World-Wide-Web

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World-Wide-Web Source : http://www3.nd.edu/~networks/resources/www/www.dat.gz (http://www3.nd.edu/~networks/resources/www/www.dat.gz)
Each number represents webpage within nd.edu domain. Data-format: From -> To (directed link) Name, Count

```
folder = '/Users/Hila/Documents/ML/Targil3'
setwd(folder)
require(igraph)
```

```
## Loading required package: igraph
```

```
##
## Attaching package: 'igraph'
```

```
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
```

```
## The following object is masked from 'package:base':
##
##     union
```

Get the data

```
ga.data = read.csv('1.csv',header = T)
ga_names =  graph.data.frame(ga.data,directed = F)
summary(ga_names)
```

```
## IGRAPH UN-- 794 1016 --
## + attr: name (v/c)
```

```
V(ga_names)$name
```

```
##   [1] "0"   "1"   "3"   "4"   "5"   "6"   "7"   "8"   "9"   "10"  "11" 
##  [12] "12"  "13"  "14"  "15"  "16"  "17"  "18"  "19"  "20"  "21"  "22" 
##  [23] "23"  "24"  "25"  "26"  "27"  "28"  "29"  "30"  "31"  "32"  "33" 
##  [34] "34"  "35"  "36"  "37"  "40"  "2"   "38"  "39"  "41"  "42"  "43" 
##  [45] "44"  "45"  "46"  "47"  "48"  "49"  "50"  "51"  "52"  "53"  "54" 
##  [56] "55"  "56"  "57"  "58"  "59"  "60"  "61"  "62"  "63"  "64"  "65" 
##  [67] "66"  "67"  "68"  "69"  "70"  "71"  "72"  "73"  "74"  "75"  "76" 
##  [78] "77"  "78"  "79"  "80"  "81"  "82"  "83"  "84"  "85"  "86"  "87"
##  [89] "88"  "89"  "90"  "91"  "92"  "93"  "94"  "95"  "96"  "97"  "98"
## [100] "99"  "100" "101" "102" "103" "104" "105" "106" "107" "108" "109"
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## [298] "297" "298" "299" "300" "301" "302" "303" "304" "305" "306" "307"
## [309] "308" "309" "310" "311" "312" "313" "314" "315" "316" "317" "318"
## [320] "319" "320" "321" "322" "323" "324" "325" "326" "327" "328" "329"
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## [617] "616" "617" "618" "619" "620" "621" "622" "623" "624" "625" "626"
## [628] "627" "628" "629" "630" "631" "632" "633" "634" "635" "636" "637"
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## [716] "715" "716" "717" "718" "719" "720" "721" "722" "723" "724" "725"
## [727] "726" "727" "728" "729" "730" "731" "732" "733" "734" "735" "736"
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## [749] "748" "749" "750" "751" "752" "753" "754" "755" "756" "757" "758"
## [760] "759" "760" "761" "762" "763" "764" "765" "766" "767" "768" "769"
## [771] "770" "771" "772" "773" "774" "775" "776" "777" "778" "779" "780"
## [782] "781" "782" "783" "784" "785" "786" "787" "788" "789" "790" "791"
## [793] "792" "793"
```

```
#Remove self-Loops is exist
ga_names = simplify(ga_names)
```

Calculate betweenness

```
ga_bet = betweenness(ga_names)
ga_bet = sort(ga_bet,decreasing = T)
names(ga_bet[1])
```

```
## [1] "20"
```

Calculate closeness

```
ga_close = closeness(ga_names)
ga_close = sort(ga_close, decreasing = T)
names(ga_close[1])
```

```
## [1] "0"
```

Calculate eigenvector

```
ga_eigen = evcent(ga_names)
ga_eigen = sort(ga_eigen$vector, decreasing = T)
names(ga_eigen[1])
```

```
## [1] "20"
```

```
#Find commuinty with Girvan-Newman community detection
fc = edge.betweenness.community(ga_names)

#Cheack what is the modularity
fc$modularity
```

```
##   [1] -0.0289304013 -0.0279700649 -0.0269418205 -0.0259146456 -0.0248874706
##   [6] -0.0238570874 -0.0228277736 -0.0217989945 -0.0207659378 -0.0197344852
##  [11] -0.0187126573 -0.0177549944 -0.0167353054 -0.0157086652 -0.0146820249
##  [16] -0.0136495029 -0.0126250015 -0.0117202748 -0.0107364112 -0.0097044239
##  [21] -0.0086793877 -0.0076522128 -0.0066255725 -0.0055930505 -0.0045610632
##  [26] -0.0035568807 -0.0025639271 -0.0015399604 -0.0005266878  0.0004635922
##  [31]  0.0014747259  0.0025051091  0.0035146387  0.0045450219  0.0055524127
##  [36]  0.0072228419  0.0081826436  0.0092103532  0.0102369935  0.0112636337
##  [41]  0.0122934822  0.0133222613  0.0143505057  0.0153814236  0.0164027167
##  [46]  0.0174218711  0.0184479766  0.0194740821  0.0205060695  0.0215300362
##  [51]  0.0224342282  0.0234175570  0.0244436626  0.0254681640  0.0264948042
##  [56]  0.0275209098  0.0285528971  0.0295843497  0.0305879975  0.0315804164
##  [61]  0.0326038484  0.0336208639  0.0346090051  0.0356196041  0.0366494526
##  [66]  0.0376584475  0.0386882960  0.0397079850  0.0406672520  0.0416944269
##  [71]  0.0427205325  0.0437466380  0.0447759518  0.0458041962  0.0468319058
##  [76]  0.0478526643  0.0488573815  0.0498760011  0.0509015719  0.0519271428
##  [81]  0.0529505748  0.0538542321  0.0548370262  0.0558609929  0.0568870984
##  [86]  0.0579126693  0.0589157823  0.0599076665  0.0609305638  0.0619550652
##  [91]  0.0629651295  0.0639511319  0.0649804457  0.0659889059  0.0670182197
##  [96]  0.0679769519  0.0690035922  0.0700291630  0.0710547338  0.0720835129
## [101]  0.0731112226  0.0741383975  0.0751586213  0.0761628038  0.0771808887
## [106]  0.0782037859  0.0791069085  0.0800891680  0.0811126000  0.0821381708
## [111]  0.0831632069  0.0841657853  0.0851143581  0.0861367207  0.0871505279
## [116]  0.0881600575  0.0891690524  0.0901978314  0.0912057569  0.0921639544
## [121]  0.0931900600  0.0942150961  0.0952401322  0.0962673072  0.0972939474
## [126]  0.0983136365  0.0993311867  0.1003535492  0.1012561371  0.1022378619
## [131]  0.1032607591  0.1042857953  0.1053102967  0.1063123403  0.1072587743
## [136]  0.1082806022  0.1092922706  0.1103012654  0.1113097256  0.1123379700
## [141]  0.1133453607  0.1143030236  0.1153285944  0.1163530958  0.1173775972
## [146]  0.1183967515  0.1194228571  0.1204420114  0.1214590269  0.1224808548
## [151]  0.1233829079  0.1243640980  0.1253864605  0.1264109620  0.1274349287
## [156]  0.1284364376  0.1293807327  0.1303763599  0.1313612929  0.1323697530
## [161]  0.1333776785  0.1344053882  0.1354122442  0.1363693723  0.1373933390
## [166]  0.1384189099  0.1394375295  0.1404540103  0.1414753034  0.1423768219
## [171]  0.1433574772  0.1443793051  0.1454032718  0.1464267038  0.1474276780
## [176]  0.1483698343  0.1493750862  0.1502648411  0.1512465658  0.1522539566
## [181]  0.1532602779  0.1555092617  0.1564658551  0.1574892871  0.1585052332
## [186]  0.1595233181  0.1605392642  0.1615600226  0.1624610064  0.1634411270
## [191]  0.1644624202  0.1654858521  0.1664750628  0.1674755023  0.1684625742
## [196]  0.1694811938  0.1704607797  0.1714676357  0.1724734223  0.1734294810
## [201]  0.1744523783  0.1754699285  0.1764853399  0.1775055636  0.1784060127
## [206]  0.1793855986  0.1804063570  0.1814292543  0.1824366451  0.1834365499
## [211]  0.1843754979  0.1853935829  0.1863993695  0.1874056908  0.1884109427
## [216]  0.1893664667  0.1903834822  0.1913983589  0.1922982732  0.1932773244
## [221]  0.1942996870  0.1952990571  0.1962845248  0.1972689231  0.1982741750
## [226]  0.1992799616  0.2002846788  0.2012396681  0.2022561489  0.2032704908
## [231]  0.2041698705  0.2051483869  0.2061702148  0.2071690502  0.2080555968
## [236]  0.2090533628  0.2100286711  0.2110339230  0.2120381055  0.2129925601
## [241]  0.2140085061  0.2150223134  0.2159211583  0.2168991401  0.2178974408
## [246]  0.2188807696  0.2198844174  0.2208891346  0.2218927824  0.2252566333
## [251]  0.2262105532  0.2272259646  0.2282392371  0.2291375473  0.2301149944
## [256]  0.2311127604  0.2320955545  0.2330676545  0.2340418933  0.2350450064
## [261]  0.2359983916  0.2370132683  0.2380260061  0.2389237816  0.2399006939
## [266]  0.2408979252  0.2418801847  0.2428501458  0.2438532589  0.2448558373
## [271]  0.2458086877  0.2468208908  0.2477181316  0.2486945093  0.2496163467
## [276]  0.2505456700  0.2515134923  0.2525160707  0.2535181143  0.2544704301
## [281]  0.2587138764  0.2596105825  0.2605864255  0.2615034505  0.2623771641
## [286]  0.2633770689  0.2643791126  0.2653806215  0.2663511174  0.2673028984
## [291]  0.2681990698  0.2691743781  0.2700865907  0.2710656419  0.2720650120
## [296]  0.2730339037  0.2740348780  0.2749861243  0.2758817610  0.2768565345
## [301]  0.2776794508  0.2786579673  0.2796568027  0.2806572423  0.2816576818
## [306]  0.2826083934  0.2835034954  0.2844777342  0.2853771138  0.2863550956
## [311]  0.2873533963  0.2883533011  0.2893532060  0.2903033829  0.2911979501
## [316]  0.2921716542  0.2931127411  0.2940901882  0.2950879542  0.2960873243
## [321]  0.2970866944  0.2980363366  0.2989303692  0.2999035386  0.3007948976
## [326]  0.3017718100  0.3027690412  0.3037325859  0.3047314213  0.3056805288
## [331]  0.3065740266  0.3075466613  0.3084332080  0.3094095856  0.3104062822
## [336]  0.3114040482  0.3124023489  0.3133509217  0.3142438848  0.3152159848
## [341]  0.3160469217  0.3170227647  0.3180189265  0.3190161578  0.3200139238
## [346]  0.3209619619  0.3218543903  0.3228259556  0.3237012734  0.3246765816
## [351]  0.3256722087  0.3266689053  0.3276661366  0.3286136400  0.3295055337
## [356]  0.3304765643  0.3314513378  0.3324073965  0.3334035584  0.3344002549
## [361]  0.3353472236  0.3362385826  0.3372090785  0.3381833173  0.3391372372
## [366]  0.3401328644  0.3410792983  0.3419701226  0.3429400838  0.3439137879
## [371]  0.3448655689  0.3458606614  0.3474797586  0.3484256579  0.3493159475
## [376]  0.3502853739  0.3512585433  0.3522531010  0.3531984656  0.3540882205
## [381]  0.3550571122  0.3560297469  0.3570237699  0.3579685998  0.3589086173
## [386]  0.3597978374  0.3607661944  0.3617382944  0.3627317828  0.3636760779
## [391]  0.3645647634  0.3655325857  0.3664415901  0.3674345437  0.3683783041
## [396]  0.3692664549  0.3702337425  0.3712042383  0.3721966572  0.3731398829
## [401]  0.3740274990  0.3749942519  0.3759642130  0.3769560972  0.3778987882
## [406]  0.3787858696  0.3797520878  0.3807215142  0.3817128637  0.3826550200
## [411]  0.3835415666  0.3845072501  0.3854761418  0.3864669566  0.3874085782
## [416]  0.3882945901  0.3892597389  0.3902280959  0.3911467251  0.3920493130
## [421]  0.3929903998  0.3938758771  0.3948404911  0.3958083134  0.3967488656
## [426]  0.3976338081  0.3985978875  0.3995651751  0.4005051926  0.4013896003
## [431]  0.4023531450  0.4033198979  0.4042593807  0.4051432537  0.4061062637
## [436]  0.4070724819  0.4079028841  0.4088418322  0.4097251705  0.4106876458
## [441]  0.4116533293  0.4125917426  0.4134745463  0.4144364868  0.4154016356
## [446]  0.4163395142  0.4172217832  0.4181831890  0.4191478030  0.4200851470
## [451]  0.4209668812  0.4219277523  0.4228918317  0.4238286409  0.4247098405
## [456]  0.4256701768  0.4266337215  0.4275699960  0.4284506608  0.4294104625
## [461]  0.4303734725  0.4313092123  0.4321893424  0.4331486094  0.4340394337
## [466]  0.4349746388  0.4358542342  0.4368129665  0.4377743723  0.4387090427
## [471]  0.4395881034  0.4405463009  0.4414339170  0.4423680527  0.4432465787
## [476]  0.4442042415  0.4451378425  0.4460158338  0.4469729619  0.4479060282
## [481]  0.4487834848  0.4497400782  0.4506726098  0.4515495316  0.4525055904
## [486]  0.4534375872  0.4543139744  0.4552694984  0.4562009606  0.4570768130
## [491]  0.4580318023  0.4589627298  0.4598380475  0.4607925021  0.4617228948
## [496]  0.4625976779  0.4635515978  0.4644814558  0.4653557041  0.4663090893
## [501]  0.4672384126  0.4681121262  0.4690649767  0.4699937653  0.4708669442
## [506]  0.4718192600  0.4761471903  0.4770754442  0.4779480884  0.4788998694
## [511]  0.4798275886  0.4806996981  0.4816509445  0.4825781289  0.4834497037
## [516]  0.4844004154  0.4853270651  0.4861981052  0.4871482821  0.4880743972
## [521]  0.4889449026  0.4898945448  0.4908201251  0.4916900958  0.4926392033
## [526]  0.4935642490  0.4944336849  0.4953822577  0.4963067687  0.4971756699
## [531]  0.4981237080  0.4990476842  0.4999160508  0.5008635542  0.5083665833
## [536]  0.5092900248  0.5101578566  0.5111048253  0.5120277321  0.5128950292
## [541]  0.5138414632  0.5147638353  0.5156305977  0.5165764970  0.5174983344
## [546]  0.5183645621  0.5193099266  0.5202312293  0.5210969223  0.5220417522
## [551]  0.5229625201  0.5238276784  0.5247719736  0.5273455254  0.5282657587
## [556]  0.5291303822  0.5300741427  0.5309938412  0.5318579301  0.5328011558
## [561]  0.5337203197  0.5345838738  0.5355265649  0.5364451940  0.5373082134
## [566]  0.5382503698  0.5391684642  0.5400309489  0.5409725705  0.5418901302
## [571]  0.5427520803  0.5436931672  0.5446101922  0.5454716075  0.5464121597
## [576]  0.5473286500  0.5481895306  0.5491295481  0.5500455037  0.5509058496
## [581]  0.5518212705  0.5526810817  0.5535959679  0.5544552444  0.5553695958
## [586]  0.5562283376  0.5571421544  0.5580003615  0.5589136435  0.5597713159
## [591]  0.5606840632  0.5615412009  0.5645291518  0.5654413644  0.5662979674
## [596]  0.5672096453  0.5680657135  0.5689768567  0.5698323903  0.5707429988
## [601]  0.5715979976  0.5725080714  0.5733625355  0.5742720746  0.5751260040
## [606]  0.5760350084  0.5768884031  0.5777968728  0.5786497328  0.5795576678
## [611]  0.5804099931  0.5813173933  0.5821691839  0.5830760494  0.5839273053
## [616]  0.5848336362  0.5856843573  0.5865901535  0.5874403399  0.5883456013
## [621]  0.5891952531  0.5900999798  0.5909490968  0.5918532888  0.5927018712
## [626]  0.5936055285  0.5944535761  0.5953566987  0.5962042116  0.5971067995
## [631]  0.5979537777  0.5988558308  0.5997022743  0.6006037928  0.6014497016
## [636]  0.6023506853  0.6031960594  0.6040965085  0.6049413478  0.6058412622
## [641]  0.6066855668  0.6075849465  0.6084287164  0.6093275613  0.6101707966
## [646]  0.6110691068  0.6119118073  0.6128095828  0.6136517487  0.6145489895
## [651]  0.6153906206  0.6162873267  0.6171284231  0.6180245945  0.6188651562
## [656]  0.6197607928  0.6206008198  0.6214959218  0.6223354141  0.6230904224
## [661]  0.6239293800  0.6246822495  0.6255206724  0.6262714030  0.6271092912
## [666]  0.6278578830  0.6286952365  0.6294416895  0.6302785082  0.6311147923
## [671]  0.6319505416  0.6327857562  0.6336204361  0.6344545813  0.6352881918
## [676]  0.6361212676  0.6369538087  0.6377858150  0.6386172867  0.6394482236
## [681]  0.6402786259  0.6411084934  0.6419378262  0.6427666244  0.6435948878
## [686]  0.6444226165  0.6452498104  0.6460764697  0.6469025943  0.6477281842
## [691]  0.6485532393  0.6493777598  0.6535409998  0.6543649856  0.6551884366
## [696]  0.6560113529  0.6568337345  0.6576555814  0.6584768936  0.6592976711
## [701]  0.6601179139  0.6609376220  0.6617567953  0.6625754340  0.6633935379
## [706]  0.6642111072  0.6650281417  0.6658446415  0.6666606066  0.6674760370
## [711]  0.6682909327  0.6691052937  0.6699191200  0.6707324116  0.6715451684
## [716]  0.6723573906  0.6727899697  0.6736016572  0.6744128099  0.6752234279
## [721]  0.6760335112  0.6768430599  0.6776520738  0.6784605530  0.6792684974
## [726]  0.6800759072  0.6808827823  0.6816891226  0.6824949283  0.6833001992
## [731]  0.6841049355  0.6849091370  0.6857128038  0.6865159359  0.6873185333
## [736]  0.6880339732  0.6888360359  0.6896375639  0.6904385572  0.6912390158
## [741]  0.6920389396  0.6928383288  0.6932281312  0.6940269857  0.6948253054
## [746]  0.6956230904  0.6964203407  0.6972170563  0.6980132372  0.6988088834
## [751]  0.6996039949  0.7003985717  0.7011926138  0.7019861211  0.7027790938
## [756]  0.7035715317  0.7043634349  0.7051548034  0.7059456373  0.7067359364
## [761]  0.7075257008  0.7083149305  0.7091036254  0.7098917857  0.7106794113
## [766]  0.7114665021  0.7122530583  0.7130390797  0.7138245664  0.7146095185
## [771]  0.7153939358  0.7161778184  0.7169611663  0.7177439795  0.7185262579
## [776]  0.7193080017  0.7195694741  0.7243508372  0.7267228039  0.7300620583
## [781]  0.7292551832  0.7290434386  0.7308630515  0.7303967858  0.7296888318
## [786]  0.7270922875  0.7256945596  0.7244208840  0.7021101735  0.6839247387
## [791]  0.6782600373  0.5150627373  0.2254667738  0.0000000000
```

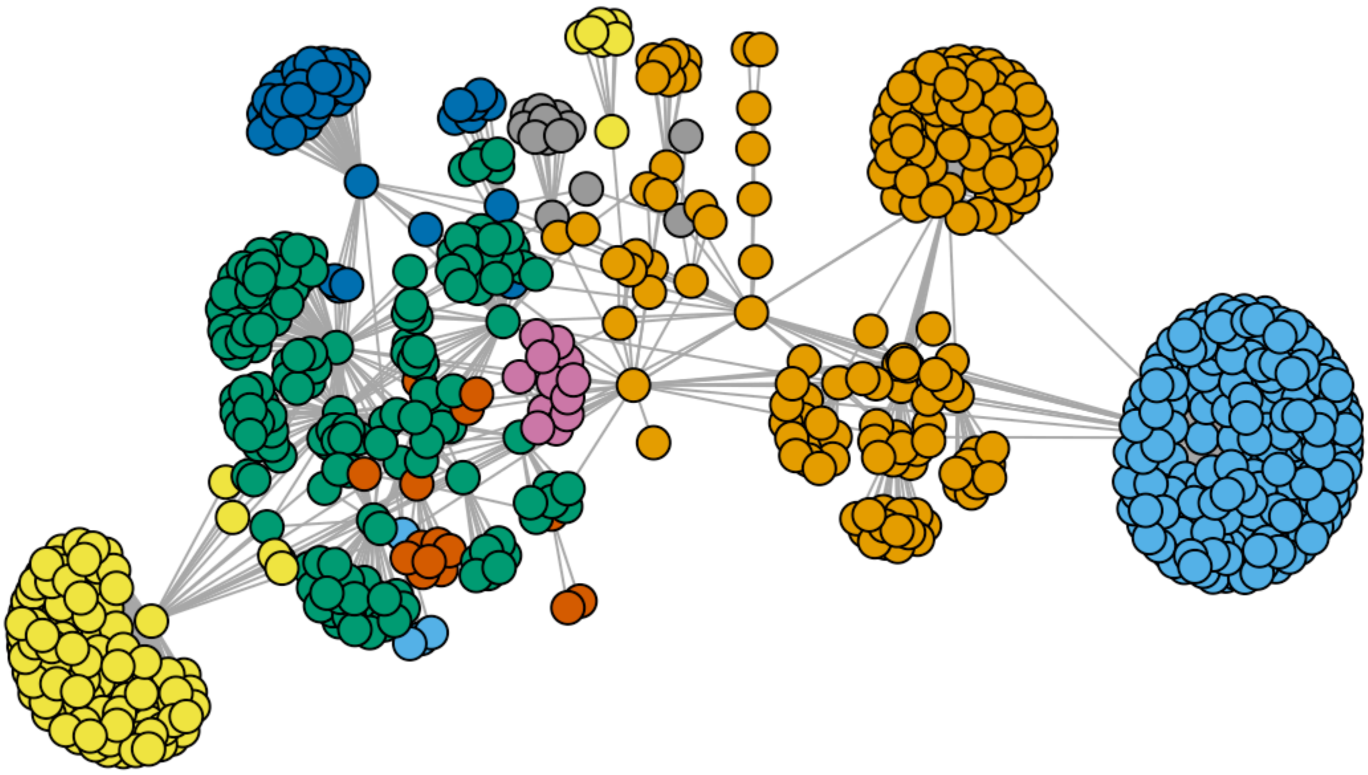
```
#What partition is the best?
max(fc$modularity)
```

```
## [1] 0.7308631
```

```
which.max(fc$modularity)
```

```
## [1] 783
```

```
#Color nodes by partitions
memb = membership(fc)
plot(ga_names, vertex.size=5, vertex.label=NA,
     vertex.color=memb, asp=FALSE)
```



```
#How many communities received
max(levels(as.factor(memb)))
```

```
## [1] "9"
```

```
#What size of each commuinty
summary(as.factor(memb))
```

```
##   1   2   3   4   5   6   7   8   9  10  11  12
##  93   4 154   7  44  15  12  13  84 232   7 129
```

```
#Find commuinty with Multi-Level algorithm
#This function implements the multi-level modularity optimization algorithm for fi
nding community structure.
ml = multilevel.community(ga_names)

#Cheack what is the modularity
ml$modularity
```

```
## [1] 0.6845092 0.7333949
```

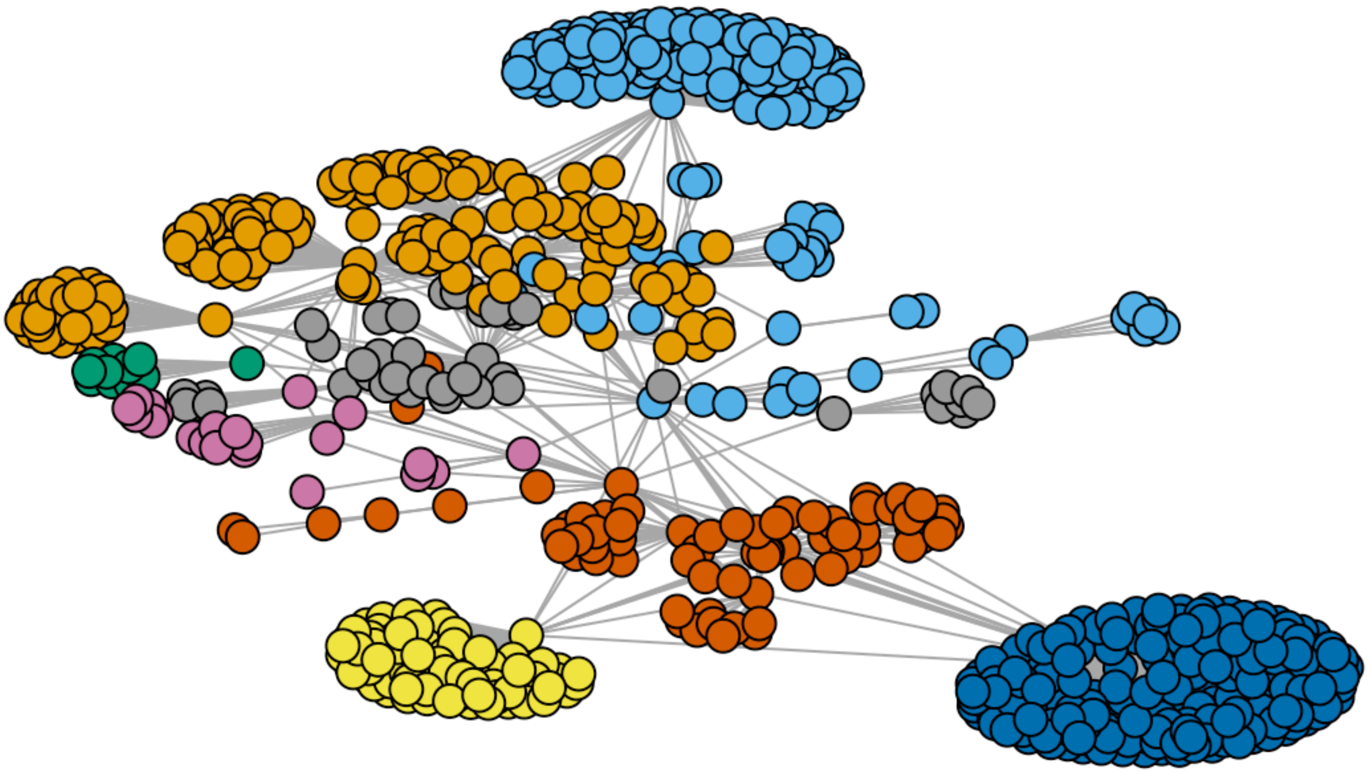
```
#What partition is the best?
max(ml$modularity)
```

```
## [1] 0.7333949
```

```
which.max(ml$modularity)
```

```
## [1] 2
```

```
#Color nodes by partitions
memb = membership(ml)
plot(ga_names, vertex.size=5, vertex.label=NA,
     vertex.color=memb, asp=FALSE)
```



```
#How many communities received
max(levels(as.factor(memb)))
```

```
## [1] "9"
```

```
#What size of each community
summary(as.factor(memb))
```

```
##   1   2   3   4   5   6   7   8   9  10 
## 127  40  12  84 232  72  23  45  35 124
```

```
#Find communinty with propagating labels algorithm
#This is a fast, nearly linear time algorithm for detecting community structure in networks.
#In works by labeling the vertices with unique labels and then updating the labels by majority voting in the neighborhood of the vertex.
pl = label.propagation.community(ga_names)

#Cheack what is the modularity
pl$modularity
```

```
## [1] 0.6952819
```

```
#What partition is the best?
max(pl$modularity)
```

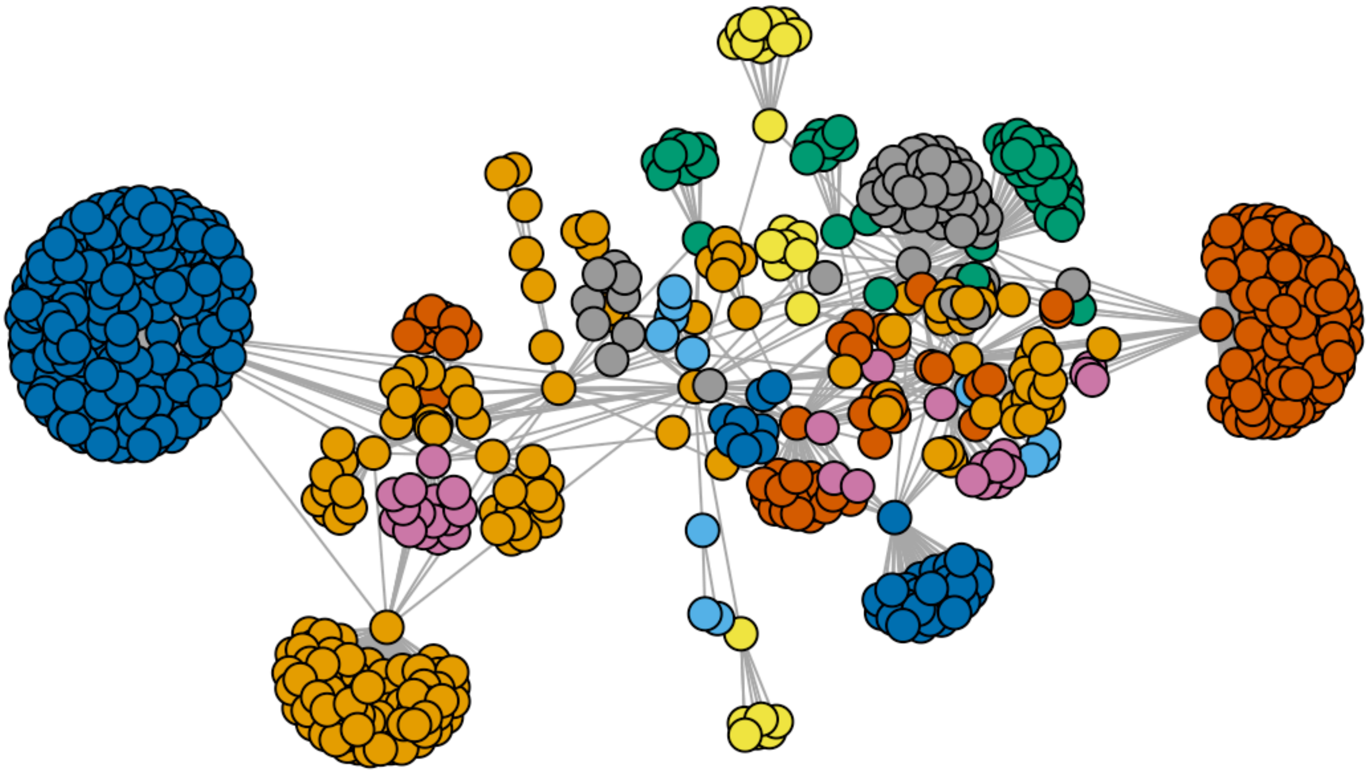
```
## [1] 0.6952819
```

```
which.max(pl$modularity)
```

```
## [1] 1
```

```
#Color nodes by partitions
memb = membership(pl)

plot(ga_names, vertex.size=5, vertex.label=NA,
     vertex.color=memb, asp=FALSE)
```



```
#How many communities received
max(levels(as.factor(memb)))
```

```
## [1] "9"
```

```r
#What size of each commuinty
summary(as.factor(memb))
```

```
##    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18 
##  138    4   30    7   33   34   15   48   33    3   10   12  232   10   15    9    6    5 
##   19   20   21   22 
##   10    7    7  126
```