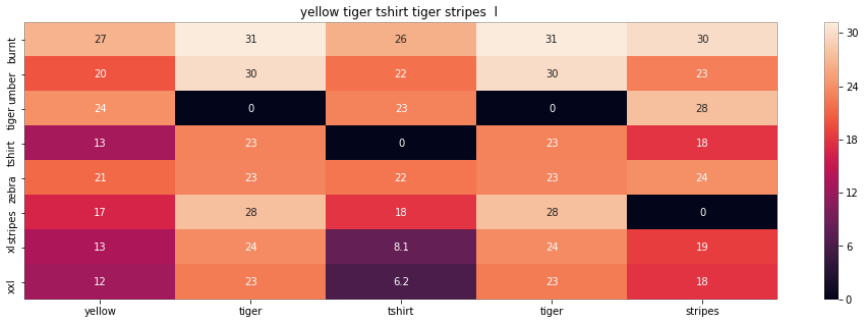
ASIN : B00JXQCWTO
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 7.942870858999399
==========



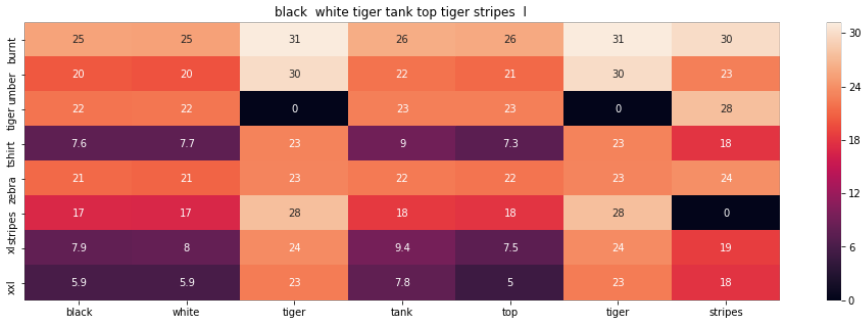
ASIN : B00JXQAFZ2
Brand : Si Row
Color : Grey
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 8.380182236919325
==========



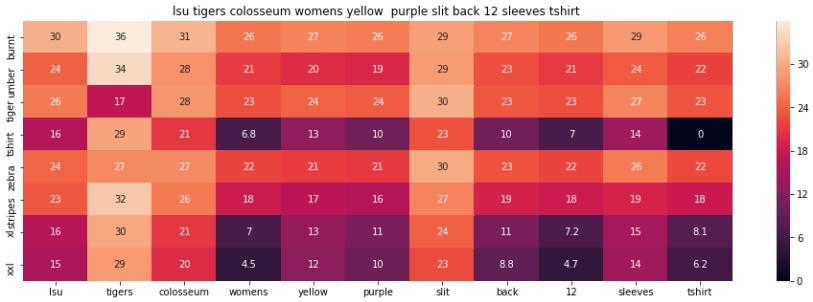
ASIN : B00JXQAUWA
Brand : Si Row
Color : Yellow
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 8.599103135356826



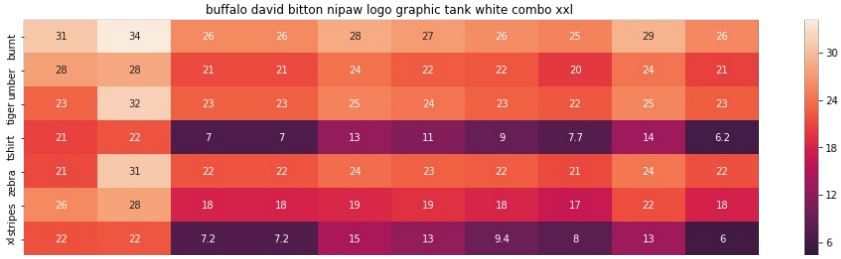
ASIN : B00JXQCUIC
Brand : Si Row
Color : Yellow
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 8.655819819551537

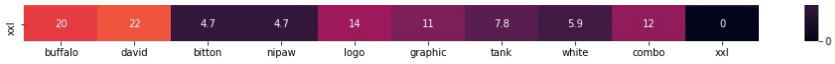


ASIN : B00JXQAO94
Brand : Si Row
Color : White
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 8.736442565945767

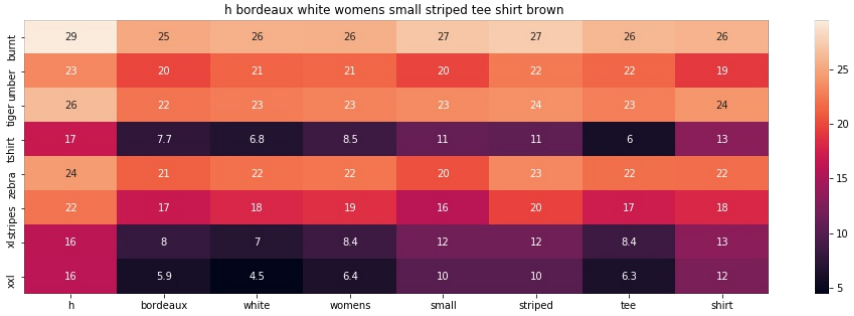


ASIN : B073R5Q8HD
Brand : Colosseum
Color : Yellow
Product Type : SPORTING_GOODS
Euclidean distance from input : 8.864318826233516

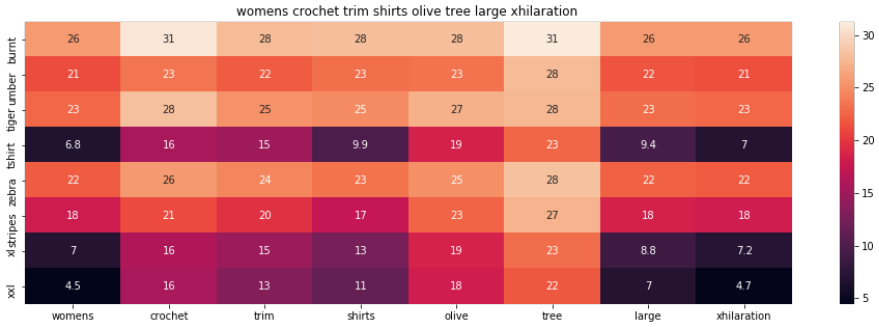




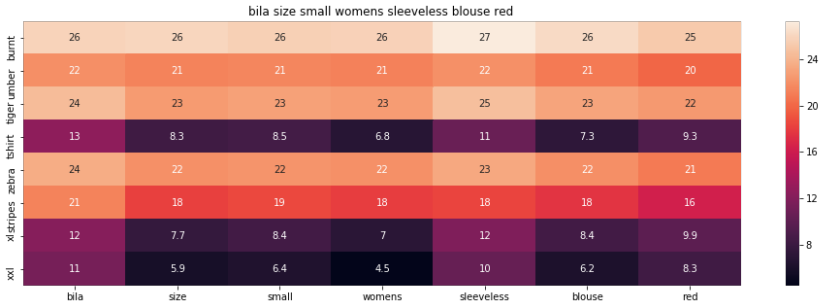
ASIN : B018H5AZXQ
Brand : Buffalo
Color : White Combo
Product Type : SHIRT
Euclidean distance from input : 9.018321772002784



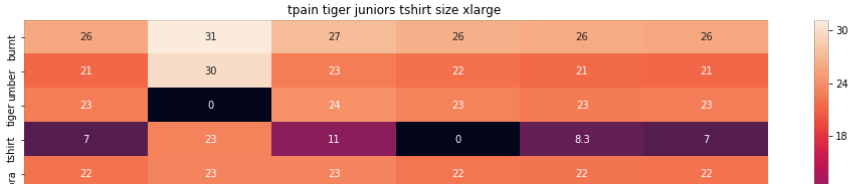
ASIN : B072BVB47Z
Brand : H By Bordeaux
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 9.155686833308293

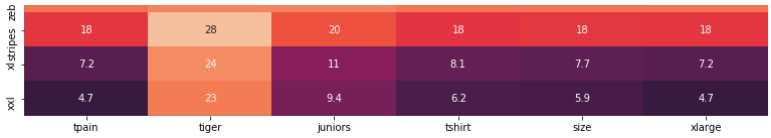


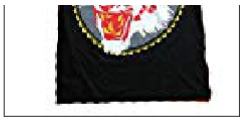
ASIN : B06XBHNM7J
Brand : Xhilaration
Color : Olive Tree
Product Type : SHIRT
Euclidean distance from input : 9.228258999692086



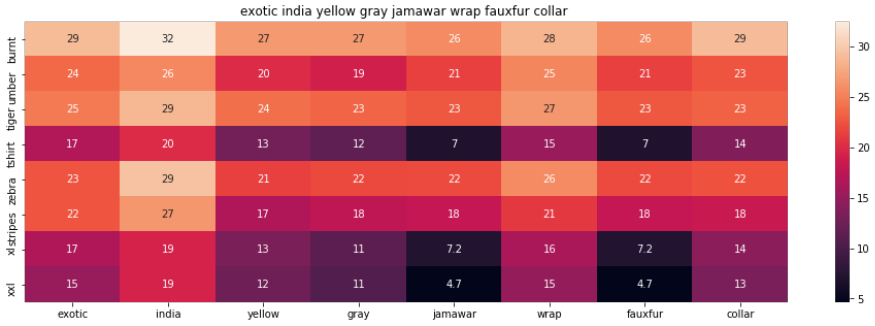
ASIN : B01L7ROZNC
Brand : Bila
Color : Red
Product Type : SHIRT
Euclidean distance from input : 9.246490457092891



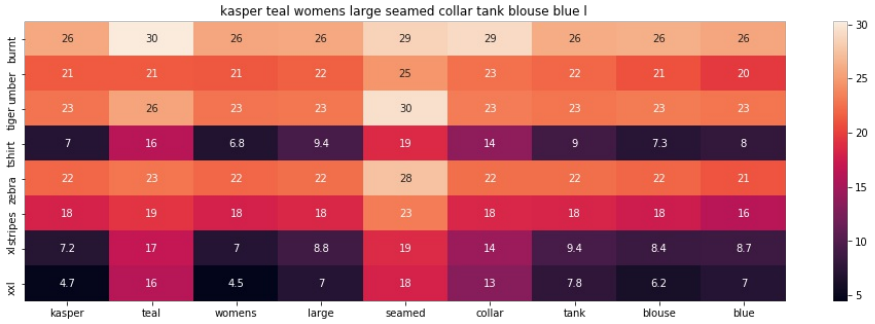




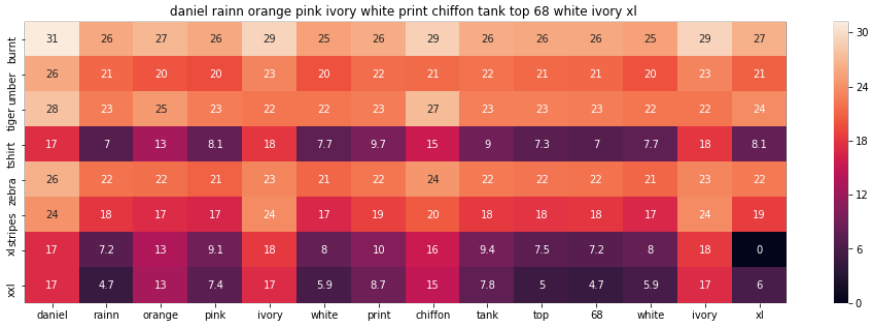
ASIN : B01K0H02OG
Brand : Tultex
Color : Black
Product Type : SHIRT
Euclidean distance from input : 9.253970080740729



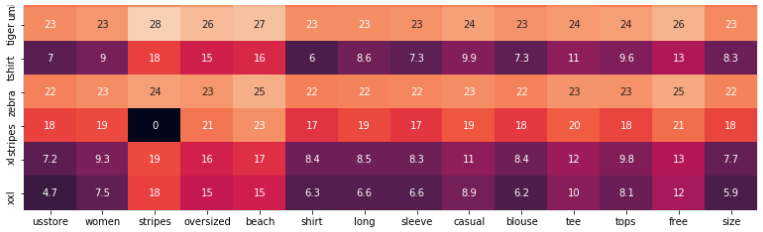
ASIN : B073ZHRBV8
Brand : Exotic India
Color : Gray
Product Type : SHIRT
Euclidean distance from input : 9.285448631901296



ASIN : B0722DJVQP
Brand : Kasper
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 9.33012270619145

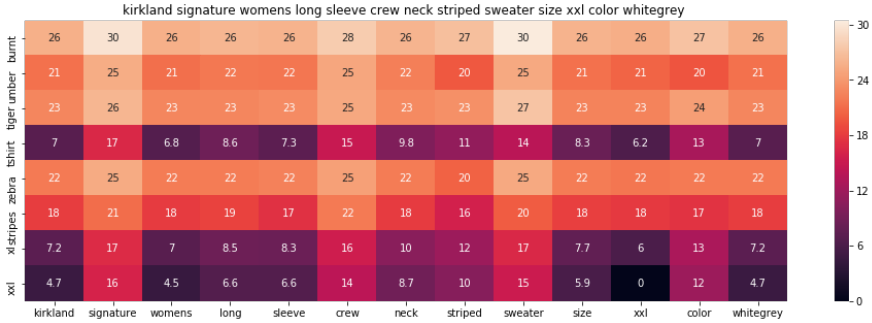


ASIN : B01IPV1SFQ
Brand : Daniel Rainn
Color : White Ivory
Product Type : SHIRT
Euclidean distance from input : 9.33093506061828



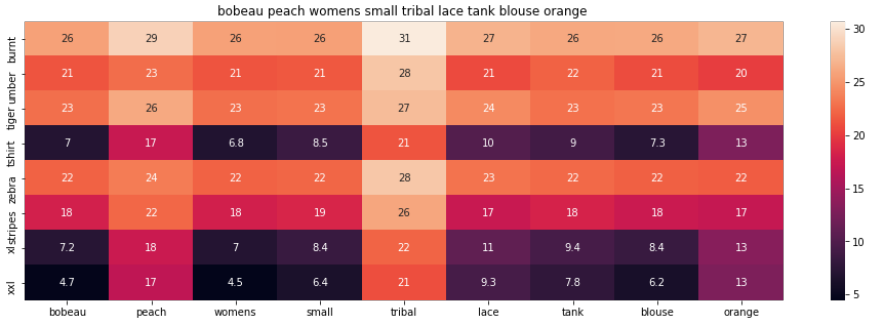
ASIN : B01DNNI1RO
Brand : Usstore
Color : as pictures
Product Type : SHIRT
Euclidean distance from input : 9.35065467652502

==========



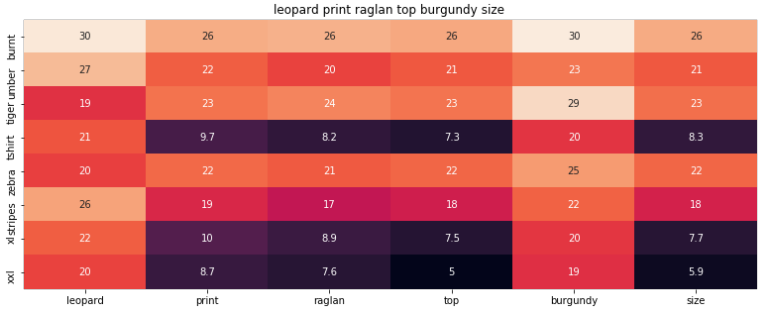
ASIN : B06XTPC3FP
Brand : Kirkland Signature
Color : White
Product Type : SWEATER
Euclidean distance from input : 9.352022259079781

==========



ASIN : B072JTHCX6
Brand : Bobeau
Color : Orange
Product Type : SHIRT
Euclidean distance from input : 9.38337447151597

==========



ASIN : B01C6ORLDQ
Brand : 1 Mad Fit
Color : Burgundy
Product Type : SHIRT
Euclidean distance from input : 9.384758934635672

==========

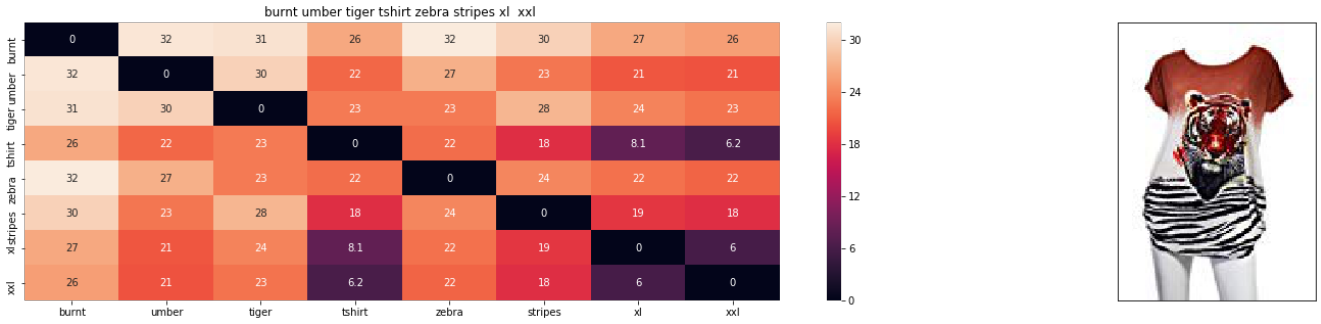
Summary:

1. On giving more weights to Title Feature , we can see that the recommended products have similar Title Descriptions
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

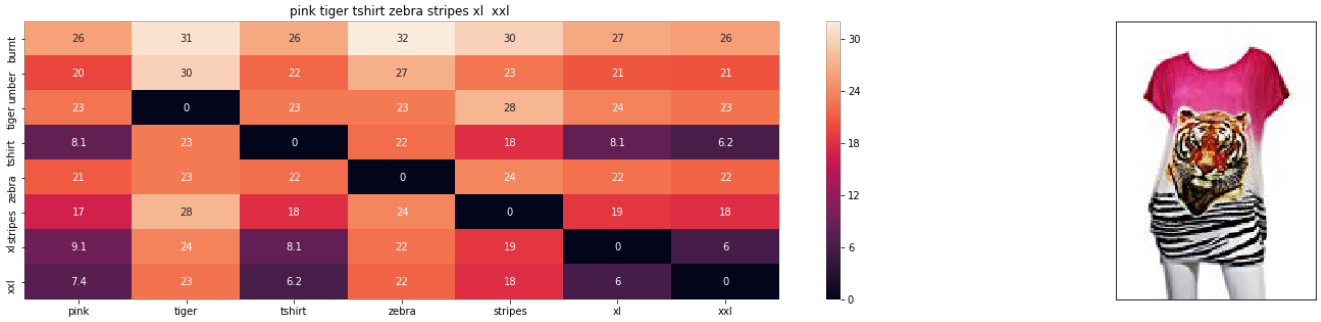
Giving preference to Brands

In [32]:

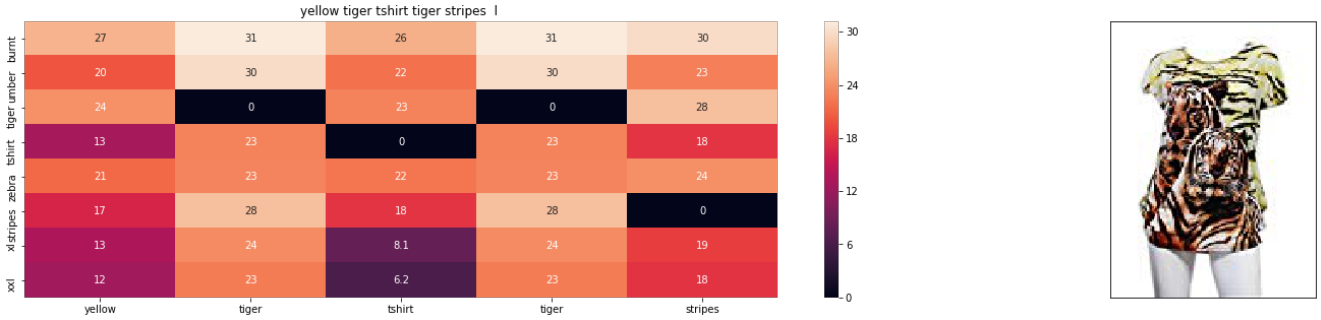
```
idf_w2v_brand_col_visual(12566, 5, 50, 5, 5, 20)
```



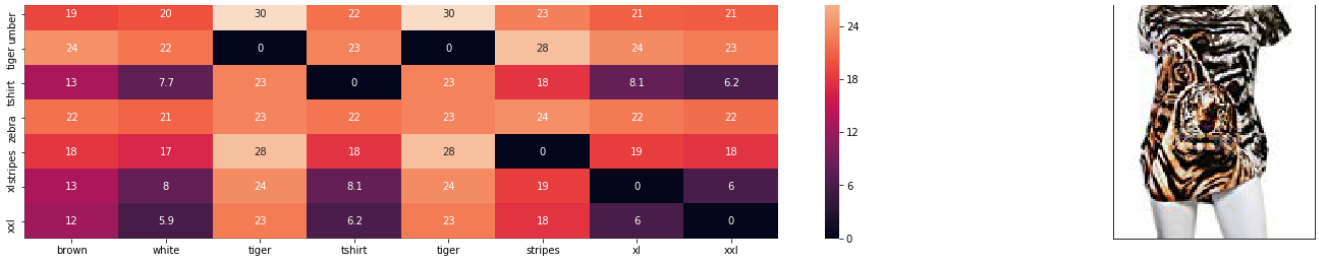
ASIN : B00JXQB5FQ
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 0.00030048076923076925
==========



ASIN : B00JXQASS6
Brand : Si Row
Color : Pink
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.152918947687804
==========

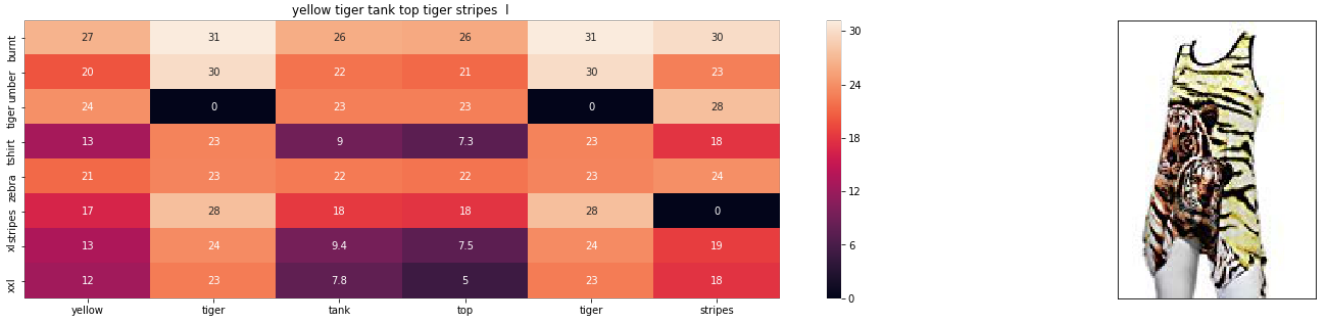


ASIN : B00JXQCUIC
Brand : Si Row
Color : Yellow
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.575744335495797
==========



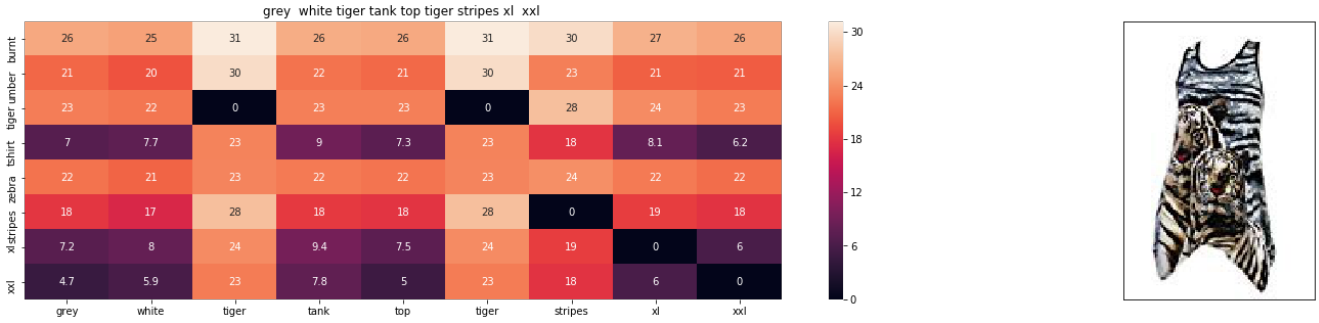
ASIN : B00JXQCWTO
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.639910976703351

==========



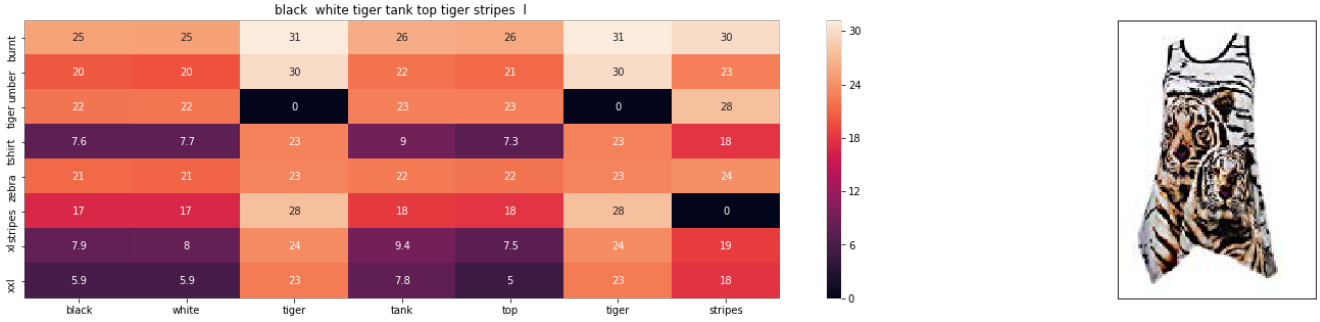
ASIN : B00JXQAUWA
Brand : Si Row
Color : Yellow
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.6602023785208875

==========



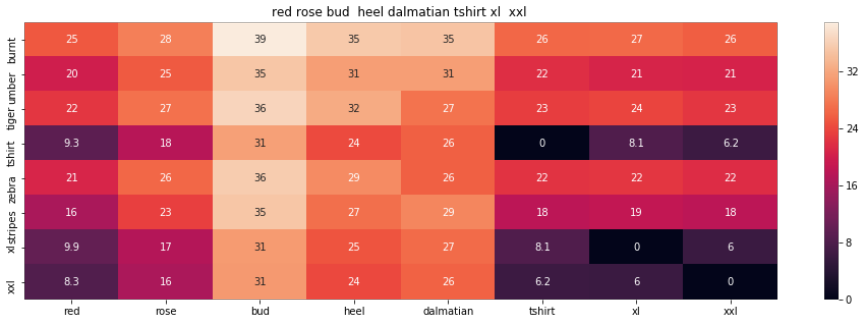
ASIN : B00JXQAFZ2
Brand : Si Row
Color : Grey
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.669301458533282

==========

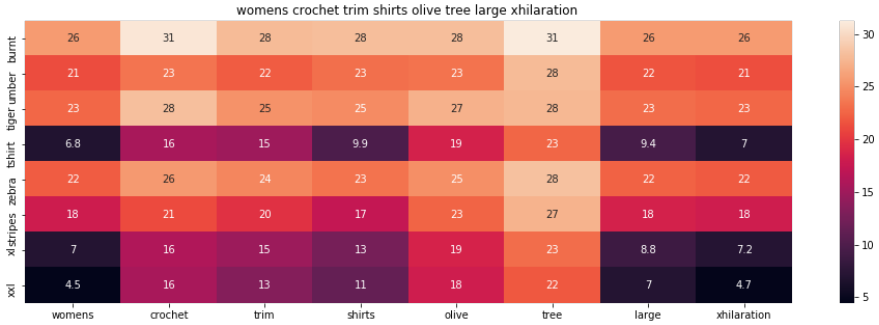


ASIN : B00JXQAO94
Brand : Si Row
Color : White
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.795119358970857

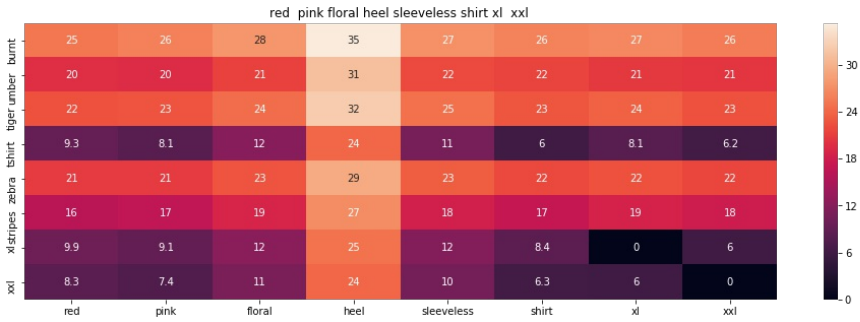
==========



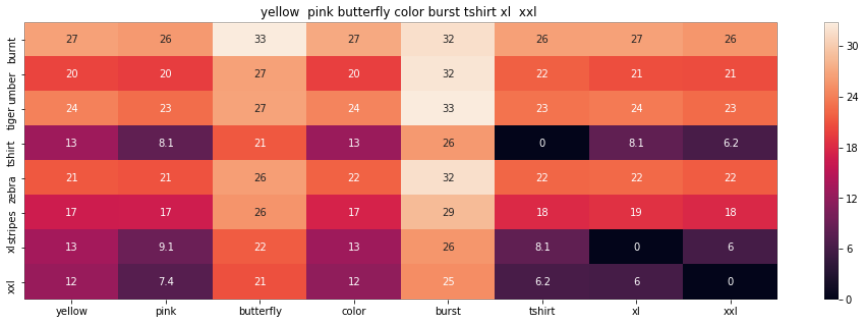
ASIN : B00JXQABB0
Brand : Si Row
Color : Red
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.910499866219956



ASIN : B06XBHNM7J
Brand : Xhilaration
Color : Olive Tree
Product Type : SHIRT
Euclidean distance from input : 4.93630159697685

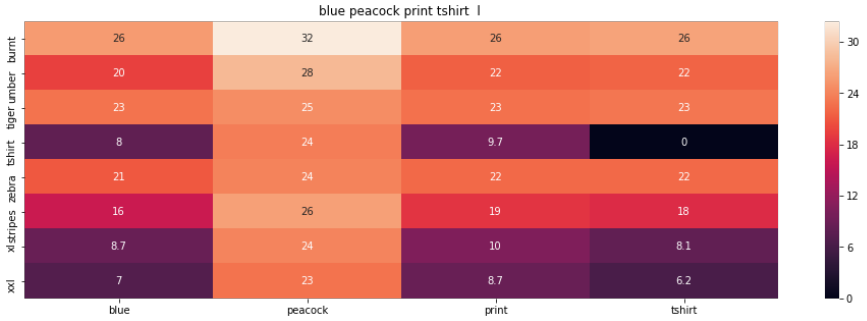


ASIN : B00JV63QQE
Brand : Si Row
Color : Red
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.964579303475815

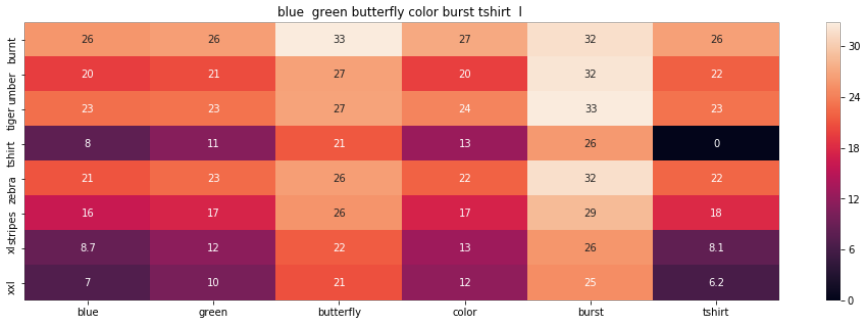


ASIN : B00JXQBBMI
Brand : Si Row
Color : Yellow

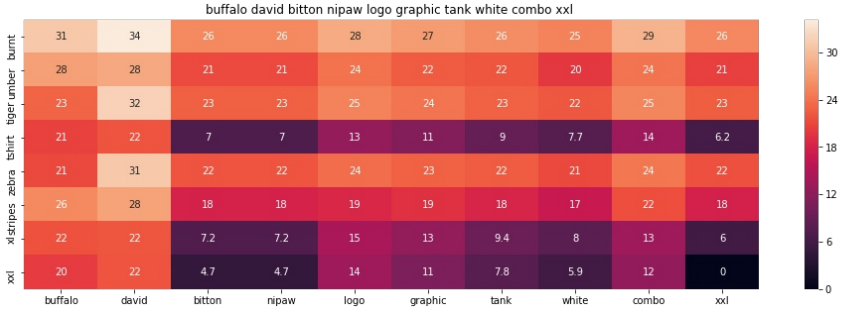
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.994197023859679
==========



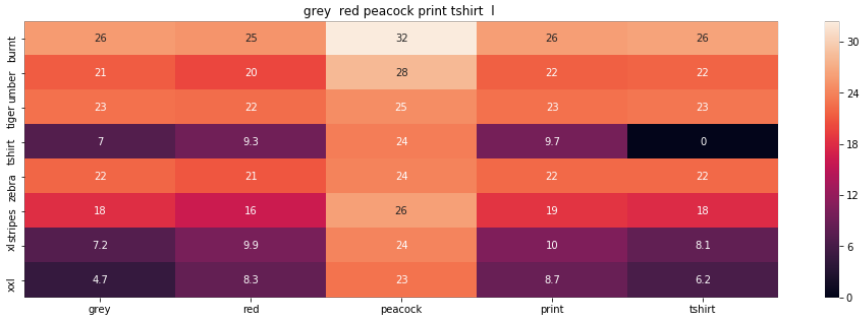
ASIN : B00JXQC8L6
Brand : Si Row
Color : Blue
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.068268291794625
==========



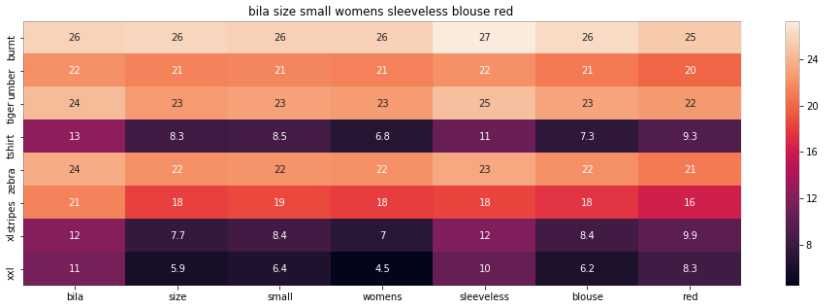
ASIN : B00JXQC0C8
Brand : Si Row
Color : Blue
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.074922238891229
==========



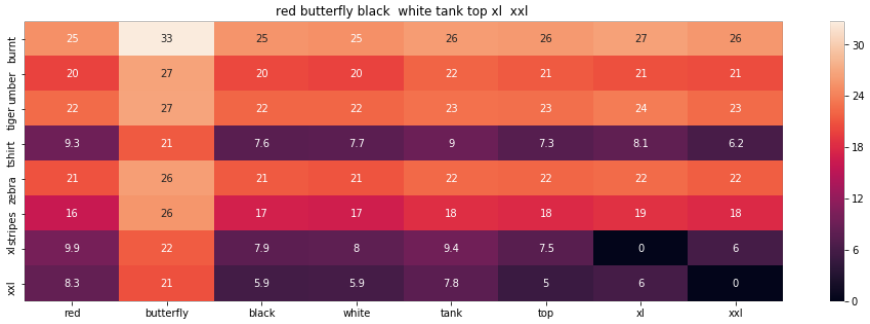
ASIN : B018H5AZXQ
Brand : Buffalo
Color : White Combo
Product Type : SHIRT
Euclidean distance from input : 5.079679223836075
==========



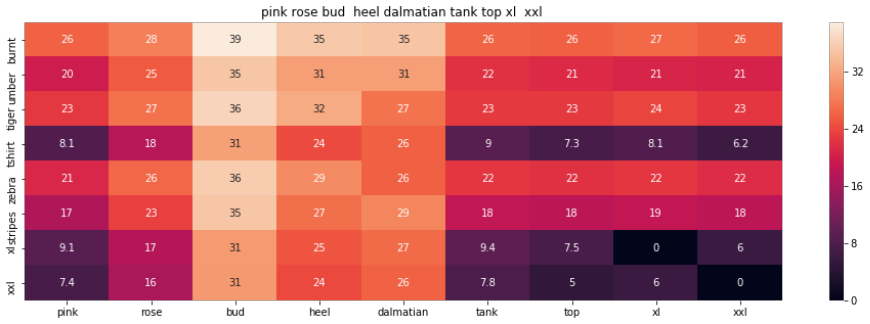
ASIN : B00JXQCFRS
Brand : Si Row
Color : Grey
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.152338116013375



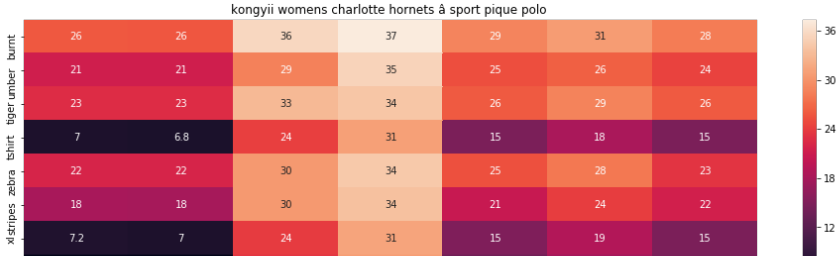
ASIN : B01L7ROZNC
Brand : Bila
Color : Red
Product Type : SHIRT
Euclidean distance from input : 5.1825636259484185

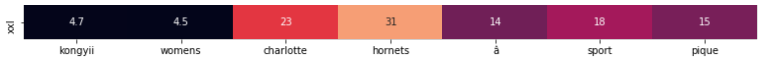


ASIN : B00JV63CW2
Brand : Si Row
Color : Red
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.2101777297077865



ASIN : B00JXQAX2C
Brand : Si Row
Color : Pink
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.268898068969355





ASIN : B01FJVZST2
Brand : KONGYII
Color : White
Product Type : SHIRT
Euclidean distance from input : 5.288002679997397

ASIN : B00JV63VC8
Brand : Si Row
Color : Purple
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 5.289709296621098

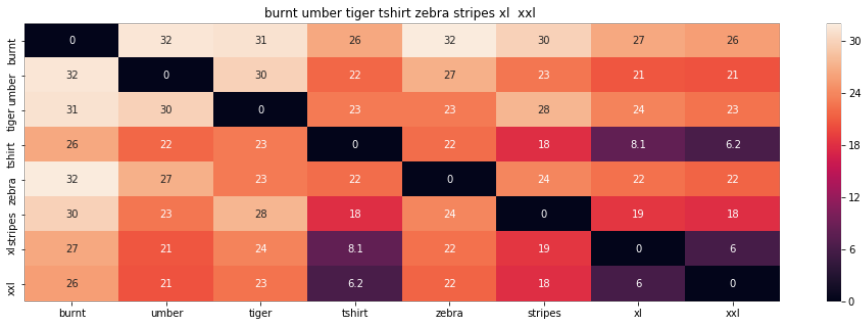
Summary:

1. On giving more weights to Brand Feature , we can see that the recommended products have similar Brands
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

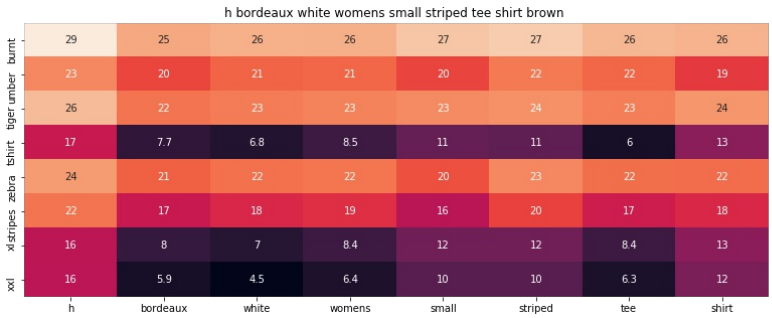
Giving preference to Color

In [33]:

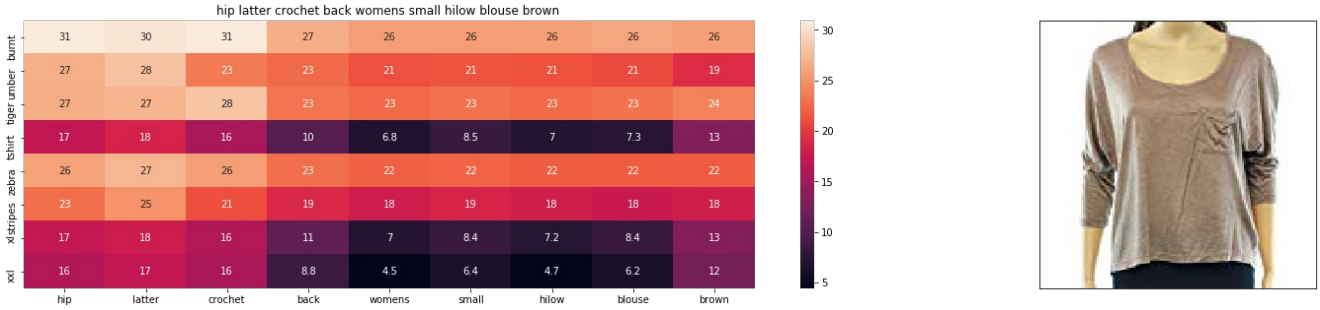
```
idf_w2v_brand_col_visual(12566, 5, 5, 50, 5, 20)
```



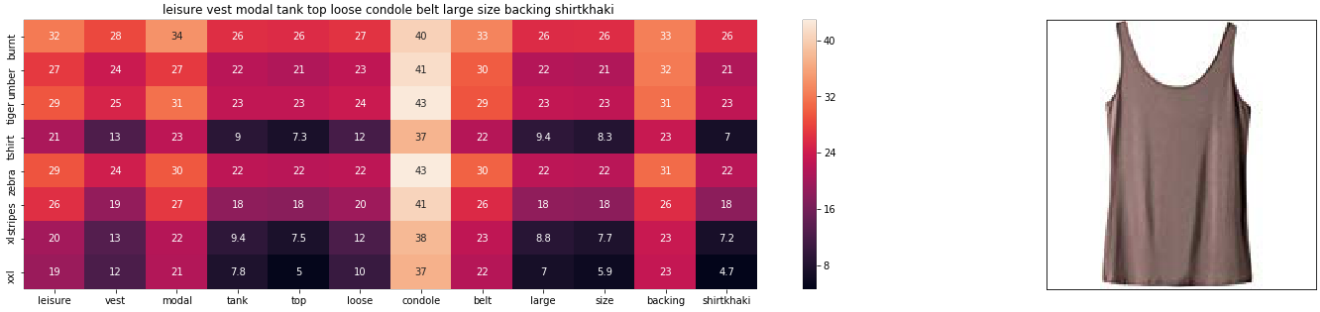
ASIN : B00JXQB5FQ
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 0.00030048076923076925



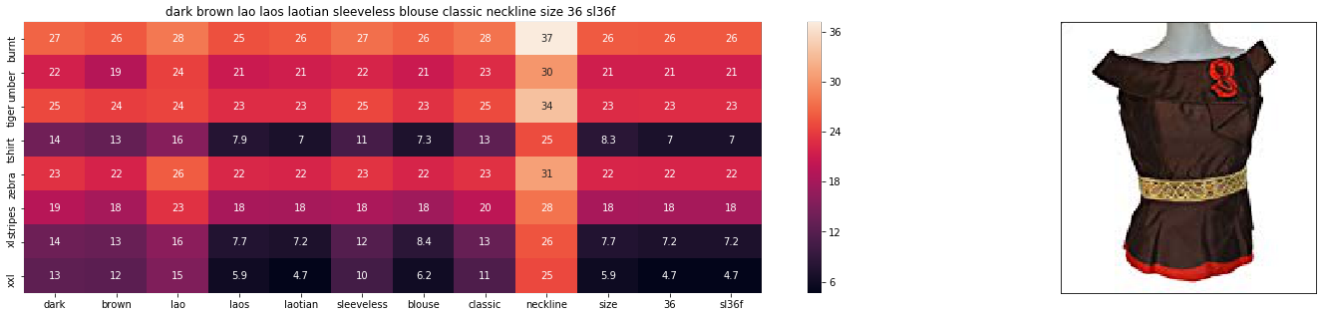
ASIN : B072BVB47Z
Brand : H By Bordeaux
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.217421076847956
==========



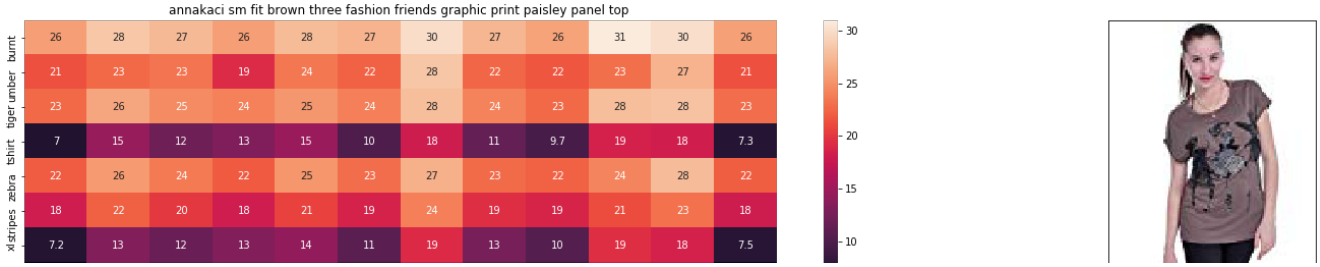
ASIN : B074MJN1K9
Brand : Hip
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.275191182913952
==========



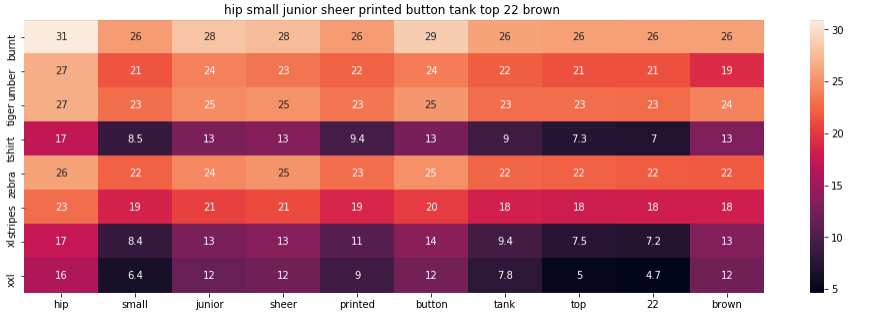
ASIN : B014OUHUZY
Brand : Black Temptation
Color : Brown
Product Type : BLAZER
Euclidean distance from input : 4.488370279165415
==========



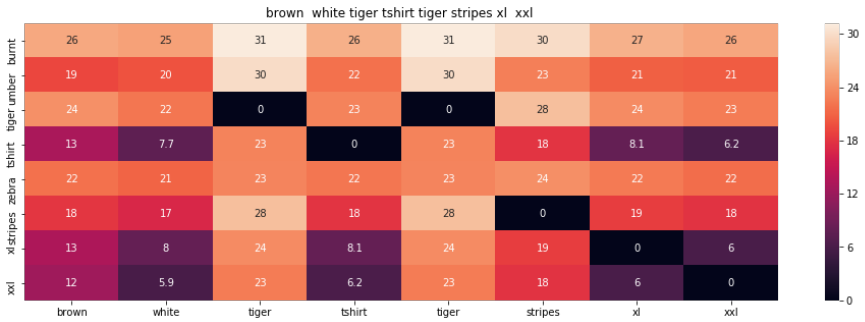
ASIN : B074J7BCYM
Brand : Nanon
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.6019762264836634
==========



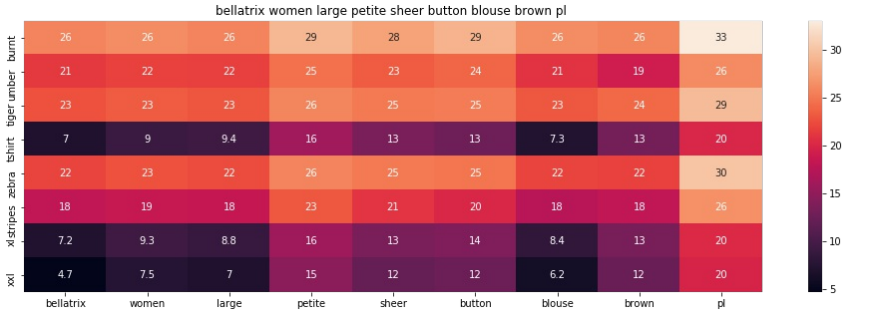
ASIN : B00BTJKAQ0
Brand : Anna-Kaci
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.620631467379057



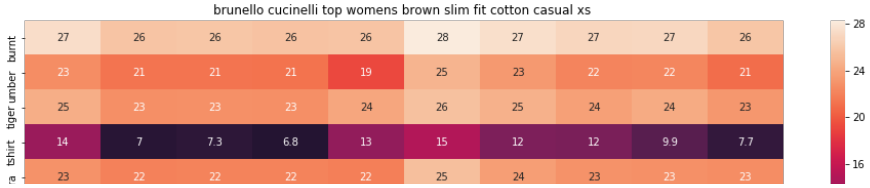
ASIN : B071LDTQ1F
Brand : Hip
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.626077483807882

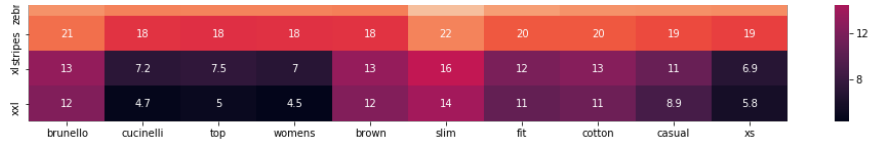


ASIN : B00JXQCWTO
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 4.639910976703351



ASIN : B074QVMXSQ
Brand : bellatrix
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.640882089145172





ASIN : B073ZCN5LG
Brand : Brunello Cucinelli
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.647620098407452

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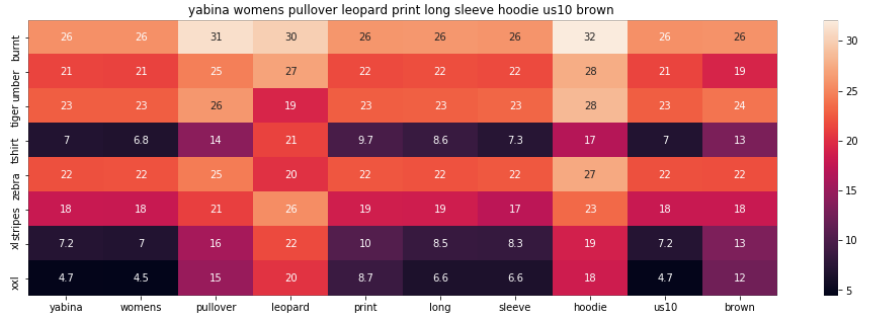

ASIN : B01KJUM6JI
Brand : YABINA
Color : Brown
Product Type : BOOKS_1973_AND_LATER
Euclidean distance from input : 4.655375063059685

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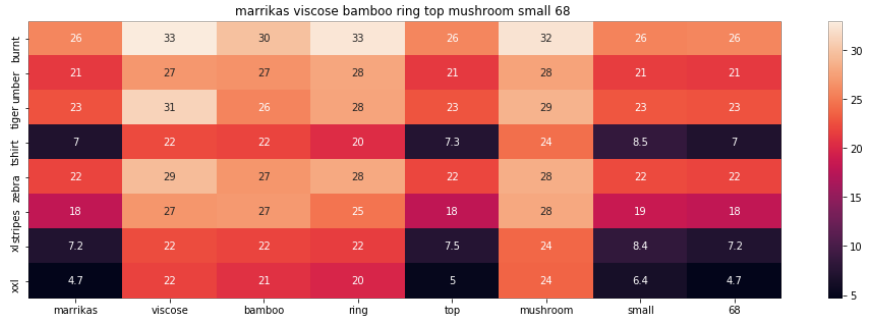

ASIN : B003SPYNAM
Brand : Marrikas
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.666180281096043

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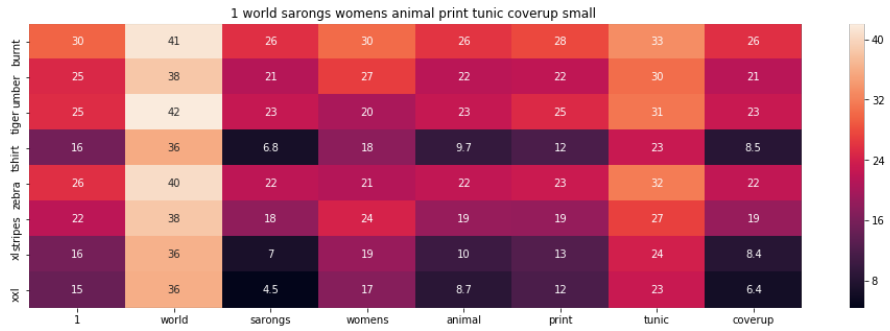

ASIN : B017YBAI9A
Brand : La Fleva
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.678307812030499

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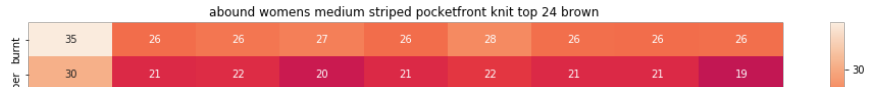
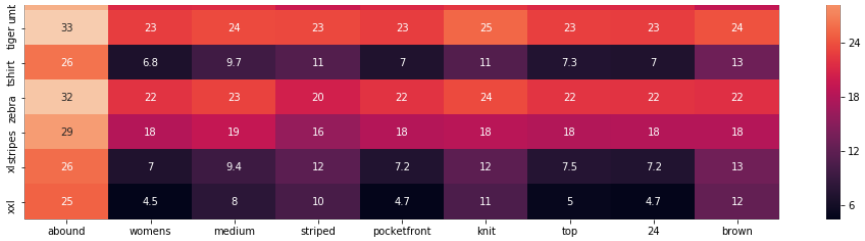
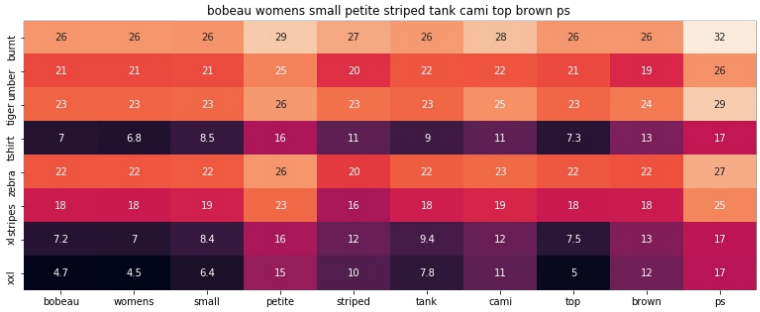
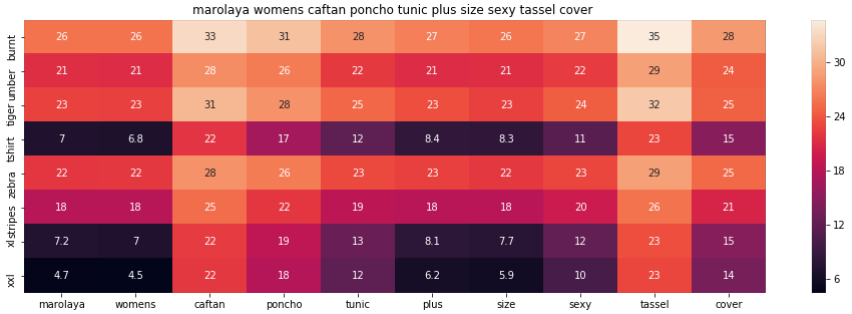




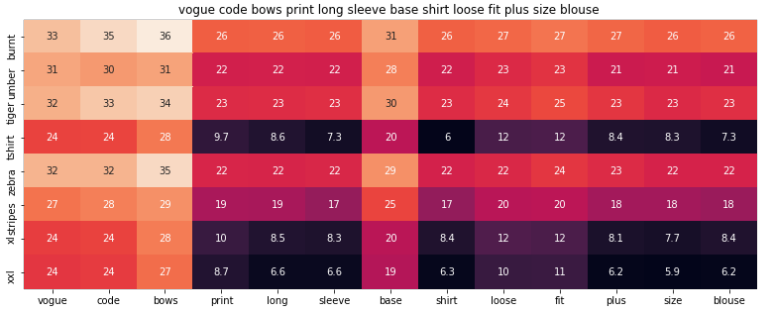
ASIN : B072M4ZF89
Brand : Abound
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.691236503864974



ASIN : B074P8YWV4
Brand : Bobeau
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.7067877921762715



ASIN : B01CE40W16
Brand : Marolaya
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.725289308665154



ASIN : B016MGC5VW
Brand : VOGUE CODE
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.741265399639423

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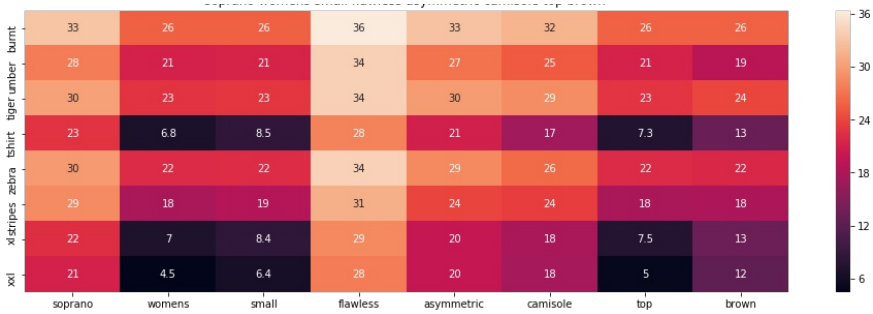
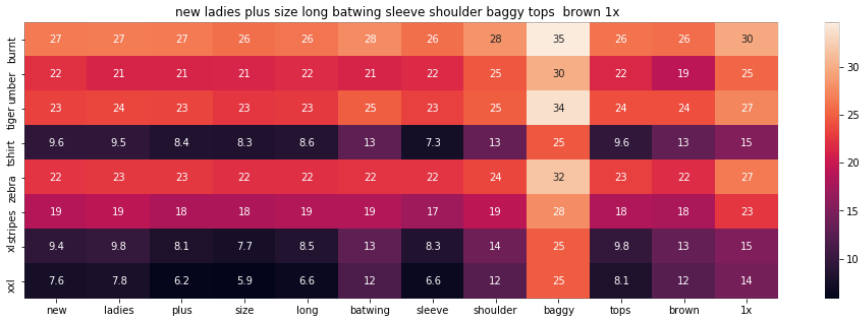
soprano womens small flawless asymmetric camisole top brown



ASIN : B0758356K3
Brand : Soprano
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.7447708502254

ASIN : B07288KFHF
Brand : Soprano
Color : Brown
Product Type : SHIRT
Euclidean distance from input : 4.749543975507101



ASIN : B00MJPVIDW
Brand : Xclusive Collection
Color : Brown
Product Type : DRESS
Euclidean distance from input : 4.749729860745943

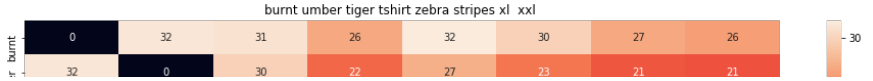
Summary:

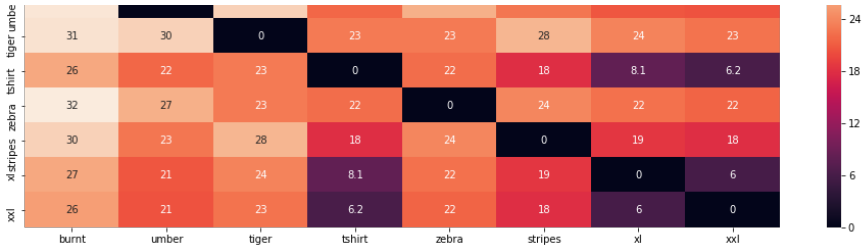
1. On giving more weights to Color Feature , we can see that the recommended products have similar Color
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

Giving preference to Image Feature

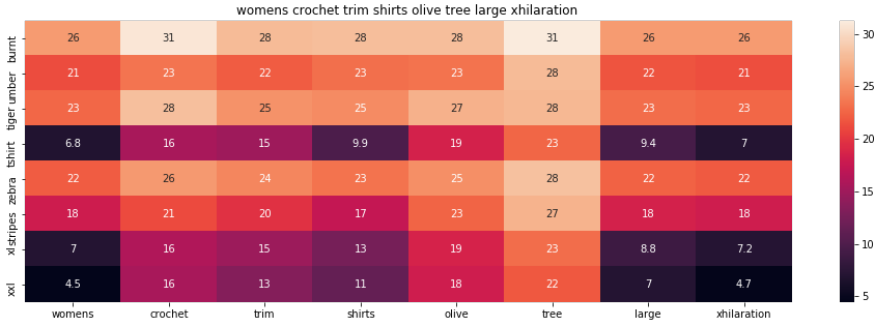
In [37]:

```
idf_w2v_brand_col_visual(12566, 5, 5, 5, 50, 20)
```





ASIN : B00JXQB5FQ
Brand : Si Row
Color : Brown
Product Type : TOYS_AND_GAMES
Euclidean distance from input : 0.00030048076923076925
==========



ASIN : B06XBHNM7J
Brand : Xhilaration
Color : Olive Tree
Product Type : SHIRT
Euclidean distance from input : 29.482601533683976
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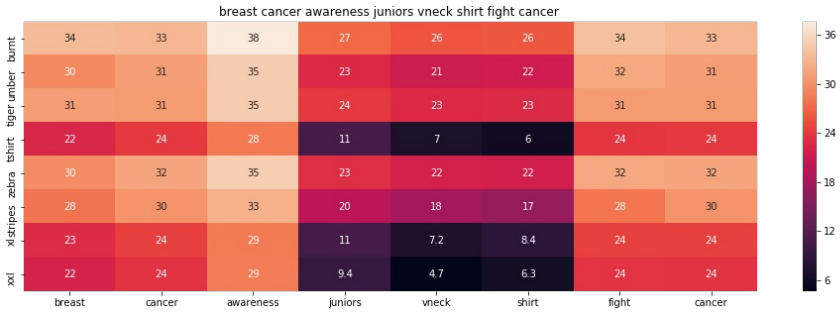

ASIN : B016CU40IY
Brand : Juiceclouds
Color : Black
Product Type : SHIRT
Euclidean distance from input : 30.649813703975404
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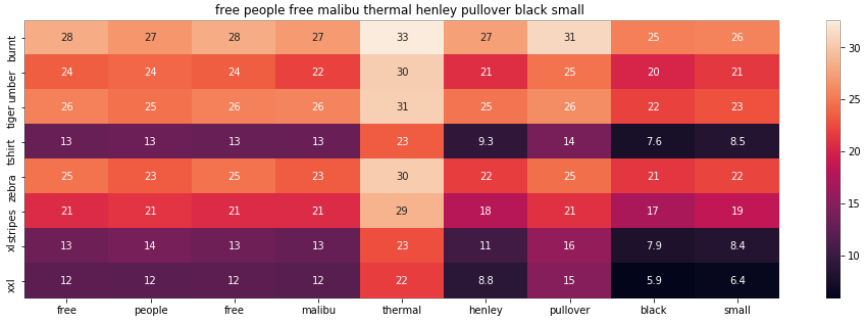

ASIN : B074MXY984
Brand : We The Free
Color : Black
Product Type : SHIRT
Euclidean distance from input : 31.209436975329012
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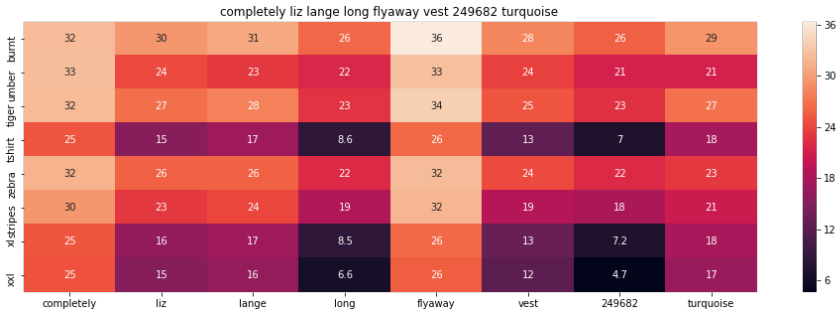
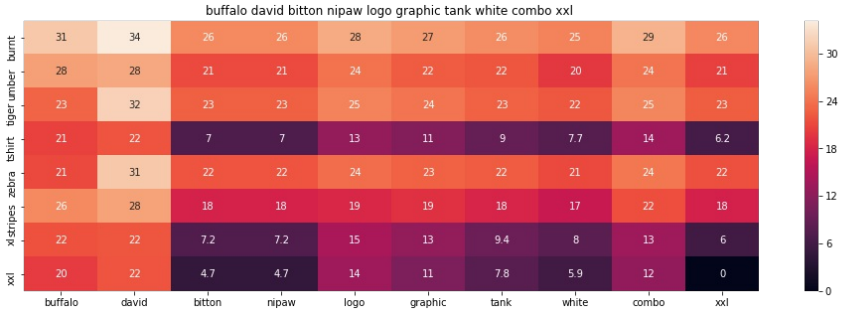


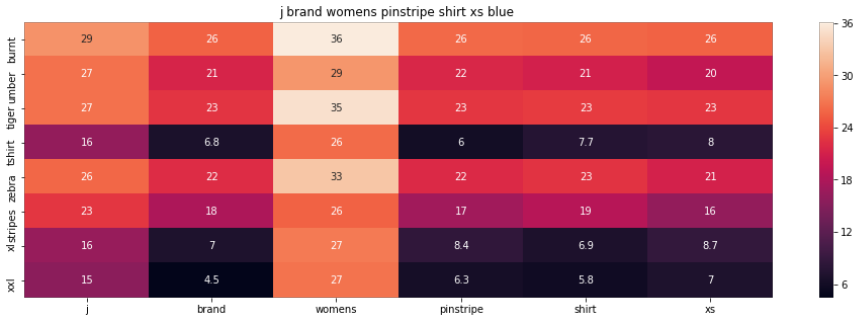
ASIN : B074LTBWSW
Brand : Liz Lange
Color : Turquoise
Product Type : SHIRT
Euclidean distance from input : 31.21034927370944

==========



ASIN : B018H5AZXQ
Brand : Buffalo
Color : White Combo
Product Type : SHIRT
Euclidean distance from input : 31.269690896195243

==========



ASIN : B06XYP1X1F
Brand : J Brand Jeans
Color : Navy/Blk Stp
Product Type : SHIRT
Euclidean distance from input : 31.386105346679688

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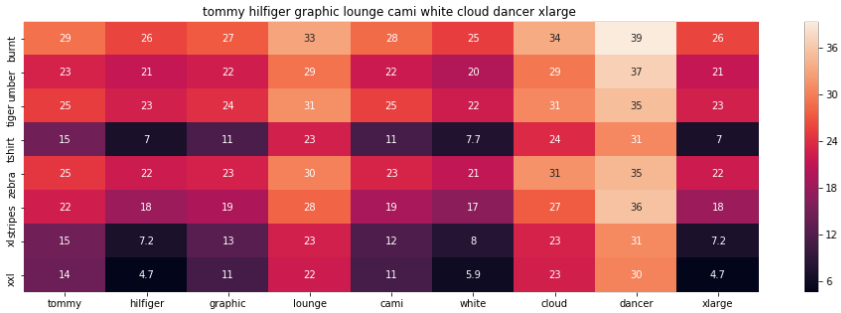
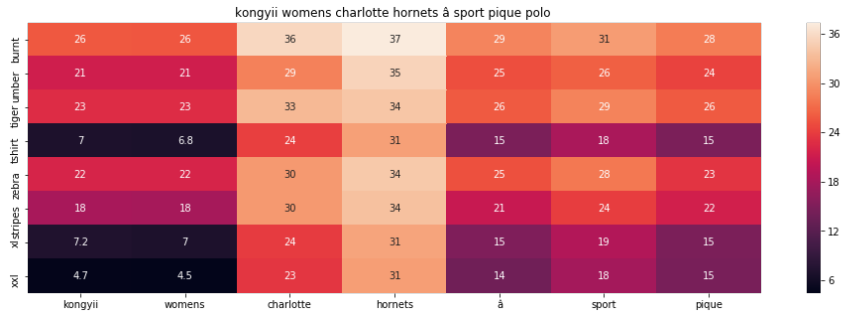


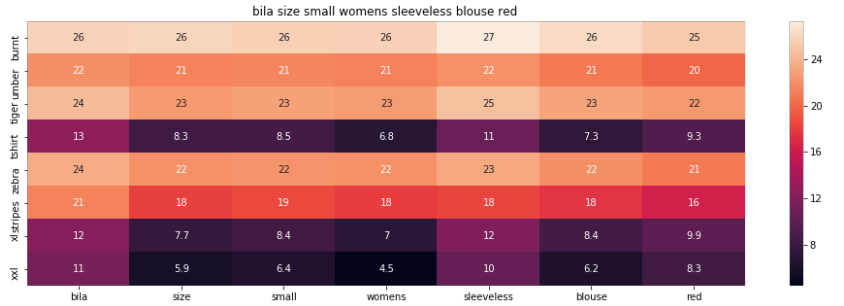
ASIN : B01BMSFYW2
Brand : igertommy hilf
Color : white cloud dancer
Product Type : SHIRT
Euclidean distance from input : 31.56028512807993

==========



ASIN : B01FJVZST2
Brand : KONGYII
Color : White
Product Type : SHIRT
Euclidean distance from input : 32.28489418821894

==========



ASIN : B01L7ROZNC
Brand : Bila
Color : Red
Product Type : SHIRT
Euclidean distance from input : 32.393291334590636

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ASIN : B01L9F153U
Brand : ATYPEMX
Color : Black
Product Type : SHIRT
Euclidean distance from input : 32.91237826039067

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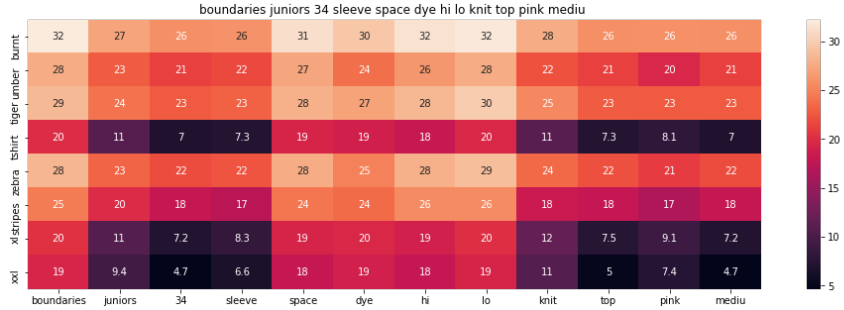
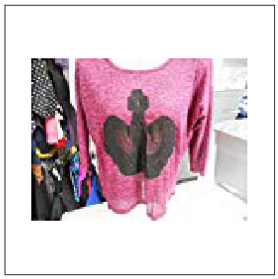
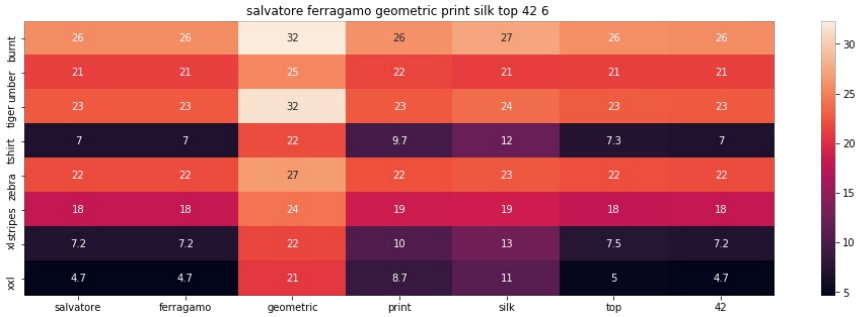
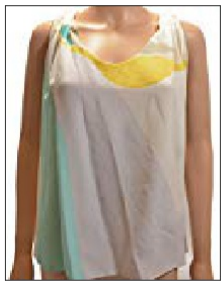




ASIN : B01EXXFS4M
Brand : No Boundaries
Color : Pink

Product Type : SHIRT
Euclidean distance from input : 32.96078221250526
==========





ASIN : B0756JTS1F
Brand : Salvatore Ferragamo
Color : Multi-color
Product Type : SWEATER
Euclidean distance from input : 33.124117316289855
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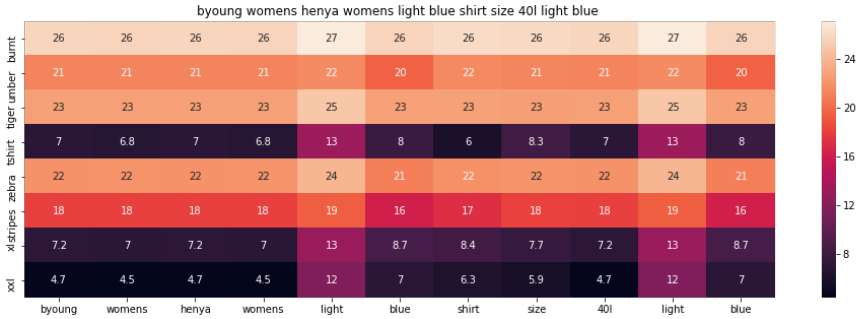

ASIN : B06Y41MRCH
Brand : Byoung
Color : Chambray Blue
Product Type : SHIRT
Euclidean distance from input : 33.15645606812658
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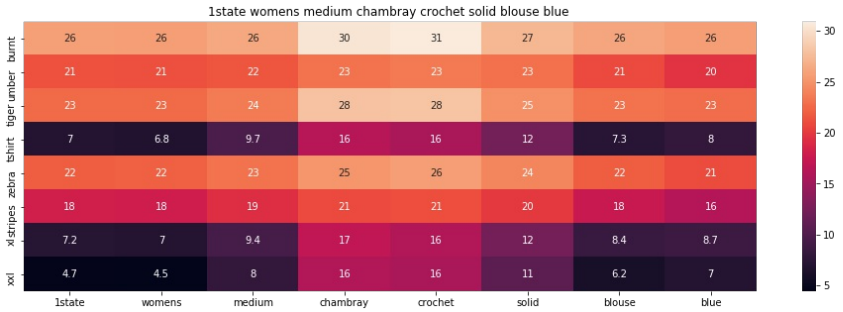

ASIN : B074MK6LV2
Brand : 1.State
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 33.21030200870046
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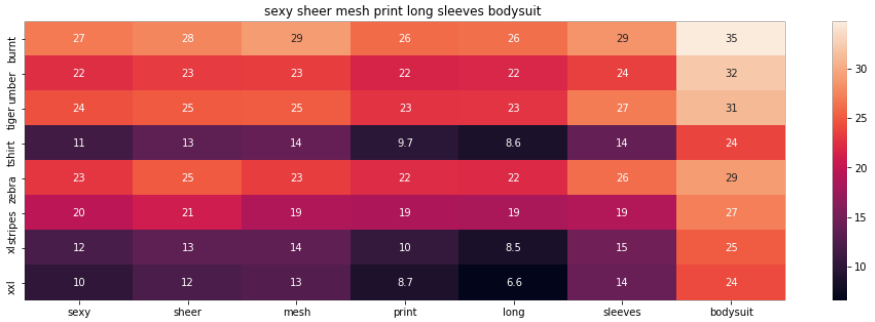

ASIN : B074Z5C98D
Brand : Ariella's closet
Color : Multi Color Black & Pink
Product Type : APPAREL
Euclidean distance from input : 33.347475434492175
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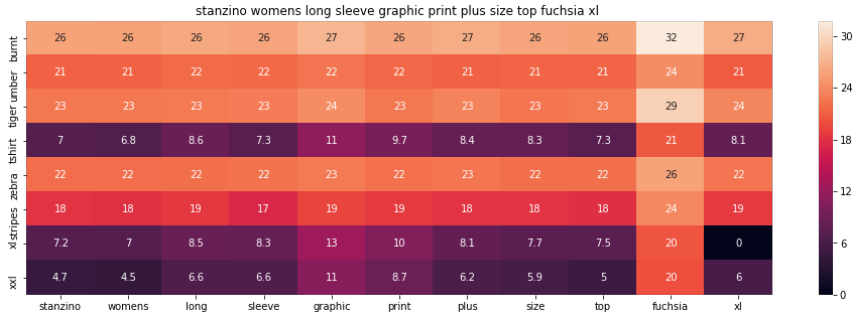

ASIN : B00DP4VHWI
Brand : Stanzino
Color : Fuchsia
Product Type : SHIRT
Euclidean distance from input : 33.434203434575615
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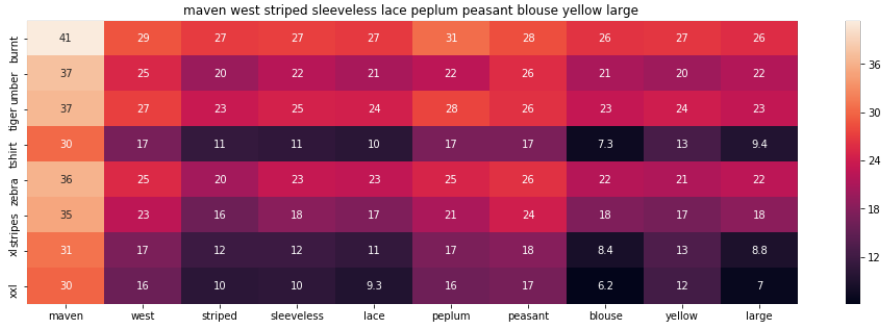
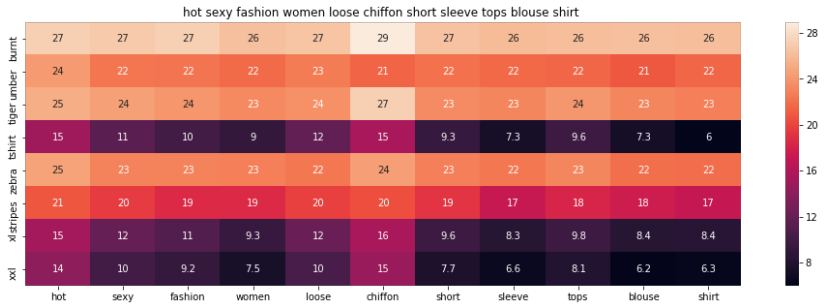
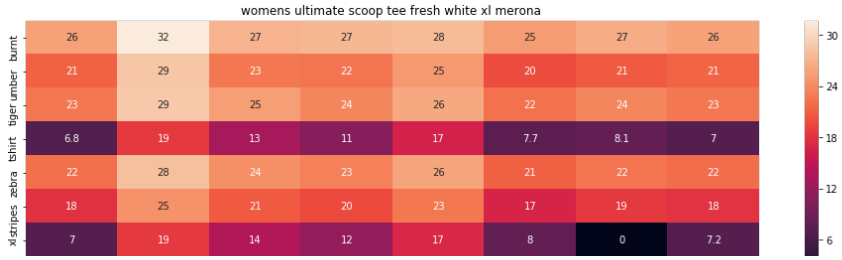


ASIN : B01M8GB3AL
Brand : Maven West
Color : Yellow
Product Type : SHIRT
Euclidean distance from input : 33.471489715603965
==========



ASIN : B00JMAASRO
Brand : Wotefusi
Color : Multicolor
Product Type : DRESS
Euclidean distance from input : 33.48219625824974
==========



ASIN : B01G7XE50E
Brand : Merona
Color : White
Product Type : SHIRT
Euclidean distance from input : 33.50777133853445

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Summary:

1. On giving more weights to Image Feature , we can see that the recommended products have similar Image(Acc. to CNN)
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

Trying with another Query point

Giving preference to Title

In [34]:

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idf_w2v_brand_col_visual(931, 50, 5, 5, 5, 20)
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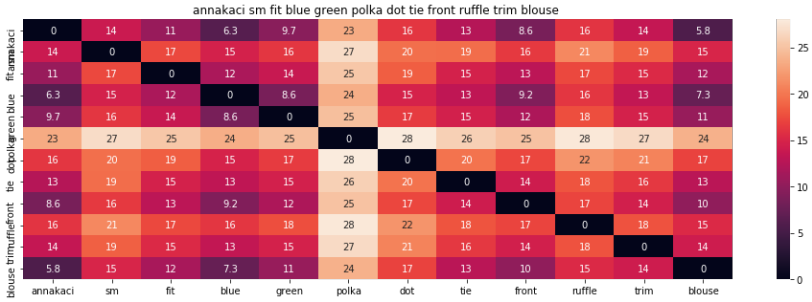

ASIN : B00KLHUIBS
Brand : Anna-Kaci
Color : Blue/Green
Product Type : SHIRT
Euclidean distance from input : 0.0038008144268622764

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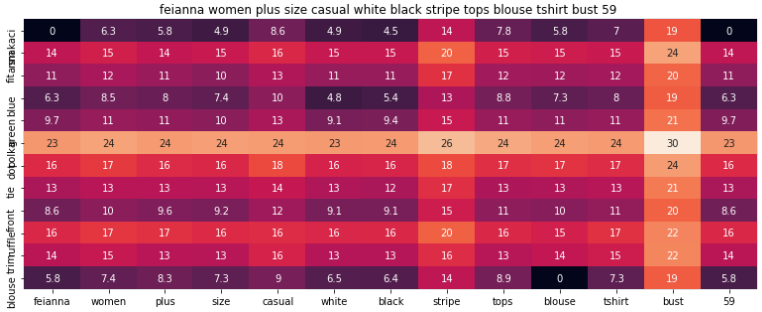

ASIN : B072WQ86QJ
Brand : FEIANNA
Color : White Black Stripe
Product Type : SHIRT
Euclidean distance from input : 5.469203107039537

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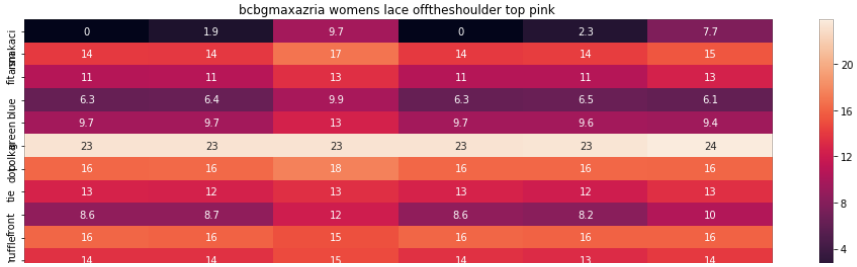

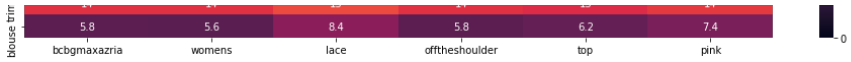

ASIN : B074TH83H1
Brand : BCBGMAXAZRIA
Color : Bare Pink
Product Type : SHIRT
Euclidean distance from input : 5.587529674500491

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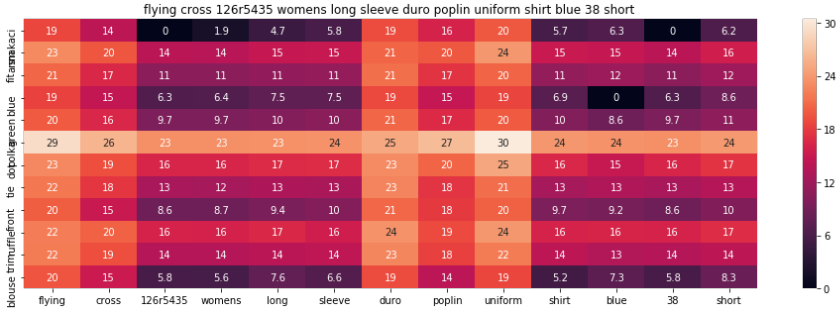

ASIN : B01J65ZE2I
Brand : Flying Cross
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 5.587654465895433

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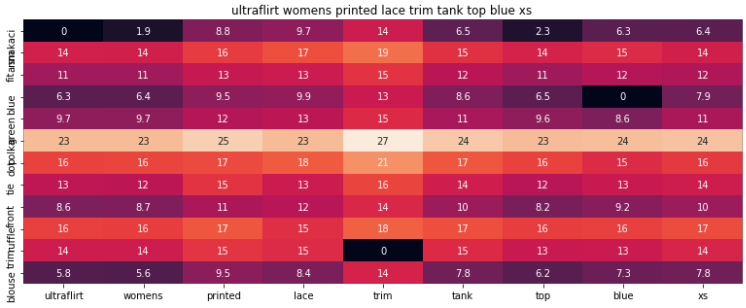

ASIN : B014JS4NIS
Brand : Ultra Flirt
Color : Multi-color
Product Type : APPAREL
Euclidean distance from input : 5.647250366210938

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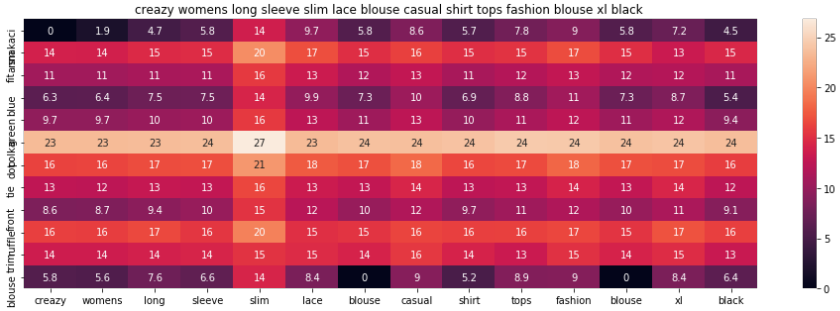

ASIN : B01EV1NKNW
Brand : Creazy
Color : Black
Product Type : SHIRT
Euclidean distance from input : 5.666671710028625

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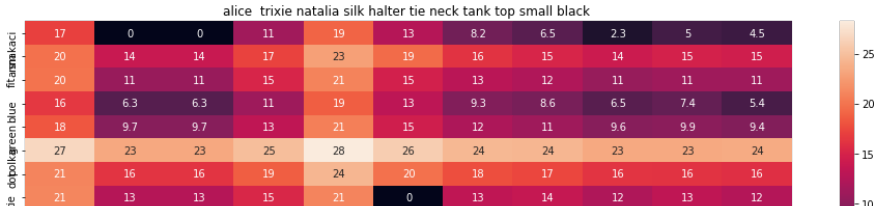
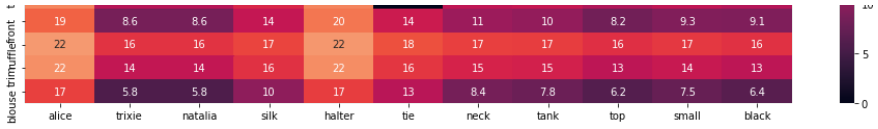
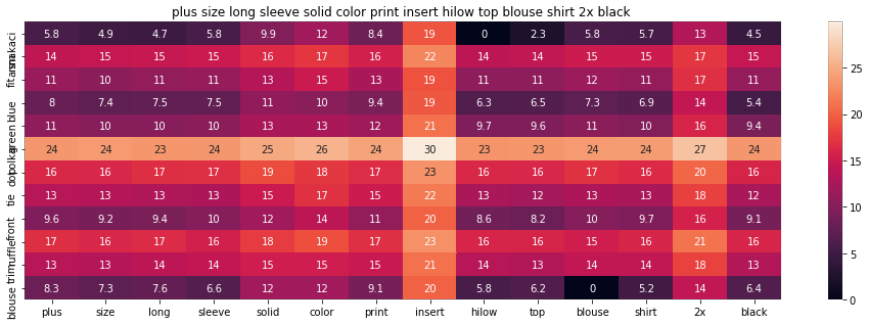




ASIN : B01D7T4BIC
Brand : Alice & Trixie
Color : Black
Product Type : SHIRT
Euclidean distance from input : 5.680274707177775

==========



ASIN : B01LDW11EC
Brand : curvyluv.com
Color : Black
Product Type : SHIRT
Euclidean distance from input : 5.682821751198207

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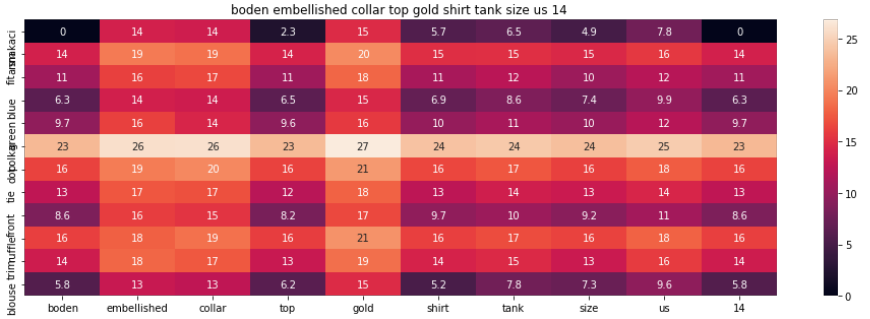

ASIN : B072HCVT7P
Brand : BODEN
Color : Multi
Product Type : SHIRT
Euclidean distance from input : 5.734122600202904

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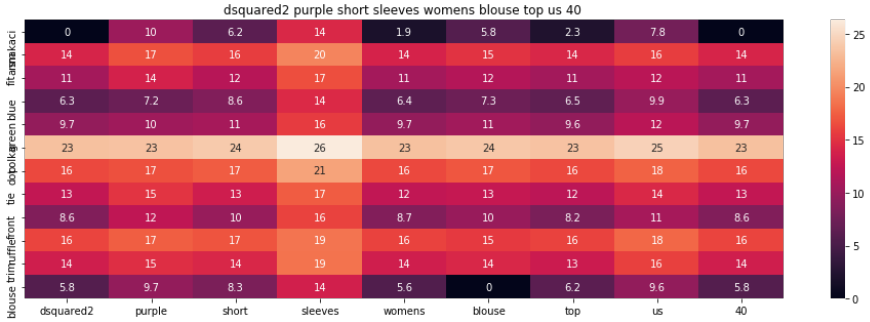

ASIN : B01D3VEIOG
Brand : DSQUARED2
Color : Purple
Product Type : BLAZER
Euclidean distance from input : 5.821583631603145

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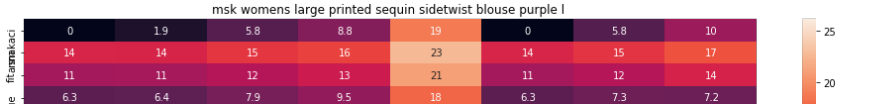
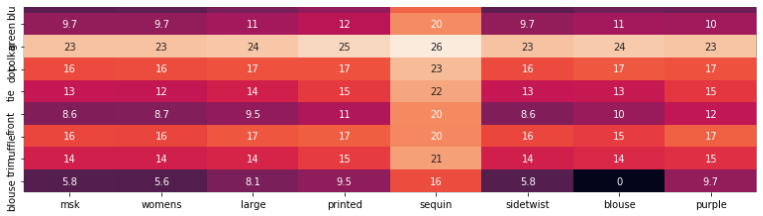
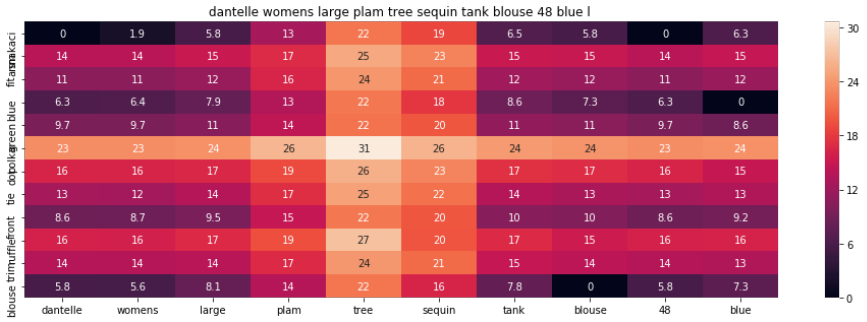
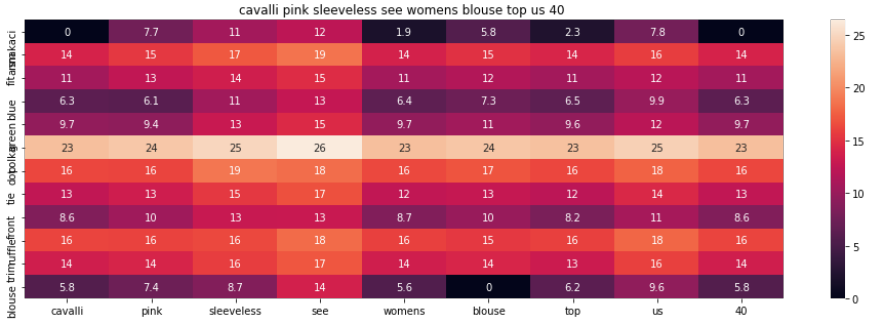




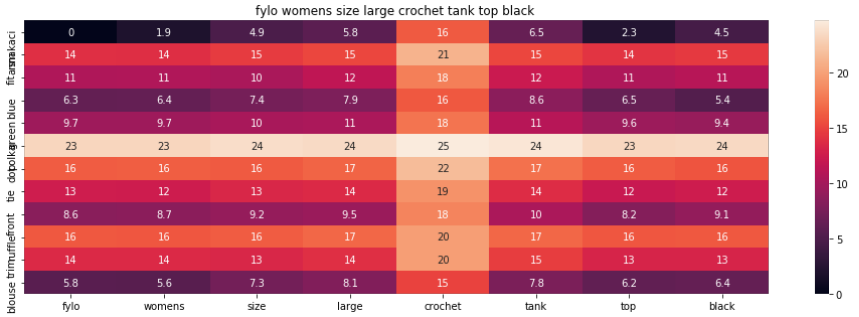
ASIN : B074MHQ1T6
Brand : MSK
Color : Purple
Product Type : SHIRT
Euclidean distance from input : 5.899789385809876



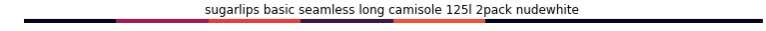
ASIN : B074P85Y4R
Brand : Dantelle
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 5.9013130560359475

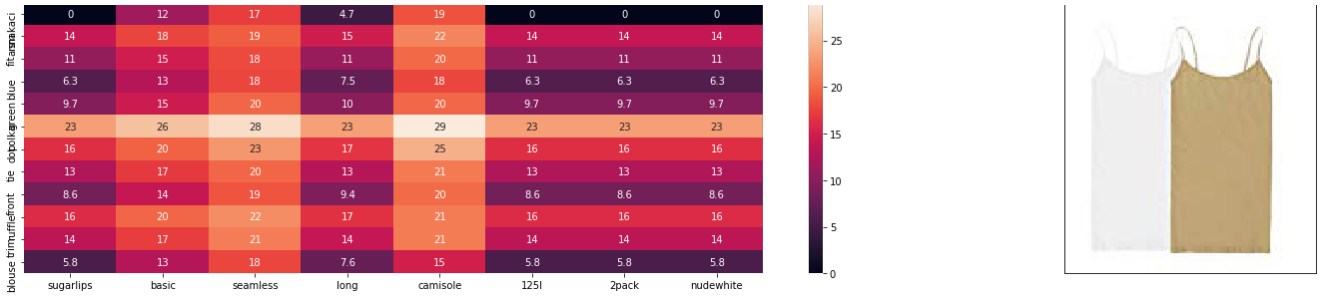


ASIN : B01HSK31WI
Brand : Just Cavalli
Color : Pink
Product Type : SHIRT
Euclidean distance from input : 5.911653115756501



ASIN : B073XRDRN7
Brand : Fylo
Color : Black
Product Type : SHIRT
Euclidean distance from input : 5.911729975127784





ASIN : B01D9B49LW
Brand : Sugar Lips
Color : 2PACK: NUDE/WHITE
Product Type : SHIRT
Euclidean distance from input : 5.916971589277328

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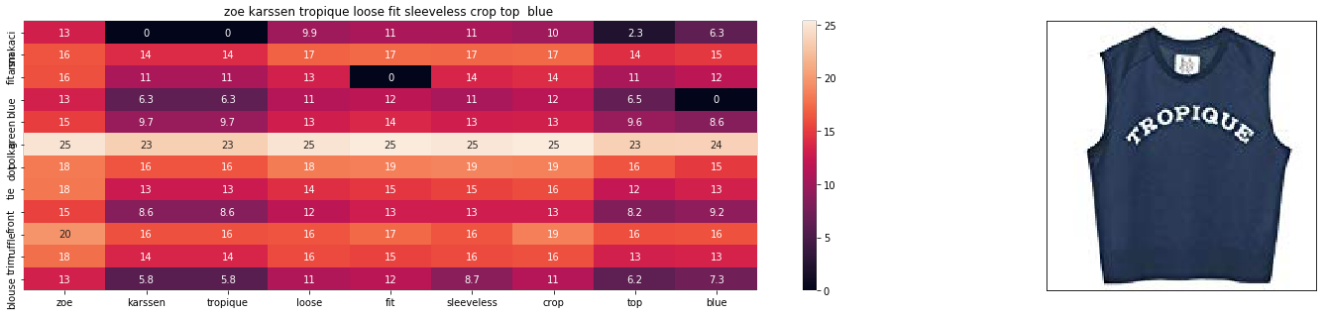

ASIN : B01ND46TFT
Brand : Zoe Karssen
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 5.954131375826322

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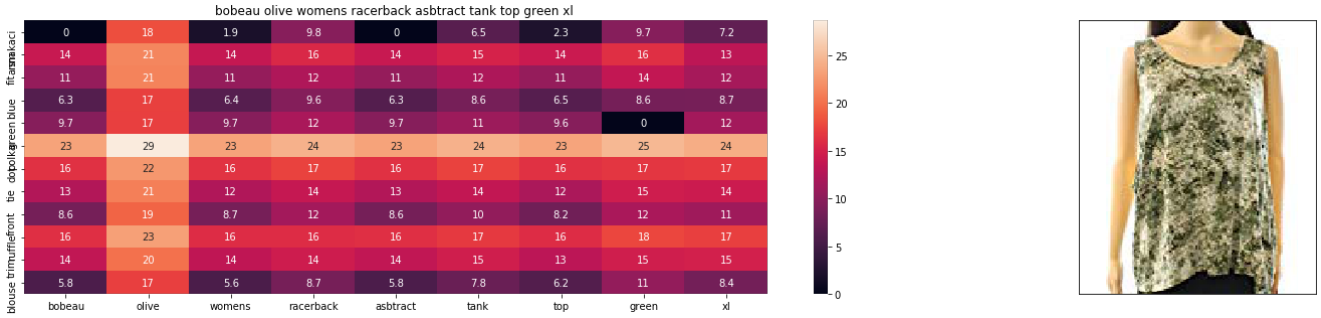

ASIN : B071FQX7CZ
Brand : Bobeau
Color : Green
Product Type : SHIRT
Euclidean distance from input : 5.969771730540154

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ASIN : B06WWHJG93
Brand : Mogul Interior
Color : White
Product Type : DRESS
Euclidean distance from input : 5.975640965065395

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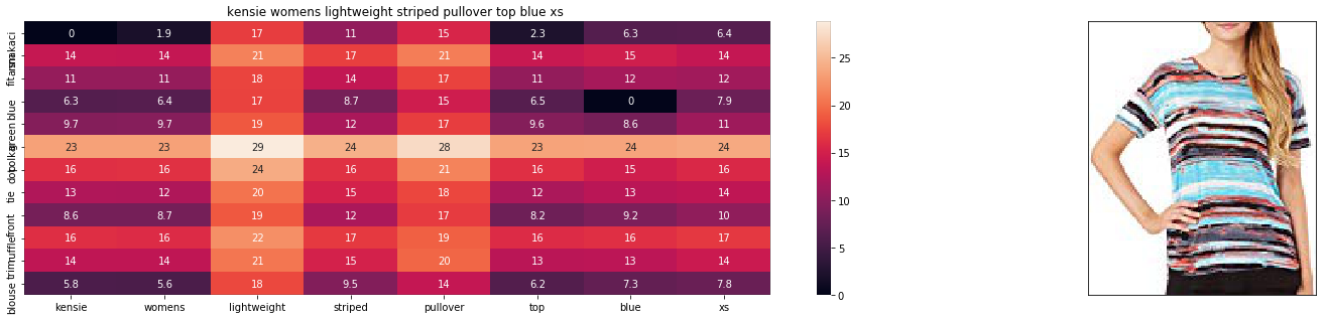

ASIN : B00Y8C6XEI
Brand : kensie
Color : Blue Multi
Product Type : SHIRT
Euclidean distance from input : 5.980468963327867

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ASIN : B00KV9G0KE
Brand : Devon & Jones
Color : White
Product Type : APPAREL
Euclidean distance from input : 5.981530153391717

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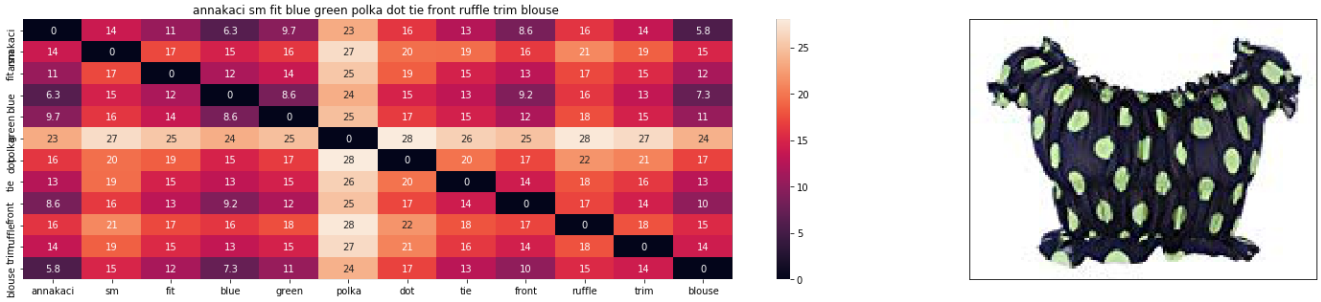
Summary:

1. On giving more weights to Title Feature , we can see that the recommended products have similar Title Descriptions
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

Giving preference to Brand

In [35]:

```
idf_w2v_brand_col_visual(931, 5, 50, 5, 5, 20)
```



ASIN : B00KLHUIBS
Brand : Anna-Kaci
Color : Blue/Green
Product Type : SHIRT
Euclidean distance from input : 0.0038008144268622764

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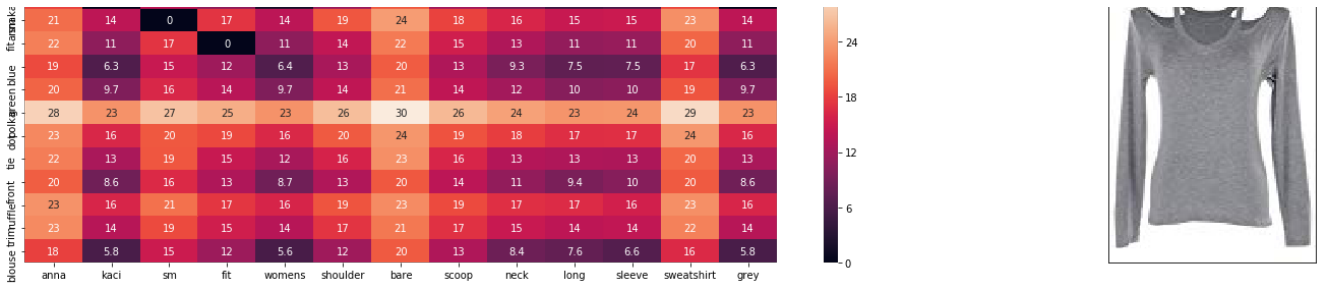

ASIN : B01934QYWG
Brand : Anna-Kaci
Color : Grey
Product Type : SHIRT
Euclidean distance from input : 3.5328409127160105

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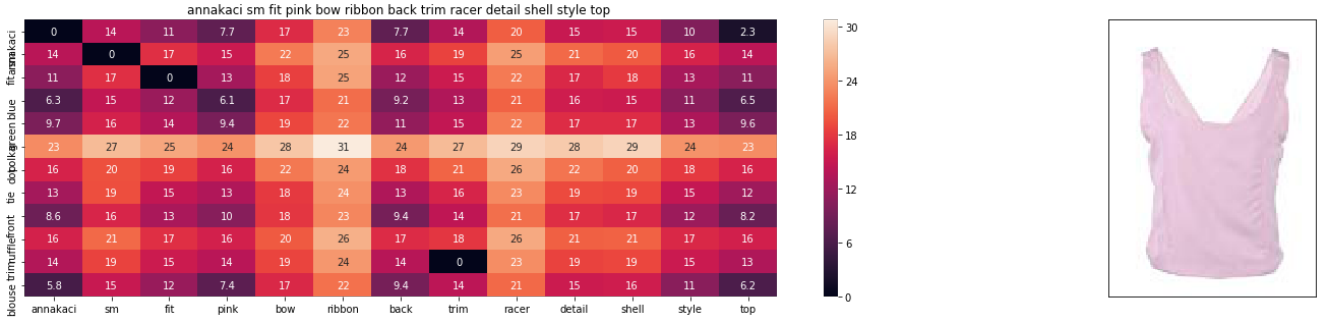

ASIN : B00KOBQEBO
Brand : Anna-Kaci
Color : Pink
Product Type : SHIRT
Euclidean distance from input : 3.629476496446855

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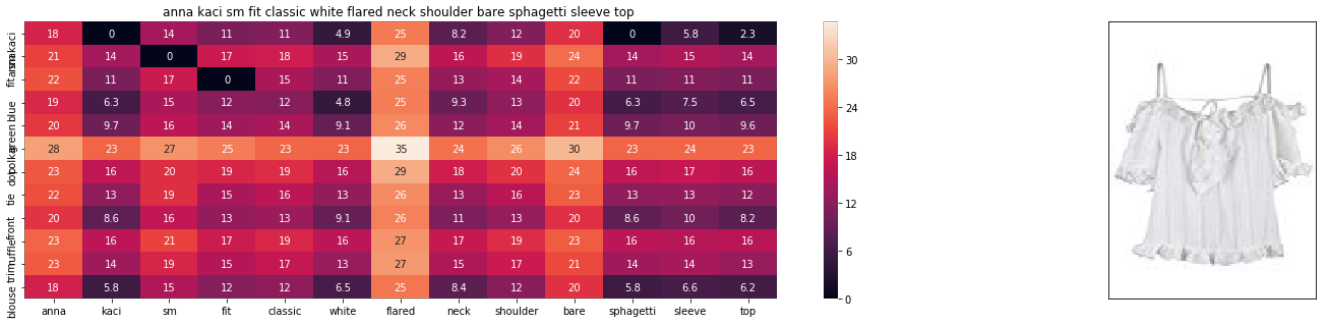

ASIN : B011WFBPK0
Brand : Anna-Kaci
Color : White
Product Type : SHIRT
Euclidean distance from input : 3.6505595946383362

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ASIN : B0094M3KW0
Brand : Anna-Kaci
Color : Off-white
Product Type : SHIRT
Euclidean distance from input : 3.677003860473633

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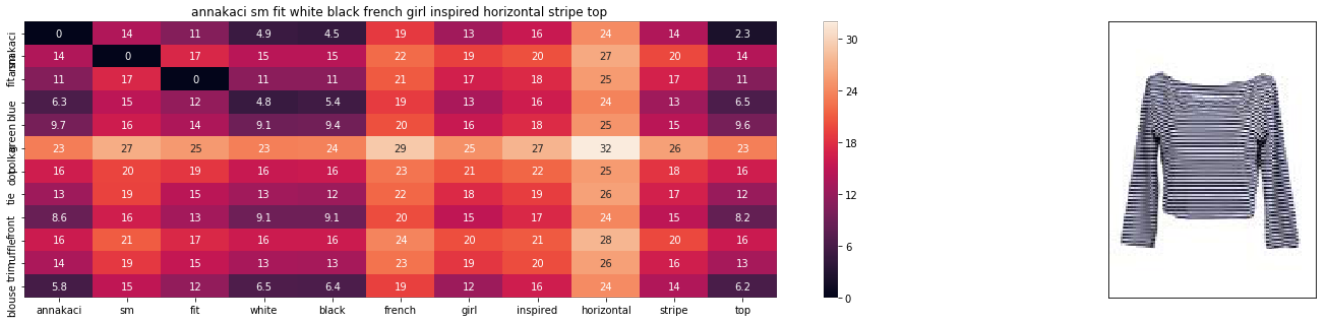

ASIN : B00H58PREY
Brand : Anna-Kaci
Color : White/Black
Product Type : SHIRT
Euclidean distance from input : 3.7390715965857875

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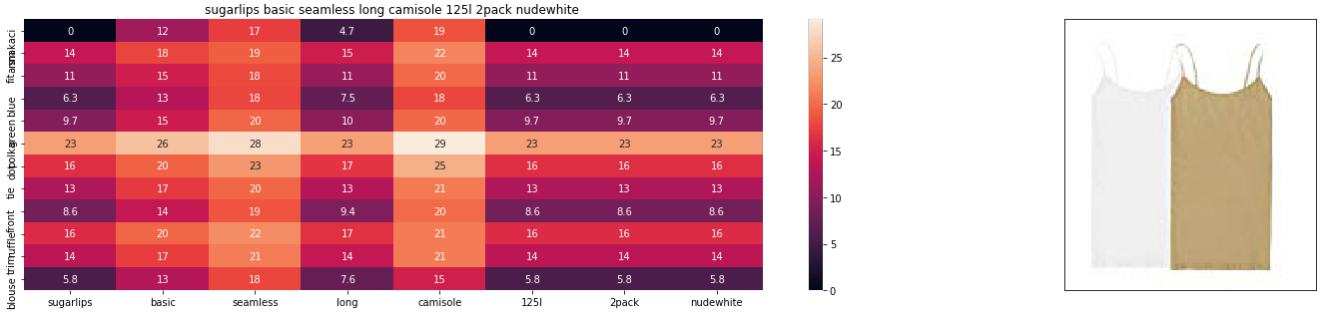

ASIN : B01D9B49LW
Brand : Sugar Lips
Color : 2PACK: NUDE/WHITE
Product Type : SHIRT
Euclidean distance from input : 3.7431026176727604

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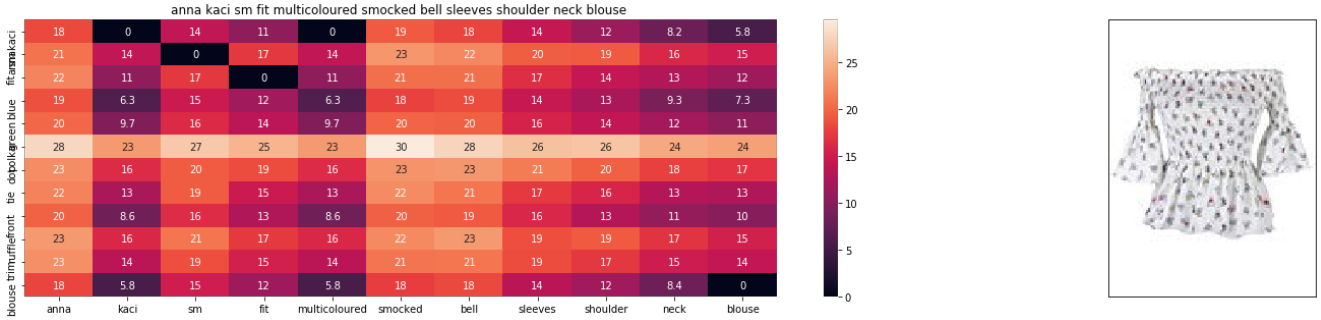

ASIN : B00X4UQ8CC
Brand : Anna-Kaci
Color : Multicoloured
Product Type : SHIRT
Euclidean distance from input : 3.7509423261493784

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ASIN : B072HCVT7P
Brand : BODEN
Color : Multi

Product Type : SHIRT
Euclidean distance from input : 3.791825161242175
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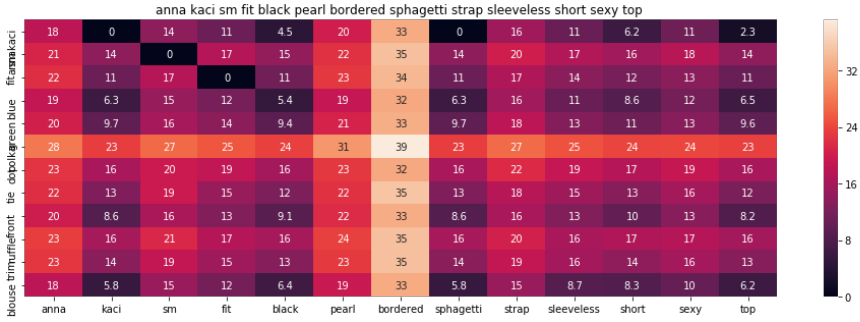

ASIN : B00W2D7P56
Brand : Anna-Kaci
Color : Black
Product Type : SHIRT
Euclidean distance from input : 3.7921243306378103
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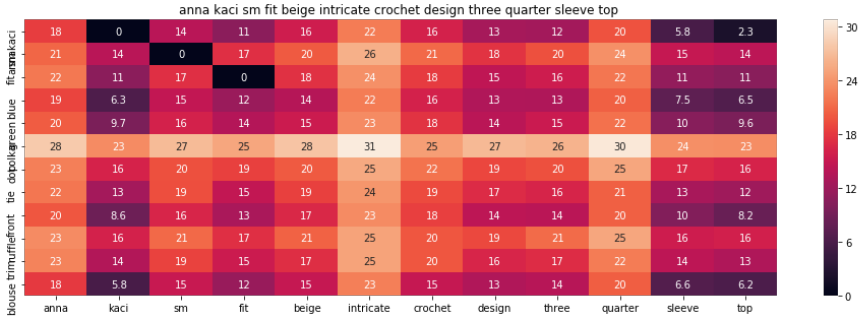

ASIN : B00W5XGDWO
Brand : Anna-Kaci
Color : Beige
Product Type : SHIRT
Euclidean distance from input : 3.8041157141170023
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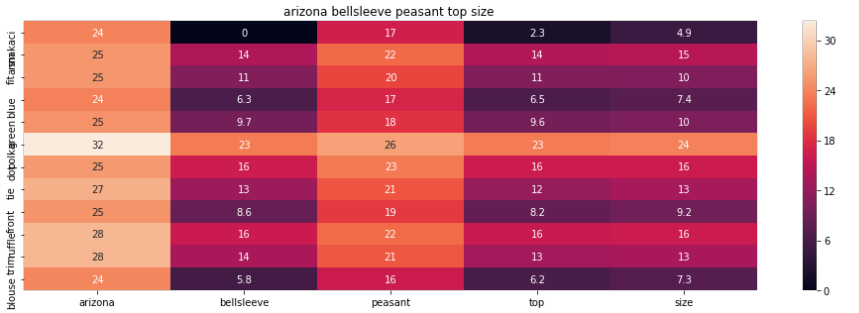

ASIN : B01LY1Z8IY
Brand : AriZona
Color : Multi-color
Product Type : ACCESSORY
Euclidean distance from input : 3.810093826585434
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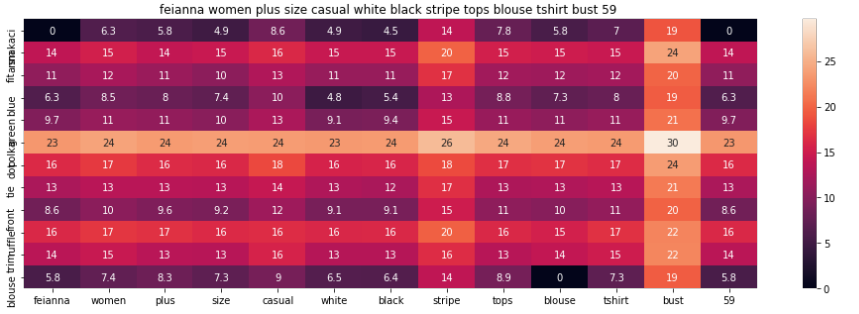

ASIN : B072WQ86QJ
Brand : FEIANNA
Color : White Black Stripe
Product Type : SHIRT
Euclidean distance from input : 3.8344195359705595

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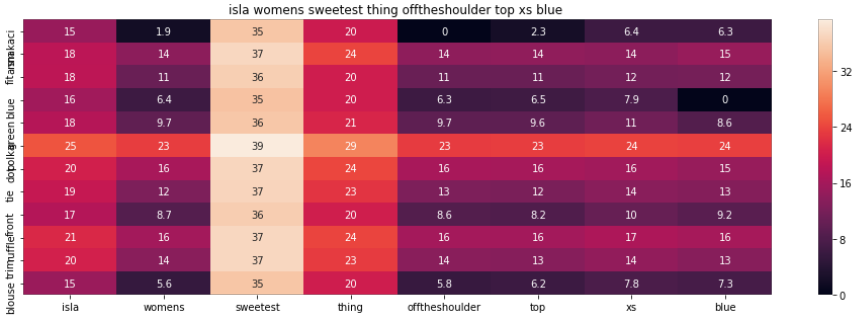

ASIN : B074MGFYFC
Brand : Isla
Color : Pale Blue
Product Type : SHIRT
Euclidean distance from input : 3.8523633132606183

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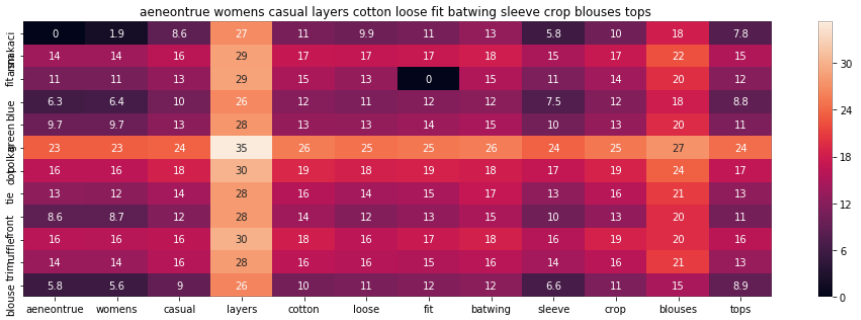

ASIN : B07486NTYQ
Brand : Aeneontrue
Color : Dark Blue
Product Type : SHIRT
Euclidean distance from input : 3.8648387524789927

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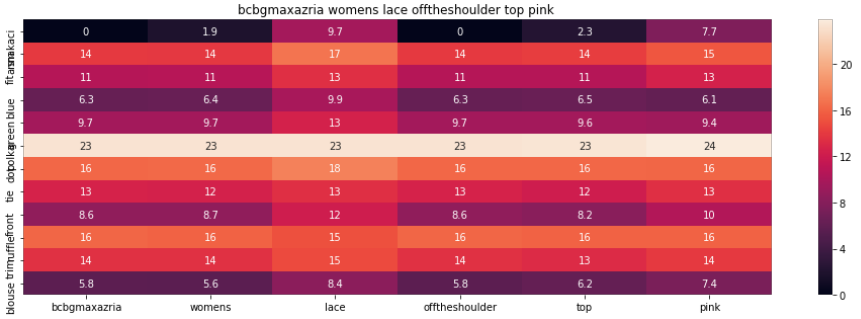

ASIN : B074TH83H1
Brand : BCBGMAXAZRIA
Color : Bare Pink
Product Type : SHIRT
Euclidean distance from input : 3.8653268282944184

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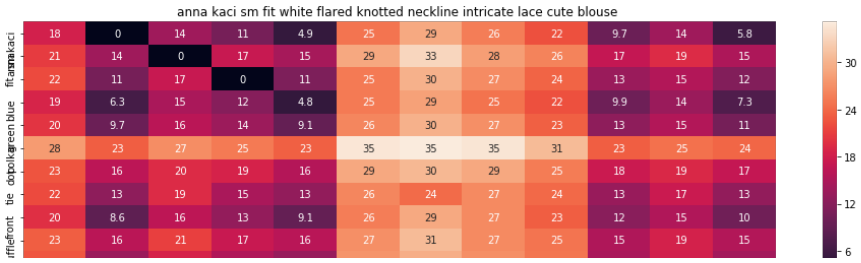
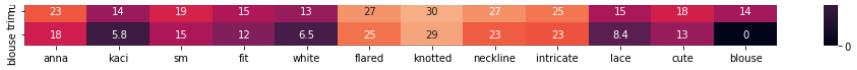
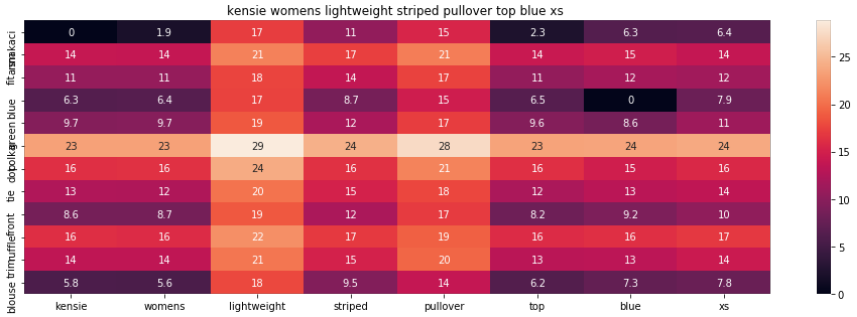




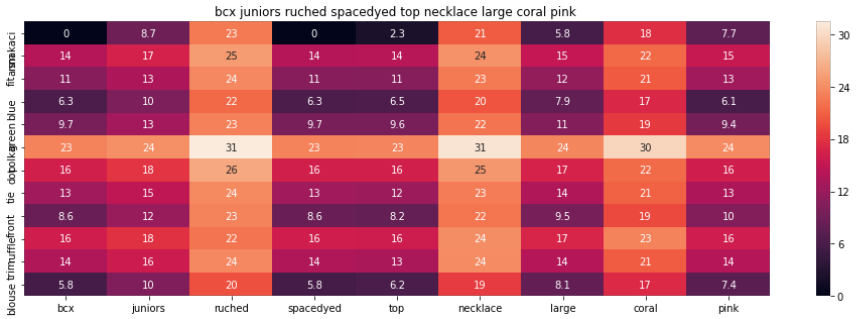
ASIN : B00X4UPOAE
Brand : Anna-Kaci
Color : White
Product Type : SHIRT
Euclidean distance from input : 3.8767817062669416

==========



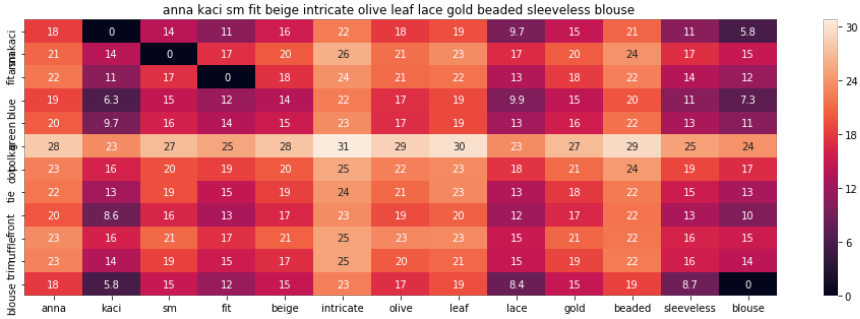
ASIN : B00Y8C6XEI
Brand : kensie
Color : Blue Multi
Product Type : SHIRT
Euclidean distance from input : 3.8783996784762134

==========



ASIN : B01KEQ5IGA
Brand : BCX
Color : Coral
Product Type : SHIRT
Euclidean distance from input : 3.892866955065417

==========



ASIN : B0759FK2NV
Brand : Anna-Kaci
Color : Multicoloured
Product Type : SHIRT
Euclidean distance from input : 3.896021777490274

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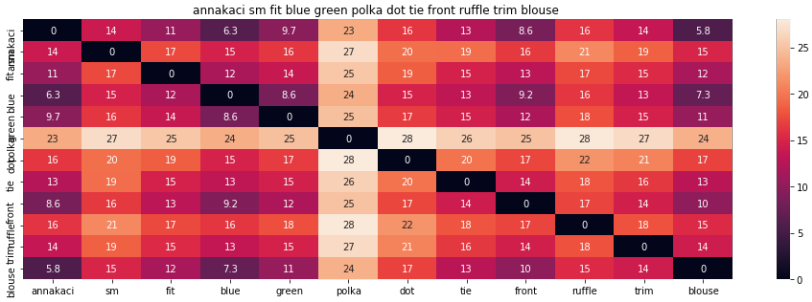
Summary:

1. On giving more weights to Brand Feature , we can see that the recommended products have similar Brand
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

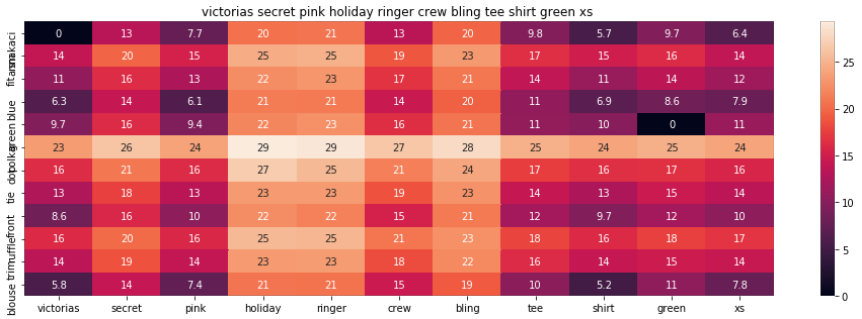
Giving preference to Color

In [36]:

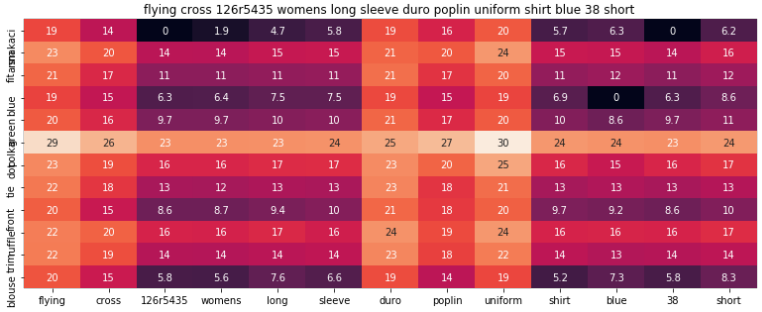
```
idf_w2v_brand_col_visual(931, 5, 5, 50, 5, 20)
```



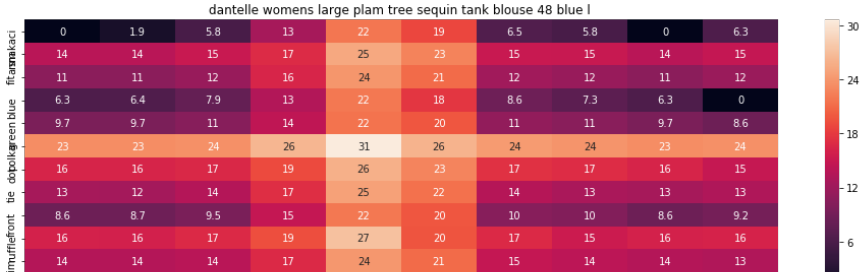
ASIN : B00KLHUIBS
Brand : Anna-Kaci
Color : Blue/Green
Product Type : SHIRT
Euclidean distance from input : 0.0038008144268622764



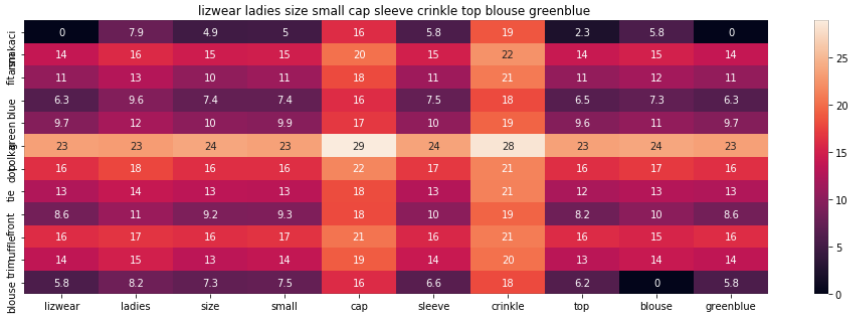
ASIN : B01MSA3SB8
Brand : Victoria's Secret
Color : Green
Product Type : SHIRT
Euclidean distance from input : 3.318022683950571



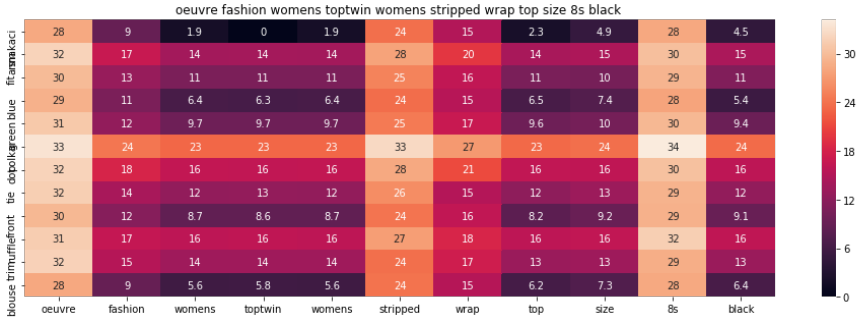
ASIN : B01J65ZE2I
Brand : Flying Cross
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.34273922259991



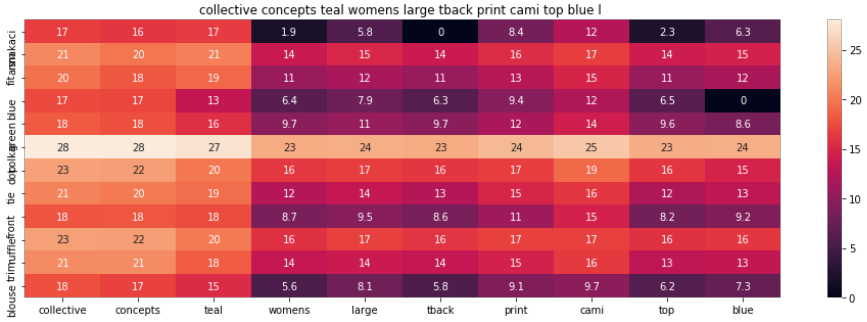
ASIN : B074P85Y4R
Brand : Dantelle
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.4152895492845197



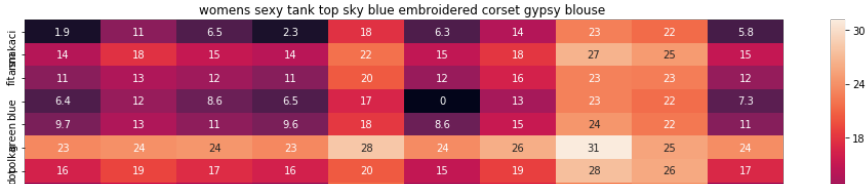
ASIN : B009AF4K66
Brand : Lizwear
Color : Green & Blue
Product Type : SHIRT
Euclidean distance from input : 3.509501450435737

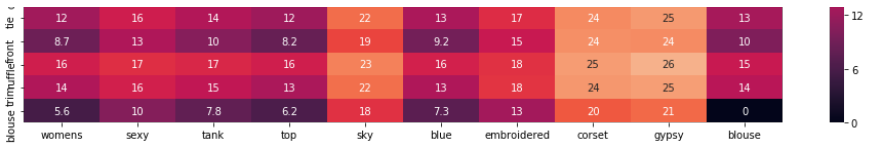


ASIN : B06XJ21PKK
Brand : OEUVRE FASHION
Color : Green-blue
Product Type : SHIRT
Euclidean distance from input : 3.589967463566707



ASIN : B06XY2X2CB
Brand : Collective Concepts
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.6265711857722356





ASIN : B01MSQTMUB
Brand : Mogul Interior
Color : Blue
Product Type : DRESS
Euclidean distance from input : 3.6277103424072266

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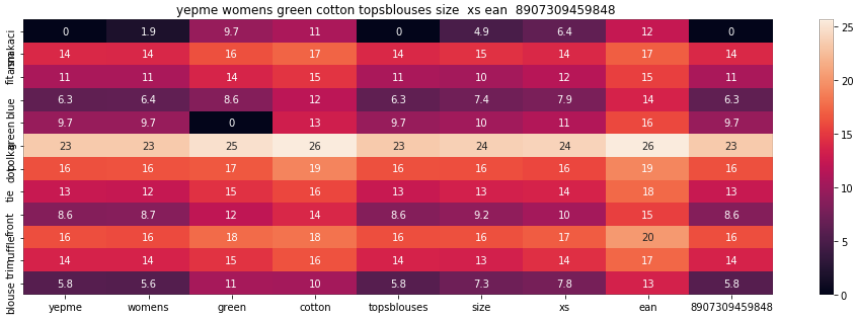

ASIN : B01JIUCV40
Brand : Yepme
Color : Green
Product Type : SHIRT
Euclidean distance from input : 3.629422151682732

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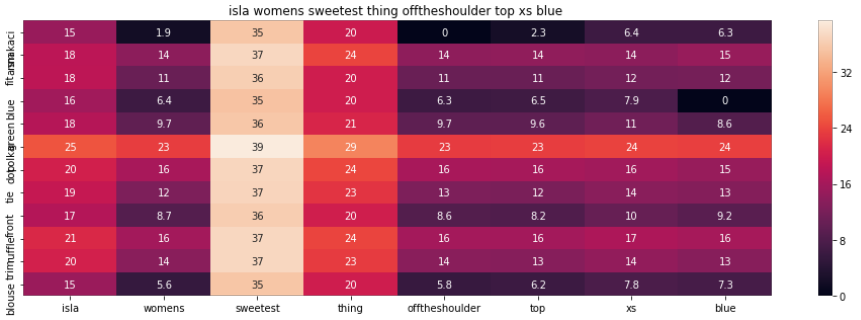

ASIN : B074MGFYFC
Brand : Isla
Color : Pale Blue
Product Type : SHIRT
Euclidean distance from input : 3.632322143509692

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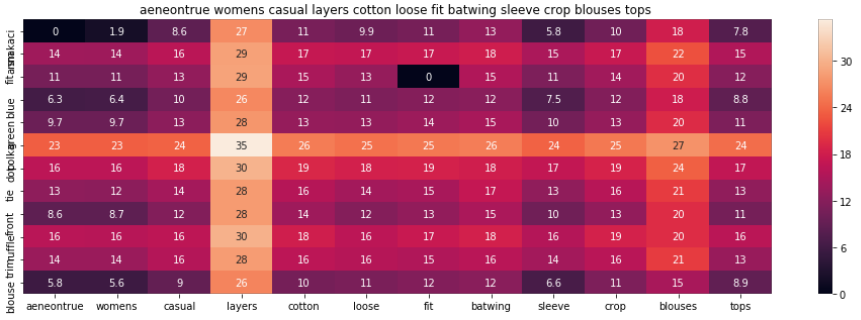

ASIN : B07486NTYQ
Brand : Aeneontrue
Color : Dark Blue
Product Type : SHIRT
Euclidean distance from input : 3.6447975827280663

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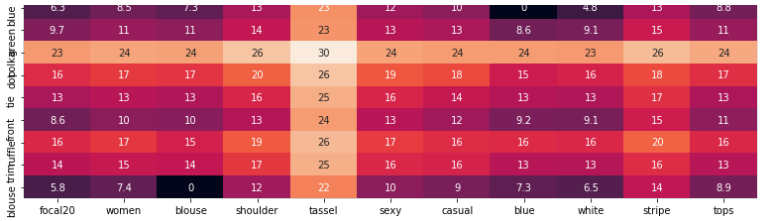

ASIN : B06XV6VFVC
Brand : Focal20
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.650732517799769

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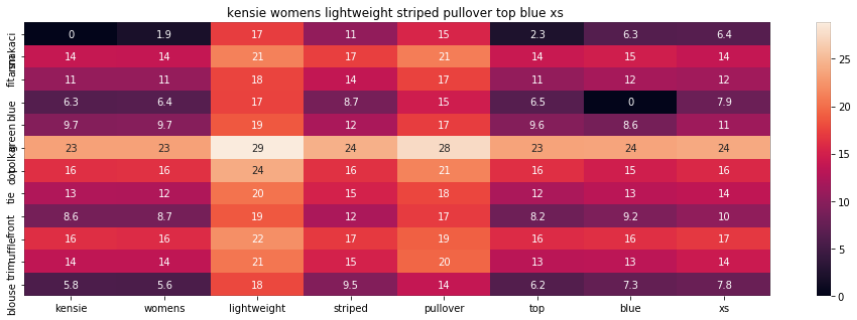

ASIN : B00Y8C6XEI
Brand : kensie
Color : Blue Multi
Product Type : SHIRT
Euclidean distance from input : 3.658358508725287

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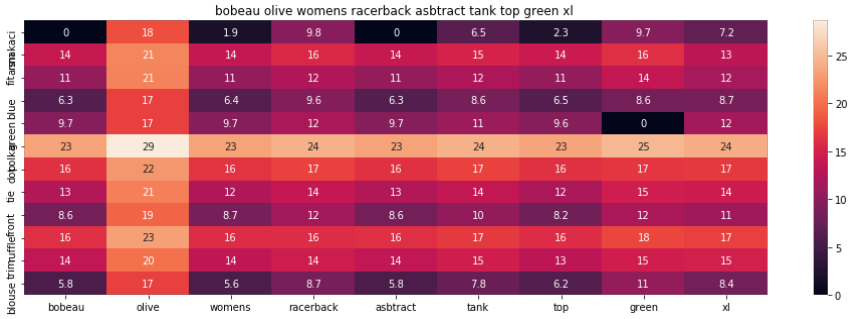

ASIN : B071FQX7CZ
Brand : Bobeau
Color : Green
Product Type : SHIRT
Euclidean distance from input : 3.65880647128159

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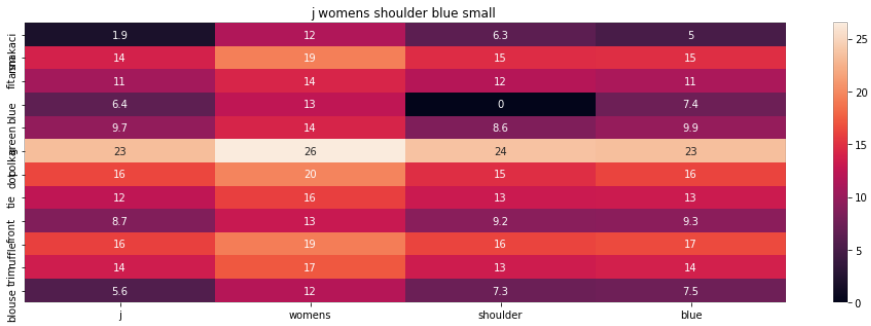

ASIN : B07583CQFT
Brand : Very J
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.6720586122070706

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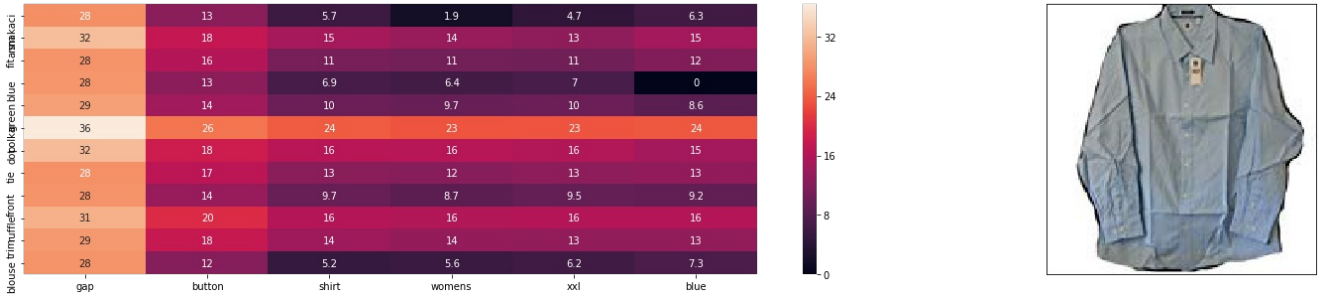
gap button shirt womens xxl blue



ASIN : B0711S2QR1
Brand : Gap Select Classic
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.6754913634941997
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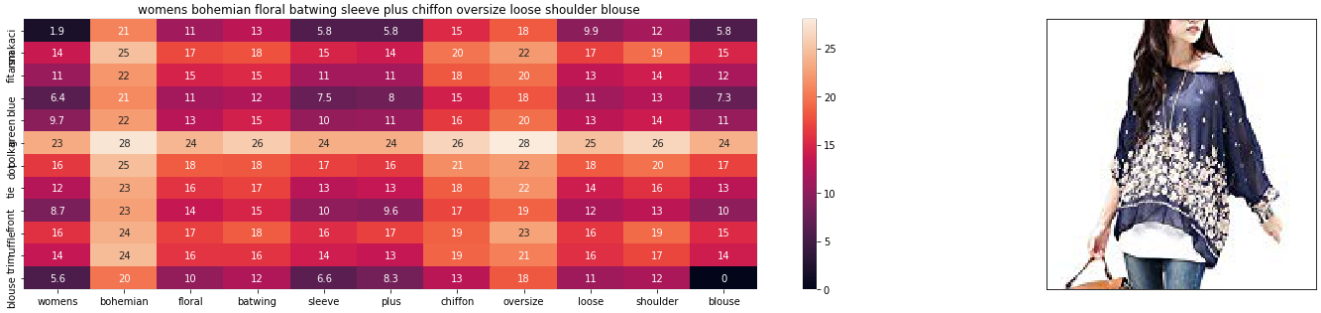

ASIN : B00YCA1YFY
Brand : Display Promotion
Color : Blue
Product Type : SHIRT
Euclidean distance from input : 3.7054554572472207
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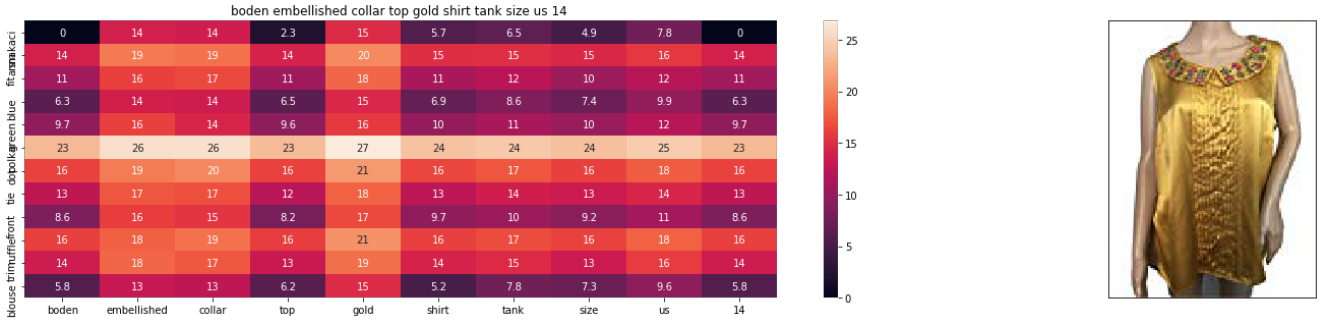
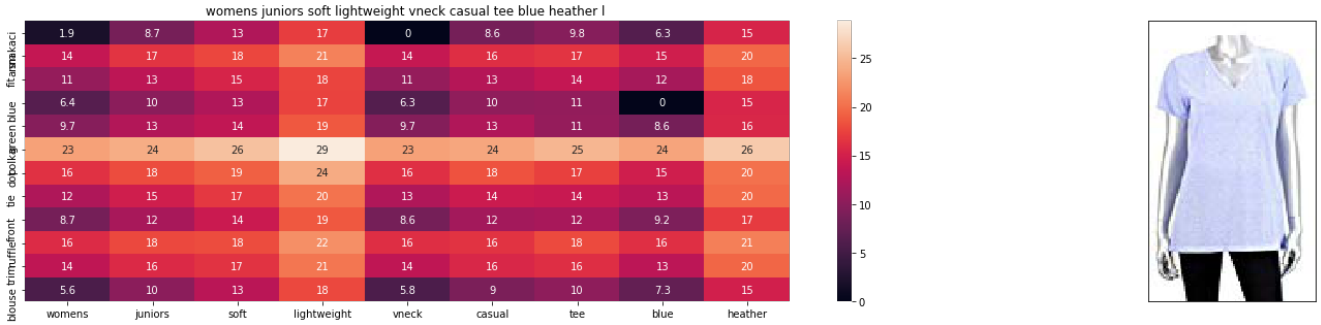


ASIN : B072HCVT7P
Brand : BODEN
Color : Multi
Product Type : SHIRT
Euclidean distance from input : 3.791825161242175
==========



ASIN : B01HCSZ4HG
Brand : Hybrid Apparel
Color : Blue Heather
Product Type : SHIRT
Euclidean distance from input : 3.8038493526010737
==========

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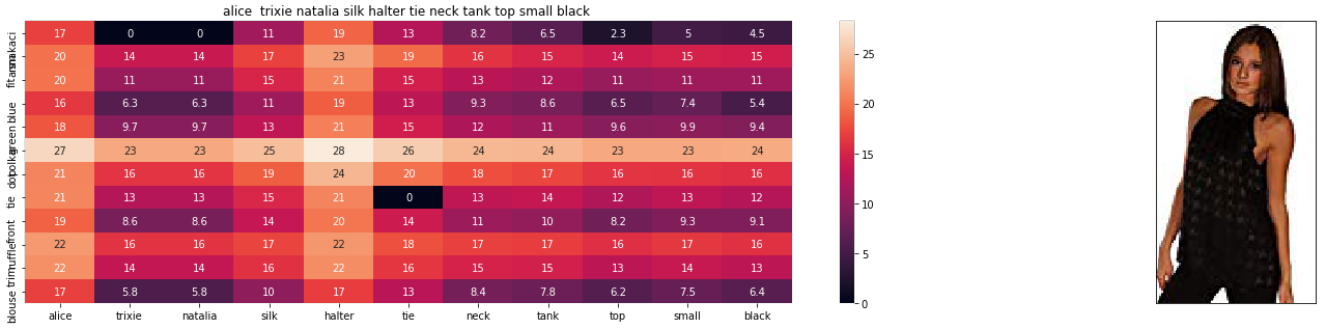


ASIN : B01D7T4BIC
Brand : Alice & Trixie
Color : Black
Product Type : SHIRT
Euclidean distance from input : 3.8124557110693584

==========

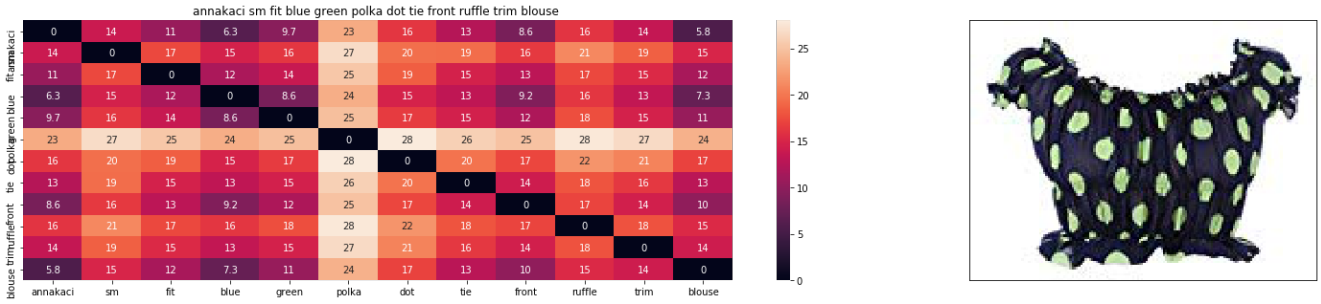
Summary:

1. On giving more weights to Color Feature , we can see that the recommended products have similar Color
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

Giving preference to Image Feature

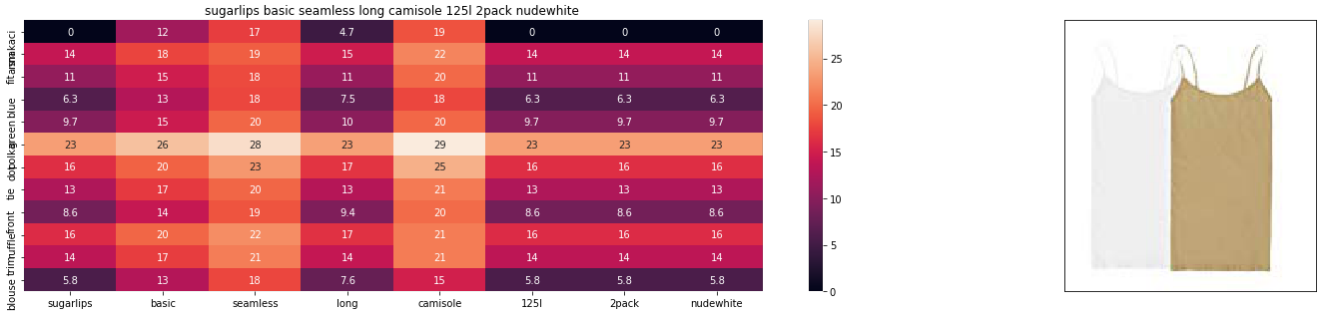
In [38]:

```
idf_w2v_brand_col_visual(931, 5, 5, 5, 50, 20)
```



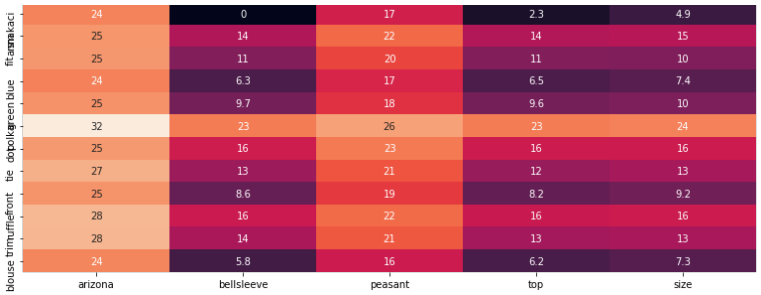
ASIN : B00KLHUIBS
Brand : Anna-Kaci
Color : Blue/Green
Product Type : SHIRT
Euclidean distance from input : 0.03800814701960637

==========

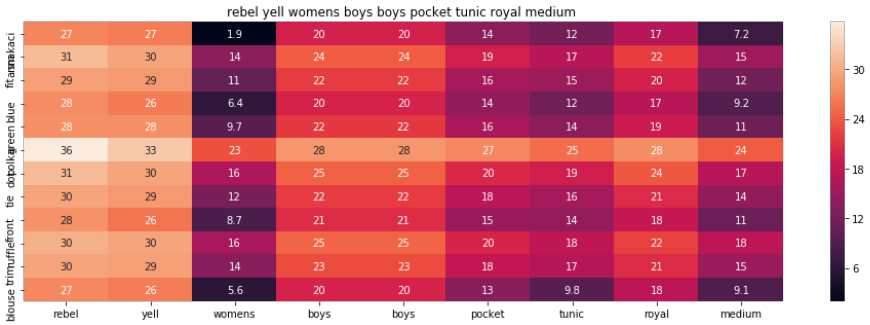


ASIN : B01D9B49LW
Brand : Sugar Lips
Color : 2PACK: NUDE/WHITE
Product Type : SHIRT
Euclidean distance from input : 17.093725763143013

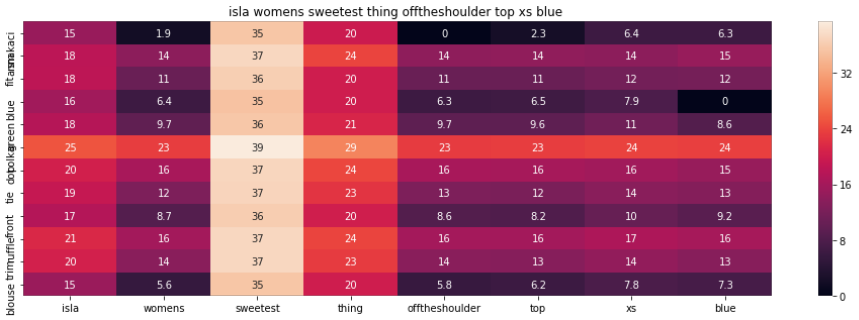
==========



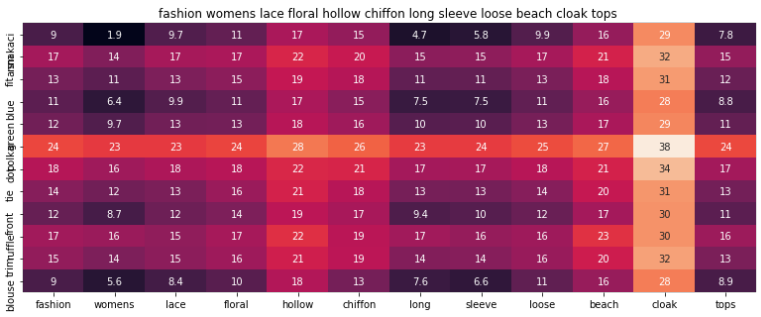
ASIN : B01LY1Z8IY
Brand : AriZona
Color : Multi-color
Product Type : ACCESSORY
Euclidean distance from input : 18.81214632676912
==========



ASIN : B01CT4G42M
Brand : Rebel Yell
Color : Royal
Product Type : SHIRT
Euclidean distance from input : 19.62806687777573
==========



ASIN : B074MGFYFC
Brand : Isla
Color : Pale Blue
Product Type : SHIRT
Euclidean distance from input : 19.75445290403926
==========



ASIN : B00Y9HREL8
Brand : Ai.Moichien
Color : Black
Product Type : APPAREL
Euclidean distance from input : 19.93172352919926
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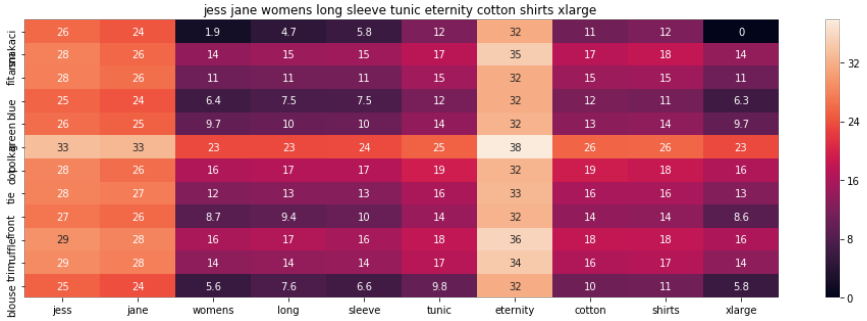

ASIN : B074XG4RZJ
Brand : Jess & Jane
Color : Eternity
Product Type : SHIRT
Euclidean distance from input : 20.08686304148141

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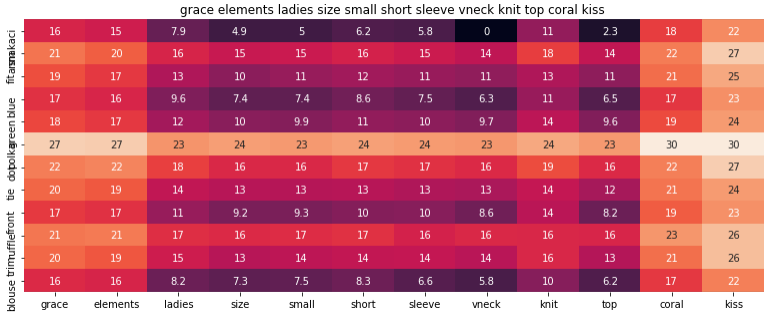

ASIN : B01MSYDNG5
Brand : Grace Elements
Color : Coral Kiss
Product Type : SHIRT
Euclidean distance from input : 20.383526288546047

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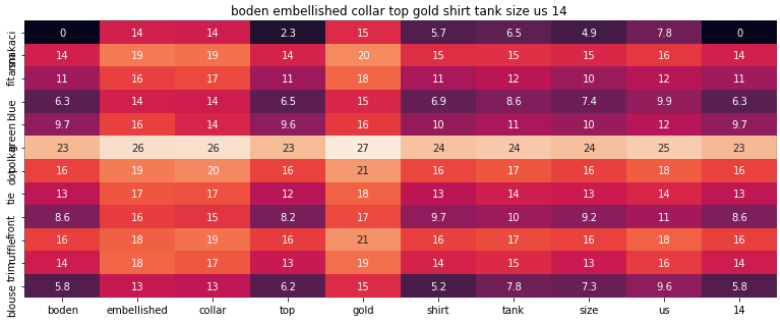

ASIN : B072HCVT7P
Brand : BODEN
Color : Multi
Product Type : SHIRT
Euclidean distance from input : 20.387496905341127

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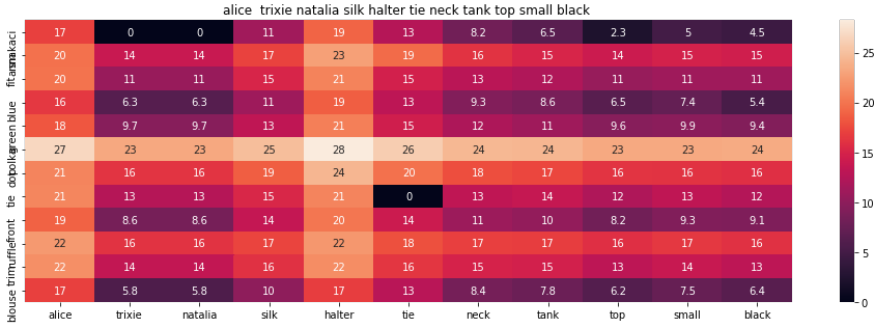
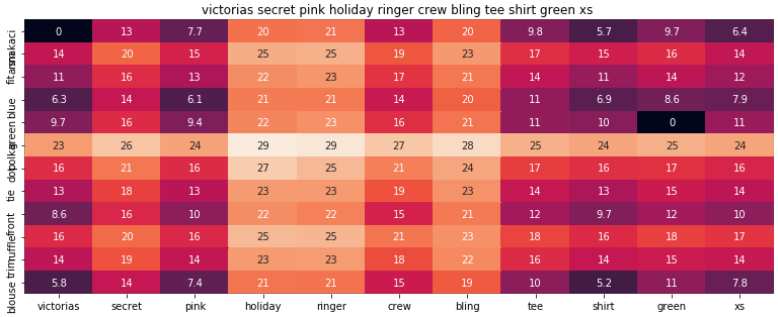
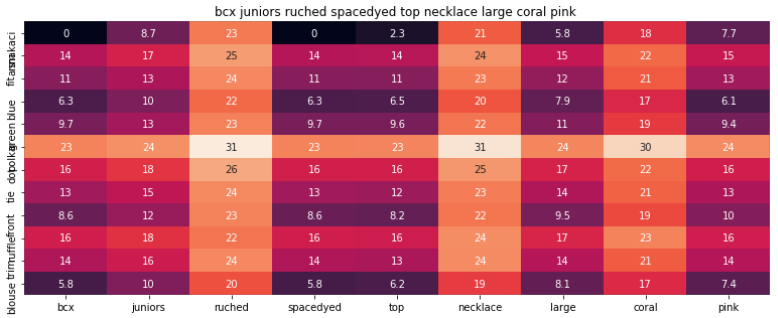


ASIN : B01D7T4BIC
Brand : Alice & Trixie

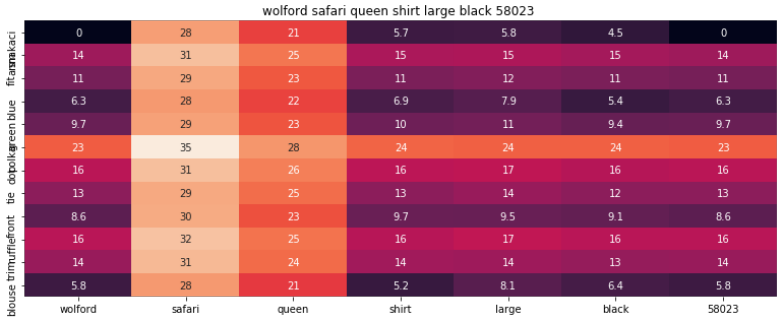
Color : Black
Product Type : SHIRT
Euclidean distance from input : 20.482776972521073
==========

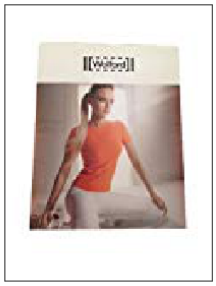


ASIN : B01MSA3SB8
Brand : Victoria's Secret
Color : Green
Product Type : SHIRT
Euclidean distance from input : 20.589598611684945
==========

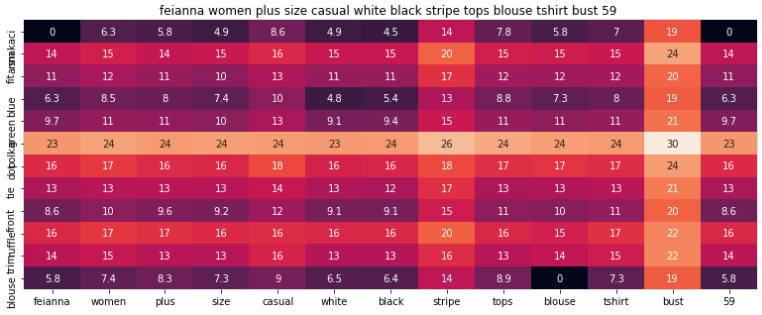


ASIN : B01KEQ5IGA
Brand : BCX
Color : Coral
Product Type : SHIRT
Euclidean distance from input : 20.625340316126508
==========





ASIN : B01LZ4IC3A
Brand : Wolford
Color : Black
Product Type : SHIRT
Euclidean distance from input : 20.68599931388229
==========



ASIN : B072WQ86QJ
Brand : FEIANNA
Color : White Black Stripe
Product Type : SHIRT
Euclidean distance from input : 20.772019615406048

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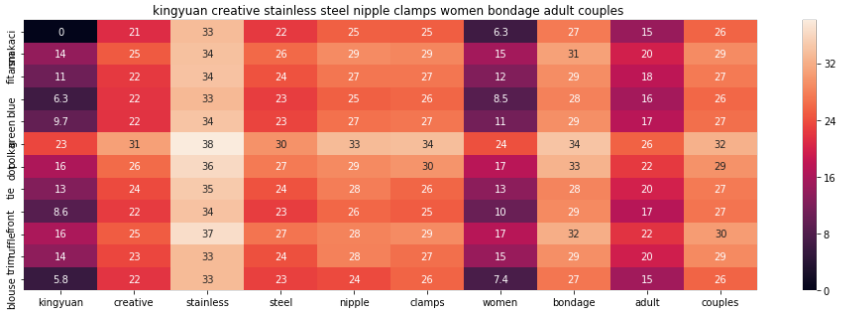

ASIN : B01LZ8MYF8
Brand : KingYuan
Color : Siliver
Product Type : SHIRT
Euclidean distance from input : 20.86060047261126

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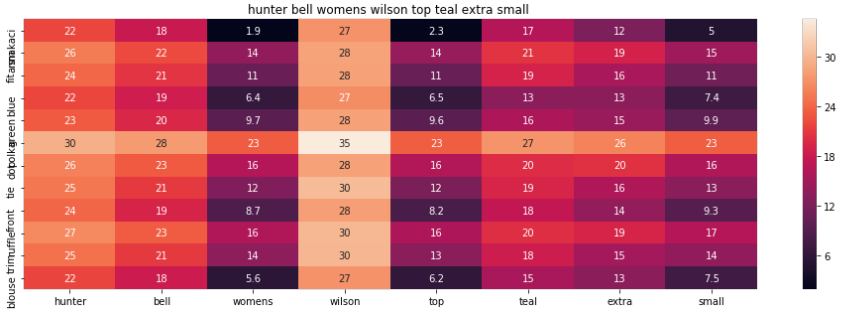
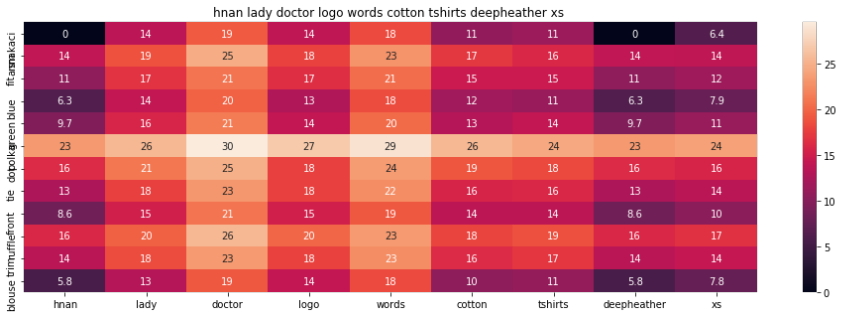


ASIN : B01N2OSO76
Brand : Hunter Bell
Color : Teal
Product Type : SHIRT
Euclidean distance from input : 20.92667131479684

==========



ASIN : B0142LT93Q
Brand : H'nan
Color : DeepHeather
Product Type : SHIRT
Euclidean distance from input : 21.058662606400322

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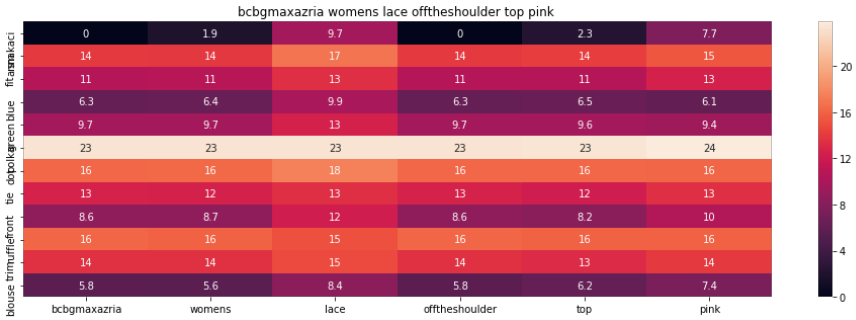
ASIN : B07486NTYQ
Brand : Aeneontrue
Color : Dark Blue
Product Type : SHIRT
Euclidean distance from input : 21.09547284258155

==========



ASIN : B074TH83H1
Brand : BCBGMAXAZRIA
Color : Bare Pink
Product Type : SHIRT
Euclidean distance from input : 21.15710405992342

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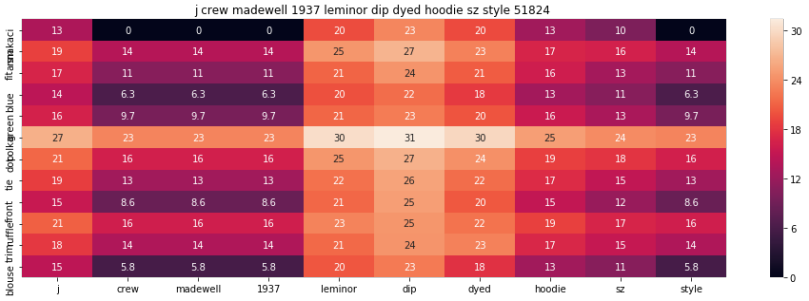

ASIN : B01GTF5X42
Brand : Madewell
Color : Multi Color
Product Type : SHIRT
Euclidean distance from input : 21.161633660800447

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Summary:

1. On giving more weights to Image Feature , we can see that the recommended products have similar Image(Acc. to CNN)
2. As we go down the similarity decreases , thus we are adding weights so that similarity persists too.

Observation

1. Given weights of features for all 4 features , see how image recommendations vary based on features.
2. After playing around with weights , We can see new results by giving more or less preferences to features.