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In [2]:
```
import networkx as nx
import networkx.algorithms.community as nx_comm
from numpy import zeros, dot, array
import pickle
import matplotlib.pyplot as plt
import json
import string
import time
import regex as re
```

Section 7.13: Modularity

The first function below calculates modularity for *directed* networks and also returns the maximum modularity value $Q_{\max}$ (NetworkX's modularity function does not report the $Q_{\max}$ value). The second function calculates scalar assortativity (NetworkX's assortativity functions differ from our book definition).

In [3]:
```
def modularity(G,c):
    d = dict()
    for k,v in enumerate(c):
        for n in v:
            d[n] = k
    L = 0
    for u,v,data in G.edges.data():
        L += data['weight']
    Q, Qmax = 0,1
    for u in G.nodes():
        for v in G.nodes():
            if d[u] == d[v]:
                Auv = 0
                if G.has_edge(v,u):
                    Auv = G[v][u]['weight']
                Q += ( Auv - G.in_degree(u,weight='weight')*G.out_degree(v,weight='wei
                Qmax -= ( G.in_degree(u,weight='weight')*G.out_degree(v,weight='weight
    return Q, Qmax

def scalar_assortativity(G,d):
    x = zeros(G.number_of_nodes())
    for i,n in enumerate(G.nodes()):
        x[i] = d[n]

    A = array(nx.adjacency_matrix(G).todense().T)
    M = 2*A.sum().sum()
    ki = A.sum(axis=1) #row sum is in-degree
    ko = A.sum(axis=0) #column sum is out-degree
    mu = ( dot(ki,x)+dot(ko,x) )/M

    R, Rmax = 0, 0
    for i in range(G.number_of_nodes()):
        for j in range(G.number_of_nodes()):
            R += ( A[i,j]*(x[i]-mu)*(x[j]-mu) )/M
            Rmax += ( A[i,j]*(x[i]-mu)**2 )/M
```

```
    return R, Rmax
```

In [4]:

```
G = nx.read_weighted_edgelist('fifa1998.edgelist',create_using=nx.DiGraph)

c = {
    'group1': {'Argentina','Brazil','Chile','Mexico','Colombia','Jamaica','Paraguay'},
    'group2': {'Japan','SouthKorea'},
    'group3': {'UnitedStates'},
    'group4': {'Nigeria','Morocco','SouthAfrica','Cameroon','Tunisia','Iran','Turkey'
    'group5': {'Scotland','Belgium','Austria','Germany','Denmark','Spain','France','Gr
    }
Q, Qmax = modularity(G,c.values())
print('FIFA exports by geographic region is assortatively mixed: %1.4f/%1.4f' % (Q,Qma

c = {
    'exporters': {'Argentina','Brazil','Chile','Colombia','Mexico','Scotland','Belgiu
    'importers': {'Paraguay','SouthKorea','UnitedStates','SouthAfrica','Iran','Turkey
    }
Q, Qmax = modularity(G,c.values())
print('FIFA exports by importers/exporters is disassortatively mixed: %1.4f/%1.4f' % (
```

```
FIFA exports by geographic region is assortatively mixed: 0.1200/0.5505
FIFA exports by importers/exporters is disassortatively mixed: -0.0185/0.5748
```

In [5]:

```
print('HIGHLIGHTED QUESTION -  Write a few sentences describing why you see the values
print('We see that FIFA exports by geogrpahic region is assortatively mixed because pl
print('We see that FIFA exports by importers/exporters is disassortatively mixed becau
```

```
HIGHLIGHTED QUESTION -  Write a few sentences describing why you see the values you g
et.
We see that FIFA exports by geogrpahic region is assortatively mixed because players
are likely to play within their own geographic region.
We see that FIFA exports by importers/exporters is disassortatively mixed because pla
yers are likely to play with other countries rather than their own.
```

Section 7.13: Assortativity

In [6]:

```
gdp = pickle.load(open('gdp.pkl','rb'))
life_expectancy = pickle.load(open('life_expectancy.pkl','rb'))
tariff = pickle.load(open('tariff.pkl','rb'))

G = nx.read_weighted_edgelist('world_trade_2014.edgelist',create_using=nx.DiGraph)

R, Rmax = scalar_assortativity(G,gdp)
print('Assortativity by GDP: %1.4f' % (R/Rmax))
R, Rmax =  scalar_assortativity(G,life_expectancy)
print('Assortativity by life expectancy: %1.4f' % (R/Rmax))
R, Rmax =  scalar_assortativity(G,tariff)
print('Assortativity by tariff: %1.4f' % (R/Rmax))
```

```
C:\Users\Humza\AppData\Local\Temp\ipykernel_12512\906063264.py:25: FutureWarning: adj
acency_matrix will return a scipy.sparse array instead of a matrix in Networkx 3.0.
  A = array(nx.adjacency_matrix(G).todense().T)
Assortativity by GDP: -0.0005
Assortativity by life expectancy: 0.1281
```

```
C:\Users\Humza\AppData\Local\Temp\ipykernel_12512\906063264.py:25: FutureWarning: adj
acency_matrix will return a scipy.sparse array instead of a matrix in Networkx 3.0.
  A = array(nx.adjacency_matrix(G).todense().T)
Assortativity by tariff: 0.1191
```

In [7]:
```
print('HIGHLIGHTED QUESTION - Again, write a few sentences to describe what these valu
print('Assortativity by GDP is disassortatively mixed which could be because a high GD
print('Assortativity by life expectancy is assoratatively mixed which could be because
print('Assortativity by tariff is assortatively mixed which could be because countries
```

```
HIGHLIGHTED QUESTION - Again, write a few sentences to describe what these values tel
l you about the world trade system and reason why these attributes might be assortati
ve, disassortative, or neither.
Assortativity by GDP is disassortatively mixed which could be because a high GDP coun
try might be connected to multiple other low GDP countries and vice versa. It is very
close to 0 (randomly mixed) which tells us that GDP is not the biggest determiner of
trade.
Assortativity by life expectancy is assoratatively mixed which could be because count
ries with higher life expectancy are likely to be more developed and hence want goods
and services from each other.
Assortativity by tariff is assortatively mixed which could be because countries may n
ot want high tariffs applied to their trade, so deciding trade based on tariff makes
sense to keep prices low
```

In [8]:
```
print('HIGHLIGHTED QUESTION -  Do this algebraic activity to show the following simpli
```

```
HIGHLIGHTED QUESTION -  Do this algebraic activity to show the following simplificati
on
```

$$R = \frac{1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij} (x_i - \mu)(x_j - \mu) = \frac{1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij} (x_i - \mu_i)(x_j - \mu_j)$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} (x_i x_j - x_i \mu_j - x_j \mu_i + \mu_i \mu_j)$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i x_j - \left(\sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i\right) \mu_j - \left(\sum_{j=1}^{n} \sum_{i=1} A_{ij} x_j\right) \mu_i + \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} \mu_i \mu_j$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i x_j - \left(\frac{1}{2m} \sum_{i=1}^{n} k_i x_i\right) \mu_j - \left(\frac{1}{2m} \sum_{j=1}^{n} k_j x_j\right) \mu_i + \left(\frac{1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij}\right) \mu^2$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i x_j - \mu_i \mu_j - \mu_j \mu_i + \left(\cancel{\frac{\sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij}}}\right)^{1} \mu^2$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i x_j - \mu^2 - \mu^2 + \mu^2$$

$$= \left(\sum_{i=1}^{n} \sum_{j=1}^{n} \frac{1}{2m} A_{ij} x_i x_j\right) - \mu^2$$

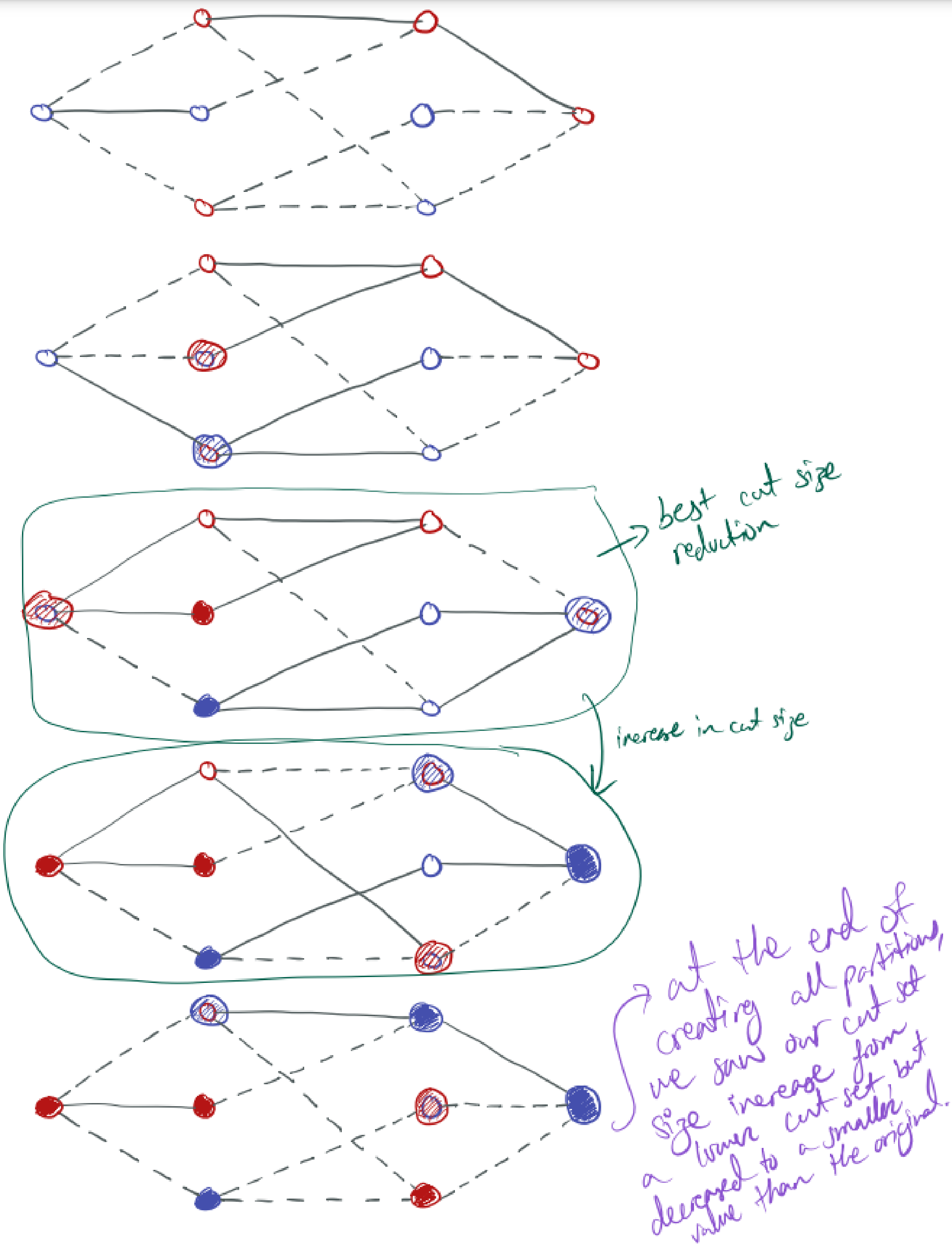
$$= \left(\frac{1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{n} A_{ij} x_i x_j\right) - \left(\frac{1}{4m} \sum_{i=1}^{n} \sum_{j=1}^{n} k_i k_j x_i x_j\right)$$

$$= \frac{1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{n} \left(A_{ij} - \frac{k_i k_j}{2m}\right) x_i x_j$$

Section 11.2 - 11.11 Partitioning & Community Detection

In [9]:
```
print('HIGHLIGHTED QUESTION - diagram an example in which the cut set size must increa
```

```
HIGHLIGHTED QUESTION - diagram an example in which the cut set size must increase bef
ore it decreases to a value smaller than the original.
```



In [10]:
```
print('HIGHLIGHTED QUESTION - Show that the modularity matrix satisfies the following
```

```
HIGHLIGHTED QUESTION - Show that the modularity matrix satisfies the following summat
ion property: ∑j=1:n Bij=0 where Bij=Aij-(kikj)/(2m)
```

Show $\sum_{j=1}^{n} B_{ij} = 0$

where $B_{ij} = A_{ij} - \frac{k_i k_j}{2m}$

$$\sum_{j=1}^{n} B_{ij} = \sum_{j=1}^{n} A_{ij} - \frac{k_i k_j}{2m}$$

$$\sum_{j=1}^{n} B_{ij} = \sum_{j=1}^{n} A_{ij} - \sum_{j=1}^{n} \frac{k_i k_j}{2m}$$

$$\sum_{j=1}^{n} B_{ij} = \sum_{j=1}^{n} A_{ij} - \frac{k_i}{2m} \sum_{j=1}^{n} k_j$$

newman eq. 6.19

newman eq. 6.20

$$\sum_{j=1}^{n} B_{ij} = k_i - \frac{k_i}{\cancel{2m}} \cancel{2m}$$

$$\sum_{j=1}^{n} B_{ij} = k_i - k_i$$

$$\sum_{j=1}^{n} B_{ij} = 0$$

Community Detection in Practice

In [10]:
```
print('HIGHLIGHTED QUESTION -  Think through why linking hashtags that co-occur in twe
```

```
HIGHLIGHTED QUESTION -  Think through why linking hashtags that co-occur in tweets co
uld give us a way of finding groups of hashtags with similar meanings. Find two tweet
s in the provided dataset that support this idea. Find one that doesn't (and explain
why).
```

In [11]:
```
print('{"created_at":"Thu Nov 26 21:31:13 +0000 2015","lang":"en","text":"RT @OrganicL
print('{"created_at":"Thu Nov 26 21:31:13 +0000 2015","lang":"en","text":"bernadine is
print('{"created_at":"Thu Nov 26 21:31:14 +0000 2015","lang":"en","text":"Hey @TheMagF

print()
print('Here we see the first two tweets contain hashtags that are related to each othe
```

{"created_at":"Thu Nov 26 21:31:13 +0000 2015","lang":"en","text":"RT @OrganicLiveFood: 37 millions bees found dead in Canada after planting #GMOs treated w #neonicotinoid class of #pesticides https://t.co/…"}
{"created_at":"Thu Nov 26 21:31:13 +0000 2015","lang":"en","text":"bernadine is currently Live Free Chat https://t.co/rl6xP0iJKx #filipina #pinay #philippines https://t.co/pvt1KzcrGn"}
{"created_at":"Thu Nov 26 21:31:14 +0000 2015","lang":"en","text":"Hey @TheMagP1 I want one of those #PiZero but MagPi#40 is out of stock. Cannot live without {it | thing | card | computer | ... }"}

Here we see the first two tweets contain hashtags that are related to each other in terms of topics and similarity, however the third tweet contains #PiZero which references a dish and #40 references a number. So, we see that co-occuring hashtags in a single tweet can be used to identify topics that are related to each other, but that may not always be the case if the hashtags do not contain useful information.

1. Identifying co-occurring hashtags in the data

In [12]:
```
# ##foggy!Living in Dallas #awesome. -- should output #foggy and #awesome
```

In [13]:
```
print('HIGHLIGHTED QUESTION - What does it mean if this file has empty lines?')
print('It means that a specific tweet did not have hashtags used, but in my hashtags_s
```

HIGHLIGHTED QUESTION - What does it mean if this file has empty lines?
It means that a specific tweet did not have hashtags used, but in my hashtags_sets.txt file I do not have empty lines because I take care of them in pre-processing before I output.

In [14]:
```
# \p{L} will match all unicode characters
# \p{N} will match all unicode digits
# [\p{L}\p{N}] will match any character present in this list
# [\p{L}\p{N}]+ will match any character present in this list from one to as many time
# #([\p{L}\p{N}]+)' will match any character present in unicode characters andor digit

pattern = r'#([\p{L}\p{N}]+)'
```

In [15]:
```
with open("raw_twitter.json", "r", encoding='utf-8') as f:
    with open('hashtag_sets.txt', 'w', encoding='utf-8') as fout:
        for line in f:
            if not line.strip():
                continue

            data = json.loads(line.strip())

            tweet = data['text']

            hashtags = re.findall(pattern, tweet)

            # hashtag pattern found in tweet
            if len(hashtags) != 0:
                result = ' '.join(hashtags)
                fout.write(result+'\n')
```

2. Building a network from the co-occuring hashtags

In [16]:
```
print('HIGHLIGHTED QUESTION -- How do we interpret this file as a (hypergraph) network
print('We can take each line as a hyperedge between the hashtags present within that l
```

HIGHLIGHTED QUESTION -- How do we interpret this file as a (hypergraph) network? Why don't we just analyze the hypergraph?
We can take each line as a hyperedge between the hashtags present within that line. This wouldn't be particulary useful to analyze since hypergraphs can't account for weights and also they are confusing.

In [17]:
```
G = nx.Graph()
```

In [18]:
```
with open("hashtag_sets.txt", "r", encoding='utf-8') as f:
    hashtags = [line.strip().split() for line in f]
```

In [19]:
```
print(hashtags[0])
```

['Simone', 'GF14']

In [20]:
```
hashtags = [[w.lower() for w in tags] for tags in hashtags]
```

In [21]:
```
print(hashtags[1])
```

['podemos']

In [22]:
```
for tweet in hashtags:
    for tag in tweet:
        G.add_node(tag)
```

In [23]:
```
print(G.number_of_nodes())
```

72379

In [24]:
```
for tweet in hashtags:
    for i in range(len(tweet)):
        for j in range(i+1, len(tweet)):
            if G.has_edge(tweet[i], tweet[j]):
                G[tweet[i]][tweet[j]]['weight'] += 1
            else:
                G.add_edge(tweet[i], tweet[j], weight=1)
```

In [25]:
```
nx.write_weighted_edgelist(G, 'hashtags.edgelist')
```

In [26]:
```
print(G.number_of_nodes())
print(G.number_of_edges())
```

72379
147860

3. Detecting communities in the network

In [27]:
```
LG = nx.read_weighted_edgelist('hashtags.edgelist',create_using=nx.Graph)
```

In [28]:
```
print(LG.number_of_nodes())
print(LG.number_of_edges())
```

51756
147860

In [29]:
```
print('I investigated the reason for why the number of nodes is lower but the number c
```

```
I investigated the reason for why the number of nodes is lower but the number of edge
s remains the same whenever I compare the original graph I created vs the one I loade
d in. This happens because write_weighted_edgelist will not account for nodes that ha
ve no edges, so they don't get written to the file.
```

In [30]:
```
cset = list(nx_comm.label_propagation_communities(LG))
```

In [31]:
```
biggest = 0
for comm in cset:
    if biggest < len(comm):
        biggest = len(comm)

print(biggest)
```

```
10500
```

4. Finding the most meaningful communities

In [33]:
```
def plot_communities(G, weight_threshold=0, component_size_threshold=0):

    # accumulate edges to remove
    remove_edges = []
    for u, v, weight in G.edges(data="weight"):
        if weight < weight_threshold: # only consider edges with weights greater than
            remove_edges.append((u, v))

    # remove edges
    G.remove_edges_from(remove_edges)

    # get components
    components = list(nx.connected_components(G))

    # accumulate nodes in small components
    small_component_nodes = []
    for comp in components:
        if len(comp) < component_size_threshold: # only consider components with size
            for n in comp:
                small_component_nodes.append(n)

    # remove nodes from original graph
    G.remove_nodes_from(small_component_nodes)

    # label propagation communities
    prop_comm = list(nx_comm.label_propagation_communities(G))

    # get sizes of each community
    comm_sizes = [len(i) for i in prop_comm]

    # plot histogram of communities
    plt.hist(comm_sizes,20, edgecolor='black', linewidth=1.2)
    plt.xlabel('community sizes')
    plt.ylabel('frequency')
    plt.show()

    with open(f'htag_communities_w{weight_threshold}_c{component_size_threshold}.txt',
        for comm in prop_comm:
            fout.write(str(comm)+'\n\n')
```

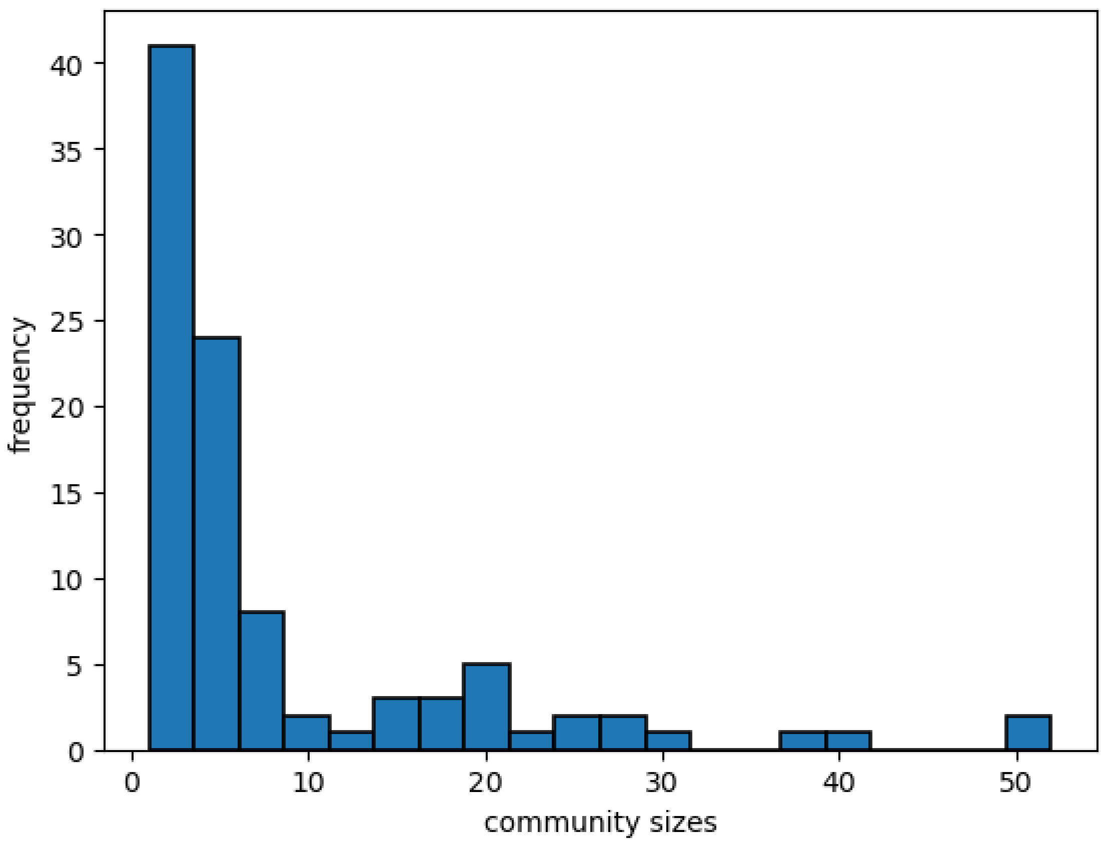
In [34]:
```
print('HIGHLIGHTED QUESTION -  What does it mean to ignore low weighted edges (in term
print('When we ignore low weighted edges, we are essentially saying that certain hasht
```

```
HIGHLIGHTED QUESTION -  What does it mean to ignore low weighted edges (in terms of t
weets/hashtags)? As we raise the threshold higher and higher, what does the network r
epresent?
When we ignore low weighted edges, we are essentially saying that certain hashtags th
at co-occur in tweets at a low frequency should not be considered in our community de
tection algorithm. As we raise the threshold higher and higher, the network represent
s only those hashtags that are very popular and occur with each other.
```

In [35]:
```
# read in graph from hashtags edgelist
LG = nx.read_weighted_edgelist('hashtags.edgelist',create_using=nx.Graph)
```

In [37]:
```
print('HIGHLIGHTED QUESTION -  plot a histogram of the distribution in community sizes
plot_communities(LG.copy(), weight_threshold=10, component_size_threshold=10)
```

```
HIGHLIGHTED QUESTION -  plot a histogram of the distribution in community sizes.
```



In [38]:
```
print('HIGHLIGHTED QUESTION - Find a community that "makes sense." Interpret the clust
print()
print("Community: {'thankfulselfie', 'blessed', 'uncles', 'gratitude', 'love', 'allabo
print()
print('This community makes sense. Based on the tags it seems to be about thanksgiving
```

```
HIGHLIGHTED QUESTION - Find a community that "makes sense." Interpret the cluster.

Community: {'thankfulselfie', 'blessed', 'uncles', 'gratitude', 'love', 'allaboutlov
e', 'football', 'teens', 'laquanmcdonald', 'thanks', 'iamthankfulfor', 'turkeyday',
'thankful', 'happythanksgiving', 'family', 'givethanks', 'lgm', 'holiday', 'matwh',
'cool', 'friends', 'thanksgiving', 'grateful', 'soccer', 'me', 'yearinspace', 'ha',
'thanksgiving2015', 'america'}

This community makes sense. Based on the tags it seems to be about thanksgiving and h
aving gratitude for family and friends. It also has references to football and americ
a since which makes sense given it is an american sport and holiday.
```

In [39]:

```python
print("HIGHLIGHTED QUESTION - Find a community that doesn't make sense. Explain why it
print()
print("Community: {'aldubdontgiveuponus', 'bwinmanila', 'ggmy', 'wheelsup'}")
print()
print("So I've gone through the communities and researched them. 'aldubdontgiveuponus'
```

```
HIGHLIGHTED QUESTION - Find a community that doesn't make sense. Explain why it does
n't make sense.

Community: {'aldubdontgiveuponus', 'bwinmanila', 'ggmy', 'wheelsup'}

So I've gone through the communities and researched them. 'aldubdontgiveuponus' seems
to be a phillipine power couple. 'bwimanilla' is a city. However, 'ggmy' means god ga
ve me you which is a song. 'wheelsup' probably means some sort of airplane flight or
it could be the private jet charter company. Overall, I'm just confused what is going
on because half of it makes sense and the other half does not.
```

In [ ]:

```python

```

In [40]:

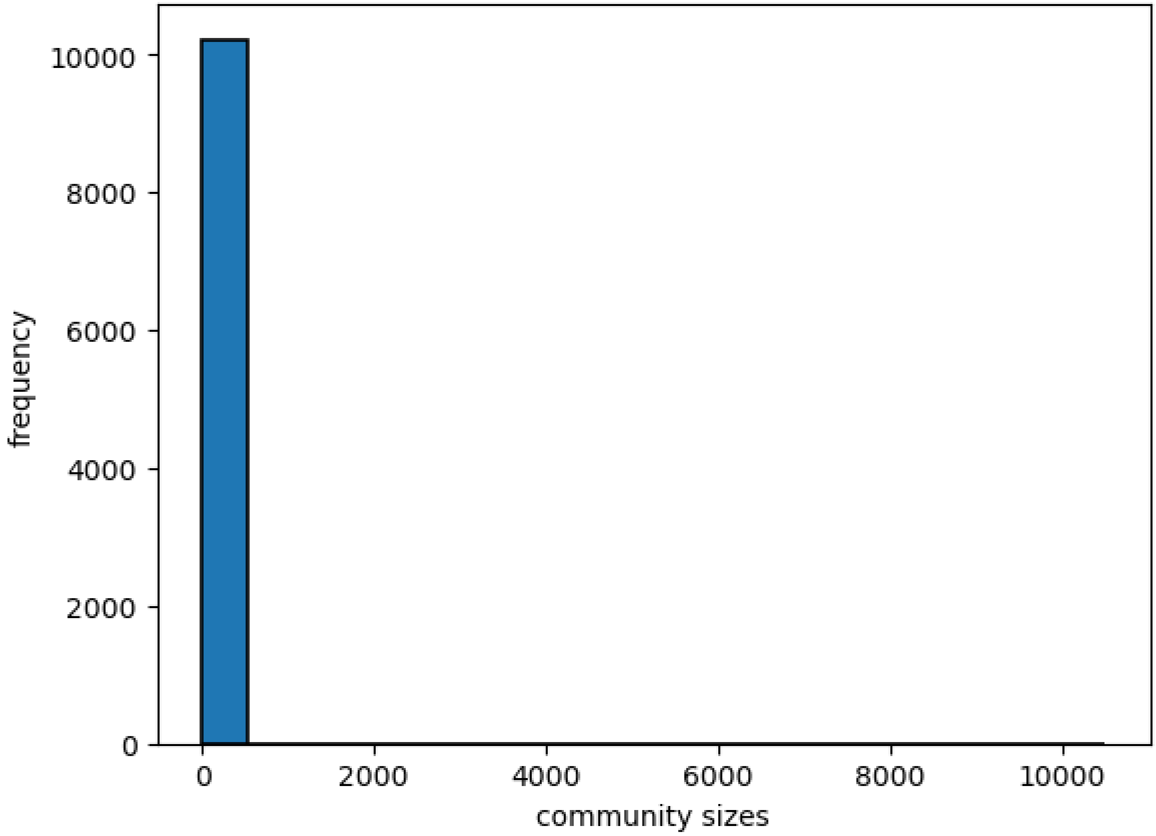
```python
print("Now explore the relationship of how the quality of the communities relates to t
```

```
Now explore the relationship of how the quality of the communities relates to the wei
ght threshold you impose and the component size you impose by trying a variety of the
se values (note the weight threshold and component threshold don't have to be the sam
e). Each time write the communities to a text file and examine the communities you ar
e finding – the ones that make sense and the ones that don't. Use these observations
to generalize the advantages and disadvantages of these threshold settings.
```

In [41]:

```python
print('Weight Threshold: 1 | Community Threshold: 1')
plot_communities(LG.copy(), weight_threshold=1, component_size_threshold=1)
print("Analysis: It seems that  this creates a lot of communities with relatively smal
```

```
Weight Threshold: 1 | Community Threshold: 1
```

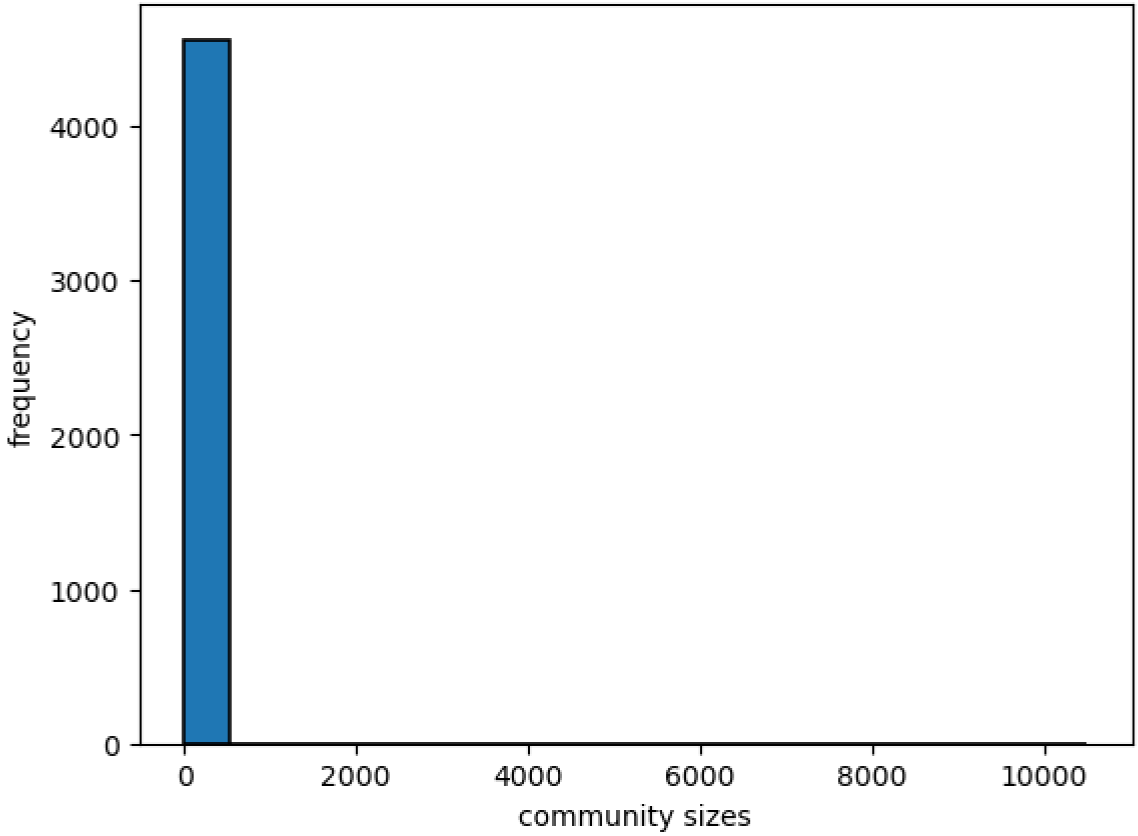



```
Analysis: It seems that  this creates a lot of communities with relatively smaller si
zes (niche interests), and a few communities that have a much larger spectrum of comp
atibility (broad interests). Overall, this seems to be better for spotting niche inte
rests as those are more easily recognizable.
```

In [42]:

```
print('Weight Threshold: 1 | Community Threshold: 15')
plot_communities(LG.copy(), weight_threshold=1, component_size_threshold=15)
print("Analysis: This is very similar to low weight and low threshold, however it defi
```

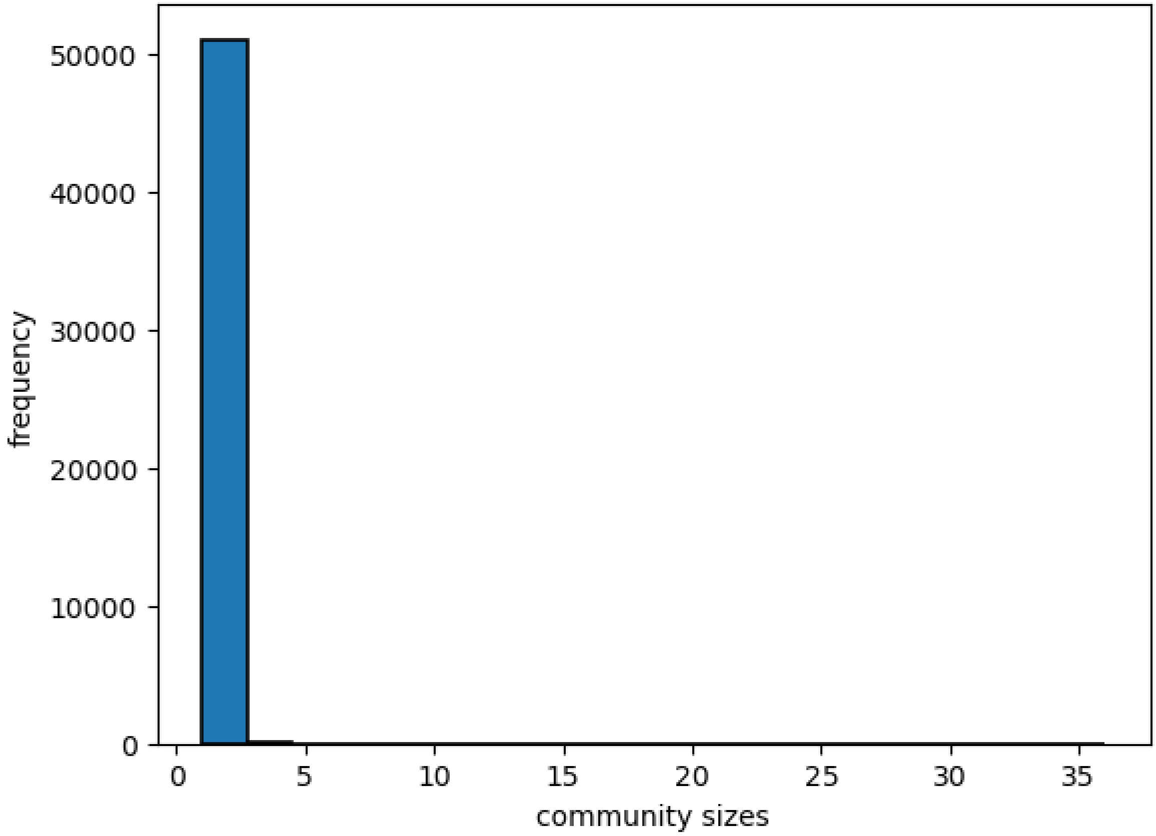
```
Weight Threshold: 1 | Community Threshold: 15
```




```
Analysis: This is very similar to low weight and low threshold, however it definitely
trims down a lot of communities that fall in the lower size threshold. This could be
useful so that we can focus on communities that are more connected with each other.
```

In [43]:
```python
print('Weight Threshold: 15 | Community Threshold: 1')
plot_communities(LG.copy(), weight_threshold=15, component_size_threshold=1)
print("Analysis: This seems to produce communities with either only one hashtag, or a
```

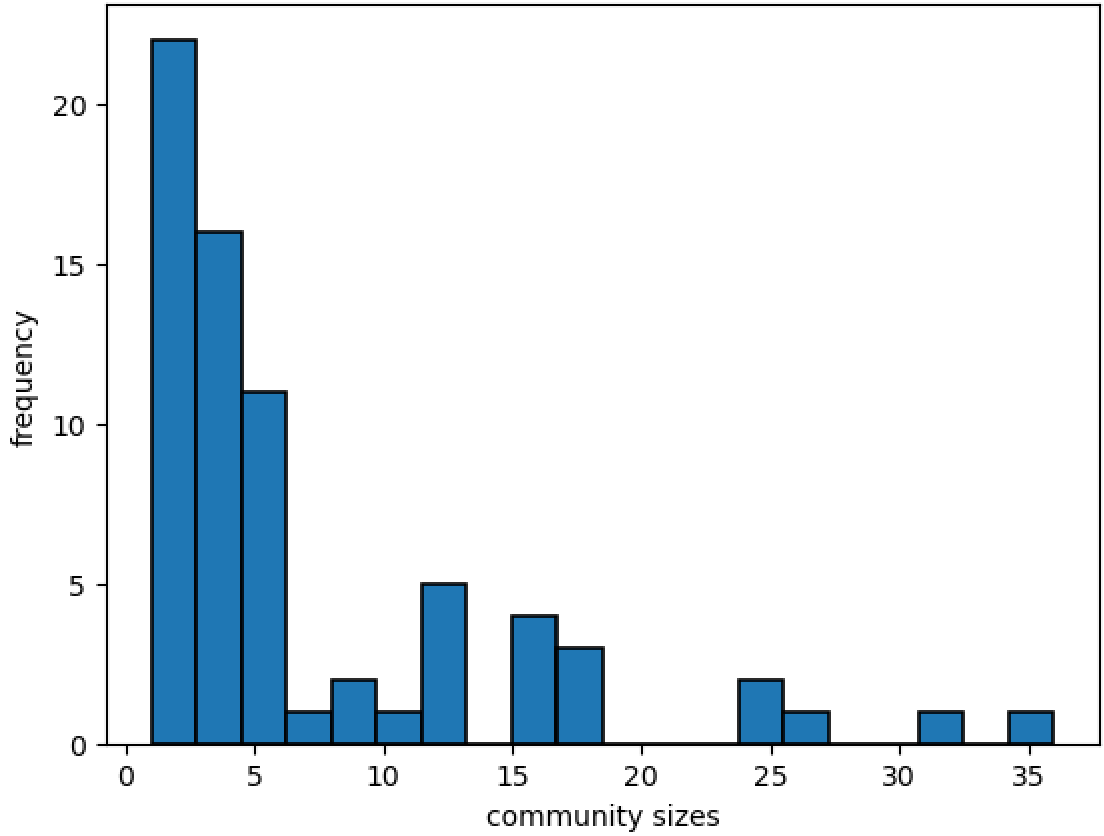
```
Weight Threshold: 15 | Community Threshold: 1
```




```
Analysis: This seems to produce communities with either only one hashtag, or a few ha
shtags combined together. This makes it easier to identify which communities are popu
lar since if the community is large then it is likely it is spoken about more often.
```

In [44]:
```
print('Weight Threshold: 15 | Community Threshold: 15')
plot_communities(LG.copy(), weight_threshold=15, component_size_threshold=15)
print("Analysis: This seems to produce communities where the hashtags are related to e
```

```
Weight Threshold: 15 | Community Threshold: 15
```




```
Analysis: This seems to produce communities where the hashtags are related to each ot
her in some way, so it could be useful in identifying categories.
```

In [45]:
```
print(' In your PDF, describe the strengths and weaknesses of each quadrant of the tab
```

```
 In your PDF, describe the strengths and weaknesses of each quadrant of the table. Pr
esent example communities from each quadrant that support your comments.
```

In [46]:
```
print('HIGHLIGHTED QUESTION - Finally, pick a topic/theme that you see in the data. Fo
```

```
HIGHLIGHTED QUESTION - Finally, pick a topic/theme that you see in the data. For each
threshold, find the communities that seem to correspond best to that topic. Which thr
eshold has communities that best represent that topic? Why? Is there a threshold choi
ce that is clearly the best? Why or why not?
```

In [47]:
```
print('Topic: Cooking')
print("Weight Threshold: 1 | Community Threshold: 1 | {'roasted', 'healthyrecipes', 'c
print()
print("Weight Threshold: 1 | Community Threshold: 15 | {'roasted', 'healthyrecipes', '
print()
print("Weight Threshold: 15 | Community Threshold: 1 | {'cooking', 'recipes'} | {'food
print()
print("Weight Threshold: 15 | Community Threshold: 15 | {'cooking', 'recipes'}")
print()
print('Lower weight thresholds seem to produce the best communities that represent the
```

```
Topic: Cooking
Weight Threshold: 1 | Community Threshold: 1 | {'roasted', 'healthyrecipes', 'cleans
e', 'taste', 'wildrice', 'grapes', 'entree', 'liquids', 'balsamicvinegar', 'feelinggo
od', 'salad', 'greens', 'detox'} | {'feastin', 'uwish', 'imgonnagetfat', 'fullplate',
'goodeats', 'goodcookin', 'eatinggood', 'bouttagettheitis'} | {'gustan', 'cupcakes',
'culinary', 'weloverecipes', 'easter', 'everdevega'}

Weight Threshold: 1 | Community Threshold: 15 | {'roasted', 'healthyrecipes', 'cleans
e', 'taste', 'wildrice', 'grapes', 'entree', 'liquids', 'balsamicvinegar', 'feelinggo
od', 'salad', 'greens', 'detox'} | {'gustan', 'cupcakes', 'culinary', 'weloverecipe
s', 'easter', 'everdevega'} | {'outdoorcooking', 'homemadefood'} | {'homecooking', 'c
arnetdecuisine', 'diner', 'soiree', 'fairelacuisine', 'bolsa'}

Weight Threshold: 15 | Community Threshold: 1 | {'cooking', 'recipes'} | {'foodrecipe
s'} | {'cookingskills'} | {'veganrecipehour'}

Weight Threshold: 15 | Community Threshold: 15 | {'cooking', 'recipes'}

Lower weight thresholds seem to produce the best communities that represent the cooki
ng topic. This is likely because of our data not having significant tweets about cook
ing related activities, so when we have a low weight threshold, those edges do not ge
t cut from our graph. From what I found community thresholds is not a huge influence
on the sub-communities formed with cooking. There is no best threshold choice since a
low weight treshold paired with either a low or high community threshold produces ver
y similar results. However, having a high weight threshold should be avoided since it
produces few communities. Although, high weight threshold and low community threshold
produces communities only related to cooking and recipes on a very literal scale. Low
weight thresholdpaired with any community threshold also includes things about how pe
ople feel about cooking and what ingredients they use, so it offers more variety. The
refore, it could be argued that its a better community since cooking has a lot to do
with taste, ingredients, and how it makes us feel.
```

In [ ]: