In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import networkx as nx
import random
# the random module will be used to create transaction ID's
```

In [2]:
```
# data source: https://snap.stanford.edu/data/soc-sign-bitcoin-otc.htm
l
trades = pd.read_csv("soc-sign-bitcoinotc.csv", names=['SOURCE', 'TARG
ET', 'RATING', 'TIME'])
```

In [3]:
```
print('shape:', trades.shape)
print('columns:', trades.columns)
print('basic info:', trades.info())
```

```
shape: (35592, 4)
columns: Index(['SOURCE', 'TARGET', 'RATING', 'TIME'], dtype='object
')
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 35592 entries, 0 to 35591
Data columns (total 4 columns):
SOURCE    35592 non-null int64
TARGET    35592 non-null int64
RATING    35592 non-null int64
TIME      35592 non-null float64
dtypes: float64(1), int64(3)
memory usage: 1.1 MB
basic info: None
```

In [4]:
```
# create column showing tuples of transactions
trades['from_to'] = list(trades[['SOURCE', 'TARGET']].itertuples(index
=False, name=None))
```

In [5]:
```
trades.shape[0]
```

Out[5]:
```
35592
```

In [6]:
```
# the next few steps will create column with transaction ID's;  ID's a
re 8-digits and begin with 4
draft_ids = random.sample(range(1000000, 9999999), trades.shape[0])
```

In [7]:
```
trades['draft_ids'] = draft_ids
```

In [8]:
```
trades['fours'] = '4'
```

In [9]:
```
trades['transaction_id'] = trades['fours'] + trades['draft_ids'].map(s
tr)
```

In [10]:
```
trades.drop(columns=['draft_ids', 'fours'], inplace=True)
```

In [11]:
```
trades.head(10)
```

Out[11]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id
0	6	2	4	1.289242e+09	(6, 2)	48055522
1	6	5	2	1.289242e+09	(6, 5)	49471633
2	1	15	1	1.289243e+09	(1, 15)	48231001
3	4	3	7	1.289245e+09	(4, 3)	48920200
4	13	16	8	1.289254e+09	(13, 16)	43574706
5	13	10	8	1.289254e+09	(13, 10)	41310084
6	7	5	1	1.289363e+09	(7, 5)	47392475
7	2	21	5	1.289371e+09	(2, 21)	44392015
8	2	20	5	1.289371e+09	(2, 20)	44677124
9	21	2	5	1.289381e+09	(21, 2)	45901069

In [14]:
```
d = {}
ID = []
for id in trades['transaction_id']:
    d['ID'] = id
    ID.append(d.copy())
```

In [15]:
```
trades['ID'] = ID
```

In [16]:
```
trades['to_from_ID'] = list(trades[['SOURCE', 'TARGET', 'ID']].itertup
les(index=False, name=None))
```

In [17]:
```
trades.head()
```

Out[17]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	to_
0	6	2	4	1.289242e+09	(6, 2)	48055522	{'ID': '48055522'}	(6, 2 '480
1	6	5	2	1.289242e+09	(6, 5)	49471633	{'ID': '49471633'}	(6, 5 '494
2	1	15	1	1.289243e+09	(1, 15)	48231001	{'ID': '48231001'}	(1, 1 '482
3	4	3	7	1.289245e+09	(4, 3)	48920200	{'ID': '48920200'}	(4, 3 '489
4	13	16	8	1.289254e+09	(13, 16)	43574706	{'ID': '43574706'}	(13, {'ID '435

In [18]:
```
df1 = trades[0:100]
```

In [19]:
```
# create single list of all nodes in the SOURCE and TARGET columns
source_unique = df1['SOURCE'].unique()
target_unique = df1['TARGET'].unique()
nodes_list = []
nodes_list.extend(source_unique)
nodes_list.extend(target_unique)
nodes_list = list(set(nodes_list))
```

In [20]:
```
print(nodes_list)
```

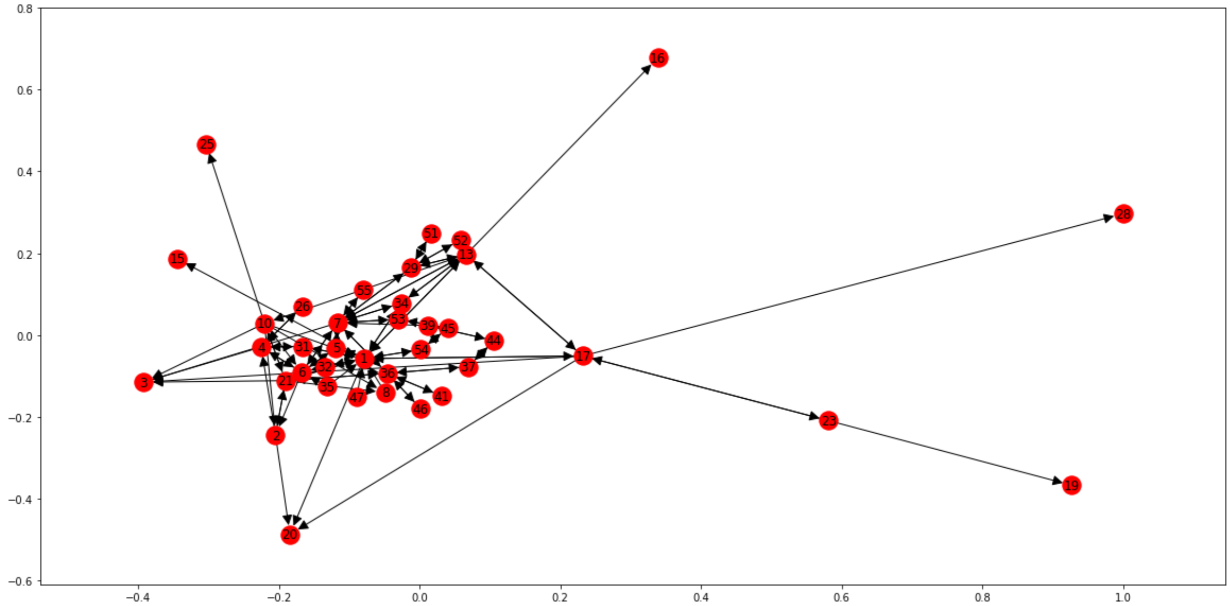
```
[1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 15, 16, 17, 19, 20, 21, 23, 25, 26,
28, 29, 31, 32, 34, 35, 36, 37, 39, 41, 44, 45, 46, 47, 51, 52, 53,
54, 55]
```

In [21]:
```
G1 = nx.DiGraph()
```

In [22]:
```
G1.add_nodes_from(nodes_list)
```

In [23]:
```
G1.add_edges_from(df1['from_to'])
```

In [24]:
```
plt.figure(figsize=(20, 10))
pos = nx.spring_layout(G1)
nx.draw_networkx(G1, pos, arrowsize=20)
plt.show()
```



In [25]:
```
# let's have a look at the transactions that node 17 sent and received
in the first hundred transactions:
df1.query("SOURCE == 17 | TARGET == 17")
```

Out[25]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	tc
14	17	3	5	1.289442e+09	(17, 3)	44542145	{'ID': '44542145'}	(17 '44
15	17	23	1	1.289490e+09	(17, 23)	48268104	{'ID': '48268104'}	(17 {'II '48
32	17	28	1	1.289836e+09	(17, 28)	44807601	{'ID': '44807601'}	(17 {'II '44
33	17	13	2	1.289873e+09	(17, 13)	45032408	{'ID': '45032408'}	(17 {'II '45
34	13	17	2	1.289874e+09	(13, 17)	45543697	{'ID': '45543697'}	(13 {'II '45
37	17	20	2	1.290108e+09	(17, 20)	45948372	{'ID': '45948372'}	(17 {'II '45
52	1	17	9	1.290969e+09	(1, 17)	47284865	{'ID': '47284865'}	(1, '47
60	17	1	9	1.291218e+09	(17, 1)	49027945	{'ID': '49027945'}	(17 '49
70	23	17	1	1.291624e+09	(23, 17)	49861456	{'ID': '49861456'}	(23 {'II '49

In [26]:
```
# In the diagram it appears that node 3 was on the strictly on the rec
eiving end in the first 100 transactions:
df1.query("SOURCE == 3 | TARGET == 3")
```

Out[26]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	to
3	4	3	7	1.289245e+09	(4, 3)	48920200	{'ID': '48920200'}	(4, '48
13	21	3	7	1.289442e+09	(21, 3)	47941408	{'ID': '47941408'}	(21 '47
14	17	3	5	1.289442e+09	(17, 3)	44542145	{'ID': '44542145'}	(17 '44
22	10	3	7	1.289556e+09	(10, 3)	49371601	{'ID': '49371601'}	(10 '49
88	7	3	6	1.292200e+09	(7, 3)	48872914	{'ID': '48872914'}	(7, '48

In [27]:
```
# this can also be shown using the following methods:
print(list(G1.predecessors(3)))
print(list(G1.successors(3)))
```

```
[4, 21, 17, 10, 7]
[]
```

In [29]:
```
# next we will use the same data to draw a multigraph
G2 = nx.MultiGraph()
```

In [30]:
```
G2.add_nodes_from(nodes_list)
```

In [31]:
```
G2.add_edges_from(df1['to_from_ID'])
G2[4]
```

Out[31]:
```
AdjacencyView({3: {0: {'ID': '48920200'}}, 26: {0: {'ID': '45604721'
}, 1: {'ID': '42307864'}}, 6: {0: {'ID': '46018265'}, 1: {'ID': '466
26573'}}, 2: {0: {'ID': '45900974'}}, 31: {0: {'ID': '46630109'}, 1:
{'ID': '44452342'}}})
```

In [33]:
```
plt.figure(figsize=(20, 10))
nx.draw_networkx(G2)
```