In [1]:

```python
import matplotlib.pyplot as plt
plt.style.use('seaborn')
```

In [2]:

```python
import pandas as pd
PRIMARY = 'Category Name'
SECONDARY = 'Order Region'

df = pd.read_csv(
    'DataCoSupplyChainDataset.csv',
    usecols = [PRIMARY, SECONDARY],
    encoding = 'unicode_escape'
).apply(lambda col: col.str.strip())
df.head()
```

Out[2]:

	Category Name	Order Region
0	Sporting Goods	Southeast Asia
1	Sporting Goods	South Asia
2	Sporting Goods	South Asia
3	Sporting Goods	Oceania
4	Sporting Goods	Oceania

Check & remove null + duplicate values

In [3]:

```python
df.isnull().sum().sort_values(ascending=False)
```

Out[3]:

```
Category Name    0
Order Region     0
dtype: int64
```

In [4]:

```python
df.drop_duplicates(inplace=True)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 691 entries, 0 to 162002
Data columns (total 2 columns):
 #   Column         Non-Null Count  Dtype 
---  ------         --------------  ----- 
 0   Category Name  691 non-null    object
 1   Order Region   691 non-null    object
dtypes: object(2)
memory usage: 16.2+ KB
```

Convert DataFrame to Graphs

In [5]:

```python
primary_col, secondary_col = df[PRIMARY], df[SECONDARY]
print(f'Number of {PRIMARY}:', primary_col.nunique())
print(f'Number of {SECONDARY}:', secondary_col.nunique())
print('Number of edges:', len(df))
```

```
Number of Category Name: 50
Number of Order Region: 23
Number of edges: 691
```

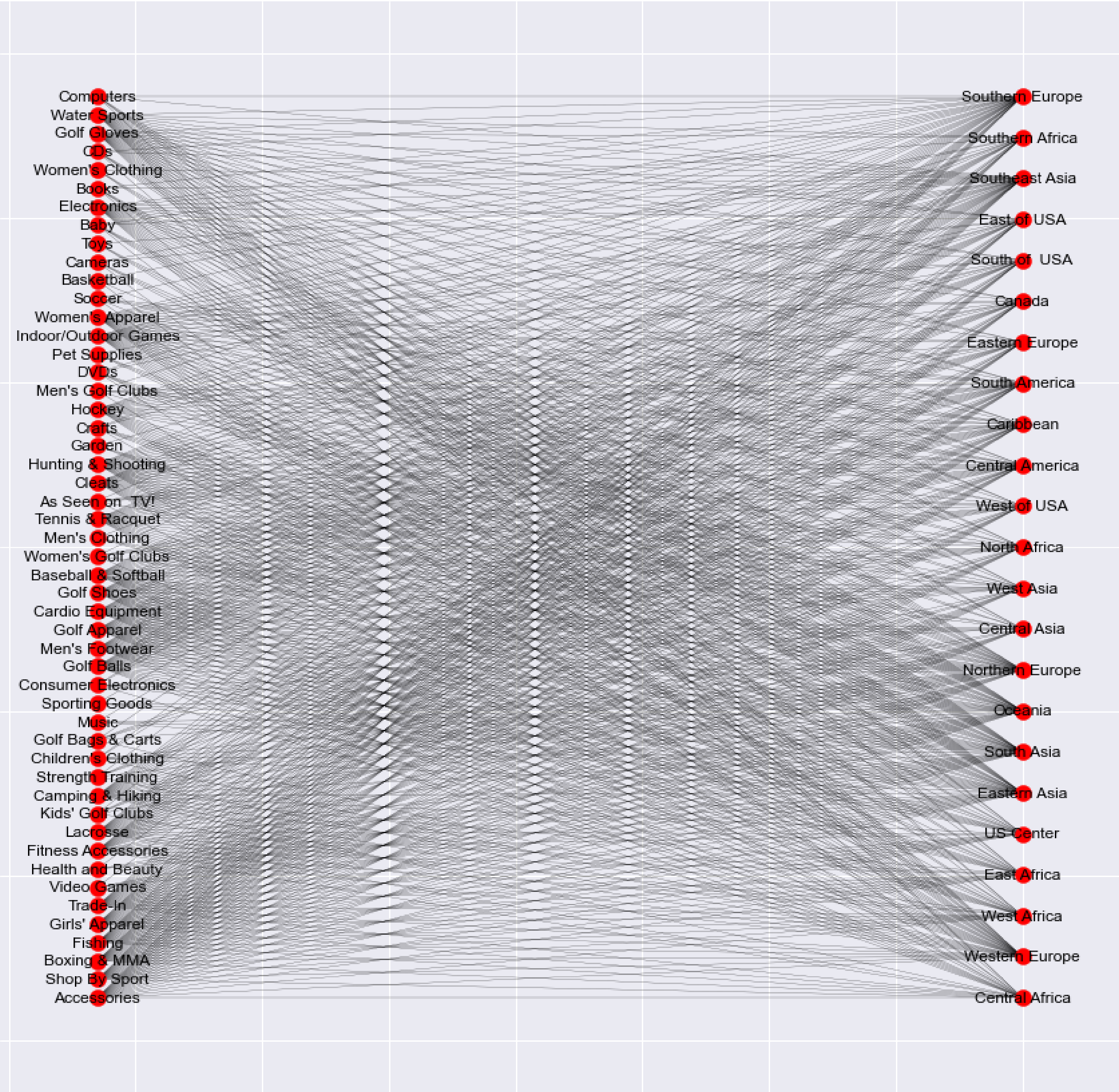
1. Bipartite Graph

In [6]:

```python
import networkx as nx
from networkx.algorithms import bipartite

B = nx.Graph()
for index, row in df.iterrows():
    B.add_edge(row[PRIMARY], row[SECONDARY], weight=1)

B.add_nodes_from(primary_col, bipartite=0)
B.add_nodes_from(secondary_col, bipartite=1)
```

In [7]:

```python
import matplotlib.pyplot as plt
plt.figure(figsize=(15, 15))
pos = nx.drawing.layout.bipartite_layout(B, primary_col)
nx.draw_networkx(B, pos=pos, node_size=150, width=0.2, node_color='red')
```



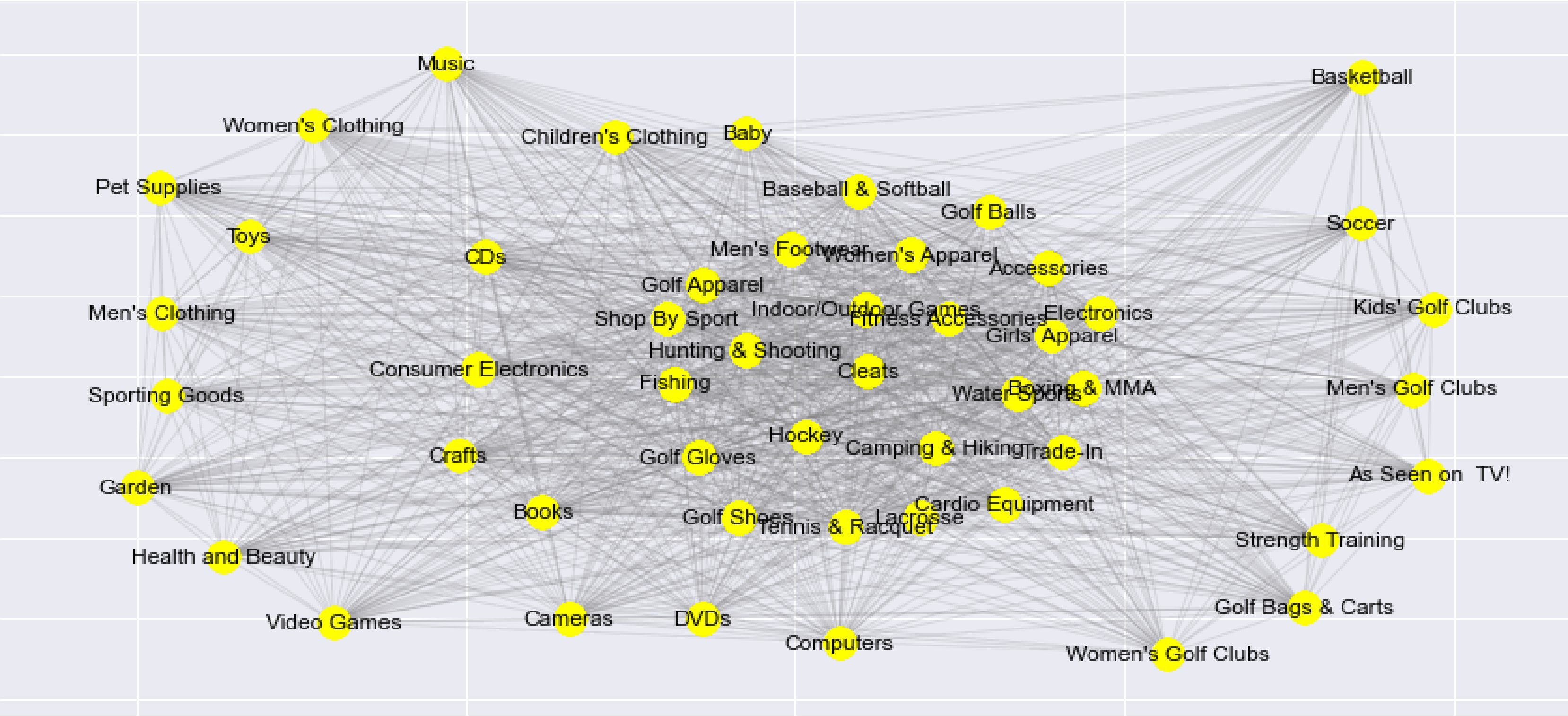
2. Weighted Projected Graph

In [8]:

```python
G = bipartite.weighted_projected_graph(B, primary_col)
node_labels = dict(zip(primary_col, primary_col))
```

In [9]:

```python
plt.figure(figsize=(15, 7))
pos = nx.spring_layout(G)

nx.draw_networkx_nodes(G, pos, nodelist=primary_col, node_color='yellow')
nx.draw_networkx_edges(G, pos, edge_color='grey', alpha=0.2)
nx.draw_networkx_labels(G, pos, labels=node_labels)
plt.show()
```



Community Detection

In [10]:

```
df_groupby_category = df.groupby([SECONDARY])[PRIMARY].apply(lambda x: sorted(set(x)))
df_groupby_category = df_groupby_category.reset_index()
# print(df_groupby_category.iloc[14][1])
df_groupby_category.head()
```

Out[10]:

	Order Region	Category Name
0	Canada	[Accessories, Baseball & Softball, Boxing & MM...
1	Caribbean	[Accessories, As Seen on TV!, Baseball & Soft...
2	Central Africa	[Accessories, Baseball & Softball, Boxing & MM...
3	Central America	[Accessories, As Seen on TV!, Baseball & Soft...
4	Central Asia	[Accessories, Boxing & MMA, Camping & Hiking, ...

In [11]:

```
def get_cluster_common_values(cluster):
    commons = []
    for index, row in df_groupby_category.iterrows():
        if set(cluster).issubset(row[PRIMARY]):
            commons.append(row[SECONDARY])
    return commons
```

In [12]:

```
def print_communities(node_groups):
    print('Number of communities:', len(node_groups))
    for index, cluster in enumerate(node_groups):
        common_values = get_cluster_common_values(cluster)
        print(f'\nCluster {index}:')
        print(f"- {len(cluster)} Nodes: {', '.join(cluster)}")
        print(f"- {len(common_values)} Common values: {', '.join(common_values)}")
```

1. Louvain Algorithm

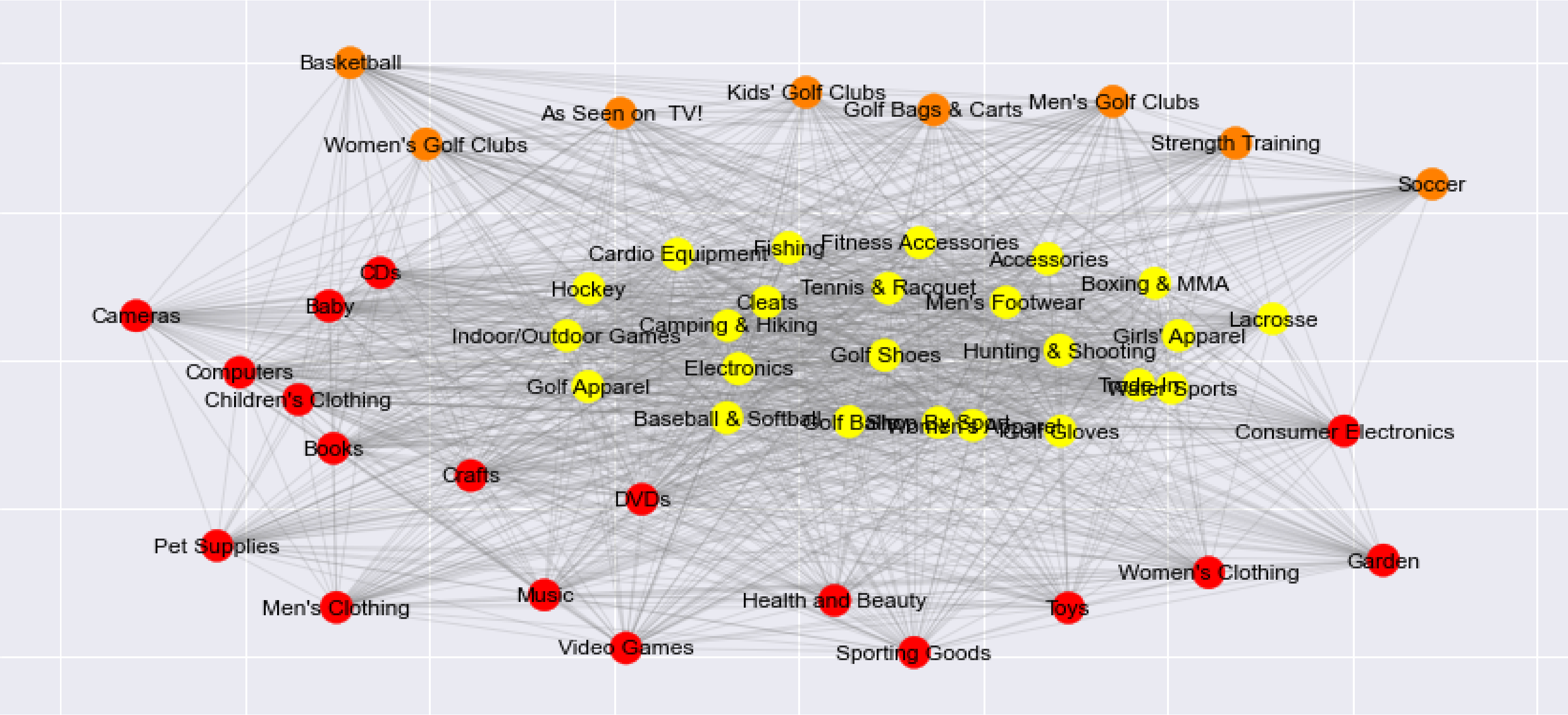
In [13]:

```
import community.community_louvain as community_louvain
from collections import defaultdict
partition = community_louvain.best_partition(G)
louvain_node_groups = [[] for _ in set(partition.values())]

for node, cluster in sorted(partition.items()):
    louvain_node_groups[cluster].append(node)
print_communities(louvain_node_groups)
```

```
Number of communities: 3

Cluster 0:
- 18 Nodes: Baby, Books, CDs, Cameras, Children's Clothing, Computers, Consumer Electronics, Crafts, DVDs, Garden, Health and Beaut
y, Men's Clothing, Music, Pet Supplies, Sporting Goods, Toys, Video Games, Women's Clothing
- 3 Common values: Oceania, South Asia, Southeast Asia

Cluster 1:
- 8 Nodes: As Seen on  TV!, Basketball, Golf Bags & Carts, Kids' Golf Clubs, Men's Golf Clubs, Soccer, Strength Training, Women's Go
lf Clubs
- 3 Common values: Northern Europe, Southern Europe, Western Europe

Cluster 2:
- 24 Nodes: Accessories, Baseball & Softball, Boxing & MMA, Camping & Hiking, Cardio Equipment, Cleats, Electronics, Fishing, Fitnes
s Accessories, Girls' Apparel, Golf Apparel, Golf Balls, Golf Gloves, Golf Shoes, Hockey, Hunting & Shooting, Indoor/Outdoor Games,
Lacrosse, Men's Footwear, Shop By Sport, Tennis & Racquet, Trade-In, Water Sports, Women's Apparel
- 22 Common values: Canada, Caribbean, Central Africa, Central America, East Africa, East of USA, Eastern Asia, Eastern Europe, Nort
h Africa, Northern Europe, Oceania, South America, South Asia, South of  USA, Southeast Asia, Southern Africa, Southern Europe, US C
enter, West Africa, West Asia, West of USA, Western Europe
```

In [14]:

```
import matplotlib.cm as cm
cmap = cm.get_cmap('autumn', max(partition.values()) + 1)
pos = nx.spring_layout(G)

plt.figure(figsize=(15, 7))
nx.draw_networkx_nodes(G, pos, partition.keys(), cmap=cmap, node_color=list(partition.values()))
nx.draw_networkx_edges(G, pos, edge_color='grey', alpha=0.2)
nx.draw_networkx_labels(G, pos)
plt.show()
```



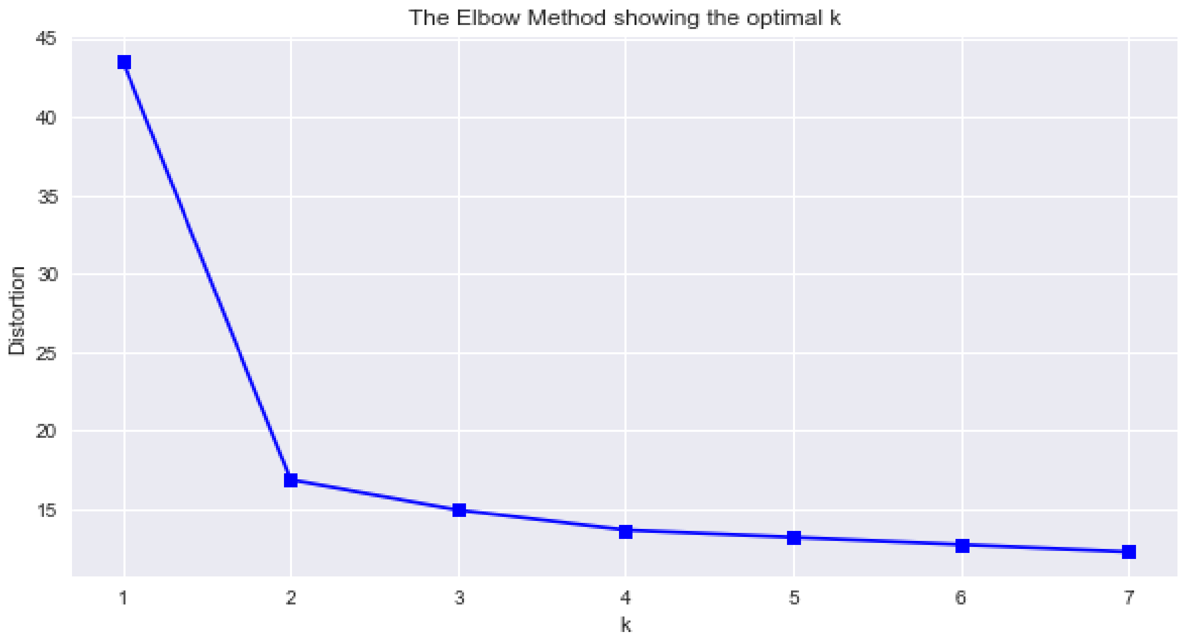
2. K-Means Algorithm

In [15]:
```
from sklearn.cluster import KMeans
from scipy.spatial.distance import cdist
adj_matrix = nx.to_numpy_array(G)
adj_matrix
```

Out[15]:
```
array([[ 0.,  4.,  4., ...,  4.,  4.,  4.],
       [ 4.,  0., 23., ...,  4., 23., 23.],
       [ 4., 23.,  0., ...,  4., 23., 23.],
       ...,
       [ 4.,  4.,  4., ...,  0.,  4.,  4.],
       [ 4., 23., 23., ...,  4.,  0., 23.],
       [ 4., 23., 23., ...,  4., 23.,  0.]])
```

In [16]:
```
import numpy as np
distortions = []
K = range(1, 8)

for k in K:
    kmean_model = KMeans(n_clusters=k)
    kmean_model.fit(adj_matrix)
    dist = sum(np.min(cdist(adj_matrix, kmean_model.cluster_centers_, 'euclidean'), axis=1))
    distortions.append(dist / adj_matrix.shape[0])
```

In [17]:
```
plt.figure(figsize=(10, 5))
plt.plot(K, distortions, 'bs-')
plt.xlabel('k')
plt.ylabel('Distortion')
plt.title('The Elbow Method showing the optimal k')
plt.show()
```



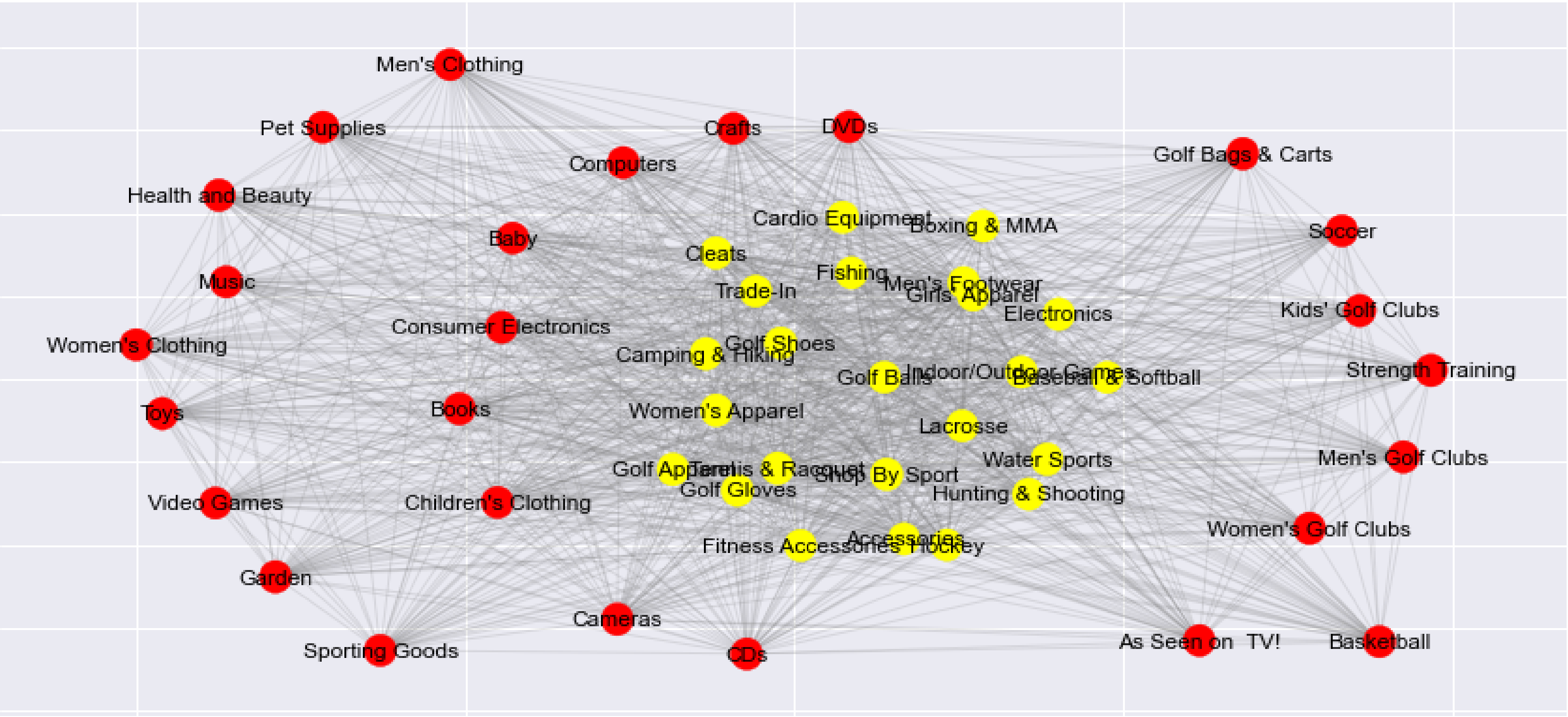
In [18]:
```
kmeans = KMeans(n_clusters=2)
kmeans.fit(adj_matrix)
kmeans_node_groups = [[] for _ in range(kmeans.n_clusters)]

for node, cluster in zip(G.nodes(), kmeans.labels_):
    kmeans_node_groups[cluster].append(node)
print_communities(kmeans_node_groups)
```

```
Number of communities: 2
```

```
Cluster 0:
- 26 Nodes: Sporting Goods, Kids' Golf Clubs, Consumer Electronics, Cameras, Computers, Basketball, Soccer, Women's Clothing, Craft
s, Men's Clothing, As Seen on  TV!, Strength Training, Children's Clothing, Baby, Books, DVDs, CDs, Garden, Pet Supplies, Health and
Beauty, Music, Video Games, Golf Bags & Carts, Women's Golf Clubs, Men's Golf Clubs, Toys
- 0 Common values:

Cluster 1:
- 24 Nodes: Cleats, Shop By Sport, Women's Apparel, Electronics, Boxing & MMA, Cardio Equipment, Trade-In, Hunting & Shooting, Baseb
all & Softball, Men's Footwear, Camping & Hiking, Girls' Apparel, Accessories, Tennis & Racquet, Fitness Accessories, Golf Balls, La
crosse, Fishing, Hockey, Golf Gloves, Golf Shoes, Golf Apparel, Water Sports, Indoor/Outdoor Games
- 22 Common values: Canada, Caribbean, Central Africa, Central America, East Africa, East of USA, Eastern Asia, Eastern Europe, Nort
h Africa, Northern Europe, Oceania, South America, South Asia, South of  USA, Southeast Asia, Southern Africa, Southern Europe, US C
enter, West Africa, West Asia, West of USA, Western Europe
```

In [19]:

```python
cmap = cm.get_cmap('autumn', max(kmeans.labels_) + 1)
pos = nx.spring_layout(G)

plt.figure(figsize=(15, 7))
nx.draw_networkx_nodes(G, pos, G.nodes(), cmap=cmap, node_color=kmeans.labels_)
nx.draw_networkx_edges(G, pos, edge_color='grey', alpha=0.2)
nx.draw_networkx_labels(G, pos)
plt.show()
```



3. Gaussian Mixture Model

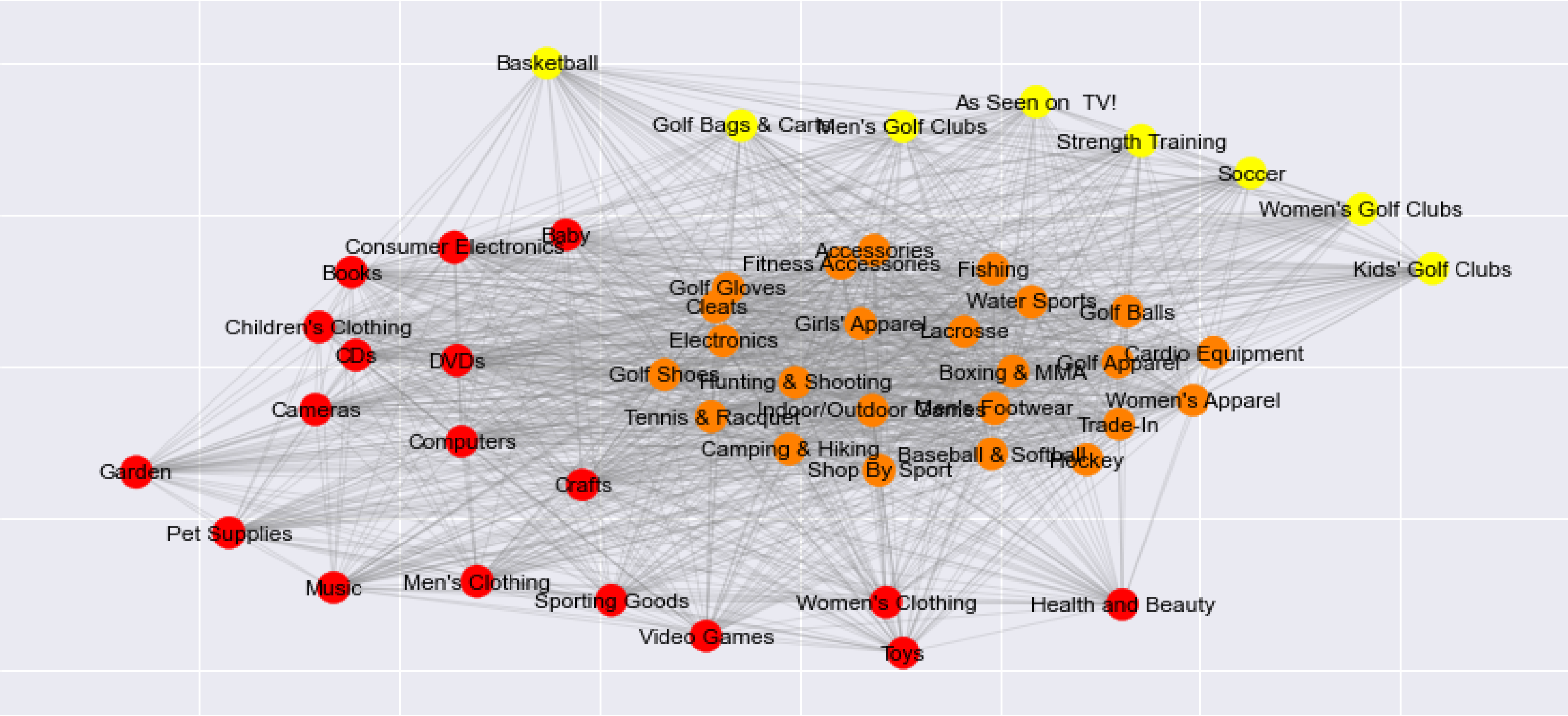
In [35]:

```python
from sklearn.mixture import GaussianMixture
n_clusters = 3
gmm = GaussianMixture(n_components=n_clusters)
gmm.fit(adj_matrix)

labels = gmm.predict(adj_matrix)
gmm_node_groups = [[] for _ in range(n_clusters)]

for node, cluster in zip(G.nodes(), labels):
    gmm_node_groups[cluster].append(node)
print_communities(gmm_node_groups)
```

```
Number of communities: 3

Cluster 0:
- 18 Nodes: Sporting Goods, Consumer Electronics, Cameras, Computers, Women's Clothing, Crafts, Men's Clothing, Children's Clothing,
Baby, Books, DVDs, CDs, Garden, Pet Supplies, Health and Beauty, Music, Video Games, Toys
- 3 Common values: Oceania, South Asia, Southeast Asia

Cluster 1:
- 24 Nodes: Cleats, Shop By Sport, Women's Apparel, Electronics, Boxing & MMA, Cardio Equipment, Trade-In, Hunting & Shooting, Baseb
all & Softball, Men's Footwear, Camping & Hiking, Girls' Apparel, Accessories, Tennis & Racquet, Fitness Accessories, Golf Balls, La
crosse, Fishing, Hockey, Golf Gloves, Golf Shoes, Golf Apparel, Water Sports, Indoor/Outdoor Games
- 22 Common values: Canada, Caribbean, Central Africa, Central America, East Africa, East of USA, Eastern Asia, Eastern Europe, Nort
h Africa, Northern Europe, Oceania, South America, South Asia, South of  USA, Southeast Asia, Southern Africa, Southern Europe, US C
enter, West Africa, West Asia, West of USA, Western Europe

Cluster 2:
- 8 Nodes: Kids' Golf Clubs, Basketball, Soccer, As Seen on  TV!, Strength Training, Golf Bags & Carts, Women's Golf Clubs, Men's Go
lf Clubs
- 3 Common values: Northern Europe, Southern Europe, Western Europe
```

In [36]:

```python
cmap = cm.get_cmap('autumn', max(labels) + 1)
pos = nx.spring_layout(G)

plt.figure(figsize=(15, 7))
nx.draw_networkx_nodes(G, pos, G.nodes(), cmap=cmap, node_color=labels)
nx.draw_networkx_edges(G, pos, edge_color='grey', alpha=0.2)
nx.draw_networkx_labels(G, pos)
plt.show()
```



Network Centrality

In [37]:

```
def print_centrality(centrality, name):
    result = pd.DataFrame(centrality, columns=['Category Name', name])
    result.sort_values(name, ascending=False, inplace=True)
    print(result.to_records(index=False).tolist())
    return result
```

In [38]:

```
# Degree Centrality
degree = nx.degree(G)
print_centrality(degree, 'Degree').head()
```

```
[('Indoor/Outdoor Games', 49), ('Golf Balls', 49), ('Golf Shoes', 49), ('Crafts', 49), ('Golf Gloves', 49), ('Tennis & Racquet', 4
9), ('Fitness Accessories', 49), ('Cleats', 49), ("Children's Clothing", 49), ('Golf Apparel', 49), ('Lacrosse', 49), ('Baby', 49),
('Fishing', 49), ('Books', 49), ('DVDs', 49), ('CDs', 49), ('Accessories', 49), ("Girls' Apparel", 49), ('Hockey', 49), ('Shop By Sp
ort', 49), ('Computers', 49), ('Cameras', 49), ('Consumer Electronics', 49), ('Camping & Hiking', 49), ("Men's Footwear", 49), ('Bas
eball & Softball', 49), ('Hunting & Shooting', 49), ('Water Sports', 49), ('Trade-In', 49), ('Cardio Equipment', 49), ('Boxing & MM
A', 49), ('Electronics', 49), ("Women's Apparel", 49), ('Music', 41), ('Health and Beauty', 41), ('Toys', 41), ('Video Games', 41),
('Sporting Goods', 41), ('Pet Supplies', 41), ('Garden', 41), ("Men's Clothing", 41), ("Women's Clothing", 41), ('Strength Trainin
g', 40), ('Golf Bags & Carts', 40), ('Soccer', 40), ("Women's Golf Clubs", 40), ("Men's Golf Clubs", 40), ('Basketball', 40), ("Kid
s' Golf Clubs", 40), ('As Seen on  TV!', 40)]
```

Out[38]:

	Category Name	Degree
49	Indoor/Outdoor Games	49
26	Golf Balls	49
43	Golf Shoes	49
21	Crafts	49
41	Golf Gloves	49

In [39]:

```
# Betweenness Centrality
betweenness = nx.betweenness_centrality(G)
print_centrality(betweenness.items(), 'Betweenness Centrality').head()
```

```
[('Indoor/Outdoor Games', 0.0018552875695732828), ("Girls' Apparel", 0.0018552875695732828), ('Golf Apparel', 0.001855287569573282
8), ('Tennis & Racquet', 0.0018552875695732828), ('Fitness Accessories', 0.0018552875695732828), ('Cleats', 0.0018552875695732828),
('Golf Balls', 0.0018552875695732828), ('Golf Shoes', 0.0018552875695732828), ("Children's Clothing", 0.0018552875695732828), ('Lacr
osse', 0.0018552875695732828), ('Baby', 0.0018552875695732828), ('Fishing', 0.0018552875695732828), ('Books', 0.001855287569573282
8), ('DVDs', 0.0018552875695732828), ('CDs', 0.0018552875695732828), ('Hockey', 0.0018552875695732828), ('Golf Gloves', 0.0018552875
695732828), ('Crafts', 0.0018552875695732828), ('Accessories', 0.0018552875695732828), ('Hunting & Shooting', 0.001855287569573282
8), ('Electronics', 0.0018552875695732828), ('Shop By Sport', 0.0018552875695732828), ("Women's Apparel", 0.0018552875695732828),
('Computers', 0.0018552875695732828), ('Cameras', 0.0018552875695732828), ('Consumer Electronics', 0.0018552875695732828), ('Camping
& Hiking', 0.0018552875695732828), ("Men's Footwear", 0.0018552875695732828), ('Baseball & Softball', 0.0018552875695732828), ('Wate
r Sports', 0.0018552875695732828), ('Trade-In', 0.0018552875695732828), ('Cardio Equipment', 0.0018552875695732828), ('Boxing & MM
A', 0.0018552875695732828), ('Golf Bags & Carts', 0.0), ('Music', 0.0), ("Women's Golf Clubs", 0.0), ('Toys', 0.0), ("Men's Golf Clu
bs", 0.0), ('Video Games', 0.0), ('Sporting Goods', 0.0), ('Health and Beauty', 0.0), ('Pet Supplies', 0.0), ('Garden', 0.0), ('Stre
ngth Training', 0.0), ("Men's Clothing", 0.0), ("Women's Clothing", 0.0), ('Soccer', 0.0), ('Basketball', 0.0), ("Kids' Golf Clubs",
0.0), ('As Seen on  TV!', 0.0)]
```

Out[39]:

	Category Name	Betweenness Centrality
49	Indoor/Outdoor Games	0.001855
18	Girls' Apparel	0.001855
44	Golf Apparel	0.001855
23	Tennis & Racquet	0.001855
24	Fitness Accessories	0.001855

In [40]:

```
# Closeness Centrality
closeness = nx.closeness_centrality(G)
print_centrality(closeness.items(), 'Closeness Centrality').head()
```

```
[('Indoor/Outdoor Games', 1.0), ('Golf Balls', 1.0), ('Golf Shoes', 1.0), ('Crafts', 1.0), ('Golf Gloves', 1.0), ('Tennis & Racque
t', 1.0), ('Fitness Accessories', 1.0), ('Cleats', 1.0), ("Children's Clothing", 1.0), ('Golf Apparel', 1.0), ('Lacrosse', 1.0), ('B
aby', 1.0), ('Fishing', 1.0), ('Books', 1.0), ('DVDs', 1.0), ('CDs', 1.0), ('Accessories', 1.0), ("Girls' Apparel", 1.0), ('Hockey',
1.0), ('Shop By Sport', 1.0), ('Computers', 1.0), ('Cameras', 1.0), ('Consumer Electronics', 1.0), ('Camping & Hiking', 1.0), ("Me
n's Footwear", 1.0), ('Baseball & Softball', 1.0), ('Hunting & Shooting', 1.0), ('Water Sports', 1.0), ('Trade-In', 1.0), ('Cardio E
quipment', 1.0), ('Boxing & MMA', 1.0), ('Electronics', 1.0), ("Women's Apparel", 1.0), ('Music', 0.8596491228070176), ('Health and
Beauty', 0.8596491228070176), ('Toys', 0.8596491228070176), ('Video Games', 0.8596491228070176), ('Sporting Goods', 0.85964912280701
76), ('Pet Supplies', 0.8596491228070176), ('Garden', 0.8596491228070176), ("Men's Clothing", 0.8596491228070176), ("Women's Clothin
g", 0.8596491228070176), ('Strength Training', 0.8448275862068966), ('Golf Bags & Carts', 0.8448275862068966), ('Soccer', 0.84482758
62068966), ("Women's Golf Clubs", 0.8448275862068966), ("Men's Golf Clubs", 0.8448275862068966), ('Basketball', 0.8448275862068966),
("Kids' Golf Clubs", 0.8448275862068966), ('As Seen on  TV!', 0.8448275862068966)]
```

Out[40]:

	Category Name	Closeness Centrality
49	Indoor/Outdoor Games	1.0
26	Golf Balls	1.0
43	Golf Shoes	1.0
21	Crafts	1.0
41	Golf Gloves	1.0

In [41]:

```
# Eigenvector Centrality
eigenvector = nx.eigenvector_centrality(G)
print_centrality(eigenvector.items(), 'Eigenvector Centrality').head()
```

```
[('Indoor/Outdoor Games', 0.14867064721396608), ("Children's Clothing", 0.14867064721396608), ('Crafts', 0.14867064721396608), ('Gol
f Gloves', 0.14867064721396608), ('Tennis & Racquet', 0.14867064721396608), ('Fitness Accessories', 0.14867064721396608), ('Cleats',
0.14867064721396608), ('Golf Balls', 0.14867064721396608), ('Lacrosse', 0.14867064721396608), ("Girls' Apparel", 0.148670647213966
8), ('Baby', 0.14867064721396608), ('Fishing', 0.14867064721396608), ('Books', 0.14867064721396608), ('DVDs', 0.14867064721396608),
('CDs', 0.14867064721396608), ('Hockey', 0.14867064721396608), ('Golf Shoes', 0.14867064721396608), ('Accessories', 0.14867064721396
608), ('Golf Apparel', 0.14867064721396608), ('Water Sports', 0.14867064721396608), ('Shop By Sport', 0.14867064721396608), ("Wome
n's Apparel", 0.14867064721396608), ('Electronics', 0.14867064721396608), ('Boxing & MMA', 0.14867064721396608), ('Cardio Equipmen
t', 0.14867064721396608), ('Trade-In', 0.14867064721396608), ('Hunting & Shooting', 0.14867064721396608), ('Baseball & Softball', 0.
14867064721396608), ("Men's Footwear", 0.14867064721396608), ('Camping & Hiking', 0.14867064721396608), ('Consumer Electronics', 0.1
4867064721396608), ('Cameras', 0.14867064721396608), ('Computers', 0.14867064721396608), ('Video Games', 0.12767929833125463), ('Mus
ic', 0.12767929833125463), ('Garden', 0.12767929833125463), ('Toys', 0.12767929833125463), ('Pet Supplies', 0.12767929833125463),
('Health and Beauty', 0.12767929833125463), ('Sporting Goods', 0.1276792983312546), ("Men's Clothing", 0.1276792983312546), ("Wome
n's Clothing", 0.1276792983312546), ('Strength Training', 0.12444087284685672), ('Golf Bags & Carts', 0.12444087284685672), ('Socce
r', 0.12444087284685672), ("Women's Golf Clubs", 0.12444087284685672), ("Men's Golf Clubs", 0.12444087284685672), ('Basketball', 0.1
2444087284685672), ("Kids' Golf Clubs", 0.12444087284685672), ('As Seen on  TV!', 0.12444087284685672)]
```

Out[41]:

	Category Name	Eigenvector Centrality
49	Indoor/Outdoor Games	0.148671
28	Children's Clothing	0.148671
21	Crafts	0.148671
41	Golf Gloves	0.148671
23	Tennis & Racquet	0.148671

In [42]:

```
# PageRank
pagerank = nx.pagerank(G)
print_centrality(pagerank.items(), 'PageRank').head()
```

```
[('Indoor/Outdoor Games', 0.02910004330793566), ("Men's Footwear", 0.02910004330793566), ('Fishing', 0.02910004330793566), ('Lacross
e', 0.02910004330793566), ('Golf Balls', 0.02910004330793566), ('Cleats', 0.02910004330793566), ('Tennis & Racquet', 0.0291000433079
3566), ('Golf Apparel', 0.02910004330793566), ('Accessories', 0.02910004330793566), ('Camping & Hiking', 0.02910004330793566), ("Gir
ls' Apparel", 0.02910004330793566), ('Cardio Equipment', 0.02910004330793566), ('Water Sports', 0.02910004330793566), ('Shop By Spor
t', 0.02910004330793566), ("Women's Apparel", 0.02910004330793566), ('Electronics', 0.02910004330793566), ('Boxing & MMA', 0.0291000
4330793566), ('Hunting & Shooting', 0.02910004330793566), ('Trade-In', 0.02910004330793566), ('Golf Gloves', 0.02910004330793566),
('Hockey', 0.028393028110741375), ('Golf Shoes', 0.028393028110741375), ('Fitness Accessories', 0.028393028110741375), ('Baseball &
Softball', 0.028393028110741375), ('Crafts', 0.01460032971973412), ('Computers', 0.01460032971973412), ("Children's Clothing", 0.014
60032971973412), ('Baby', 0.01460032971973412), ('Consumer Electronics', 0.01460032971973412), ('Books', 0.01460032971973412), ('DVD
s', 0.01460032971973412), ('CDs', 0.01460032971973412), ('Cameras', 0.012939485390217484), ("Women's Golf Clubs", 0.011343155157043l
8), ("Men's Golf Clubs", 0.011343155157043l8), ('Golf Bags & Carts', 0.011343155157043l8), ('As Seen on  TV!', 0.011343155157043l8),
('Strength Training', 0.011343155157043l8), ('Soccer', 0.011343155157043l8), ("Kids' Golf Clubs", 0.011343155157043l8), ('Pet Suppli
es', 0.009718050588254678), ('Health and Beauty', 0.009718050588254678), ('Music', 0.009718050588254678), ('Video Games', 0.00971805
0588254678), ('Garden', 0.009718050588254678), ("Men's Clothing", 0.009718050588254678), ("Women's Clothing", 0.009718050588254678),
('Toys', 0.009718050588254678), ('Sporting Goods', 0.009718050588254678), ('Basketball', 0.007820356856636094)]
```

Out[42]:

	Category Name	PageRank
49	Indoor/Outdoor Games	0.0291
11	Men's Footwear	0.0291
31	Fishing	0.0291
29	Lacrosse	0.0291
26	Golf Balls	0.0291