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| **Problem** | **Solutions** |
| 1. Create an m x n matrix with replicate(m, rnorm(n)) with m=10 column vectors of n=10 elements each,  constructed with rnorm(n), which creates random normal numbers.  Then we transform it into a dataframe (thus 10 observations of 10 variables) and perform an algebraic  operation on each element using a nested for loop: at each iteration, every element referred by the two  indexes is incremented by a sinusoidal function, compare the vectorized and non-vectorized form of creating  the solution and report the system time differences. | set.seed(42);  m=10; n=10;  mymat<-replicate(m, rnorm(n)) # create matrix of normal random numbers  mydframe=data.frame(mymat) # transform into data frame  for (i in 1:m) {  for (j in 1:n) {  mydframe[i,j]<-mydframe[i,j] + 10\*sin(0.75\*pi)  print(mydframe)  }  }  #### vectorized version  set.seed(42);  m=10; n=10;  mymat<-replicate(m, rnorm(n))  mydframe=data.frame(mymat)  mydframe<-mydframe + 10\*sin(0.75\*pi)  print(mydframe)  X1 X2 X3 X4 X5 X6  1 8.442026 8.375937 6.764429 7.526518 7.277066 7.392993  2 6.506370 9.357713 5.289759 7.775905 6.710011 6.287229  3 7.434196 5.682207 6.899150 8.106171 7.829231 8.646795  4 7.703930 6.792279 8.285743 6.462141 6.344363 7.713967  5 7.475336 6.937746 8.966261 7.576023 5.702787 7.160828  6 6.964943 7.707018 6.640599 5.354059 7.503886 7.347619  7 8.582590 6.786815 6.813798 6.286609 6.259675 7.750357  8 6.976409 4.414612 5.307905 6.220160 8.515169 7.160901  9 9.089492 4.630601 7.531165 4.656860 6.639622 4.077978  10 7.008354 8.391181 6.431073 7.107190 7.726716 7.355951  X7 X8 X9 X10  1 6.703833 6.027949 8.583775 8.463184  2 7.256298 6.980881 7.328989 6.594894  3 7.652892 7.694586 7.159508 7.721416  4 8.470805 6.117544 6.950171 8.462178  5 6.343776 6.528239 5.876739 5.960279  6 8.373610 7.652064 7.683065 6.210275  7 7.406916 7.839247 6.853928 5.939329  8 8.109574 7.534835 6.888311 5.611854  9 7.991796 6.185292 8.004414 7.151050  10 7.791946 5.971287 7.892841 7.724272  # measure loop execution  system.time(  for (i in 1:m) {  for (j in 1:n) {  mydframe[i,j]<-mydframe[i,j] + 10\*sin(0.75\*pi)  }  }  )  user system elapsed  0.03 0.00 0.03 |
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