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SMA_Labsheet - 7: Detecting communities in large networks using networkx package

EXERCISSE - 1

1. Import the networkx package and set up the environment to initialise communities

In [6]:
```
import networkx as nx
import networkx.algorithms.community as nxcom
from matplotlib import pyplot as plt
%matplotlib inline
plt.rcParams.update(plt.rcParamsDefault)
plt.rcParams.update({'figure.figsize': (15, 10)})
```

In [7]:
```
import random
from numpy import random as nprand
random.seed(123)
nprand.seed(123)
```

2. Initialise the karate club graph and find the number of communities

In [11]:
```
G_karate = nx.karate_club_graph()
communities = sorted(nxcom.greedy_modularity_communities(G_karate), key=len, r
print(f"The karate club has {len(communities)} communities.")
```

```
The karate club has 3 communities.
```

3. Define utility functions to assign the communities to nodes and edges

In [13]:
```
def set_node_community(G, communities):
        '''Add community to node attributes'''
        for c, v_c in enumerate(communities):
            for v in v_c:
                G.nodes[v]['community'] = c + 1
```

In [14]:
```
def set_edge_community(G):
        '''Find internal edges and add their community to their attributes'''
        for v, w, in G.edges:
            if G.nodes[v]['community'] == G.nodes[w]['community']:
                G.edges[v, w]['community'] = G.nodes[v]['community']
            else:
                G.edges[v, w]['community'] = 0
```

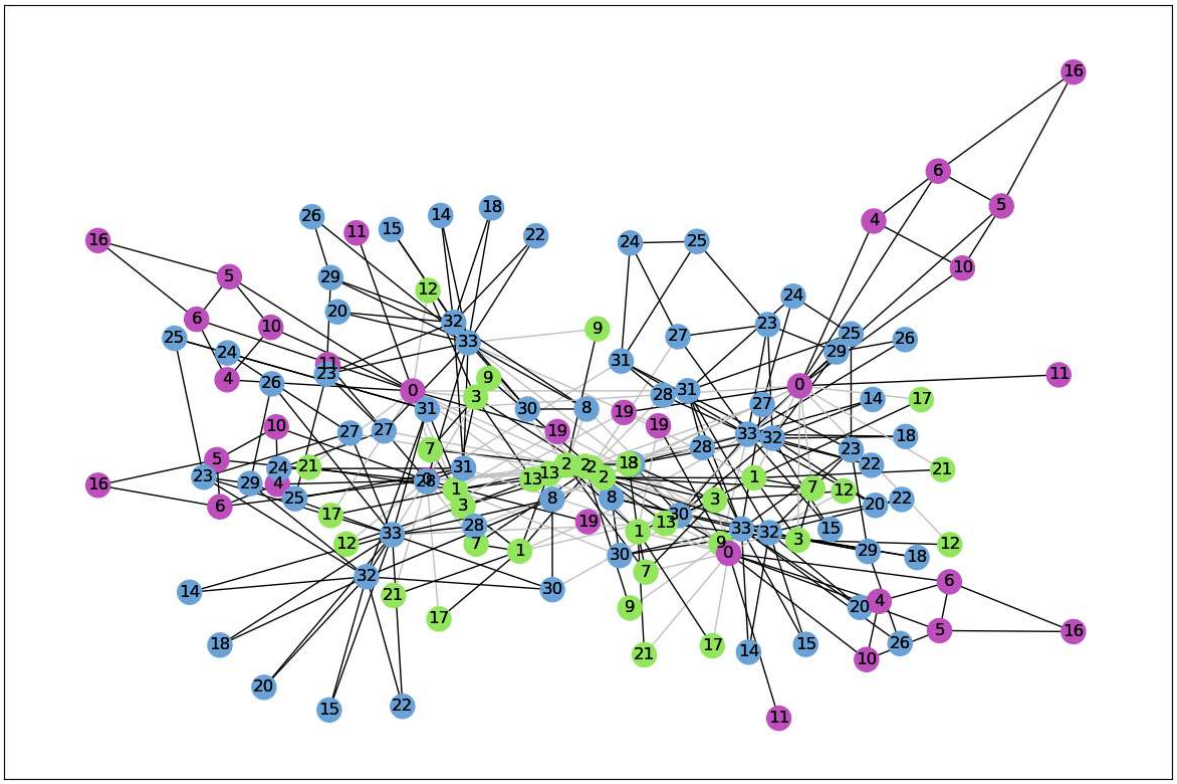
In [15]:
```
def get_color(i, r_off=1, g_off=1, b_off=1):
        '''Assign a color to a vertex.'''
        r0, g0, b0 = 0, 0, 0
        n = 16
        low, high = 0.1, 0.9
        span = high - low
        r = low + span * (((i + r_off) * 3) % n) / (n - 1)
        g = low + span * (((i + g_off) * 5) % n) / (n - 1)
        b = low + span * (((i + b_off) * 7) % n) / (n - 1)
        return (r, g, b)
```

4. Visualise the communities by plotting the graph

In [16]:
```
set_node_community(G_karate, communities)
set_edge_community(G_karate)
node_color = [get_color(G_karate.nodes[v]['community']) for v in G_karate.node
```

In [17]:
```
external = [(v, w) for v, w in G_karate.edges if G_karate.edges[v, w]['communi
internal = [(v, w) for v, w in G_karate.edges if G_karate.edges[v, w]['communi
internal_color = ['black' for e in internal]
```

In [23]:
```
karate_pos = nx.spring_layout(G_karate)
plt.rcParams.update({'figure.figsize': (15, 10)})
nx.draw_networkx(G_karate,pos=karate_pos,node_size=0,edgelist=external,edge_cc
nx.draw_networkx(G_karate,pos=karate_pos,node_color=node_color,edgelist=interr
plt.show()
```



Exercise - 2

1. Import the facebook dataset and find the communities using the above steps

In [44]:
```
data_path = './facebook_combined.txt'
G_social = nx.read_edgelist(data_path)
```

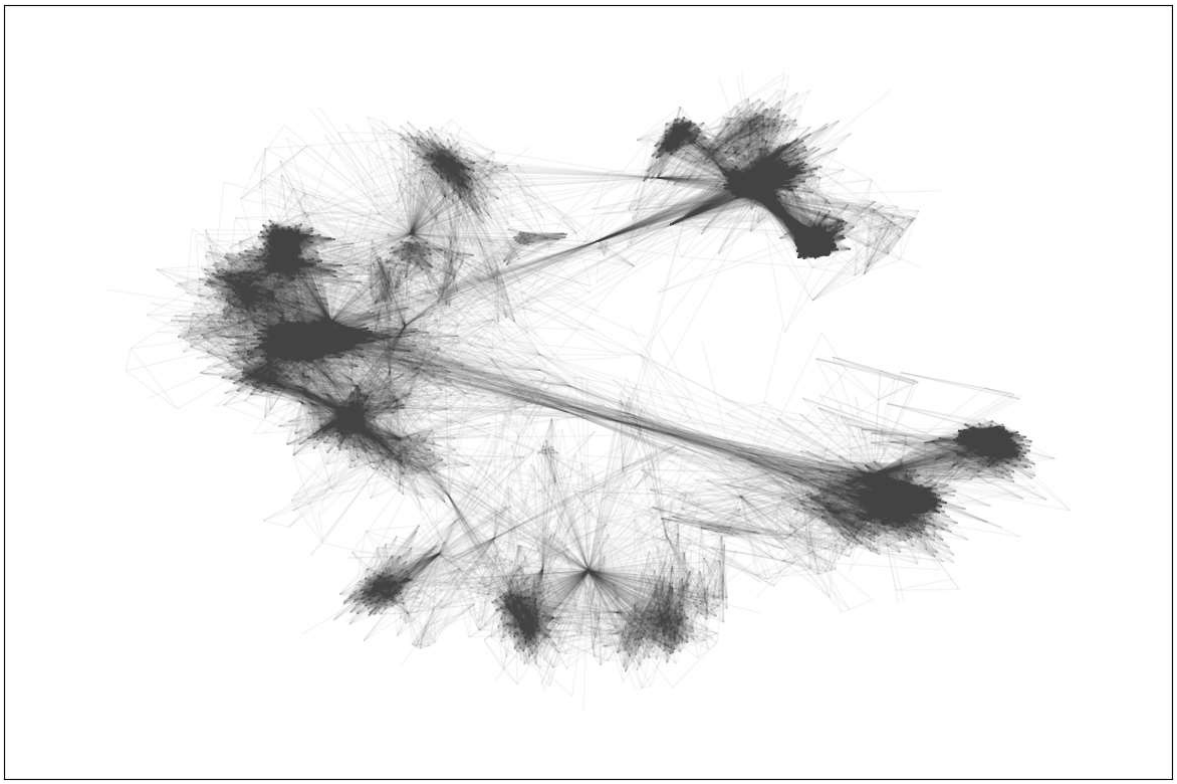
In [41]:
```
df = open("facebook_combined.txt", "r")
print(df.read())
```

```
0 1
0 2
0 3
0 4
0 5
0 6
0 7
0 8
0 9
0 10
0 11
0 12
0 13
0 14
0 15
0 16
0 17
0 18
0 19
```

2. Plot the graph and visualise it

In [45]:
```
G_social = nx.read_edgelist(data_path)
```

In [46]:
```
pos = nx.spring_layout(G_social, k=0.1)
plt.rcParams.update({'figure.figsize': (15, 10)})
nx.draw_networkx(G_social,pos=pos,node_size=0,edge_color="#444444",alpha=0.05,
plt.show()
```



3. Render the graph using the defined utility functions

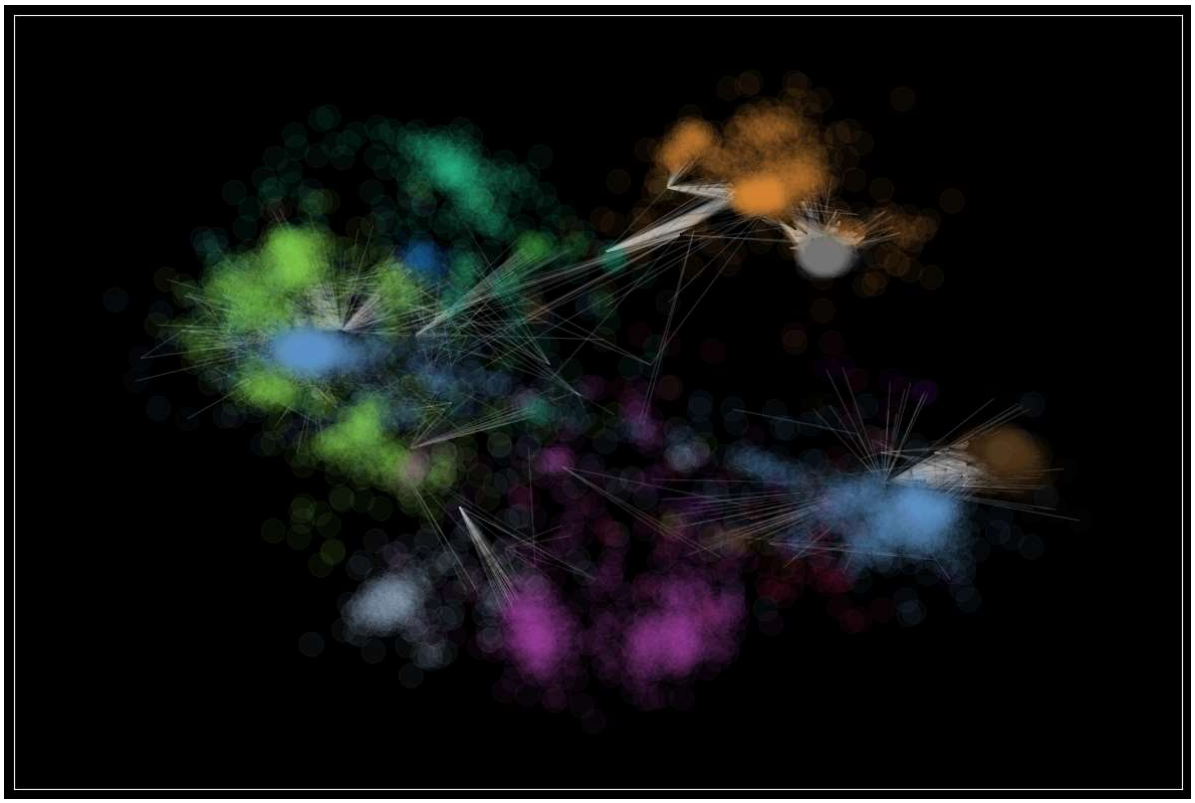
In [47]:
```
communities = sorted(nxcom.greedy_modularity_communities(G_social), key=len, r
len(communities)
```

Out[47]: 16

In [48]:
```
plt.rcParams.update(plt.rcParamsDefault)
plt.rcParams.update({'figure.figsize': (15, 10)})
plt.style.use('dark_background')
set_node_community(G_social, communities)
set_edge_community(G_social)
```

In [49]:
```
external = [(v, w) for v, w in G_social.edges if G_social.edges[v, w]['communi
internal = [(v, w) for v, w in G_social.edges if G_social.edges[v, w]['communi
internal_color = ["black" for e in internal]
node_color = [get_color(G_social.nodes[v]['community']) for v in G_social.node
```

In [50]:
```
nx.draw_networkx(G_social,pos=pos,node_size=0,edgelist=external,edge_color="si
nx.draw_networkx(G_social, pos=pos,edgelist=internal,edge_color=internal_color
plt.show()
```



4. Apply Girvan Community Detection to find the communities from the 2 datasets - karate club and facebook

In [51]:
```
result = nxcom.girvan_newman(G_karate)
communities = next(result)
len(communities)
```

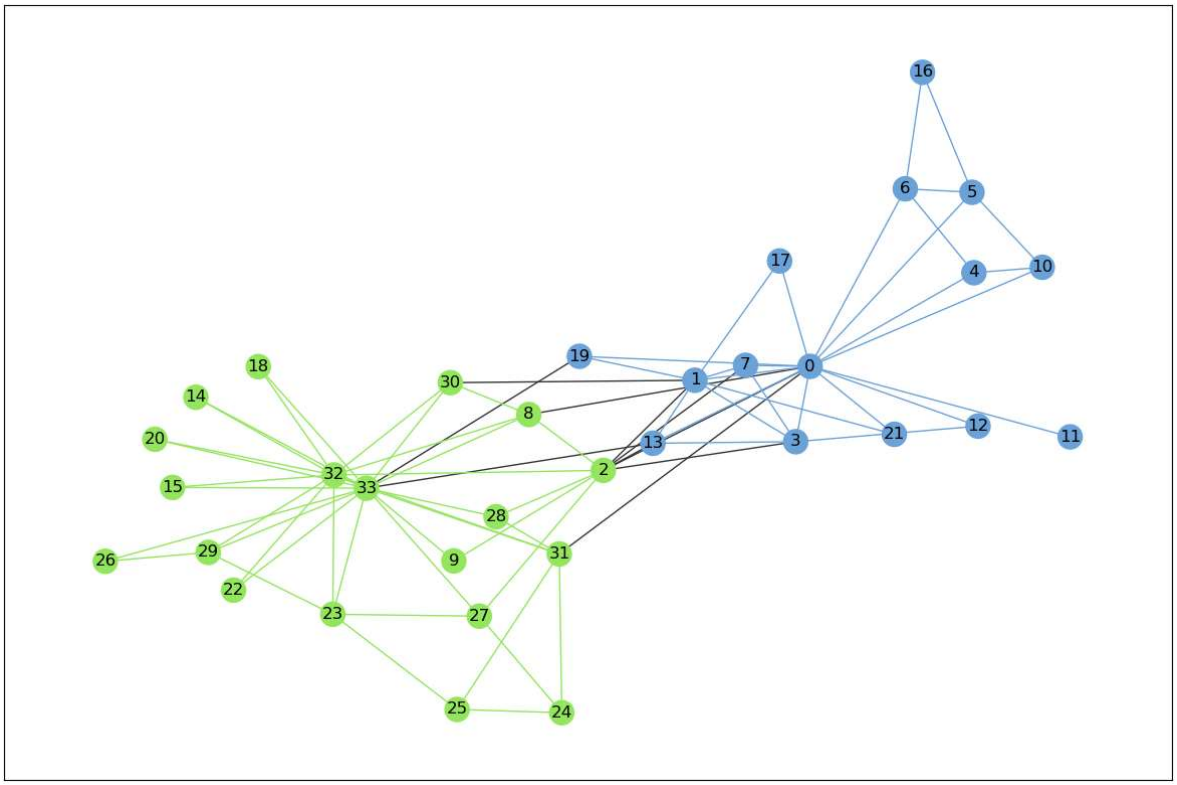
Out[51]: 2

In [52]:
```
 plt.rcParams.update(plt.rcParamsDefault)
plt.rcParams.update({'figure.figsize': (15, 10)})
```

In [53]:
```
set_node_community(G_karate, communities)
set_edge_community(G_karate)
```

In [54]:
```
node_color = [get_color(G_karate.nodes[v]['community']) for v in G_karate.node
external = [(v, w) for v, w in G_karate.edges if G_karate.edges[v, w]['communi
internal = [(v, w) for v, w in G_karate.edges if G_karate.edges[v, w]['communi
internal_color = [get_color(G_karate.edges[e]['community']) for e in internal]
karate_pos = nx.spring_layout(G_karate)
```

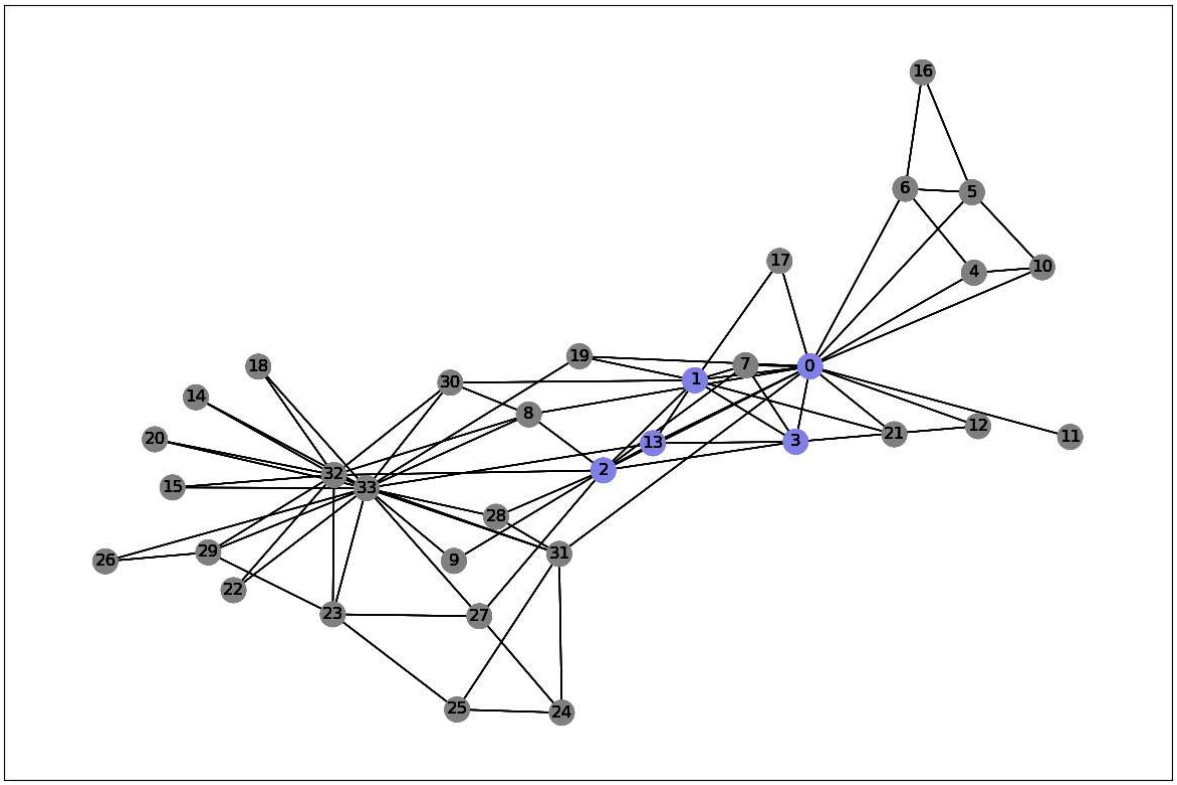
In [55]:
```
nx.draw_networkx(G_karate, pos=karate_pos, node_size=0,edgelist=external, edge
nx.draw_networkx(G_karate, pos=karate_pos, node_color=node_color,edgelist=inte
plt.show()
```



5. Find the Cliques, k-plex and k-core from the graph

In [56]:
```
#Cliques

plt.rcParams.update(plt.rcParamsDefault)
plt.rcParams.update({'figure.figsize': (15, 10)})
cliques = list(nx.find_cliques(G_karate))
max_clique = max(cliques, key=len)
node_color = [(0.5, 0.5, 0.5) for v in G_karate.nodes()]
for i, v in enumerate(G_karate.nodes()):
    if v in max_clique:
        node_color[i] = (0.5, 0.5, 0.9)
        nx.draw_networkx(G_karate, node_color=node_color, pos=karate_pos)
plt.show()
```



In [58]:
```
# k-core

G_core_30 = nx.k_core(G_social, 30)
G_core_60 = nx.k_core(G_social, 60)
```

In [59]:
```
plt.rcParams.update(plt.rcParamsDefault)
plt.rcParams.update({'figure.figsize': (15, 10)})
plt.style.use('dark_background')
pos = nx.spring_layout(G_social, k=0.1)
nx.draw_networkx(G_social, pos=pos, node_size=0, edge_color="#333333", alpha=0
nx.draw_networkx(G_core_30, pos=pos, node_size=0, edge_color="green", alpha=0.
nx.draw_networkx(G_core_60, pos=pos, node_size=0, edge_color="red", alpha=0.05
plt.show()
```