Amazon Apparel Recommendations

[4.2] Data and Code:

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

[4.3] Overview of the data

In [2]:

```
#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")
```

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('gdrive/My Drive/Applied_AI_Workshop_Code_Data/tops_fashion.json')
```

In [4]:

```
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 [5]:

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

Out[5]:

```
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 [7]:

```
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[7]:

	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 [8]:

```
# 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 [9]:

```
# 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 [10]:

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

Out[10]:

```
[('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 [11]:

```
# 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 [12]:

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

Out[12]:

```
[('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 [13]:

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


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

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

In [14]:

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

Out[14]:

```
[(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 [15]:

```

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 [16]:

```
price_count = Counter(list(data['formatted_price']))
price_count.most_common(10)
```

Out[16]:

```
[(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 [17]:

```
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.
```

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

In [0]:

```
# we alredy have an pickel files so we can use directly with our saving as an pickel file
#data.to_pickle('gdrive/My Drive/Applied_AI_Workshop_Code_Data/pickels/my_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()]
print('Number of data points After eliminating price=NULL :', data.shape[0])
```

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

In [18]:

```
# consider products which have color information
# data['color'].isnull() => gives the information about the dataframe row's which have null values
price == 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 : 64956
```

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

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]:

```
## we alredy have an pickel files so we can use directly with our saving as an pickel file
#data.to_pickle('gdrive/My Drive/Applied_AI_Workshop_Code_Data/pickels/my_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.open(BytesIO(response.content))\n
img.save('images/28k_images/'+row['asin']+'.jpeg')\n\n\n"
```

[5.2] Remove near duplicate items

[5.2.1] Understand about duplicates.

In [19]:

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

In [21]:

```
data.head()
```

Out[21]:

	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
15	B003BSRPB0	FeatherLite	White	https://images-na.ssl-images-amazon.com/images...	SHIRT	FeatherLite 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 [22]:

```
# 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 [23]:

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

Out[23]:

	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
						xiaoming	

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
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 for woman Neon Wolf t-shirt
62. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head
Shirt for woman Neon Wolf t-shirt
63. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head
Shirt for woman Neon Wolf t-shirt
64. psychedelic colorful Howling Galaxy Wolf T-shirt/Colorful Rainbow Animal Print Head
Shirt for woman Neon Wolf t-shirt
```

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', 'Diam
onds', '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', '
Diamonds', 'Women's', 'Shirt', 'Small']
        b = data['title'].loc[indices[j]].split()

        # store the maximum length of two strings
```

```
        # 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 t
hose two apperals are different
        # if the number of words in which both strings differ are < 2 , we are considering it as t
hose 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
```

In [0]:

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

We removed the dupliactes which differ only at the end.

In [28]:

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

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

In [0]:

```
#we have already pickel files so we can use those files if we don't have we create a pickel files
#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 titles 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('gdrive/My Drive/Applied_AI_Workshop_Code_Data/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', 'Diam
onds', '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', '
Diamonds', '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 t
hose 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 [36]:

```
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:  16435
```

In [0]:

```
#we have already pickel files if we don't have any pickel files we create like below code

#data.to_pickle('gdrive/My Drive/Applied_AI_Workshop_Code_Data/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('gdrive/My Drive/Applied_AI_Workshop_Code_Data/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 [38]:

```
# we use the list of stop words that are downloaded from nltk lib.
import nltk
nltk.download('stopwords')
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
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
list of stop words: {'hers', "isn't", 'while', 'not', 'and', 'ourselves', 'of', 'he', 'are', 'afte
r', 'each', 'ain', "mightn't", 'i', 'is', 'mustn', 'being', 's', 'off', 'it', "you're", 'y', 'you'
, 'these', "should've", 'will', 'up', 'doing', 'when', 'himself', 'we', 'from', 'your', 'our',
'she', 'a', 'in', 'itself', 'through', 'have', 'further', 'more', 'an', 'where', 'on', 'shan',
'as', 'has', 'once', 'd', 'won', 'theirs', "mustn't", 'against', "weren't", "hasn't", "needn't", '
now', "you'd", 't', 'couldn', 'didn', 'shouldn', "it's", 'herself', "shan't", "don't", 'than', 'wh
at', 'does', 'here', 'that', 'below', 'out', 'but', 'needn', 'if', 'those', "doesn't", 'don', 'thi
s', 'my', 'so', 've', 'yourselves', "wasn't", 'then', 'they', 'am', 'both', 'been', 'how', 'him',
're', 'mightn', "shouldn't", 'should', 'were', "haven't", 'her', 'only', 'ours', "you'll", 'few',
'own', 'same', 'until', 'them', 'themselves', 'most', 'was', "she's", 'who', 'down', 'there', 'ver
y', 'yours', 'all', 'into', "that'll", 'about', 'such', 'other', 'his', 'doesn', 'any', 'no', 'the
', 'some', 'haven', 'at', 'again', 'hadn', 'before', 'be', 'having', 'above', 'because', 'its', 'o
ver', "didn't", 'll', 'hasn', 'myself', 'ma', "wouldn't", 'or', 'nor', "won't", "couldn't", 'had',
'o', 'under', 'for', 'wasn', 'did', "hadn't", 'between', 'whom', 'during', 'to', 'by', 'why', 'the
ir', 'isn', 'yourself', 'do', "you've", 'weren', 'me', 'which', 'too', 'm', 'can', 'wouldn', 'with
', 'just', 'aren', "aren't"}
```

In [39]:

```
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")
```

```
5.806878999999753 seconds
```

In [40]:

```
data.head()
```

Out[40]:

	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]:

```
#we have already pickel files if we don't have any pickel files we create like below code

#data.to_pickle('gdrive/My
Drive/Applied_AI_Workshop_Code_Data/pickels/16k_apperal_data_preprocessed')
```

Stemming

In [42]:

```
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 [43]:

```
data = pd.read_pickle('gdrive/My
Drive/Applied_AI_Workshop_Code_Data/pickels/16k_apperal_data_preprocessed')
data.head()
```

Out[43]:

	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

	asin	brand	color	medium_image_url	product_type_name	title	formatted_price
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.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
between 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
heatmap
    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 wo
rd in 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 given 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 object {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 [45]:

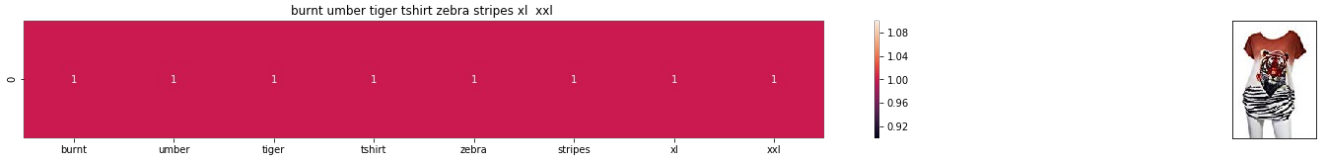
```
from sklearn.feature_extraction.text import CountVectorizer
title_vectorizer = CountVectorizer()
title_features   = title_vectorizer.fit_transform(data['title'])
title_features.get_shape() # get number of rows and columns in feature matrix.
# title_features.shape = #data_points * #words_in_corpus
# 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[45]:

```
(16042, 12609)
```

In [46]:

```
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 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(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]], d
ata['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.

#try 12566
#try 931
```

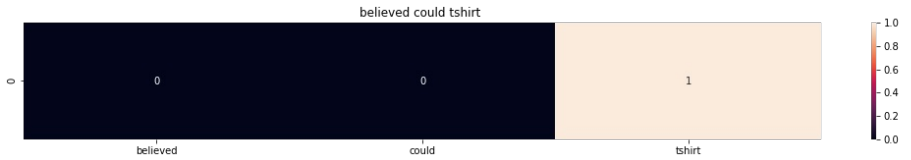



```
ASIN : B00JXQB5FQ
Brand: Si Row
Title: burnt umber tiger tshirt zebra stripes xl  xxl
Euclidean similarity with the query image : 0.0
============================================================
```

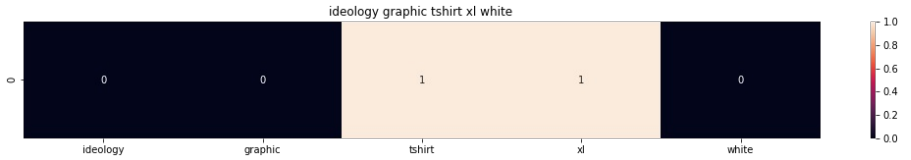
ASIN : B00JXQASS6
Brand: Si Row
Title: pink tiger tshirt zebra stripes xl xxl
Euclidean similarity with the query image : 1.7320508075688772
==

ASIN : B00JXQCWTO
Brand: Si Row
Title: brown white tiger tshirt tiger stripes xl xxl
Euclidean similarity with the query image : 2.449489742783178
==

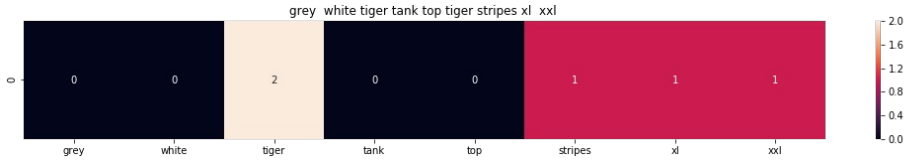
ASIN : B00JXQCUIC
Brand: Si Row
Title: yellow tiger tshirt tiger stripes l
Euclidean similarity with the query image : 2.6457513110645907
==



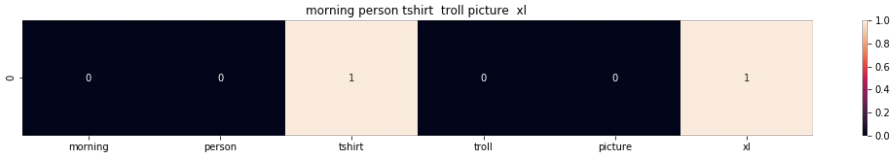
ASIN : B07568NZX4
Brand: Rustic Grace
Title: believed could tshirt
Euclidean similarity with the query image : 3.0
==



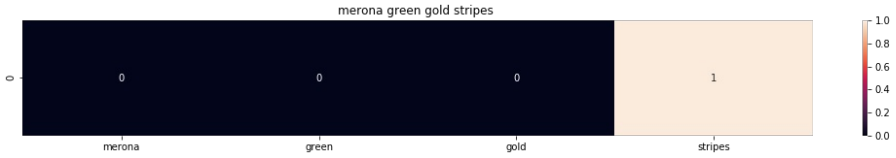
ASIN : B01NB0NKRO
Brand: Ideology
Title: ideology graphic tshirt xl white
Euclidean similarity with the query image : 3.0
==



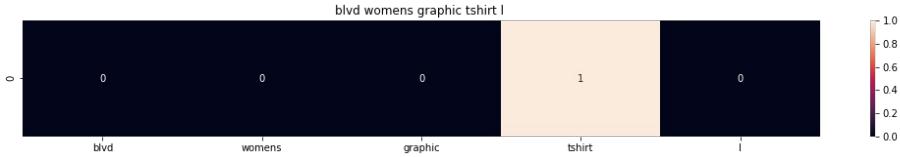
ASIN : B00JXQAFZ2
Brand: Si Row
Title: grey white tiger tank top tiger stripes xl xxl
Euclidean similarity with the query image : 3.0
==========



ASIN : B01CLS8LMW
Brand: Awake
Title: morning person tshirt troll picture xl
Euclidean similarity with the query image : 3.1622776601683795
==========

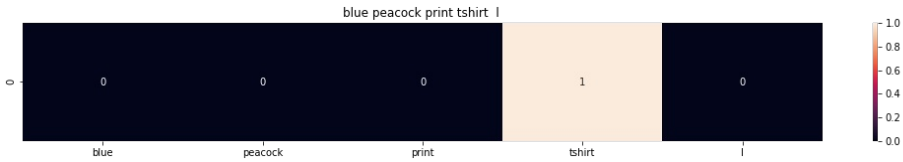


ASIN : B01KVZUB6G
Brand: Merona
Title: merona green gold stripes
Euclidean similarity with the query image : 3.1622776601683795
==========

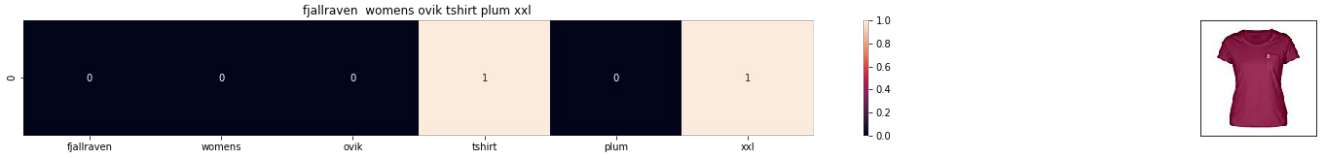


ASIN : B0733R2CJK
Brand: BLVD
Title: blvd womens graphic tshirt l
Euclidean similarity with the query image : 3.1622776601683795
==========

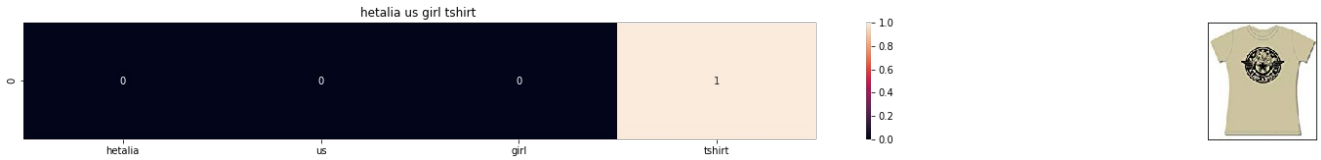
ASIN : B012VQLT6Y
Brand: KM T-shirt
Title: km tiger printed sleeveless vest tshirt
Euclidean similarity with the query image : 3.1622776601683795
==========



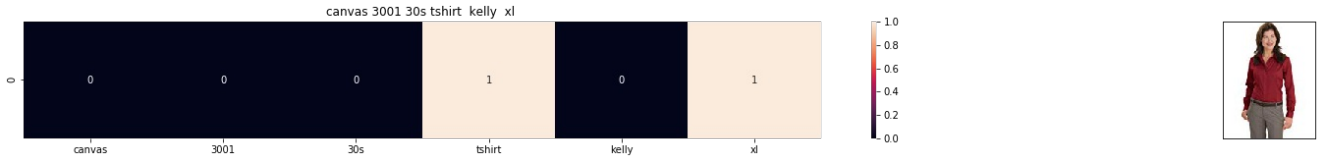
ASIN : B00JXQC8L6
Brand: Si Row
Title: blue peacock print tshirt l
Euclidean similarity with the query image : 3.1622776601683795
==========



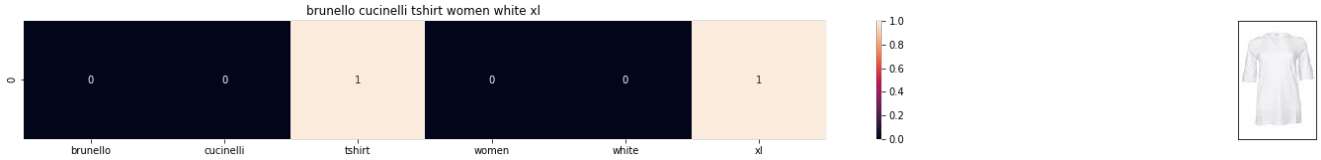
ASIN : B06XC3CZF6
Brand: Fjallraven
Title: fjallraven womens ovik tshirt plum xxl
Euclidean similarity with the query image : 3.1622776601683795
===



ASIN : B005IT8OBA
Brand: Hetalia
Title: hetalia us girl tshirt
Euclidean similarity with the query image : 3.1622776601683795
===

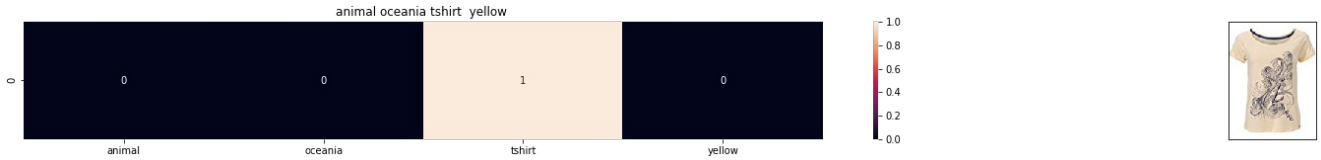


ASIN : B0088PN0LA
Brand: Red House
Title: canvas 3001 30s tshirt kelly xl
Euclidean similarity with the query image : 3.1622776601683795
===

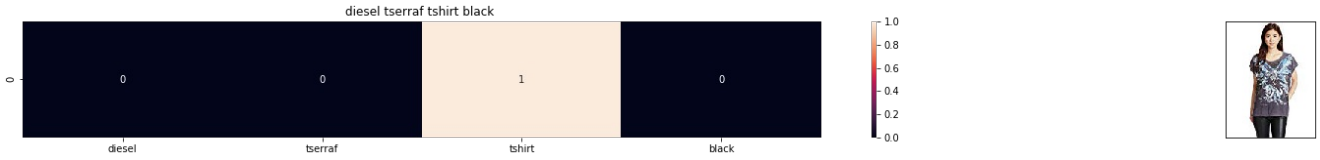


ASIN : B06X99V6WC
Brand: Brunello Cucinelli
Title: brunello cucinelli tshirt women white xl
Euclidean similarity with the query image : 3.1622776601683795
===

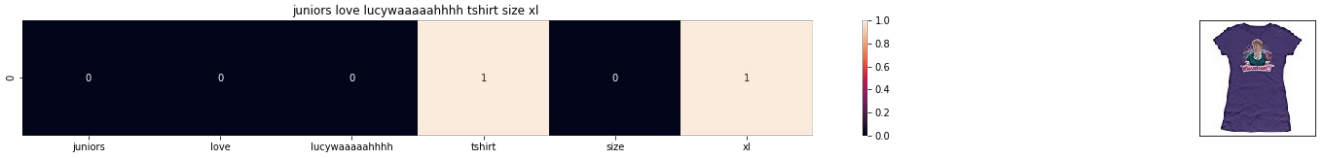
ASIN : B06Y1JPW1Q
Brand: Xhilaration
Title: xhilaration womens lace tshirt salmon xxl
Euclidean similarity with the query image : 3.1622776601683795
===



```
ASIN : B06X6GX6WG
Brand: Animal
Title: animal oceania tshirt  yellow
Euclidean similarity with the query image : 3.1622776601683795
============================================================
```




```
ASIN : B017X8PW9U
Brand: Diesel
Title: diesel tserraf tshirt black
Euclidean similarity with the query image : 3.1622776601683795
============================================================
```




```
ASIN : B00IAA4JIQ
Brand: I Love Lucy
Title: juniors love lucywaaaaahhhh tshirt size xl
Euclidean similarity with the query image : 3.1622776601683795
============================================================
```

[8.5] TF-IDF based product similarity

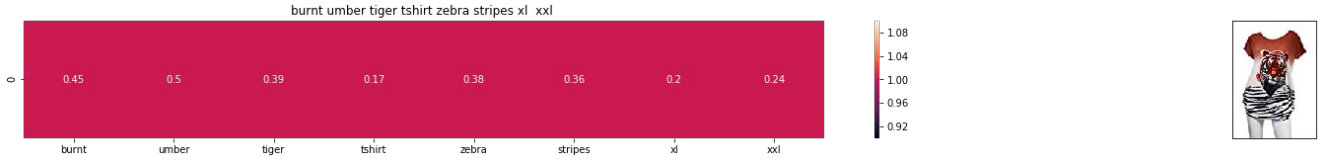
In [0]:

```
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
* #words_in_corpus
# tfidf_title_features[doc_id, index_of_word_in_corpus] = tfidf values of the word in given doc
```

In [48]:

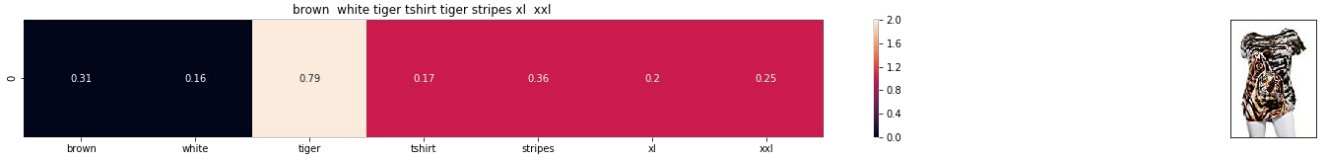
```
def tfidf_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # 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 repre
sents 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 : 0.7536331912451363
==========

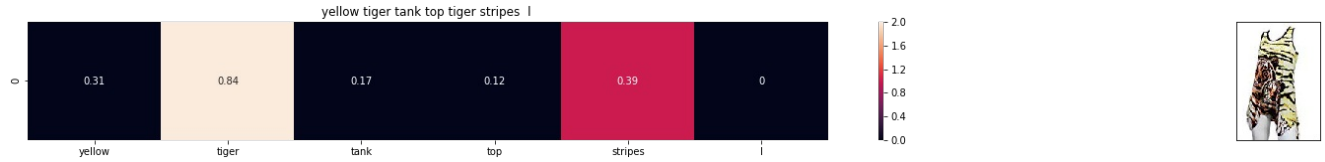


ASIN : B00JXQCWTO
BRAND : Si Row
Eucliden distance from the given image : 0.9357643943769647
==========

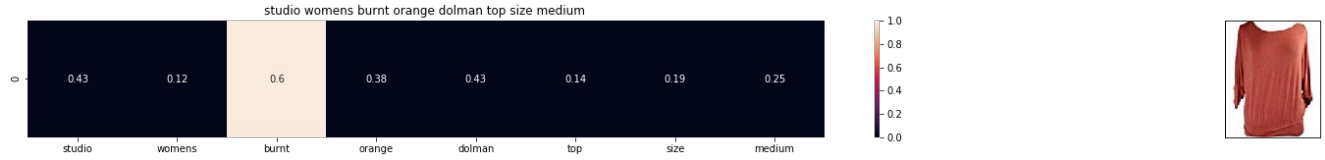
ASIN : B00JXQAFZ2
BRAND : Si Row
Eucliden distance from the given image : 0.9586153524200749
==========

ASIN : B00JXQCUIC
BRAND : Si Row
Eucliden distance from the given image : 1.000074961446881
==========

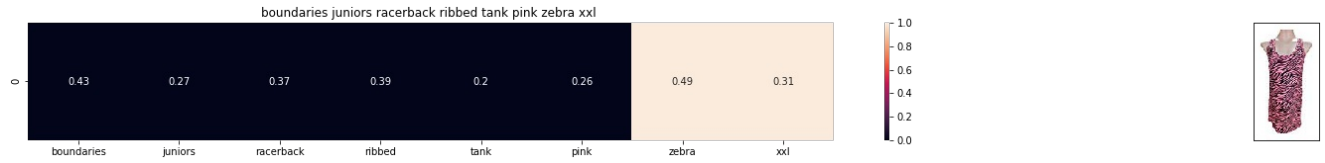
ASIN : B00JXQAO94
BRAND : Si Row
Eucliden distance from the given image : 1.0232155552457452



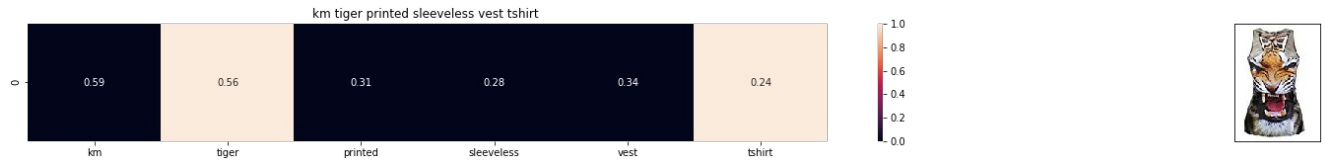
ASIN : B00JXQAUWA
BRAND : Si Row
Eucliden distance from the given image : 1.031991846303421



ASIN : B06XSCVFT5
BRAND : Studio M
Eucliden distance from the given image : 1.2106843670424716



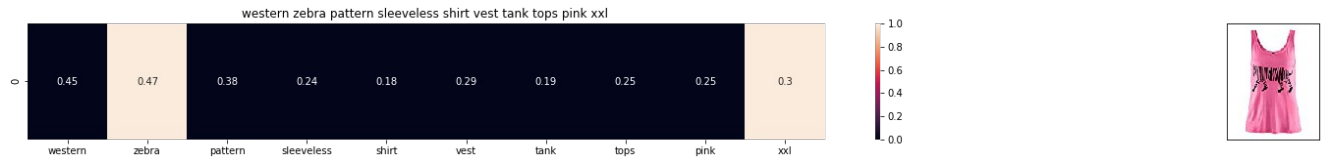
ASIN : B06Y2GTYPM
BRAND : No Boundaries
Eucliden distance from the given image : 1.2121683810720831



ASIN : B012VQLT6Y
BRAND : KM T-shirt
Eucliden distance from the given image : 1.219790640280982

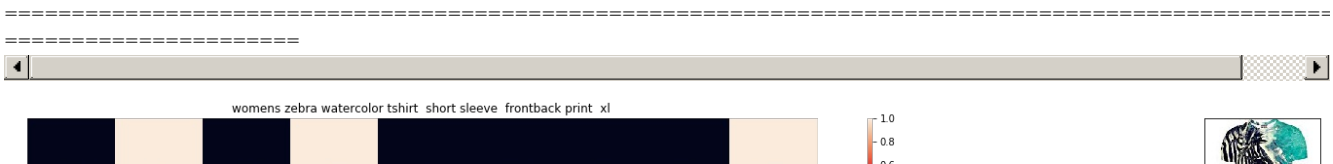
ASIN : B06Y1VN8WQ
BRAND : Black Swan

Eucliden distance from the given image : 1.2206849659998316

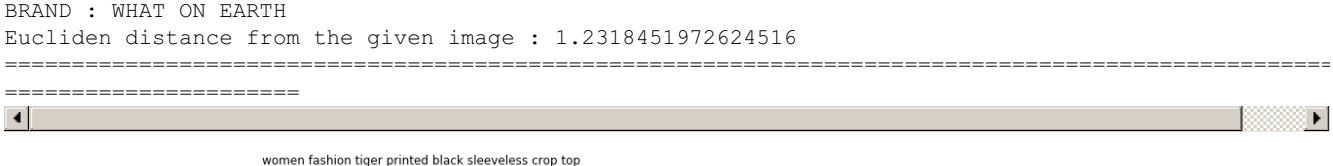


ASIN : B00Z6HEXWI
BRAND : Black Temptation
Eucliden distance from the given image : 1.221281392120943

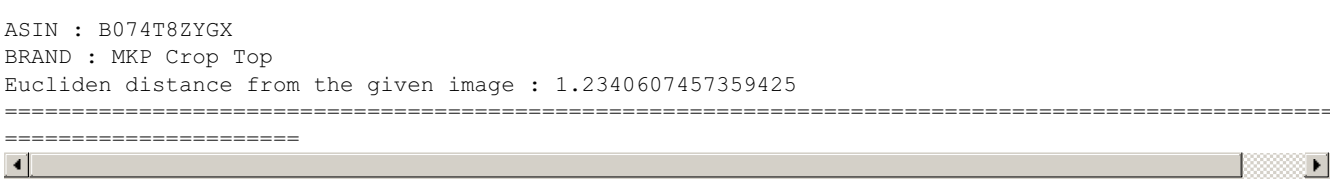
ASIN : B074TR12BH
BRAND : Ultra Flirt
Eucliden distance from the given image : 1.2313364094597743



ASIN : B072R2JXKW
BRAND : WHAT ON EARTH
Eucliden distance from the given image : 1.2318451972624516



ASIN : B074T8ZYGX
BRAND : MKP Crop Top
Eucliden distance from the given image : 1.2340607457359425

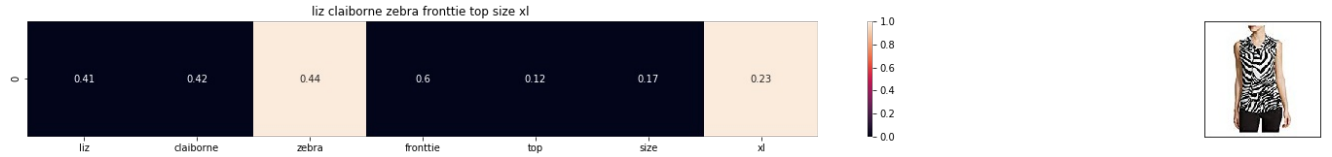


ASIN : B071ZDF6T2
BRAND : Mossimo
Eucliden distance from the given image : 1.2352785577664824


```
ASIN : B01K0H02OG
BRAND : Tultex
Eucliden distance from the given image : 1.236457298812782
```


```
ASIN : B00H8A6ZLI
BRAND : Vivian's Fashions
Eucliden distance from the given image : 1.24996155052848
```


```
ASIN : B010NN9RXO
BRAND : YICHUN
Eucliden distance from the given image : 1.2535461420856102
```




```
ASIN : B06XBY5QXL
BRAND : Liz Claiborne
Eucliden distance from the given image : 1.2538832938357722
```

[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
* #words_in_corpus
# idf_title_features[doc_id, index_of_word_in_corpus] = number of times the word occured in that d
oc
```

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)
```

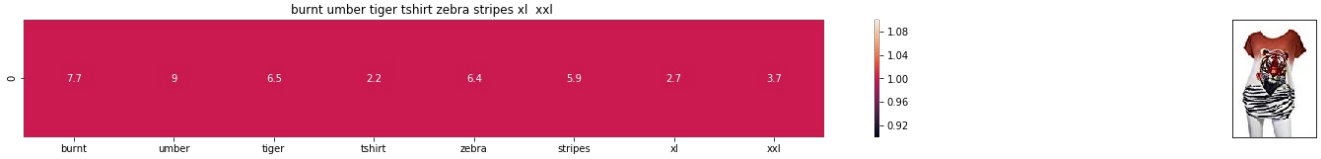
```
    return math.log(data.shape[0] / (n_containing(word)))
```

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 t
he word
    # idf_title_features[:, idf_title_vectorizer.vocabulary_[i]].nonzero()[0] will return all docu
ments 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
```

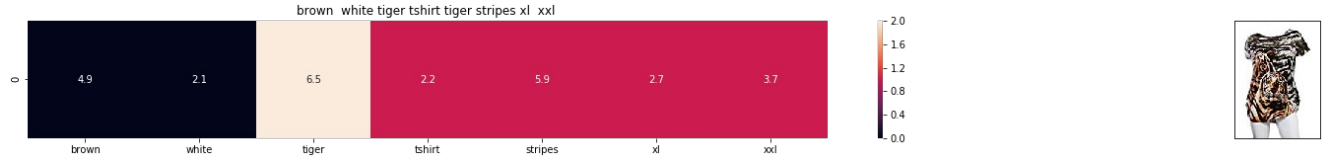
In [52]:

```
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]], d
ata['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 represe
nts the intersection with inputs title
```




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

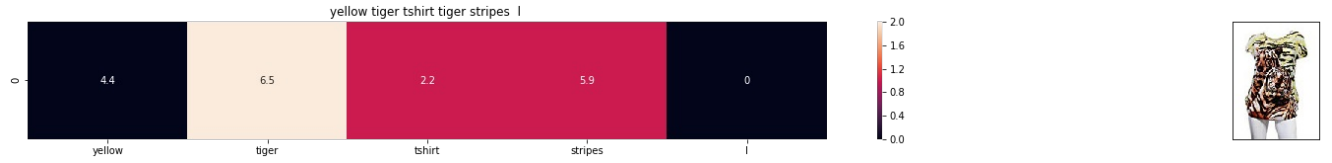
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from the given image : 12.20507131122177



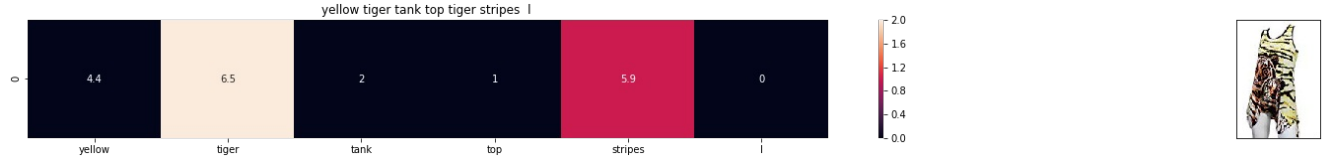
ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from the given image : 14.468362685603465

ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from the given image : 14.486832924778964

ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from the given image : 14.833392966672909

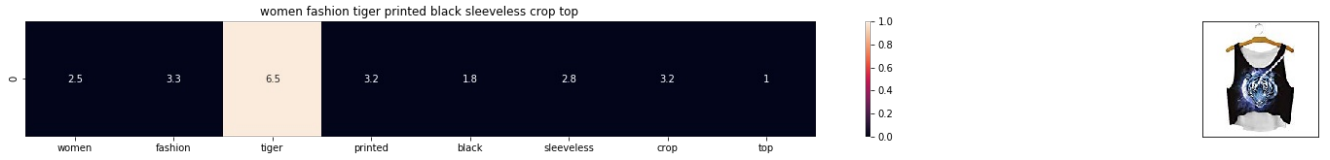


ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from the given image : 14.898744516719225



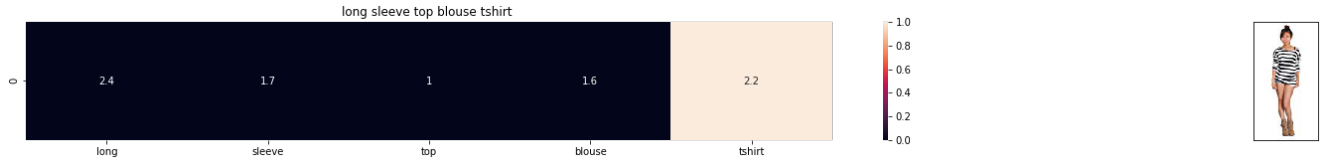
ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from the given image : 15.224458287343769

==========



ASIN : B074T8ZYGX
Brand : MKP Crop Top
euclidean distance from the given image : 17.080812955631995

==========

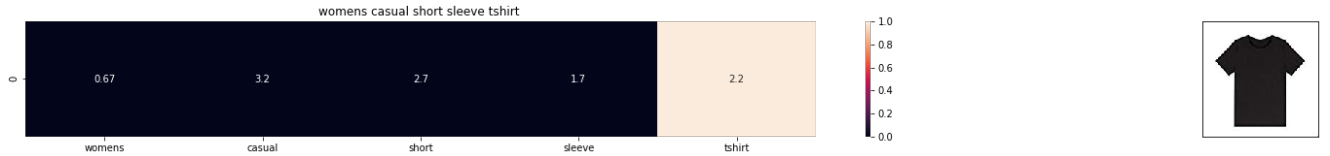


ASIN : B00KF2N5PU
Brand : Vietsbay
euclidean distance from the given image : 17.090168125645416

==========

ASIN : B00JPOZ9GM
Brand : Sofra
euclidean distance from the given image : 17.153215337562703

==========



ASIN : B074T9KG9Q
Brand : Rain
euclidean distance from the given image : 17.33671523874989

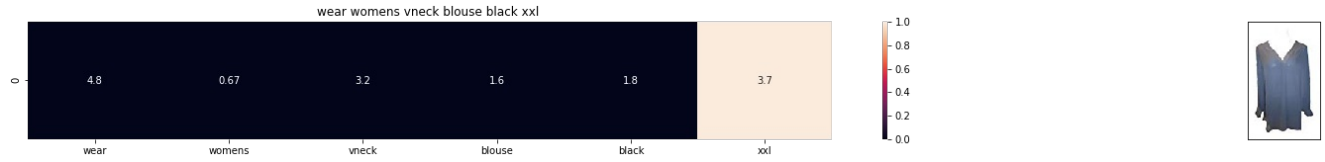
==========

ASIN : B00H8A6ZLI
Brand : Vivian's Fashions
euclidean distance from the given image : 17.410075941001253

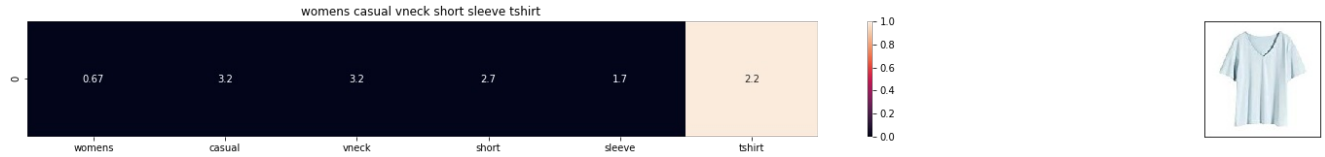
==========

ASIN : B074G5G5RK
Brand : ERMANNO SCERVINO
euclidean distance from the given image : 17.539921335459557

ASIN : B06XSCVFT5
Brand : Studio M
euclidean distance from the given image : 17.61275854366134

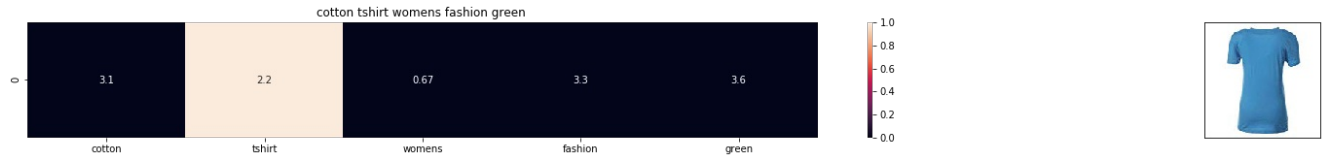


ASIN : B06Y6FH453
Brand : Who What Wear
euclidean distance from the given image : 17.623745282500135



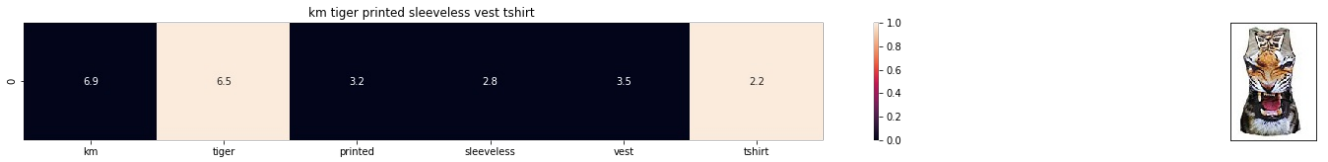
ASIN : B074V45DCX
Brand : Rain
euclidean distance from the given image : 17.634342496835046

ASIN : B07583CQFT
Brand : Very J
euclidean distance from the given image : 17.63753712743611



ASIN : B073GJGVBN
Brand : Ivan Levi
euclidean distance from the given image : 17.7230738913371

```
======================
```




```
ASIN : B012VQLT6Y
Brand : KM T-shirt
euclidean distance from the given image : 17.762588561202364
======================================================================================================
======================
```


```
ASIN : B00ZZMYBRG
Brand : HP-LEISURE
euclidean distance from the given image : 17.779536864674238
======================================================================================================
======================
```

[9] Text Semantics based product similarity

In [53]:

```
# 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)

'''
```

Out[53]:

```
'\n# Set values for various parameters\nnum_features = 300    # Word vector dimensionality
\nmin_word_count = 1    # Minimum word count                          \nnum_workers = 4       # Numbe
of threads to run in parallel\ncontext = 10          # Context window size
\ndownsampling = 1e-3   # Downsample setting for frequent words\n\n# Initialize and train the
model (this will take some time)\nfrom gensim.models import word2vec\nprint ("Training
model...")\nmodel = word2vec.Word2Vec(sen_corpus, workers=num_workers,
size=num_features, min_count = min_word_count,             window = context)\n    \n'
```

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.
with open('gdrive/My Drive/Applied_AI_Workshop_Code_Data/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
ignoring it
            vec.append(np.zeros(shape=(300,)))
    # we will return a numpy array of shape (#number of words in title * 300 ) 300 =
len(w2v_model[word])
    # each row represents the word2vec representation of each word (weighted/avg) in given
sentance
    return  np.array(vec)

def get_distance(vec1, vec2):
    # vec1 = np.array(#number_of_words_title1 * 300), each row is a vector of length 300
corresponds to each word in give 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 lengt
h 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 lengt
h 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 appare
l
    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.voc
abulary_[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.

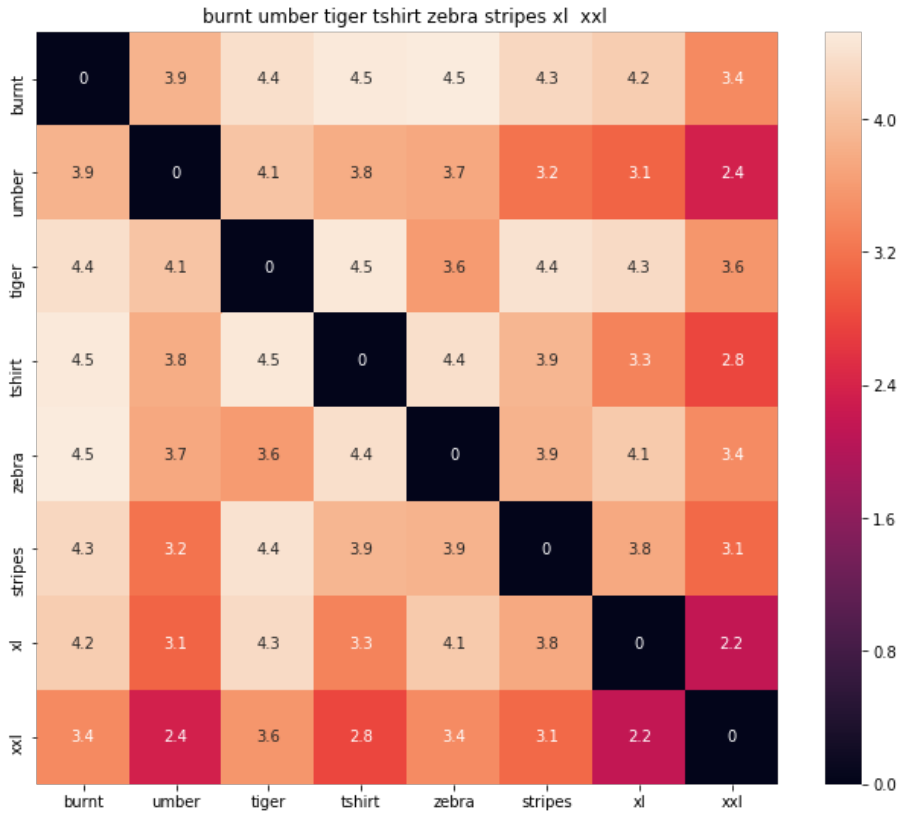
In [0]:

```
doc_id = 0
w2v_title = []
# for every title we build a avg vector representation
for i in data['title']:
```

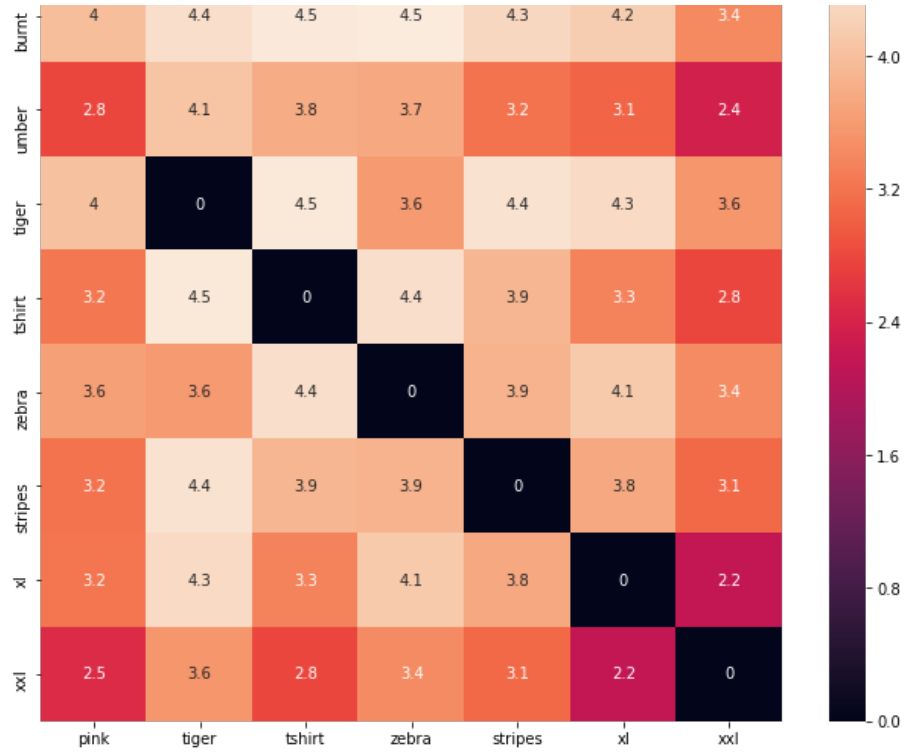
```
    w2v_title.append(build_avg_vec(i, 300, doc_id,'avg'))
    doc_id += 1

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

In [58]:

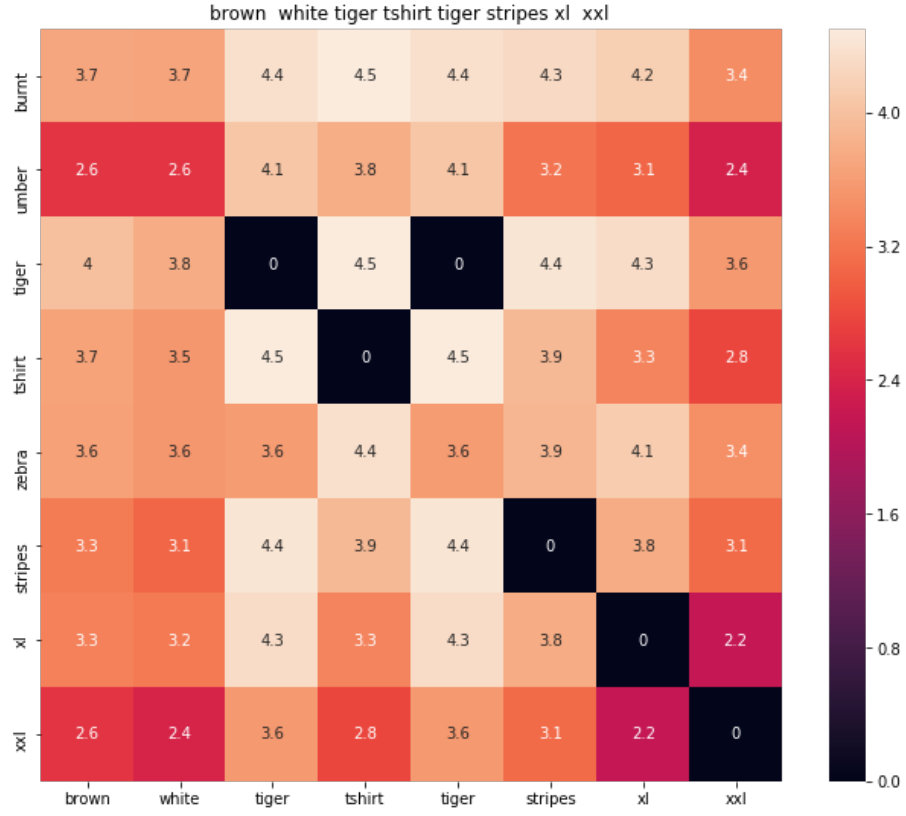
```
def avg_w2v_model(doc_id, num_results):
    # doc_id: apparel's id in given corpus

    # 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['mediu
m_image_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
```



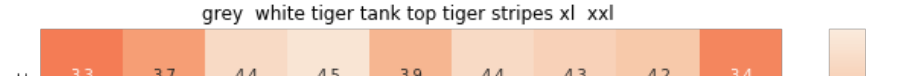
```
ASIN : B00JXQB5FQ
BRAND : Si Row
euclidean distance from given input image : 0.0
=============================================================================================================
======================
```



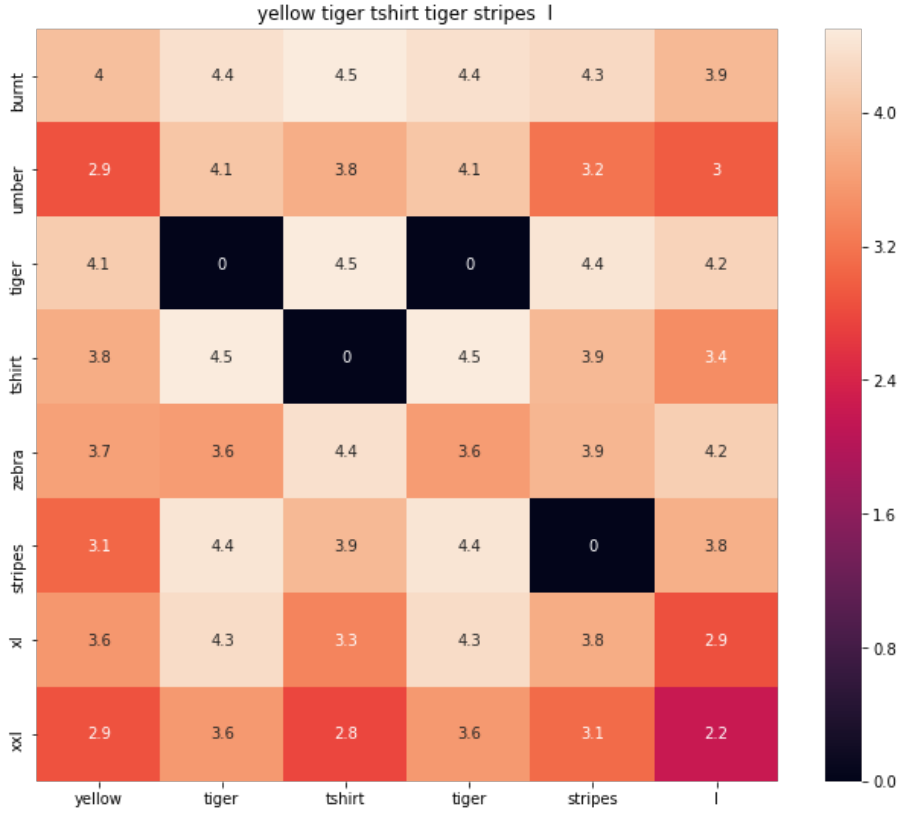
ASIN : B00JXQASS6
BRAND : Si Row
euclidean distance from given input image : 0.5891926
==========



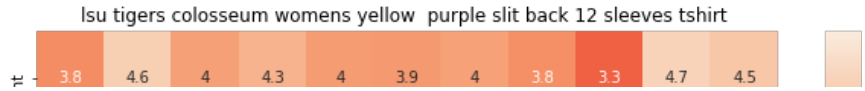
ASIN : B00JXQCWTO
BRAND : Si Row
euclidean distance from given input image : 0.7003438
==========

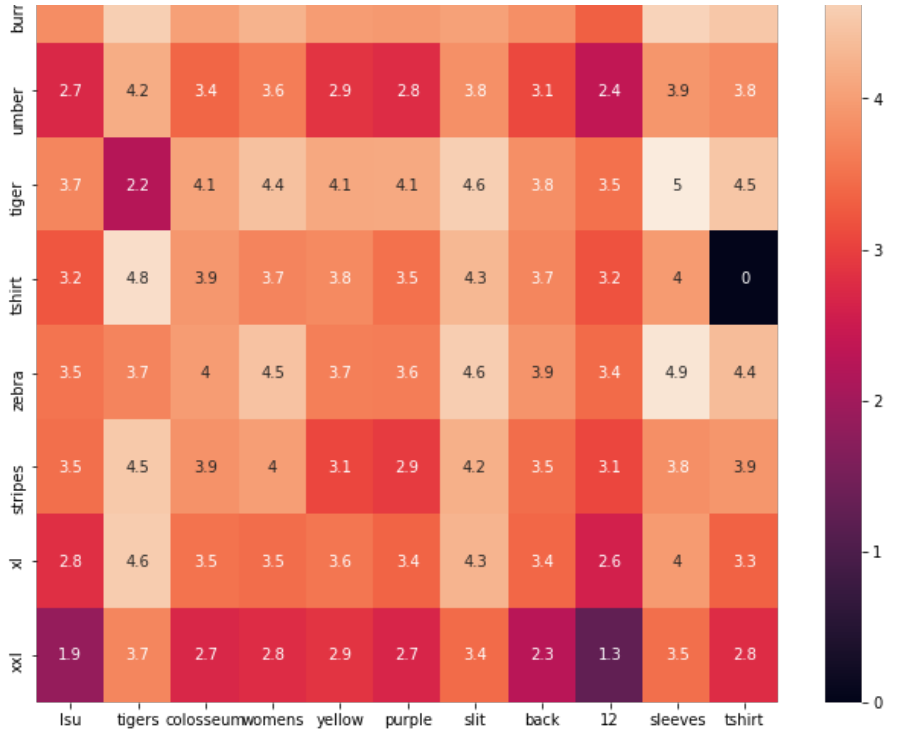


ASIN : B00JXQAFZ2
BRAND : Si Row
euclidean distance from given input image : 0.89283955
==========

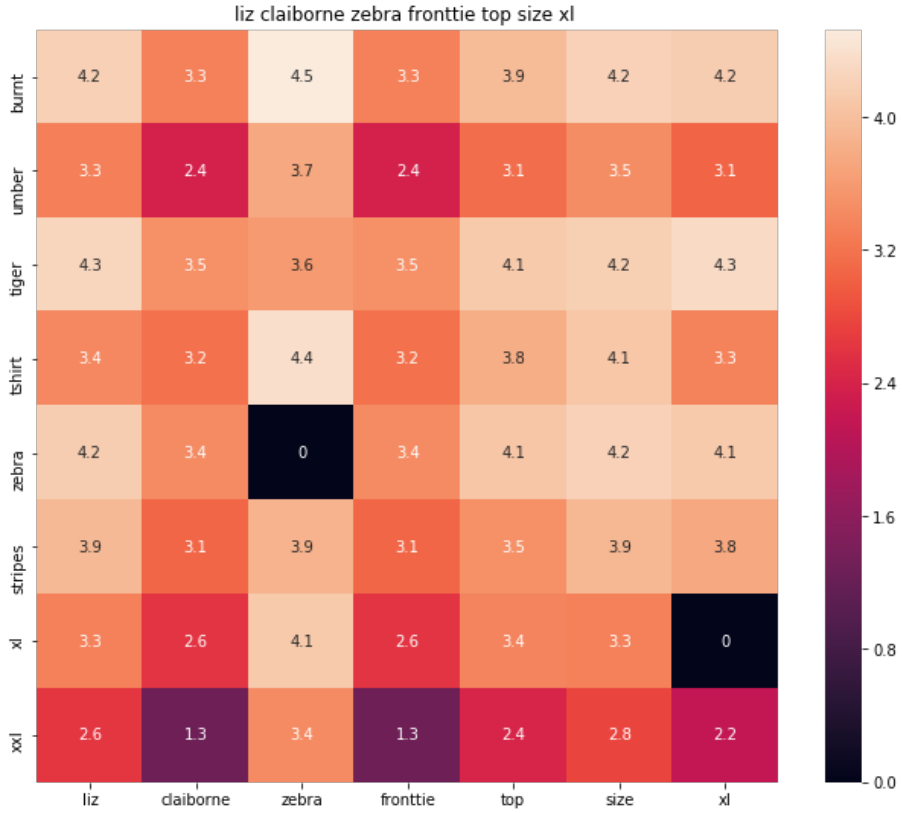


ASIN : B00JXQCUIC
BRAND : Si Row
euclidean distance from given input image : 0.95601255
==========

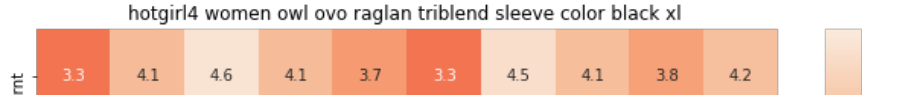


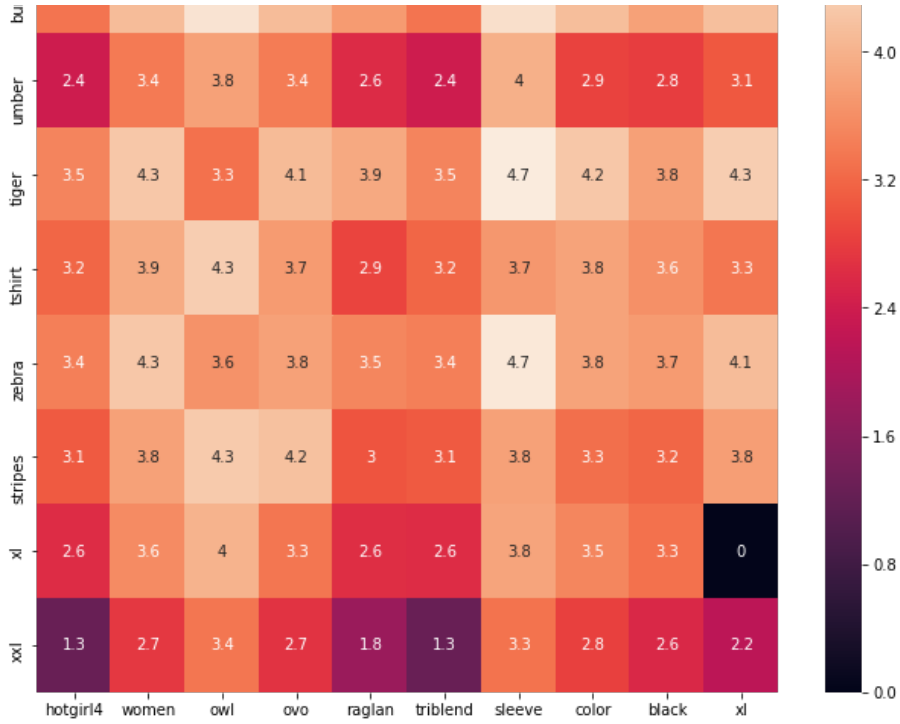


ASIN : B073R5Q8HD
BRAND : Colosseum
euclidean distance from given input image : 1.022969
==========

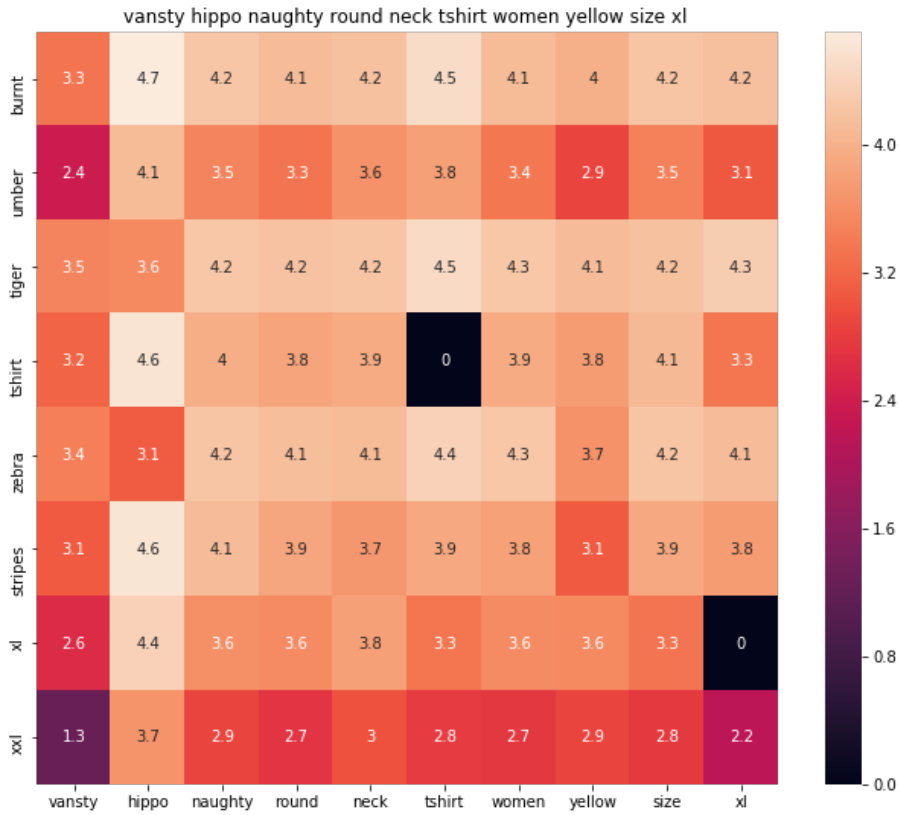


ASIN : B06XBY5QXL
BRAND : Liz Claiborne
euclidean distance from given input image : 1.0669324
==========

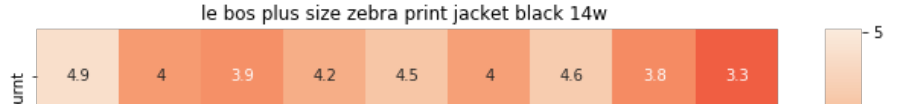


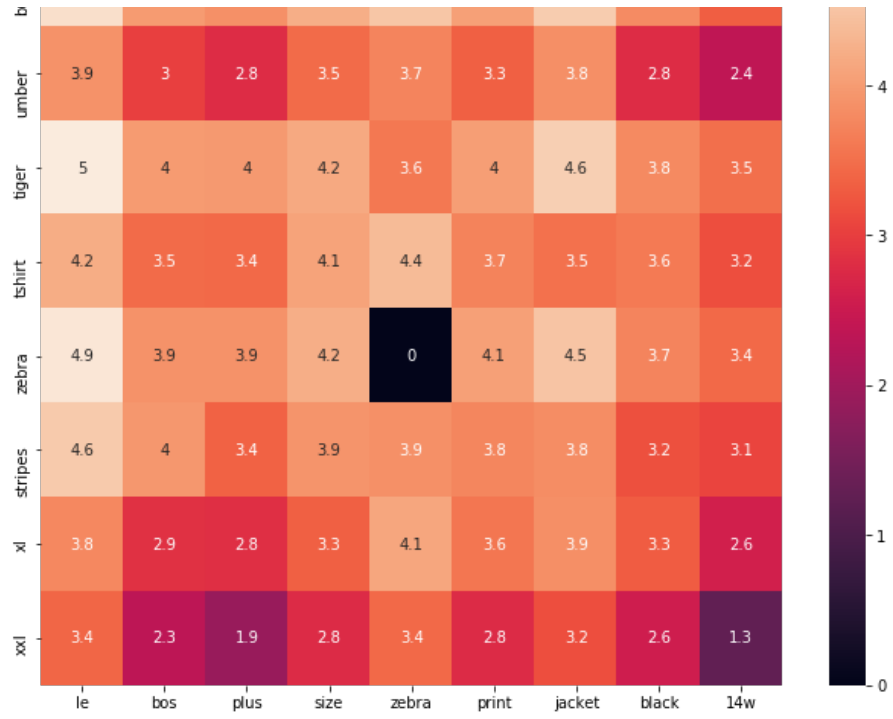


ASIN : B01L8L73M2
BRAND : Hotgirl4 Raglan Design
euclidean distance from given input image : 1.0731405
==========



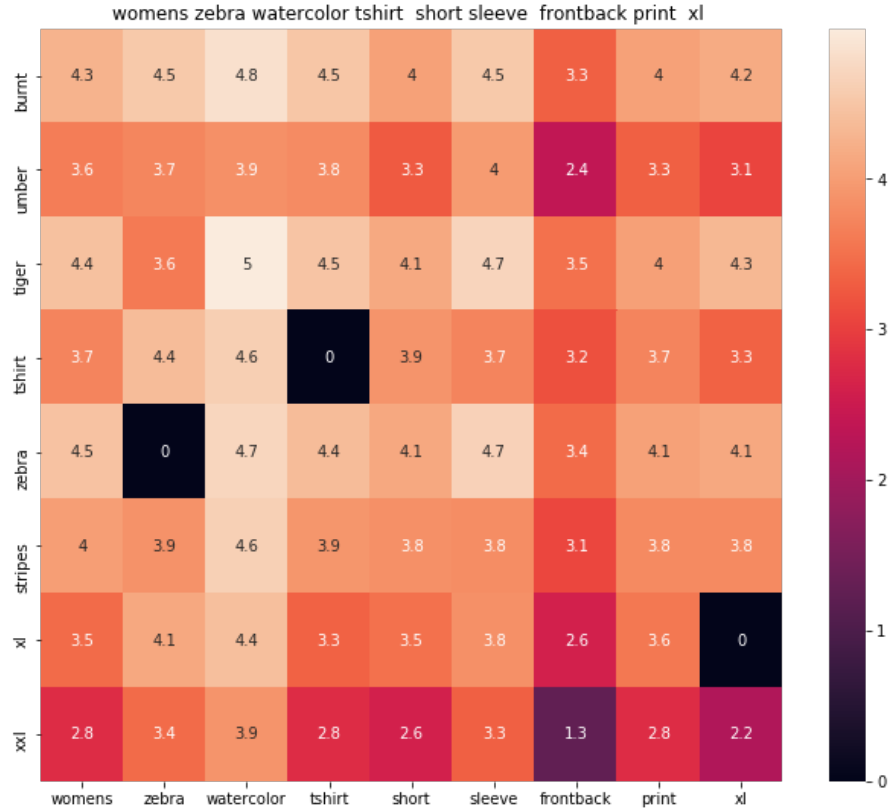
ASIN : B01EJS5H06
BRAND : Vansty
euclidean distance from given input image : 1.075719
==========





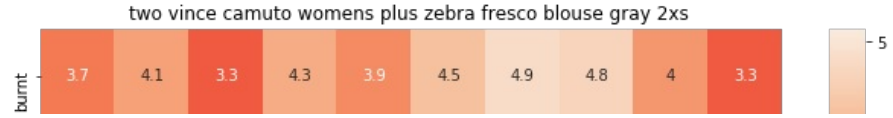
ASIN : B01BO1XRK8
BRAND : Le Bos
euclidean distance from given input image : 1.0839964
==========

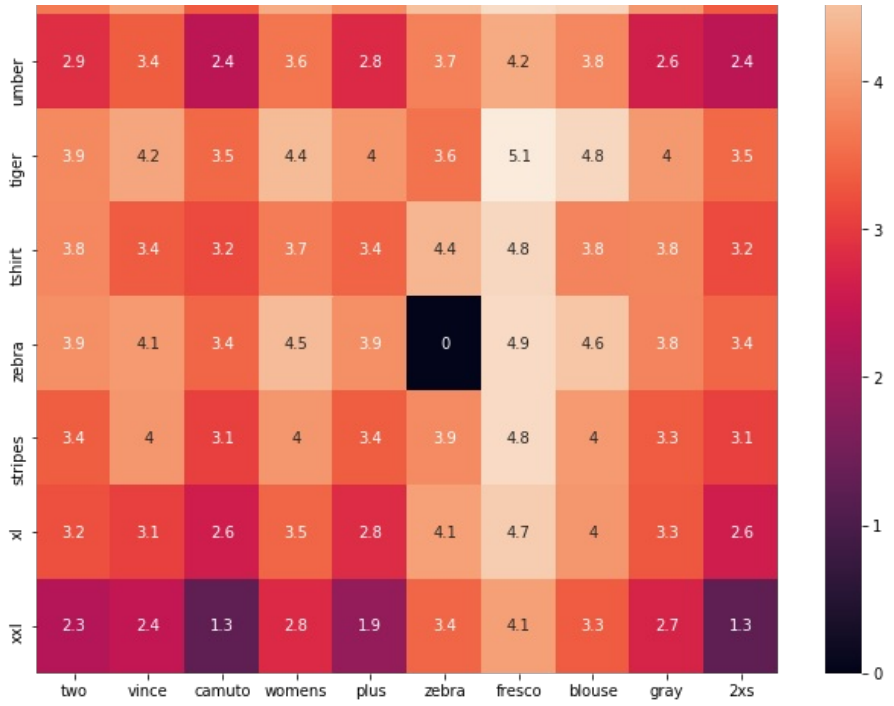
womens zebra watercolor tshirt short sleeve frontback print xl



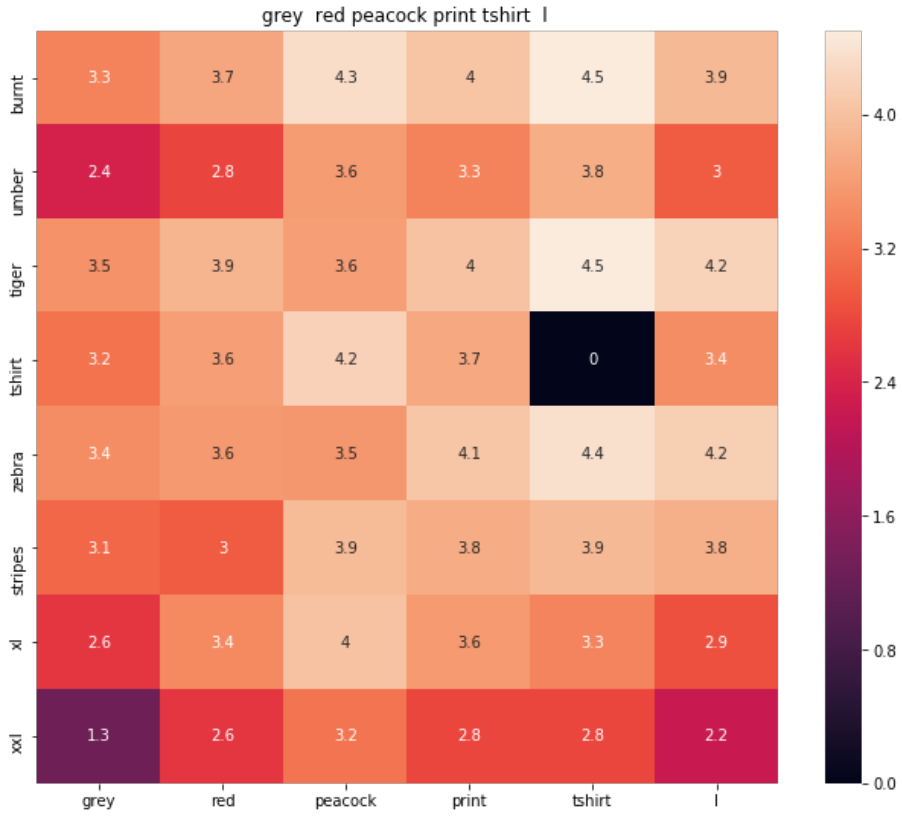
ASIN : B072R2JXKW
BRAND : WHAT ON EARTH
euclidean distance from given input image : 1.0842218
==========

two vince camuto womens plus zebra fresco blouse gray 2xs

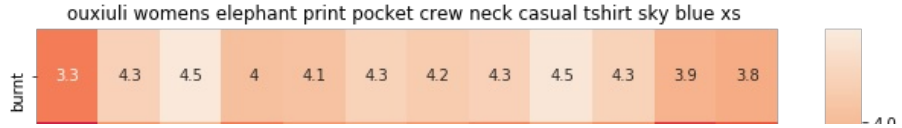


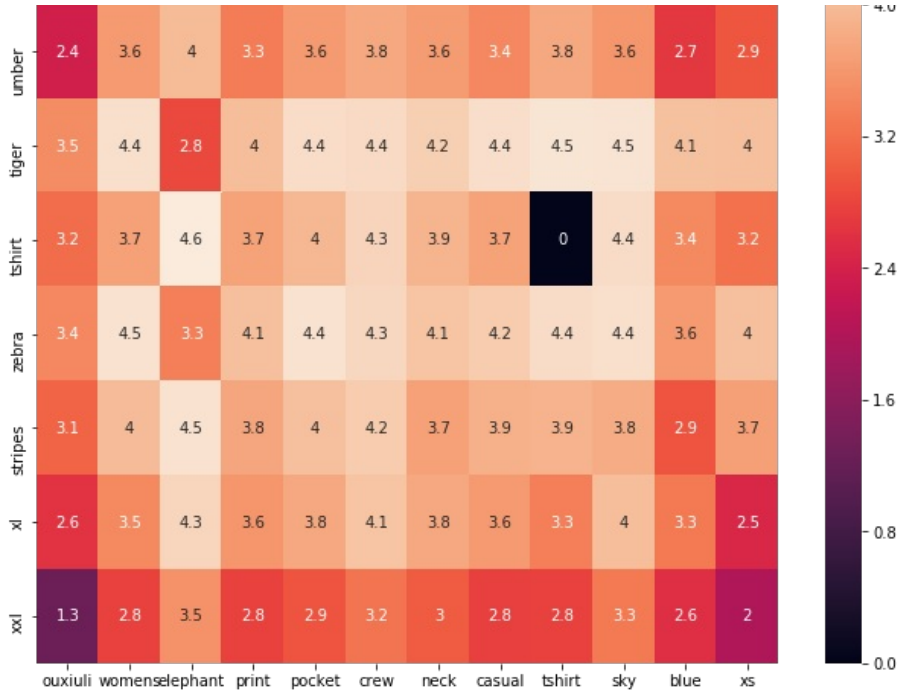


ASIN : B074MJRGW6
BRAND : Two by Vince Camuto
euclidean distance from given input image : 1.0895038

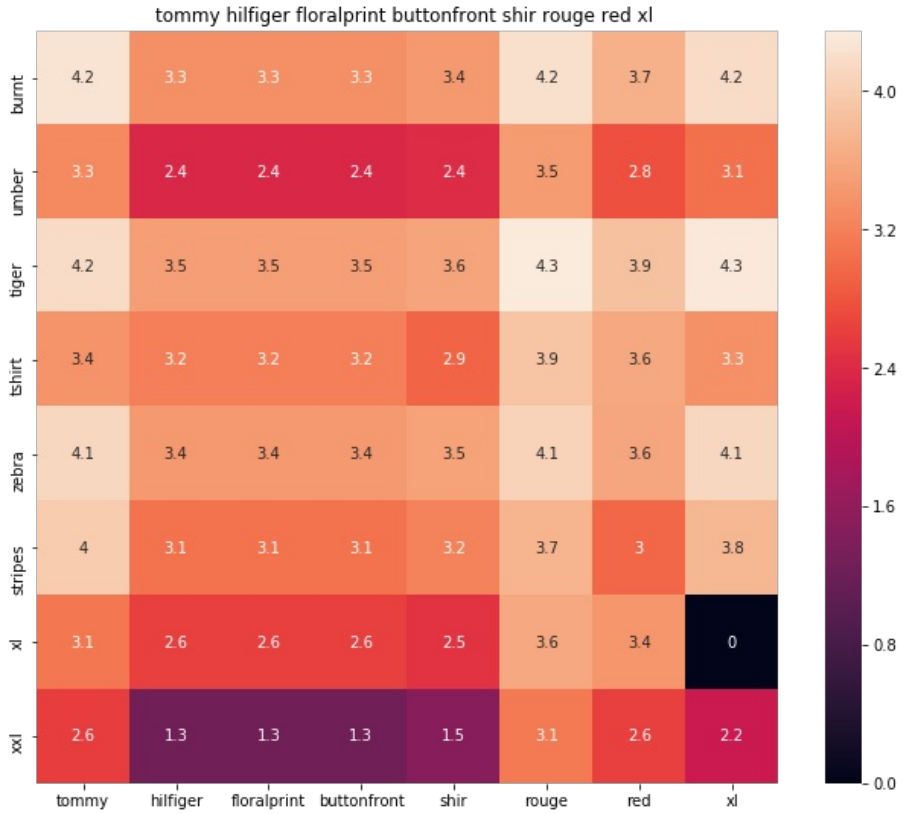


ASIN : B00JXQCFRS
BRAND : Si Row
euclidean distance from given input image : 1.0900588

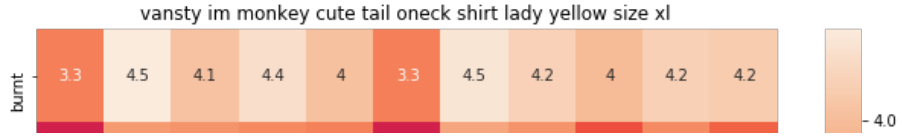


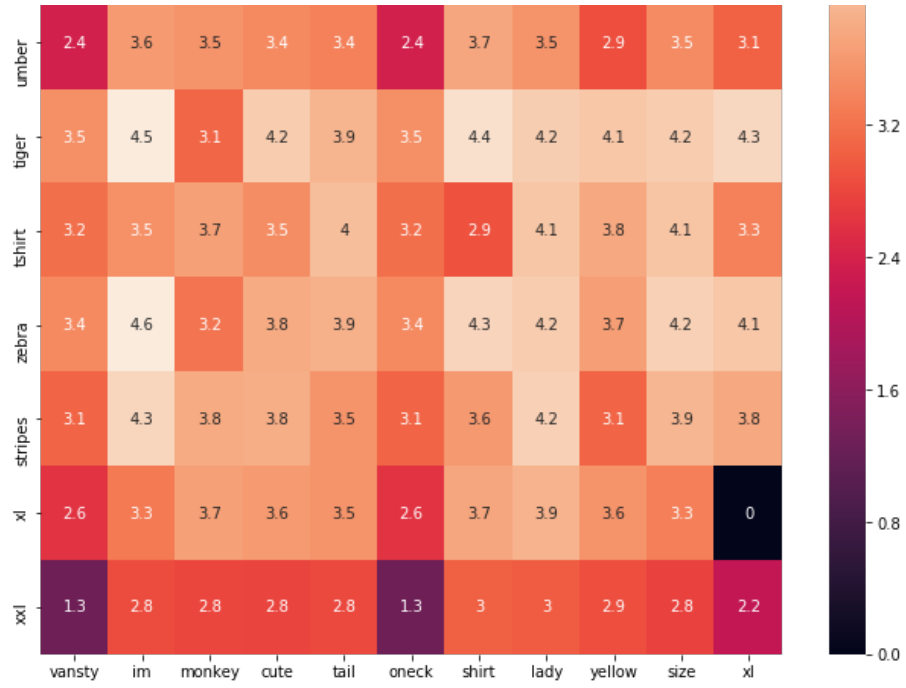


ASIN : B01I53HU6K
BRAND : ouxiuli
euclidean distance from given input image : 1.0920111

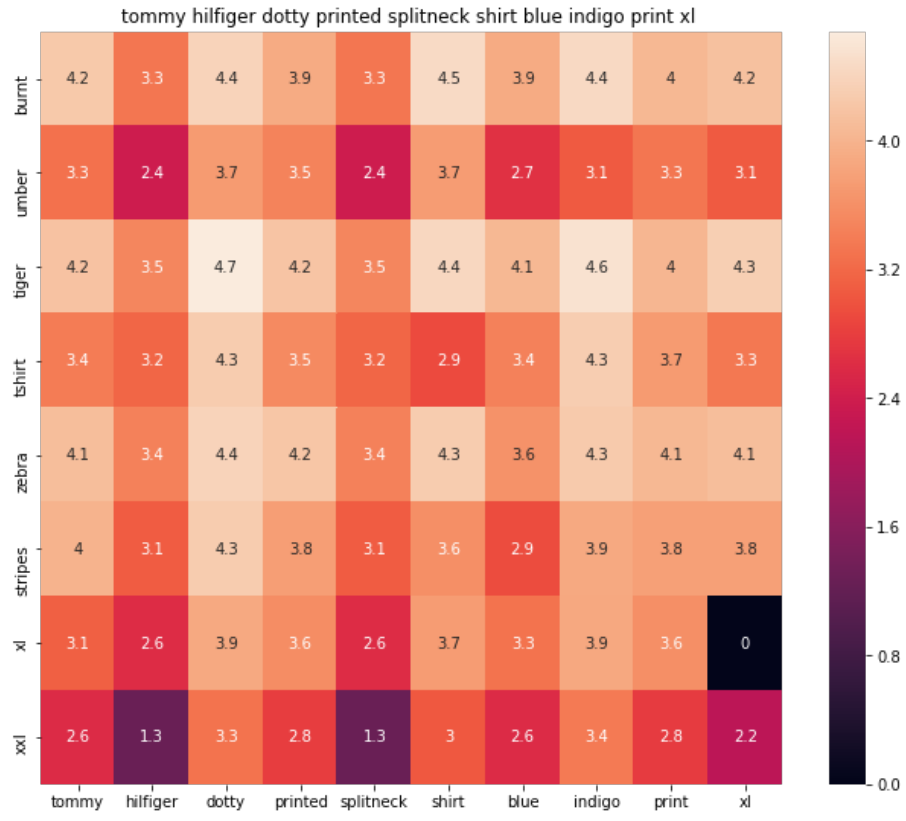


ASIN : B0711NGTQM
BRAND : THILFIGER RTW
euclidean distance from given input image : 1.0923415

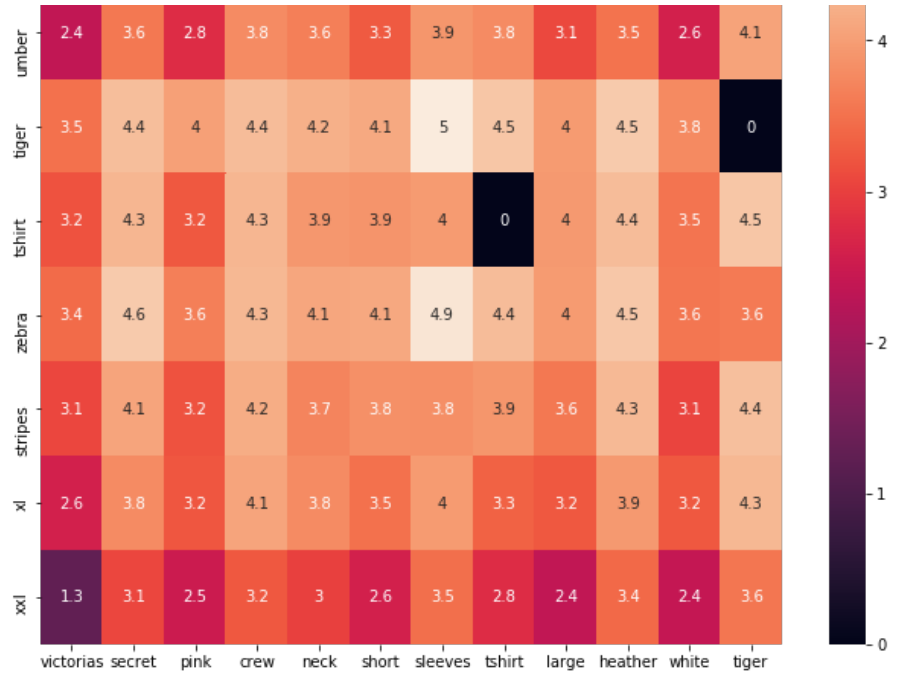




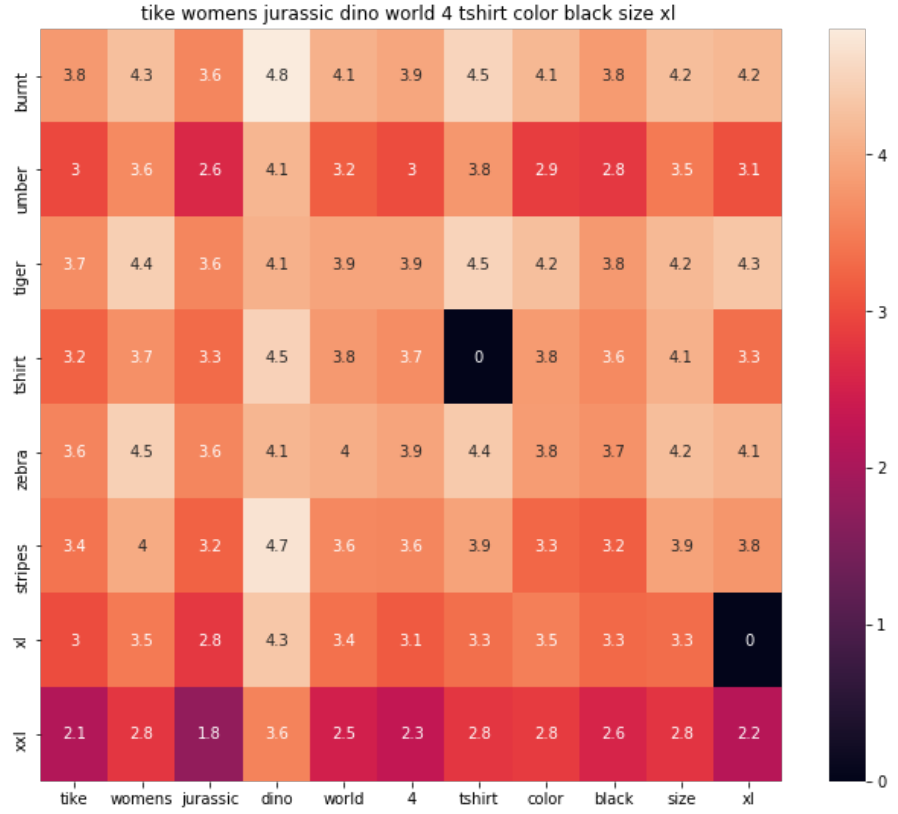
ASIN : B01EFSLO8Y
BRAND : Vansty
euclidean distance from given input image : 1.0934004
==========



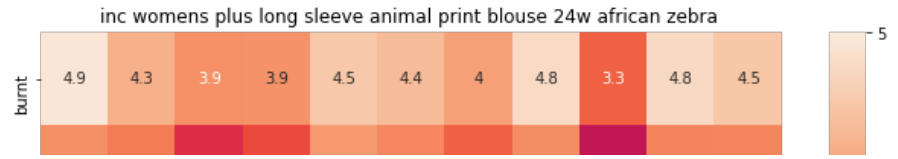
ASIN : B0716TVWQ4
BRAND : THILFIGER RTW
euclidean distance from given input image : 1.0942024
==========

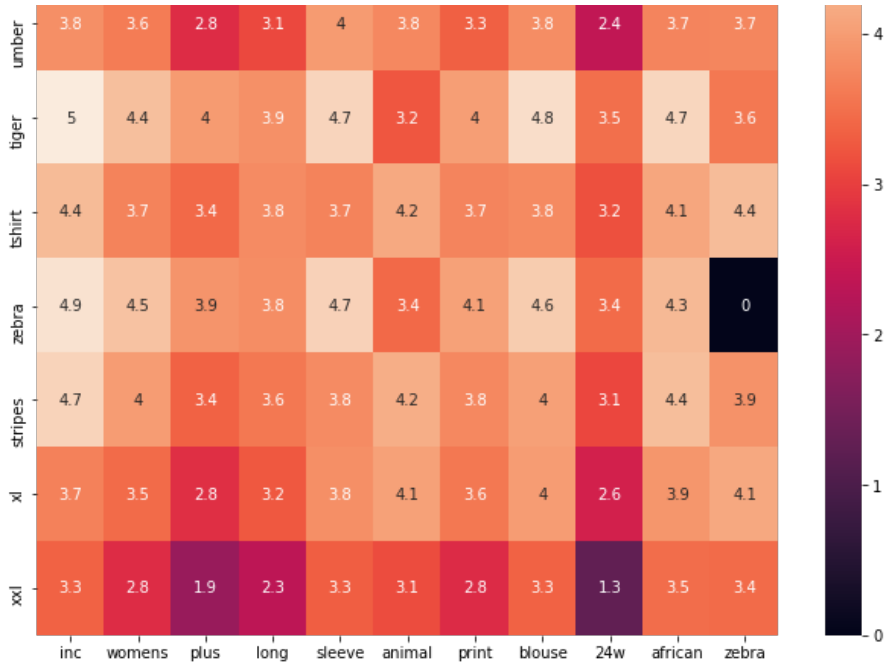


ASIN : B0716MVPGV
BRAND : V.Secret
euclidean distance from given input image : 1.0948304
==========



ASIN : B016OPN4OI
BRAND : TIKE Fashions
euclidean distance from given input image : 1.0951275
==========





```
ASIN : B018WDJCUA
BRAND : INC - International Concepts Woman
euclidean distance from given input image : 1.0966892
==========================================================================================================
======================
```

[9.4] IDF weighted Word2Vec for product similarity

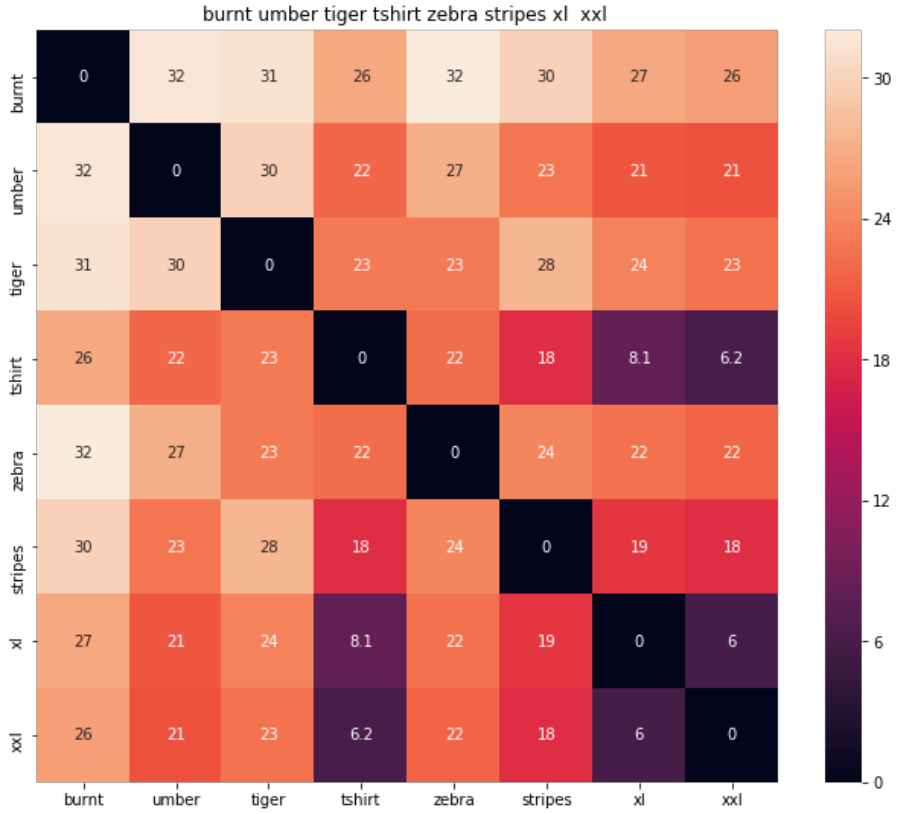
In [0]:

```
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)
```

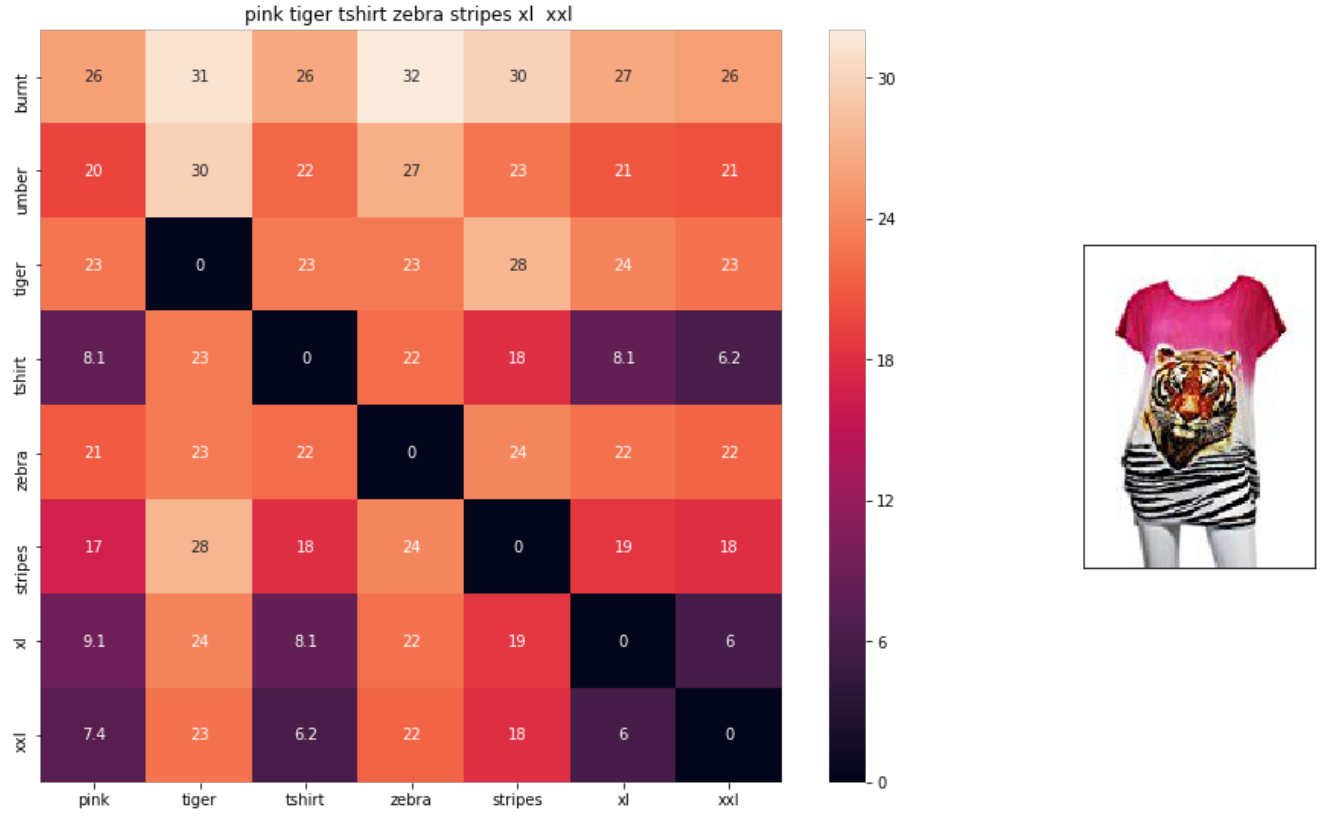
In [60]:

```
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['mediu
m_image_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
```

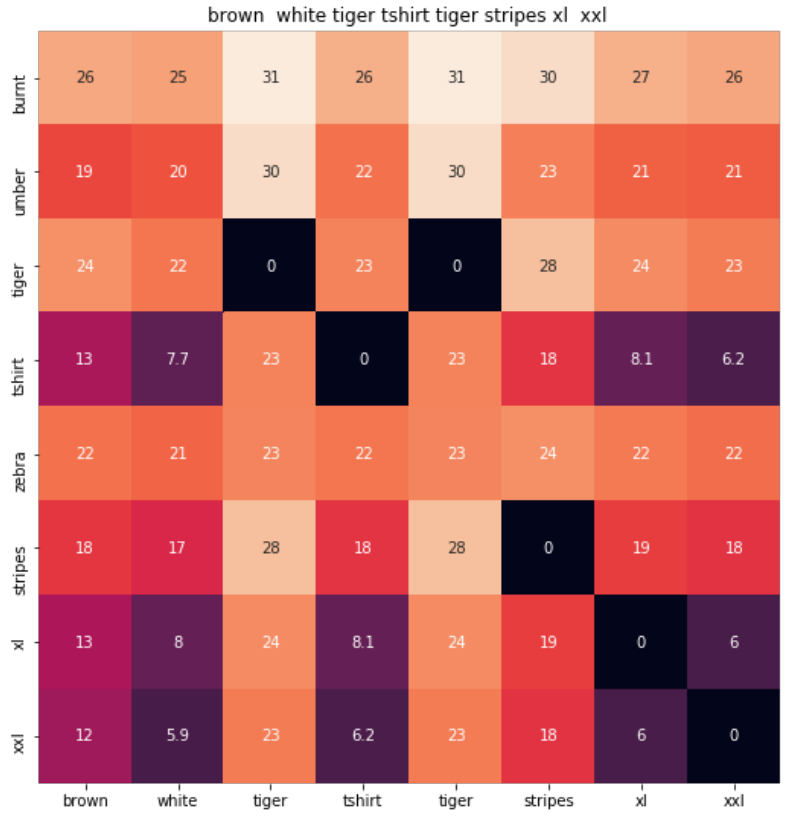


```
ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.0
```



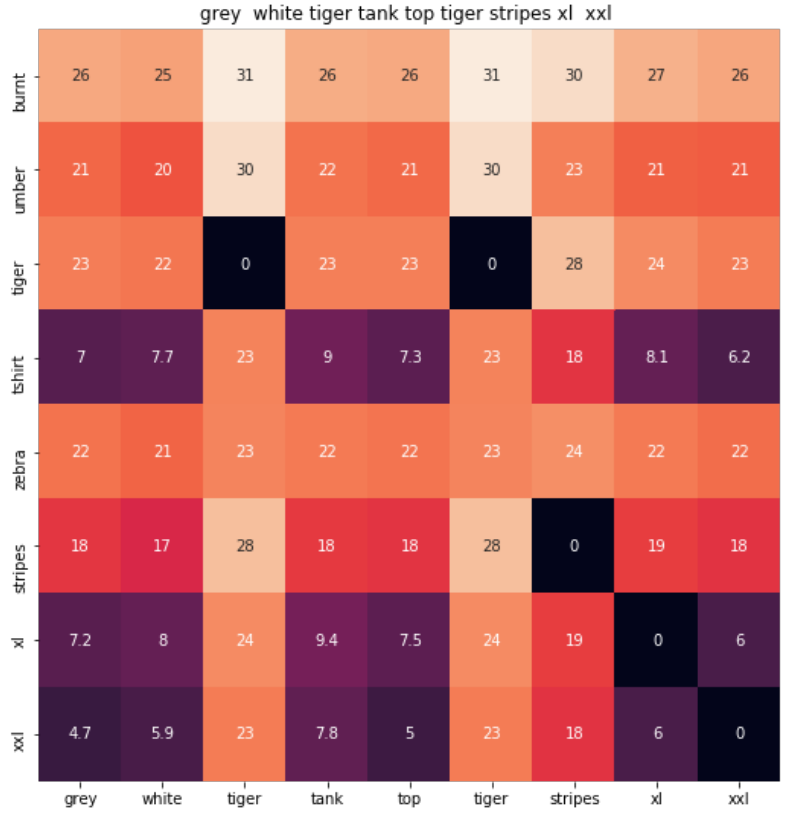

```
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 4.0638866
```

==========



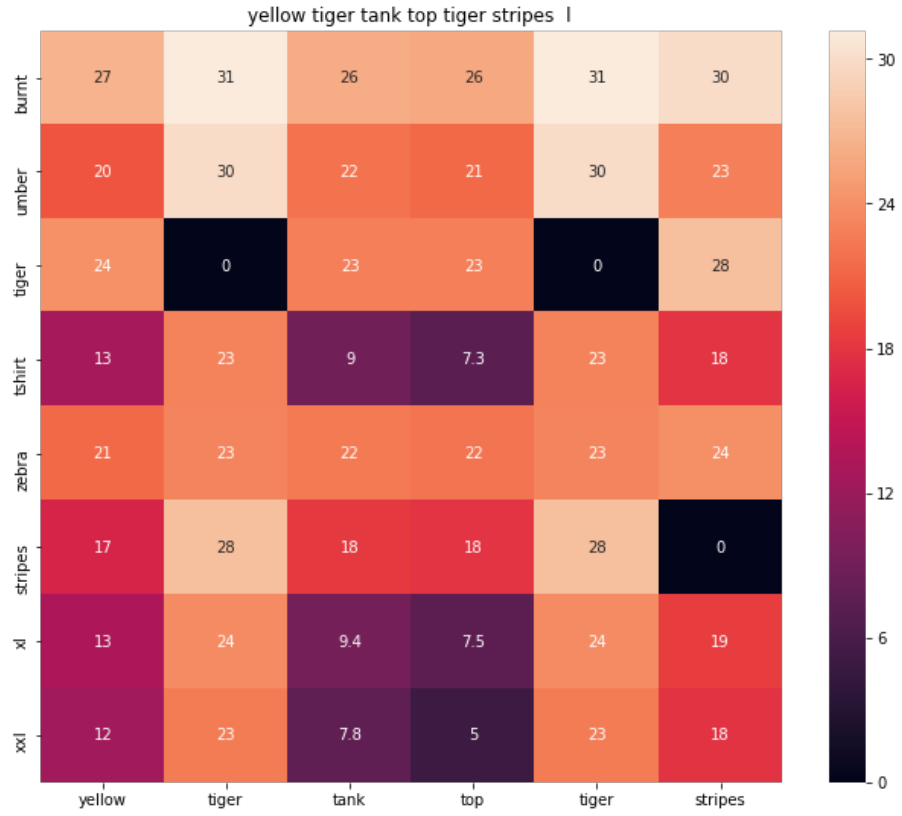
ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 4.7709413

==========



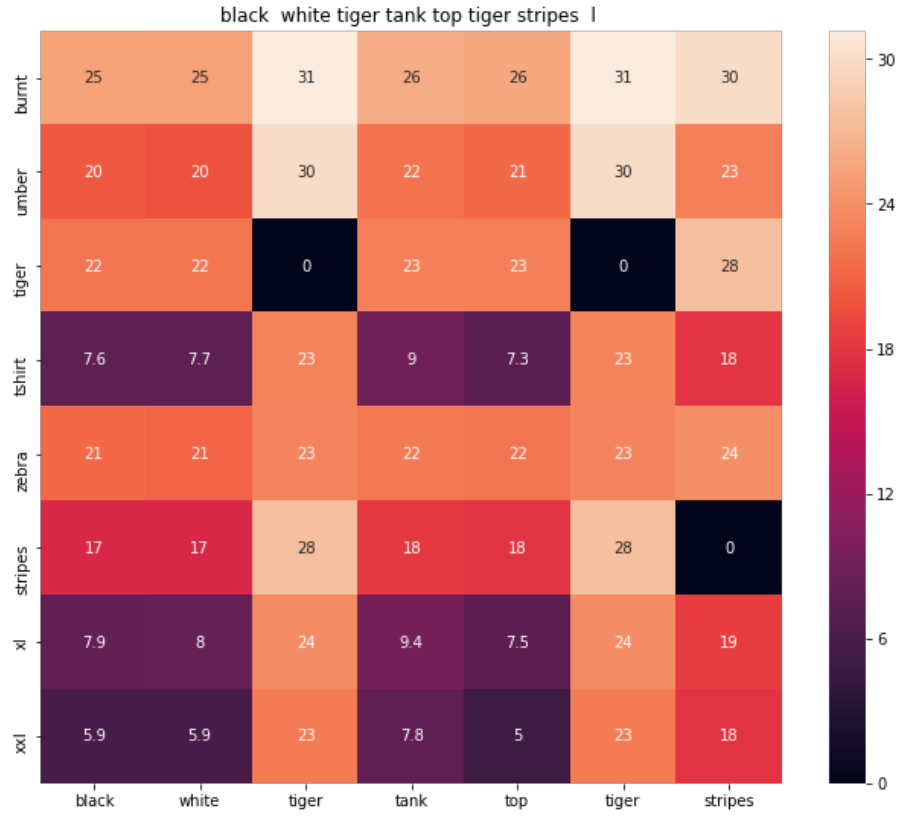
ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 5.3601604

==========



ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 5.6895227

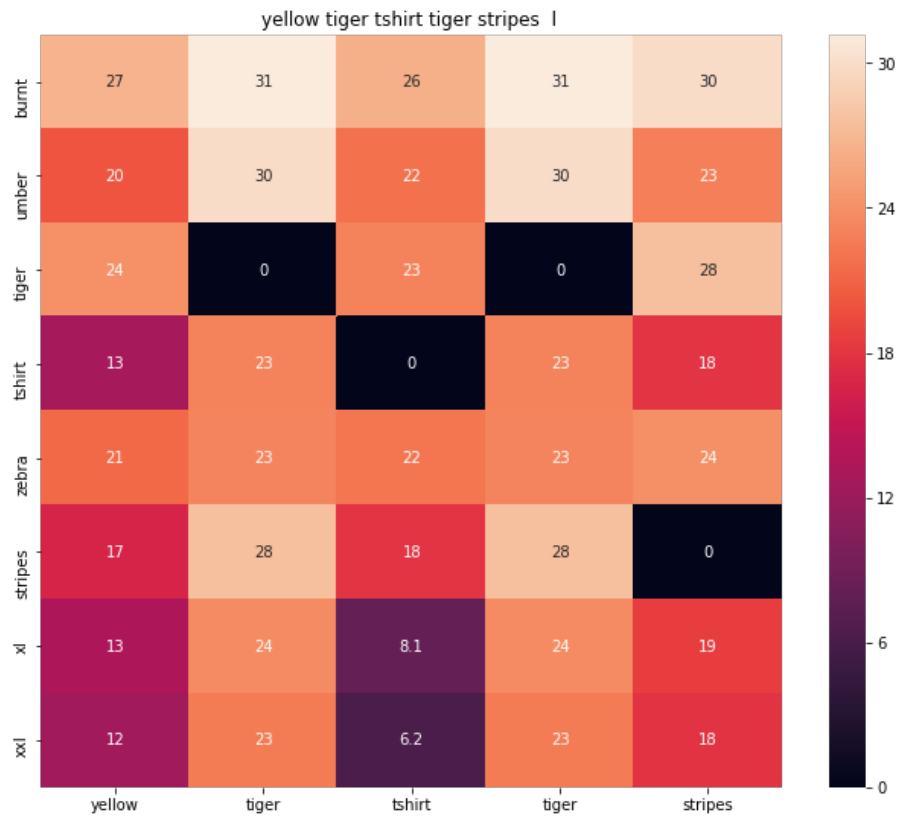
==========



ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 5.693021

==========

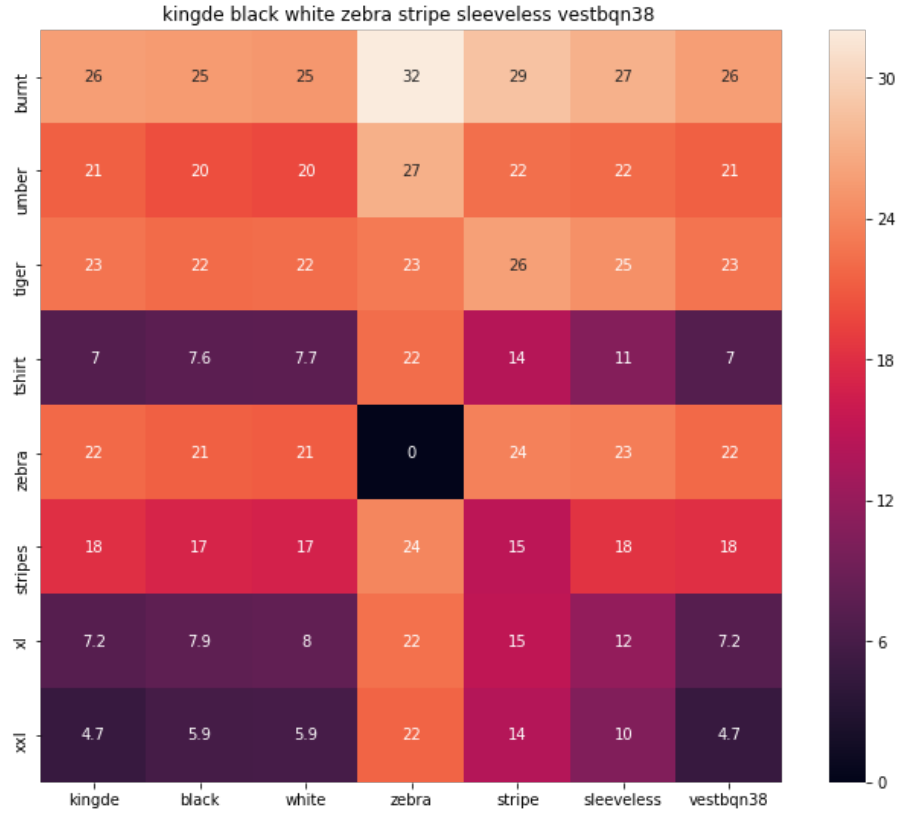
==========



ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 5.893442

==========

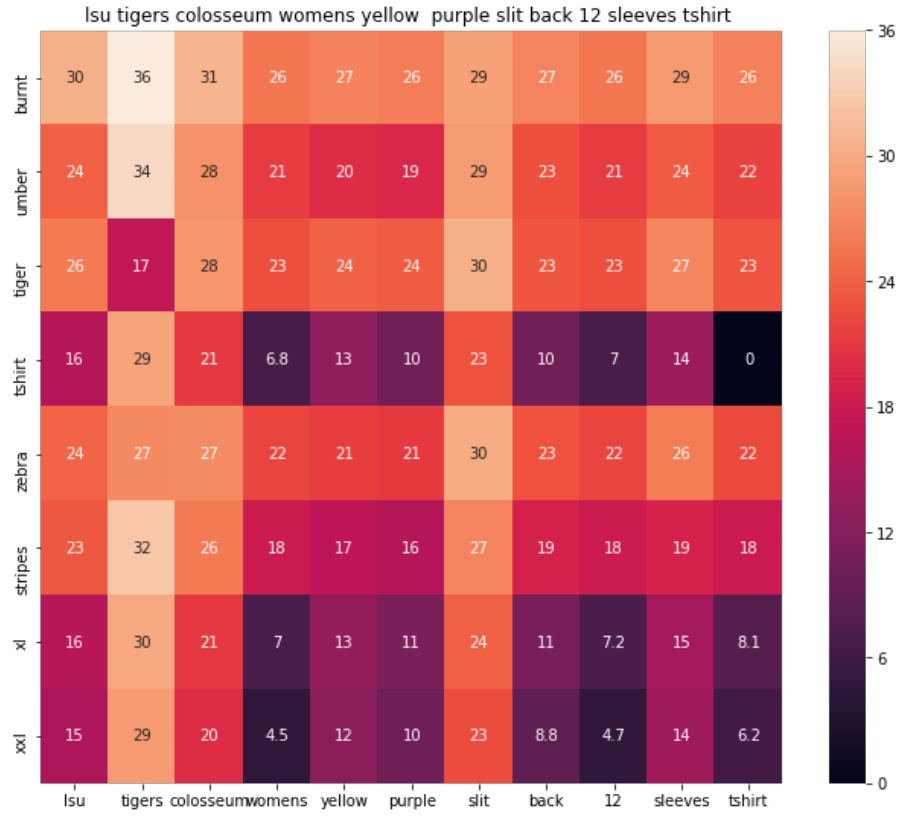
==========



ASIN : B015H41F6G
Brand : KINGDE
euclidean distance from input : 6.1329894

==========

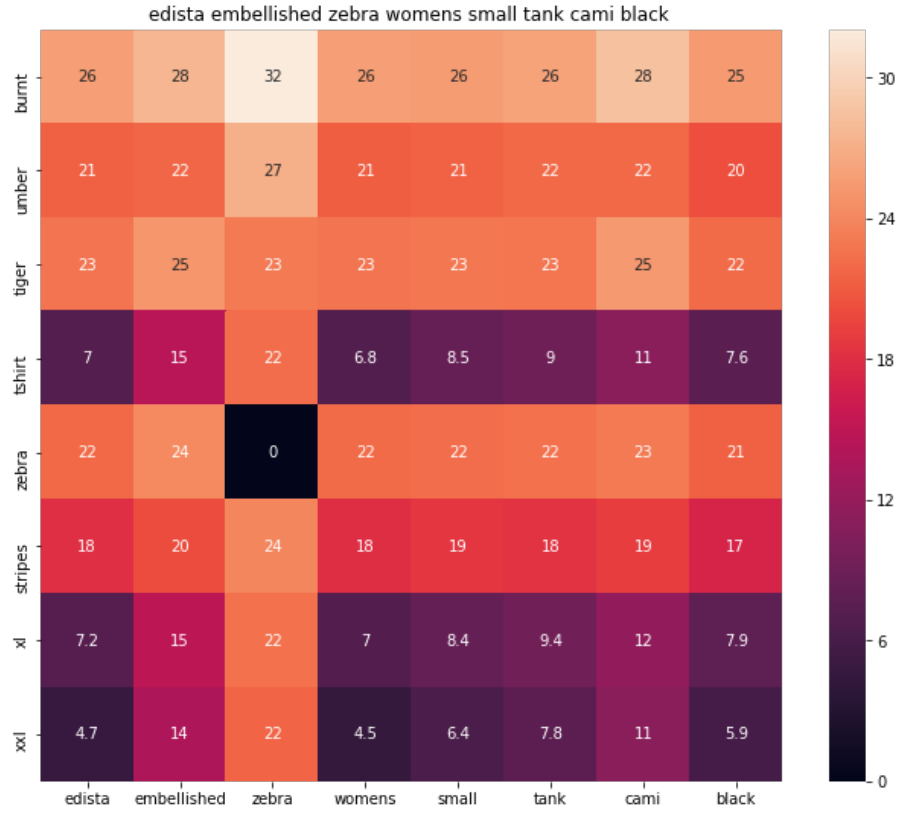
==========



ASIN : B073R5Q8HD
Brand : Colosseum
euclidean distance from input : 6.2567053

==========

==========



ASIN : B074P8MD22
Brand : Edista
euclidean distance from input : 6.3922033

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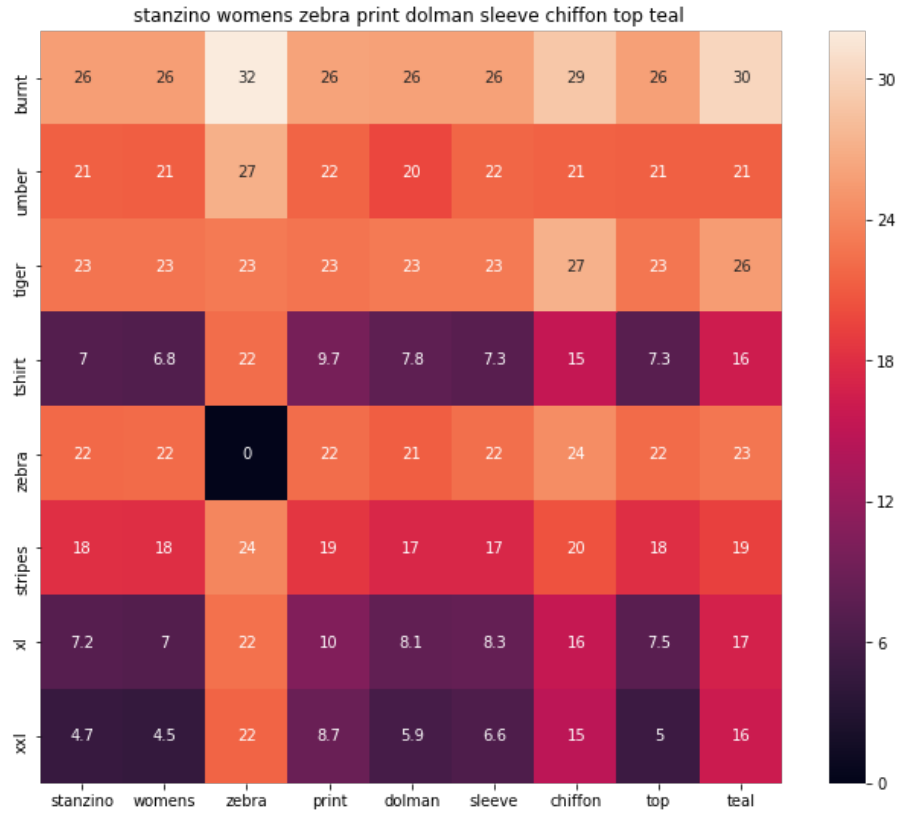

ASIN : B00C0I3U3E
Brand : Stanzino
euclidean distance from input : 6.4149003

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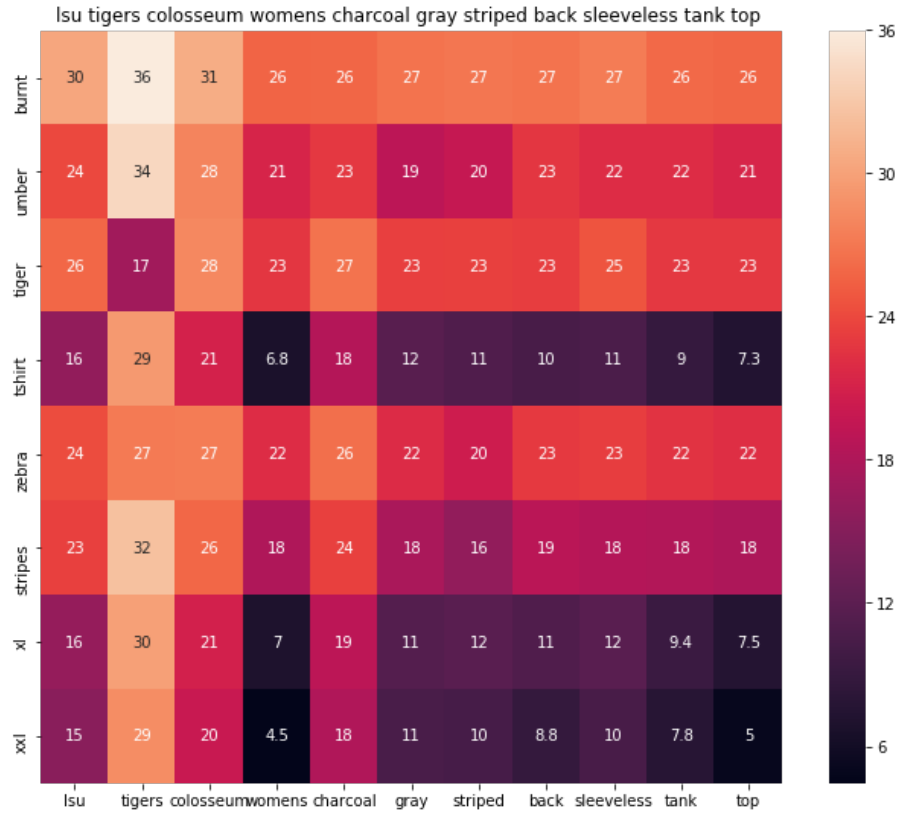

ASIN : B073R4ZM7Y
Brand : Colosseum
euclidean distance from input : 6.450959

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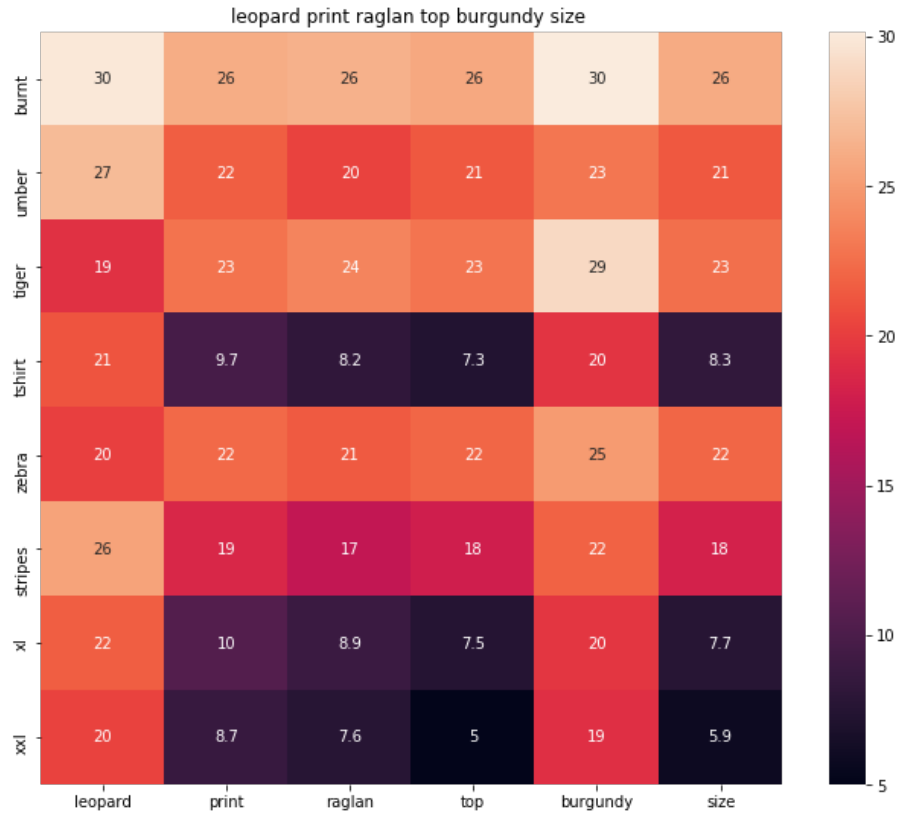
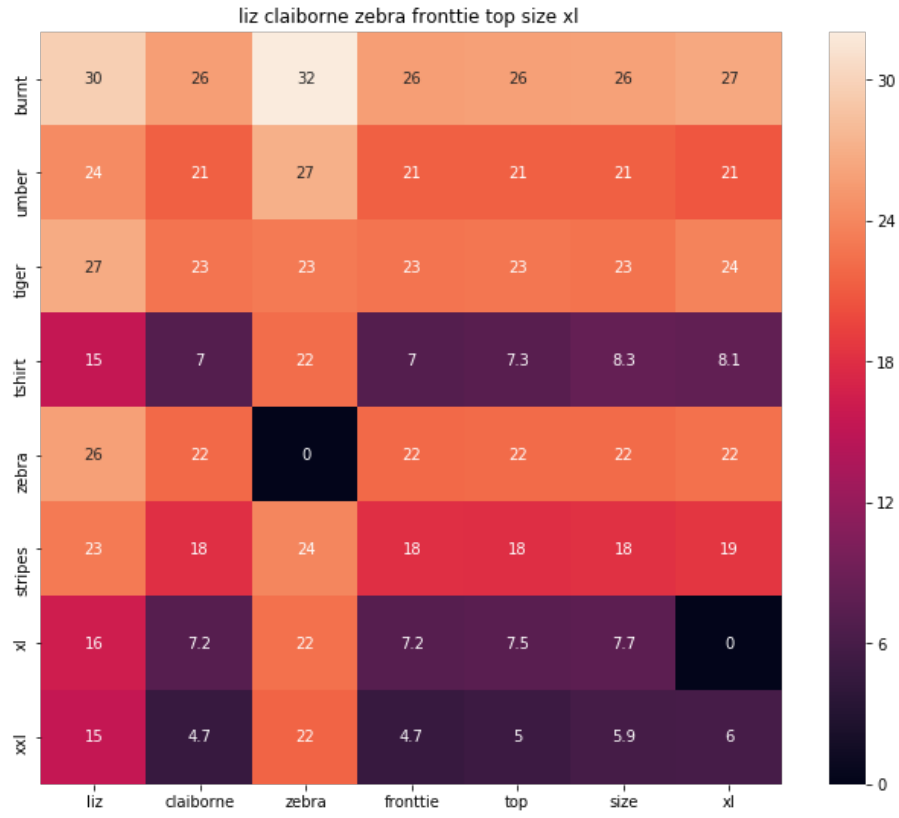
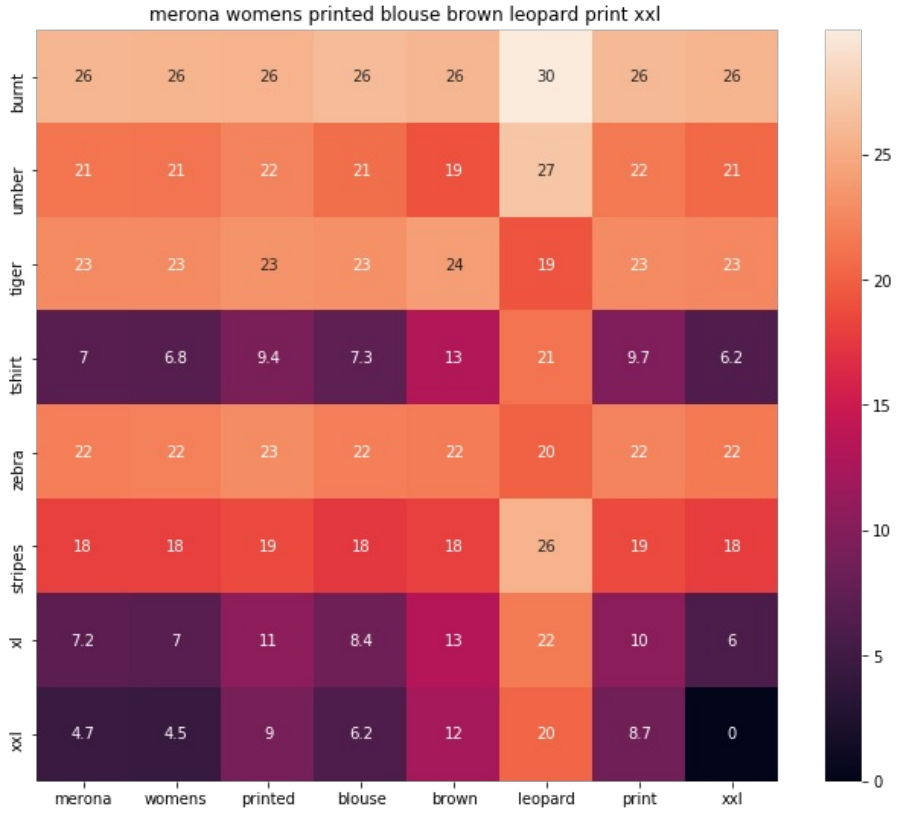


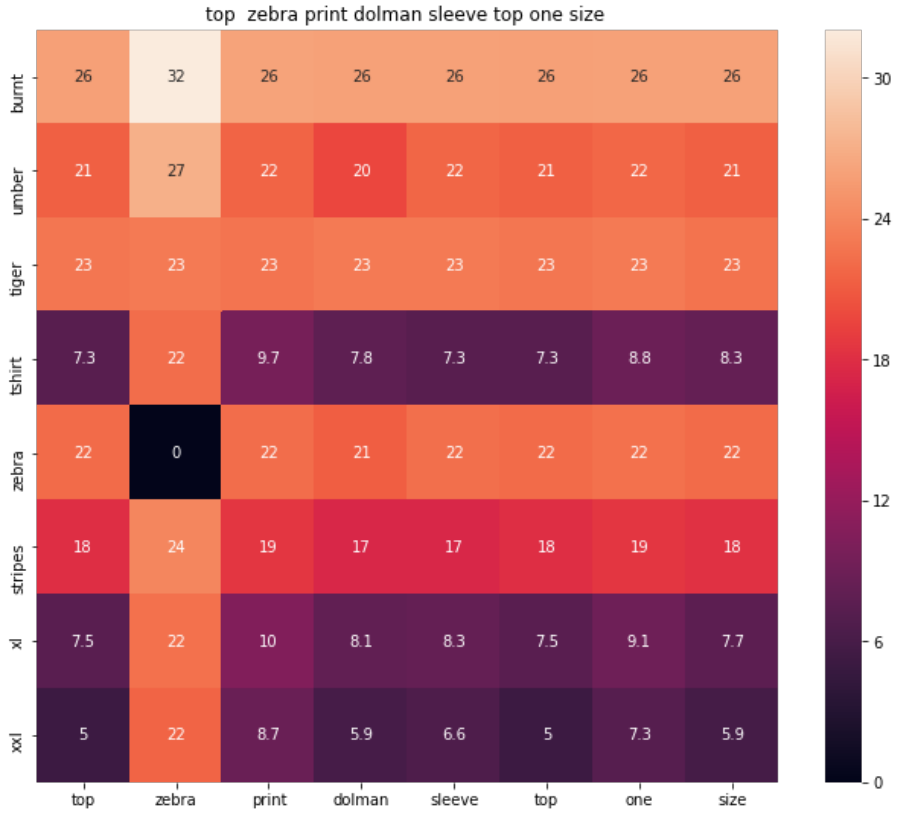
ASIN : B01C6ORLDQ
Brand : 1 Mad Fit
euclidean distance from input : 6.463409



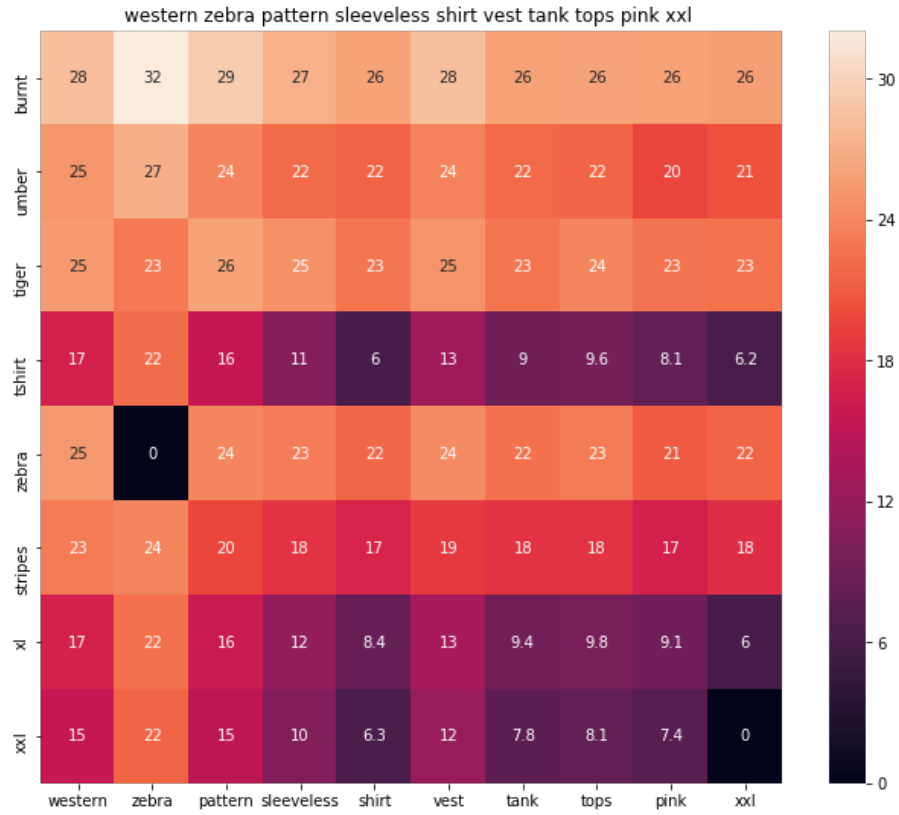
ASIN : B06XBY5QXL
Brand : Liz Claiborne
euclidean distance from input : 6.5392227



ASIN : B071YF3WDD
Brand : Merona
euclidean distance from input : 6.5755024



ASIN : B00H8A6ZLI
Brand : Vivian's Fashions
euclidean distance from input : 6.6382146



ASIN : B00Z6HEXWI
Brand : Black Temptation
euclidean distance from input : 6.6607366
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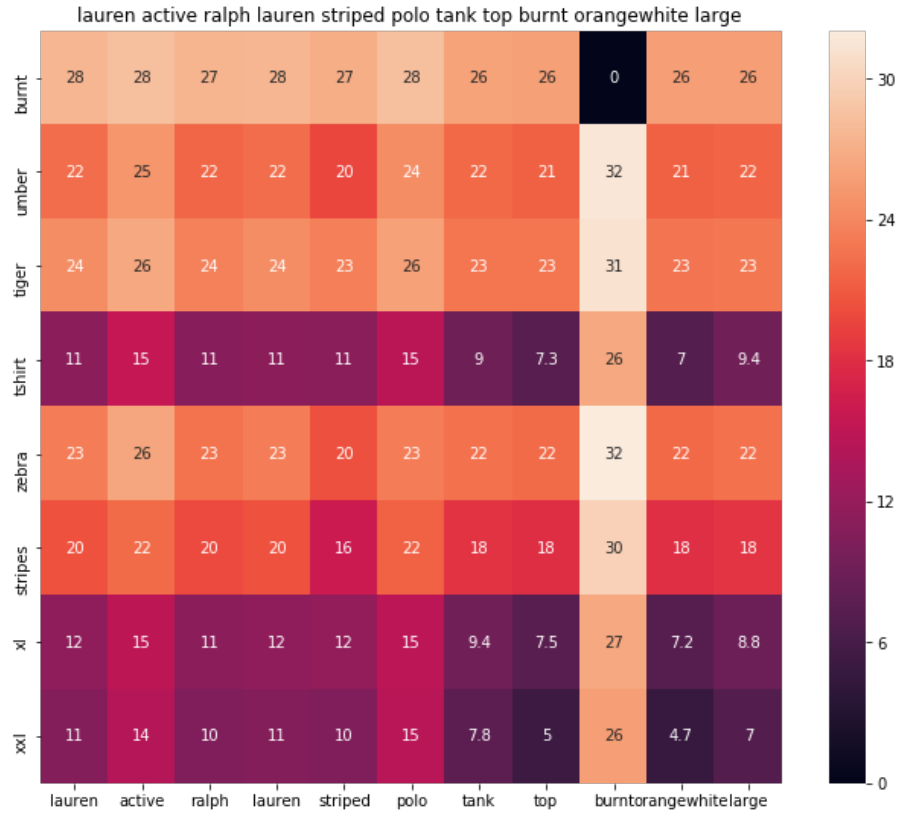
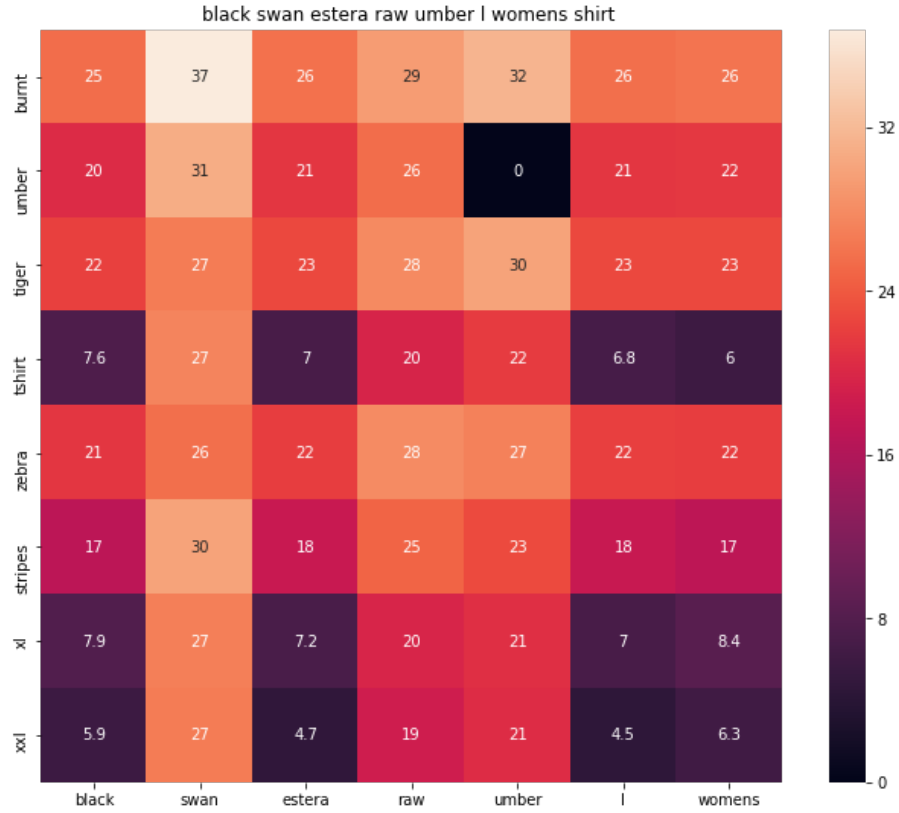
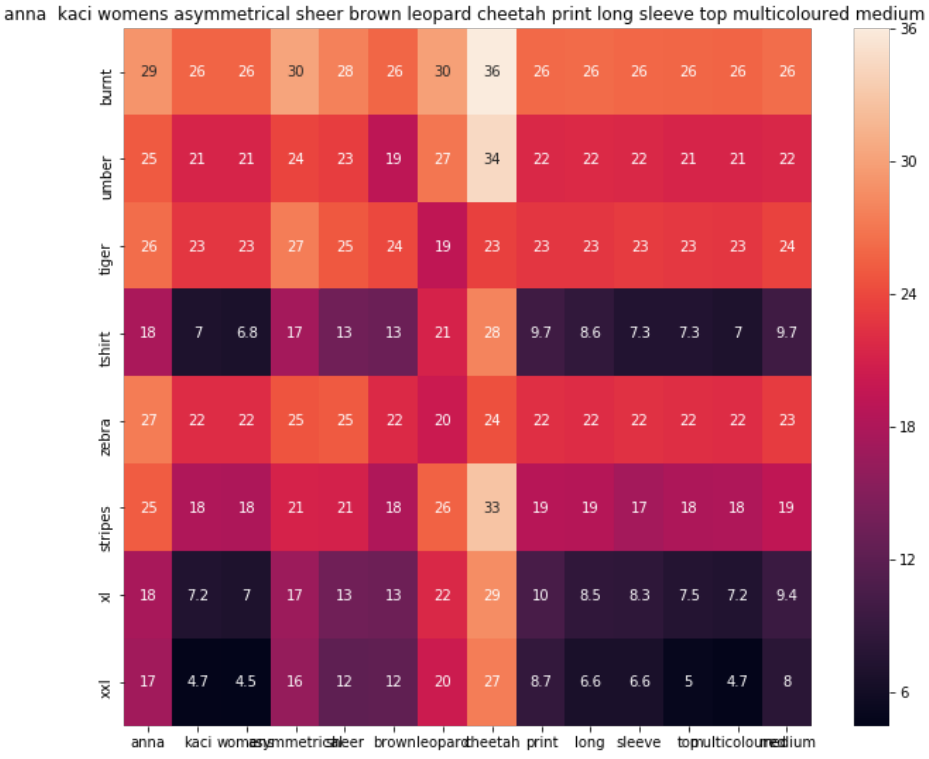


ASIN : B00ILGH5OY
Brand : Ralph Lauren Active
euclidean distance from input : 6.6839046
==========



ASIN : B06Y1VN8WQ
Brand : Black Swan
euclidean distance from input : 6.705763



ASIN : B00KSNTY7Y
Brand : Anna-Kaci
euclidean distance from input : 6.7061243

[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]

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()
```

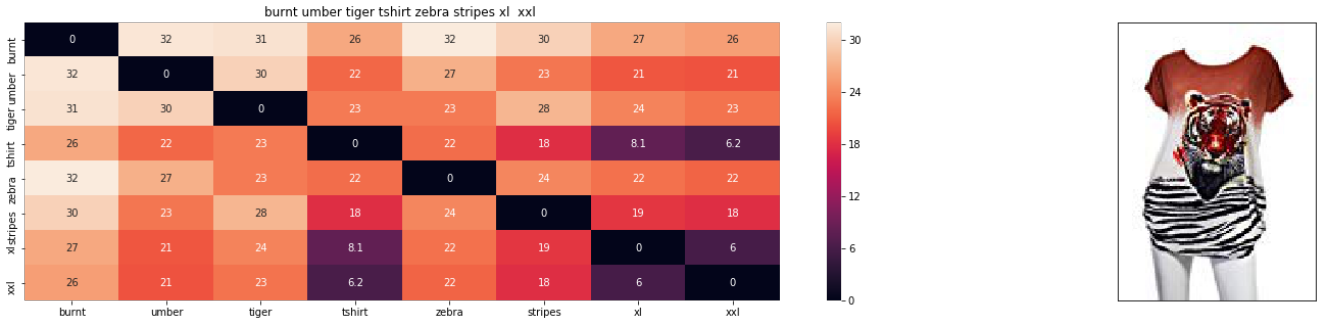
In [0]:

```
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 lengt
h 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 lengt
h 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
apparel's features
                [data['asin'].loc[df_id2],brands[doc_id2], colors[doc_id2], types[doc_id2]]] #
recommonded apparel's features

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

    # 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 [63]:

```
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])
    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[
'medium_image_url'].loc[df_indices[i]], indices[0], indices[i],df_indices[0], df_indices[i], 'weigh
ted')
        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)
# in the give heat map, each cell contains the euclidean distance between words i, j
```




```
ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.0
=============================================================================================================
```

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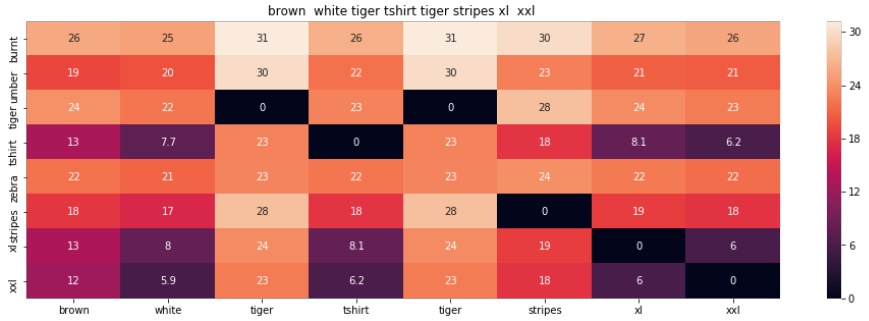

ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 2.3854705810546877

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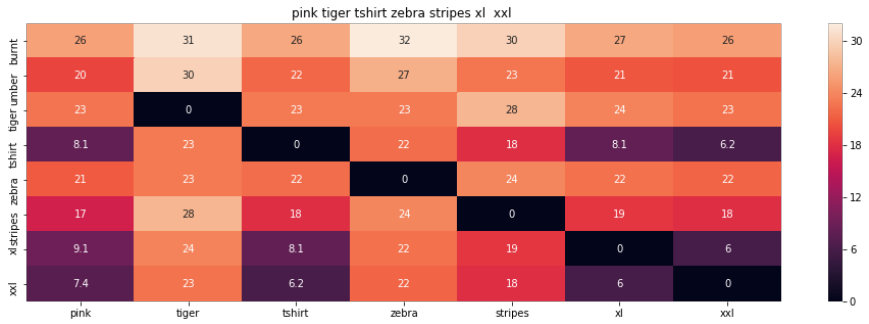

ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 2.739050102414575

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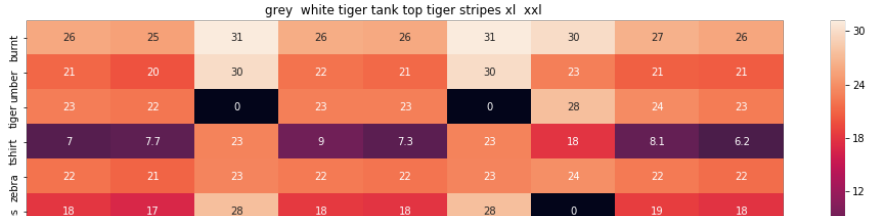

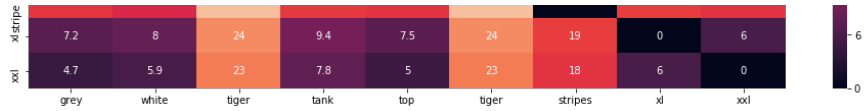

ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 3.387187004270044

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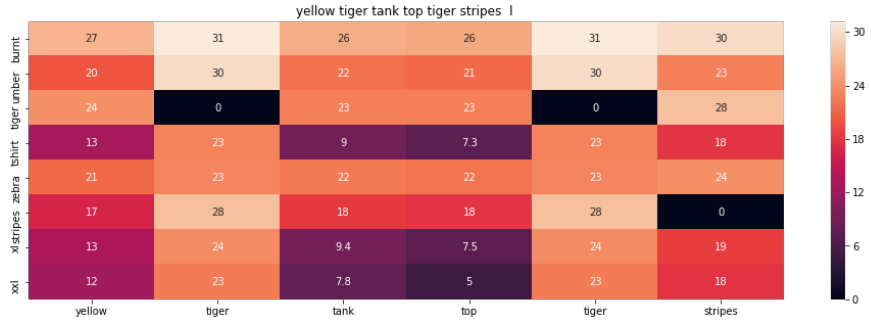
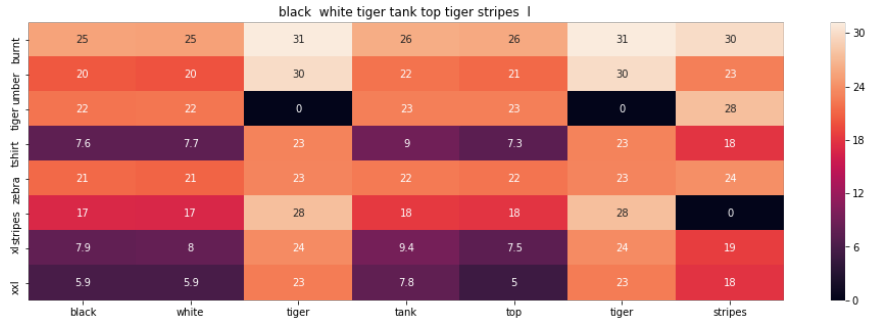


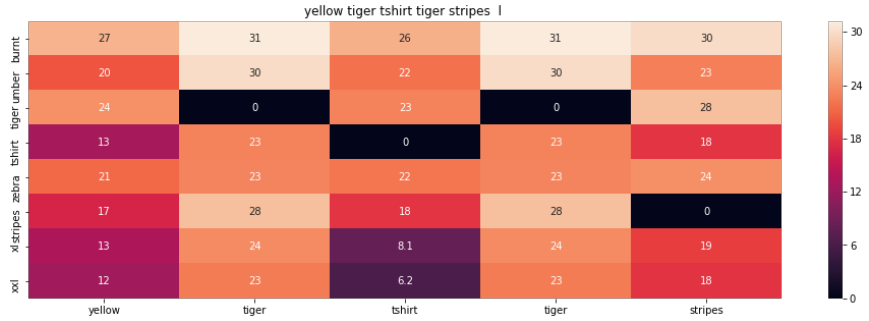
ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 3.5518680574316646

==========



ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 3.5536170961279536

==========



ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 3.6538278581518795

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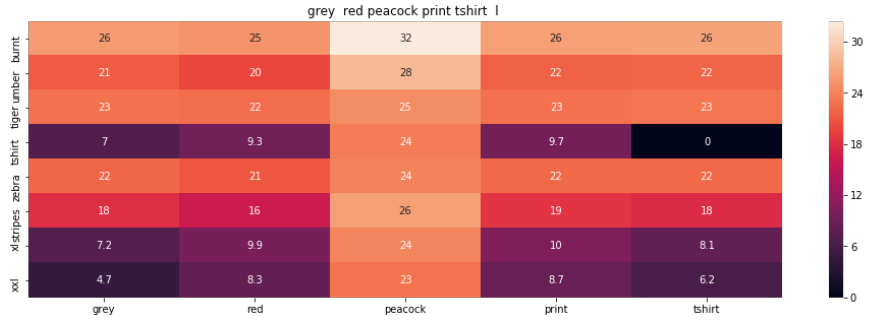

ASIN : B00JXQCFRS
Brand : Si Row
euclidean distance from input : 4.128811264218774

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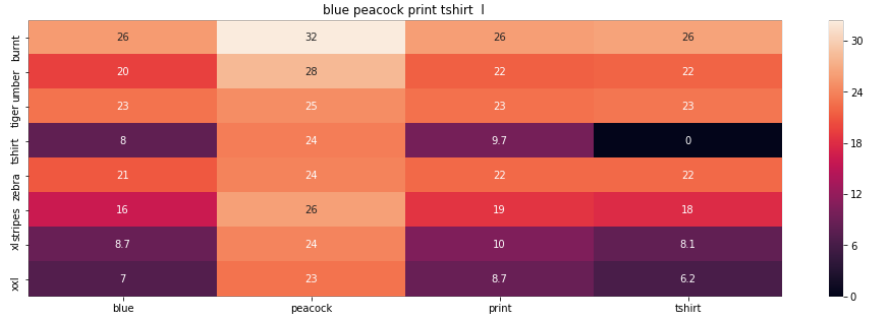
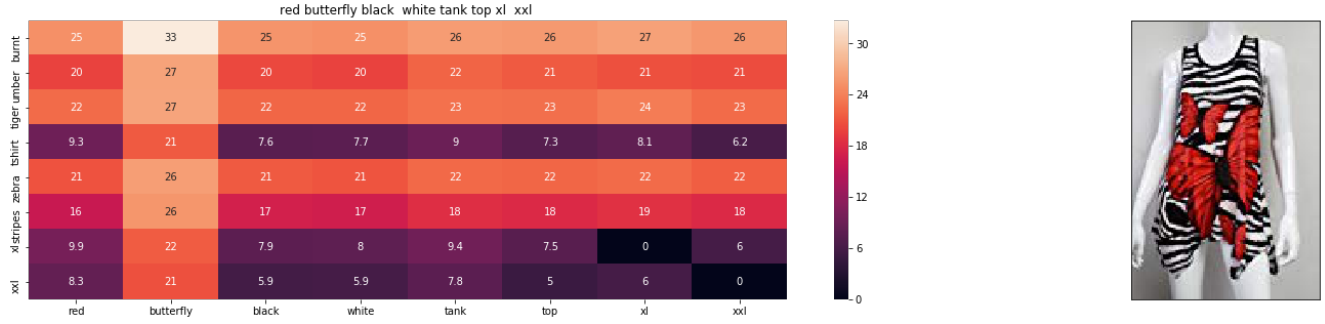
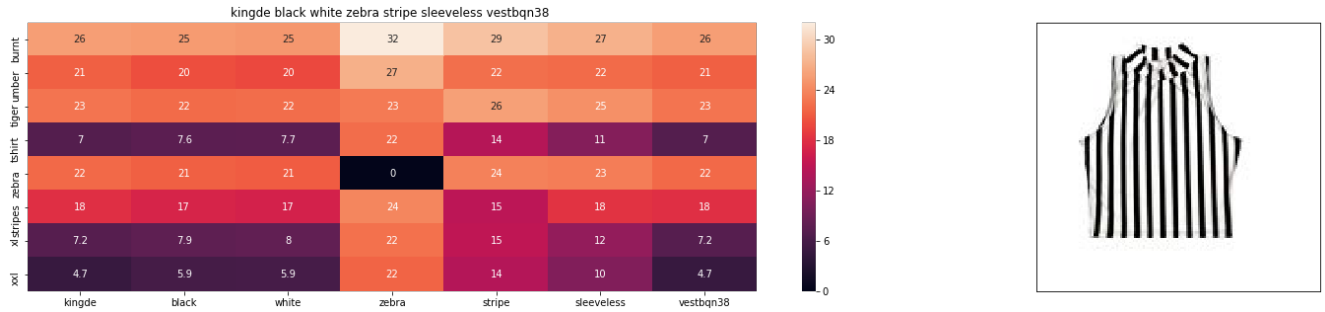


ASIN : B00JXQC8L6
Brand : Si Row
euclidean distance from input : 4.203900146665063

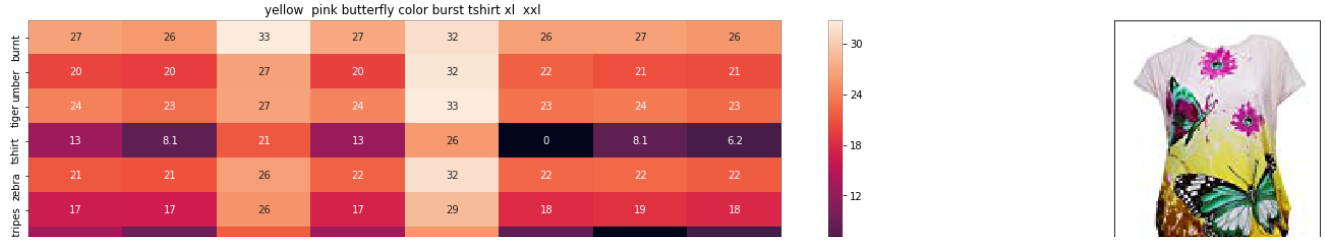
==========

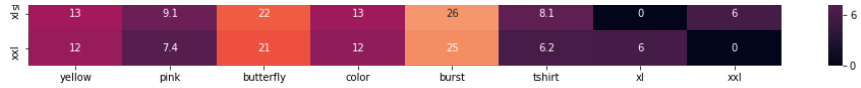


ASIN : B00JV63CW2
Brand : Si Row
euclidean distance from input : 4.286586380185571



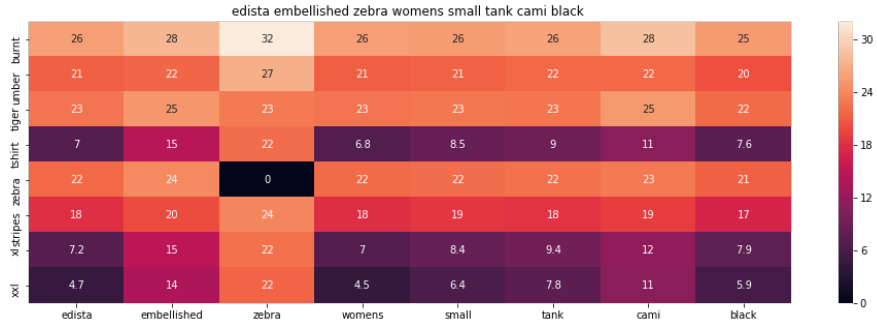
ASIN : B015H41F6G
Brand : KINGDE
euclidean distance from input : 4.389370406508858



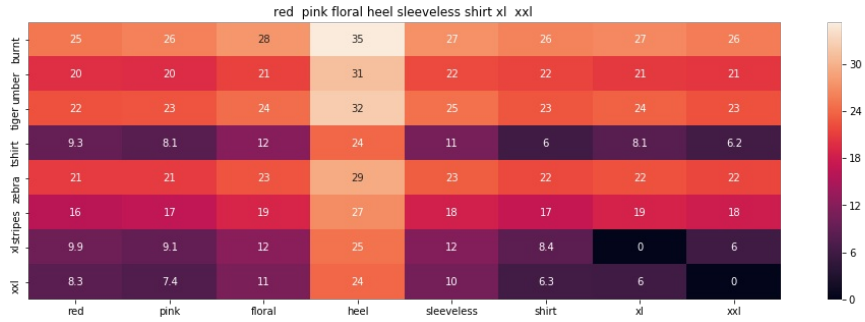


ASIN : B00JXQBBMI
Brand : Si Row
euclidean distance from input : 4.397909927548852

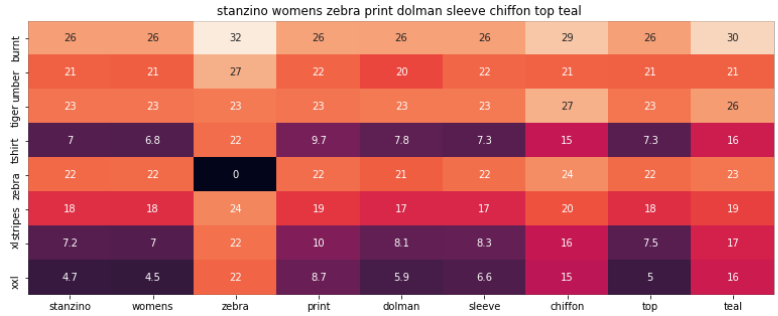
ASIN : B073R5Q8HD
Brand : Colosseum
euclidean distance from input : 4.451228392959053



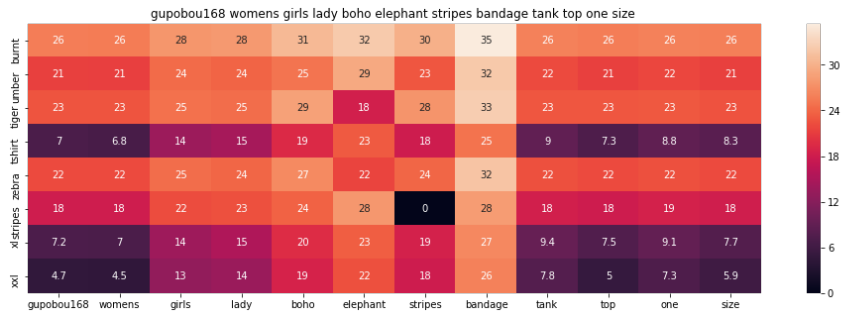
ASIN : B074P8MD22
Brand : Edista
euclidean distance from input : 4.518977416396553



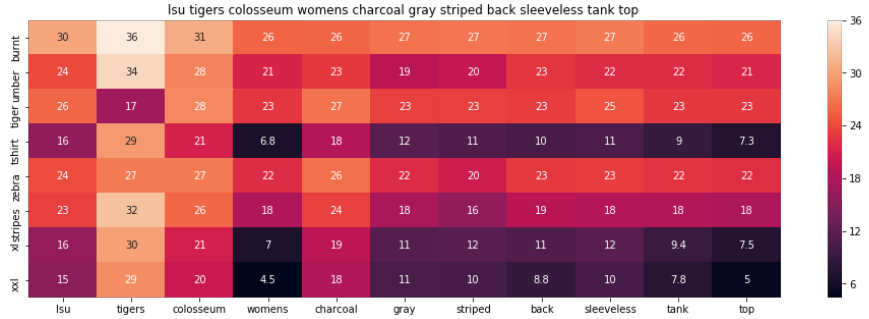
ASIN : B00JV63QQE
Brand : Si Row
euclidean distance from input : 4.529374695004907
==========



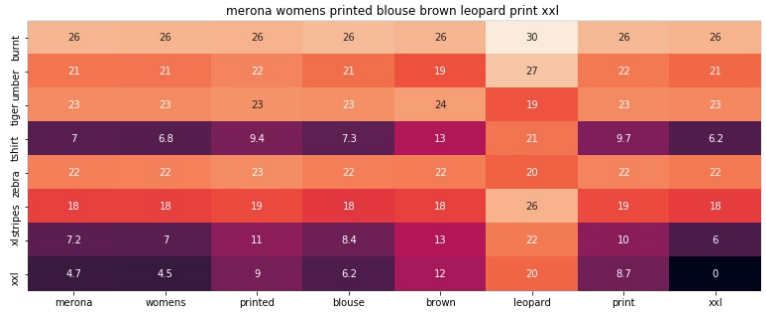
ASIN : B00C0I3U3E
Brand : Stanzino
euclidean distance from input : 4.530325759292061
==========



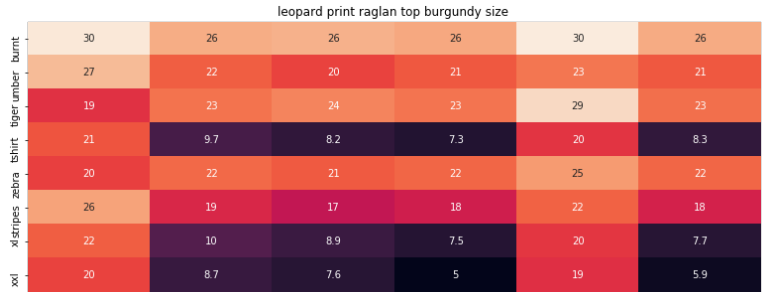
ASIN : B01ER184O6
Brand : GuPoBoU168
euclidean distance from input : 4.546816642558488
==========

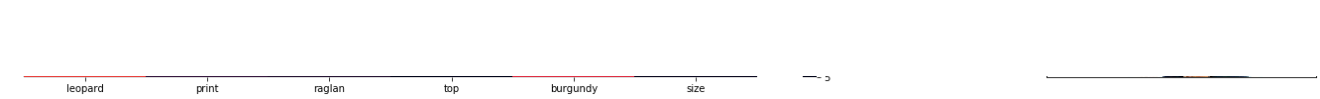


ASIN : B073R4ZM7Y
Brand : Colosseum
euclidean distance from input : 4.548355162978584
==========



ASIN : B071YF3WDD
Brand : Merona
euclidean distance from input : 4.610626662612374
==========

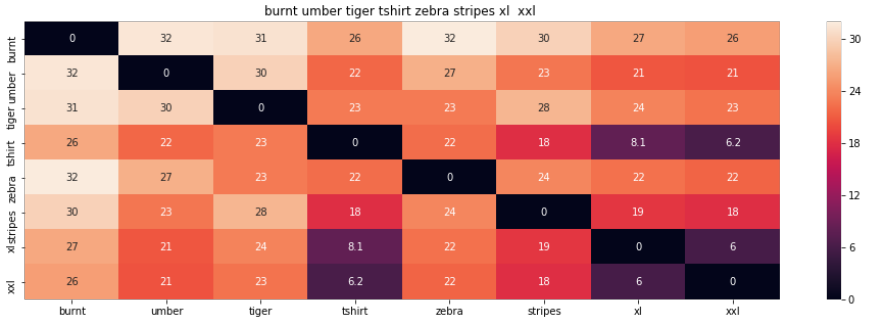




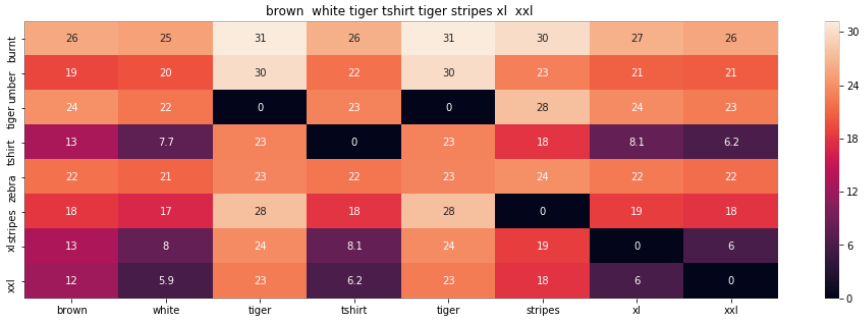
ASIN : B01C6ORLDQ
Brand : 1 Mad Fit
euclidean distance from input : 4.645917892817431
==========

In [64]:

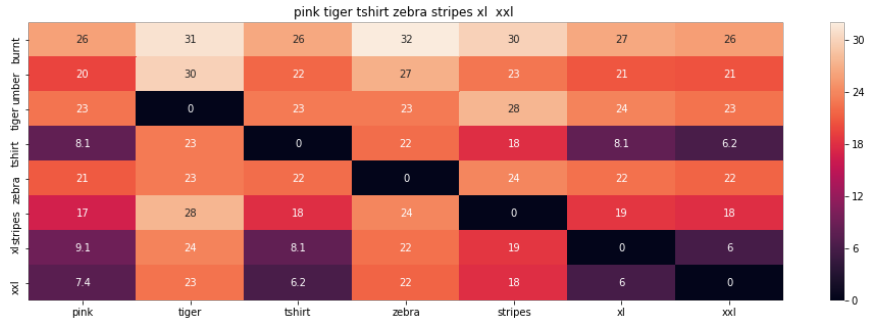
```
# brand and color weight =50
# title vector weight = 5

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



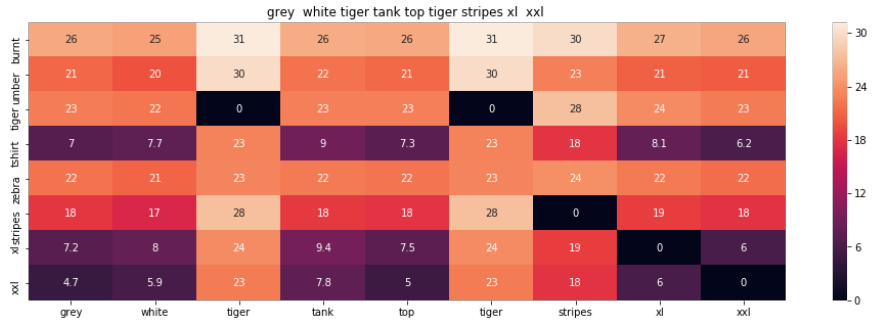
ASIN : B00JXQB5FQ
Brand : Si Row
euclidean distance from input : 0.0
==========



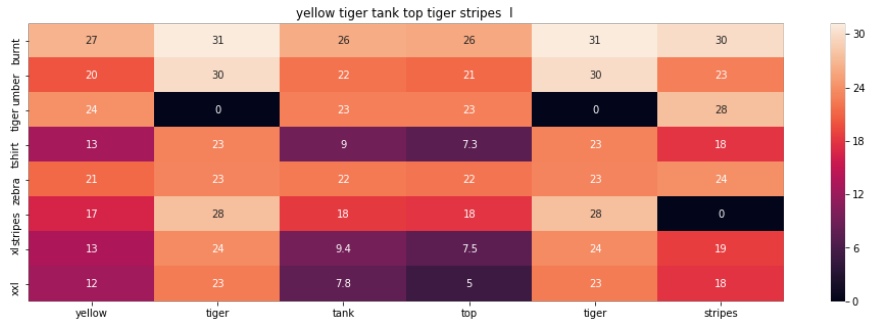
ASIN : B00JXQCWTO
Brand : Si Row
euclidean distance from input : 0.433721923828125
==========



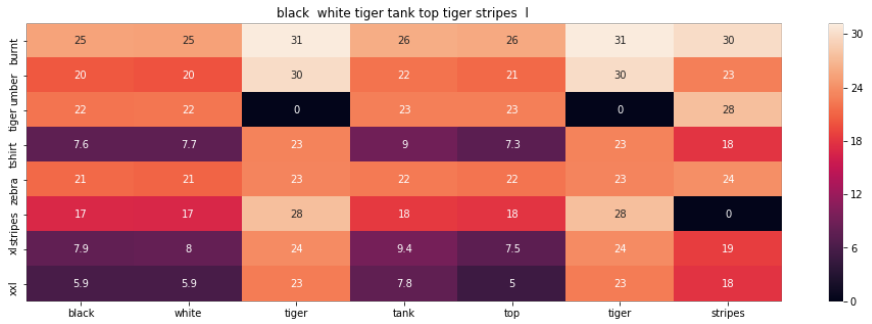
ASIN : B00JXQASS6
Brand : Si Row
euclidean distance from input : 1.6550929332897277



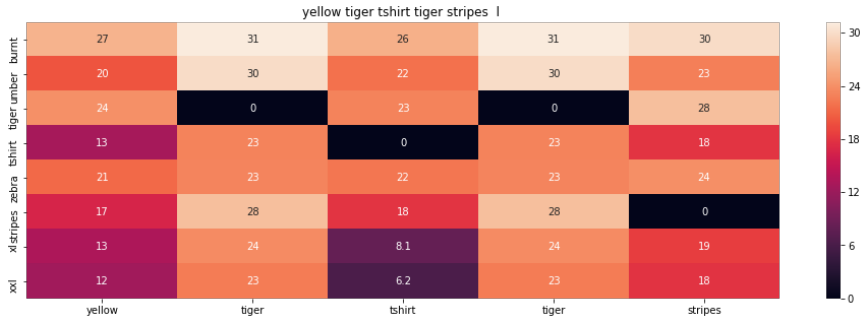
ASIN : B00JXQAFZ2
Brand : Si Row
euclidean distance from input : 1.7729360063543584



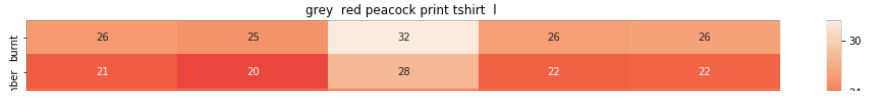
ASIN : B00JXQAUWA
Brand : Si Row
euclidean distance from input : 1.8028780160201077



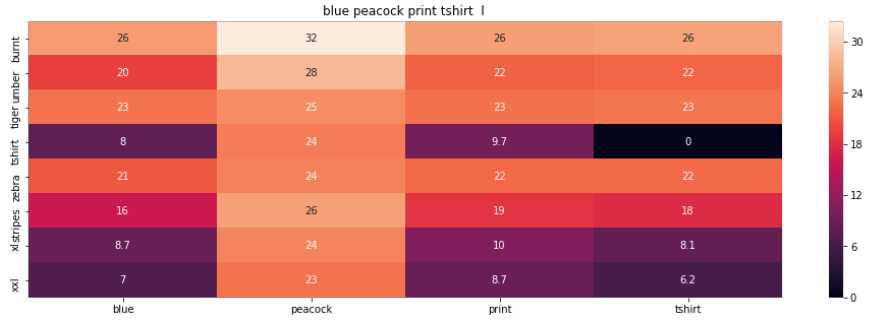
ASIN : B00JXQAO94
Brand : Si Row
euclidean distance from input : 1.8031960230557966



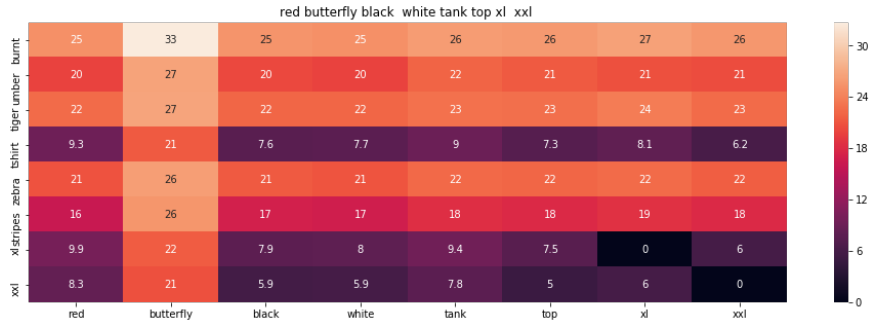
ASIN : B00JXQCUIC
Brand : Si Row
euclidean distance from input : 1.8214161616056013



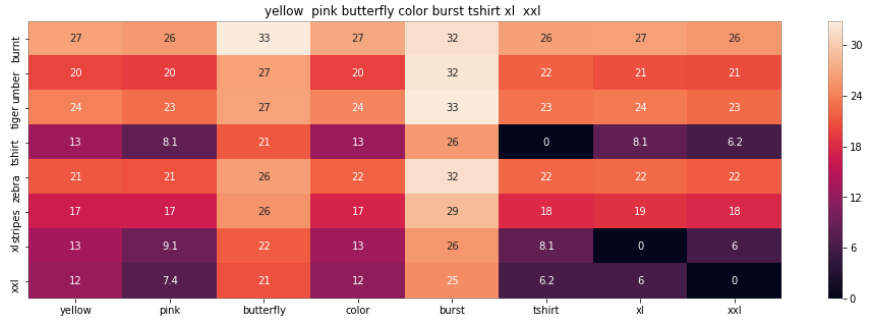
ASIN : B00JXQCFRS
Brand : Si Row
euclidean distance from input : 1.9077767808904913
==========



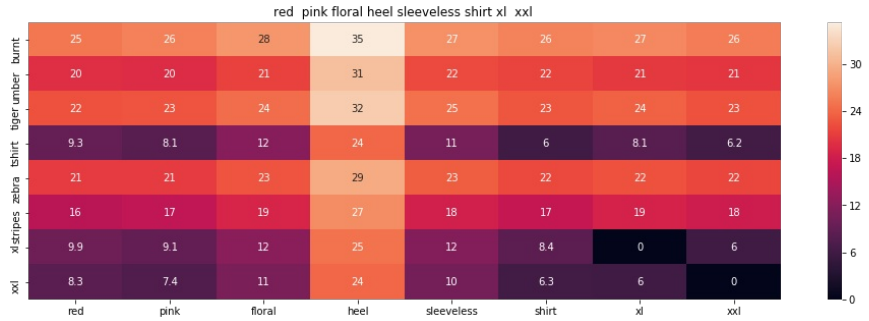
ASIN : B00JXQC8L6
Brand : Si Row
euclidean distance from input : 1.9214293049716347
==========



ASIN : B00JV63CW2
Brand : Si Row
euclidean distance from input : 1.936463165611727
==========

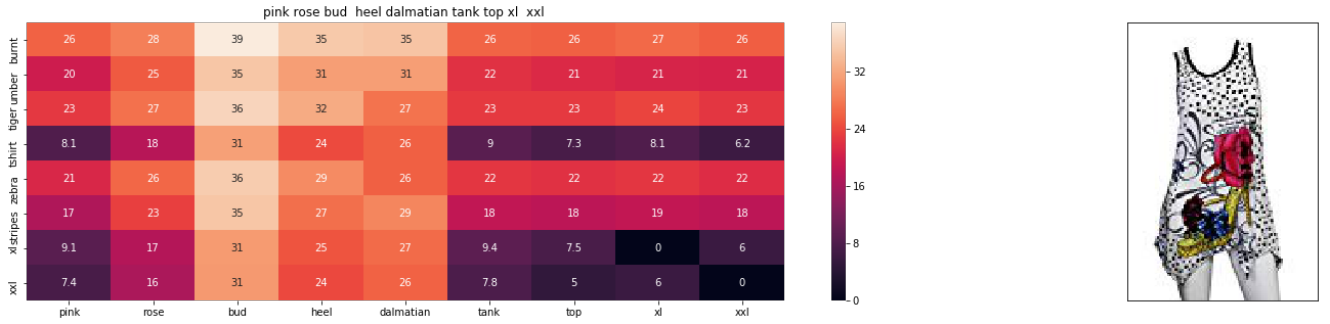


ASIN : B00JXQBBMI
Brand : Si Row
euclidean distance from input : 1.956703810586869

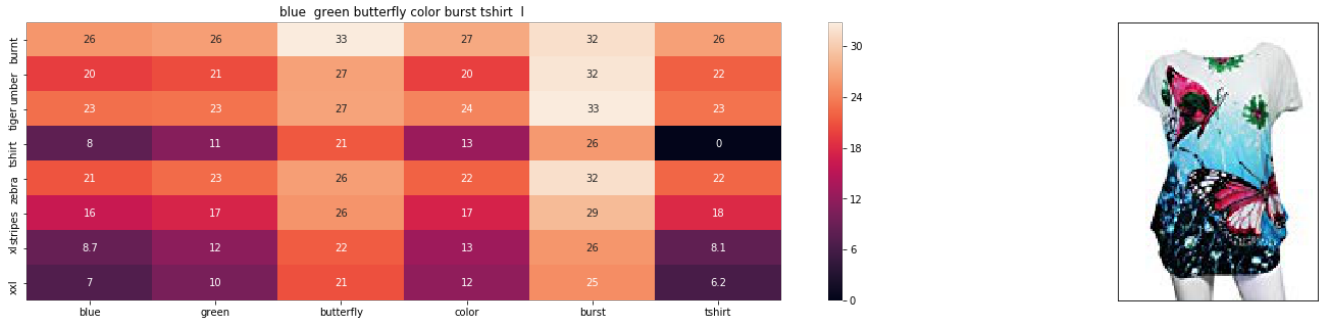


ASIN : B00JV63QQE
Brand : Si Row
euclidean distance from input : 1.9806064955788791

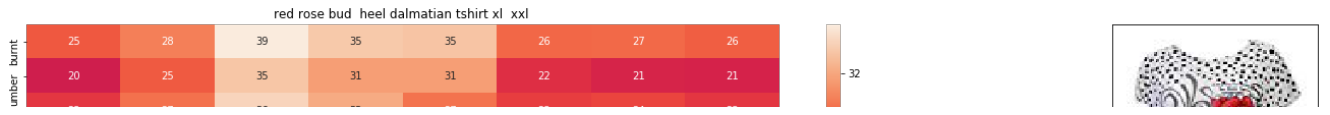
ASIN : B00JV63VC8
Brand : Si Row
euclidean distance from input : 2.012185530557572
==========
==========

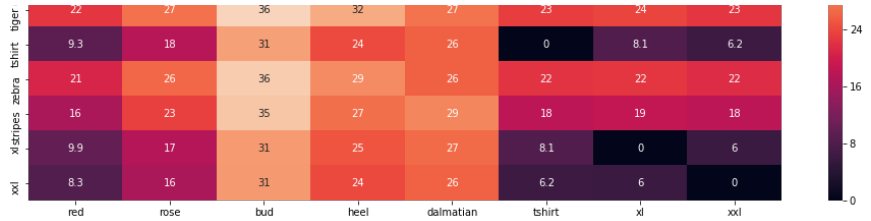


ASIN : B00JXQAX2C
Brand : Si Row
euclidean distance from input : 2.01335171819074
==========
==========

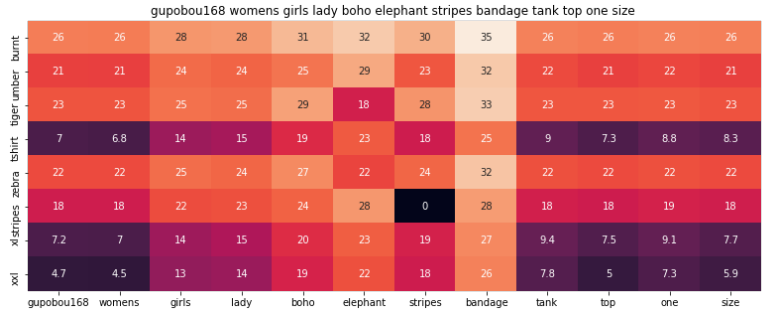


ASIN : B00JXQC0C8
Brand : Si Row
euclidean distance from input : 2.0138832789151717
==========
==========

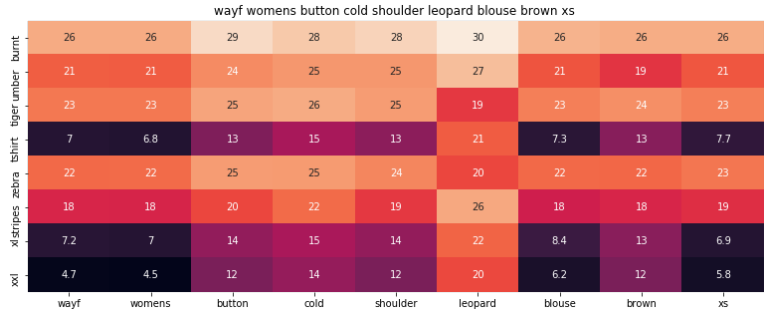




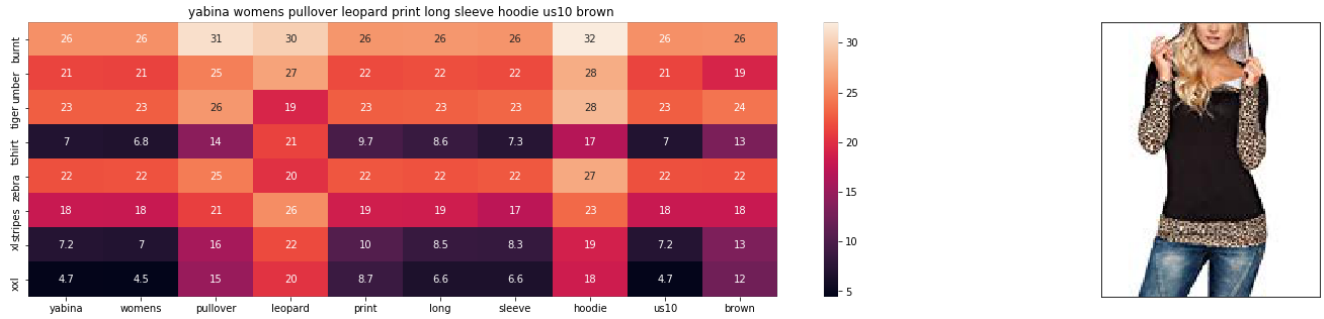
ASIN : B00JXQABB0
Brand : Si Row
euclidean distance from input : 2.0367257554998663



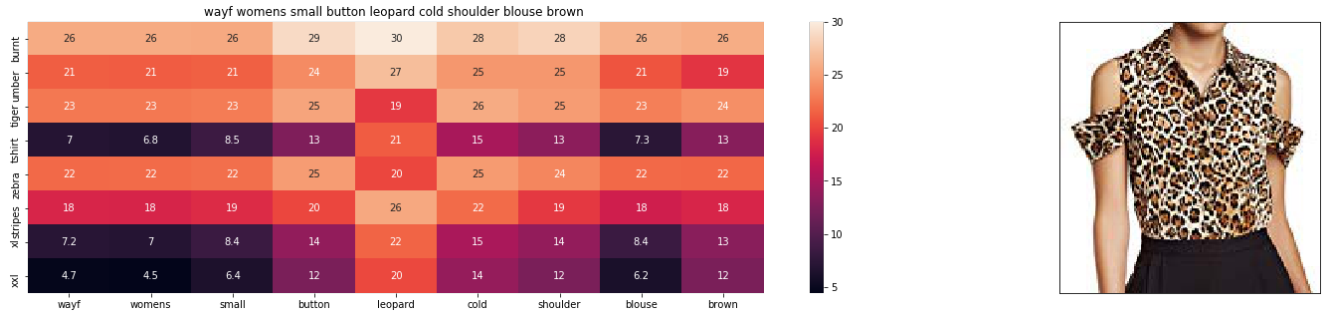
ASIN : B01ER184O6
Brand : GuPoBoU168
euclidean distance from input : 2.656204098419553



ASIN : B01LZ7BQ4H
Brand : WAYF
euclidean distance from input : 2.6849067129437008



ASIN : B01KJUM6JI
Brand : YABINA
euclidean distance from input : 2.6858381232997024
==========



ASIN : B01M06V4X1
Brand : WAYF
euclidean distance from input : 2.694761948650377
==========

[10.2] Keras and Tensorflow to extract features

In [65]:

```
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 [66]:

```
# 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()

'''
```

Out[66]:

```
"\n# dimensions of our images.\nimg_width, img_height = 224, 224\n\ntop_model_weights_path = 'bott
leneck_fc_model.h5'\ntrain_data_dir = 'images2/'\nnb_train_samples = 16042\nepochs =
50\nbatch_size = 1\n\n\ndef save_bottlebeck_features():\n    \n    #Function to compute VGG-16 CNN
for image feature extraction.\n    \n    asins = []\n    datagen = ImageDataGenerator(rescale=1. /
255)\n    \n    # build the VGG16 network\n    model = applications.VGG16(include_top=False, weight
s='imagenet')\n    generator = datagen.flow_from_directory(\n        train_data_dir,\n        targe
t_size=(img_width, img_height),\n        batch_size=batch_size,\n        class_mode=None,\n
shuffle=False)\n\n    for i in generator.filenames:\n        asins.append(i[2:-5])\n\n    bottlenec
k_features_train = model.predict_generator(generator, nb_train_samples // batch_size)\n
bottleneck_features_train = bottleneck_features_train.reshape((16042,25088))\n    \n
np.save(open('16k_data_cnn_features.npy', 'wb'), bottleneck_features_train)\n
np.save(open('16k_data_cnn_feature_asins.npy', 'wb'), np.array(asins))\n
\n\nsave_bottlebeck_features()\n\n"
```

[10.3] Visual features based product similarity.

In [67]:

```
#load the features and corresponding ASINS info.
bottleneck_features_train = np.load('gdrive/My
Drive/Applied_AI_Workshop_Code_Data/16k_data_cnn_features.npy')
asins = np.load('gdrive/My Drive/Applied_AI_Workshop_Code_Data/16k_data_cnn_feature_asins.npy')
asins = list(asins)

# load the original 16K dataset
data = pd.read_pickle('gdrive/My
Drive/Applied_AI_Workshop_Code_Data/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)
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]
.reshape(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(50, 20)
```

```
Product Title:  love fire womens textured knit short sleeve crop top juniors l white
Euclidean Distance from input image: 6.32596e-06
Amazon Url: www.amzon.com/dp/B01092E6XK
```

```
Product Title:  maison jules tiered scalloptrim tank top snow white small
Euclidean Distance from input image: 39.571304
Amazon Url: www.amzon.com/dp/B01LOOYQ8C
```

Product Title: bella dahl womens sleeveless seamed shirt white water size
Euclidean Distance from input image: 39.88145
Amazon Url: www.amzon.com/dp/B01LOPJ8GQ

Product Title: faded glory womens short sleeve crew neck tshirt black xlarge
Euclidean Distance from input image: 41.77116
Amazon Url: www.amzon.com/dp/B06XHHTDRX

Product Title: eileen fisher womens petites silk printed buttondown top pp whiteblack
Euclidean Distance from input image: 43.08961
Amazon Url: www.amzon.com/dp/B01KXW0A9U

Product Title: vero moda womens chiffon faux wrap sleeveless blouse shirt black size small
Euclidean Distance from input image: 43.112137
Amazon Url: www.amzon.com/dp/B0719JZ1N3

Product Title: cooper ella womens lace inset short sleeves blouse ivory size xsmall
Euclidean Distance from input image: 43.137527
Amazon Url: www.amzon.com/dp/B07144GTFJ

Product Title: vintage havana womens lace trim hilow tank top medium royal
Euclidean Distance from input image: 43.280495
Amazon Url: www.amzon.com/dp/B01N23RZ12

Product Title: cooper ella ls lucy cut blouse white
Euclidean Distance from input image: 43.49595
Amazon Url: www.amzon.com/dp/B00U5YWUB8

Product Title: max mara womens geo striped jersey tank sz medium black white
Euclidean Distance from input image: 43.738113
Amazon Url: www.amzon.com/dp/B0749RK9BF

Product Title: mountain mamas essential tunic white cloud lxl
Euclidean Distance from input image: 43.851948
Amazon Url: www.amzon.com/dp/B074JH8R1Q

Product Title: trina turk womens deming silkblend top
Euclidean Distance from input image: 43.967823
Amazon Url: www.amzon.com/dp/B074TF25Q3

Product Title: rag bone womens jean tunic shirt xxs white
Euclidean Distance from input image: 43.971992
Amazon Url: www.amzon.com/dp/B06XCSHG55

Product Title: laundry womens high low abstract print pleat neck blouse 023 pink 2
Euclidean Distance from input image: 44.00368
Amazon Url: www.amzon.com/dp/B01E77AKBK

Product Title: escada sport womens silk blouse 36 white
Euclidean Distance from input image: 44.077824
Amazon Url: www.amzon.com/dp/B06XCJ1FNR

Product Title: danskin womens active short sleeve performance mesh tshirt greystone
Euclidean Distance from input image: 44.125286
Amazon Url: www.amzon.com/dp/B06XC7BBWX

Product Title: fox womens dust storm ss top heather grey tshirt lg
Euclidean Distance from input image: 44.131817
Amazon Url: www.amzon.com/dp/B00D5NFKPY

```
Product Title:  benjamin jay womens slider cross front tank black size small
Euclidean Distance from input image: 44.165924
Amazon Url: www.amzon.com/dp/B071NBCMLT
```

```
Product Title:  injiri womens long sleeve silk blouse white extra small
Euclidean Distance from input image: 44.23283
Amazon Url: www.amzon.com/dp/B073BMC2KY
```

```
Product Title:  one clothing juniors thermalknit highlow tunic top size xl
Euclidean Distance from input image: 44.23853
Amazon Url: www.amzon.com/dp/B06XNQ49FN
```

Assingment

In [0]:

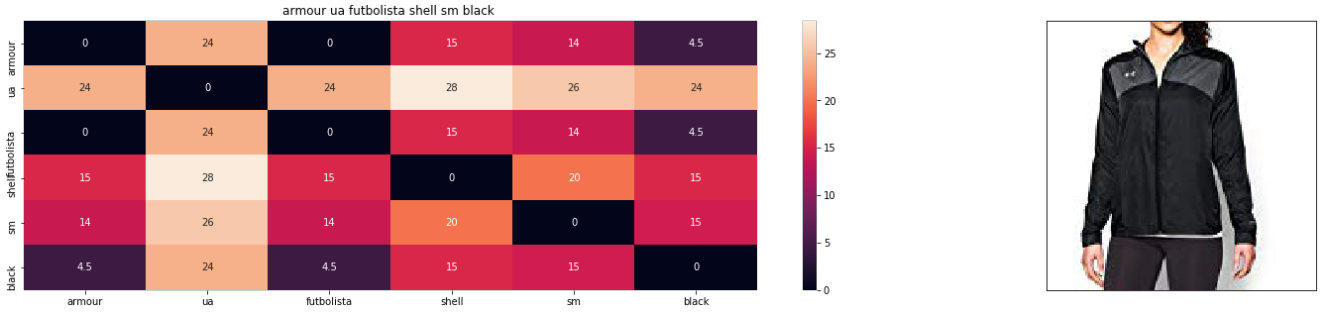
```
#we need to call below library becasue we imported ipython image  library which has no attribute i
mage open that access is avaailable in pil library
from PIL import Image

def text_and_img_similarity(doc_id, wei_1, wei_2, wei_3, num_results):
    doc_id = asins.index(df_asins[doc_id])
    #below is  text idf features
    idf_w2v_dist  = pairwise_distances(w2v_title_weight, w2v_title_weight[doc_id].reshape(1,-1))
    #below is  brand and color features
    ex_feat_dist = pairwise_distances(extra_features, extra_features[doc_id])
    #below is cnn features i.e, image vectors
    img_feat_dist = pairwise_distances(bottleneck_features_train, bottleneck_features_train[doc_id]
.reshape(1,-1))
    #here we computing weighted vectors for text and brand and color and image features
    pairwise_dist   = (wei_1 * idf_w2v_dist +  wei_2 * ex_feat_dist + wei_3 * img_feat_dist)/float(
wei_1 + wei_2 + wei_3)


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

    df_indices = list(data.index[indices])


    for i in range(len(indices)):
        rows = data[['medium_image_url','title']].loc[data['asin']==asins[indices[i]]]
        heat_map_w2v_brand(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], 'weigh
ted')
        for indx, row in rows.iterrows():
            print('ASIN :',data['asin'].loc[df_indices[i]])
            print('Brand :',data['brand'].loc[df_indices[i]])
            print('Product Title: ', row['title'])
```

```
            print('Euclidean Distance from input image:', pdists[i])
            print('Amazon Url: www.amzon.com/dp/'+ asins[indices[i]])
```

Here we try with first giving more weight to title we see by giving more weight to title can we get similar titles or not ,we seeing top 10 results

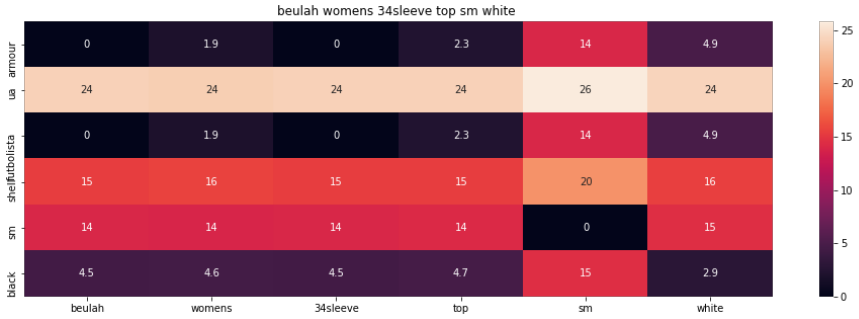
In [131]:

```
#giving more weight to title feature
text_and_img_similarity(931, 50,1,1,10)
```

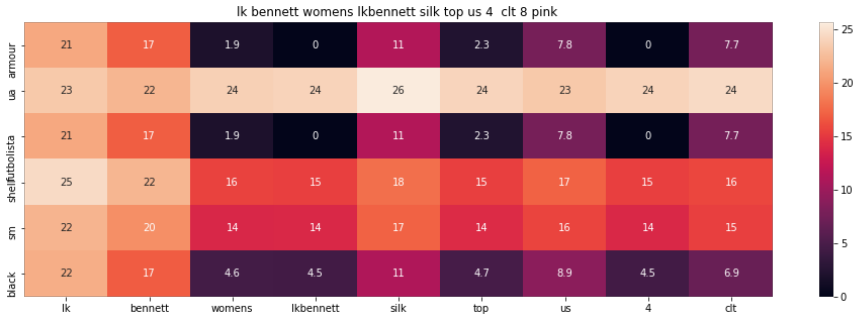


ASIN : B0185VYVR8
Brand : UNDER ARMOUR > UA Tops
Product Title: annakaci sm fit blue green polka dot tie front ruffle trim blouse
Euclidean Distance from input image: 1.2165307557902102e-07
Amazon Url: www.amzon.com/dp/B00KLHUIBS

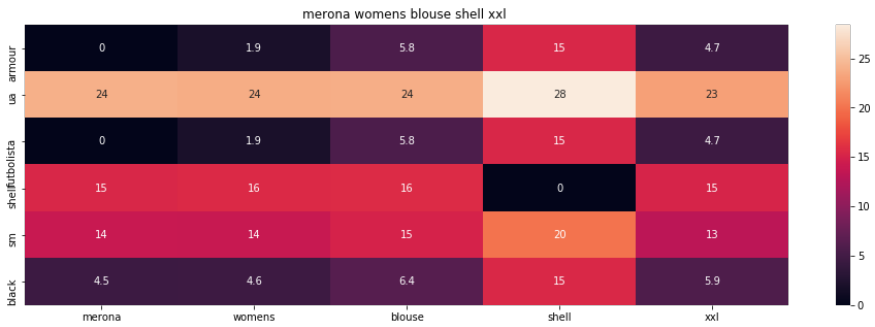
ASIN : B00W873FDC
Brand : Protokolo
Product Title: bar iii womens knit peplum blouse green xs
Euclidean Distance from input image: 5.772421176616962
Amazon Url: www.amzon.com/dp/B01AND54VS



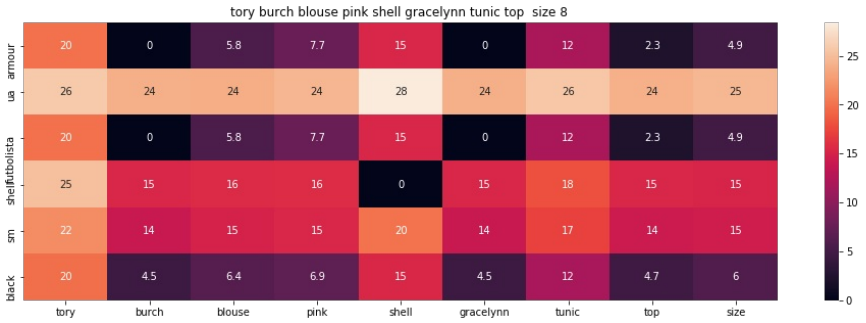
ASIN : B01MZ5CBH4
Brand : Beulah
Product Title: greenice womens boat neck slim fit half sleeve long shirt shapewear dress 6pack
Euclidean Distance from input image: 5.781677759610689
Amazon Url: www.amzon.com/dp/B01LYRC9GO



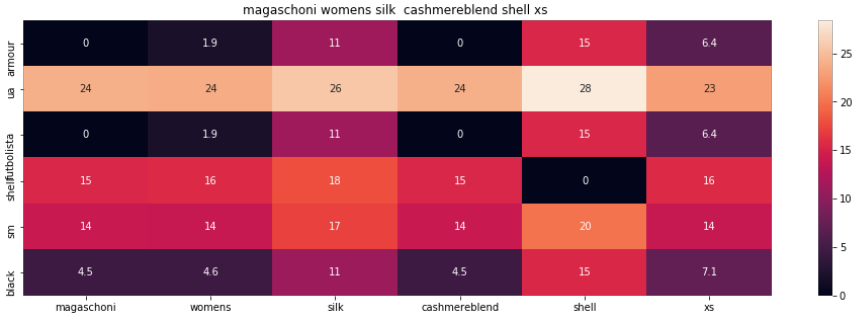
ASIN : B072VH217H
Brand : L.K. Bennett
Product Title: officially licensed merchandise monopoly good hood girly tee red medium
Euclidean Distance from input image: 5.785941425833128
Amazon Url: www.amzon.com/dp/B0141GYOG4



ASIN : B06ZYH5VXR
Brand : Merona
Product Title: womens plain sleeveless stretch boob tube bodysuit bandeau leotard top
Euclidean Distance from input image: 5.812352620638334
Amazon Url: www.amzon.com/dp/B0721YCCH1



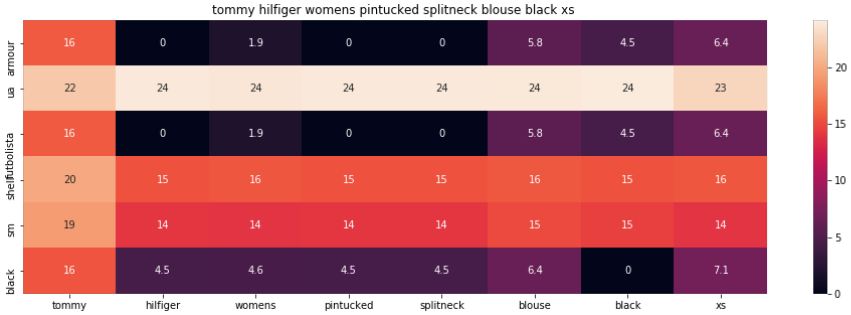
ASIN : B00IK50R64
Brand : Tory Burch
Product Title: halogen womens large vneck short sleeve tee tshirt pink l
Euclidean Distance from input image: 5.813228481662671
Amazon Url: www.amzon.com/dp/B0731D7HQN



ASIN : B06XQB1H99
Brand : Magaschoni
Product Title: autobotusa blk head lights awbumper signalled tail lamps red jy 20012006 yukon den ali
Euclidean Distance from input image: 5.890313001779409
Amazon Url: www.amzon.com/dp/B01I8UA31Y

ASIN : B073413HNY
Brand : Karen Scott
Product Title: olive oak frosty white blouse
Euclidean Distance from input image: 5.897649911733774
Amazon Url: www.amzon.com/dp/B01M0AGM75

ASIN : B074J5KW4M
Brand : Nanon
Product Title: 2016 tank crop tops daisy stripes print women
Euclidean Distance from input image: 5.90311902229215
Amazon Url: www.amzon.com/dp/B01EBYZC9E



ASIN : B0759NHBZK
Brand : Tommy Hilfiger
Product Title: disney faded mickey tee cream xsmall
Euclidean Distance from input image: 5.910331520681343
Amazon Url: www.amzon.com/dp/B075888FJJ

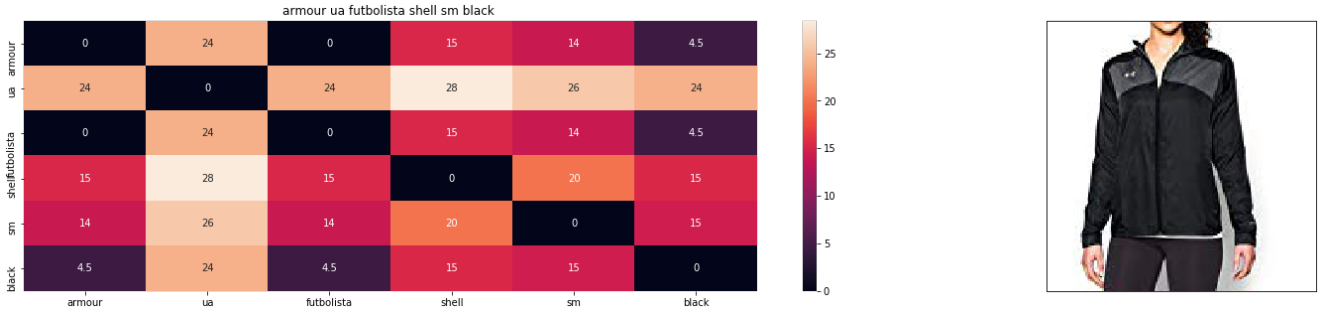
Here we observe the above results we got similar products based on product title's

Here we observe the above results we got similar products based on product title's

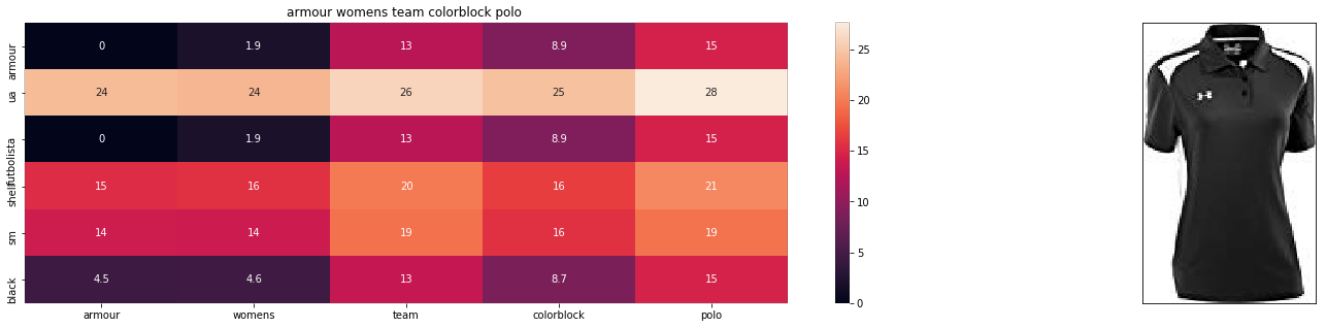
Here we try with giving more weight to brand and color and type we see by giving more weight to extra features can we get similar brands or colors or types or not ,we seeing top 10 results

In [132]:

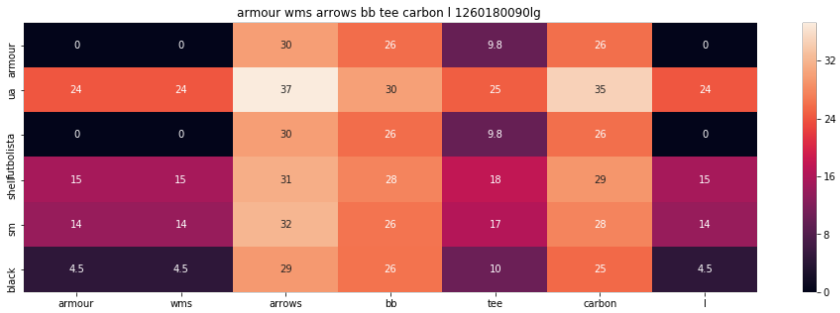
```
#giving more weight to extra feature i.e..., brand and color and type features
text_and_img_similarity(931,1,50,1,10)
```



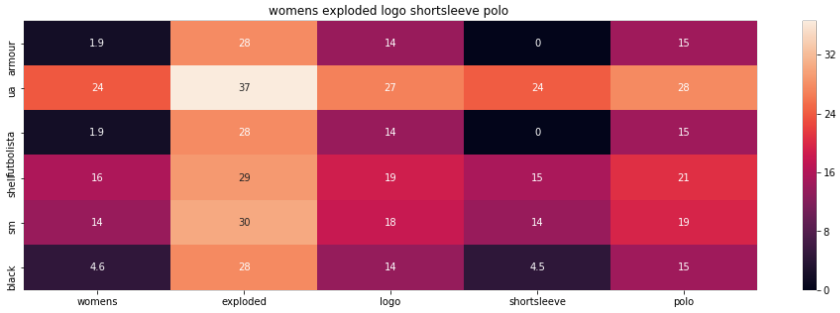
ASIN : B0185VYVR8
Brand : UNDER ARMOUR > UA Tops
Product Title: annakaci sm fit blue green polka dot tie front ruffle trim blouse
Euclidean Distance from input image: 1.2165307557902102e-07
Amazon Url: www.amzon.com/dp/B00KLHUIBS



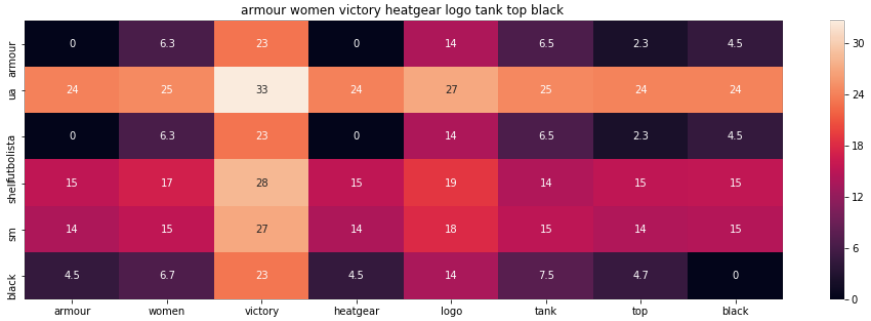
ASIN : B00DC3Y1M0
Brand : Under Armour
Product Title: cavalli womens white see long sleeve blouse top us 40
Euclidean Distance from input image: 2.982056523834139
Amazon Url: www.amzon.com/dp/B01FZTK0D2



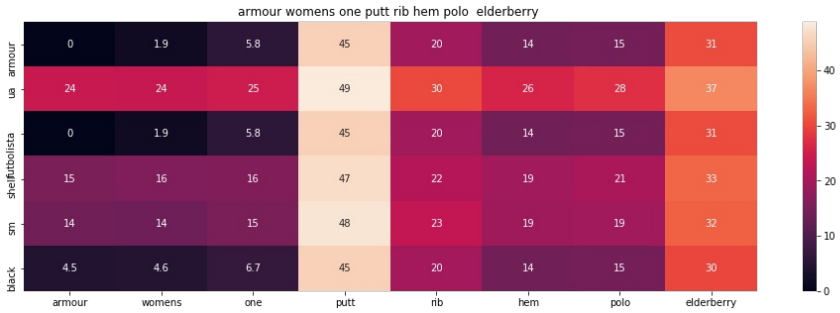
ASIN : B00RF3LQF8
Brand : Under Armour
Product Title: jordache womens sheer cap sleeve hilo knit top greengrey stripe large
Euclidean Distance from input image: 3.1477447197987485
Amazon Url: www.amzon.com/dp/B01KFMD48M



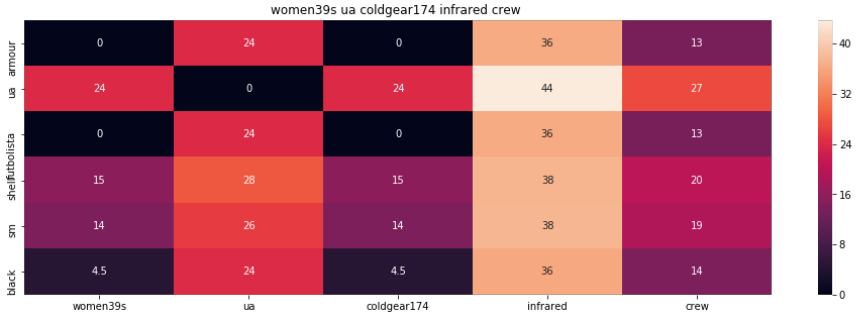
ASIN : B004KPUL78
Brand : Under Armour
Product Title: tqq popular girls ovo logo åæœ womens tank top black l
Euclidean Distance from input image: 3.171513850872333
Amazon Url: www.amzon.com/dp/B01J5HMDTO



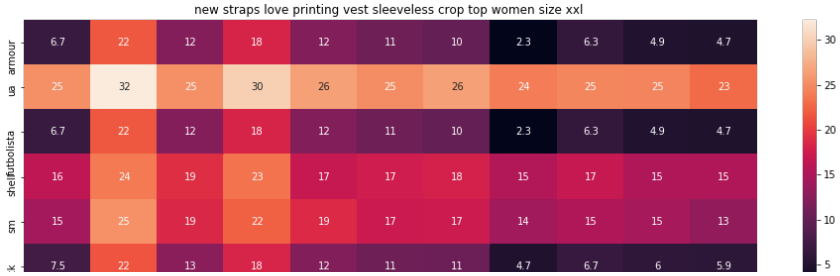
ASIN : B01E664Y2I
Brand : under armour
Product Title: flamingo long sleeve stripe casual top olive small
Euclidean Distance from input image: 3.1885043749442468
Amazon Url: www.amzon.com/dp/B017WSOVJS

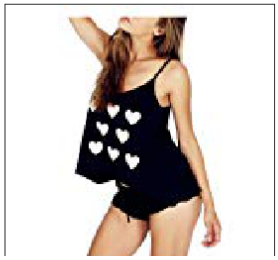


ASIN : B004LHD12M
Brand : Under Armour
Product Title: bky summer hot season chiffon blouse green bkyo1521
Euclidean Distance from input image: 3.1899090730226956
Amazon Url: www.amzon.com/dp/B00Z3U7EA6

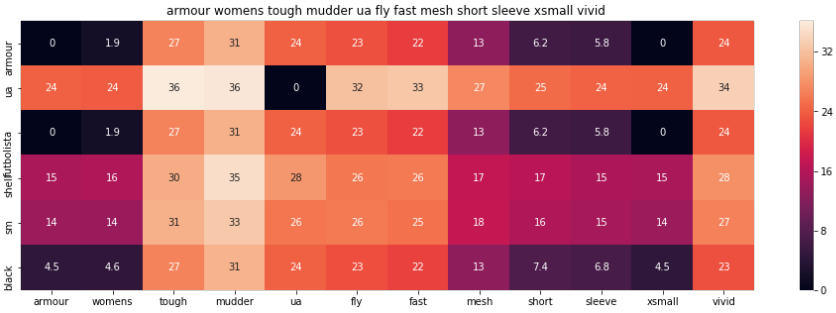


ASIN : B00GOAMWLU
Brand : Under Armour
Product Title: annakaci sm fit beige multicoloured peacock feathers design pullover top
Euclidean Distance from input image: 3.2077419574444113
Amazon Url: www.amzon.com/dp/B00PMQO3AA

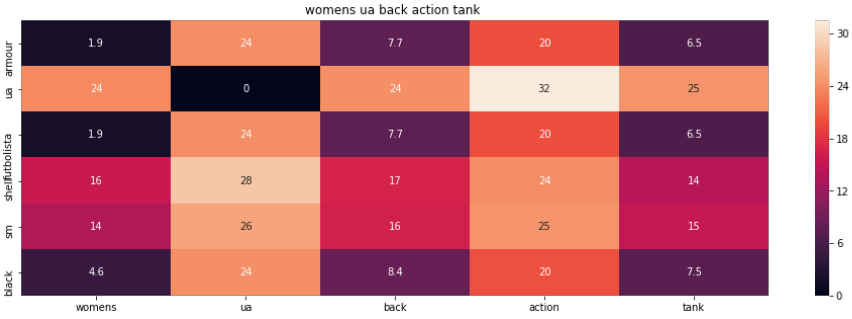




ASIN : B00KDW8B1A
Brand : namnoishop Crop Tops
Product Title: annakaci sm fit white sheer floral embroidered antique lace scallop hem top
Euclidean Distance from input image: 3.2235460149093953
Amazon Url: www.amzon.com/dp/B00L87YPVY



ASIN : B00UICIGQK
Brand : Under Armour
Product Title: vintage green loose blouse plus size bky12store3004
Euclidean Distance from input image: 3.2657964871479916
Amazon Url: www.amzon.com/dp/B014BNLKBE



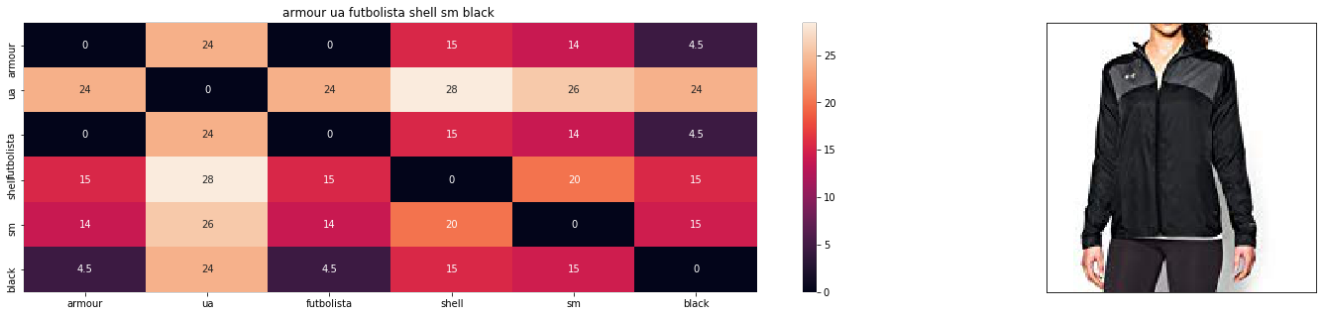
ASIN : B00HNKUCRG
Brand : Under Armour
Product Title: badger womens layered mesh ideal racerback jersey tank top largexlarge royalwhite
Euclidean Distance from input image: 3.2820982382847714
Amazon Url: www.amzon.com/dp/B01CCKHWAQ

Here we observe the above results we got same brand and almost same color products and some products are may be shape related similar products

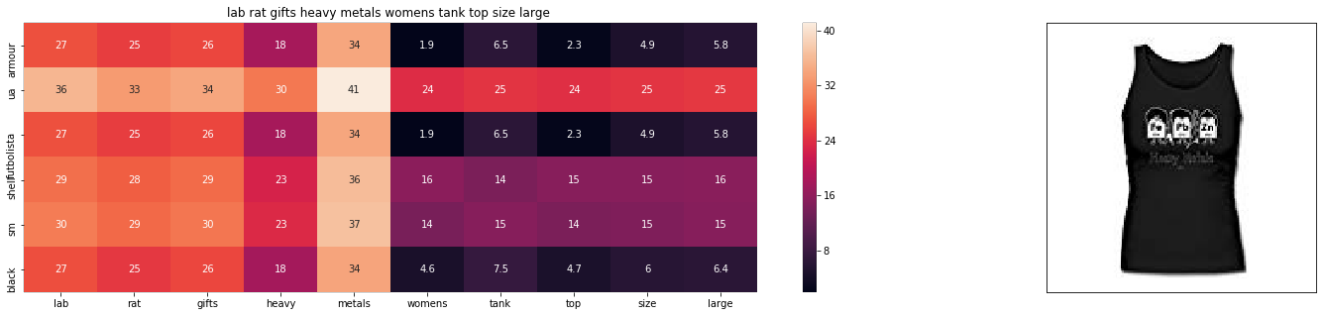
Here we try with giving more weight to image features i.e.., extra features we see by giving more weight to image features can we get similar images or not ,we seeing top 10 results

In [133]:

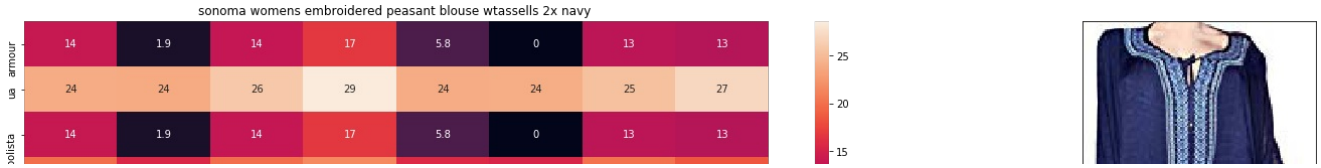
```
#giving more weight to img feature
text_and_img_similarity(931, 1,1,50,10)
```

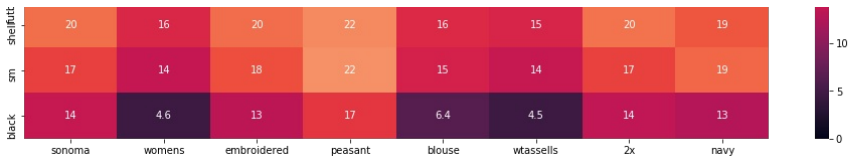


ASIN : B0185VYVR8
Brand : UNDER ARMOUR > UA Tops
Product Title: annakaci sm fit blue green polka dot tie front ruffle trim blouse
Euclidean Distance from input image: 6.082653551577376e-06
Amazon Url: www.amzon.com/dp/B00KLHUIBS

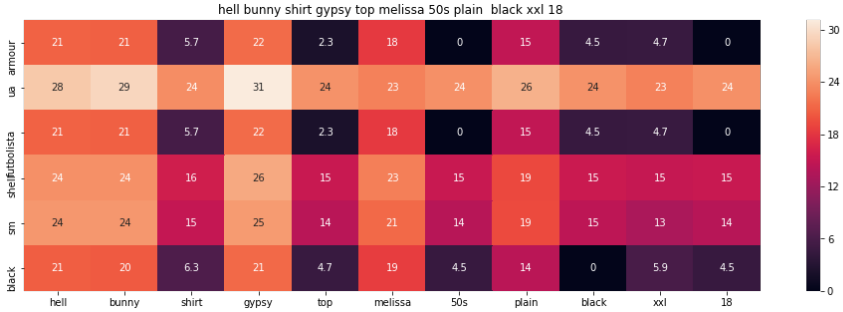


ASIN : B01N3PVWQN
Brand : Lab Rat Gifts
Product Title: eternal child womens black floral printed vneck short sleeve tunic sz new
Euclidean Distance from input image: 45.787285804748535
Amazon Url: www.amzon.com/dp/B0184RPZNM

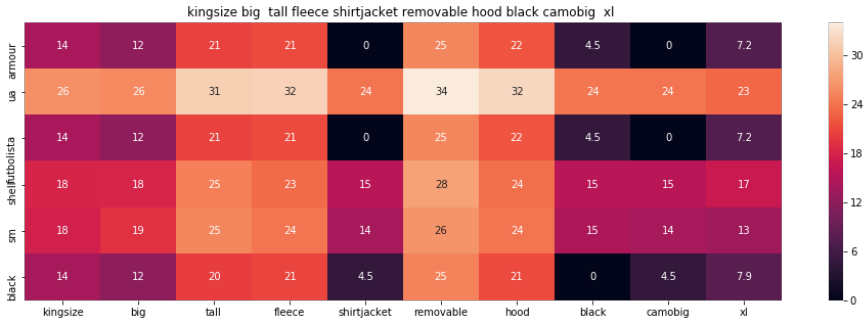




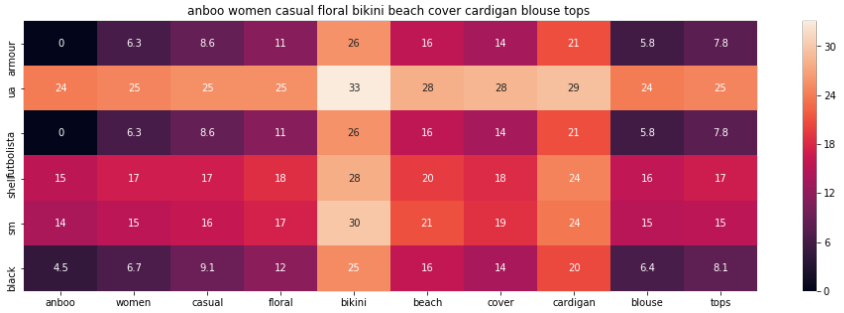
ASIN : B0755R5GF1
Brand : Sonoma
Product Title: harajuku cloud printed elastic crop tops women
Euclidean Distance from input image: 46.54151579966912
Amazon Url: www.amzon.com/dp/B01KQHFVP0



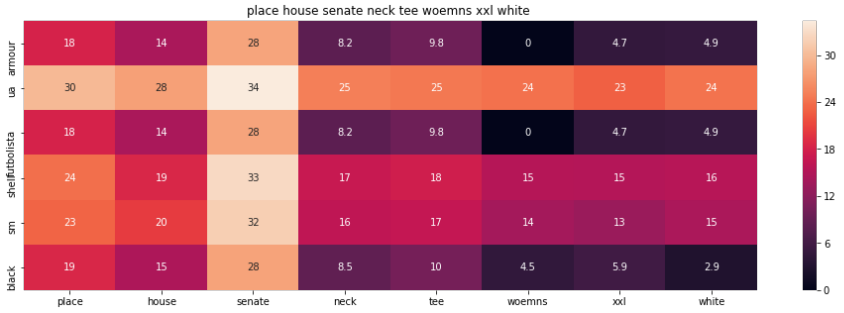
ASIN : B01ANZH0S6
Brand : Ripleys Clothing
Product Title: bandolino womens erin round v neck tie dyed shirt top small aqua refelction
Euclidean Distance from input image: 46.816377168449215
Amazon Url: www.amzon.com/dp/B00ROB8A8W



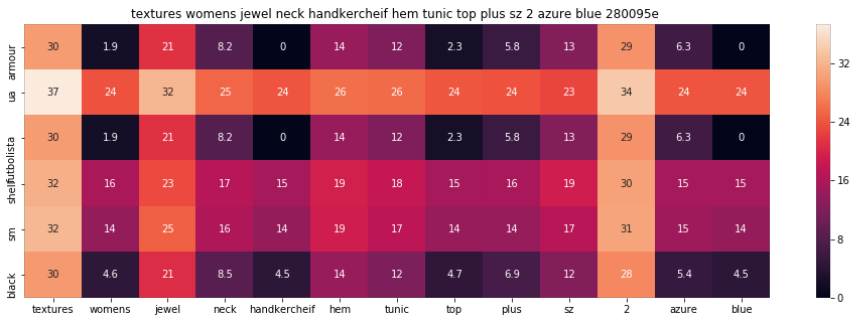
ASIN : B0758NFBN7
Brand : Bargain Catalog Outlet
Product Title: new kawaii cotton pastel tops tees rabbit design
Euclidean Distance from input image: 46.93077166190127
Amazon Url: www.amzon.com/dp/B074S5F9ZK



ASIN : B01H17WYB2
Brand : Anboo
Product Title: cute womens tops tees pastel rainbow print size
Euclidean Distance from input image: 47.03402076243967
Amazon Url: www.amzon.com/dp/B01415UNVU

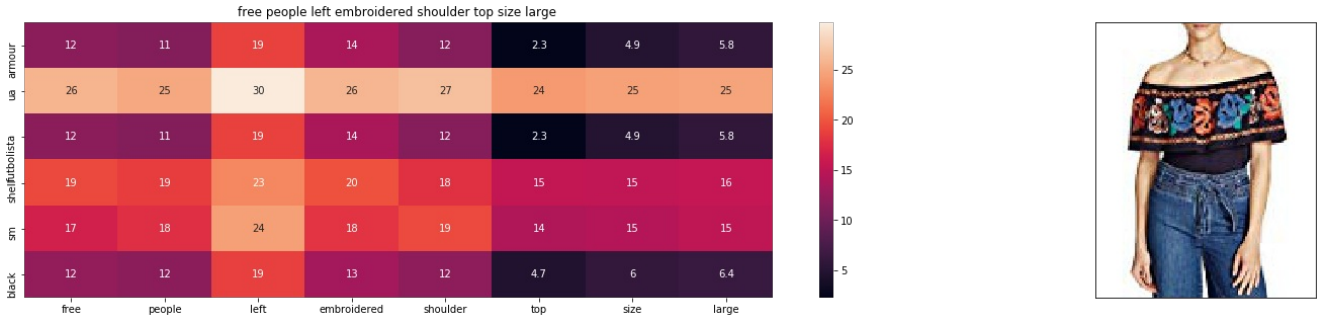


ASIN : B01JW4QSVY
Brand : Cheryle Sigafoos
Product Title: fever ladies size small rayon blouse white green
Euclidean Distance from input image: 47.05415327658633
Amazon Url: www.amzon.com/dp/B0731PMQZ2

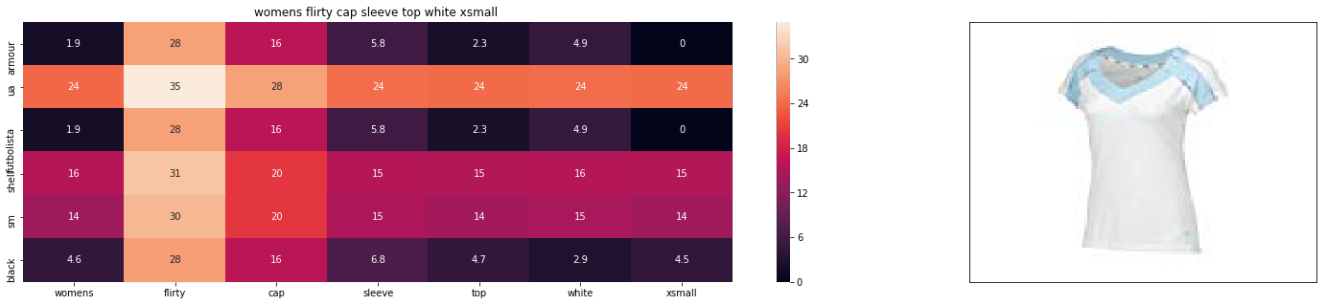


ASIN : B073T2SP79
Brand : Textures
Product Title: style co plus size new whit cuffed shortsleeve tee 2x 1498 dbfl
Euclidean Distance from input image: 47.16396616055415

Amazon Url: www.amzon.com/dp/B0178WOJVS



ASIN : B01C7UUMLC
Brand : Free People
Product Title: women blouses turn collar floral tops lady long sleeve shirt sxxxxl
Euclidean Distance from input image: 47.27295414852652
Amazon Url: www.amzon.com/dp/B07552VG9B



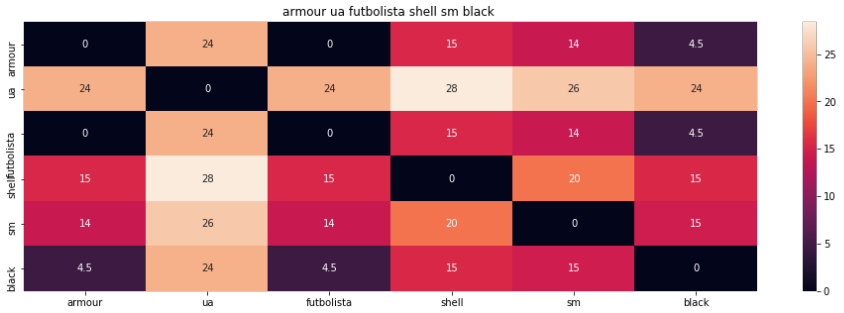
ASIN : B00U7PRVEG
Brand : Wilson
Product Title: miraclebody miraclesuit womens roll sleeve long tunic sz medium ivory
Euclidean Distance from input image: 47.30369416249258
Amazon Url: www.amzon.com/dp/B01MUF826N

Here we see the above results we get results based on image similarity and our query image color is black and we got most of products are darker in color and some products are white in color and may be its shape related images

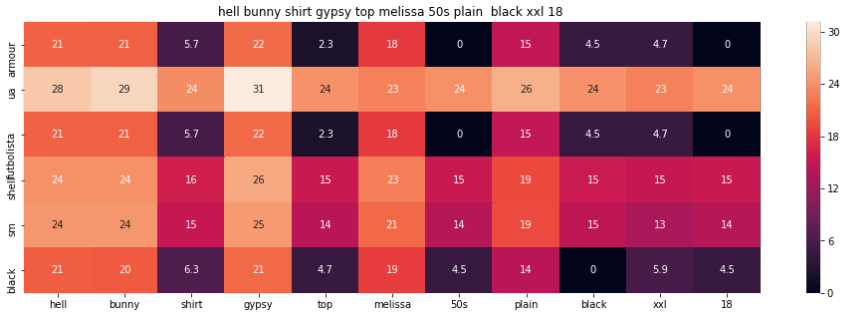
Here we try with giving equal weight to all features we see by giving equal weight to all features can we a good similarity or not ,we seeing top 10 results

In [134]:

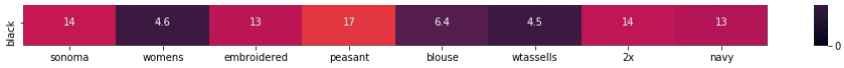
```
#giving equal  weight to all  features
text_and_img_similarity(931, 50,50,50,10)
```



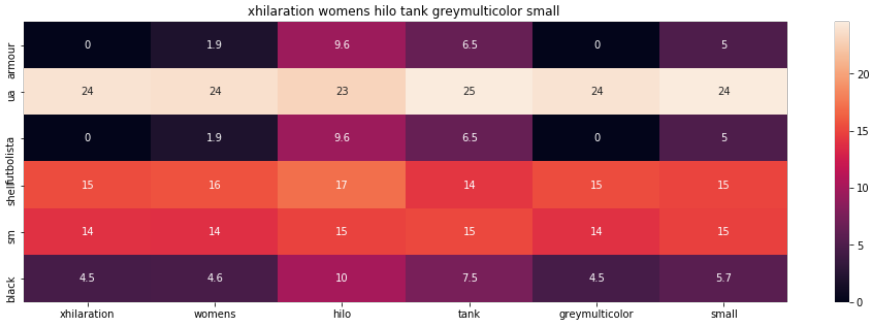
ASIN : B0185VYVR8
Brand : UNDER ARMOUR > UA Tops
Product Title: annakaci sm fit blue green polka dot tie front ruffle trim blouse
Euclidean Distance from input image: 2.10865323121349e-06
Amazon Url: www.amzon.com/dp/B00KLHUIBS



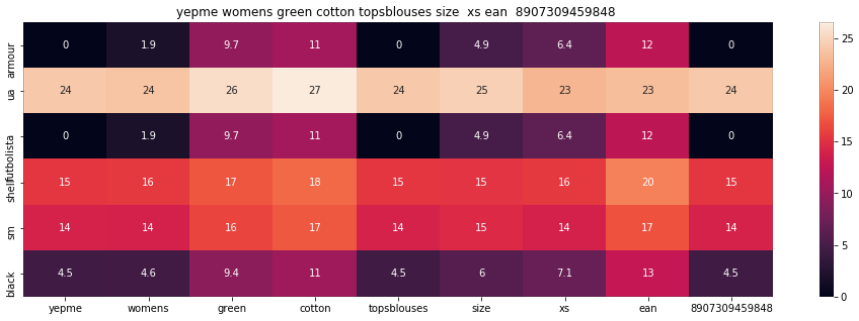
ASIN : B01ANZH0S6
Brand : Ripleys Clothing
Product Title: bandolino womens erin round v neck tie dyed shirt top small aqua refelction
Euclidean Distance from input image: 19.159613037350294
Amazon Url: www.amzon.com/dp/B00ROB8A8W



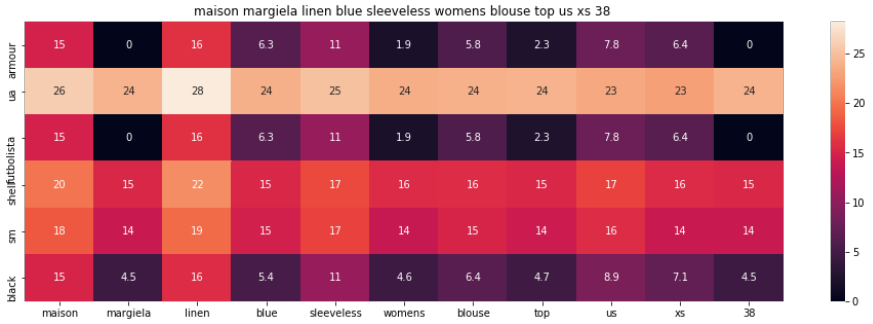
ASIN : B0755R5GF1
Brand : Sonoma
Product Title: harajuku cloud printed elastic crop tops women
Euclidean Distance from input image: 19.19948669433594
Amazon Url: www.amzon.com/dp/B01KQHFVP0



ASIN : B071XX6JBT
Brand : Xhilaration
Product Title: tinacrochetstudio crochet summer tops designer blouse short sleeve jumpsuits
Euclidean Distance from input image: 19.20346511198321
Amazon Url: www.amzon.com/dp/B016YGD3TI



ASIN : B01JIUCV40
Brand : Yepme
Product Title: alexis alona ivory lace ruffle blouse l
Euclidean Distance from input image: 19.23976257324219
Amazon Url: www.amzon.com/dp/B071H9WVQX

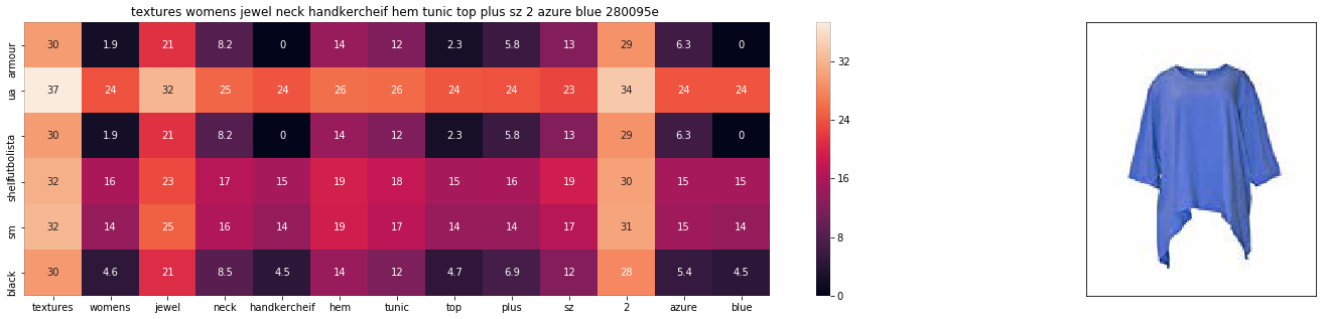


ASIN : B074G3XPWW
Brand : Maison Margiela
Product Title: fever womens sleeveless bright white blouse large
Euclidean Distance from input image: 19.31445123665769
Amazon Url: www.amzon.com/dp/B01M1MOBCA

ASIN : B01ND46TFT
Brand : Zoe Karssen
Product Title: kawaii cotton pastel tops tees white ice cream design
Euclidean Distance from input image: 19.346873925459775
Amazon Url: www.amzon.com/dp/B072MSFJVW

ASIN : B00KDW8B1A
Brand : namnoishop Crop Tops
Product Title: annakaci sm fit white sheer floral embroidered antique lace scallop hem top
Euclidean Distance from input image: 19.352353673163993
Amazon Url: www.amzon.com/dp/B00L87YPVY

ASIN : B00KV9G0KE
Brand : Devon & Jones
Product Title: max mara womens curve tie waist button shirt sz 2 white
Euclidean Distance from input image: 19.36350844694415
Amazon Url: www.amzon.com/dp/B06WWJQ3P2



ASIN : B073T2SP79
Brand : Textures
Product Title: style co plus size new whit cuffed shortsleeve tee 2x 1498 dbfl
Euclidean Distance from input image: 19.391339518229167
Amazon Url: www.amzon.com/dp/B0178WOJVS

Here we see the results we get good equal weight products and givning equal weights to all features title , brand , color , image features

OBSERVATIONS

1. In this case study we use amazon apperals womens data for product similarity
2. We clean the data and remove the duplicates and NaN values in thee data
3. We also done text-preprocessing by removing stop words
4. We apply text to vector vectorizations like BOW , TFIDF , /Semantic similarity /--> AVGW2V ,TFIDFW2V
5. By using above vectorizers we get different results in product similarity one-compare to other vectorizers
6. And we also implemented Image to vector vectorization by using CNN features like VGG-16
7. We implemented both text based similarity and image based similarity and both text and image
8. However we got different weighted results in text and image based similarity and both text and imaged based similarity
9. By giving more weights to particular we get similar more weighted products i.e.., which featurre has more weight we get

those related recommendations

10. we also applied by giving equal weights to all features we get good results
11. Product recommednations are changing when we pass more weights to particular features or catogory of a product and we got good similar products when we give respective weights to features, we get optimal results
12. Compare to all recommendations if we observe Brand and color product recommendations and equal weight product recommendations gives better results compare to rest of all recommednтaions