GDAT622\_Invest5\_James

James Stanfield

6/26/2020

fread("Amazon\_data/amazon-2003-03-02.txt") -> amazon\_el

## Warning in fread("Amazon\_data/amazon-2003-03-02.txt"): Detected 1 column  
## names but the data has 2 columns (i.e. invalid file). Added 1 extra default  
## column name for the first column which is guessed to be row names or an  
## index. Use setnames() afterwards if this guess is not correct, or fix the  
## file write command that created the file to create a valid file.

head(amazon\_el)

## V1 FromNodeId ToNodeId  
## 1: 0 1  
## 2: 0 2  
## 3: 0 3  
## 4: 0 4  
## 5: 0 5  
## 6: 1 0

We need to clean up the ID = 0 entries, as Igraph does not like vertices with a name of 0.

# paste an "a" in front of every name  
paste0("a", amazon\_el$V1) -> amazon\_el$V1  
paste0("a", amazon\_el$`FromNodeId ToNodeId`) -> amazon\_el$`FromNodeId ToNodeId`  
head(amazon\_el)

## V1 FromNodeId ToNodeId  
## 1: a0 a1  
## 2: a0 a2  
## 3: a0 a3  
## 4: a0 a4  
## 5: a0 a5  
## 6: a1 a0

Hopefully we won’t have any issues from the node names!

#I'm treating it as undirected, as some methods only work with undirected  
graph\_from\_data\_frame(amazon\_el, directed = FALSE) -> amazon\_igraph  
amazon\_igraph

## IGRAPH 714750a UN-- 262111 1234877 --   
## + attr: name (v/c)  
## + edges from 714750a (vertex names):  
## [1] a0 --a1 a0 --a2 a0 --a3 a0 --a4 a0 --a5 a0 --a1 a1 --a2   
## [8] a1 --a4 a1 --a5 a1 --a15 a0 --a2 a2 --a11 a2 --a12 a2 --a13   
## [15] a2 --a14 a3 --a63 a3 --a64 a3 --a65 a3 --a66 a3 --a67 a4 --a7   
## [22] a4 --a16 a4 --a17 a4 --a18 a4 --a19 a5 --a6 a5 --a7 a5 --a8   
## [29] a5 --a9 a5 --a10 a5 --a6 a6 --a7 a6 --a8 a6 --a9 a6 --a20   
## [36] a5 --a7 a7 --a8 a7 --a9 a7 --a30 a7 --a290 a8 --a13 a8 --a21   
## [43] a8 --a22 a8 --a23 a8 --a24 a5 --a10 a7 --a10 a10--a137 a10--a138  
## [50] a10--a139 a6 --a11 a11--a9 a11--a20 a11--a25 a11--a26 a12--a260  
## + ... omitted several edges

Now for the long haul, Let’s plot the network

#start\_time <- Sys.time()  
  
#plot(amazon\_igraph)  
  
#end\_time <- Sys.time()  
  
#end\_time - start\_time

After 3 hours, I wasn’t sure if my computer was hung up or if it really needed that long. I stopped the attempt to show the whole network in favor of pursuing other approaches to study the data.

cluster\_louvain(amazon\_igraph, weights = NULL) -> amazon\_louvain  
amazon\_louvain

## IGRAPH clustering multi level, groups: 210, mod: 0.92  
## + groups:  
## $`1`  
## [1] "a0" "a1" "a2" "a3" "a4" "a5"   
## [7] "a6" "a10" "a12" "a16" "a19" "a30"   
## [13] "a48" "a49" "a50" "a63" "a64" "a65"   
## [19] "a66" "a67" "a73" "a74" "a75" "a89"   
## [25] "a90" "a97" "a98" "a99" "a100" "a101"   
## [31] "a108" "a109" "a110" "a116" "a117" "a118"   
## [37] "a119" "a123" "a124" "a125" "a126" "a127"   
## [43] "a131" "a135" "a136" "a139" "a149" "a150"   
## [49] "a156" "a157" "a158" "a172" "a173" "a175"   
## + ... omitted several groups/vertices

Louvain identified 210 groups.

amazon\_louvain[1]

## $`1`  
## [1] "a0" "a1" "a2" "a3" "a4" "a5"   
## [7] "a6" "a10" "a12" "a16" "a19" "a30"   
## [13] "a48" "a49" "a50" "a63" "a64" "a65"   
## [19] "a66" "a67" "a73" "a74" "a75" "a89"   
## [25] "a90" "a97" "a98" "a99" "a100" "a101"   
## [31] "a108" "a109" "a110" "a116" "a117" "a118"   
## [37] "a119" "a123" "a124" "a125" "a126" "a127"   
## [43] "a131" "a135" "a136" "a139" "a149" "a150"   
## [49] "a156" "a157" "a158" "a172" "a173" "a175"   
## [55] "a176" "a177" "a180" "a184" "a185" "a186"   
## [61] "a196" "a204" "a205" "a206" "a207" "a211"   
## [67] "a218" "a233" "a234" "a246" "a247" "a248"   
## [73] "a257" "a258" "a260" "a261" "a262" "a263"   
## [79] "a264" "a279" "a280" "a281" "a282" "a294"   
## [85] "a298" "a307" "a308" "a316" "a318" "a320"   
## [91] "a344" "a345" "a346" "a359" "a360" "a361"   
## [97] "a362" "a366" "a367" "a368" "a369" "a370"   
## [103] "a372" "a388" "a389" "a393" "a394" "a395"   
## [109] "a396" "a397" "a398" "a400" "a405" "a406"   
## [115] "a407" "a411" "a412" "a413" "a414" "a415"   
## [121] "a416" "a417" "a418" "a419" "a430" "a431"   
## [127] "a440" "a453" "a460" "a461" "a462" "a463"   
## [133] "a464" "a465" "a466" "a482" "a491" "a492"   
## [139] "a495" "a496" "a497" "a498" "a499" "a526"   
## [145] "a527" "a528" "a529" "a530" "a534" "a535"   
## [151] "a536" "a542" "a543" "a544" "a547" "a548"   
## [157] "a549" "a550" "a551" "a552" "a553" "a554"   
## [163] "a567" "a569" "a570" "a579" "a580" "a584"   
## [169] "a585" "a588" "a589" "a590" "a591" "a594"   
## [175] "a597" "a608" "a609" "a612" "a615" "a629"   
## [181] "a630" "a639" "a640" "a641" "a642" "a643"   
## [187] "a644" "a652" "a661" "a662" "a665" "a666"   
## [193] "a668" "a669" "a670" "a671" "a672" "a673"   
## [199] "a674" "a675" "a677" "a734" "a735" "a736"   
## [205] "a737" "a738" "a739" "a740" "a741" "a742"   
## [211] "a743" "a744" "a745" "a746" "a747" "a748"   
## [217] "a751" "a752" "a762" "a769" "a770" "a771"   
## [223] "a779" "a799" "a800" "a801" "a807" "a808"   
## [229] "a827" "a836" "a837" "a840" "a841" "a855"   
## [235] "a856" "a857" "a858" "a859" "a867" "a868"   
## [241] "a869" "a870" "a871" "a872" "a905" "a906"   
## [247] "a907" "a908" "a909" "a910" "a911" "a912"   
## [253] "a913" "a914" "a918" "a944" "a945" "a946"   
## [259] "a947" "a951" "a971" "a999" "a1000" "a1001"   
## [265] "a1002" "a1003" "a1004" "a1005" "a1006" "a1034"   
## [271] "a1035" "a1036" "a1037" "a1038" "a1042" "a1043"   
## [277] "a1053" "a1066" "a1079" "a1080" "a1081" "a1123"   
## [283] "a1124" "a1126" "a1127" "a1128" "a1132" "a1136"   
## [289] "a1137" "a1138" "a1159" "a1160" "a1167" "a1169"   
## [295] "a1170" "a1175" "a1176" "a1179" "a1187" "a1188"   
## [301] "a1190" "a1196" "a1197" "a1198" "a1208" "a1209"   
## [307] "a1210" "a1211" "a1212" "a1214" "a1215" "a1216"   
## [313] "a1217" "a1225" "a1226" "a1227" "a1228" "a1229"   
## [319] "a1236" "a1237" "a1242" "a1243" "a1244" "a1245"   
## [325] "a1246" "a1247" "a1256" "a1257" "a1259" "a1260"   
## [331] "a1271" "a1272" "a1273" "a1274" "a1275" "a1314"   
## [337] "a1315" "a1328" "a1329" "a1330" "a1332" "a1344"   
## [343] "a1345" "a1346" "a1357" "a1358" "a1359" "a1360"   
## [349] "a1362" "a1363" "a1420" "a1421" "a1457" "a1458"   
## [355] "a1472" "a1473" "a1474" "a1478" "a1479" "a1492"   
## [361] "a1493" "a1494" "a1496" "a1505" "a1506" "a1507"   
## [367] "a1510" "a1511" "a1512" "a1521" "a1522" "a1527"   
## [373] "a1551" "a1552" "a1554" "a1555" "a1556" "a1669"   
## [379] "a1670" "a1680" "a1681" "a1700" "a1701" "a1712"   
## [385] "a1715" "a1716" "a1717" "a1722" "a1723" "a1724"   
## [391] "a1729" "a1730" "a1740" "a1741" "a1753" "a1754"   
## [397] "a1755" "a1756" "a1757" "a1778" "a1779" "a1780"   
## [403] "a1781" "a1803" "a1806" "a1807" "a1858" "a1859"   
## [409] "a1860" "a1861" "a1863" "a1887" "a1888" "a1889"   
## [415] "a1892" "a1893" "a1922" "a1923" "a1924" "a1948"   
## [421] "a1949" "a1952" "a1953" "a1959" "a1960" "a1961"   
## [427] "a1965" "a1966" "a1967" "a2004" "a2005" "a2006"   
## [433] "a2007" "a2019" "a2020" "a2021" "a2029" "a2031"   
## [439] "a2041" "a2042" "a2043" "a2054" "a2055" "a2090"   
## [445] "a2091" "a2092" "a2101" "a2102" "a2118" "a2134"   
## [451] "a2135" "a2136" "a2137" "a2138" "a2139" "a2140"   
## [457] "a2141" "a2142" "a2149" "a2150" "a2151" "a2152"   
## [463] "a2162" "a2163" "a2164" "a2165" "a2166" "a2167"   
## [469] "a2168" "a2193" "a2194" "a2195" "a2196" "a2233"   
## [475] "a2234" "a2235" "a2236" "a2237" "a2238" "a2239"   
## [481] "a2240" "a2241" "a2242" "a2251" "a2252" "a2253"   
## [487] "a2301" "a2302" "a2303" "a2304" "a2305" "a2311"   
## [493] "a2312" "a2313" "a2393" "a2403" "a2404" "a2405"   
## [499] "a2406" "a2407" "a2431" "a2432" "a2460" "a2462"   
## [505] "a2464" "a2465" "a2466" "a2467" "a2468" "a2469"   
## [511] "a2484" "a2486" "a2487" "a2559" "a2568" "a2569"   
## [517] "a2578" "a2596" "a2597" "a2598" "a2601" "a2602"   
## [523] "a2610" "a2611" "a2612" "a2613" "a2614" "a2615"   
## [529] "a2656" "a2711" "a2712" "a2713" "a2715" "a2716"   
## [535] "a2722" "a2723" "a2725" "a2726" "a2727" "a2728"   
## [541] "a2729" "a2730" "a2731" "a2732" "a2735" "a2736"   
## [547] "a2737" "a2738" "a2742" "a2746" "a2753" "a2754"   
## [553] "a2755" "a2756" "a2757" "a2758" "a2772" "a2778"   
## [559] "a2779" "a2780" "a2781" "a2790" "a2791" "a2847"   
## [565] "a2848" "a2854" "a2855" "a2872" "a2873" "a2885"   
## [571] "a2909" "a2945" "a2946" "a2947" "a2958" "a2960"   
## [577] "a2961" "a2962" "a2963" "a2964" "a2965" "a2970"   
## [583] "a2972" "a2973" "a2974" "a2975" "a2976" "a2977"   
## [589] "a3023" "a3024" "a3027" "a3043" "a3044" "a3045"   
## [595] "a3121" "a3122" "a3147" "a3176" "a3177" "a3178"   
## [601] "a3183" "a3184" "a3185" "a3186" "a3207" "a3208"   
## [607] "a3209" "a3210" "a3224" "a3225" "a3226" "a3227"   
## [613] "a3238" "a3239" "a3240" "a3261" "a3262" "a3263"   
## [619] "a3264" "a3265" "a3274" "a3275" "a3276" "a3308"   
## [625] "a3332" "a3333" "a3358" "a3359" "a3360" "a3363"   
## [631] "a3364" "a3365" "a3366" "a3367" "a3373" "a3374"   
## [637] "a3375" "a3376" "a3377" "a3378" "a3409" "a3410"   
## [643] "a3411" "a3444" "a3445" "a3453" "a3454" "a3455"   
## [649] "a3463" "a3465" "a3466" "a3475" "a3478" "a3479"   
## [655] "a3489" "a3495" "a3496" "a3520" "a3526" "a3527"   
## [661] "a3528" "a3530" "a3532" "a3533" "a3539" "a3540"   
## [667] "a3541" "a3555" "a3576" "a3577" "a3578" "a3579"   
## [673] "a3580" "a3581" "a3582" "a3583" "a3584" "a3597"   
## [679] "a3598" "a3599" "a3600" "a3601" "a3602" "a3616"   
## [685] "a3617" "a3636" "a3637" "a3638" "a3639" "a3640"   
## [691] "a3641" "a3642" "a3643" "a3644" "a3648" "a3649"   
## [697] "a3650" "a3651" "a3726" "a3727" "a3728" "a3775"   
## [703] "a3776" "a3777" "a3778" "a3779" "a3780" "a3781"   
## [709] "a3820" "a3821" "a3822" "a3824" "a3825" "a3826"   
## [715] "a3827" "a3828" "a3842" "a3843" "a3846" "a3874"   
## [721] "a3875" "a3876" "a3877" "a3878" "a3879" "a3884"   
## [727] "a3885" "a3946" "a3969" "a3970" "a3971" "a3991"   
## [733] "a3992" "a3993" "a3994" "a3997" "a3998" "a3999"   
## [739] "a4000" "a4004" "a4005" "a4006" "a4007" "a4008"   
## [745] "a4034" "a4035" "a4036" "a4037" "a4047" "a4056"   
## [751] "a4057" "a4058" "a4059" "a4086" "a4087" "a4098"   
## [757] "a4105" "a4106" "a4136" "a4157" "a4158" "a4159"   
## [763] "a4190" "a4191" "a4192" "a4193" "a4208" "a4209"   
## [769] "a4210" "a4211" "a4246" "a4266" "a4267" "a4268"   
## [775] "a4269" "a4282" "a4322" "a4323" "a4324" "a4325"   
## [781] "a4346" "a4347" "a4369" "a4370" "a4371" "a4379"   
## [787] "a4380" "a4381" "a4386" "a4387" "a4388" "a4401"   
## [793] "a4418" "a4419" "a4455" "a4465" "a4480" "a4499"   
## [799] "a4500" "a4501" "a4502" "a4510" "a4511" "a4535"   
## [805] "a4553" "a4554" "a4565" "a4566" "a4567" "a4568"   
## [811] "a4569" "a4570" "a4588" "a4589" "a4603" "a4657"   
## [817] "a4658" "a4659" "a4660" "a4682" "a4683" "a4684"   
## [823] "a4685" "a4686" "a4687" "a4688" "a4719" "a4720"   
## [829] "a4721" "a4722" "a4751" "a4752" "a4753" "a4754"   
## [835] "a4755" "a4756" "a4757" "a4786" "a4788" "a4809"   
## [841] "a4810" "a4847" "a4850" "a4851" "a4852" "a4857"   
## [847] "a4858" "a4859" "a4860" "a4861" "a4922" "a4947"   
## [853] "a4948" "a4949" "a4975" "a4976" "a5011" "a5012"   
## [859] "a5013" "a5014" "a5015" "a5016" "a5053" "a5054"   
## [865] "a5071" "a5072" "a5073" "a5077" "a5078" "a5174"   
## [871] "a5175" "a5176" "a5204" "a5205" "a5206" "a5217"   
## [877] "a5270" "a5271" "a5299" "a5300" "a5302" "a5319"   
## [883] "a5321" "a5335" "a5351" "a5370" "a5384" "a5385"   
## [889] "a5439" "a5440" "a5503" "a5504" "a5531" "a5532"   
## [895] "a5533" "a5534" "a5535" "a5552" "a5553" "a5554"   
## [901] "a5560" "a5561" "a5562" "a5567" "a5568" "a5569"   
## [907] "a5572" "a5573" "a5574" "a5582" "a5583" "a5584"   
## [913] "a5585" "a5586" "a5587" "a5603" "a5604" "a5662"   
## [919] "a5663" "a5664" "a5665" "a5671" "a5722" "a5723"   
## [925] "a5724" "a5743" "a5744" "a5764" "a5766" "a5783"   
## [931] "a5824" "a5830" "a5890" "a5891" "a5892" "a5897"   
## [937] "a5919" "a5920" "a5983" "a5985" "a5986" "a5998"   
## [943] "a6048" "a6058" "a6059" "a6061" "a6062" "a6091"   
## [949] "a6092" "a6093" "a6102" "a6103" "a6139" "a6140"   
## [955] "a6141" "a6143" "a6144" "a6145" "a6146" "a6160"   
## [961] "a6171" "a6178" "a6223" "a6224" "a6234" "a6239"   
## [967] "a6240" "a6263" "a6296" "a6297" "a6298" "a6299"   
## [973] "a6300" "a6329" "a6330" "a6356" "a6403" "a6404"   
## [979] "a6405" "a6516" "a6523" "a6535" "a6536" "a6542"   
## [985] "a6543" "a6544" "a6545" "a6552" "a6553" "a6569"   
## [991] "a6570" "a6577" "a6610" "a6611" "a6623" "a6635"   
## [997] "a6637" "a6638" "a6690" "a6700" "a6782" "a6786"   
## [1003] "a6812" "a6813" "a6814" "a6829" "a6844" "a6845"   
## [1009] "a6906" "a6907" "a6921" "a6922" "a6923" "a6924"   
## [1015] "a6925" "a6987" "a6988" "a6989" "a6990" "a7009"   
## [1021] "a7010" "a7011" "a7012" "a7013" "a7048" "a7049"   
## [1027] "a7052" "a7068" "a7071" "a7072" "a7073" "a7074"   
## [1033] "a7075" "a7106" "a7107" "a7108" "a7109" "a7118"   
## [1039] "a7128" "a7129" "a7130" "a7131" "a7132" "a7133"   
## [1045] "a7147" "a7148" "a7150" "a7151" "a7155" "a7156"   
## [1051] "a7157" "a7158" "a7216" "a7217" "a7218" "a7228"   
## [1057] "a7229" "a7237" "a7238" "a7239" "a7256" "a7267"   
## [1063] "a7268" "a7269" "a7270" "a7296" "a7298" "a7302"   
## [1069] "a7314" "a7316" "a7317" "a7318" "a7344" "a7352"   
## [1075] "a7362" "a7363" "a7378" "a7379" "a7380" "a7423"   
## [1081] "a7424" "a7425" "a7426" "a7439" "a7440" "a7450"   
## [1087] "a7462" "a7463" "a7477" "a7478" "a7489" "a7490"   
## [1093] "a7491" "a7496" "a7564" "a7589" "a7590" "a7603"   
## [1099] "a7626" "a7635" "a7636" "a7637" "a7638" "a7640"   
## [1105] "a7641" "a7644" "a7645" "a7646" "a7647" "a7658"   
## [1111] "a7659" "a7660" "a7661" "a7681" "a7693" "a7694"   
## [1117] "a7696" "a7697" "a7727" "a7734" "a7735" "a7736"   
## [1123] "a7737" "a7738" "a7749" "a7751" "a7755" "a7756"   
## [1129] "a7757" "a7764" "a7766" "a7781" "a7782" "a7822"   
## [1135] "a7823" "a7844" "a7845" "a7846" "a7847" "a7848"   
## [1141] "a7861" "a7879" "a7880" "a7881" "a7882" "a7886"   
## [1147] "a7947" "a7948" "a7949" "a7950" "a7977" "a7978"   
## [1153] "a7995" "a7996" "a7997" "a8010" "a8067" "a8068"   
## [1159] "a8069" "a8080" "a8081" "a8082" "a8108" "a8109"   
## [1165] "a8110" "a8111" "a8112" "a8113" "a8133" "a8134"   
## [1171] "a8135" "a8154" "a8156" "a8167" "a8168" "a8169"   
## [1177] "a8170" "a8196" "a8197" "a8198" "a8199" "a8207"   
## [1183] "a8215" "a8248" "a8260" "a8263" "a8293" "a8319"   
## [1189] "a8345" "a8346" "a8366" "a8399" "a8400" "a8401"   
## [1195] "a8408" "a8409" "a8415" "a8416" "a8417" "a8425"   
## [1201] "a8434" "a8452" "a8487" "a8488" "a8576" "a8577"   
## [1207] "a8578" "a8588" "a8589" "a8590" "a8591" "a8613"   
## [1213] "a8621" "a8625" "a8626" "a8627" "a8661" "a8662"   
## [1219] "a8668" "a8669" "a8670" "a8683" "a8687" "a8688"   
## [1225] "a8689" "a8723" "a8746" "a8747" "a8785" "a8790"   
## [1231] "a8875" "a8876" "a8877" "a8878" "a8879" "a8880"   
## [1237] "a8881" "a8891" "a8973" "a8974" "a8991" "a8992"   
## [1243] "a8993" "a8994" "a8995" "a9002" "a9005" "a9006"   
## [1249] "a9051" "a9052" "a9053" "a9067" "a9102" "a9127"   
## [1255] "a9128" "a9142" "a9143" "a9203" "a9204" "a9205"   
## [1261] "a9226" "a9227" "a9238" "a9239" "a9240" "a9241"   
## [1267] "a9242" "a9244" "a9245" "a9342" "a9401" "a9431"   
## [1273] "a9437" "a9438" "a9439" "a9440" "a9444" "a9445"   
## [1279] "a9446" "a9447" "a9458" "a9459" "a9460" "a9461"   
## [1285] "a9503" "a9515" "a9516" "a9517" "a9606" "a9656"   
## [1291] "a9657" "a9750" "a9751" "a9762" "a9768" "a9769"   
## [1297] "a9971" "a9986" "a10044" "a10045" "a10113" "a10114"   
## [1303] "a10122" "a10123" "a10147" "a10155" "a10156" "a10157"   
## [1309] "a10158" "a10159" "a10184" "a10186" "a10187" "a10200"   
## [1315] "a10201" "a10202" "a10257" "a10258" "a10266" "a10267"   
## [1321] "a10268" "a10269" "a10270" "a10271" "a10272" "a10273"   
## [1327] "a10306" "a10307" "a10357" "a10359" "a10360" "a10388"   
## [1333] "a10389" "a10390" "a10392" "a10393" "a10394" "a10395"   
## [1339] "a10397" "a10407" "a10408" "a10428" "a10429" "a10430"   
## [1345] "a10431" "a10448" "a10449" "a10478" "a10537" "a10542"   
## [1351] "a10543" "a10544" "a10573" "a10574" "a10575" "a10576"   
## [1357] "a10612" "a10613" "a10614" "a10615" "a10616" "a10617"   
## [1363] "a10642" "a10643" "a10658" "a10659" "a10664" "a10665"   
## [1369] "a10691" "a10711" "a10752" "a10753" "a10761" "a10766"   
## [1375] "a10767" "a10771" "a10786" "a10792" "a10816" "a10821"   
## [1381] "a10822" "a10823" "a10824" "a10871" "a10907" "a10908"   
## [1387] "a10909" "a10911" "a10912" "a10916" "a10938" "a10939"   
## [1393] "a10960" "a10970" "a10971" "a10996" "a11017" "a11018"   
## [1399] "a11019" "a11032" "a11054" "a11065" "a11067" "a11141"   
## [1405] "a11142" "a11203" "a11209" "a11212" "a11213" "a11215"   
## [1411] "a11216" "a11218" "a11224" "a11255" "a11256" "a11257"   
## [1417] "a11281" "a11301" "a11305" "a11341" "a11342" "a11343"   
## [1423] "a11349" "a11360" "a11361" "a11378" "a11380" "a11382"   
## [1429] "a11391" "a11408" "a11446" "a11447" "a11448" "a11498"   
## [1435] "a11499" "a11500" "a11513" "a11514" "a11575" "a11616"   
## [1441] "a11618" "a11619" "a11620" "a11664" "a11665" "a11687"   
## [1447] "a11688" "a11689" "a11690" "a11698" "a11699" "a11700"   
## [1453] "a11701" "a11771" "a11772" "a11782" "a11828" "a11832"   
## [1459] "a11858" "a11859" "a11884" "a11899" "a11928" "a11937"   
## [1465] "a11938" "a11939" "a11956" "a11963" "a11968" "a11969"   
## [1471] "a11970" "a11992" "a12005" "a12008" "a12035" "a12048"   
## [1477] "a12049" "a12050" "a12051" "a12064" "a12088" "a12091"   
## [1483] "a12128" "a12151" "a12152" "a12153" "a12154" "a12161"   
## [1489] "a12162" "a12163" "a12164" "a12165" "a12214" "a12227"   
## [1495] "a12416" "a12420" "a12421" "a12433" "a12437" "a12438"   
## [1501] "a12440" "a12469" "a12533" "a12605" "a12606" "a12607"   
## [1507] "a12613" "a12614" "a12632" "a12633" "a12652" "a12653"   
## [1513] "a12654" "a12661" "a12662" "a12663" "a12664" "a12667"   
## [1519] "a12668" "a12670" "a12671" "a12672" "a12673" "a12693"   
## [1525] "a12776" "a12777" "a12778" "a12799" "a12807" "a12843"   
## [1531] "a12844" "a12845" "a12846" "a12847" "a12848" "a12888"   
## [1537] "a12892" "a12900" "a12901" "a12984" "a13022" "a13067"   
## [1543] "a13068" "a13080" "a13081" "a13082" "a13083" "a13117"   
## [1549] "a13159" "a13160" "a13227" "a13228" "a13241" "a13276"   
## [1555] "a13281" "a13282" "a13283" "a13332" "a13333" "a13334"   
## [1561] "a13335" "a13357" "a13358" "a13365" "a13366" "a13370"   
## [1567] "a13371" "a13372" "a13391" "a13456" "a13533" "a13551"   
## [1573] "a13568" "a13572" "a13596" "a13604" "a13605" "a13680"   
## [1579] "a13773" "a13774" "a13786" "a13805" "a13814" "a13826"   
## [1585] "a13827" "a13828" "a13829" "a13830" "a13831" "a13842"   
## [1591] "a13983" "a14058" "a14073" "a14087" "a14088" "a14089"   
## [1597] "a14090" "a14091" "a14093" "a14094" "a14095" "a14096"   
## [1603] "a14097" "a14133" "a14188" "a14191" "a14192" "a14204"   
## [1609] "a14205" "a14234" "a14235" "a14236" "a14326" "a14327"   
## [1615] "a14328" "a14358" "a14359" "a14360" "a14415" "a14417"   
## [1621] "a14567" "a14568" "a14569" "a14570" "a14571" "a14604"   
## [1627] "a14690" "a14784" "a14805" "a14806" "a14807" "a14867"   
## [1633] "a14900" "a14901" "a14902" "a14915" "a14974" "a15029"   
## [1639] "a15030" "a15031" "a15032" "a15058" "a15059" "a15060"   
## [1645] "a15097" "a15098" "a15099" "a15147" "a15148" "a15149"   
## [1651] "a15150" "a15151" "a15196" "a15250" "a15251" "a15321"   
## [1657] "a15322" "a15323" "a15328" "a15356" "a15357" "a15358"   
## [1663] "a15359" "a15384" "a15385" "a15386" "a15470" "a15552"   
## [1669] "a15721" "a15723" "a15744" "a15751" "a15752" "a15817"   
## [1675] "a15846" "a15889" "a15943" "a15962" "a15989" "a16030"   
## [1681] "a16031" "a16058" "a16170" "a16200" "a16214" "a16225"   
## [1687] "a16239" "a16297" "a16298" "a16299" "a16326" "a16327"   
## [1693] "a16348" "a16349" "a16434" "a16439" "a16440" "a16441"   
## [1699] "a16477" "a16491" "a16534" "a16535" "a16536" "a16552"   
## [1705] "a16565" "a16566" "a16567" "a16594" "a16608" "a16613"   
## [1711] "a16614" "a16615" "a16616" "a16648" "a16649" "a16650"   
## [1717] "a16694" "a16715" "a16812" "a16816" "a16817" "a16830"   
## [1723] "a16872" "a16873" "a16874" "a16875" "a16887" "a16888"   
## [1729] "a16924" "a16928" "a16930" "a16936" "a17032" "a17115"   
## [1735] "a17145" "a17181" "a17182" "a17184" "a17191" "a17192"   
## [1741] "a17198" "a17228" "a17342" "a17363" "a17378" "a17381"   
## [1747] "a17407" "a17408" "a17430" "a17431" "a17432" "a17448"   
## [1753] "a17451" "a17452" "a17453" "a17454" "a17455" "a17499"   
## [1759] "a17516" "a17694" "a17706" "a17707" "a17708" "a17709"   
## [1765] "a17725" "a17755" "a17756" "a17911" "a17936" "a17954"   
## [1771] "a17955" "a17961" "a17964" "a17965" "a17970" "a17974"   
## [1777] "a17980" "a18038" "a18062" "a18156" "a18172" "a18232"   
## [1783] "a18233" "a18316" "a18428" "a18429" "a18506" "a18539"   
## [1789] "a18550" "a18555" "a18556" "a18557" "a18569" "a18582"   
## [1795] "a18583" "a18584" "a18595" "a18596" "a18597" "a18598"   
## [1801] "a18599" "a18615" "a18649" "a18650" "a18651" "a18652"   
## [1807] "a18653" "a18746" "a18779" "a18780" "a18791" "a18792"   
## [1813] "a18829" "a18836" "a18837" "a18838" "a18893" "a18908"   
## [1819] "a18909" "a18910" "a19009" "a19011" "a19012" "a19028"   
## [1825] "a19029" "a19030" "a19083" "a19107" "a19108" "a19109"   
## [1831] "a19137" "a19144" "a19145" "a19146" "a19153" "a19154"   
## [1837] "a19265" "a19266" "a19282" "a19292" "a19352" "a19425"   
## [1843] "a19426" "a19472" "a19484" "a19485" "a19486" "a19507"   
## [1849] "a19515" "a19590" "a19639" "a19640" "a19641" "a19696"   
## [1855] "a19697" "a19698" "a19699" "a19727" "a19732" "a19733"   
## [1861] "a19810" "a19872" "a19928" "a19929" "a19930" "a20043"   
## [1867] "a20044" "a20045" "a20094" "a20184" "a20200" "a20210"   
## [1873] "a20211" "a20251" "a20256" "a20269" "a20316" "a20333"   
## [1879] "a20348" "a20453" "a20551" "a20566" "a20574" "a20575"   
## [1885] "a20622" "a20623" "a20624" "a20625" "a20626" "a20632"   
## [1891] "a20633" "a20634" "a20727" "a20728" "a20880" "a20941"   
## [1897] "a20993" "a20994" "a21012" "a21013" "a21078" "a21100"   
## [1903] "a21101" "a21102" "a21169" "a21170" "a21193" "a21202"   
## [1909] "a21203" "a21209" "a21210" "a21280" "a21301" "a21525"   
## [1915] "a21528" "a21529" "a21546" "a21547" "a21578" "a21579"   
## [1921] "a21580" "a21581" "a21582" "a21589" "a21590" "a21591"   
## [1927] "a21700" "a21719" "a21720" "a21750" "a21804" "a21836"   
## [1933] "a21842" "a21843" "a21913" "a21914" "a22112" "a22113"   
## [1939] "a22185" "a22186" "a22187" "a22188" "a22225" "a22229"   
## [1945] "a22230" "a22231" "a22232" "a22233" "a22358" "a22359"   
## [1951] "a22366" "a22367" "a22368" "a22369" "a22387" "a22388"   
## [1957] "a22534" "a22762" "a22775" "a22776" "a22844" "a22845"   
## [1963] "a22930" "a23035" "a23036" "a23037" "a23046" "a23047"   
## [1969] "a23048" "a23156" "a23229" "a23248" "a23276" "a23277"   
## [1975] "a23278" "a23279" "a23375" "a23376" "a23444" "a23445"   
## [1981] "a23446" "a23459" "a23485" "a23486" "a23487" "a23488"   
## [1987] "a23505" "a23506" "a23507" "a23508" "a23523" "a23661"   
## [1993] "a23715" "a23716" "a23717" "a23866" "a23914" "a23915"   
## [1999] "a23979" "a23990" "a23991" "a23992" "a23993" "a23994"   
## [2005] "a24132" "a24222" "a24231" "a24232" "a24274" "a24341"   
## [2011] "a24346" "a24362" "a24385" "a24386" "a24387" "a24388"   
## [2017] "a24389" "a24402" "a24500" "a24501" "a24554" "a24581"   
## [2023] "a24587" "a24588" "a24589" "a24767" "a24772" "a24773"   
## [2029] "a24774" "a24775" "a24776" "a24788" "a24800" "a24801"   
## [2035] "a24809" "a24821" "a24822" "a24834" "a24835" "a24883"   
## [2041] "a24898" "a24899" "a24900" "a24924" "a24932" "a25000"   
## [2047] "a25001" "a25002" "a25009" "a25073" "a25074" "a25075"   
## [2053] "a25076" "a25077" "a25139" "a25140" "a25147" "a25187"   
## [2059] "a25188" "a25215" "a25222" "a25223" "a25224" "a25225"   
## [2065] "a25228" "a25237" "a25238" "a25343" "a25344" "a25413"   
## [2071] "a25414" "a25421" "a25422" "a25423" "a25563" "a25614"   
## [2077] "a25659" "a25683" "a25684" "a25685" "a25686" "a25718"   
## [2083] "a25728" "a25729" "a25736" "a25772" "a25773" "a25774"   
## [2089] "a26039" "a26040" "a26110" "a26116" "a26149" "a26150"   
## [2095] "a26151" "a26153" "a26171" "a26214" "a26215" "a26216"   
## [2101] "a26262" "a26263" "a26264" "a26317" "a26328" "a26329"   
## [2107] "a26330" "a26331" "a26378" "a26408" "a26418" "a26419"   
## [2113] "a26420" "a26421" "a26428" "a26531" "a26563" "a26564"   
## [2119] "a26565" "a26568" "a26575" "a26591" "a26592" "a26633"   
## [2125] "a26636" "a26648" "a26649" "a26752" "a26850" "a26851"   
## [2131] "a26852" "a26905" "a26911" "a26923" "a26924" "a26925"   
## [2137] "a26926" "a27001" "a27002" "a27073" "a27089" "a27090"   
## [2143] "a27092" "a27097" "a27098" "a27158" "a27159" "a27163"   
## [2149] "a27178" "a27254" "a27255" "a27307" "a27308" "a27309"   
## [2155] "a27310" "a27382" "a27383" "a27426" "a27436" "a27575"   
## [2161] "a27576" "a27638" "a27690" "a27691" "a27692" "a27693"   
## [2167] "a27707" "a27711" "a27722" "a27735" "a27736" "a27737"   
## [2173] "a27761" "a27817" "a27835" "a27836" "a27854" "a27894"   
## [2179] "a27895" "a27896" "a27897" "a27925" "a27926" "a27927"   
## [2185] "a27944" "a28038" "a28045" "a28046" "a28113" "a28153"   
## [2191] "a28226" "a28342" "a28416" "a28495" "a28576" "a28577"   
## [2197] "a28578" "a28606" "a28656" "a28664" "a28674" "a28675"   
## [2203] "a28697" "a28702" "a28703" "a28704" "a28857" "a28858"   
## [2209] "a28987" "a28993" "a28994" "a29011" "a29012" "a29013"   
## [2215] "a29024" "a29025" "a29026" "a29027" "a29098" "a29099"   
## [2221] "a29100" "a29101" "a29159" "a29230" "a29231" "a29232"   
## [2227] "a29233" "a29337" "a29338" "a29339" "a29340" "a29382"   
## [2233] "a29394" "a29395" "a29396" "a29408" "a29409" "a29413"   
## [2239] "a29434" "a29457" "a29588" "a29589" "a29590" "a29591"   
## [2245] "a29592" "a29593" "a29594" "a29658" "a29660" "a29672"   
## [2251] "a29673" "a29712" "a29713" "a29714" "a29799" "a29879"   
## [2257] "a29880" "a29922" "a29924" "a29965" "a30066" "a30067"   
## [2263] "a30068" "a30069" "a30070" "a30116" "a30117" "a30118"   
## [2269] "a30156" "a30314" "a30335" "a30354" "a30422" "a30428"   
## [2275] "a30454" "a30455" "a30456" "a30475" "a30476" "a30495"   
## [2281] "a30496" "a30497" "a30530" "a30531" "a30716" "a30717"   
## [2287] "a30823" "a30839" "a30849" "a30879" "a30880" "a30922"   
## [2293] "a30929" "a30930" "a30982" "a30983" "a31046" "a31047"   
## [2299] "a31099" "a31115" "a31116" "a31133" "a31143" "a31150"   
## [2305] "a31155" "a31169" "a31200" "a31201" "a31202" "a31203"   
## [2311] "a31204" "a31291" "a31292" "a31293" "a31308" "a31403"   
## [2317] "a31484" "a31485" "a31534" "a31627" "a31648" "a31650"   
## [2323] "a31663" "a31681" "a31705" "a31742" "a31743" "a31744"   
## [2329] "a31820" "a31821" "a31837" "a31843" "a31850" "a31851"   
## [2335] "a31874" "a31912" "a31964" "a31965" "a31988" "a31989"   
## [2341] "a32049" "a32065" "a32066" "a32094" "a32100" "a32101"   
## [2347] "a32205" "a32215" "a32246" "a32247" "a32248" "a32249"   
## [2353] "a32295" "a32296" "a32297" "a32499" "a32500" "a32501"   
## [2359] "a32502" "a32517" "a32518" "a32626" "a32627" "a32628"   
## [2365] "a32726" "a32727" "a32728" "a32729" "a32730" "a32762"   
## [2371] "a32763" "a32813" "a32824" "a32825" "a32861" "a32880"   
## [2377] "a32909" "a32910" "a33170" "a33171" "a33175" "a33192"   
## [2383] "a33193" "a33253" "a33254" "a33290" "a33291" "a33302"   
## [2389] "a33337" "a33368" "a33371" "a33401" "a33616" "a33690"   
## [2395] "a33700" "a33933" "a33934" "a33956" "a33957" "a33958"   
## [2401] "a33986" "a33990" "a33991" "a34016" "a34032" "a34033"   
## [2407] "a34278" "a34391" "a34442" "a34702" "a34785" "a34817"   
## [2413] "a34856" "a34859" "a34948" "a34949" "a34986" "a34987"   
## [2419] "a34988" "a35068" "a35133" "a35182" "a35183" "a35262"   
## [2425] "a35278" "a35279" "a35280" "a35281" "a35282" "a35327"   
## [2431] "a35543" "a35544" "a35606" "a35631" "a35632" "a35662"   
## [2437] "a35693" "a35695" "a35740" "a35908" "a35909" "a35938"   
## [2443] "a35939" "a35940" "a36006" "a36007" "a36008" "a36132"   
## [2449] "a36225" "a36226" "a36227" "a36228" "a36367" "a36368"   
## [2455] "a36383" "a36417" "a36539" "a36540" "a36541" "a36626"   
## [2461] "a36627" "a36629" "a36697" "a36799" "a36885" "a36886"   
## [2467] "a36887" "a36888" "a36925" "a36926" "a36927" "a36949"   
## [2473] "a36950" "a36951" "a36955" "a36956" "a36957" "a36996"   
## [2479] "a37013" "a37115" "a37116" "a37118" "a37133" "a37154"   
## [2485] "a37172" "a37212" "a37225" "a37320" "a37322" "a37462"   
## [2491] "a37463" "a37464" "a37570" "a37583" "a37591" "a37592"   
## [2497] "a37593" "a37729" "a37730" "a37731" "a37732" "a37748"   
## [2503] "a37749" "a37821" "a37869" "a37870" "a37871" "a37872"   
## [2509] "a37902" "a37990" "a38106" "a38117" "a38144" "a38145"   
## [2515] "a38146" "a38198" "a38208" "a38209" "a38210" "a38211"   
## [2521] "a38223" "a38224" "a38225" "a38306" "a38366" "a38433"   
## [2527] "a38715" "a38736" "a38737" "a38799" "a38800" "a38801"   
## [2533] "a38873" "a38874" "a38875" "a38922" "a38923" "a38937"   
## [2539] "a39026" "a39027" "a39251" "a39293" "a39340" "a39341"   
## [2545] "a39440" "a39441" "a39465" "a39468" "a39469" "a39470"   
## [2551] "a39628" "a39629" "a39630" "a39631" "a39709" "a39710"   
## [2557] "a39716" "a39786" "a39787" "a40009" "a40010" "a40011"   
## [2563] "a40012" "a40013" "a40156" "a40157" "a40240" "a40241"   
## [2569] "a40277" "a40345" "a40575" "a40784" "a40862" "a40863"   
## [2575] "a40864" "a40985" "a41008" "a41009" "a41212" "a41244"   
## [2581] "a41256" "a41281" "a41282" "a41296" "a41297" "a41298"   
## [2587] "a41299" "a41300" "a41367" "a41368" "a41620" "a41621"   
## [2593] "a41622" "a41623" "a41624" "a41767" "a41815" "a41888"   
## [2599] "a41889" "a41979" "a41980" "a41981" "a42039" "a42040"   
## [2605] "a42045" "a42046" "a42047" "a42186" "a42246" "a42356"   
## [2611] "a42357" "a42358" "a42359" "a42393" "a42394" "a42402"   
## [2617] "a42403" "a42404" "a42405" "a42410" "a42428" "a42429"   
## [2623] "a42511" "a42512" "a42624" "a42697" "a42698" "a42704"   
## [2629] "a42705" "a42724" "a42846" "a42848" "a42849" "a42853"   
## [2635] "a42854" "a42855" "a42856" "a43089" "a43129" "a43178"   
## [2641] "a43179" "a43315" "a43377" "a43378" "a43379" "a43380"   
## [2647] "a43427" "a43428" "a43536" "a43537" "a43611" "a43614"   
## [2653] "a43836" "a43842" "a43869" "a43952" "a43953" "a43954"   
## [2659] "a44045" "a44046" "a44129" "a44130" "a44179" "a44236"   
## [2665] "a44237" "a44239" "a44619" "a44635" "a44645" "a44646"   
## [2671] "a44647" "a44786" "a44892" "a44958" "a45185" "a45254"   
## [2677] "a45602" "a45603" "a45627" "a45750" "a45828" "a45905"   
## [2683] "a45997" "a46042" "a46043" "a46311" "a46312" "a46313"   
## [2689] "a46384" "a46385" "a46409" "a46605" "a46606" "a46607"   
## [2695] "a46619" "a46648" "a46715" "a46716" "a46717" "a46804"   
## [2701] "a46869" "a46870" "a46871" "a46941" "a46942" "a46943"   
## [2707] "a47001" "a47011" "a47128" "a47129" "a47131" "a47469"   
## [2713] "a47484" "a47570" "a47571" "a47572" "a47573" "a47574"   
## [2719] "a47614" "a47615" "a47616" "a47617" "a47727" "a47728"   
## [2725] "a47796" "a47872" "a47873" "a47874" "a47898" "a48039"   
## [2731] "a48145" "a48146" "a48147" "a48148" "a48183" "a48184"   
## [2737] "a48336" "a48536" "a48607" "a48728" "a49042" "a49098"   
## [2743] "a49260" "a49415" "a49521" "a49544" "a49578" "a49579"   
## [2749] "a49580" "a49779" "a49780" "a49781" "a49782" "a49883"   
## [2755] "a49884" "a49901" "a49902" "a49945" "a50048" "a50049"   
## [2761] "a50050" "a50151" "a50155" "a50156" "a50169" "a50341"   
## [2767] "a50342" "a50484" "a50669" "a50670" "a50672" "a50684"   
## [2773] "a50734" "a50950" "a50951" "a51009" "a51010" "a51011"   
## [2779] "a51012" "a51013" "a51065" "a51066" "a51067" "a51068"   
## [2785] "a51069" "a51070" "a51109" "a51148" "a51149" "a51255"   
## [2791] "a51256" "a51257" "a51339" "a51356" "a51357" "a51358"   
## [2797] "a51359" "a51399" "a51433" "a51468" "a51469" "a51571"   
## [2803] "a51601" "a51751" "a51788" "a51809" "a51827" "a51835"   
## [2809] "a51922" "a51923" "a51924" "a51928" "a51929" "a51930"   
## [2815] "a52151" "a52228" "a52320" "a52326" "a52327" "a52400"   
## [2821] "a52468" "a52469" "a52490" "a52491" "a52937" "a52960"   
## [2827] "a52988" "a53039" "a53108" "a53188" "a53213" "a53214"   
## [2833] "a53215" "a53216" "a53375" "a53376" "a53377" "a53483"   
## [2839] "a53486" "a53487" "a53630" "a53632" "a53663" "a53774"   
## [2845] "a53775" "a53975" "a53996" "a53997" "a53998" "a53999"   
## [2851] "a54000" "a54080" "a54109" "a54110" "a54132" "a54206"   
## [2857] "a54249" "a54455" "a54456" "a54457" "a54458" "a54459"   
## [2863] "a54467" "a54773" "a54774" "a54864" "a54865" "a54866"   
## [2869] "a54867" "a54868" "a54997" "a54998" "a55112" "a55113"   
## [2875] "a55153" "a55154" "a55289" "a55313" "a55322" "a55323"   
## [2881] "a55380" "a55381" "a55382" "a55383" "a55384" "a55385"   
## [2887] "a55767" "a55786" "a55787" "a55831" "a55832" "a56038"   
## [2893] "a56043" "a56053" "a56058" "a56064" "a56065" "a56088"   
## [2899] "a56107" "a56108" "a56109" "a56221" "a56222" "a56223"   
## [2905] "a56367" "a56468" "a56469" "a56470" "a56527" "a56582"   
## [2911] "a56583" "a56642" "a56643" "a56729" "a56730" "a56745"   
## [2917] "a56908" "a56909" "a56970" "a56986" "a57400" "a57401"   
## [2923] "a57402" "a57403" "a57573" "a57574" "a57575" "a57576"   
## [2929] "a57630" "a57681" "a57880" "a58025" "a58026" "a58027"   
## [2935] "a58028" "a58029" "a58120" "a58387" "a58408" "a58409"   
## [2941] "a58410" "a58431" "a58580" "a58669" "a58707" "a58929"   
## [2947] "a59074" "a59110" "a59270" "a59271" "a59272" "a59273"   
## [2953] "a59448" "a59449" "a59475" "a59751" "a60186" "a60187"   
## [2959] "a60188" "a60217" "a60457" "a60721" "a60723" "a60836"   
## [2965] "a60837" "a60838" "a60839" "a60936" "a60937" "a60938"   
## [2971] "a60951" "a61456" "a61589" "a61638" "a61639" "a61920"   
## [2977] "a62066" "a62067" "a62068" "a62233" "a62348" "a62349"   
## [2983] "a62350" "a62582" "a62583" "a62584" "a62585" "a62769"   
## [2989] "a62770" "a62771" "a62772" "a62790" "a62791" "a62823"   
## [2995] "a62824" "a62869" "a62870" "a62901" "a62912" "a63263"   
## [3001] "a63264" "a63416" "a63454" "a63455" "a63502" "a63623"   
## [3007] "a63636" "a63637" "a63639" "a63719" "a63720" "a63721"   
## [3013] "a63731" "a63732" "a63733" "a63982" "a63991" "a64171"   
## [3019] "a64172" "a64370" "a64432" "a64433" "a64617" "a64618"   
## [3025] "a64619" "a64621" "a64977" "a65052" "a65232" "a65233"   
## [3031] "a65234" "a65235" "a65834" "a65835" "a65836" "a65837"   
## [3037] "a65929" "a65937" "a65938" "a65939" "a65940" "a65956"   
## [3043] "a65988" "a65989" "a66056" "a66061" "a66063" "a66518"   
## [3049] "a66519" "a66666" "a66908" "a66909" "a66910" "a67129"   
## [3055] "a67130" "a67131" "a67288" "a67289" "a67290" "a67291"   
## [3061] "a67292" "a67394" "a67395" "a67493" "a67517" "a67881"   
## [3067] "a67908" "a67909" "a67929" "a68133" "a68293" "a68358"   
## [3073] "a68359" "a68360" "a68393" "a68455" "a68609" "a68611"   
## [3079] "a68612" "a68753" "a68788" "a68789" "a68808" "a68809"   
## [3085] "a68810" "a68846" "a68847" "a68872" "a68922" "a68923"   
## [3091] "a68982" "a68983" "a68984" "a68985" "a68986" "a69068"   
## [3097] "a69078" "a69079" "a69080" "a69081" "a69132" "a69133"   
## [3103] "a69134" "a69135" "a69175" "a69385" "a69386" "a69387"   
## [3109] "a69417" "a69870" "a69928" "a70263" "a70267" "a70302"   
## [3115] "a70372" "a70477" "a70478" "a70503" "a71063" "a71064"   
## [3121] "a71386" "a71387" "a71604" "a71682" "a72096" "a72136"   
## [3127] "a72137" "a72138" "a72139" "a72208" "a72415" "a72416"   
## [3133] "a72417" "a72504" "a72628" "a72629" "a72630" "a72661"   
## [3139] "a72692" "a72693" "a72694" "a72871" "a73068" "a73103"   
## [3145] "a73113" "a73446" "a73485" "a73489" "a73614" "a73826"   
## [3151] "a73827" "a73828" "a73829" "a73963" "a73964" "a74131"   
## [3157] "a74132" "a74133" "a74134" "a74182" "a74220" "a74278"   
## [3163] "a74279" "a74339" "a74340" "a74341" "a74342" "a74426"   
## [3169] "a74427" "a74428" "a74462" "a74593" "a74594" "a74787"   
## [3175] "a74926" "a74940" "a74941" "a75053" "a75167" "a75169"   
## [3181] "a75414" "a75415" "a75478" "a75640" "a75697" "a75698"   
## [3187] "a75699" "a75700" "a75800" "a75801" "a76097" "a76192"   
## [3193] "a76531" "a76645" "a76776" "a76991" "a77083" "a77351"   
## [3199] "a77352" "a77406" "a77587" "a77588" "a77855" "a77866"   
## [3205] "a78063" "a78064" "a78287" "a78288" "a78418" "a78433"   
## [3211] "a78934" "a78935" "a78970" "a78992" "a79089" "a79090"   
## [3217] "a79172" "a79173" "a79174" "a79175" "a79295" "a79381"   
## [3223] "a79569" "a79570" "a79571" "a80016" "a80076" "a80256"   
## [3229] "a80286" "a80287" "a80288" "a80289" "a80290" "a80368"   
## [3235] "a80442" "a80443" "a80444" "a80465" "a80592" "a80954"   
## [3241] "a81063" "a81064" "a81065" "a81066" "a81067" "a81155"   
## [3247] "a81230" "a81231" "a81258" "a81438" "a81573" "a81617"   
## [3253] "a81618" "a81678" "a81745" "a82048" "a82302" "a82466"   
## [3259] "a82512" "a83117" "a83118" "a83124" "a83125" "a83284"   
## [3265] "a83440" "a83690" "a84085" "a84086" "a84293" "a84294"   
## [3271] "a84485" "a84486" "a84488" "a84489" "a84534" "a84568"   
## [3277] "a84645" "a84646" "a84647" "a84651" "a84652" "a84853"   
## [3283] "a84854" "a84939" "a85134" "a85150" "a85235" "a85332"   
## [3289] "a85411" "a85412" "a85473" "a85474" "a85475" "a85476"   
## [3295] "a85531" "a85532" "a85533" "a85534" "a85535" "a86107"   
## [3301] "a86108" "a86154" "a86155" "a86156" "a86157" "a86158"   
## [3307] "a86265" "a86266" "a86312" "a86327" "a86580" "a86675"   
## [3313] "a86743" "a86744" "a86745" "a86830" "a86831" "a87011"   
## [3319] "a87066" "a87067" "a87339" "a87711" "a87821" "a87822"   
## [3325] "a87882" "a87883" "a87884" "a88260" "a88319" "a88697"   
## [3331] "a88806" "a89374" "a89375" "a89376" "a89583" "a89653"   
## [3337] "a89771" "a89772" "a89840" "a90072" "a90073" "a90228"   
## [3343] "a90229" "a90501" "a90557" "a90588" "a90630" "a90635"   
## [3349] "a90636" "a90709" "a90791" "a90792" "a90793" "a90794"   
## [3355] "a90929" "a91016" "a91364" "a91478" "a91692" "a91809"   
## [3361] "a91810" "a92111" "a92347" "a92355" "a92833" "a92834"   
## [3367] "a92835" "a92836" "a93247" "a93614" "a93766" "a93767"   
## [3373] "a93768" "a93769" "a93817" "a94265" "a94266" "a94267"   
## [3379] "a94583" "a94840" "a95066" "a95584" "a95593" "a95646"   
## [3385] "a95976" "a95977" "a96258" "a96659" "a97319" "a97320"   
## [3391] "a97466" "a97467" "a97559" "a97560" "a97745" "a97816"   
## [3397] "a97817" "a97843" "a97909" "a98049" "a98092" "a98093"   
## [3403] "a98094" "a98254" "a98260" "a98261" "a98262" "a98263"   
## [3409] "a98305" "a98306" "a98307" "a98404" "a98559" "a98560"   
## [3415] "a98561" "a98735" "a98745" "a99280" "a99281" "a99454"   
## [3421] "a99459" "a99460" "a99473" "a99564" "a99565" "a99566"   
## [3427] "a99996" "a100022" "a100213" "a100446" "a100808" "a100809"  
## [3433] "a100974" "a101072" "a101073" "a101074" "a101075" "a101076"  
## [3439] "a101450" "a101451" "a101577" "a101578" "a101958" "a101959"  
## [3445] "a101960" "a102005" "a102174" "a102774" "a102775" "a102912"  
## [3451] "a103200" "a103395" "a103775" "a103937" "a103938" "a103939"  
## [3457] "a103940" "a103941" "a103942" "a103943" "a103944" "a103973"  
## [3463] "a103974" "a103975" "a104384" "a104385" "a104606" "a104607"  
## [3469] "a105566" "a105813" "a105814" "a106075" "a106213" "a106524"  
## [3475] "a106544" "a106545" "a106546" "a106547" "a107104" "a107105"  
## [3481] "a107106" "a107174" "a107175" "a107225" "a107226" "a107227"  
## [3487] "a107811" "a108301" "a108305" "a108581" "a108859" "a108860"  
## [3493] "a108919" "a108920" "a109358" "a109359" "a109656" "a109657"  
## [3499] "a109899" "a109900" "a109901" "a109902" "a110351" "a110629"  
## [3505] "a111082" "a111083" "a111087" "a111154" "a111155" "a111156"  
## [3511] "a111157" "a111931" "a111992" "a111993" "a112196" "a112286"  
## [3517] "a112287" "a112288" "a112289" "a112487" "a112504" "a113393"  
## [3523] "a113441" "a113500" "a113501" "a113502" "a113815" "a114051"  
## [3529] "a114141" "a114151" "a114206" "a114395" "a114396" "a114573"  
## [3535] "a114674" "a114677" "a115341" "a115429" "a115430" "a115431"  
## [3541] "a115739" "a115836" "a115837" "a115838" "a115874" "a115875"  
## [3547] "a115876" "a116253" "a116254" "a116255" "a116341" "a116342"  
## [3553] "a116577" "a117158" "a117279" "a117381" "a117382" "a117383"  
## [3559] "a117847" "a117883" "a118525" "a118607" "a118608" "a118609"  
## [3565] "a118610" "a118611" "a119168" "a119456" "a119785" "a119786"  
## [3571] "a119845" "a119846" "a120186" "a120187" "a120230" "a120231"  
## [3577] "a120232" "a120422" "a120496" "a120946" "a121698" "a121699"  
## [3583] "a121761" "a121916" "a122293" "a122294" "a122447" "a122668"  
## [3589] "a122678" "a122682" "a122683" "a122684" "a122742" "a122951"  
## [3595] "a123073" "a123337" "a123338" "a123339" "a123577" "a123759"  
## [3601] "a123760" "a123761" "a123762" "a123763" "a123947" "a123964"  
## [3607] "a124226" "a124286" "a124301" "a124826" "a125062" "a125126"  
## [3613] "a125296" "a125297" "a125298" "a125299" "a125466" "a125467"  
## [3619] "a125546" "a125547" "a125548" "a125549" "a125550" "a126175"  
## [3625] "a126384" "a126437" "a126498" "a126499" "a126500" "a126501"  
## [3631] "a126556" "a126557" "a127059" "a127272" "a127273" "a127274"  
## [3637] "a127398" "a127399" "a127400" "a127401" "a127402" "a127585"  
## [3643] "a127924" "a127958" "a128228" "a128293" "a128459" "a128460"  
## [3649] "a128874" "a128875" "a128876" "a128877" "a129289" "a129290"  
## [3655] "a129291" "a129528" "a129529" "a129530" "a129645" "a129732"  
## [3661] "a129952" "a130400" "a130737" "a130985" "a130986" "a130987"  
## [3667] "a130988" "a131091" "a131221" "a131222" "a131541" "a131542"  
## [3673] "a131543" "a132129" "a132130" "a132476" "a132828" "a133400"  
## [3679] "a133415" "a133416" "a133417" "a133418" "a133637" "a133790"  
## [3685] "a133791" "a133792" "a133793" "a133794" "a133798" "a134209"  
## [3691] "a134210" "a134947" "a135173" "a135962" "a135963" "a136266"  
## [3697] "a136268" "a136663" "a136664" "a137289" "a137395" "a137396"  
## [3703] "a137696" "a137697" "a138102" "a138103" "a138135" "a138136"  
## [3709] "a138506" "a139041" "a139042" "a139145" "a139251" "a139368"  
## [3715] "a139369" "a139370" "a139383" "a139384" "a139385" "a139386"  
## [3721] "a139387" "a140278" "a140279" "a140280" "a140526" "a140527"  
## [3727] "a141245" "a141294" "a141295" "a141408" "a141409" "a142100"  
## [3733] "a142606" "a142709" "a142909" "a142919" "a142920" "a142921"  
## [3739] "a142922" "a142996" "a143328" "a143329" "a143330" "a143484"  
## [3745] "a143485" "a143486" "a143627" "a144236" "a144237" "a144238"  
## [3751] "a144239" "a144335" "a144336" "a144337" "a144708" "a145108"  
## [3757] "a145109" "a145511" "a145553" "a146507" "a146786" "a147068"  
## [3763] "a147336" "a147845" "a148015" "a148016" "a148121" "a148220"  
## [3769] "a148221" "a148269" "a148298" "a148543" "a148544" "a148545"  
## [3775] "a149108" "a149154" "a149312" "a149415" "a150057" "a150713"  
## [3781] "a151346" "a151347" "a151575" "a151969" "a152058" "a152059"  
## [3787] "a152060" "a152061" "a152062" "a152225" "a152226" "a152227"  
## [3793] "a152237" "a152238" "a152335" "a152336" "a152337" "a152638"  
## [3799] "a152639" "a152640" "a152641" "a152642" "a152648" "a153443"  
## [3805] "a154118" "a154152" "a154153" "a154845" "a154852" "a154853"  
## [3811] "a155156" "a155157" "a155158" "a155404" "a155726" "a155727"  
## [3817] "a155728" "a155737" "a155791" "a155792" "a155979" "a155980"  
## [3823] "a155981" "a156067" "a156068" "a156069" "a156070" "a156071"  
## [3829] "a156274" "a156275" "a156276" "a156277" "a156435" "a156436"  
## [3835] "a156769" "a156770" "a156784" "a157334" "a157428" "a157429"  
## [3841] "a157635" "a157687" "a158067" "a158068" "a158069" "a158070"  
## [3847] "a158103" "a158177" "a158820" "a158821" "a159227" "a159532"  
## [3853] "a159533" "a159549" "a159638" "a159639" "a160275" "a160276"  
## [3859] "a160379" "a160515" "a160516" "a160517" "a160518" "a162282"  
## [3865] "a162398" "a162413" "a162414" "a162564" "a162565" "a162566"  
## [3871] "a162685" "a163116" "a163362" "a163432" "a164248" "a164506"  
## [3877] "a164597" "a164598" "a164766" "a165020" "a165080" "a165437"  
## [3883] "a165438" "a165882" "a165883" "a165935" "a165940" "a166027"  
## [3889] "a167314" "a167331" "a167821" "a167822" "a167880" "a168470"  
## [3895] "a168471" "a168916" "a168917" "a168939" "a169235" "a169236"  
## [3901] "a169285" "a169439" "a169447" "a169718" "a169886" "a169995"  
## [3907] "a169996" "a169997" "a170222" "a170272" "a170273" "a170324"  
## [3913] "a170616" "a170729" "a170730" "a171557" "a172184" "a172188"  
## [3919] "a172189" "a172190" "a172191" "a172282" "a172386" "a172387"  
## [3925] "a172726" "a172727" "a172728" "a172729" "a172730" "a172893"  
## [3931] "a173172" "a173173" "a173394" "a173649" "a173859" "a174093"  
## [3937] "a174094" "a174162" "a174163" "a174164" "a174529" "a174955"  
## [3943] "a174995" "a175170" "a175171" "a175277" "a175278" "a175279"  
## [3949] "a175565" "a176014" "a176015" "a176016" "a176017" "a176030"  
## [3955] "a176031" "a176032" "a176035" "a176627" "a176628" "a176629"  
## [3961] "a176712" "a176713" "a176983" "a177154" "a177225" "a177226"  
## [3967] "a177227" "a177228" "a177582" "a177583" "a177977" "a178206"  
## [3973] "a178345" "a178346" "a178661" "a178737" "a178915" "a178916"  
## [3979] "a179149" "a179150" "a179258" "a179259" "a179438" "a179760"  
## [3985] "a179829" "a180071" "a180072" "a180343" "a180570" "a180571"  
## [3991] "a180721" "a180722" "a180786" "a181691" "a182604" "a182617"  
## [3997] "a183114" "a183115" "a183329" "a183330" "a183331" "a183983"  
## [4003] "a184072" "a184198" "a184297" "a184298" "a184608" "a184609"  
## [4009] "a184610" "a184944" "a185012" "a185013" "a185272" "a185547"  
## [4015] "a186614" "a186615" "a187763" "a187964" "a188093" "a188118"  
## [4021] "a189371" "a189881" "a190391" "a190392" "a190414" "a190830"  
## [4027] "a190837" "a190838" "a190839" "a190840" "a190871" "a190872"  
## [4033] "a190974" "a191317" "a191441" "a191782" "a192561" "a192770"  
## [4039] "a193000" "a193288" "a193289" "a193290" "a193367" "a193368"  
## [4045] "a193369" "a193371" "a193372" "a193373" "a193374" "a193416"  
## [4051] "a193417" "a193986" "a194027" "a194529" "a194922" "a195131"  
## [4057] "a195534" "a195535" "a195536" "a195537" "a195538" "a196223"  
## [4063] "a196224" "a196225" "a196226" "a196798" "a196980" "a197282"  
## [4069] "a197283" "a197284" "a197312" "a198174" "a198840" "a198841"  
## [4075] "a198976" "a199331" "a199332" "a199333" "a199528" "a199769"  
## [4081] "a199770" "a200014" "a200015" "a200071" "a200322" "a200840"  
## [4087] "a201760" "a201821" "a202065" "a202548" "a203156" "a203595"  
## [4093] "a203893" "a203894" "a204471" "a204472" "a204473" "a204474"  
## [4099] "a204490" "a204757" "a205528" "a205529" "a205530" "a205547"  
## [4105] "a205860" "a206009" "a206145" "a206197" "a206198" "a206199"  
## [4111] "a206200" "a206201" "a206217" "a206724" "a206725" "a206726"  
## [4117] "a206727" "a207252" "a207253" "a207254" "a207255" "a207375"  
## [4123] "a207614" "a208297" "a208322" "a209526" "a209638" "a209639"  
## [4129] "a209640" "a209838" "a209839" "a209840" "a209978" "a209979"  
## [4135] "a210275" "a210313" "a210314" "a210466" "a210890" "a210947"  
## [4141] "a211301" "a211640" "a211693" "a212038" "a212735" "a212981"  
## [4147] "a213436" "a213437" "a213438" "a213439" "a213440" "a214906"  
## [4153] "a214907" "a214908" "a215343" "a215344" "a215394" "a218607"  
## [4159] "a218807" "a218808" "a218809" "a218810" "a219174" "a219577"  
## [4165] "a219997" "a220076" "a220103" "a221191" "a221192" "a221265"  
## [4171] "a221365" "a221589" "a222285" "a222286" "a222287" "a222899"  
## [4177] "a223205" "a223419" "a223420" "a223421" "a223422" "a223423"  
## [4183] "a223707" "a224138" "a224425" "a224426" "a225316" "a225834"  
## [4189] "a226093" "a226347" "a226348" "a227812" "a227944" "a227945"  
## [4195] "a228927" "a229259" "a229772" "a229773" "a229774" "a229978"  
## [4201] "a229979" "a229980" "a230187" "a230533" "a230534" "a230535"  
## [4207] "a230711" "a230950" "a230951" "a230952" "a230953" "a230999"  
## [4213] "a231000" "a232005" "a232046" "a232917" "a232918" "a233359"  
## [4219] "a233522" "a234019" "a234020" "a234302" "a234303" "a234568"  
## [4225] "a235013" "a235014" "a235024" "a235436" "a235651" "a235792"  
## [4231] "a235793" "a235794" "a236037" "a236038" "a236039" "a236373"  
## [4237] "a236440" "a236441" "a236442" "a236450" "a236451" "a237045"  
## [4243] "a237245" "a238165" "a238344" "a238944" "a239185" "a239403"  
## [4249] "a239421" "a239422" "a239423" "a239964" "a239965" "a240039"  
## [4255] "a240361" "a240362" "a240397" "a240854" "a240855" "a241065"  
## [4261] "a241127" "a241410" "a241411" "a241522" "a242562" "a242569"  
## [4267] "a242570" "a243531" "a243532" "a243772" "a243774" "a243847"  
## [4273] "a243848" "a244220" "a244221" "a244222" "a244423" "a245051"  
## [4279] "a245199" "a245200" "a245201" "a245202" "a245483" "a245484"  
## [4285] "a245683" "a245784" "a246931" "a247221" "a247222" "a247223"  
## [4291] "a247587" "a247588" "a247777" "a247796" "a247797" "a248094"  
## [4297] "a248809" "a248939" "a248940" "a248941" "a249267" "a250490"  
## [4303] "a250491" "a250541" "a250542" "a250543" "a250544" "a250545"  
## [4309] "a250607" "a250608" "a250609" "a250634" "a250635" "a250671"  
## [4315] "a250672" "a250673" "a250674" "a250872" "a250930" "a250968"  
## [4321] "a250969" "a251133" "a251658" "a251679" "a251680" "a251681"  
## [4327] "a251682" "a252049" "a252426" "a252427" "a252428" "a252429"  
## [4333] "a252459" "a252460" "a252461" "a252462" "a252854" "a252855"  
## [4339] "a252983" "a253110" "a253410" "a253573" "a253574" "a253575"  
## [4345] "a253696" "a253819" "a254059" "a254205" "a254251" "a254252"  
## [4351] "a254269" "a254270" "a254271" "a254675" "a254676" "a254677"  
## [4357] "a254678" "a254679" "a255022" "a255162" "a255163" "a255451"  
## [4363] "a255455" "a255490" "a255543" "a255737" "a255841" "a255989"  
## [4369] "a255990" "a255991" "a255992" "a256594" "a256666" "a256667"  
## [4375] "a256668" "a256678" "a256679" "a256699" "a256837" "a257319"  
## [4381] "a257320" "a257705" "a257706" "a257718" "a257850" "a258003"  
## [4387] "a258004" "a258007" "a258030" "a258307" "a258308" "a258312"  
## [4393] "a258412" "a258413" "a258545" "a258605" "a258606" "a258654"  
## [4399] "a258850" "a258953" "a258954" "a258955" "a259005" "a259006"  
## [4405] "a259007" "a259022" "a259023" "a259035" "a259060" "a259061"  
## [4411] "a259279" "a259280" "a259333" "a259382" "a259383" "a259430"  
## [4417] "a259431" "a259517" "a259584" "a259695" "a259727" "a259770"  
## [4423] "a259771" "a259800" "a259896" "a260021" "a260022" "a260036"  
## [4429] "a260153" "a260154" "a260155" "a260156" "a260336" "a260375"  
## [4435] "a260376" "a260377" "a260378" "a260379" "a260448" "a260449"  
## [4441] "a260503" "a260504" "a260544" "a260547" "a260567" "a260568"  
## [4447] "a260569" "a260570" "a260571" "a260606" "a260661" "a260662"  
## [4453] "a260669" "a260676" "a260766" "a261671" "a261696" "a261697"  
## [4459] "a261698" "a261704" "a261728" "a261790" "a653" "a676"   
## [4465] "a1125" "a399" "a1168" "a595" "a596" "a866"   
## [4471] "a1340" "a1361" "a2654" "a1092" "a10361" "a2477"   
## [4477] "a2028" "a2030" "a3511" "a3334" "a10785" "a4536"   
## [4483] "a3823" "a11217" "a11617" "a3847" "a4479" "a7297"   
## [4489] "a7783" "a6849" "a24363" "a24823" "a7448" "a7449"   
## [4495] "a17966" "a11359" "a12928" "a9518" "a12242" "a11883"   
## [4501] "a12631" "a21526" "a27091" "a27093" "a19487" "a16740"   
## [4507] "a16442" "a23973" "a23983" "a57680" "a57682" "a22184"   
## [4513] "a23524" "a37134" "a52185" "a40769" "a44131" "a29659"   
## [4519] "a39211" "a39212" "a39742" "a39743" "a37857" "a52322"   
## [4525] "a41803" "a52321" "a46230" "a43615" "a48182" "a63638"   
## [4531] "a73102" "a51432" "a58579" "a64620" "a81257" "a78969"   
## [4537] "a61640" "a85004" "a93564" "a66062" "a101090" "a101914"  
## [4543] "a84011" "a87885" "a107346" "a108506" "a111869" "a130811"  
## [4549] "a139596" "a173016" "a170973" "a178662" "a243773" "a250041"  
## [4555] "a252366" "a260545"

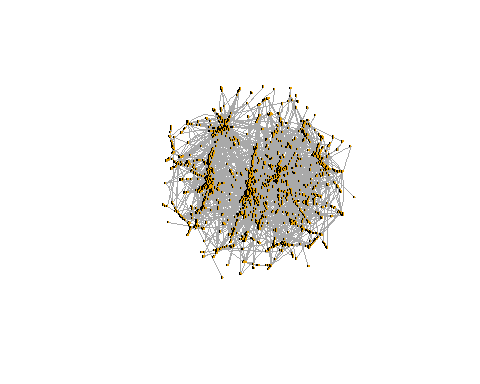
Let’s try to only show the first group Louvain pulled out.

#Isolate group 1  
amazon\_louvain[1] -> al\_1  
#n\_distinct(al\_1$`1`) to give us the length of the for loop  
  
#initialize our collection data  
temp2 <- character()  
  
#for each member of group 1  
for (i in 1:n\_distinct(al\_1$`1`)) {  
   
 #Filter out the V1 values that match  
 dplyr::filter(amazon\_el, V1 == al\_1$`1`[i]) -> temp1  
   
 #and combine with all other group 1 edges  
 temp2 <- bind\_rows(temp2, temp1)  
   
}  
  
str(temp2)

## Registered S3 method overwritten by 'cli':  
## method from   
## print.boxx spatstat

## tibble [21,580 x 2] (S3: tbl\_df/tbl/data.frame)  
## $ V1 : chr [1:21580] NA "a0" "a0" "a0" ...  
## $ FromNodeId ToNodeId: chr [1:21580] NA "a1" "a2" "a3" ...

set.seed(42)  
  
#Take our group 1 edgelist and clean out any rows with NAs  
amazon\_g1 <- na.omit(temp2)  
  
#Convert edgelist to igraph  
graph\_from\_data\_frame(amazon\_g1, directed = FALSE) -> g1\_igraph  
  
#plot without labels, I made the nodes small and unlabeled so we can see the edges better  
plot(g1\_igraph, vertex.label=NA, vertex.size = .5)



Looking at group 1, we can see what mostly appears to be a hairball. However, we can see what appears to be a further breakdown of approximately 4 large groups.

cluster\_louvain(g1\_igraph) -> g1\_lovain  
g1\_lovain

## IGRAPH clustering multi level, groups: 70, mod: 0.89  
## + groups:  
## $`1`  
## [1] "a417" "a744" "a745" "a746" "a747" "a748" "a910" "a911"   
## [9] "a912" "a1003" "a1004" "a1005" "a1006" "a1053" "a1757" "a2569"  
## [17] "a1007"  
##   
## $`2`  
## [1] "a414" "a734" "a735" "a736" "a737" "a738" "a1314"   
## [8] "a1315" "a1551" "a1552" "a1753" "a2195" "a2393" "a2872"   
## [15] "a2873" "a3023" "a3024" "a3261" "a3262" "a3263" "a3265"   
## [22] "a4007" "a4008" "a4282" "a5054" "a5503" "a5504" "a6535"   
## + ... omitted several groups/vertices

#Isolate sub-group 2  
g1\_lovain[1] -> g1\_s1  
#n\_distinct(al\_1$`1`) to give us the length of the for loop  
  
#initialize our collection data  
temp2 <- character()  
  
#for each member of group 1  
for (i in 1:n\_distinct(g1\_s1$`1`)) {  
   
 #Filter out the V1 values that match  
 dplyr::filter(amazon\_el, V1 == g1\_s1$`1`[i]) -> temp1  
   
 #and combine with all other group 1 edges  
 temp2 <- bind\_rows(temp2, temp1)  
   
}  
  
str(temp2)

## tibble [86 x 2] (S3: tbl\_df/tbl/data.frame)  
## $ V1 : chr [1:86] NA "a417" "a417" "a417" ...  
## $ FromNodeId ToNodeId: chr [1:86] NA "a744" "a745" "a746" ...

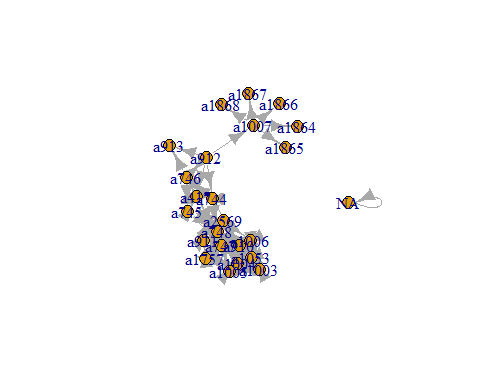
#transfer temp2 to new data.frame  
temp2 -> g1\_s1\_el  
  
#create igraph object  
graph\_from\_data\_frame(g1\_s1\_el) -> g1\_s1\_igraph

## Warning in graph\_from\_data\_frame(g1\_s1\_el): In `d' `NA' elements were  
## replaced with string "NA"

g1\_s1\_igraph

## IGRAPH 387801c DN-- 24 86 --   
## + attr: name (v/c)  
## + edges from 387801c (vertex names):  
## [1] NA ->NA a417->a744 a417->a745 a417->a746 a417->a747   
## [6] a417->a748 a744->a417 a744->a746 a744->a748 a744->a910   
## [11] a744->a911 a745->a417 a745->a746 a745->a747 a745->a748   
## [16] a745->a2569 a746->a417 a746->a744 a746->a745 a746->a912   
## [21] a746->a913 a747->a910 a747->a1004 a747->a1005 a747->a1053  
## [26] a747->a1757 a748->a910 a748->a1004 a748->a1006 a748->a1053  
## [31] a748->a1757 a910->a747 a910->a1003 a910->a1004 a910->a1005  
## [36] a910->a1006 a911->a747 a911->a748 a911->a1005 a911->a1006  
## + ... omitted several edges

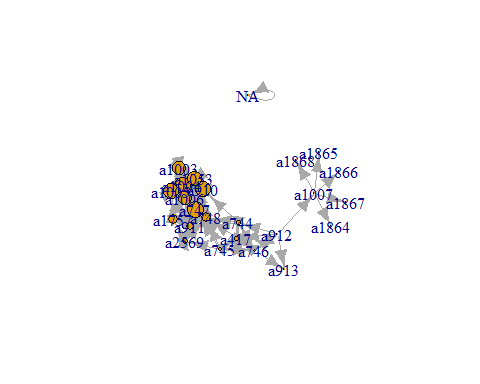
plot(g1\_s1\_igraph)



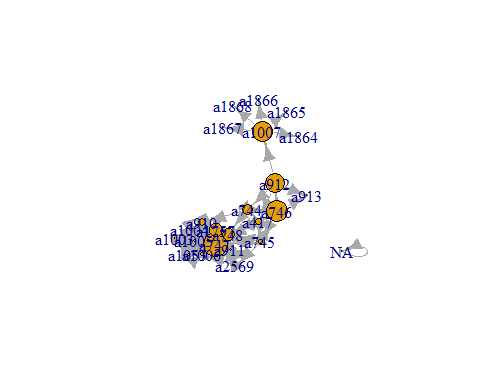
transitivity(g1\_s1\_igraph)

## [1] 0.4941

g1\_s1\_igraph$eigen <- centr\_eigen(g1\_s1\_igraph)  
g1\_s1\_igraph$betw <- centr\_betw(g1\_s1\_igraph)  
  
plot(g1\_s1\_igraph, edge.size = 0.5, arrow.size = 0.5,  
 vertex.size = g1\_s1\_igraph$eigen$vector\*20)



plot(g1\_s1\_igraph, edge.size = 0.5, arrow.size = 0.5,  
 vertex.size = g1\_s1\_igraph$betw$res)



A transitivity of almost 0.5 shows that there is a definite tendency to fulfill the strong triadic closure property. This is to be expected, as this is relating products that are bought together.

Looking at eigen vs betweeness, The nodes that catch the eye are: a1004 and a1007.

Searching the meta text, we get:

Id: 1004 ASIN: 0531112004 title: How to Write a Term Paper (A Speak Out, Write on! Book) group: Book salesrank: 837629 similar: 0 categories: 1 |Books[283155]|Subjects[1000]|Children’s Books[4]|Reference & Nonfiction[3176]|Language Arts[3182]|Composition & Creative Writing[3183] reviews: total: 1 downloaded: 1 avg rating: 5 1999-8-22 cutomer: ATVPDKIKX0DER rating: 5 votes: 10 helpful: 2

Id: 1007 ASIN: 0443071373 title: Clinical Pharmacy and Therapeutics group: Book salesrank: 706603 similar: 0 categories: 2 |Books[283155]|Subjects[1000]|Medicine[13996]|Pharmacology[14080]|Pharmacy[14088] |Books[283155]|Subjects[1000]|Professional & Technical[173507]|Medical[173514]|Pharmacology[265544]|Pharmacy[265548] reviews: total: 0 downloaded: 0 avg rating: 0

Starting with 1007, we can see from the plots that it is surrounded by 1864 - 1868.

Id: 1864 ASIN: 069401057X title: Zoom City (Growing Tree) group: Book salesrank: 66993 similar: 5 0694010588 0694010723 0694006513 1552090345 0694010391 categories: 6 |Books[283155]|Subjects[1000]|Children’s Books[4]|Baby-3[2752]|Basic Concepts[2753]|General[2765] |Books[283155]|Subjects[1000]|Children’s Books[4]|Baby-3[2752]|Board Books[2778] |Books[283155]|Subjects[1000]|Children’s Books[4]|Authors & Illustrators, A-Z[170540]|( H )[170548]|Hurd, Thacher[170709] |[540744]|Specialty Stores[547930]|Books, Music & More[559958]|Books for Babies[692218]|Board Books[692220] |[540744]|Specialty Stores[547930]|Books, Music & More[559958]|Books for Babies[692218]|Concept Books[694936]|General[694944] |Books[283155]|Subjects[1000]|Children’s Books[4]|Baby-3[2752]|General[3049241] reviews: total: 11 downloaded: 11 avg rating: 4 1998-9-30 cutomer: ATVPDKIKX0DER rating: 5 votes: 0 helpful: 0 1998-10-2 cutomer: ATVPDKIKX0DER rating: 5 votes: 1 helpful: 1 1999-7-31 cutomer: ATVPDKIKX0DER rating: 5 votes: 2 helpful: 2 2000-3-24 cutomer: A1RYHBX54KOLWD rating: 5 votes: 1 helpful: 1 2000-10-23 cutomer: A3SMR4HRFJARSC rating: 2 votes: 0 helpful: 0 2001-4-30 cutomer: A87BV8TBFB0C5 rating: 5 votes: 4 helpful: 4 2001-8-2 cutomer: AM9KJ9C2VLVK8 rating: 2 votes: 5 helpful: 3 2002-1-8 cutomer: A1OZ8X4ZK4SFFQ rating: 2 votes: 5 helpful: 1 2003-6-22 cutomer: A3UOI3KH0BZK58 rating: 5 votes: 0 helpful: 0 2004-10-5 cutomer: AOM91Q2SIB4ZN rating: 5 votes: 0 helpful: 0 2005-1-6 cutomer: A389VZ934X0K9R rating: 5 votes: 0 helpful: 0

Id: 1865 ASIN: 0486654605 title: Catalysis in Chemistry and Enzymology group: Book salesrank: 116258 similar: 5 0126437319 0716732688 0471359297 0471303097 0199638209 categories: 2 |Books[283155]|Subjects[1000]|Science[75]|Chemistry[13570]|Physical & Theoretical[13588] |Books[283155]|Subjects[1000]|Professional & Technical[173507]|Professional Science[173510]|Chemistry[227282]|Physical & Theoretical[227289] reviews: total: 1 downloaded: 1 avg rating: 5 2004-1-4 cutomer: A1DIZO95XRBLPO rating: 5 votes: 1 helpful: 1

Id: 1866 ASIN: 0765801485 title: Media and Democracy in Africa group: Book salesrank: 1726823 similar: 0 categories: 6 |Books[283155]|Subjects[1000]|History[9]|Africa[4762]|General[4776] |Books[283155]|Subjects[1000]|Nonfiction[53]|Government[10753]|Democracy[10761] |Books[283155]|Subjects[1000]|Law[10777]|Perspectives on Law[173495]|Non-US Legal Systems[10955] |Books[283155]|Subjects[1000]|Nonfiction[53]|Social Sciences[11232]|Special Groups[11298]|African-American Studies[11300] |Books[283155]|Subjects[1000]|Professional & Technical[173507]|Law[173518]|Perspectives on Law[227505]|Non-US Legal Systems[227513] |Books[283155]|Subjects[1000]|Nonfiction[53]|Social Sciences[11232]|Media Studies[13022421] reviews: total: 0 downloaded: 0 avg rating: 0

Id: 1867 ASIN: B00007KIBN title: Pacific Chants: Polynesian Himene group: Music salesrank: 53183 similar: 5 B000093FHF B000004BQU B000003EKA B000003EK1 B00000412X categories: 3 |Music[5174]|Styles[301668]|International[33]|General[63848] |Music[5174]|Styles[301668]|New Age[36]|General[63957] |Music[5174]|Specialty Stores[468040]|Indie Music[266023]|International[171245]|General[520182] reviews: total: 1 downloaded: 1 avg rating: 5 2004-1-24 cutomer: A1O2IZYNEX8RW2 rating: 5 votes: 5 helpful: 5

Id: 1868 ASIN: 0965669408 title: 111 Days to Zion group: Book salesrank: 1200784 similar: 0 categories: 0 reviews: total: 0 downloaded: 0 avg rating: 0

I can see why a book about pharmocology (1007) would be tied to a book on chemistry and enzymology (1865), but I’m unsure why it would end up tied to a children’s book (1864), and two social/cultural texts (1866 and 1867). 1868 provides nothing but the title in this data, but a quick google search identifies it as a book about Mormon history.

If I was pressed to make a profile of the person who would buy these items together, I would say a college student who is purchasing text books for both STEM and Liberal Arts courses, and has either a child or a much younger sibling and/or niece/nephew.

Seeing a book on how to write a term paper in the same subgroup is not surprising, as it would fit with our image of a college student.

Error in if (matrix.type == “edgelist”) { : missing value where TRUE/FALSE needed

I wanted to do some clustering and a blockmodel, but I couldn’t convert the data into a network object, which is needed for those functions to work. I just kept getting the error message above.