Social Network Analysis Home Assignment 3

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Contents

Network communities

Yahoo Music Network

For this assignment, you have to load the part of Yahoo Music Network. Archive contains network in GML format and corresponding list of artists.

```
yg.f = "music2K.gml"
yg = read.graph(yg.f, format = c("gml"))
```

Edges in this network appear if enough number of users have given ratings to both music bands. Note, that edges are weighted with similarity of the ratings.

1. Preprocessing

This network needs to be preprocessed. Do the steps, described on seminar, to make it look properly. How many vertices and edges were deleted?

```
# Deleting isolated nodes.
yg.isolated.vertices= V(yg)[degree(yg) == 0]
yg.delete.vertices.diff = vcount(yg)
yg = delete.vertices(yg, degree(yg) == 0)
yg.delete.vertices.diff = yg.delete.vertices.diff - vcount(yg)
paste("Deleted vertex count: ", yg.delete.vertices.diff)
```

[1] “Deleted vertex count: 4”

```
# Simplifying the graph's overall structure
# (get rid of loops and multiedges).
yg.deleted.edge.diff = ecount(yg)
yg = simplify(yg)
yg.deleted.edge.diff = yg.deleted.edge.diff - ecount(yg)
paste("Deleted edge count: ", yg.deleted.edge.diff)
```

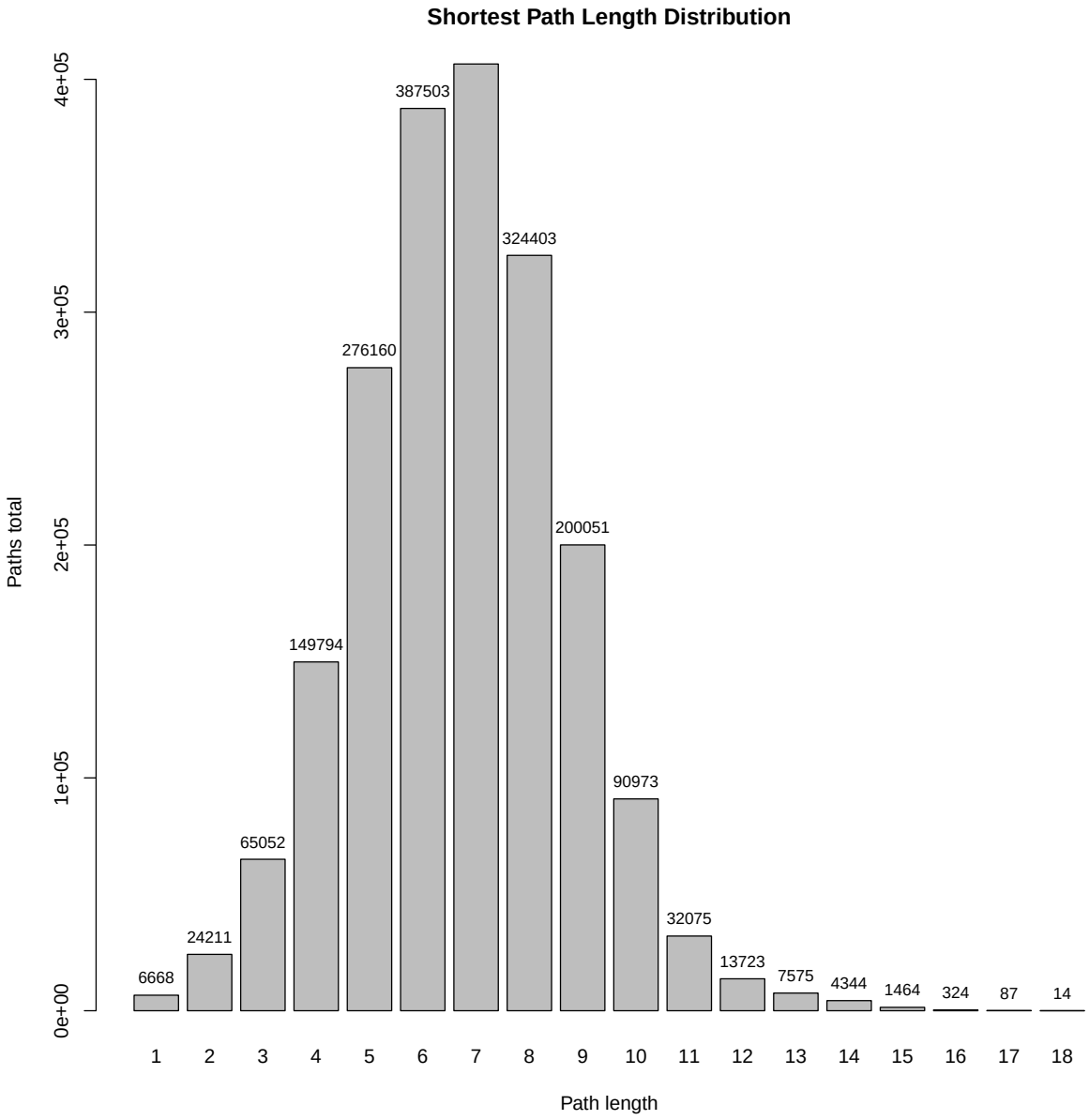
[1] “Deleted edge count: 0”

```
# Obtaining descriptives.
func_print.graph.descriptives = function(g) {
  g.n = vcount(g)
  g.m = ecount(g)
  g.dens = graph.density(g)
  g.avgdeg = 2 * g.m / g.n
```

```
  g.avgpathlen = average.path.length(g)
  g.diam = diameter(g)
  tbl = rbind(g.n,
              g.m,
              g.dens,
              g.avgdeg,
              g.avgpathlen,
              g.diam)
  rownames(tbl) = c("Node count",
                    "Edge count",
                    "Network Density",
                    "Average Node Degree",
                    "Average Path Length",
                    "Diameter")
  colnames(tbl) = c("Value")
  print(xtable(tbl),
        type = "latex",
        floating = T,
        include.rownames = T,
        latex.environments = "center")
}
func_print.graph.descriptives(yg)
```

	Value
Node count	1996.00
Edge count	6668.00
Network Density	0.00
Average Node Degree	6.68
Average Path Length	6.74
Diameter	3.54

```
func_plot.graph.shortestpathsdistribution = function(g) {
  g.plh = path.length.hist(g)$res
  g.plh.tbl = as.table(g.plh)
  names(g.plh.tbl) = 1:length(g.plh.tbl)
  g.plh.bp = barplot(g.plh.tbl,
                     main = "Shortest Path Length Distribution",
                     xlab = "Path length",
                     ylab = "Paths total")
  text(x = g.plh.bp,
       y = g.plh,
       label = g.plh,
       cex = 0.8,
       pos = 3)
}
func_plot.graph.shortestpathsdistribution(yg)
```



2. Clustering

Define clusters for this networks using one of the algorithms described on lectures and seminars. Compute density of obtained clusters:

```
# Thanks to its speed on large graphs, the Louvain algorithm is used
# to reveal communities in the given network.
yg.communities = multilevel.community(yg)
yg.communities.count = length(groups(yg.communities))

# yg.communities.as.subgraphs = c()
yg.communities.as.subgraphs = vector("list", yg.communities.count)
for (i in seq_along(yg.communities.as.subgraphs)) {
```

```
    yg.communities.as.subgraphs[[i]] = induced.subgraph(yg, yg.communities$membership == i)
}

yg.community.densities = vector("list", yg.communities.count)
for (i in seq_along(yg.community.densities)) {
  yg.community.densities[[i]] = graph.density(yg.communities.as.subgraphs[[i]])
}
yg.community.names = vector("list", yg.communities.count)
for (i in seq_along(yg.community.names)) {
  yg.community.names[[i]] = paste("Community #", i)
}

tbl = cbind(as.matrix(yg.community.names),
            as.matrix(yg.community.densities))
colnames(tbl) = c("", "Density")
tbl = xtable(tbl)
align(tbl) = "c|r|c"
print(tbl,
      floating = T,
      type = "latex",
      include.rownames = F,
      latex.environments = "center")
```

V1	Density
Community # 1	0.54
Community # 2	0.13
Community # 3	0.03
Community # 4	0.10
Community # 5	0.07
Community # 6	0.10
Community # 7	0.05
Community # 8	0.17
Community # 9	0.04
Community # 10	0.18
Community # 11	0.04
Community # 12	0.05
Community # 13	0.06
Community # 14	0.09
Community # 15	0.25
Community # 16	0.05
Community # 17	0.35
Community # 18	0.10
Community # 19	0.06
Community # 20	0.04
Community # 21	0.07
Community # 22	0.11
Community # 23	0.64
Community # 24	0.10
Community # 25	0.14
Community # 26	0.11
Community # 27	0.14
Community # 28	0.11

Compute the ratio of inner clusters connections to outer ones:

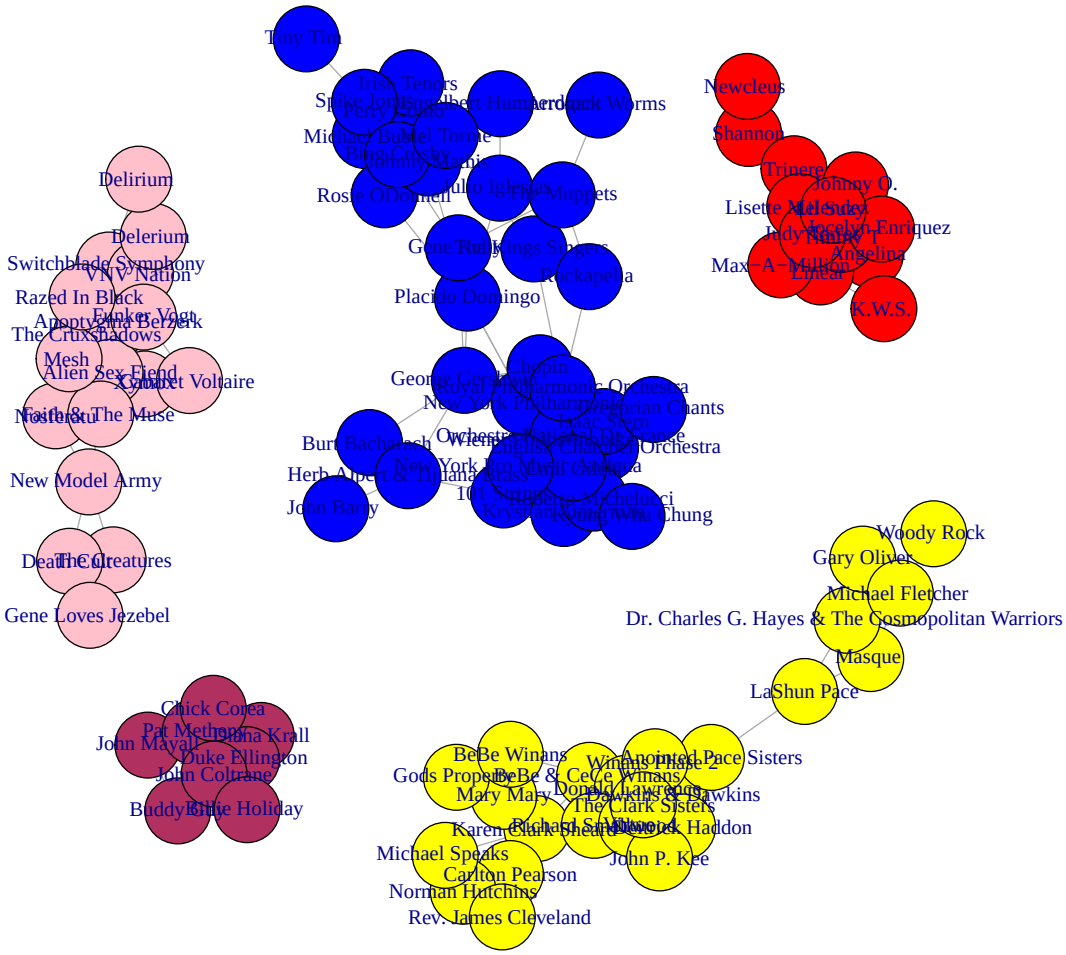
```
yg.m = ecount(yg)
yg.community.inoutratios = vector("list", yg.communities.count)
for (i in seq_along(yg.community.inoutratios)) {
  c = yg.communities.as.subgraphs[[i]]
  c.m = ecount(c)
  yg.community.inoutratios[[i]] = c.m / ( yg.m - c.m )
}

tbl = cbind(as.matrix(yg.community.names),
            as.matrix(yg.community.inoutratios))
colnames(tbl) = c("", "Inner-Outer Connections Ratio")
tbl = xtable(tbl)
digits(tbl) = c(0, 0, 4)
align(tbl) = "c|r|c"
print(tbl,
      floating = T,
      type = "latex",
      include.rownames = F,
      latex.environments = "center")
```

V1	Inner-Outer Connections Ratio
Community # 1	0.0063
Community # 2	0.0114
Community # 3	0.0630
Community # 4	0.0229
Community # 5	0.0257
Community # 6	0.0285
Community # 7	0.0341
Community # 8	0.0071
Community # 9	0.0710
Community # 10	0.0162
Community # 11	0.0593
Community # 12	0.0539
Community # 13	0.0308
Community # 14	0.0367
Community # 15	0.0106
Community # 16	0.0420
Community # 17	0.0080
Community # 18	0.0369
Community # 19	0.0398
Community # 20	0.0689
Community # 21	0.0507
Community # 22	0.0320
Community # 23	0.0027
Community # 24	0.0229
Community # 25	0.0197
Community # 26	0.0380
Community # 27	0.0165
Community # 28	0.0362

3. Visualization & interpretation

Visulize five of the most dense clusters. Use names of artists as node labels on the graph.

```
yg.artists = scan("artists.txt", what = character(), sep = "\n")
yg.artists = yg.artists[-yg.isolated.vertices]
V(yg)$label = yg.artists

func_top.N.indecies = function(l, N) {
  l = unlist(l)
  N = as.integer(N)
  which( l > sort(l)[ length(l)-N ] )
}

yg.communities.top.5.density.indecies = func_top.N.indecies(yg.community.densities, 5)
yg.communities.top.5.density = yg.communities[yg.communities.top.5.density.indecies]
yg.vertices.in.communities.top.5.density = V(yg)[yg.communities$membership %in% yg.communities.top.5.de

# palette()
crp = colorRampPalette(c("red", "blue", "yellow", "pink", "maroon"))(5)
for (v.i in yg.vertices.in.communities.top.5.density) {
  V(yg)[v.i]$color = crp[which( yg.communities.top.5.density.indecies == yg.communities$membership[v.i]
  V(yg)[v.i]$label = yg.artists[v.i]
}

yg.subgraph.vertices.in.communities.top.5.density = induced.subgraph(yg, yg.vertices.in.communities.top

# V(yg.subgraph.vertices.in.communities.top.5.density)$color = 7
plot(yg.subgraph.vertices.in.communities.top.5.density)
```



(Extra task) Try to interpret (using Wikipedia or other resources) obtained clusters.

Artist clusters colored by genre:

Sky Blue — **Pop/Folk**;

Blue — **Jazz/Blues**;

Dark Green— **Gospel**;

Orange — **Electro/Hip-hop/Dance**

Yellow — **Rock/Punk-rock**