NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Cachar, Assam

B.Tech. VIth Sem

Subject Code: CS-321

Subject Name: Social Network Analysis Lab

Submitted By:

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Branch : CSE – B

AIM: TO GENERATE OVERLAPPING COMMUNITIES WITH WLC ALGORITHM METHOD AND VISUALIZE THE GENERATED COMMUNITIES USING NETWORKX LIBRARY OR GEPHI. (ALTERNATIVELY, CAN ALSO USE ANY OF THE FOLLOWING TOOLS: MATPLOTLIB, PLOTLY, GGPLOT, SEABORN, BOKEH).

THEORY:

1. **Overlapping Community:** In network theory, overlapping community detection is one node having multiple community memberships in the networks.

2. **WLC Algorithm:** It is a local algorithm for overlapping community detection based on clustering coefficient and common neighbour similarity**.**

   REAL WORLD NETWORK DATASETS: Zachary's Karate Club, American College Football and Dolphin Social Network.

CODE:

```
import networkx as nx
import time
import matplotlib.pyplot as plt
from collections import defaultdict

def modu1(G,N,res):
    m=0
    for  U in res:
        n=len(U);

        S=G.subgraph(U)

        rr=[]
        for kk in res:
            if not kk==U:
                rr.extend(kk)

        ov=list(set(U).intersection(set(rr)))

        sum1= 0
        i=0
        while i<len(U):
            j=i+1
            while j<len(U):
                if U[i] in ov :


                    o=S.degree(U[i])
```

```
                    o1=0

                    for ll in res:
                        if U[i] in ll:
                            S1=G.subgraph(ll)
                            o1=o1+S1.degree(U[i])

                    al1=o/o1
                else :
                    al1=1

                if  U[j] in ov  :


                    oo=S.degree(U[j])


                    oo1=0
                    for ll in res:

                        if U[j]in ll:
                            S1=G.subgraph(ll)
                            oo1=oo1+S1.degree(U[j])

                    al2=oo/oo1

                else :

                    al2=1




                #tt=2*cpt


                if G.has_edge(U[j],U[i]) :
                    x=((1-((G.degree(U[i])*G.degree(U[j]))/(2*N)))*al1*al2)
                    sum1= sum1+2*x

                else :


                    sum1= sum1+2*((0-
((G.degree(U[i])*G.degree(U[j]))/(2*N)))*al1*al2)
                j=j+1
            i=i+1
        m=m+sum1
```

```
    m=m/(2*N)

    return(m)

def WLC(path,sep):

    t=[]
    tri=[]

    print('graph loading')
    G=nx.read_edgelist(path, comments='#', delimiter=sep,
nodetype=int,encoding='utf-8')#txt file

    print('graph loading')


    ns=len(G.nodes())
    N=G.number_of_edges()

    t=[]
    den=nx.density(G)

    re=[]
    res=[]
    res1=[]
    res2=[]
    rr=[]

    w1=[]
    tps1= time.time()
    T11=list(G.nodes())
    i=0
    while i<len(T11):
        cpt1=0
        xx=list (G.neighbors(T11[i]))
        a=len(xx)
        j=0
        while j < a-1:
            j1=j+1
            while j1<a:
                if  G.has_edge(xx[j],xx[j1]):
                   cpt1=cpt1+1
                j1=j1+1
            j=j+1
        if a>1:
            w1.append(2*cpt1/(a*(a-1)))
        else:
```

```
        w1.append(0)
    i=i+1

T=G.nodes()
while len(T)>0:
    nst=[]
    S=G.subgraph(T)
    for k in T:
        nst.append([S.degree(k),k])

    nst.sort(reverse=True)
    l=nst[0][1]
    print('processing of ',l)
    ini=list(set(S.neighbors(l)))
    ini.append(l)
    n=len(ini)
    n1=len(ini)
    b=True

    while b==True:


        m1=[]
        temp=-1
        for r in ini:

            a=w1[T11.index (r)]
            x=list(S.neighbors(r))
            ww1=0
            ww2=0
            if len(x)>0:
                for rr1 in x:
                    d1=w1[T11.index (rr1)]
                    d=(d1+len(sorted(nx.common_neighbors(G, r, rr1))))
                    ww1=ww1+d
                    if rr1 in ini:
                        ww2=ww2+d
                if ww1>0:
                    bl=ww2/ww1
                    if bl<0.5:

                        ini.remove(r)

        n1=len(ini)
        if  n1<n:
            n=n1
            b=True
        else:
```

```
        b=False


b=1
print('expansion of community')
while b==1:
    x=[]
    for k in ini:
        x.extend(G.neighbors(k))
        x=list(set(x)-set(ini))

    n=len(ini)
    m1=[]
    for r in x:

        x1=list(G.neighbors(r))
        ww1=0
        ww2=0
        if len(x1)>0:
            for rr1 in x1:
                d1=w1[T11.index(rr1)]
                d=(d1+len(sorted(nx.common_neighbors(G, r, rr1))))#
                ww1=ww1+d
                if rr1 in ini:
                    ww2=ww2+d
            if ww1>0:
                bl=ww2/ww1

                if bl>=0.4:

                    m1.append(r)



    ini.extend(m1)
    n1=len(ini)
    if n1>n:
        b=1

    else:

            b=0

            break


res.append(ini)
```

```
            rr.extend(ini)
            T=list(set(T)-set(ini))


            if (len(ini)==0):
                T.remove(l)

        tps2= time.time()
        print('time',tps2-tps1)
        m=0
        print("loading results in the file \'results\'")
        fichier = open("results.txt", "w")
        for res1 in res:
            for k in res1:
                fichier.write(str(k-1))
                fichier.write(' ')
            fichier.write('\n')
        fichier.close()

        m=modu1(G,N,res)
        print("the overlapping modularity is ",m, '\n\n')

    def graphPlot (path, title):

        GG = nx.read_gml (path, label = 'id')
        community = {}
        openResult = open ('results.txt', 'r')
        readLine = openResult.readlines ()

        ii = 0
        for line in readLine:
            aa = list (map (int, line.split ()))
            for xx in range(0, len(aa)):
                aa [xx] = aa [xx] + 1
            community [ii] = aa
            ii = ii + 1

        comDict = defaultdict (lambda: 0)
        comColour = dict ()

        for ii, com in community.items ():
            comColour |= {node: ii + 10 for node in com}
            for node in com:
                comDict [node] = comDict [node] + 1

        pos = nx.spring_layout (GG, k = 0.2, seed = 4572321)
```

```
    overlappedNodes = {node for node, n_comm in comDict.items() if n_comm > 1}
    nodeColour = [0 if nn in overlappedNodes else comColour [nn] for nn in GG]

    options = {
        "pos" : pos,
        "with_labels" : False,
        "node_color" : nodeColour,
        "node_size" : 250,
        "alpha" : 0.2
    }
    plt.figure (figsize = (15, 15))
    plt.title (title)
    nx.draw_networkx (GG, **options)
    plt.show ()

graph = nx.read_gml ('karate.gml', label = 'id') # karate club dataset
nx.write_edgelist (graph, 'karateedge.txt', delimiter = ',')
f = 'karateedge.txt'
WLC(f,',')
graphPlot ('karate.gml', 'Karate Club')

graph = nx.read_gml ('football.gml', label = 'id') # football club dataset
nx.write_edgelist (graph, 'footballedge.txt', delimiter = ',')
f = 'footballedge.txt'
WLC(f,',')
graphPlot ('football.gml', 'Football Club')

graph = nx.read_gml ('dolphins.gml', label = 'id') # dolphin social network
dataset
nx.write_edgelist (graph, 'dolphinsedge.txt', delimiter = ',')
f = 'dolphinsedge.txt'
WLC(f,',')
graphPlot ('dolphins.gml', 'Dolphin Network')
```

OUTPUT AND OBSERVATIONS (NETWORKX LIBRARY):

// KARATE CLUB

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL

Windows PowerShell
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Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS D:\Documents\NITS\Semester VI\(LAB) CS321 SNA> python -u "d:\Documents\NITS\Semester VI\(LAB) CS321 SNA\lab5revised.py"
graph loading
graph loading
processing of  34
expansion of community
processing of  1
expansion of community
time 0.007913589477539062
loading results in the file 'results'
the overlapping modularity is  0.421597633136095
```
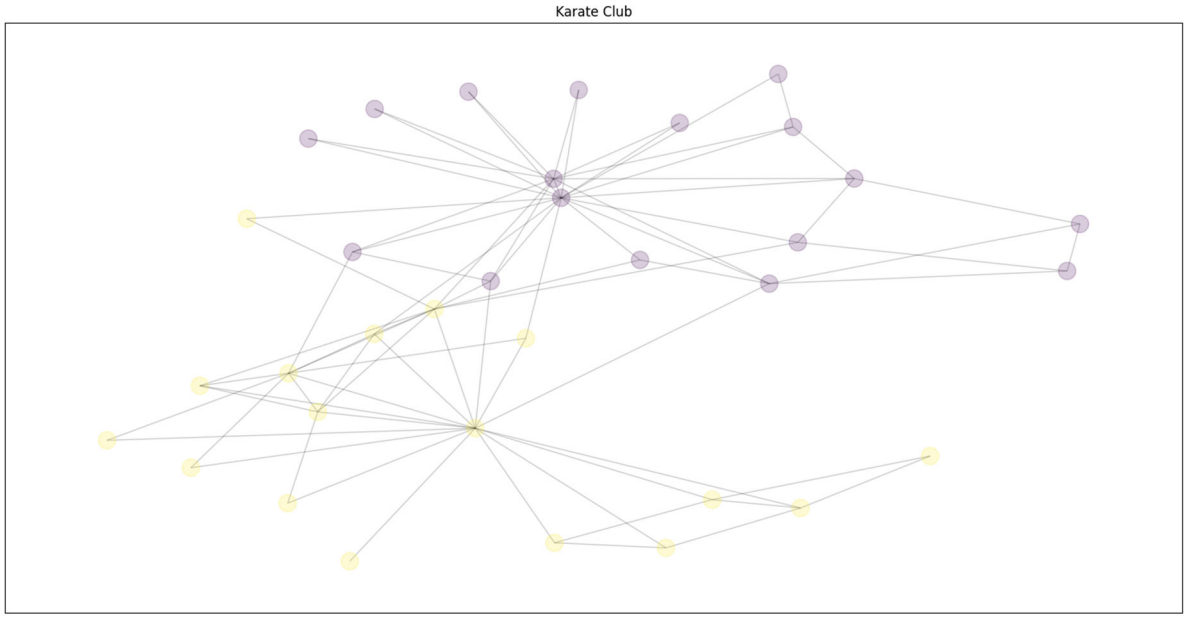
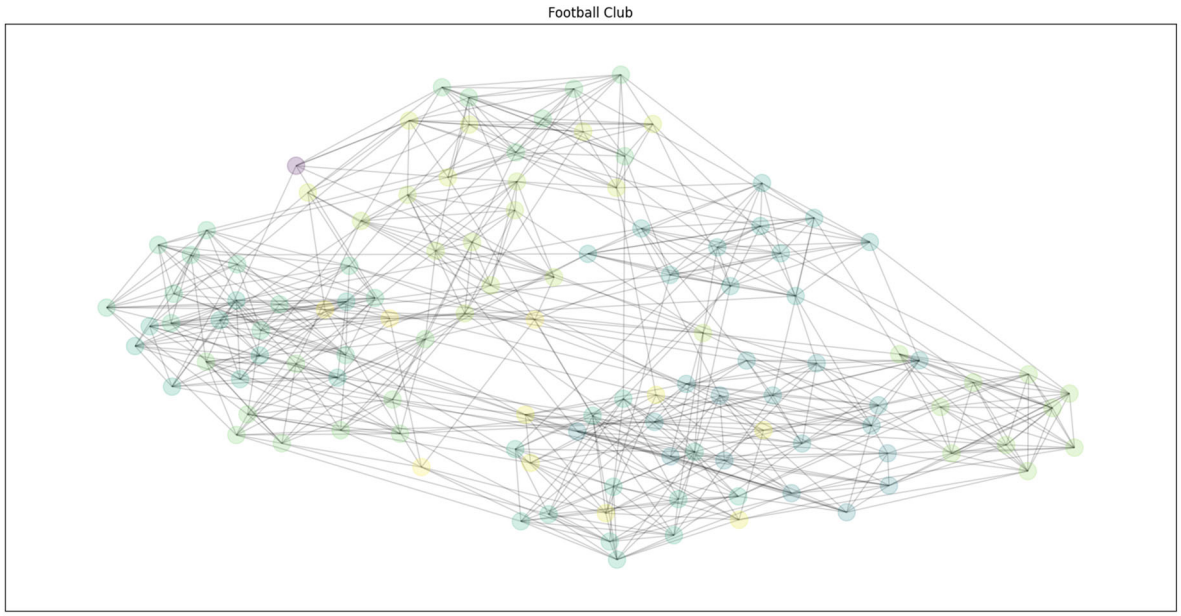



// FOOTBALL CLUB

```
graph loading
graph loading
processing of  104
expansion of community
processing of  88
expansion of community
processing of  6
expansion of community
processing of  109
expansion of community
processing of  98
expansion of community
processing of  76
expansion of community
processing of  34
expansion of community
processing of  91
expansion of community
processing of  78
expansion of community
processing of  94
expansion of community
processing of  43
expansion of community
processing of  11
expansion of community
processing of  97
expansion of community
time 0.2198338508605957
loading results in the file 'results'
the overlapping modularity is  0.5894918154504497
```



// DOLPHINS NETWORK

```
graph loading
graph loading
processing of  14
expansion of community
processing of  57
expansion of community
processing of  51
expansion of community
processing of  47
expansion of community
time 0.023172378540039062
loading results in the file 'results'
the overlapping modularity is  0.5471302559234211


PS D:\Documents\NITS\Semester VI\(LAB) CS321 SNA>
```