HW2-Programming

Graded

Student

Brian Bertness

View or edit group

Total Points

30 / 30 pts

Autograder Score

20.0 / 20.0

Passed Tests

test_Kmeans_predict (test_all.Testall) (2/2)
test_assignCen (test_all.Testall) (2/2)
test_centerData (test_all.Testall) (2/2)
test_computeDim (test_all.Testall) (2/2)
test_computeDis (test_all.Testall) (2/2)
test_computeE (test_all.Testall) (2/2)
test_computeError (test_all.Testall) (2/2)
test_initCenters (test_all.Testall) (2/2)
test_project (test_all.Testall) (2/2)
test_updateCen (test_all.Testall) (2/2)

Question 2

Code Sanity **10** / 10 pts

✔ **– 0 pts** Correct

Autograder Results

test_Kmeans_predict (test_all.Testall) (2/2)

This test the class labels predict() function in Kmeans
Make sure you have the correct helper function before test predict(), since they may be dependent

test_assignCen (test_all.Testall) (2/2)

This test the assignCen() function with 10 random tests with 5 centers
---
The distances are:
[0.55055943 0.02189162 0.39491921 0.10727902 0.08801835]
GT is:
[1. 1. 1. 1. 1.]
Your answer is:
[1. 1. 1. 1. 1.]

The distances are:
[0.47065956 0.3275857 0.26390126 0.22989814 0.77992433]
GT is:
[3. 3. 3. 3. 3.]
Your answer is:
[3. 3. 3. 3. 3.]

The distances are:
[0.03986269 0.74030852 0.27007735 0.33204819 0.53472669]
GT is:
[0. 0. 0. 0. 0.]
Your answer is:
[0. 0. 0. 0. 0.]

The distances are:
[0.19542204 0.9872711 0.67369938 0.86723946 0.52695127]
GT is:
[0. 0. 0. 0. 0.]
Your answer is:
[0. 0. 0. 0. 0.]

The distances are:
[0.42436712 0.41745725 0.63498634 0.75519338 0.0692606]
GT is:
[4. 4. 4. 4. 4.]
Your answer is:
[4. 4. 4. 4. 4.]

The distances are:
[0.07248493 0.74621119 0.98875042 0.12717798 0.28056644]
GT is:
[0. 0. 0. 0. 0.]
Your answer is:
[0. 0. 0. 0. 0.]

The distances are:
[0.32805659 0.97194215 0.87846767 0.60471425 0.04525563]
GT is:
[4. 4. 4. 4. 4.]
Your answer is:
[4. 4. 4. 4. 4.]

The distances are:

[0.94694514 0.19267063 0.53606442 0.53297326 0.28066356]
GT is:
[1. 1. 1. 1. 1.]
Your answer is:
[1. 1. 1. 1. 1.]

The distances are:
[0.74029976 0.35115155 0.59973678 0.54940344 0.93572826]
GT is:
[1. 1. 1. 1. 1.]
Your answer is:
[1. 1. 1. 1. 1.]

The distances are:
[0.30026123 0.73652814 0.80042138 0.90042483 0.6343148]
GT is:
[0. 0. 0. 0. 0.]
Your answer is:
[0. 0. 0. 0. 0.]

test_centerData (test_all.Testall) (2/2)

```
This test the centerData() function with 10 random tests
----------
The data sample are:
[[0.72838515 0.59810487 0.42312375 0.06116138 0.79730906]
 [0.0394958  0.73288739 0.16506395 0.23711013 0.52905032]
 [0.3867918  0.47116108 0.17823223 0.20454979 0.63687416]
 [0.9086831  0.91164952 0.10446834 0.81485024 0.51649649]
 [0.67757073 0.17920955 0.48781802 0.63601147 0.08025731]
 [0.11313868 0.96194627 0.85830377 0.72503815 0.45081815]
 [0.05638767 0.13924102 0.96690342 0.46241538 0.14619864]
 [0.66503257 0.39879794 0.70641056 0.04900313 0.72787896]
 [0.27884734 0.65574748 0.38336206 0.33466618 0.9893511 ]
 [0.69966233 0.68571945 0.22859962 0.97035392 0.2079847 ]]
The mean is:
[0.87603226 0.43714821 0.04857858 0.86378589 0.13487543]
GT is:
[[-0.1476471   0.16095666  0.37454518 -0.80262451  0.66243363]
 [-0.83653646  0.29573918  0.11648538 -0.62667576  0.39417489]
 [-0.48924046  0.03401287  0.12965365 -0.6592361   0.50199874]
 [ 0.03265085  0.47450132  0.05588976 -0.04893565  0.38162107]
 [-0.19846152 -0.25793866  0.43923944 -0.22777441 -0.05461811]
 [-0.76289358  0.52479806  0.80972519 -0.13874774  0.31594273]
 [-0.81964459 -0.29790719  0.91832484 -0.40137051  0.01132321]
 [-0.21099969 -0.03835027  0.65783199 -0.81478275  0.59300354]
 [-0.59718492  0.21859928  0.33478349 -0.52911971  0.85447567]
 [-0.17636993  0.24857124  0.18002104  0.10656803  0.07310927]]
Your answer is:
[[-0.1476471   0.16095666  0.37454518 -0.80262451  0.66243363]
 [-0.83653646  0.29573918  0.11648538 -0.62667576  0.39417489]
 [-0.48924046  0.03401287  0.12965365 -0.6592361   0.50199874]
 [ 0.03265085  0.47450132  0.05588976 -0.04893565  0.38162107]
 [-0.19846152 -0.25793866  0.43923944 -0.22777441 -0.05461811]
 [-0.76289358  0.52479806  0.80972519 -0.13874774  0.31594273]
 [-0.81964459 -0.29790719  0.91832484 -0.40137051  0.01132321]
 [-0.21099969 -0.03835027  0.65783199 -0.81478275  0.59300354]
 [-0.59718492  0.21859928  0.33478349 -0.52911971  0.85447567]
 [-0.17636993  0.24857124  0.18002104  0.10656803  0.07310927]]
----------
The data sample are:
[[4.20547990e-01 3.92772785e-01 6.90241140e-01 3.05943346e-01
  2.33354744e-01]
 [3.71961051e-02 9.27846989e-01 2.98249244e-01 6.92668123e-02
  5.20505790e-01]
 [8.65746226e-01 3.60815055e-01 2.97931090e-01 5.46514498e-01
  7.95110465e-01]
 [8.50670010e-01 7.36757625e-03 8.07708221e-01 7.10574416e-01
  8.17306766e-01]
 [1.13431436e-01 7.52001195e-01 9.18949594e-01 6.34396218e-01
  3.41123861e-01]
 [1.99810814e-01 7.17992037e-01 5.14721499e-03 4.29758411e-02
  3.58294569e-04]
 [1.09494975e-01 7.29401605e-01 1.44625879e-01 9.78011145e-01
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  9.68321452e-01]
 [9.29309575e-01 5.39918716e-01 9.39424239e-01 2.72286693e-01
  4.18505129e-01]
 [8.94007661e-01 9.45246904e-01 3.51300407e-01 2.74490915e-01
  9.81505479e-01]
 [8.63291362e-01 1.25494329e-02 8.02324921e-01 4.71447299e-01
  5.47395058e-01]]
The mean is:
[0.70717083 0.79903567 0.64380872 0.92735386 0.85325232]
GT is:
[[-0.28662284 -0.40626288  0.04643242 -0.62141051 -0.61989758]
 [-0.66997472  0.12881132 -0.34555948 -0.85808704 -0.33274653]
 [ 0.1585754  -0.43822061 -0.34587763 -0.38083936 -0.05814186]
 [ 0.14349918 -0.79166809  0.1638995  -0.21677944 -0.03594556]
 [-0.59373939 -0.04703447  0.27514087 -0.29295764 -0.51212846]
 [-0.50736002 -0.08104363 -0.63866151 -0.88437801 -0.85289403]
 [-0.59767585 -0.06963406 -0.49918284  0.05065729  0.11506913]
 [ 0.22213875 -0.25911695  0.29561552 -0.65506716 -0.43474719]
 [ 0.18683683  0.14621124 -0.29250831 -0.65286294  0.12825316]
 [ 0.15612053 -0.78648624  0.1585162  -0.45590656 -0.30585726]]
Your answer is:
[[-0.28662284 -0.40626288  0.04643242 -0.62141051 -0.61989758]
 [-0.66997472  0.12881132 -0.34555948 -0.85808704 -0.33274653]
 [ 0.1585754  -0.43822061 -0.34587763 -0.38083936 -0.05814186]
 [ 0.14349918 -0.79166809  0.1638995  -0.21677944 -0.03594556]
 [-0.59373939 -0.04703447  0.27514087 -0.29295764 -0.51212846]
 [-0.50736002 -0.08104363 -0.63866151 -0.88437801 -0.85289403]
 [-0.59767585 -0.06963406 -0.49918284  0.05065729  0.11506913]
 [ 0.22213875 -0.25911695  0.29561552 -0.65506716 -0.43474719]
 [ 0.18683683  0.14621124 -0.29250831 -0.65286294  0.12825316]
 [ 0.15612053 -0.78648624  0.1585162  -0.45590656 -0.30585726]]
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The data sample are:
[[0.35783635 0.22004991 0.50363404 0.70463968 0.90427999]
 [0.20862789 0.67713618 0.20041956 0.81290411 0.57791497]
 [0.78666589 0.430857   0.67757356 0.17160912 0.21271366]
 [0.72442638 0.79240296 0.43602669 0.84272502 0.13868511]
 [0.96496991 0.30001617 0.5996688  0.87836711 0.47948654]
 [0.76735928 0.83041722 0.61931175 0.29003699 0.54162783]
 [0.24628327 0.64231743 0.88779943 0.71217489 0.30242642]
 [0.23899462 0.88148342 0.68857636 0.02533957 0.26661914]
 [0.71921107 0.90706376 0.92479251 0.65378013 0.8913416 ]
 [0.20807602 0.32906917 0.51322054 0.4731645  0.61217702]]
The mean is:
[0.82728258 0.74363555 0.72115954 0.9508461  0.52763305]
GT is:
[[-0.46944623 -0.52358564 -0.2175255  -0.24620642  0.37664694]
 [-0.61865468 -0.06649937 -0.52073998 -0.13794199  0.05028193]
 [-0.04061668 -0.31277855 -0.04358599 -0.77923698 -0.31491939]
 [-0.1028562   0.04876741 -0.28513286 -0.10812108 -0.38894793]
 [ 0.13768733 -0.44361939 -0.12149075 -0.07247899 -0.0481465 ]
 [-0.05992329  0.08678167 -0.10184779 -0.66080911  0.01399478]
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 [-0.58099931 -0.10131812  0.16663989 -0.23867121 -0.22520662]
 [-0.58828796  0.13784786 -0.03258318 -0.92550653 -0.2610139 ]
 [-0.1080715   0.16342821  0.20363297 -0.29706597  0.36370856]
 [-0.61920656 -0.41456638 -0.20793901 -0.47768161  0.08454397]]
Your answer is:
[[-0.46944623 -0.52358564 -0.2175255  -0.24620642  0.37664694]
 [-0.61865468 -0.06649937 -0.52073998 -0.13794199  0.05028193]
 [-0.04061668 -0.31277855 -0.04358599 -0.77923698 -0.31491939]
 [-0.1028562   0.04876741 -0.28513286 -0.10812108 -0.38894793]
 [ 0.13768733 -0.44361939 -0.12149075 -0.07247899 -0.0481465 ]
 [-0.05992329  0.08678167 -0.10184779 -0.66080911  0.01399478]
 [-0.58099931 -0.10131812  0.16663989 -0.23867121 -0.22520662]
 [-0.58828796  0.13784786 -0.03258318 -0.92550653 -0.2610139 ]
 [-0.1080715   0.16342821  0.20363297 -0.29706597  0.36370856]
 [-0.61920656 -0.41456638 -0.20793901 -0.47768161  0.08454397]]
----------
The data sample are:
[[0.371763   0.9130242  0.05454086 0.93821418 0.62828122]
 [0.76975377 0.08496918 0.99262094 0.7431402  0.73514194]
 [0.21333993 0.527979   0.01973495 0.37520131 0.47548081]
 [0.62217425 0.95099369 0.58376984 0.94370995 0.78705118]
 [0.31845142 0.79123074 0.25823384 0.2286334  0.35901448]
 [0.52925995 0.99568012 0.64578388 0.89648386 0.43276439]
 [0.93316296 0.58802756 0.09064896 0.6445675  0.15857238]
 [0.30365486 0.07535086 0.18430138 0.64750799 0.48024177]
 [0.44558366 0.07261553 0.29139939 0.44057484 0.47794337]
 [0.23423694 0.6056907  0.98471166 0.15816816 0.82016909]]
The mean is:
[0.85804748 0.40747026 0.40509705 0.7724957  0.6105462 ]
GT is:
[[-0.48628448  0.50555394 -0.35055619  0.16571849  0.01773502]
 [-0.08829371 -0.32250108  0.58752389 -0.0293555   0.12459575]
 [-0.64470755  0.12050874 -0.3853621  -0.39729439 -0.13506539]
 [-0.23587322  0.54352343  0.17867279  0.17121426  0.17650498]
 [-0.53959606  0.38376048 -0.14686322 -0.5438623  -0.25153172]
 [-0.32878753  0.58820986  0.24068682  0.12398816 -0.1777818 ]
 [ 0.07511548  0.18055729 -0.3144481  -0.1279282  -0.45197382]
 [-0.55439262 -0.3321194  -0.22079568 -0.12498771 -0.13030442]
 [-0.41246382 -0.33485473 -0.11369767 -0.33192086 -0.13260283]
 [-0.62381054  0.19822044  0.57961461 -0.61432754  0.20962289]]
Your answer is:
[[-0.48628448  0.50555394 -0.35055619  0.16571849  0.01773502]
 [-0.08829371 -0.32250108  0.58752389 -0.0293555   0.12459575]
 [-0.64470755  0.12050874 -0.3853621  -0.39729439 -0.13506539]
 [-0.23587322  0.54352343  0.17867279  0.17121426  0.17650498]
 [-0.53959606  0.38376048 -0.14686322 -0.5438623  -0.25153172]
 [-0.32878753  0.58820986  0.24068682  0.12398816 -0.1777818 ]
 [ 0.07511548  0.18055729 -0.3144481  -0.1279282  -0.45197382]
 [-0.55439262 -0.3321194  -0.22079568 -0.12498771 -0.13030442]
 [-0.41246382 -0.33485473 -0.11369767 -0.33192086 -0.13260283]
 [-0.62381054  0.19822044  0.57961461 -0.61432754  0.20962289]]
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The data sample are:
[[0.39674828 0.38056108 0.1433027  0.85603372 0.04106444]
 [0.4895277  0.5877038  0.87327401 0.82556895 0.86089825]
 [0.15942504 0.03926607 0.11624026 0.72106415 0.54742056]
 [0.47453492 0.83972145 0.90009777 0.22393391 0.9327821 ]
 [0.82804529 0.79057958 0.10283253 0.87354941 0.42889013]
 [0.20477172 0.42736371 0.78513913 0.01368207 0.98307665]
 [0.12917148 0.02610293 0.94103613 0.54241874 0.04537516]
 [0.36844669 0.50934152 0.51316335 0.06901372 0.47558761]
 [0.14816866 0.77333063 0.80444336 0.47634082 0.61890988]
 [0.19557902 0.38999378 0.6966617  0.31915359 0.42614204]]
The mean is:
[0.90133718 0.80878245 0.49798073 0.97727172 0.72250516]
GT is:
[[-0.5045889  -0.42822137 -0.35467803 -0.121238   -0.68144072]
 [-0.41180948 -0.22107865  0.37529328 -0.15170277  0.13839309]
 [-0.74191214 -0.76951637 -0.38174047 -0.25620757 -0.1750846 ]
 [-0.42680227  0.03093901  0.40211704 -0.7533378   0.21027694]
 [-0.07329189 -0.01820287 -0.3951482  -0.1037223  -0.29361503]
 [-0.69656546 -0.38141874  0.2871584  -0.96358965  0.26057149]
 [-0.7721657  -0.78267951  0.4430554  -0.43485298 -0.67713   ]
 [-0.53289049 -0.29944093  0.01518262 -0.908258   -0.24691755]
 [-0.75316852 -0.03545181  0.30646263 -0.50093089 -0.10359528]
 [-0.70575816 -0.41878866  0.19868097 -0.65811813 -0.29636312]]
Your answer is:
[[-0.5045889  -0.42822137 -0.35467803 -0.121238   -0.68144072]
 [-0.41180948 -0.22107865  0.37529328 -0.15170277  0.13839309]
 [-0.74191214 -0.76951637 -0.38174047 -0.25620757 -0.1750846 ]
 [-0.42680227  0.03093901  0.40211704 -0.7533378   0.21027694]
 [-0.07329189 -0.01820287 -0.3951482  -0.1037223  -0.29361503]
 [-0.69656546 -0.38141874  0.2871584  -0.96358965  0.26057149]
 [-0.7721657  -0.78267951  0.4430554  -0.43485298 -0.67713   ]
 [-0.53289049 -0.29944093  0.01518262 -0.908258   -0.24691755]
 [-0.75316852 -0.03545181  0.30646263 -0.50093089 -0.10359528]
 [-0.70575816 -0.41878866  0.19868097 -0.65811813 -0.29636312]]
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The data sample are:
[[0.79069189 0.52058133 0.20690773 0.36646865 0.49254013]
 [0.49378313 0.04620408 0.31053937 0.81678911 0.91545838]
 [0.48813563 0.59977837 0.66574502 0.35833967 0.21554706]
 [0.41971575 0.02921864 0.01546791 0.45880411 0.35884711]
 [0.62031966 0.01297583 0.67540736 0.96441838 0.73359962]
 [0.10130151 0.14782241 0.70536111 0.00452511 0.99593135]
 [0.81675637 0.68871712 0.00371657 0.24728085 0.65425076]
 [0.31164144 0.23822764 0.76099922 0.188867   0.31358703]
 [0.24252676 0.22435918 0.73647357 0.71547319 0.52231598]
 [0.67219626 0.19249    0.73760421 0.10279512 0.07138567]]
The mean is:
[0.13887553 0.48633585 0.26315135 0.0103182  0.04972561]
GT is:
[[ 0.65181636  0.03424548 -0.05624362  0.35615045  0.44281452]
 [ 0.3549076  -0.44013177  0.04738802  0.80647091  0.86573277]
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 [ 0.3492601   0.11344252  0.40259367  0.34802146  0.16582145]
 [ 0.28084022 -0.45711721 -0.24768344  0.44848591  0.3091215 ]
 [ 0.48144413 -0.47336001  0.41225601  0.95410018  0.68387401]
 [-0.03757402 -0.33851344  0.44220976 -0.00579309  0.94620574]
 [ 0.67788084  0.20238127 -0.25943478  0.23696265  0.60452515]
 [ 0.17276591 -0.2481082   0.49784787  0.1785488   0.26386142]
 [ 0.10365123 -0.26197667  0.47332222  0.70515499  0.47259037]
 [ 0.53332072 -0.29384585  0.47445285  0.09247692  0.02166005]]
Your answer is:
[[ 0.65181636  0.03424548 -0.05624362  0.35615045  0.44281452]
 [ 0.3549076  -0.44013177  0.04738802  0.80647091  0.86573277]
 [ 0.3492601   0.11344252  0.40259367  0.34802146  0.16582145]
 [ 0.28084022 -0.45711721 -0.24768344  0.44848591  0.3091215 ]
 [ 0.48144413 -0.47336001  0.41225601  0.95410018  0.68387401]
 [-0.03757402 -0.33851344  0.44220976 -0.00579309  0.94620574]
 [ 0.67788084  0.20238127 -0.25943478  0.23696265  0.60452515]
 [ 0.17276591 -0.2481082   0.49784787  0.1785488   0.26386142]
 [ 0.10365123 -0.26197667  0.47332222  0.70515499  0.47259037]
 [ 0.53332072 -0.29384585  0.47445285  0.09247692  0.02166005]]
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The data sample are:
[[0.38487529 0.5011443  0.01238428 0.62377311 0.74170188]
 [0.64187672 0.0387129  0.06179478 0.90082222 0.04637165]
 [0.86751987 0.41094675 0.67480219 0.6295358  0.51967148]
 [0.13988258 0.03541986 0.08563114 0.32634562 0.09077042]
 [0.10649685 0.70798917 0.67636414 0.11941004 0.80832458]
 [0.64365945 0.16227921 0.6285622  0.54632713 0.4014192 ]
 [0.35251748 0.20280144 0.2151906  0.37515391 0.68378374]
 [0.84944584 0.49585623 0.31343794 0.17314414 0.94864198]
 [0.37919141 0.85087286 0.6919983  0.0146738  0.86170378]
 [0.2273837  0.85429781 0.04725015 0.25744967 0.8663199 ]]
The mean is:
[0.91143604 0.57050386 0.19855502 0.29561394 0.53647832]
GT is:
[[-0.52656075 -0.06935956 -0.18617073  0.32815918  0.20522356]
 [-0.26955932 -0.53179096 -0.13676024  0.60520828 -0.49010667]
 [-0.04391618 -0.15955711  0.47624718  0.33392186 -0.01680683]
 [-0.77155346 -0.535084   -0.11292388  0.03073168 -0.4457079 ]
 [-0.80493919  0.1374853   0.47780912 -0.1762039   0.27184626]
 [-0.26777659 -0.40822466  0.43000719  0.25071319 -0.13505912]
 [-0.55891856 -0.36770242  0.01663559  0.07953997  0.14730542]
 [-0.06199021 -0.07464763  0.11488292 -0.1224698   0.41216366]
 [-0.53224463  0.280369    0.49344329 -0.28094014  0.32522546]
 [-0.68405234  0.28379395 -0.15130487 -0.03816427  0.32984158]]
Your answer is:
[[-0.52656075 -0.06935956 -0.18617073  0.32815918  0.20522356]
 [-0.26955932 -0.53179096 -0.13676024  0.60520828 -0.49010667]
 [-0.04391618 -0.15955711  0.47624718  0.33392186 -0.01680683]
 [-0.77155346 -0.535084   -0.11292388  0.03073168 -0.4457079 ]
 [-0.80493919  0.1374853   0.47780912 -0.1762039   0.27184626]
 [-0.26777659 -0.40822466  0.43000719  0.25071319 -0.13505912]
 [-0.55891856 -0.36770242  0.01663559  0.07953997  0.14730542]
```

```
 [-0.06199021 -0.07464763  0.11488292 -0.1224698   0.41216366]
 [-0.53224463  0.280369    0.49344329 -0.28094014  0.32522546]
 [-0.68405234  0.28379395 -0.15130487 -0.03816427  0.32984158]]
----------
The data sample are:
[[0.64018991 0.15190345 0.98223423 0.4476299  0.39251098]
 [0.902029   0.08279886 0.16643803 0.59529286 0.94324972]
 [0.02902004 0.52236133 0.45791581 0.98454656 0.4346483 ]
 [0.83004596 0.43748638 0.20441748 0.28947532 0.14832503]
 [0.91058702 0.69124909 0.87502072 0.41718819 0.57636733]
 [0.39302804 0.60561048 0.26408439 0.7918509  0.52765534]
 [0.87644175 0.67913382 0.17354045 0.73869885 0.65876845]
 [0.22417322 0.90136989 0.58393686 0.94777969 0.47840994]
 [0.79461504 0.85952735 0.20780244 0.98925688 0.08951123]
 [0.53424919 0.24153106 0.78079024 0.35896064 0.45305677]]
The mean is:
[0.71084124 0.91490852 0.10558187 0.87639477 0.83682017]
GT is:
[[-0.07065133 -0.76300507  0.87665237 -0.42876487 -0.44430919]
 [ 0.19118776 -0.83210965  0.06085617 -0.28110191  0.10642955]
 [-0.6818212  -0.39254719  0.35233394  0.10815178 -0.40217187]
 [ 0.11920472 -0.47742214  0.09883562 -0.58691945 -0.68849514]
 [ 0.19974578 -0.22365943  0.76943885 -0.45920658 -0.26045284]
 [-0.31781321 -0.30929804  0.15850252 -0.08454387 -0.30916483]
 [ 0.16560051 -0.2357747   0.06795858 -0.13769592 -0.17805172]
 [-0.48666802 -0.01353863  0.47835499  0.07138492 -0.35841023]
 [ 0.08377379 -0.05538117  0.10222057  0.11286211 -0.74730894]
 [-0.17659205 -0.67337746  0.67520837 -0.51743413 -0.3837634 ]]
Your answer is:
[[-0.07065133 -0.76300507  0.87665237 -0.42876487 -0.44430919]
 [ 0.19118776 -0.83210965  0.06085617 -0.28110191  0.10642955]
 [-0.6818212  -0.39254719  0.35233394  0.10815178 -0.40217187]
 [ 0.11920472 -0.47742214  0.09883562 -0.58691945 -0.68849514]
 [ 0.19974578 -0.22365943  0.76943885 -0.45920658 -0.26045284]
 [-0.31781321 -0.30929804  0.15850252 -0.08454387 -0.30916483]
 [ 0.16560051 -0.2357747   0.06795858 -0.13769592 -0.17805172]
 [-0.48666802 -0.01353863  0.47835499  0.07138492 -0.35841023]
 [ 0.08377379 -0.05538117  0.10222057  0.11286211 -0.74730894]
 [-0.17659205 -0.67337746  0.67520837 -0.51743413 -0.3837634 ]]
----------
The data sample are:
[[0.73530845 0.47078943 0.41897266 0.11434804 0.80546902]
 [0.27650898 0.66624541 0.98079223 0.90081791 0.49074353]
 [0.34131814 0.65831316 0.45661341 0.82346076 0.01604659]
 [0.51704447 0.42557944 0.08841567 0.03611643 0.92060322]
 [0.97751248 0.97985408 0.69017429 0.80081315 0.97137747]
 [0.33797345 0.7546114  0.82876089 0.32607527 0.04588212]
 [0.7939359  0.46991038 0.37749168 0.74690234 0.45231311]
 [0.89289359 0.18733969 0.88200168 0.07950322 0.47260121]
 [0.31816934 0.09938491 0.11083949 0.51125217 0.22751167]
 [0.36512096 0.64451283 0.77671255 0.80694661 0.69908337]]
The mean is:
```

```
[0.83454977 0.22615537 0.20016758 0.78042906 0.07779389]
GT is:
[[-0.09924132  0.24463406  0.21880508 -0.66608102  0.72767513]
 [-0.55804079  0.44009003  0.78062465  0.12038885  0.41294964]
 [-0.49323163  0.43215779  0.25644583  0.0430317  -0.0617473 ]
 [-0.3175053   0.19942407 -0.11175192 -0.74431263  0.84280933]
 [ 0.14296271  0.7536987   0.49000671  0.0203841   0.89358358]
 [-0.49657632  0.52845602  0.6285933  -0.45435379 -0.03191177]
 [-0.04061387  0.243755    0.1773241  -0.03352672  0.37451922]
 [ 0.05834382 -0.03881569  0.68183409 -0.70092584  0.39480732]
 [-0.51638043 -0.12677047 -0.0893281  -0.26917689  0.14971778]
 [-0.46942881  0.41835746  0.57654497  0.02651755  0.62128948]]
Your answer is:
[[-0.09924132  0.24463406  0.21880508 -0.66608102  0.72767513]
 [-0.55804079  0.44009003  0.78062465  0.12038885  0.41294964]
 [-0.49323163  0.43215779  0.25644583  0.0430317  -0.0617473 ]
 [-0.3175053   0.19942407 -0.11175192 -0.74431263  0.84280933]
 [ 0.14296271  0.7536987   0.49000671  0.0203841   0.89358358]
 [-0.49657632  0.52845602  0.6285933  -0.45435379 -0.03191177]
 [-0.04061387  0.243755    0.1773241  -0.03352672  0.37451922]
 [ 0.05834382 -0.03881569  0.68183409 -0.70092584  0.39480732]
 [-0.51638043 -0.12677047 -0.0893281  -0.26917689  0.14971778]
 [-0.46942881  0.41835746  0.57654497  0.02651755  0.62128948]]
----------
The data sample are:
[[0.28545089 0.15101178 0.39021565 0.78309724 0.03627572]
 [0.8376932  0.98651962 0.38503648 0.96552358 0.69146613]
 [0.78278576 0.60480298 0.50262608 0.18103245 0.00901895]
 [0.20589132 0.72924468 0.22214706 0.45185944 0.95631878]
 [0.58017048 0.91297201 0.28197446 0.84899418 0.50785395]
 [0.91262825 0.05654469 0.38106629 0.28531108 0.19291841]
 [0.67708037 0.08533343 0.63293557 0.36167096 0.10957881]
 [0.37262228 0.09993589 0.25346189 0.42951208 0.0955062 ]
 [0.48440682 0.61064767 0.20909696 0.50204429 0.27171831]
 [0.69415348 0.25714154 0.05342512 0.14978995 0.00383867]]
The mean is:
[0.73916765 0.76480222 0.62832641 0.14335966 0.28560684]
GT is:
[[-0.45371676 -0.61379044 -0.23811076  0.63973758 -0.24933112]
 [ 0.09852555  0.2217174  -0.24328993  0.82216392  0.40585929]
 [ 0.04361811 -0.15999924 -0.12570033  0.03767279 -0.27658789]
 [-0.53327633 -0.03555754 -0.40617935  0.30849978  0.67071194]
 [-0.15899717  0.14816978 -0.34635195  0.70563452  0.22224711]
 [ 0.1734606  -0.70825753 -0.24726012  0.14195143 -0.09268843]
 [-0.06208728 -0.67946879  0.00460916  0.2183113  -0.17602803]
 [-0.36654537 -0.66486633 -0.37486452  0.28615242 -0.19010064]
 [-0.25476083 -0.15415455 -0.41922945  0.35868464 -0.01388852]
 [-0.04501417 -0.50766068 -0.57490128  0.00643029 -0.28176817]]
Your answer is:
[[-0.45371676 -0.61379044 -0.23811076  0.63973758 -0.24933112]
 [ 0.09852555  0.2217174  -0.24328993  0.82216392  0.40585929]
 [ 0.04361811 -0.15999924 -0.12570033  0.03767279 -0.27658789]
```

```
[-0.53327633 -0.03555754 -0.40617935  0.30849978  0.67071194]
[-0.15899717  0.14816978 -0.34635195  0.70563452  0.22224711]
[ 0.1734606  -0.70825753 -0.24726012  0.14195143 -0.09268843]
[-0.06208728 -0.67946879  0.00460916  0.2183113  -0.17602803]
[-0.36654537 -0.66486633 -0.37486452  0.28615242 -0.19010064]
[-0.25476083 -0.15415455 -0.41922945  0.35868464 -0.01388852]
[-0.04501417 -0.50766068 -0.57490128  0.00643029 -0.28176817]]
```

test_computeDim (test_all.Testall) (2/2)

```
This test the computeDim() function with 10 random tests
----------
The eigen vals are:
[0.97089296 0.88266303 0.84220675 0.70216466 0.53853547 0.53699965
 0.45957153 0.32572013 0.27601846 0.25837228]
The percent to keep is
0.4274635988050741
GT num_dim is:
3.0
Your num_dim is:
3.0
----------
The eigen vals are:
[0.80070399 0.73536173 0.64371808 0.57574103 0.49642815 0.35833851
 0.26689843 0.26234592 0.17046651 0.11861417]
The percent to keep is
0.9025300190384121
GT num_dim is:
8.0
Your num_dim is:
8.0
----------
The eigen vals are:
[0.97219128 0.83479819 0.76158255 0.66334965 0.5890081  0.51247158
 0.47964523 0.25198351 0.09987322 0.05119271]
The percent to keep is
0.2795677394396946
GT num_dim is:
2.0
Your num_dim is:
2.0
----------
The eigen vals are:
[0.9721245  0.85865814 0.82503849 0.80679179 0.7352915  0.70888145
 0.575696   0.43934301 0.28294912 0.23532658]
The percent to keep is
0.7869487348412744
GT num_dim is:
7.0
Your num_dim is:
7.0
----------
The eigen vals are:
[0.85953882 0.8527704  0.78372089 0.75800499 0.6385148  0.63756889
 0.59476791 0.35448504 0.2585135  0.2331388 ]
The percent to keep is
0.6965852068187812
GT num_dim is:
6.0
Your num_dim is:
6.0
----------
```

```
The eigen vals are:
[0.84198328 0.83882433 0.71197408 0.60948589 0.44034099 0.36214032
 0.31432665 0.28927519 0.20102376 0.04985845]
The percent to keep is
0.6145896000607263
GT num_dim is:
4.0
Your num_dim is:
4.0
----------
The eigen vals are:
[0.92923109 0.85985542 0.84934581 0.80326064 0.60147122 0.55215518
 0.39183581 0.18325515 0.15236808 0.05970797]
The percent to keep is
0.5032296308080206
GT num_dim is:
4.0
Your num_dim is:
4.0
----------
The eigen vals are:
[0.76892436 0.750138   0.7150702  0.65438743 0.51387998 0.50682241
 0.49381176 0.48472488 0.19610925 0.04430367]
The percent to keep is
0.7290752375019863
GT num_dim is:
6.0
Your num_dim is:
6.0
----------
The eigen vals are:
[0.60794351 0.60671827 0.46437153 0.33653012 0.27616872 0.25970089
 0.23213466 0.19875964 0.18094726 0.03709563]
The percent to keep is
0.02797632013953133
GT num_dim is:
1.0
Your num_dim is:
1.0
----------
The eigen vals are:
[0.98874718 0.8618819  0.83385387 0.81483379 0.75812934 0.73706886
 0.67998076 0.5336463  0.23445405 0.19234099]
The percent to keep is
0.3623229701437237
GT num_dim is:
3.0
Your num_dim is:
3.0
```

test_computeDis (test_all.Testall) (2/2)

```
This test the computeDis() function with 10 random tests with 5 centers
----------
The sample data is:
[0.5549084  0.94387    0.35718673 0.00503953 0.74387148]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]
```

```
 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[1.39971751 1.17914576 0.98225262 1.303662   0.77389492]
Your answer is:
[1.39971751 1.17914576 0.98225262 1.303662   0.77389492]
----------
The sample data is:
[0.50605314 0.93289759 0.34854646 0.74972473 0.95555207]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
```

```
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[1.17691853 1.53492732 0.63902273 0.37630852 1.05104196]
Your answer is:
[1.17691853 1.53492732 0.63902273 0.37630852 1.05104196]
----------
The sample data is:
[0.16465999 0.97610184 0.26556876 0.09701049 0.32242077]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]
```

```
 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.94096965 1.03177171 1.0125424  1.28498969 1.101638  ]
Your answer is:
[0.94096965 1.03177171 1.0125424  1.28498969 1.101638  ]
----------
The sample data is:
[0.94811518 0.20540382 0.93374973 0.57817385 0.82120537]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
```

```
 [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
 [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
 [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

[[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
 [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
 [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
 [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
 [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

[[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
 [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
 [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
 [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
 [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

[[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
 [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
 [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
 [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
 [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

[[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
 [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
 [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
 [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
 [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

[[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
 [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
 [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
 [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
 [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

[[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
 [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
 [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
 [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
 [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

[[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
 [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
 [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
 [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
 [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

[[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
 [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
 [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
 [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
 [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]
```

```
 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[1.3574198  0.5900311  0.9027844  0.59025298 0.91433406]
Your answer is:
[1.3574198  0.5900311  0.9027844  0.59025298 0.91433406]
----------
The sample data is:
[0.0309705  0.26843067 0.5401483  0.2078951  0.68041885]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
```

```
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.84483792 0.95098565 1.11542807 1.21163814 0.84381483]
Your answer is:
[0.84483792 0.95098565 1.11542807 1.21163814 0.84381483]
----------
The sample data is:
[0.4900687  0.27207204 0.01069006 0.96146612 0.89944044]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]
```

```
 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[1.2050558  1.01988447 0.82130053 0.50834045 0.82703113]
Your answer is:
[1.2050558  1.01988447 0.82130053 0.50834045 0.82703113]
----------
The sample data is:
[0.61323751 0.59531401 0.47041085 0.51946878 0.86698188]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
```

```
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.79604188 0.63999441 0.94143126 1.03754149 0.87670518]
```

Your answer is:
[0.79604188 0.63999441 0.94143126 1.03754149 0.87670518]

The sample data is:
[0.833469 0.17558295 0.16892286 0.17388979 0.54376373]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968 0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197]
  [0.01094993 0.90878789 0.78339509 0.6927479 0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239 0.02760077 0.66482675]
  [0.26791934 0.0615407 0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692 0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277 0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378 0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711 0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747 0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975 0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712 0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522 0.82885972 0.84415291 0.6546126]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]

```
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.81473243 0.7622315  0.62649355 1.04052763 1.0982433 ]
Your answer is:
[0.81473243 0.7622315  0.62649355 1.04052763 1.0982433 ]
----------
The sample data is:
[0.66978831 0.49257661 0.12772726 0.72832083 0.58298862]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
```

```
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.45372351 0.97291248 0.64682336 0.95046545 0.84854707]
Your answer is:
[0.45372351 0.97291248 0.64682336 0.95046545 0.84854707]
----------
The sample data is:
[0.40896199 0.00863944 0.64434171 0.65750619 0.52353427]
The 5 centers are:
[[[0.60743833 0.07127204 0.97730282 0.5292968  0.01200205]
  [0.85400188 0.58603542 0.85103757 0.96696636 0.8046197 ]
  [0.01094993 0.90878789 0.78339509 0.6927479  0.85833664]
  [0.69414588 0.18435042 0.17451789 0.86802239 0.1736345 ]
  [0.13246171 0.80454779 0.27845809 0.63208738 0.70319891]]

 [[0.87139527 0.13048012 0.3910239  0.02760077 0.66482675]
  [0.26791934 0.0615407  0.76575636 0.00560365 0.05430236]
  [0.31005598 0.84904832 0.1349692  0.45344671 0.47648156]
  [0.36193922 0.64699832 0.198778   0.67666444 0.8490979 ]
  [0.26561162 0.82940672 0.88935365 0.76497087 0.09330974]]

 [[0.63242135 0.63158468 0.43983581 0.49660165 0.92065903]
  [0.60437359 0.52017727 0.62527669 0.66290588 0.78470876]
  [0.10443237 0.2487277  0.19985354 0.77558439 0.15580572]
  [0.69137675 0.02187593 0.02830816 0.71689571 0.17185325]
```

```
  [0.24808442 0.30020284 0.49637881 0.88088833 0.03594314]]

 [[0.01661065 0.46883256 0.37015571 0.01314153 0.30294539]
  [0.65352627 0.00709743 0.48355405 0.45747308 0.75204014]
  [0.29533022 0.62217707 0.64422191 0.40476565 0.50293699]
  [0.97074608 0.26358889 0.55905082 0.12659081 0.80799895]
  [0.36340886 0.45599636 0.35442001 0.74881065 0.56315727]]

 [[0.63889925 0.77688143 0.35825432 0.40191661 0.80257369]
  [0.42123864 0.90411101 0.04268094 0.16210393 0.36672411]
  [0.93774032 0.03102262 0.20696156 0.59905404 0.99911461]
  [0.92071359 0.83491877 0.04766366 0.40103845 0.95550063]
  [0.44090599 0.59339486 0.562879   0.42316668 0.05470638]]

 [[0.70638561 0.19663516 0.94630985 0.58357546 0.28179166]
  [0.65766684 0.75831988 0.77342668 0.53500565 0.78988434]
  [0.81485822 0.64858644 0.00621326 0.3140378  0.98943916]
  [0.20550929 0.57776888 0.25514244 0.8204711  0.96538611]
  [0.86501277 0.32618115 0.00152053 0.4660747  0.35632635]]

 [[0.14214675 0.10939381 0.69959112 0.16899666 0.85014652]
  [0.61793147 0.2179975  0.37051402 0.19483162 0.47732254]
  [0.88819067 0.4806712  0.88639197 0.96681201 0.21552632]
  [0.29702821 0.21374527 0.04816064 0.52765661 0.05917805]
  [0.13777402 0.0819522  0.82885972 0.84415291 0.6546126 ]]

 [[0.78672205 0.42839294 0.73863823 0.69074228 0.46644194]
  [0.18857118 0.50505866 0.26035744 0.36861963 0.64510189]
  [0.28267704 0.06003122 0.23076601 0.22562468 0.80695398]
  [0.11740297 0.68817504 0.11796267 0.03240512 0.01030175]
  [0.27456252 0.8646989  0.58830519 0.64186495 0.38884826]]

 [[0.88661249 0.22361311 0.30848632 0.66273441 0.80555439]
  [0.91331935 0.95248631 0.53938419 0.03040341 0.72149581]
  [0.97883346 0.06689624 0.47575799 0.83592464 0.67766603]
  [0.19627999 0.18649392 0.02243563 0.20101639 0.03860682]
  [0.03935469 0.1875613  0.55022453 0.50435844 0.55318697]]

 [[0.45595695 0.70553672 0.74076977 0.70722301 0.32727033]
  [0.89207125 0.96893149 0.65579962 0.85970647 0.90224014]
  [0.02435573 0.80988237 0.95559894 0.51670788 0.2578795 ]
  [0.36063549 0.33160499 0.60868137 0.01674912 0.65245681]
  [0.40643584 0.18128348 0.47174539 0.81601495 0.96035341]]]
GT is:
[0.73359663 1.15757926 0.98852915 0.73150838 0.52491697]
Your answer is:
[0.73359663 1.15757926 0.98852915 0.73150838 0.52491697]
```

test_computeE (test_all.Testall) (2/2)

```
This test the computeE() function with 10 random tests
----------
The data sample are:
[[0.79310185 0.44872612 0.51998657 0.18024152 0.10853303]
 [0.96743804 0.14173189 0.74383586 0.04239011 0.64558969]
 [0.00939254 0.96376759 0.19299778 0.63014133 0.26754822]
 [0.35681024 0.69907635 0.91194614 0.53388962 0.00690862]
 [0.51939392 0.60772682 0.99788082 0.03525774 0.54829233]
 [0.52753631 0.51562253 0.95930147 0.87475785 0.39034439]
 [0.89858374 0.04080121 0.63311822 0.5765423  0.96459683]
 [0.19661352 0.4101329  0.38691588 0.51860296 0.25456788]
 [0.39614534 0.86559604 0.30343113 0.10283261 0.47833763]
 [0.63360033 0.69816071 0.20178144 0.47216938 0.69815974]]
GT eigenvectors are is:
[[-0.61659155  0.08191692 -0.07384139  0.24698693  0.73935742]
 [ 0.55513558  0.08877155 -0.24132755 -0.51444566  0.60087502]
 [-0.30872774 -0.82775059 -0.13868543 -0.44649204 -0.03045234]
 [ 0.20867519 -0.27693099  0.89535437  0.0725992   0.2698774 ]
 [-0.41566958  0.47280801  0.33972838 -0.68535927 -0.13615678]]
GT eigenvalues are is:
[0.2137291  0.09890405 0.08041373 0.03399303 0.01574817]
Your eigenvectors are is:
[[-0.61659155  0.08191692 -0.07384139  0.24698693  0.73935742]
 [ 0.55513558  0.08877155 -0.24132755 -0.51444566  0.60087502]
 [-0.30872774 -0.82775059 -0.13868543 -0.44649204 -0.03045234]
 [ 0.20867519 -0.27693099  0.89535437  0.0725992   0.2698774 ]
 [-0.41566958  0.47280801  0.33972838 -0.68535927 -0.13615678]]
Your eigenvalues are is:
[0.2137291  0.09890405 0.08041373 0.03399303 0.01574817]
----------
The data sample are:
[[0.88919584 0.43786182 0.044042   0.62265244 0.5916449 ]
 [0.82233664 0.18533621 0.21194934 0.94312867 0.72252575]
 [0.18774837 0.40673302 0.75090438 0.42084266 0.74770465]
 [0.38136366 0.07423766 0.78334852 0.35470003 0.42589744]
 [0.64491997 0.56346935 0.26318414 0.24870862 0.00532234]
 [0.72273212 0.88964845 0.08411747 0.53954934 0.60902473]
 [0.86062596 0.03904594 0.03826459 0.18451527 0.82004889]
 [0.37775373 0.18943635 0.84872247 0.53055179 0.26745141]
 [0.46361613 0.67943347 0.84660123 0.59276513 0.59981303]
 [0.25127009 0.53349453 0.62478913 0.45398554 0.10057697]]
GT eigenvectors are is:
[[ 0.56045595  0.00988201  0.09581392  0.22276016  0.79182642]
 [ 0.00542789  0.78110053 -0.53605172 -0.2911429   0.13317984]
 [-0.76005888 -0.23461465 -0.23443368  0.04290869  0.5571949 ]
 [ 0.09166848 -0.07539879 -0.58275217  0.77558354 -0.21161758]
 [ 0.31585925 -0.57363341 -0.55579583 -0.51209643 -0.00508809]]
GT eigenvalues are is:
[0.19467921 0.09001918 0.06499727 0.03561541 0.00670689]
Your eigenvectors are is:
[[ 0.56045595  0.00988201  0.09581392  0.22276016  0.79182642]
 [ 0.00542789  0.78110053 -0.53605172 -0.2911429   0.13317984]
```

```
 [-0.76005888 -0.23461465 -0.23443368  0.04290869  0.5571949 ]
 [ 0.09166848 -0.07539879 -0.58275217  0.77558354 -0.21161758]
 [ 0.31585925 -0.57363341 -0.55579583 -0.51209643 -0.00508809]]
Your eigenvalues are is:
[0.19467921 0.09001918 0.06499727 0.03561541 0.00670689]
----------
The data sample are:
[[0.55863051 0.73743625 0.38391544 0.00323511 0.50071377]
 [0.13534859 0.1098819  0.21520833 0.30798866 0.24942154]
 [0.93964131 0.67080415 0.09848324 0.09667531 0.10736171]
 [0.36344699 0.43412424 0.98441228 0.65759141 0.40493753]
 [0.8758587  0.77273777 0.78136142 0.73031344 0.96066087]
 [0.13373101 0.48878437 0.94634045 0.97587622 0.82542477]
 [0.75601731 0.92518957 0.39775293 0.15540665 0.1650682 ]
 [0.27952168 0.64086596 0.81141292 0.73225355 0.73924228]
 [0.50171009 0.7578524  0.08168422 0.14362444 0.92575771]
 [0.30564728 0.23697774 0.99306277 0.17590744 0.49531321]]
GT eigenvectors are is:
[[-0.34180762 -0.53261901  0.4694179  -0.01777215 -0.61547991]
 [-0.17752158 -0.63026349  0.13053794 -0.0208979   0.74416205]
 [ 0.62848909  0.01680044  0.59277453  0.49783393  0.07415482]
 [ 0.57895639 -0.21057222  0.05811377 -0.78220908 -0.0723919 ]
 [ 0.34851772 -0.52389122 -0.63862964  0.3735743  -0.23805   ]]
GT eigenvalues are is:
[0.27271909 0.12067883 0.06443515 0.03224707 0.01486486]
Your eigenvectors are is:
[[-0.34180762 -0.53261901  0.4694179  -0.01777215 -0.61547991]
 [-0.17752158 -0.63026349  0.13053794 -0.0208979   0.74416205]
 [ 0.62848909  0.01680044  0.59277453  0.49783393  0.07415482]
 [ 0.57895639 -0.21057222  0.05811377 -0.78220908 -0.0723919 ]
 [ 0.34851772 -0.52389122 -0.63862964  0.3735743  -0.23805   ]]
Your eigenvalues are is:
[0.27271909 0.12067883 0.06443515 0.03224707 0.01486486]
----------
The data sample are:
[[0.69925778 0.69213278 0.87208626 0.8917735  0.27794825]
 [0.31359517 0.29186051 0.33605505 0.28626538 0.11669546]
 [0.54576366 0.70636172 0.98709874 0.43038234 0.05441368]
 [0.63896745 0.05174877 0.31940198 0.04504805 0.98191186]
 [0.47106567 0.77815738 0.20189728 0.00598104 0.9837777 ]
 [0.26045798 0.30822708 0.08481222 0.48037088 0.35451296]
 [0.17322165 0.01384164 0.04806319 0.57783499 0.74008344]
 [0.14305809 0.27918041 0.7442594  0.95014032 0.80801899]
 [0.36487024 0.88496097 0.40785279 0.3939622  0.28974875]
 [0.00837222 0.54512075 0.1234399  0.53723671 0.75776057]]
GT eigenvectors are is:
[[ 0.1955196   0.36181005  0.36587152 -0.44016807  0.70940516]
 [ 0.38233313  0.48017088  0.06367778  0.78037384  0.10108962]
 [ 0.61758881 -0.10529726  0.53513289 -0.2134536  -0.52494466]
 [ 0.29924238 -0.7881339   0.05915935  0.27404767  0.45901742]
 [-0.58705325 -0.07928972  0.75644969  0.27677458 -0.01616542]]
GT eigenvalues are is:
```

```
[0.2257372  0.1095331  0.07471932 0.05929257 0.01264742]
Your eigenvectors are is:
[[ 0.1955196   0.36181005  0.36587152 -0.44016807  0.70940516]
 [ 0.38233313  0.48017088  0.06367778  0.78037384  0.10108962]
 [ 0.61758881 -0.10529726  0.53513289 -0.2134536  -0.52494466]
 [ 0.29924238 -0.7881339   0.05915935  0.27404767  0.45901742]
 [-0.58705325 -0.07928972  0.75644969  0.27677458 -0.01616542]]
Your eigenvalues are is:
[0.2257372  0.1095331  0.07471932 0.05929257 0.01264742]
----------
The data sample are:
[[0.5474961  0.22812387 0.59775291 0.85949104 0.92374583]
 [0.60807872 0.56947111 0.64877355 0.18100411 0.64961151]
 [0.39928641 0.69346559 0.99233912 0.42214685 0.8002988 ]
 [0.58705938 0.08502439 0.52279094 0.59090827 0.27438315]
 [0.7939282  0.25946465 0.11316609 0.72863825 0.28206564]
 [0.68734809 0.3679258  0.07058854 0.43823553 0.08850664]
 [0.19240155 0.79933266 0.89656885 0.02207974 0.30209581]
 [0.60446022 0.66887931 0.9299324  0.36398063 0.66176657]
 [0.47338568 0.19380284 0.70849406 0.60507579 0.98821825]
 [0.73704602 0.83042654 0.02717372 0.44287409 0.15217971]]
GT eigenvectors are is:
[[-0.28566654  0.12997334 -0.35556441  0.35339616 -0.80634153]
 [ 0.14641111 -0.62451099 -0.68788987 -0.33963739  0.00194468]
 [ 0.75670519 -0.05484302  0.32181162 -0.22771166 -0.51862721]
 [-0.16839141  0.5878216  -0.19383425 -0.76140397 -0.09382098]
 [ 0.54405883  0.49452095 -0.50916308  0.35800697  0.26838962]]
GT eigenvalues are is:
[0.22027339 0.13894384 0.0317299  0.00977979 0.00783171]
Your eigenvectors are is:
[[-0.28566654  0.12997334 -0.35556441  0.35339616 -0.80634153]
 [ 0.14641111 -0.62451099 -0.68788987 -0.33963739  0.00194468]
 [ 0.75670519 -0.05484302  0.32181162 -0.22771166 -0.51862721]
 [-0.16839141  0.5878216  -0.19383425 -0.76140397 -0.09382098]
 [ 0.54405883  0.49452095 -0.50916308  0.35800697  0.26838962]]
Your eigenvalues are is:
[0.22027339 0.13894384 0.0317299  0.00977979 0.00783171]
----------
The data sample are:
[[0.58110565 0.90016525 0.19368174 0.48890475 0.98539233]
 [0.01436263 0.46039197 0.48339245 0.18597043 0.11755885]
 [0.94214942 0.95345973 0.07991689 0.36612938 0.48539208]
 [0.4537263  0.95770116 0.8242415  0.21952048 0.3274296 ]
 [0.34179192 0.56417936 0.84596636 0.0374047  0.55898816]
 [0.69941412 0.23734293 0.926248   0.06223631 0.01653743]
 [0.19471837 0.55015369 0.67924979 0.1594395  0.79283778]
 [0.79493222 0.49522563 0.80537723 0.06078047 0.12167656]
 [0.7089162  0.80151896 0.20700303 0.85736314 0.19121502]
 [0.36016772 0.37716448 0.75277491 0.91353419 0.89172612]]
GT eigenvectors are is:
[[-1.65835814e-01  6.15797149e-01 -1.16935142e-02 -7.57103205e-01
  -1.41245719e-01]
```

```
 [-3.74424101e-01  2.39580257e-01  4.99108458e-01  1.32622028e-01
   7.31922153e-01]
 [ 5.62708413e-01 -3.17324362e-01 -1.36082693e-01 -4.86077849e-01
   5.72603105e-01]
 [-5.38745258e-01 -9.37606042e-02 -7.85190411e-01 -3.38401606e-04
   2.90582864e-01]
 [-4.74781912e-01 -6.73727964e-01  3.40163973e-01 -4.15853755e-01
  -1.78960589e-01]]
GT eigenvalues are is:
[0.20796746 0.1292216  0.06608613 0.04863801 0.02180845]
Your eigenvectors are is:
[[-1.65835814e-01  6.15797149e-01 -1.16935142e-02 -7.57103205e-01
  -1.41245719e-01]
 [-3.74424101e-01  2.39580257e-01  4.99108458e-01  1.32622028e-01
   7.31922153e-01]
 [ 5.62708413e-01 -3.17324362e-01 -1.36082693e-01 -4.86077849e-01
   5.72603105e-01]
 [-5.38745258e-01 -9.37606042e-02 -7.85190411e-01 -3.38401606e-04
   2.90582864e-01]
 [-4.74781912e-01 -6.73727964e-01  3.40163973e-01 -4.15853755e-01
  -1.78960589e-01]]
Your eigenvalues are is:
[0.20796746 0.1292216  0.06608613 0.04863801 0.02180845]
----------
The data sample are:
[[0.94070141 0.5429775  0.2579354  0.15043454 0.9200104 ]
 [0.84798938 0.66554663 0.8990672  0.98992206 0.61947561]
 [0.72808481 0.98095802 0.01653522 0.75936976 0.07787503]
 [0.19653567 0.07955101 0.27677176 0.62743228 0.70229297]
 [0.09448887 0.46522763 0.90740683 0.46356881 0.6056579 ]
 [0.25966821 0.61958405 0.65042041 0.66907791 0.72675583]
 [0.89199768 0.23797661 0.30339642 0.89716727 0.80550676]
 [0.82324431 0.9551125  0.6716668  0.08830347 0.59062383]
 [0.4622755  0.21207048 0.31571564 0.30338531 0.32886739]
 [0.2623035  0.59972359 0.00110009 0.26579355 0.23587554]]
GT eigenvectors are is:
[[-0.13574345  0.78317178 -0.28158666  0.38883939  0.37111799]
 [-0.32381809  0.54141479  0.39603896 -0.42904136 -0.51096822]
 [ 0.70773157  0.2354151   0.4997574  -0.2259505   0.3780009 ]
 [ 0.37215151  0.15662144 -0.7169817  -0.54209153 -0.17043178]
 [ 0.48717024  0.11645362  0.0064716   0.56551798 -0.65517268]]
GT eigenvalues are is:
[0.14317444 0.13412504 0.09728422 0.08670823 0.016463  ]
Your eigenvectors are is:
[[-0.13574345  0.78317178 -0.28158666  0.38883939  0.37111799]
 [-0.32381809  0.54141479  0.39603896 -0.42904136 -0.51096822]
 [ 0.70773157  0.2354151   0.4997574  -0.2259505   0.3780009 ]
 [ 0.37215151  0.15662144 -0.7169817  -0.54209153 -0.17043178]
 [ 0.48717024  0.11645362  0.0064716   0.56551798 -0.65517268]]
Your eigenvalues are is:
[0.14317444 0.13412504 0.09728422 0.08670823 0.016463  ]
----------
```

```
The data sample are:
[[0.01617579 0.53177251 0.96680441 0.18570676 0.73386505]
 [0.07600533 0.18536046 0.15700671 0.00304168 0.18246836]
 [0.26412346 0.07390453 0.05258486 0.65619282 0.89648408]
 [0.69968537 0.92592924 0.87737858 0.47582372 0.99151425]
 [0.83923115 0.86193458 0.40532543 0.15575803 0.12494344]
 [0.11808263 0.54545776 0.89762872 0.6730992  0.41704445]
 [0.17333631 0.93322743 0.63351443 0.63202025 0.46027351]
 [0.96479734 0.50419634 0.2211628  0.41826033 0.93828049]
 [0.25245428 0.49325558 0.50990476 0.95928646 0.3598545 ]
 [0.16311309 0.90838014 0.57006868 0.95011337 0.34481939]]
GT eigenvectors are is:
[[ 0.27802915 -0.78670882 -0.13549205 -0.28781612  0.45010311]
 [-0.54380167 -0.41452127 -0.31640696 -0.21504349 -0.62136526]
 [-0.67278487 -0.11177853 -0.06889493  0.50631193  0.52322825]
 [-0.40260243  0.08364221  0.63749408 -0.62388427  0.18784295]
 [ 0.11068581 -0.435627    0.68584497  0.47469445 -0.31978058]]
GT eigenvalues are is:
[0.16803048 0.15079716 0.10761469 0.08660291 0.01275807]
Your eigenvectors are is:
[[ 0.27802915 -0.78670882 -0.13549205 -0.28781612  0.45010311]
 [-0.54380167 -0.41452127 -0.31640696 -0.21504349 -0.62136526]
 [-0.67278487 -0.11177853 -0.06889493  0.50631193  0.52322825]
 [-0.40260243  0.08364221  0.63749408 -0.62388427  0.18784295]
 [ 0.11068581 -0.435627    0.68584497  0.47469445 -0.31978058]]
Your eigenvalues are is:
[0.16803048 0.15079716 0.10761469 0.08660291 0.01275807]
----------
The data sample are:
[[0.05720078 0.19058648 0.35069803 0.45632923 0.81293038]
 [0.46215288 0.33428232 0.71544358 0.03890787 0.0193982 ]
 [0.19669747 0.90417605 0.16674857 0.36010541 0.82005542]
 [0.26829167 0.6957418  0.53293649 0.06893071 0.9398695 ]
 [0.29082957 0.80737028 0.64468026 0.13548115 0.49722201]
 [0.84857957 0.57690069 0.7803376  0.15026924 0.30291602]
 [0.96685133 0.39339817 0.89110092 0.32530418 0.32916437]
 [0.12022361 0.38970382 0.39468127 0.80343889 0.75906924]
 [0.78648577 0.53843674 0.56057595 0.06374328 0.49825386]
 [0.17973095 0.97506276 0.21919199 0.55983469 0.54792443]]
GT eigenvectors are is:
[[-0.63275773 -0.12492403 -0.11581174 -0.67772449 -0.33359975]
 [ 0.18216675 -0.87846165 -0.34077269 -0.08221765  0.26876502]
 [-0.46113435  0.11330838  0.15422767 -0.0426804   0.86539502]
 [ 0.33705041  0.44571019 -0.69651971 -0.38915521  0.22618126]
 [ 0.49008679 -0.03468071  0.60127842 -0.61698167  0.12810181]]
GT eigenvalues are is:
[0.22901913 0.07125168 0.0377592  0.03339135 0.00967468]
Your eigenvectors are is:
[[-0.63275773 -0.12492403 -0.11581174 -0.67772449 -0.33359975]
 [ 0.18216675 -0.87846165 -0.34077269 -0.08221765  0.26876502]
 [-0.46113435  0.11330838  0.15422767 -0.0426804   0.86539502]
 [ 0.33705041  0.44571019 -0.69651971 -0.38915521  0.22618126]
```

```
 [ 0.49008679 -0.03468071  0.60127842 -0.61698167  0.12810181]]
Your eigenvalues are is:
[0.22901913 0.07125168 0.0377592  0.03339135 0.00967468]
----------
The data sample are:
[[0.64006795 0.83172327 0.66015068 0.08674621 0.39046984]
 [0.33997666 0.77041296 0.49214224 0.86282685 0.40760851]
 [0.08046556 0.59485525 0.05992648 0.73735535 0.81647861]
 [0.95848946 0.21998195 0.89736538 0.85449421 0.50443713]
 [0.34538023 0.71941402 0.28334268 0.36306416 0.2519262 ]
 [0.2158709  0.15007603 0.59888496 0.53739898 0.91406221]
 [0.97663439 0.37910062 0.80598204 0.14363534 0.91138661]
 [0.87937853 0.95369482 0.35039864 0.69648917 0.06014559]
 [0.51830882 0.72681966 0.103131   0.11095954 0.62348666]
 [0.40301655 0.93292552 0.52129486 0.26791883 0.38560669]]
GT eigenvectors are is:
[[-0.42550834 -0.66659424 -0.03224204 -0.60438392 -0.09096866]
 [ 0.58769491 -0.37674729  0.07746693  0.10363176 -0.70422688]
 [-0.56813038 -0.27105798 -0.08165011  0.73784362 -0.22951143]
 [-0.02405291  0.20786863 -0.93645388 -0.12435524 -0.25259058]
 [-0.38756506  0.54500624  0.33067616 -0.25318591 -0.61588286]]
GT eigenvalues are is:
[0.16409696 0.13795991 0.10140917 0.02535909 0.00955496]
Your eigenvectors are is:
[[-0.42550834 -0.66659424 -0.03224204 -0.60438392 -0.09096866]
 [ 0.58769491 -0.37674729  0.07746693  0.10363176 -0.70422688]
 [-0.56813038 -0.27105798 -0.08165011  0.73784362 -0.22951143]
 [-0.02405291  0.20786863 -0.93645388 -0.12435524 -0.25259058]
 [-0.38756506  0.54500624  0.33067616 -0.25318591 -0.61588286]]
Your eigenvalues are is:
[0.16409696 0.13795991 0.10140917 0.02535909 0.00955496]
```

test_computeError (test_all.Testall) (2/2)

This test the computeError() function with 10 random tests with 5 centers
---
The data sample are:
[[0.01210866 0.07813595 0.67164018 0.97945796 0.18434426]
 [0.85117003 0.32059211 0.11437186 0.12943346 0.47942031]
 [0.81230077 0.9059346 0.90205551 0.67722156 0.24779032]
 [0.21659521 0.2107007 0.18396116 0.62757599 0.44326151]
 [0.23671541 0.28512689 0.62656433 0.41332177 0.79102448]
 [0.11835603 0.96183968 0.53965475 0.49415339 0.57996795]
 [0.56707935 0.49888921 0.28619792 0.39517143 0.65375645]
 [0.38396133 0.86630775 0.38595607 0.73890857 0.31414648]
 [0.30904989 0.18435996 0.87133484 0.19206566 0.23307787]
 [0.19272297 0.12567325 0.61529771 0.8949241 0.60389488]]
The assignments are:
[1 3 0 2 1 0 1 1 2 4]
The centers are:
[[0.20118467 0.80290993 0.97013776 0.24646927 0.05516025]
 [0.34789129 0.13278567 0.85342347 0.31617282 0.47520928]
 [0.42277021 0.76729482 0.37265041 0.48387813 0.06191694]
 [0.30606674 0.4408722 0.49351807 0.6972919 0.06165965]
 [0.77410668 0.5206323 0.25515079 0.89629189 0.50778422]]
GT is:
[6.39473324]
Your answer is:
[6.39473324]

The data sample are:
[[0.52290011 0.07733345 0.69500143 0.17101611 0.00500854]
 [0.50915239 0.99969542 0.61910524 0.67936774 0.2921101]
 [0.20549696 0.91316003 0.44140865 0.23031138 0.67682717]
 [0.03964806 0.68465331 0.13524165 0.92034328 0.45104742]
 [0.57415948 0.43553849 0.36142194 0.84804809 0.65873895]
 [0.47293317 0.28170256 0.02306985 0.83841974 0.19172002]
 [0.41124644 0.2773519 0.8360677 0.25374069 0.22745523]
 [0.70603761 0.93347977 0.41091812 0.09017159 0.97916966]
 [0.54052847 0.81267225 0.35460522 0.37223601 0.66247465]
 [0.86303413 0.93902326 0.19617624 0.84328108 0.04064836]]
The assignments are:
[0 0 0 1 2 1 2 3 4 3]
The centers are:
[[0.26388433 0.23468757 0.28298194 0.60117747 0.56031379]
 [0.61718442 0.82676132 0.03935076 0.67669296 0.11540821]
 [0.54421922 0.53029861 0.35919983 0.16218939 0.92361279]
 [0.98094034 0.15772657 0.03291971 0.15013076 0.14041722]
 [0.93555228 0.41104258 0.16112267 0.54958134 0.83627351]]
GT is:
[7.55418662]
Your answer is:
[7.55418662]

The data sample are:
[[0.16403281 0.77922923 0.99100861 0.34852676 0.84472706]

```
 [0.4855576  0.69312554 0.06153198 0.72907968 0.91049659]
 [0.62979986 0.63077012 0.93170872 0.57550736 0.5925221 ]
 [0.34960419 0.74384022 0.9869716  0.48720474 0.0711904 ]
 [0.94779752 0.47783534 0.02399713 0.08722861 0.75603383]
 [0.0096963  0.99119908 0.21364988 0.34259973 0.06503165]
 [0.14915674 0.11976379 0.7336321  0.66266797 0.04504003]
 [0.63416958 0.47144908 0.6366457  0.41900312 0.92932904]
 [0.34897764 0.49055812 0.86127595 0.34788949 0.35562577]
 [0.11338245 0.16948394 0.31606238 0.68970816 0.33357327]]
The assignments are:
[1 3 1 2 4 2 4 2 0 0]
The centers are:
[[0.27640325 0.55924954 0.7871082  0.78303716 0.60140882]
 [0.53033889 0.13920903 0.12874345 0.96311498 0.44433233]
 [0.83786652 0.42515415 0.56242828 0.40258871 0.17785306]
 [0.01702883 0.42725013 0.06030747 0.00826598 0.40175623]
 [0.57781663 0.90725923 0.18056124 0.709849   0.22948567]]
GT is:
[9.16234672]
Your answer is:
[9.16234672]
----------
The data sample are:
[[0.05532643 0.74677314 0.35863201 0.08683497 0.23087971]
 [0.19059793 0.00532732 0.81835821 0.42557875 0.63192198]
 [0.34668086 0.37497817 0.54443432 0.18559064 0.59463999]
 [0.44706986 0.30485022 0.03419643 0.98558169 0.34756718]
 [0.26131226 0.14716897 0.48091411 0.44041898 0.04846982]
 [0.90666369 0.1483417  0.69172924 0.40493097 0.54740376]
 [0.55055043 0.93000934 0.66901194 0.48969993 0.65887169]
 [0.88810978 0.94619246 0.74937633 0.58565821 0.57144149]
 [0.85206438 0.2849262  0.39314271 0.25581185 0.76649968]
 [0.74669246 0.38406224 0.84574947 0.95704158 0.27266615]]
The assignments are:
[2 1 0 2 4 0 2 3 4 0]
The centers are:
[[0.29245898 0.5614531  0.60636591 0.48006027 0.38406425]
 [0.7667489  0.55147416 0.39136823 0.87754221 0.26976998]
 [0.07846068 0.13912623 0.8808807  0.60286113 0.10891039]
 [0.45269357 0.38784212 0.787844   0.84355829 0.94640689]
 [0.39196336 0.85529336 0.26845478 0.22722376 0.30440796]]
GT is:
[7.81039158]
Your answer is:
[7.81039158]
----------
The data sample are:
[[0.37621304 0.61881922 0.31845639 0.84457976 0.5674195 ]
 [0.19797492 0.05590136 0.58688877 0.65680473 0.55518638]
 [0.04381492 0.55309222 0.64199248 0.15789452 0.26695966]
 [0.23417848 0.42635951 0.10235751 0.55107924 0.24133318]
 [0.86534046 0.39630747 0.55503395 0.03088433 0.38636551]
```

```
 [0.47449997 0.52761756 0.98748428 0.48399289 0.40153773]
 [0.95532814 0.98091235 0.99506403 0.81512292 0.75889825]
 [0.71695954 0.32675829 0.49218432 0.22263768 0.44276132]
 [0.19861323 0.47787605 0.46290026 0.23477794 0.0394943 ]
 [0.86698192 0.73821786 0.3328172  0.04271391 0.08921924]]
The assignments are:
[0 2 2 2 2 2 2 3 4 4]
The centers are:
[[0.59318283 0.47856197 0.56717031 0.7662373  0.73266522]
 [0.54943361 0.62890115 0.19955242 0.61262559 0.26099787]
 [0.86360281 0.70393    0.88093449 0.73576561 0.133633  ]
 [0.16996705 0.42475023 0.40931254 0.2322646  0.68900708]
 [0.84302227 0.90558061 0.82436371 0.1127282  0.22291224]]
GT is:
[6.55693537]
Your answer is:
[6.55693537]
----------
The data sample are:
[[0.30749813 0.19353784 0.67637978 0.05572687 0.93652013]
 [0.49692618 0.51665054 0.36036685 0.29420576 0.82285064]
 [0.16883594 0.49106226 0.23111634 0.47970957 0.10916819]
 [0.96169347 0.24770058 0.16863895 0.53405666 0.41096293]
 [0.61641877 0.06418836 0.96740064 0.59738312 0.9343621 ]
 [0.35597404 0.78774052 0.49966066 0.63918485 0.56550388]
 [0.03877404 0.18396558 0.44578324 0.29220177 0.2127423 ]
 [0.34243848 0.28508934 0.76989893 0.28644913 0.98086967]
 [0.20282212 0.8816851  0.69686113 0.6968553  0.96179678]
 [0.56621433 0.59379608 0.7793762  0.64275003 0.24267998]]
The assignments are:
[2 0 1 3 4 4 3 0 1 4]
The centers are:
[[0.99301779 0.9909712  0.73407433 0.77925179 0.48663859]
 [0.3670486  0.18338966 0.47948541 0.86801997 0.58540467]
 [0.29642899 0.69479086 0.17355717 0.44777396 0.5710091 ]
 [0.39838385 0.89976184 0.6367684  0.89401109 0.79825206]
 [0.62127348 0.44639912 0.41714792 0.9410192  0.1443307 ]]
GT is:
[8.99880029]
Your answer is:
[8.99880029]
----------
The data sample are:
[[0.55170669 0.92968303 0.23332966 0.91848796 0.59454027]
 [0.52905055 0.66811447 0.24262994 0.80443513 0.83550807]
 [0.12244084 0.5939559  0.56727079 0.17944549 0.30277273]
 [0.49736688 0.45335095 0.18462504 0.35530551 0.67727309]
 [0.75225984 0.12476369 0.43078675 0.28252086 0.00695817]
 [0.90764743 0.18214199 0.28479753 0.62273794 0.17460948]
 [0.17052079 0.18809081 0.48627791 0.34520656 0.47066804]
 [0.81200476 0.65113661 0.35943887 0.26050158 0.91470183]
 [0.75764113 0.31999216 0.92909481 0.35226992 0.5916969 ]
```

```
 [0.82380737 0.93602669 0.90108672 0.88990195 0.76367955]]
The assignments are:
[4 0 4 0 3 2 1 0 3 2]
The centers are:
[[0.02363962 0.3215009  0.77362865 0.58295306 0.71101379]
 [0.41956197 0.67947073 0.20627825 0.24589093 0.18733008]
 [0.90274982 0.10307222 0.10706539 0.48488862 0.3235709 ]
 [0.2291144  0.54977904 0.57245111 0.28108953 0.07333036]
 [0.90260352 0.94448876 0.4413711  0.83612607 0.30524839]]
GT is:
[7.29792048]
Your answer is:
[7.29792048]
----------
The data sample are:
[[0.586726   0.75285215 0.86584483 0.34382431 0.57308078]
 [0.5580386  0.13968204 0.73674574 0.69179315 0.90300217]
 [0.01818311 0.23258669 0.02562696 0.20728744 0.90535257]
 [0.19093526 0.0837735  0.94708289 0.84025664 0.91484802]
 [0.50334575 0.06654401 0.41983289 0.94378957 0.17536535]
 [0.96048566 0.73455143 0.62905552 0.54515479 0.30853411]
 [0.32234386 0.81478379 0.28306668 0.20774097 0.158118  ]
 [0.48128346 0.2607991  0.30348522 0.65729127 0.90014601]
 [0.69286345 0.52672221 0.37575437 0.4417921  0.04650525]
 [0.89974758 0.49744372 0.38043449 0.80092048 0.44318848]]
The assignments are:
[3 4 0 0 0 4 0 0 3 4]
The centers are:
[[0.19396589 0.98745435 0.82560395 0.6458547  0.43054831]
 [0.95265064 0.74570953 0.56376196 0.65433756 0.59409281]
 [0.27272996 0.99640961 0.26173283 0.47202859 0.43118311]
 [0.88835112 0.57287787 0.03433634 0.5814681  0.84137015]
 [0.95421848 0.60052024 0.71476365 0.40871156 0.70590126]]
GT is:
[8.5255204]
Your answer is:
[8.5255204]
----------
The data sample are:
[[0.37429765 0.97379695 0.08655284 0.21777931 0.76002154]
 [0.10813141 0.56371277 0.50245735 0.30396048 0.25310362]
 [0.93540371 0.43777297 0.99561208 0.80498902 0.05410919]
 [0.85470501 0.93092582 0.44155229 0.48173599 0.38844527]
 [0.15511091 0.12141785 0.5234594  0.72297951 0.43828214]
 [0.56043443 0.34537256 0.34738689 0.43477541 0.13750104]
 [0.56723292 0.97025095 0.95657636 0.29272763 0.19538079]
 [0.84585009 0.90967868 0.83019129 0.05341432 0.95045232]
 [0.41222995 0.33896076 0.70358132 0.15823296 0.73452592]
 [0.80924877 0.65859589 0.73789096 0.51793651 0.45185238]]
The assignments are:
[2 3 1 0 1 3 2 2 4 4]
The centers are:
```

```
[[0.10237137 0.41604119 0.24820675 0.86154414 0.35848468]
 [0.07679865 0.78088929 0.08287482 0.38166522 0.37183999]
 [0.1631402  0.05421626 0.83084505 0.62735102 0.02427134]
 [0.00329904 0.63823741 0.5774395  0.32985219 0.35462517]
 [0.74648927 0.26112412 0.15462461 0.62189923 0.43887769]]
GT is:
[11.21076449]
Your answer is:
[11.21076449]
----------
The data sample are:
[[0.16799446 0.68895068 0.80225112 0.57723672 0.82528007]
 [0.59967864 0.24670434 0.60570609 0.02845249 0.18079315]
 [0.0149233  0.9477615  0.66879218 0.81528442 0.14185426]
 [0.74495337 0.62457667 0.56379832 0.51340686 0.62236178]
 [0.06937636 0.79726724 0.77620401 0.7570153  0.42239554]
 [0.02007741 0.33462561 0.07886166 0.41744827 0.5704962 ]
 [0.99096731 0.76323024 0.0421618  0.98083945 0.32463169]
 [0.3070582  0.41418726 0.31669811 0.99144764 0.4512681 ]
 [0.48175995 0.65516198 0.10826679 0.22321597 0.23395568]
 [0.91751704 0.42239206 0.19772592 0.00734771 0.12958407]]
The assignments are:
[4 4 3 4 0 0 4 2 4 3]
The centers are:
[[0.21979367 0.65008182 0.96294392 0.57729263 0.49095899]
 [0.90238617 0.38811886 0.61940175 0.97899239 0.47466304]
 [0.69208604 0.58239998 0.75654846 0.34567107 0.87554817]
 [0.22382168 0.90112599 0.63930022 0.48728383 0.66525672]
 [0.44534256 0.51352548 0.70362124 0.9315975  0.21631792]]
GT is:
[7.57344084]
Your answer is:
[7.57344084]
```

test_initCenters (test_all.Testall) (2/2)

```
This test the initCenters() function with 10 random tests
----------
The 20 sample data is:
[[0.43869624 0.46744729 0.4815106  0.54994411 0.97544056]
 [0.30804398 0.05789245 0.29089163 0.09002954 0.9306939 ]
 [0.31540369 0.04296783 0.79808289 0.9177896  0.083396  ]
 [0.59975867 0.80912904 0.8026537  0.11802977 0.4474872 ]
 [0.96138508 0.30523861 0.82546623 0.59592298 0.17143837]
 [0.19734034 0.63534571 0.9820387  0.40922094 0.72930865]
 [0.64571619 0.44238743 0.10422131 0.67071999 0.8854224 ]
 [0.37558806 0.69736903 0.90985162 0.12369534 0.38887918]
 [0.28676398 0.37562735 0.86882121 0.49808432 0.90232431]
 [0.98934594 0.46906636 0.50256985 0.43444656 0.32361101]
 [0.32813971 0.06984767 0.25862994 0.56794767 0.15881136]
 [0.18090185 0.9391739  0.39611075 0.51071911 0.06344798]
 [0.74891063 0.2046383  0.39003376 0.13166629 0.63332066]
 [0.27923598 0.17184579 0.20402161 0.53321681 0.51710746]
 [0.45282823 0.7301717  0.29954934 0.81809389 0.12542224]
 [0.27699525 0.65871409 0.10054732 0.0952399  0.18590953]
 [0.3189415  0.84525248 0.95050434 0.5726961  0.63270137]
 [0.4550028  0.98782193 0.52113008 0.69315173 0.27937822]
 [0.98641649 0.84648886 0.9814497  0.2471819  0.03222262]
 [0.09940235 0.05493609 0.98000197 0.85731118 0.80096615]]
The 3 dataindex is:
[10  9  9]
GT is:
[[0.32813971 0.06984767 0.25862994 0.56794767 0.15881136]
 [0.98934594 0.46906636 0.50256985 0.43444656 0.32361101]
 [0.98934594 0.46906636 0.50256985 0.43444656 0.32361101]]
Your answer is:
[[0.32813971 0.06984767 0.25862994 0.56794767 0.15881136]
 [0.98934594 0.46906636 0.50256985 0.43444656 0.32361101]
 [0.98934594 0.46906636 0.50256985 0.43444656 0.32361101]]
----------
The 20 sample data is:
[[0.18021932 0.84447515 0.21777524 0.48012025 0.8292375 ]
 [0.22568448 0.82711715 0.2728008  0.46173774 0.40276779]
 [0.02623124 0.91250181 0.0699367  0.90813104 0.85635551]
 [0.62084949 0.0842831  0.78482268 0.77855048 0.68867198]
 [0.3812778  0.93483721 0.3373757  0.99222536 0.60502492]
 [0.36607851 0.59055835 0.53574139 0.57800471 0.62056097]
 [0.63524413 0.71213046 0.43023635 0.84177129 0.42527568]
 [0.44835041 0.8273179  0.45578165 0.1542979  0.6169894 ]
 [0.44812754 0.97522593 0.93851132 0.09613115 0.63637343]
 [0.3722853  0.49932802 0.79758234 0.70892385 0.41436851]
 [0.08715181 0.90014622 0.64690593 0.14127571 0.84170792]
 [0.69251171 0.77017988 0.68138421 0.29761094 0.08654392]
 [0.57101042 0.82365595 0.18113774 0.4895698  0.39749616]
 [0.21939185 0.34870766 0.57403699 0.65267538 0.20575032]
 [0.02843139 0.11479598 0.02873836 0.98471441 0.42069721]
 [0.87035751 0.46368388 0.87918771 0.66401692 0.06691252]
 [0.55854473 0.01512061 0.45320731 0.2096572  0.89532343]
```

```
 [0.63334253 0.24445028 0.86115417 0.73116225 0.50431885]
 [0.33762703 0.06303511 0.7415769  0.88226594 0.90120756]
 [0.30471354 0.39497439 0.57069875 0.20277517 0.51451135]]
The 3 dataindex is:
[5 9 6]
GT is:
[[0.36607851 0.59055835 0.53574139 0.57800471 0.62056097]
 [0.3722853  0.49932802 0.79758234 0.70892385 0.41436851]
 [0.63524413 0.71213046 0.43023635 0.84177129 0.42527568]]
Your answer is:
[[0.36607851 0.59055835 0.53574139 0.57800471 0.62056097]
 [0.3722853  0.49932802 0.79758234 0.70892385 0.41436851]
 [0.63524413 0.71213046 0.43023635 0.84177129 0.42527568]]
----------
The 20 sample data is:
[[0.61739432 0.39866117 0.89123021 0.47486174 0.15364649]
 [0.26921642 0.49659446 0.44688914 0.03871807 0.09990907]
 [0.27571487 0.80321537 0.27715779 0.21419408 0.39129677]
 [0.53977656 0.58338232 0.20415209 0.22986325 0.83386055]
 [0.38642002 0.72366928 0.82573727 0.44160148 0.8465326 ]
 [0.77833645 0.48404608 0.35929143 0.1989888  0.73048951]
 [0.89106902 0.05661065 0.0887927  0.54990293 0.07714557]
 [0.96103918 0.09092917 0.14831215 0.850863   0.8347527 ]
 [0.41374275 0.22253584 0.41493382 0.99146711 0.3112586 ]
 [0.44076707 0.01584271 0.76032777 0.26091176 0.02969964]
 [0.30744464 0.89159217 0.69758897 0.951262   0.24266122]
 [0.40528357 0.44493184 0.32727372 0.92422419 0.67013606]
 [0.14649073 0.81070952 0.88915581 0.18006163 0.93157362]
 [0.72098705 0.24757693 0.09576297 0.90295095 0.89413221]
 [0.77385633 0.46259304 0.53325722 0.32487137 0.66160268]
 [0.82525052 0.12037481 0.95153195 0.5671772  0.04391411]
 [0.4504364  0.18986665 0.28561611 0.92389129 0.49571937]
 [0.76703631 0.96954245 0.77698858 0.33034142 0.01612213]
 [0.67035345 0.50308329 0.98835102 0.63861296 0.42443589]
 [0.25955231 0.71692402 0.72562843 0.17201616 0.21767996]]
The 3 dataindex is:
[ 9  1 16]
GT is:
[[0.44076707 0.01584271 0.76032777 0.26091176 0.02969964]
 [0.26921642 0.49659446 0.44688914 0.03871807 0.09990907]
 [0.4504364  0.18986665 0.28561611 0.92389129 0.49571937]]
Your answer is:
[[0.44076707 0.01584271 0.76032777 0.26091176 0.02969964]
 [0.26921642 0.49659446 0.44688914 0.03871807 0.09990907]
 [0.4504364  0.18986665 0.28561611 0.92389129 0.49571937]]
----------
The 20 sample data is:
[[0.50578386 0.38366137 0.57353984 0.91910834 0.92875538]
 [0.99897907 0.90702276 0.59666274 0.63692093 0.07195877]
 [0.34868408 0.64232375 0.08184354 0.29693737 0.78959265]
 [0.19662302 0.78360435 0.38836329 0.41364015 0.70534457]
 [0.68014695 0.4547603  0.23248122 0.1441437  0.69567901]
```

```
 [0.00337841 0.46396977 0.01957938 0.36239945 0.77549729]
 [0.32897053 0.05508847 0.73544249 0.00816094 0.81262607]
 [0.72130133 0.96313971 0.91826053 0.52705625 0.83752343]
 [0.73891431 0.08362091 0.9480918  0.85825369 0.11546181]
 [0.55897916 0.81591697 0.24429787 0.28084055 0.17251721]
 [0.94330647 0.02425499 0.59524165 0.9554956  0.79010317]
 [0.51390828 0.43930646 0.45847059 0.95658256 0.99344695]
 [0.35626603 0.94422683 0.30492394 0.79797718 0.14693731]
 [0.14648585 0.82594927 0.62740438 0.13091844 0.03070898]
 [0.6385236  0.87587955 0.53443663 0.29858725 0.23048596]
 [0.60607724 0.54801857 0.17125317 0.18597951 0.26975894]
 [0.27848408 0.47061669 0.32414583 0.07391086 0.38323344]
 [0.13345079 0.4756311  0.06734544 0.72730078 0.31914089]
 [0.49938609 0.44754036 0.33703523 0.93914779 0.9578164 ]
 [0.35755331 0.05704482 0.21975686 0.19579357 0.58215205]]
The 3 dataindex is:
[10 17 12]
GT is:
[[0.94330647 0.02425499 0.59524165 0.9554956  0.79010317]
 [0.13345079 0.4756311  0.06734544 0.72730078 0.31914089]
 [0.35626603 0.94422683 0.30492394 0.79797718 0.14693731]]
Your answer is:
[[0.94330647 0.02425499 0.59524165 0.9554956  0.79010317]
 [0.13345079 0.4756311  0.06734544 0.72730078 0.31914089]
 [0.35626603 0.94422683 0.30492394 0.79797718 0.14693731]]
----------
The 20 sample data is:
[[0.48374129 0.27924968 0.74036696 0.94121182 0.03424163]
 [0.35790618 0.71772609 0.88476332 0.27292616 0.44433104]
 [0.85034971 0.75068079 0.18365901 0.76892596 0.12362215]
 [0.27445513 0.6766239  0.18387073 0.7537088  0.71354434]
 [0.39405908 0.06543305 0.0808818  0.3458597  0.79794275]
 [0.55177461 0.7080664  0.71425057 0.07342677 0.56381419]
 [0.31597442 0.16835115 0.60344801 0.93478942 0.5374922 ]
 [0.49496492 0.14634557 0.08223389 0.1861492  0.83745746]
 [0.62648694 0.14835247 0.42095098 0.33911165 0.62606206]
 [0.56124122 0.87915113 0.55441292 0.24524183 0.30948252]
 [0.20528547 0.32726707 0.42738871 0.06621234 0.41204561]
 [0.60874509 0.67375487 0.25200243 0.61238556 0.42280068]
 [0.46252798 0.84403763 0.82006059 0.48712176 0.69239983]
 [0.4277026  0.74447808 0.82267913 0.70500113 0.09158967]
 [0.2405693  0.81655933 0.67103626 0.83859012 0.42545723]
 [0.24893337 0.73351914 0.78164126 0.64469017 0.71278684]
 [0.27222925 0.31479573 0.7614267  0.14267094 0.35243082]
 [0.4185268  0.84464605 0.29696145 0.55252872 0.05663855]
 [0.43313922 0.1193142  0.57956451 0.42419296 0.74066148]
 [0.18421657 0.98155681 0.55422832 0.65869708 0.1330404 ]]
The 3 dataindex is:
[16 14 10]
GT is:
[[0.27222925 0.31479573 0.7614267  0.14267094 0.35243082]
 [0.2405693  0.81655933 0.67103626 0.83859012 0.42545723]
```

```
 [0.20528547 0.32726707 0.42738871 0.06621234 0.41204561]]
Your answer is:
[[0.27222925 0.31479573 0.7614267  0.14267094 0.35243082]
 [0.2405693  0.81655933 0.67103626 0.83859012 0.42545723]
 [0.20528547 0.32726707 0.42738871 0.06621234 0.41204561]]
----------
The 20 sample data is:
[[0.53541891 0.85425233 0.85949204 0.8852199  0.06820826]
 [0.84992586 0.88710489 0.21911457 0.39012217 0.45235346]
 [0.81673733 0.0362523  0.52636415 0.95110762 0.27256568]
 [0.22563173 0.84614414 0.25463055 0.08589435 0.32659441]
 [0.69719315 0.34495292 0.34138417 0.34718923 0.22470053]
 [0.63196453 0.09594203 0.22227871 0.20356075 0.71919356]
 [0.29233241 0.20570401 0.84361552 0.29424346 0.76686283]
 [0.22603643 0.7871981  0.21408586 0.75877082 0.26531121]
 [0.91773374 0.98912536 0.11366382 0.41798107 0.80724652]
 [0.94061609 0.05943535 0.77617955 0.48651477 0.5445859 ]
 [0.01174516 0.95324198 0.57394016 0.02554348 0.42309208]
 [0.12215276 0.67847156 0.50478912 0.72558221 0.5923826 ]
 [0.67199982 0.28297927 0.88874769 0.90163564 0.38369895]
 [0.20771656 0.1907073  0.68097206 0.91220351 0.07394963]
 [0.37262267 0.76988803 0.65141065 0.86507995 0.02753441]
 [0.92013923 0.47048112 0.70660768 0.20269359 0.60239151]
 [0.45952192 0.71414306 0.60333452 0.73409149 0.92189046]
 [0.12142942 0.80153848 0.80208149 0.55358353 0.90512886]
 [0.30398009 0.68138624 0.58355394 0.38221491 0.72518598]
 [0.27615517 0.41383737 0.91512465 0.50063381 0.69468534]]
The 3 dataindex is:
[14 12  5]
GT is:
[[0.37262267 0.76988803 0.65141065 0.86507995 0.02753441]
 [0.67199982 0.28297927 0.88874769 0.90163564 0.38369895]
 [0.63196453 0.09594203 0.22227871 0.20356075 0.71919356]]
Your answer is:
[[0.37262267 0.76988803 0.65141065 0.86507995 0.02753441]
 [0.67199982 0.28297927 0.88874769 0.90163564 0.38369895]
 [0.63196453 0.09594203 0.22227871 0.20356075 0.71919356]]
----------
The 20 sample data is:
[[0.31148123 0.63626952 0.1091863  0.94845222 0.46496662]
 [0.77903148 0.83499227 0.42347239 0.92449181 0.047956 ]
 [0.81711335 0.30460698 0.9476585  0.15019441 0.56494202]
 [0.83556523 0.7065064  0.33752234 0.06287298 0.15326501]
 [0.05943759 0.43886896 0.55813057 0.73830422 0.60047737]
 [0.09996035 0.04051669 0.02075545 0.09621862 0.13808845]
 [0.21821296 0.73108888 0.92731052 0.59358109 0.43701963]
 [0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]
 [0.361909   0.44177502 0.23585919 0.77094163 0.86848958]
 [0.53636455 0.66061025 0.09260628 0.09061124 0.14363368]
 [0.63982115 0.3528241  0.14260127 0.81490606 0.70183129]
 [0.74117898 0.37948645 0.59727171 0.61622739 0.07166338]
 [0.1146724  0.53902625 0.21512928 0.30580842 0.11188306]
```

```
 [0.39970726 0.26789816 0.46608199 0.00163359 0.12953757]
 [0.04449866 0.53665824 0.70402158 0.90608801 0.40459519]
 [0.43425045 0.96018296 0.40685228 0.53526382 0.23579722]
 [0.27751046 0.62444644 0.61017453 0.08631753 0.8818223 ]
 [0.47889914 0.50628506 0.1942199  0.2515018  0.20750586]
 [0.12877522 0.54421056 0.74457996 0.66170809 0.23526451]
 [0.86720854 0.84397729 0.59593946 0.32861708 0.25799852]]
The 3 dataindex is:
[7 7 7]
GT is:
[[0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]
 [0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]
 [0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]]
Your answer is:
[[0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]
 [0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]
 [0.5297056  0.63870729 0.29033887 0.3346646  0.9272674 ]]
----------
The 20 sample data is:
[[0.75842357 0.69725824 0.41949689 0.35277219 0.88590088]
 [0.09175117 0.46814826 0.48080637 0.53562281 0.22573171]
 [0.31658464 0.22184692 0.89479011 0.52046768 0.21188612]
 [0.93458568 0.31974821 0.36394134 0.12218054 0.50280021]
 [0.66517715 0.54237397 0.82057103 0.98521388 0.53772842]
 [0.85531331 0.01019906 0.22059522 0.88863374 0.21273242]
 [0.3787948  0.95867811 0.56342452 0.24036016 0.98990943]
 [0.18978539 0.83588489 0.26489361 0.73584008 0.4229551 ]
 [0.22916655 0.36512854 0.62144876 0.82497238 0.9578067 ]
 [0.13858739 0.24734387 0.21230878 0.17532509 0.44109453]
 [0.31117464 0.1967616  0.91490547 0.06751448 0.79716099]
 [0.39916564 0.2169601  0.92778169 0.1278703  0.1168381 ]
 [0.47136796 0.43601598 0.06306115 0.38886612 0.61299013]
 [0.36668227 0.09900997 0.21770387 0.05057718 0.53764093]
 [0.13321415 0.4562159  0.8673886  0.73567793 0.34559134]
 [0.32966258 0.21834923 0.97199263 0.2084169  0.76040442]
 [0.02772278 0.40463058 0.57650619 0.35484855 0.27000726]
 [0.5353483  0.41358624 0.0618557  0.7388683  0.70426206]
 [0.88955387 0.61696402 0.85711083 0.44126434 0.27562826]
 [0.4021769  0.9780958  0.32871329 0.47666056 0.20159201]]
The 3 dataindex is:
[ 0 14  7]
GT is:
[[0.75842357 0.69725824 0.41949689 0.35277219 0.88590088]
 [0.13321415 0.4562159  0.8673886  0.73567793 0.34559134]
 [0.18978539 0.83588489 0.26489361 0.73584008 0.4229551 ]]
Your answer is:
[[0.75842357 0.69725824 0.41949689 0.35277219 0.88590088]
 [0.13321415 0.4562159  0.8673886  0.73567793 0.34559134]
 [0.18978539 0.83588489 0.26489361 0.73584008 0.4229551 ]]
----------
The 20 sample data is:
[[0.40268736 0.84436161 0.09322046 0.31505728 0.18554146]
```

```
 [0.67631273 0.54839343 0.89978328 0.72360594 0.70499739]
 [0.15938814 0.2458683  0.48776192 0.89272455 0.66432551]
 [0.14343984 0.76909737 0.70213954 0.63795389 0.33722539]
 [0.16815188 0.58891746 0.51440751 0.37397022 0.96784455]
 [0.85467031 0.34152126 0.7945494  0.27266225 0.10470228]
 [0.84311832 0.34747495 0.991076   0.32329028 0.58036272]
 [0.93367471 0.02445746 0.76018913 0.78856177 0.53529424]
 [0.08214449 0.97331653 0.63835437 0.38733893 0.4457447 ]
 [0.85010802 0.47940971 0.91635785 0.63716657 0.59497277]
 [0.20395071 0.92387868 0.35355514 0.79272283 0.85713966]
 [0.17390943 0.66332952 0.64787312 0.03312638 0.89040213]
 [0.04244547 0.4853907  0.18793096 0.56073099 0.61189042]
 [0.76588358 0.06854468 0.73061541 0.21403324 0.12078213]
 [0.57467789 0.41445755 0.42725138 0.30805756 0.73674288]
 [0.59087229 0.56674905 0.33427642 0.42204428 0.26199098]
 [0.32209848 0.90970418 0.12309833 0.27272112 0.38224177]
 [0.50742163 0.13185755 0.36056967 0.08088826 0.16643832]
 [0.038164   0.7809234  0.46143824 0.23606827 0.80611144]
 [0.55013771 0.35963391 0.9439169  0.78669056 0.60277929]]
The 3 dataindex is:
[17 18  7]
GT is:
[[0.50742163 0.13185755 0.36056967 0.08088826 0.16643832]
 [0.038164   0.7809234  0.46143824 0.23606827 0.80611144]
 [0.93367471 0.02445746 0.76018913 0.78856177 0.53529424]]
Your answer is:
[[0.50742163 0.13185755 0.36056967 0.08088826 0.16643832]
 [0.038164   0.7809234  0.46143824 0.23606827 0.80611144]
 [0.93367471 0.02445746 0.76018913 0.78856177 0.53529424]]
----------
The 20 sample data is:
[[0.12102102 0.43778054 0.32794779 0.07888046 0.83223753]
 [0.34270299 0.3737628  0.65833742 0.42615247 0.24728721]
 [0.6507522  0.63751781 0.85817238 0.15144503 0.63021542]
 [0.94613935 0.34888934 0.34399527 0.46204511 0.43886428]
 [0.01417495 0.74076346 0.93454106 0.77711019 0.99161318]
 [0.80697918 0.96992706 0.00854917 0.00209697 0.56445993]
 [0.61149708 0.40477419 0.73308682 0.71131111 0.4573199 ]
 [0.64170413 0.64492638 0.24648722 0.18241945 0.54024726]
 [0.6271192  0.69014741 0.89127862 0.37235292 0.8951031 ]
 [0.4979715  0.78313347 0.52357871 0.45916193 0.33117618]
 [0.68291381 0.58147493 0.47205144 0.61292442 0.20760339]
 [0.46904471 0.94332501 0.89482198 0.67050921 0.95725017]
 [0.97118792 0.88366302 0.8320052  0.2750776  0.25270933]
 [0.17232445 0.34060895 0.43845134 0.76713081 0.18728707]
 [0.81803799 0.26837794 0.68443855 0.34630605 0.15836183]
 [0.06727952 0.41965987 0.98209029 0.81623587 0.83923692]
 [0.30226052 0.19620367 0.64240523 0.80857107 0.10155584]
 [0.59537081 0.17042301 0.68597878 0.80827021 0.46551966]
 [0.85320977 0.13048051 0.14409698 0.07756312 0.27707316]
 [0.08839169 0.08813744 0.45121782 0.24106051 0.21808185]]
The 3 dataindex is:
```

[4 5 15]
GT is:
[[0.01417495 0.74076346 0.93454106 0.77711019 0.99161318]
 [0.80697918 0.96992706 0.00854917 0.00209697 0.56445993]
 [0.06727952 0.41965987 0.98209029 0.81623587 0.83923692]]
Your answer is:
[[0.01417495 0.74076346 0.93454106 0.77711019 0.99161318]
 [0.80697918 0.96992706 0.00854917 0.00209697 0.56445993]
 [0.06727952 0.41965987 0.98209029 0.81623587 0.83923692]]

test_project (test_all.Testall) (2/2)

This test the project() function with 10 random tests
GT is:
[[0.97659292 1.03124089]
 [1.16238577 1.15460027]
 [1.49601706 1.71145859]
 [1.40298584 1.37580562]
 [1.39610564 1.48040075]
 [1.8451346 2.04210765]
 [1.7131957 1.86537892]
 [1.60572453 1.65777756]
 [1.29005991 1.23606026]
 [1.0304877 0.8209785]]
Your result is:
[[0.97659292 1.03124089]
 [1.16238577 1.15460027]
 [1.49601706 1.71145859]
 [1.40298584 1.37580562]
 [1.39610564 1.48040075]
 [1.8451346 2.04210765]
 [1.7131957 1.86537892]
 [1.60572453 1.65777756]
 [1.29005991 1.23606026]
 [1.0304877 0.8209785]]
GT is:
[[1.75218403 1.63218448]
 [1.401159   1.16121744]
 [1.41723648 1.80718406]
 [0.98976602 1.17065198]
 [1.69569262 1.36801296]
 [1.23769364 1.16531805]
 [0.96969908 0.9781079]
 [1.11280549 1.26189327]
 [1.83837259 1.64665786]
 [0.48239316 0.60043893]]
Your result is:
[[1.75218403 1.63218448]
 [1.401159   1.16121744]
 [1.41723648 1.80718406]
 [0.98976602 1.17065198]
 [1.69569262 1.36801296]
 [1.23769364 1.16531805]
 [0.96969908 0.9781079]
 [1.11280549 1.26189327]
 [1.83837259 1.64665786]
 [0.48239316 0.60043893]]
GT is:
[[0.96059654 0.94555543]
 [1.24801404 1.11682351]
 [1.09588857 0.97479348]
 [1.42210734 1.36041846]
 [0.34231657 0.2690713]
 [1.20915173 1.09125646]

```
 [1.16610657 1.15057853]
 [1.32940199 1.19023495]
 [0.98000793 0.85984258]
 [1.1700669  1.01887766]]
Your result is:
[[0.96059654 0.94555543]
 [1.24801404 1.11682351]
 [1.09588857 0.97479348]
 [1.42210734 1.36041846]
 [0.34231657 0.2690713 ]
 [1.20915173 1.09125646]
 [1.16610657 1.15057853]
 [1.32940199 1.19023495]
 [0.98000793 0.85984258]
 [1.1700669  1.01887766]]
GT is:
[[1.46575086 2.18315652]
 [0.3890829  0.83797612]
 [1.22111305 2.00314572]
 [1.3116405  1.96122276]
 [0.59301597 1.24927916]
 [0.91594673 1.50334486]
 [1.30550344 2.30296462]
 [1.68985271 2.78115986]
 [1.2093422  1.94672012]
 [1.32324593 1.95277403]]
Your result is:
[[1.46575086 2.18315652]
 [0.3890829  0.83797612]
 [1.22111305 2.00314572]
 [1.3116405  1.96122276]
 [0.59301597 1.24927916]
 [0.91594673 1.50334486]
 [1.30550344 2.30296462]
 [1.68985271 2.78115986]
 [1.2093422  1.94672012]
 [1.32324593 1.95277403]]
GT is:
[[1.4768971  1.54700064]
 [1.13210263 1.00538312]
 [0.88836423 0.91404713]
 [1.6443568  1.6919214 ]
 [2.28901229 2.16979134]
 [1.90817754 1.96826399]
 [1.70183923 1.88636442]
 [1.16433707 1.30386931]
 [1.72994046 1.69050338]
 [1.13447746 1.12727776]]
Your result is:
[[1.4768971  1.54700064]
 [1.13210263 1.00538312]
 [0.88836423 0.91404713]
```

```
 [1.6443568  1.6919214 ]
 [2.28901229 2.16979134]
 [1.90817754 1.96826399]
 [1.70183923 1.88636442]
 [1.16433707 1.30386931]
 [1.72994046 1.69050338]
 [1.13447746 1.12727776]]
GT is:
[[1.35251541 0.96484521]
 [0.61435694 0.4648373 ]
 [0.86016828 0.69960997]
 [1.57959961 1.14403907]
 [1.35697048 0.99541892]
 [1.73847232 1.39091689]
 [1.06974672 0.87721298]
 [1.62151222 1.40912276]
 [1.28787198 1.06276126]
 [1.88584895 1.5575292 ]]
Your result is:
[[1.35251541 0.96484521]
 [0.61435694 0.4648373 ]
 [0.86016828 0.69960997]
 [1.57959961 1.14403907]
 [1.35697048 0.99541892]
 [1.73847232 1.39091689]
 [1.06974672 0.87721298]
 [1.62151222 1.40912276]
 [1.28787198 1.06276126]
 [1.88584895 1.5575292 ]]
GT is:
[[1.60447597 1.38167645]
 [1.77844081 1.28287347]
 [1.33118766 0.85204232]
 [1.54839993 1.21081693]
 [1.72389381 1.31309677]
 [1.24729298 0.91854579]
 [0.99235286 0.88800651]
 [1.06269289 0.74618875]
 [2.34655723 1.53828188]
 [1.82615509 1.11302175]]
Your result is:
[[1.60447597 1.38167645]
 [1.77844081 1.28287347]
 [1.33118766 0.85204232]
 [1.54839993 1.21081693]
 [1.72389381 1.31309677]
 [1.24729298 0.91854579]
 [0.99235286 0.88800651]
 [1.06269289 0.74618875]
 [2.34655723 1.53828188]
 [1.82615509 1.11302175]]
GT is:
```

```
[[1.49508555 1.79633721]
 [0.98181422 1.05063664]
 [1.33466013 1.83782062]
 [1.28705775 1.39315617]
 [1.15045237 1.58677734]
 [1.32947598 1.79536617]
 [1.24563491 1.84284545]
 [1.09246373 1.30219205]
 [0.62711317 1.21495024]
 [1.21645743 1.97055886]]
Your result is:
[[1.49508555 1.79633721]
 [0.98181422 1.05063664]
 [1.33466013 1.83782062]
 [1.28705775 1.39315617]
 [1.15045237 1.58677734]
 [1.32947598 1.79536617]
 [1.24563491 1.84284545]
 [1.09246373 1.30219205]
 [0.62711317 1.21495024]
 [1.21645743 1.97055886]]
GT is:
[[0.61940839 0.64435055]
 [0.95064406 1.50016018]
 [0.72037212 1.04553063]
 [0.67850858 1.07724409]
 [0.5935697  0.62094122]
 [0.83040844 1.45834119]
 [0.91847718 1.49702168]
 [0.50644825 0.69328541]
 [0.68603993 1.57537374]
 [0.6287565  0.92945174]]
Your result is:
[[0.61940839 0.64435055]
 [0.95064406 1.50016018]
 [0.72037212 1.04553063]
 [0.67850858 1.07724409]
 [0.5935697  0.62094122]
 [0.83040844 1.45834119]
 [0.91847718 1.49702168]
 [0.50644825 0.69328541]
 [0.68603993 1.57537374]
 [0.6287565  0.92945174]]
GT is:
[[0.76457133 1.09259706]
 [1.11302231 1.23799533]
 [0.90233017 1.36470911]
 [1.67160289 1.30797726]
 [1.4135905  1.11569663]
 [1.21127872 1.04252766]
 [1.38761118 1.52910664]
 [1.3592493  0.69139122]
```

```
 [1.32643102 1.2546044 ]
 [1.38499405 1.13553391]]
Your result is:
[[0.76457133 1.09259706]
 [1.11302231 1.23799533]
 [0.90233017 1.36470911]
 [1.67160289 1.30797726]
 [1.4135905  1.11569663]
 [1.21127872 1.04252766]
 [1.38761118 1.52910664]
 [1.3592493  0.69139122]
 [1.32643102 1.2546044 ]
 [1.38499405 1.13553391]]
```

test_updateCen (test_all.Testall) (2/2)

```
This test the updateCen() function with 10 random tests with 5 centers
----------
The new_sample are:
{'center': array([[0.43368842, 0.37716081, 0.49969865, 0.02498456, 0.71258167],
       [0.35848122, 0.66891004, 0.23682343, 0.06559659, 0.38608305],
       [0.97286378, 0.08893154, 0.68241201, 0.05578675, 0.23941758],
       [0.23700237, 0.23416099, 0.53201507, 0.85511008, 0.88526814],
       [0.89640656, 0.58397883, 0.34201256, 0.24435673, 0.54036372]]), 'num_sample': array([3, 5, 8, 8, 8])}
GT is:
[[0.14456281 0.12572027 0.16656622 0.00832819 0.23752722]
 [0.07169624 0.13378201 0.04736469 0.01311932 0.07721661]
 [0.12160797 0.01111644 0.0853015  0.00697334 0.0299272 ]
 [0.0296253  0.02927012 0.06650188 0.10688876 0.11065852]
 [0.11205082 0.07299735 0.04275157 0.03054459 0.06754546]]
Your answer is:
[[0.14456281 0.12572027 0.16656622 0.00832819 0.23752722]
 [0.07169624 0.13378201 0.04736469 0.01311932 0.07721661]
 [0.12160797 0.01111644 0.0853015  0.00697334 0.0299272 ]
 [0.0296253  0.02927012 0.06650188 0.10688876 0.11065852]
 [0.11205082 0.07299735 0.04275157 0.03054459 0.06754546]]
----------
The new_sample are:
{'center': array([[0.38530879, 0.23047354, 0.72845627, 0.99133589, 0.82727938],
       [0.76174635, 0.94924776, 0.42643112, 0.07027117, 0.9791115 ],
       [0.04970884, 0.85558518, 0.92604624, 0.53526104, 0.67104161],
       [0.66323623, 0.15922652, 0.46446568, 0.7305854 , 0.8051707 ],
       [0.90589437, 0.65670814, 0.0441932 , 0.34575128, 0.28421865]]), 'num_sample': array([3, 6, 9, 1, 5])}
GT is:
[[0.12843626 0.07682451 0.24281876 0.3304453  0.27575979]
 [0.12695773 0.15820796 0.07107185 0.01171186 0.16318525]
 [0.0055232  0.09506502 0.10289403 0.05947345 0.07456018]
 [0.66323623 0.15922652 0.46446568 0.7305854  0.8051707 ]
 [0.18117887 0.13134163 0.00883864 0.06915026 0.05684373]]
Your answer is:
[[0.12843626 0.07682451 0.24281876 0.3304453  0.27575979]
 [0.12695773 0.15820796 0.07107185 0.01171186 0.16318525]
 [0.0055232  0.09506502 0.10289403 0.05947345 0.07456018]
 [0.66323623 0.15922652 0.46446568 0.7305854  0.8051707 ]
 [0.18117887 0.13134163 0.00883864 0.06915026 0.05684373]]
----------
The new_sample are:
{'center': array([[0.35416611, 0.94686924, 0.80661418, 0.31563087, 0.66385294],
       [0.71680011, 0.68806176, 0.38920312, 0.85135462, 0.66962184],
       [0.31039654, 0.96992171, 0.8176038 , 0.80067511, 0.51474262],
       [0.54503134, 0.60033252, 0.61583613, 0.09575837, 0.62237646],
       [0.45261938, 0.13054936, 0.3546789 , 0.94480405, 0.11422891]]), 'num_sample': array([1, 8, 5, 4, 9])}
GT is:
[[0.35416611 0.94686924 0.80661418 0.31563087 0.66385294]
 [0.08960001 0.08600772 0.04865039 0.10641933 0.08370273]
 [0.06207931 0.19398434 0.16352076 0.16013502 0.10294852]
 [0.13625783 0.15008313 0.15395903 0.02393959 0.15559412]
 [0.05029104 0.01450548 0.03940877 0.10497823 0.0126921 ]]
```

Your answer is:
[[0.35416611 0.94686924 0.80661418 0.31563087 0.66385294]
 [0.08960001 0.08600772 0.04865039 0.10641933 0.08370273]
 [0.06207931 0.19398434 0.16352076 0.16013502 0.10294852]
 [0.13625783 0.15008313 0.15395903 0.02393959 0.15559412]
 [0.05029104 0.01450548 0.03940877 0.10497823 0.0126921]]

The new_sample are:
{'center': array([[0.4590555 , 0.93681975, 0.15667254, 0.21368509, 0.0581235],
       [0.22749268, 0.14426715, 0.95511362, 0.65742478, 0.17290649],
       [0.07599098, 0.22050629, 0.58875527, 0.251152 , 0.59538921],
       [0.07742771, 0.06929575, 0.42716545, 0.95371083, 0.58048069],
       [0.84112001, 0.90561048, 0.71239842, 0.43551741, 0.33342205]]), 'num_sample': array([5, 2, 8, 8, 8])}
GT is:
[[0.0918111 0.18736395 0.03133451 0.04273702 0.0116247]
 [0.11374634 0.07213358 0.47755681 0.32871239 0.08645325]
 [0.00949887 0.02756329 0.07359441 0.031394   0.07442365]
 [0.00967846 0.00866197 0.05339568 0.11921385 0.07256009]
 [0.10514   0.11320131 0.0890498 0.05443968 0.04167776]]
Your answer is:
[[0.0918111 0.18736395 0.03133451 0.04273702 0.0116247]
 [0.11374634 0.07213358 0.47755681 0.32871239 0.08645325]
 [0.00949887 0.02756329 0.07359441 0.031394   0.07442365]
 [0.00967846 0.00866197 0.05339568 0.11921385 0.07256009]
 [0.10514   0.11320131 0.0890498 0.05443968 0.04167776]]

The new_sample are:
{'center': array([[8.67128616e-01, 1.81367387e-01, 6.77197043e-03, 4.30469016e-01,
        6.86626725e-01],
       [9.06382498e-01, 7.60352676e-01, 9.49203702e-01, 2.49129617e-01,
        5.66174232e-01],
       [9.37434706e-01, 6.73803023e-01, 2.17533988e-01, 5.81825540e-01,
        2.13886811e-01],
       [6.63752533e-01, 8.81207521e-01, 2.36132781e-01, 7.31513711e-01,
        8.82003863e-05],
       [9.45469537e-02, 5.91094973e-01, 2.65236566e-01, 8.05856101e-01,
        1.44798463e-02]]), 'num_sample': array([6, 6, 4, 8, 6])}
GT is:
[[1.44521436e-01 3.02278979e-02 1.12866174e-03 7.17448360e-02
  1.14437788e-01]
 [1.51063750e-01 1.26725446e-01 1.58200617e-01 4.15216028e-02
  9.43623720e-02]
 [2.34358677e-01 1.68450756e-01 5.43834970e-02 1.45456385e-01
  5.34717027e-02]
 [8.29690666e-02 1.10150940e-01 2.95165976e-02 9.14392139e-02
  1.10250483e-05]
 [1.57578256e-02 9.85158289e-02 4.42060943e-02 1.34309350e-01
  2.41330772e-03]]
Your answer is:
[[1.44521436e-01 3.02278979e-02 1.12866174e-03 7.17448360e-02
  1.14437788e-01]
 [1.51063750e-01 1.26725446e-01 1.58200617e-01 4.15216028e-02

```
  9.43623720e-02]
 [2.34358677e-01 1.68450756e-01 5.43834970e-02 1.45456385e-01
  5.34717027e-02]
 [8.29690666e-02 1.10150940e-01 2.95165976e-02 9.14392139e-02
  1.10250483e-05]
 [1.57578256e-02 9.85158289e-02 4.42060943e-02 1.34309350e-01
  2.41330772e-03]]
----------
The new_sample are:
{'center': array([[0.28297421, 0.19928256, 0.93320831, 0.07502059, 0.84834267],
       [0.75027319, 0.31497294, 0.68636562, 0.66934673, 0.12612736],
       [0.09918213, 0.92018588, 0.56716209, 0.16227081, 0.19454301],
       [0.54415749, 0.1778028 , 0.14943515, 0.47219458, 0.39147831],
       [0.13744067, 0.21577436, 0.73980469, 0.35701287, 0.09707716]]), 'num_sample': array([8, 7, 6, 2, 4])}
GT is:
[[0.03537178 0.02491032 0.11665104 0.00937757 0.10604283]
 [0.10718188 0.04499613 0.09805223 0.09562096 0.01801819]
 [0.01653036 0.15336431 0.09452701 0.02704513 0.03242383]
 [0.27207875 0.0889014  0.07471757 0.23609729 0.19573915]
 [0.03436017 0.05394359 0.18495117 0.08925322 0.02426929]]
Your answer is:
[[0.03537178 0.02491032 0.11665104 0.00937757 0.10604283]
 [0.10718188 0.04499613 0.09805223 0.09562096 0.01801819]
 [0.01653036 0.15336431 0.09452701 0.02704513 0.03242383]
 [0.27207875 0.0889014  0.07471757 0.23609729 0.19573915]
 [0.03436017 0.05394359 0.18495117 0.08925322 0.02426929]]
----------
The new_sample are:
{'center': array([[0.82301267, 0.80204612, 0.69231558, 0.32239993, 0.64546442],
       [0.85003063, 0.2045377 , 0.25293239, 0.72972079, 0.91483073],
       [0.19723209, 0.54550663, 0.70786235, 0.20806563, 0.83146652],
       [0.92982643, 0.95872581, 0.44489933, 0.50318544, 0.98692752],
       [0.86863637, 0.85971046, 0.35788483, 0.97566112, 0.47085382]]), 'num_sample': array([1, 9, 9, 7, 5])}
GT is:
[[0.82301267 0.80204612 0.69231558 0.32239993 0.64546442]
 [0.09444785 0.02272641 0.0281036  0.08108009 0.10164786]
 [0.02191468 0.06061185 0.07865137 0.0231184  0.09238517]
 [0.13283235 0.13696083 0.06355705 0.07188363 0.14098965]
 [0.17372727 0.17194209 0.07157697 0.19513222 0.09417076]]
Your answer is:
[[0.82301267 0.80204612 0.69231558 0.32239993 0.64546442]
 [0.09444785 0.02272641 0.0281036  0.08108009 0.10164786]
 [0.02191468 0.06061185 0.07865137 0.0231184  0.09238517]
 [0.13283235 0.13696083 0.06355705 0.07188363 0.14098965]
 [0.17372727 0.17194209 0.07157697 0.19513222 0.09417076]]
----------
The new_sample are:
{'center': array([[0.13881495, 0.13568199, 0.01039788, 0.04460842, 0.60228941],
       [0.00383895, 0.15994012, 0.40412388, 0.20890887, 0.88295372],
       [0.16031766, 0.49937524, 0.09796035, 0.39342371, 0.63435297],
       [0.78023746, 0.84991905, 0.49646555, 0.95890019, 0.51737373],
       [0.12005037, 0.62931874, 0.56528322, 0.06207202, 0.14031826]]), 'num_sample': array([7, 4, 5, 2, 6])}
```

```
GT is:
[[0.01983071 0.01938314 0.00148541 0.00637263 0.08604134]
 [0.00095974 0.03998503 0.10103097 0.05222722 0.22073843]
 [0.03206353 0.09987505 0.01959207 0.07868474 0.12687059]
 [0.39011873 0.42495952 0.24823278 0.4794501  0.25868687]
 [0.0200084  0.10488646 0.09421387 0.01034534 0.02338638]]
Your answer is:
[[0.01983071 0.01938314 0.00148541 0.00637263 0.08604134]
 [0.00095974 0.03998503 0.10103097 0.05222722 0.22073843]
 [0.03206353 0.09987505 0.01959207 0.07868474 0.12687059]
 [0.39011873 0.42495952 0.24823278 0.4794501  0.25868687]
 [0.0200084  0.10488646 0.09421387 0.01034534 0.02338638]]
----------
The new_sample are:
{'center': array([[0.47220956, 0.08996154, 0.34309353, 0.7108189 , 0.87729532],
       [0.21277737, 0.28654373, 0.65889663, 0.08558968, 0.3395733 ],
       [0.21982291, 0.86548989, 0.12846325, 0.48870338, 0.40524735],
       [0.94705222, 0.89375568, 0.72372409, 0.51160248, 0.86404072],
       [0.13974162, 0.56198293, 0.43946376, 0.97918662, 0.47427918]]), 'num_sample': array([3, 1, 4, 9, 7])}
GT is:
[[0.15740319 0.02998718 0.11436451 0.23693963 0.29243177]
 [0.21277737 0.28654373 0.65889663 0.08558968 0.3395733 ]
 [0.05495573 0.21637247 0.03211581 0.12217585 0.10131184]
 [0.10522802 0.09930619 0.08041379 0.05684472 0.09600452]
 [0.01996309 0.08028328 0.06278054 0.1398838  0.06775417]]
Your answer is:
[[0.15740319 0.02998718 0.11436451 0.23693963 0.29243177]
 [0.21277737 0.28654373 0.65889663 0.08558968 0.3395733 ]
 [0.05495573 0.21637247 0.03211581 0.12217585 0.10131184]
 [0.10522802 0.09930619 0.08041379 0.05684472 0.09600452]
 [0.01996309 0.08028328 0.06278054 0.1398838  0.06775417]]
----------
The new_sample are:
{'center': array([[0.17306511, 0.67623607, 0.36062753, 0.63656834, 0.0737309 ],
       [0.27722127, 0.73088824, 0.87972535, 0.47921859, 0.45542582],
       [0.98755643, 0.64822426, 0.86326686, 0.55630947, 0.89114596],
       [0.77942456, 0.17245619, 0.68953576, 0.01613403, 0.06174909],
       [0.65570069, 0.28635795, 0.52704795, 0.13073025, 0.36918652]]), 'num_sample': array([4, 4, 7, 1, 3])}
GT is:
[[0.04326628 0.16905902 0.09015688 0.15914209 0.01843272]
 [0.06930532 0.18272206 0.21993134 0.11980465 0.11385646]
 [0.14107949 0.09260347 0.12332384 0.07947278 0.12730657]
 [0.77942456 0.17245619 0.68953576 0.01613403 0.06174909]
 [0.2185669  0.09545265 0.17568265 0.04357675 0.12306217]]
Your answer is:
[[0.04326628 0.16905902 0.09015688 0.15914209 0.01843272]
 [0.06930532 0.18272206 0.21993134 0.11980465 0.11385646]
 [0.14107949 0.09260347 0.12332384 0.07947278 0.12730657]
 [0.77942456 0.17245619 0.68953576 0.01613403 0.06174909]
 [0.2185669  0.09545265 0.17568265 0.04357675 0.12306217]]
```

Submitted Files

Mykmeans.py

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```
# Implementation of KMEANS
# import libraries
import numpy
import numpy as np


class Kmeans:
    def __init__(self,k=8):
        self.num_cluster = k  # Placeholders for the number of clusters
        self.center = None    # Placeholders for the postion of all k centers
        self.cluster_label = np.zeros([k])  # Placeholders for the labels of all the cluster, you don't need to create it, just access it, the shape is (k,)
        self.error_history = []  # the reconstruction error history during the training, you don't need to handle this

    # the fit function does 2 things: (1) find the optimized k-means cluster centers (2) assign label for each cluster
    # Input:
    #   X: training data, (n, d)
    #   y: training_labels, (n, )
    # Output:
    #   num_iter: number of iterations, scaler
    #   error_history: a list of reconstruction errors, list
    def fit(self, X, y):
        # initialization with pre-defined centers
        dataIndex = np.array([1, 200, 500, 1000, 1001, 1500, 2000, 2005])
        self.center = initCenters(X, dataIndex[:self.num_cluster])

        # reset num_iter
        num_iter = 0

        # initialize the cluster assignment
        # cluster assignment are like follows: if there are 10 data, and 3 centers indexed by 0,1,2
        # the cluster assignment [0,0,0,0,0,1,2,1,2,2] means you assign the first 5 points to cluster 0,
        # point 6,8 to cluster 1, rest to cluster 2
        prev_cluster_assignment = np.zeros([len(X),]).astype('int')
        cluster_assignment = np.zeros([len(X),]).astype('int')
        is_converged = False  # Flag to check whether the center stops updating

        # main-loop for kmeans update
        while not is_converged:
            # using additional space to reduce time complexity
            # For instance, assuming you have X = [1,2,3,4,5,5,5,7,8], and expect to have 2 centers, new_center['center'] = [[0], [0]] at first
            # during iteration, for each data assessed, you can add the point postion to corresponding center, if you assign x[0],x[1] to cluster 0, new_center['center'] = [[1+2], [0]]
            # and new_center['num_sample'] = [2, 0]. Until finished, you can directly compute the updated center by dividing new_center['center'] with its corresponding count new_center['num_sample']
```

```
43            new_center = dict()
44            new_center['center'] = np.zeros(self.center.shape)  # to save time, this variable can store the summation of point positions that are assigned to the same cluster (k,d)
45            new_center['num_sample'] = np.zeros(self.num_cluster)  # this variable stores the number of points that have being assinged for each cluster (k, )
46
47            # iterate through the samples and compute their cluster assignment (E step)
48            for i in range(len(X)):
49                # compute the euclidean distance between sample and centers
50                distances = computeDis(X[i], self.center)
51                cur_cluster = assignCen(distances)
52                cluster_assignment[i] = cur_cluster
53                new_center['center'][cur_cluster] += X[i]
54                new_center['num_sample'][cur_cluster] += 1
55
56            # update the centers based on cluster assignment (M step)
57            self.center = updateCen(new_center)
58
59            # compute the reconstruction error for the current iteration
60            cur_error = computeError(X, cluster_assignment, self.center)
61            self.error_history.append(cur_error)
62
63            # reach convergence if the assignment does not change anymore
64            is_converged = True if (cluster_assignment==prev_cluster_assignment).sum() == len(X) else False
65            prev_cluster_assignment = np.copy(cluster_assignment)
66            num_iter += 1
67            print('Iteration is', num_iter)
68
69
70        # compute the class label of each cluster based on majority voting
71        contingency_matrix = np.zeros([self.num_cluster,3])
72        label2idx = {0:0,8:1,9:2}
73        idx2label = {0:0,1:8,2:9}
74        for i in range(len(cluster_assignment)):
75            contingency_matrix[cluster_assignment[i],label2idx[y[i]]] += 1
76        cluster_label = np.argmax(contingency_matrix,-1)
77        for i in range(self.num_cluster):
78            self.cluster_label[i] = idx2label[cluster_label[i]]
79
80        return num_iter, self.error_history
81
82    def predict(self,X):
83        # predicting the labels of test samples based on their clustering results
84        prediction = np.ones([len(X),])  # placeholder
85
86        # print('self: centers[0] is:', self.center[0])
87        # iterate through the test samples
88        for i in range(len(X)):
89
90            # (1) find the cluster of each sample
91            # (2) get the label of the cluster as predicted label for that data
```

```
92            distances = computeDis(X[i], self.center)
93            # print('distances', distances)
94            prediction[i] = self.cluster_label[ assignCen(distances) ]
95            # print('prediction[i]', prediction[i])
96            # if i >= 10:
97            #     exit('finish test');
98
99        return prediction
100
101    def params(self):
102        return self.center
103
104
105 # ----------------------------------------------------------
106 # You are going to implement the following helper functions
107 # ----------------------------------------------------------
108
109 # init K data centers specified by the dataIndex
110 # For example, if X = [1,2,3,4,8,10,8,8], dataIndex = [0,4,5] => centers = [1, 8, 10]
111 # Input:
112 #   X: training data, (n, d)
113 #   dataIndex: list of center index, (k, )
114 # Output:
115 #   centers: (k, d)
116 def initCenters(X, dataIndex):
117     centers = np.zeros([len(dataIndex), X.shape[1]])  # placeholders of centers, can be ignored or
    removed
118
119     # assign the position of specified points as the centers
120     for i in range(len(dataIndex)):
121         centers[i] = X[dataIndex[i]]
122
123     return centers
124
125
126 # compute the euclidean distance between x to all the centers
127 # input:
128 #   x: single data, (1, d) or (d, )
129 #   centers:   k center position, (k, d)
130 # Output:
131 #   dis: k distances, k
132 def computeDis(x, centers):
133     dis = np.zeros(len(centers))  # placeholders of distances to all centers, can be ignored or removed
134
135     # ---------- fill your code ----------
136     for i in range(len(centers)):
137         dis[i] = np.linalg.norm((x - centers[i]))
138
139     return dis
140
141
142 # compute the index of closest cluster for assignment
```

```
143 # input:
144 #   distances:  k distances denote the distance between x and k centers
145 # Output
146 #   centers:  1
147 def assignCen(distances):
148 
149     # get the index of min distance
150     assignment = np.where(distances == np.min(distances))
151 
152     return assignment[0]
153 
154 
155 # compute center by dividing the sum of points with the corresponding count
156 # input:
157 #   new_center:  dict, structure specified in the previous comments line 38-41
158 # Output
159 #   centers:   k center position, (k, d)
160 def updateCen(new_center):
161     centers = np.zeros_like(new_center['center'])  # placeholders of centers, can be ignored or
    removed
162 
163     # ---------------- fill your code ----------------------
164     # get the postion of each center by division between the
165     # sum of points at one center and their corresponding count
166     for i in range(len(new_center['center'])):
167         centers[i] = new_center['center'][i] / new_center['num_sample'][i]
168 
169     return centers
170 
171 
172 # compute reconstruction error, assume data X = [1,2,5,7] has assignment [0,0,1,1], and the center
    positions are [1.5, 6].
173 # the reconstruction error is (1-1.5)^2+(2-1.5)^2+(5-6)^2+(7-6)^2
174 def computeError(X, assign, centers):
175     error = 0   # placeholders of errors, can be ignored or removed
176 
177     for i in range( len(assign) ):
178 
179         centersX = X[i] - centers[assign[i]]
180         error += np.dot( centersX, numpy.transpose(centersX) )
181 
182     return error
183 
```

MyPCA.py

Download

```python
# Implementation of PCA
# import libraries
import numpy as np


class PCA():
    def __init__(self, percent=0.9, num_dim=None):
        self.num_dim = num_dim  # the number of dimensions to keep, if None, we will refer to the percenage of variance to determine
        self.percent = percent  # placeholders to store the percentage of variance
        self.mean = None  # store the means of training data for normalizing purpose
        self.W = None  # placeholder of projection matrix

    def fit(self,X):
        # normalize the data to make it centered at zero
        self.mean = X.mean(0).reshape(1,-1)  # get the mean
        X = centerData(X, self.mean)

        # finding the projection matrix that maximize the variance (Hint: for eigen computation, use numpy.eigh instead of numpy.eig)
        eig_val, eig_vec = computeE(X)

        # if we do not specify the num_dim, we will compute the num_dim based on the pertange of cov
        if self.num_dim is None:
            # select the reduced dimension that keep >90% of the variance
            self.num_dim = computeDim(eig_val, self.percent)

        # determine the projection matrix and store it as class attribute
        self.W = eig_vec[:,:self.num_dim]

        # project the high-dimensional data to low-dimensional one
        X_pca = project(X, self.W)

        return X_pca, self.num_dim

    def predict(self, X):
        # normalize the test data based on training statistics
        X = centerData(X, self.mean)
        # project the test data
        X_pca = project(X, self.W)
        return X_pca

    def params(self):
        return self.W, self.mean, self.num_dim


# --------------------------------------------------------
# You are going to implement the following helper functions
```

```
47  # ------------------------------------------------------------
48
49
50  # center the data based on the computed mean
51  # Input:
52  #   X: data, (n,d)
53  #   mean: precomuted mean (1, d)
54  # Output:
55  #   centered_X: (n,d)
56  def centerData(X, mean):
57
58      centered_X = np.zeros_like(X)  # placeholder, can be ignored
59
60      centered_X = X - mean;
61
62      return centered_X
63
64
65  # compute eigen vectors and eigen values
66  # Input:
67  #   centered_X: data, (n,d)
68  # Output:
69  #   eig_val: eigenvectors, (d,p)
70  #   eig_vec: eigenvalues, (p,) p is the number of eigenvectors
71  def computeE(centered_X):
72      # placeholders, can be ignored
73      eig_val = 0
74      eig_vec = np.zeros([centered_X.shape[1]])
75
76      # (1) get the covariance matrix
77      covMatrix = np.cov(centered_X, rowvar=False)
78
79      # (2) eigen decomposation of cov, can use np.linalg.eigh(),
80      # please note the output vals and corresponding vectors are in ascending order, and the shape
    of vectors are (d, p)
81      eig_val, eig_vec = np.linalg.eigh(covMatrix)
82
83      # (3) reverse the order of eig_val and eig_vec to make it in descending order
84      idx = eig_val.argsort()[::-1]
85      eig_val = eig_val[idx]
86      eig_vec = eig_vec[:,idx]
87
88      return eig_val, eig_vec
89
90
91  # compute number of dimensions
92  # Input:
93  #   eig_val: eigenvalues (p, )
94  #   percent: scaler
95  # Output:
96  #   num_dim: number of dimensions to keep, scaler
97  def computeDim(eig_val, percent):
```

```
    num_dim = 0     # placeholders
    value_sum = 0
    tuple_sum = sum(eig_val)

    # ---------- fill your code ----------
    # iterate to add eigen values, until reach the percentage to keep
    # e.g. if eig_val = [0.1, 0.1, 0.3, 0.1, 0.1, 0.3], to keep percent>0.5, num_dim = 4,
    # because (0.1+0.1+0.3) / sum(eig_val) = 0.5 is no bigger than 0.5, while (0.1+0.1+0.3+0.1) /
sum(eig_val) > 0.5
    for num_dim in range(len(eig_val)):
        value_sum += eig_val[num_dim]
        if (value_sum / tuple_sum) >= percent:
            break

    num_dim += 1

    return num_dim


#  project the data to lower dimensions
# Input:
#   X: centered data (n,d)
#   W: projection matrix (d, p)
# Output:
#   X_pca: projected data (n, p)
def project(X, w):
    X_pca = np.zeros([X.shape[0], w.shape[1]])  # placeholders

    X_pca = np.dot(X, w)

    return X_pca

```