BIG DATA
EXPERIENCE
CENTER

Data Sciences

Network Data

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Import module

In [1]:
```
import numpy as np
import networkx as nx
import pandas as pd
import matplotlib.pyplot as plt
```

Read data

In [2]:
```
dol_edge = pd.read_csv('./dolphin_edges.csv')
dol_vertice = pd.read_csv('./dolphin_vertices.csv')
```

In [3]:
```
dol_edge.head()
```

Out[3]:

	From	To
0	CCL	Double
1	DN16	Feather
2	DN21	Feather
3	Beak	Fish
4	Bumper	Fish

In [4]:
```
dol_vertice.head()
```

Out[4]:

	Name	Gender
0	Beak	Male
1	Beescratch	Male
2	Bumper	Male
3	CCL	Female
4	Cross	Male

In [5]:
```
#Returns a graph from Pandas DataFrame containing an edge list.
G = nx.from_pandas_edgelist(dol_edge, source='From', target='To',create_using=nx.MultiDiGraph)
```

In [6]:
```
#Sets node attributes from data dolphin_vertices
nx.set_node_attributes(G, dol_vertice.set_index('Name').to_dict('index'))
```

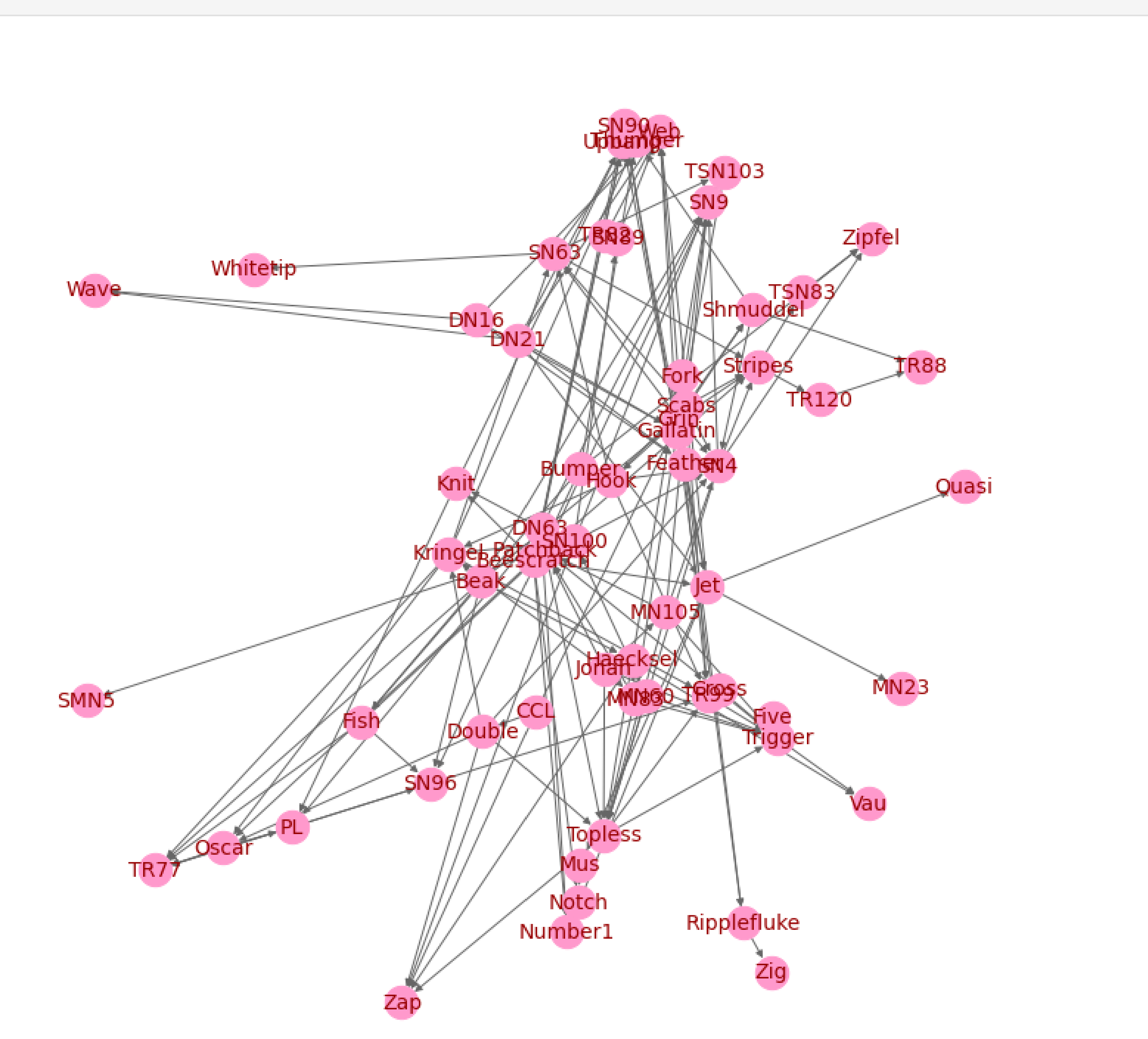
In [7]:
```
G.nodes(data=True)
```

Out[7]:
```
NodeDataView({'CCL': {'Gender': 'Female'}, 'Double': {'Gender': 'Female'}, 'DN16': {'Gender': 'Female'}, 'Feath
er': {'Gender': 'Male'}, 'DN21': {'Gender': 'Male'}, 'Beak': {'Gender': 'Male'}, 'Fish': {'Gender': 'Female'},
'Bumper': {'Gender': 'Male'}, 'Gallatin': {'Gender': 'Male'}, 'Grin': {'Gender': 'Female'}, 'Haecksel': {'Gende
r': 'Male'}, 'Hook': {'Gender': 'Female'}, 'Beescratch': {'Gender': 'Male'}, 'Jet': {'Gender': 'Male'}, 'Jona
h': {'Gender': 'Male'}, 'Knit': {'Gender': 'Male'}, 'DN63': {'Gender': 'Male'}, 'Kringel': {'Gender': 'Femal
e'}, 'MN105': {'Gender': 'Male'}, 'MN23': {'Gender': 'Male'}, 'MN83': {'Gender': 'Male'}, 'Mus': {'Gender': 'Ma
le'}, 'Notch': {'Gender': 'Male'}, 'Number1': {'Gender': 'Male'}, 'Oscar': {'Gender': 'Male'}, 'Patchback': {'G
ender': 'Male'}, 'PL': {'Gender': 'Male'}, 'Quasi': {'Gender': 'Male'}, 'Ripplefluke': {'Gender': 'Unknown'},
'Fork': {'Gender': 'Male'}, 'Scabs': {'Gender': 'Female'}, 'Shmuddel': {'Gender': 'Female'}, 'SMN5': {'Gender':
'Male'}, 'SN100': {'Gender': 'Female'}, 'MN60': {'Gender': 'Male'}, 'SN4': {'Gender': 'Female'}, 'SN63': {'Gend
er': 'Female'}, 'SN89': {'Gender': 'Female'}, 'SN9': {'Gender': 'Female'}, 'SN90': {'Gender': 'Male'}, 'SN96':
{'Gender': 'Male'}, 'Stripes': {'Gender': 'Female'}, 'Thumper': {'Gender': 'Male'}, 'Topless': {'Gender': 'Mal
e'}, 'TR120': {'Gender': 'Female'}, 'TR77': {'Gender': 'Female'}, 'TR88': {'Gender': 'Female'}, 'TR99': {'Gende
r': 'Female'}, 'Cross': {'Gender': 'Male'}, 'Trigger': {'Gender': 'Female'}, 'Five': {'Gender': 'Female'}, 'TSN
103': {'Gender': 'Female'}, 'TSN83': {'Gender': 'Unknown'}, 'Upbang': {'Gender': 'Male'}, 'Vau': {'Gender': 'Fe
male'}, 'Wave': {'Gender': 'Female'}, 'Web': {'Gender': 'Male'}, 'TR82': {'Gender': 'Unknown'}, 'Whitetip': {'G
ender': 'Female'}, 'Zap': {'Gender': 'Unknown'}, 'Zig': {'Gender': 'Male'}, 'Zipfel': {'Gender': 'Male'}})
```

In [8]:
```
#Test node attributes
G.nodes["CCL"]
```

Out[8]:
```
{'Gender': 'Female'}
```

In [9]:
```
#Draw networks graph
plt.figure(3,figsize=(10,10))
nx.draw(G,with_labels=True, node_size=500, font_size=14, node_color='#FF99CC',edge_color ='#666666',font_color
plt.show()
```



In [10]:
```
print(nx.info(G))
```

```
Name:
Type: MultiDiGraph
Number of nodes: 62
Number of edges: 159
Average in degree:   2.5645
Average out degree:   2.5645
```

In [11]:
```
pd.DataFrame(G.degree, columns=['Node','Degree'])
```

Out[11]:

	Node	Degree
0	CCL	3
1	Double	6
2	DN16	4
3	Feather	7
4	DN21	6
...	...	...
57	TR82	1
58	Whitetip	1
59	Zap	5
60	Zig	1
61	Zipfel	3

62 rows × 2 columns

In [12]:
```
dol_in = pd.DataFrame(G.in_degree, columns=['Node','In-degree'])
dol_in
```

Out[12]:

	Node	In-degree
0	CCL	0
1	Double	1
2	DN16	0
3	Feather	2
4	DN21	0
...	...	...
57	TR82	0
58	Whitetip	1
59	Zap	5
60	Zig	1
61	Zipfel	3

62 rows × 2 columns

In [13]:
```
dol_out = pd.DataFrame(G.out_degree, columns=['Node','Out-degree'])
dol_out
```

Out[13]:

	Node	Out-degree
0	CCL	3
1	Double	5
2	DN16	4
3	Feather	5
4	DN21	6
...	...	...
57	TR82	1
58	Whitetip	0
59	Zap	0
60	Zig	0
61	Zipfel	0

62 rows × 2 columns

1. Who are the most popular?

In [14]:
```
dol_in.sort_values('In-degree',ascending=False).head()
```

Out[14]:

	Node	In-degree
49	Trigger	9
56	Web	9
43	Topless	8
35	SN4	7
38	SN9	7

จากข้อมูล โหนดที่มีระดับ most popular คือ Node "Trigger" และ "Web" โดยมีค่า In-degree เท่ากับ 9

2. Pick 2 individuals, find the shortest path between them

In [15]:
```
dolphin_weight = dol_edge.copy()
dolphin_weight['Weight'] = 1
dolphin_weight
```

Out[15]:

	From	To	Weight
0	CCL	Double	1
1	DN16	Feather	1
2	DN21	Feather	1
3	Beak	Fish	1
4	Bumper	Fish	1
...	...	...	...
154	Topless	Zap	1
155	Ripplefluke	Zig	1
156	Bumper	Zipfel	1
157	SN4	Zipfel	1
158	TSN83	Zipfel	1

159 rows × 3 columns

In [16]:
```
G_dolphin_weight = nx.from_pandas_edgelist(dolphin_weight,source='From', target='To',
                                           edge_attr='Weight',create_using=nx.MultiDiGraph)
```

In [17]:
```
print([p for p in nx.all_shortest_paths(G_dolphin_weight,'Beak','Trigger',weight='Weight')])
```

```
[['Beak', 'Fish', 'Patchback', 'Trigger'], ['Beak', 'Grin', 'MN83', 'Trigger'], ['Beak', 'Haecksel', 'MN83', 'T
rigger'], ['Beak', 'Grin', 'TR99', 'Trigger'], ['Beak', 'SN96', 'TR99', 'Trigger'], ['Beak', 'Haecksel', 'Jona
h', 'Trigger'], ['Beak', 'Haecksel', 'Topless', 'Trigger']]
```

In [18]:
```
nx.shortest_path(G_dolphin_weight,'Beak','Trigger',weight='Weight')
```

Out[18]:
```
['Beak', 'Fish', 'Patchback', 'Trigger']
```

In [19]:
```
nx.shortest_path_length(G_dolphin_weight,'Beak','Trigger',weight='Weight')
```

Out[19]:
```
3
```

จากข้อมูล 'Beak', 'Fish', 'Patchback', 'Trigger' นี่คือเส้นทางที่สั้นที่สุดระหว่าง Node Beak และ Node Trigger โดยเส้นทางที่สั้นที่สุดมีความยาวเท่ากับ 3 หน่วย

3. What does the shortest path mean?

จากข้อมูลกราฟชุดนี้แต่ละโหนดจะแสดงข้อมูลเกี่ยวกับ Dolphin Social Network ซึ่ง shortest path จะแสดงถึงระยะห่างของการเชื่อมต่อระหว่างกัน ยิ่งระยะห่างใกล้กันมากเท่าไหร่ ก็จะทำให้โหนด 2 โหนด สามารถที่จะโต้ตอบและค้นหากันบนอินเทอร์เน็ตได้ง่ายขึ้น

4. Find how many components are there in the network

In [20]:
```
G_dol_components = nx.from_pandas_edgelist(dol_edge, 'From', 'To',create_using=nx.Graph)
```

In [21]:
```
[x for x in nx.connected_components(G_dol_components)]
```

Out[21]:
```
[{'Beak',
  'Beescratch',
  'Bumper',
  'CCL',
  'Cross',
  'DN16',
  'DN21',
  'DN63',
  'Double',
  'Feather',
  'Fish',
  'Five',
  'Fork',
  'Gallatin',
  'Grin',
  'Haecksel',
  'Hook',
  'Jet',
  'Jonah',
  'Knit',
  'Kringel',
  'MN105',
  'MN23',
  'MN60',
  'MN83',
  'Mus',
  'Notch',
  'Number1',
  'Oscar',
  'PL',
  'Patchback',
  'Quasi',
  'Ripplefluke',
  'SMN5',
  'SN100',
  'SN4',
  'SN63',
  'SN89',
  'SN9',
  'SN90',
  'SN96',
  'Scabs',
  'Shmuddel',
  'Stripes',
  'TR120',
  'TR77',
  'TR82',
  'TR88',
  'TR99',
  'TSN103',
  'TSN83',
  'Thumper',
  'Topless',
  'Trigger',
  'Upbang',
  'Vau',
  'Wave',
  'Web',
  'Whitetip',
  'Zap',
  'Zig',
  'Zipfel'}]
```

In [22]:
```
nx.number_connected_components(G_dol_components)
```

Out[22]:
```
1
```

In [23]:
```
len([x for x in nx.connected_components(G_dol_components)])
```

Out[23]:
```
1
```

จากข้อมูลสรุปได้ว่า มีเพียง 1 component ใน network