In [266]:
```
import pandas as pd
import matplotlib.pyplot as plt
import networkx as nx
import random
# networks will not be random but the random module will be used to cr
eate transaction ID's
```

In [267]:
```
# 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 [268]:
```
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 [269]:
```
# create column showing tuples of transactions
trades['from_to'] = list(trades[['SOURCE', 'TARGET']].itertuples(index
=False, name=None))
```

In [270]:
```
# create column with transaction ID's;  ID's are 6-digits and begin wi
th 4
transaction_ids = []
for a in range(0, trades.shape[0]):
    a = random.randint(10000, 100000)
    a = int(str('4') + str(a))
    transaction_ids.append(a)
```

In [271]:
```
trades['transaction_id'] = transaction_ids
```

In [272]:
```
d = {}
ID = []
for id in transaction_ids:
    d['ID'] = id
    ID.append(d.copy())
```

In [273]:
```
trades['ID'] = ID
```

In [274]:
```
trades['to_from_ID'] = list(trades[['SOURCE', 'TARGET', 'ID']].itertup
les(index=False, name=None))
```

In [275]:
```
trades.head()
```

Out[275]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	to_fron
0	6	2	4	1.289242e+09	(6, 2)	425116	{'ID': 425116}	(6, 2, {'I 425116
1	6	5	2	1.289242e+09	(6, 5)	472350	{'ID': 472350}	(6, 5, {'I 472350
2	1	15	1	1.289243e+09	(1, 15)	426239	{'ID': 426239}	(1, 15, { 426239
3	4	3	7	1.289245e+09	(4, 3)	437924	{'ID': 437924}	(4, 3, {'I 437924
4	13	16	8	1.289254e+09	(13, 16)	425102	{'ID': 425102}	(13, 16, {'ID': 425102

In [276]:
```
df1 = trades[0:100]
```

In [277]:
```
# 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 [278]:
```
print(nodes_list)
```

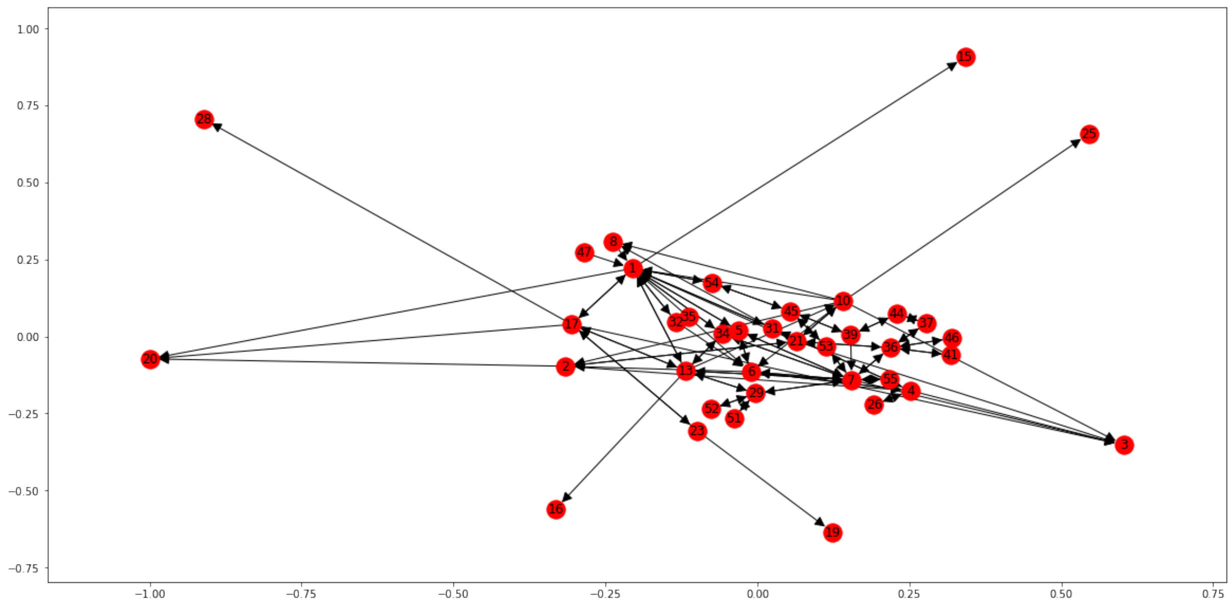
```
[1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 15, 16, 17, 19, 20, 21, 23, 25, 26,
28, 29, 31, 32, 34, 35, 36, 37, 39, 41, 44, 45, 46, 47, 51, 52, 53,
54, 55]
```

In [279]:
```
G1 = nx.DiGraph()
```

In [289]:
```
G1.add_nodes_from(nodes_list)
```

In [290]:
```
G1.add_edges_from(df1['from_to'])
```

In [291]:
```
plt.figure(figsize=(20, 10))
pos = nx.spring_layout(G1)
nx.draw_networkx(G1, pos, arrowsize=20)
plt.show()
```



In [292]:
```
# 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[292]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	to_fro
14	17	3	5	1.289442e+09	(17, 3)	416730	{'ID': 416730}	(17, 3, 41673
15	17	23	1	1.289490e+09	(17, 23)	480751	{'ID': 480751}	(17, 23 {'ID': 48075
32	17	28	1	1.289836e+09	(17, 28)	451787	{'ID': 451787}	(17, 28 {'ID': 45178
33	17	13	2	1.289873e+09	(17, 13)	417131	{'ID': 417131}	(17, 13 {'ID': 41713
34	13	17	2	1.289874e+09	(13, 17)	427246	{'ID': 427246}	(13, 17 {'ID': 42724
37	17	20	2	1.290108e+09	(17, 20)	470079	{'ID': 470079}	(17, 20 {'ID': 47007
52	1	17	9	1.290969e+09	(1, 17)	491966	{'ID': 491966}	(1, 17, 49196
60	17	1	9	1.291218e+09	(17, 1)	492426	{'ID': 492426}	(17, 1, 49242
70	23	17	1	1.291624e+09	(23, 17)	494014	{'ID': 494014}	(23, 17 {'ID': 49401

In [293]:
```
# 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[293]:

	SOURCE	TARGET	RATING	TIME	from_to	transaction_id	ID	to_fro
3	4	3	7	1.289245e+09	(4, 3)	437924	{'ID': 437924}	(4, 3, { 43792
13	21	3	7	1.289442e+09	(21, 3)	444614	{'ID': 444614}	(21, 3, 44461
14	17	3	5	1.289442e+09	(17, 3)	416730	{'ID': 416730}	(17, 3, 41673
22	10	3	7	1.289556e+09	(10, 3)	412171	{'ID': 412171}	(10, 3, 41217
88	7	3	6	1.292200e+09	(7, 3)	455404	{'ID': 455404}	(7, 3, { 45540

In [367]:
```
# 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 [376]:
```
# next we will use the same data to draw a multigraph
G2 = nx.MultiGraph()
```

In [377]:
```
G2.add_nodes_from(nodes_list)
```

In [378]:
```
G2.add_edges_from(df1['to_from_ID'])
G2[4]
```

Out[378]:
```
AdjacencyView({3: {0: {'ID': 437924}}, 26: {0: {'ID': 449035}, 1: {'
ID': 470085}}, 6: {0: {'ID': 485016}, 1: {'ID': 434719}}, 2: {0: {'I
D': 498119}}, 31: {0: {'ID': 424978}, 1: {'ID': 477738}}})
```

In [379]:
```
plt.figure(figsize=(20, 10))
nx.draw_networkx(G2)
```