HW11

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#1  
library(igraph)

##   
## Attaching package: 'igraph'

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

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

g.er <- erdos.renyi.game(500, p = 0.01, directed = FALSE)  
g.er

## IGRAPH U--- 500 1230 -- Erdos renyi (gnp) graph  
## + attr: name (g/c), type (g/c), loops (g/l), p (g/n)  
## + edges:  
## [1] 22-- 27 26-- 27 18-- 28 29-- 31 15-- 35 21-- 35 23-- 39  
## [8] 2-- 40 18-- 44 1-- 46 18-- 46 3-- 48 20-- 49 41-- 51  
## [15] 22-- 53 39-- 53 5-- 61 49-- 61 53-- 65 60-- 65 34-- 67  
## [22] 12-- 73 18-- 74 32-- 75 67-- 76 21-- 78 72-- 79 28-- 81  
## [29] 34-- 82 69-- 82 72-- 83 43-- 84 12-- 86 44-- 86 26-- 89  
## [36] 73-- 89 11-- 90 39-- 90 54-- 90 54-- 91 34-- 92 80-- 94  
## [43] 59-- 95 8-- 96 89-- 97 3-- 98 20--101 19--102 57--102  
## [50] 36--103 88--104 27--105 71--108 3--110 72--110 95--110  
## + ... omitted several edges

#2  
g.b <- barabasi.game(500, power = 3, directed = FALSE)  
g.b

## IGRAPH U--- 500 499 -- Barabasi graph  
## + attr: name (g/c), power (g/n), m (g/n), zero.appeal (g/n),  
## | algorithm (g/c)  
## + edges:  
## [1] 1-- 2 2-- 3 3-- 4 3-- 5 3-- 6 3-- 7 3-- 8 3-- 9 3--10 3--11 3--12  
## [12] 3--13 3--14 3--15 3--16 3--17 3--18 3--19 3--20 3--21 3--22 3--23  
## [23] 3--24 3--25 3--26 3--27 3--28 3--29 3--30 3--31 3--32 3--33 3--34  
## [34] 3--35 3--36 3--37 3--38 3--39 3--40 3--41 3--42 3--43 3--44 3--45  
## [45] 3--46 3--47 3--48 3--49 3--50 3--51 3--52 3--53 3--54 3--55 3--56  
## [56] 3--57 3--58 3--59 3--60 3--61 3--62 3--63 3--64 3--65 3--66 3--67  
## [67] 3--68 3--69 3--70 3--71 3--72 3--73 3--74 3--75 3--76 3--77 3--78  
## + ... omitted several edges

#3  
E(g.er)

## + 1230/1230 edges:  
## [1] 22-- 27 26-- 27 18-- 28 29-- 31 15-- 35 21-- 35 23-- 39  
## [8] 2-- 40 18-- 44 1-- 46 18-- 46 3-- 48 20-- 49 41-- 51  
## [15] 22-- 53 39-- 53 5-- 61 49-- 61 53-- 65 60-- 65 34-- 67  
## [22] 12-- 73 18-- 74 32-- 75 67-- 76 21-- 78 72-- 79 28-- 81  
## [29] 34-- 82 69-- 82 72-- 83 43-- 84 12-- 86 44-- 86 26-- 89  
## [36] 73-- 89 11-- 90 39-- 90 54-- 90 54-- 91 34-- 92 80-- 94  
## [43] 59-- 95 8-- 96 89-- 97 3-- 98 20--101 19--102 57--102  
## [50] 36--103 88--104 27--105 71--108 3--110 72--110 95--110  
## [57] 6--112 28--114 8--115 81--118 116--118 66--119 109--119  
## [64] 15--121 43--121 77--121 35--123 114--124 12--125 54--125  
## + ... omitted several edges

E(g.b)

## + 499/499 edges:  
## [1] 1-- 2 2-- 3 3-- 4 3-- 5 3-- 6 3-- 7 3-- 8 3-- 9 3-- 10 3-- 11  
## [11] 3-- 12 3-- 13 3-- 14 3-- 15 3-- 16 3-- 17 3-- 18 3-- 19 3-- 20 3-- 21  
## [21] 3-- 22 3-- 23 3-- 24 3-- 25 3-- 26 3-- 27 3-- 28 3-- 29 3-- 30 3-- 31  
## [31] 3-- 32 3-- 33 3-- 34 3-- 35 3-- 36 3-- 37 3-- 38 3-- 39 3-- 40 3-- 41  
## [41] 3-- 42 3-- 43 3-- 44 3-- 45 3-- 46 3-- 47 3-- 48 3-- 49 3-- 50 3-- 51  
## [51] 3-- 52 3-- 53 3-- 54 3-- 55 3-- 56 3-- 57 3-- 58 3-- 59 3-- 60 3-- 61  
## [61] 3-- 62 3-- 63 3-- 64 3-- 65 3-- 66 3-- 67 3-- 68 3-- 69 3-- 70 3-- 71  
## [71] 3-- 72 3-- 73 3-- 74 3-- 75 3-- 76 3-- 77 3-- 78 3-- 79 3-- 80 3-- 81  
## [81] 3-- 82 3-- 83 3-- 84 3-- 85 3-- 86 3-- 87 3-- 88 3-- 89 3-- 90 3-- 91  
## [91] 3-- 92 3-- 93 3-- 94 3-- 95 3-- 96 3-- 97 3-- 98 3-- 99 3--100 3--101  
## + ... omitted several edges

V(g.er)

## + 500/500 vertices:  
## [1] 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17  
## [18] 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34  
## [35] 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51  
## [52] 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68  
## [69] 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85  
## [86] 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102  
## [103] 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119  
## [120] 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136  
## [137] 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153  
## [154] 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170  
## + ... omitted several vertices

V(g.b)

## + 500/500 vertices:  
## [1] 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17  
## [18] 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34  
## [35] 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51  
## [52] 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68  
## [69] 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85  
## [86] 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102  
## [103] 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119  
## [120] 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136  
## [137] 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153  
## [154] 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170  
## + ... omitted several vertices

#4  
g.er.density <- graph.density(g.er)  
g.er.density

## [1] 0.009859719

g.b.density <- graph.density(g.b)  
g.b.density

## [1] 0.004

#5  
g.er.avg <- average.path.length(g.er)  
g.er.avg

## [1] 4.06777

g.b.avg <- average.path.length(g.b)  
g.b.avg

## [1] 1.999984

#6  
g.er.dia <- diameter(g.er)  
g.er.dia

## [1] 8

g.b.dia <- diameter(g.b)  
g.b.dia

## [1] 3

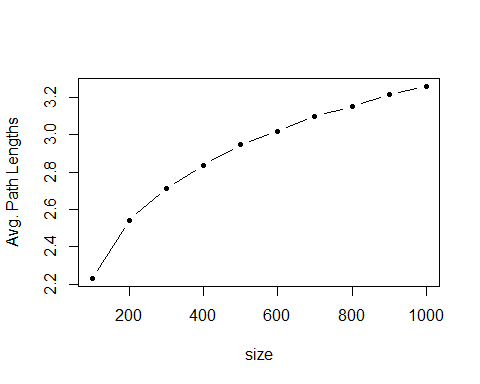
paths <- matrix(ncol = 10, nrow = 10)  
dias <- matrix(ncol = 10, nrow = 10)  
  
for (n in seq(100, 1000, 100)) {  
 for (i in 1:10) {  
 g.er <- erdos.renyi.game(n, p = (10/(n-1)), directed = FALSE)   
 paths[i, n/100] = average.path.length(g.er)  
 dias[i, n/100] = diameter(g.er)  
 }  
}  
paths.avg <- apply(paths, 2, mean)  
paths.avg

## [1] 2.230182 2.542312 2.714580 2.836822 2.945938 3.019122 3.099411  
## [8] 3.150510 3.218978 3.259734

mean\_dias <- apply(dias, 2, mean)  
mean\_dias

## [1] 3.9 4.2 4.6 4.9 5.0 5.1 5.1 5.2 5.5 5.2

x <- seq(100, 1000, 100)  
plot(x, paths.avg, type = "b", pch = 20, xlab = "size", ylab = "Avg. Path Lengths")



plot(x, mean\_dias, type = "b", pch = 20, xlab = "size", ylab = "Mean Diameter")

