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Assignment 4 – CS 271

Professor Mark Stamp

a. 2A =

**[[ 2 0 -4]**

**[-4 6 2]]**

b. B +C =

**[[ 4 1]**

**[ 1 -5]**

**[ 5 0]]**

c. A+B is **undefined** because A 2x3 and B is 3x2. To add matrix with another matrix we need nxm = sxt

d. AB =

**[[-5 -3]**

**[ 7 -3]]**

e. BA =

**[[ 3 -3 -3]**

**[ 6 -6 -6]**

**[ 1 3 -5]]**

f. BC is **undefined** because B 3x2 and C is 3x2.

To get product of 2 matrices we need m = s where B nxm = C sxt

4.

a./

**[[2.5 2.5 4. ]**

**[2.5 5. 4.5]**

**[4. 4.5 6.5]]**

b./

Eigenvalues of C =

**[12.499999999999984, 1.5000000000000004]**

c./

**[-0.42426407 -0.80829038 0.40824829]**

**[-0.70710678 0.57735027 0.40824829]**

Text, letter

Description automatically generatedText, letter

Description automatically generated

11.a

B matrix =

**[[ 2. -2. -1. 3.]**

**[-1. 3. 3. -1.]**

**[ 0. 2. 3. 0.]**

**[ 1. 3. 1. 3.]**

**[ 1. 0. -1. 2.]**

**[-3. 2. 4. -1.]**

**[ 5. -1. 5. 3.]**

**[ 2. 1. 2. 0.]]**

**[[ 1.5 -2.5 -1.5 2.5 ]**

**[-2. 2. 2. -2. ]**

**[-1.25 0.75 1.75 -1.25]**

**[-1. 1. -1. 1. ]**

**[ 0.5 -0.5 -1.5 1.5 ]**

**[-3.5 1.5 3.5 -1.5 ]**

**[ 2. -4. 2. 0. ]**

**[ 0.75 -0.25 0.75 -1.25]]**

rowmean [0.5, 1.0, 1.25, 2.0, 0.5, 0.5, 3.0, 1.25]

B matrix after mean = 0

[[ 1.5 -2.5 -1.5 2.5 ]

[-2. 2. 2. -2. ]

[-1.25 0.75 1.75 -1.25]

[-1. 1. -1. 1. ]

[ 0.5 -0.5 -1.5 1.5 ]

[-3.5 1.5 3.5 -1.5 ]

[ 2. -4. 2. 0. ]

[ 0.75 -0.25 0.75 -1.25]]

Covariance matrix =

**[[ 2.12 -2. -1.19 0. 1. -2.25 1.25 -0.31]**

**[-2. 2. 1.25 0. -1. 2.5 -1. 0.25]**

**[-1.19 1.25 0.84 -0.12 -0.69 1.69 -0.25 0.22]**

**[ 0. 0. -0.12 0.5 0.25 0. -1. -0.38]**

**[ 1. -1. -0.69 0.25 0.62 -1.25 0. -0.31]**

**[-2.25 2.5 1.69 0. -1.25 3.62 -0.75 0.19]**

**[ 1.25 -1. -0.25 -1. 0. -0.75 3. 0.5 ]**

**[-0.31 0.25 0.22 -0.38 -0.31 0.19 0.5 0.34]]**

Eigenvalues of C =

[ 8.99 0. 0.74 3.33 -0. -0. 0. 0. ]

Eigenvector of C =

[[ 0.47 -0.74 -0.48 -0.04 0.56 0.56 -0.27 -0.27]

[-0.47 -0.36 0.11 -0.04 0.08 0.08 -0.12 -0.12]

[-0.29 -0.15 -0.04 -0.15 0.04 0.04 -0.22 -0.22]

[-0.02 0.19 -0.33 0.35 -0.37 -0.37 0.6 0.6 ]

[ 0.23 0.28 -0.22 0.2 0.08 0.08 -0.31 -0.31]

[-0.6 0.03 -0.61 -0.21 0.2 0.2 -0.04 -0.04]

[ 0.26 0.3 -0.14 -0.84 -0.36 -0.36 0.24 0.24]

[-0.04 -0.31 0.45 -0.23 0.51 0.51 0.02 0.02]]

U :

[[-0.47 -0.04 0.48 -0.69 -0.2 0.17 -0.04 0.01]

[ 0.47 -0.04 -0.11 -0.57 0.05 -0.65 0.11 0.04]

[ 0.29 -0.15 0.04 -0.19 0.36 0.41 0.26 -0.7 ]

[ 0.02 0.35 0.33 0.17 -0.13 -0.07 0.84 0.1 ]

[-0.23 0.2 0.22 0.01 0.89 -0.15 -0.07 0.21]

[ 0.6 -0.21 0.61 0.11 -0.02 0.23 -0.21 0.34]

[-0.26 -0.84 0.14 0.21 0.06 -0.3 0.25 -0.03]

[ 0.04 -0.23 -0.45 -0.27 0.14 0.46 0.32 0.58]]

S :

[8.48 5.16 2.44 0. ]

V :

[[-0.56 0.52 0.48 -0.44]

[-0.22 0.63 -0.69 0.28]

[-0.63 -0.29 0.22 0.69]

[-0.5 -0.5 -0.5 -0.5 ]]

The 3 most significant eigenvector of C is :

**[[-4.71 4.38 4.07 -3.74]**

**[-1.16 3.27 -3.54 1.44]**

**[-1.53 -0.7 0.54 1.69]**

[-0. 0. -0. 0. ]

[ 0. 0. -0. 0. ]]

11.b

UVector choose:

[[-0.465 0.47 0.291 0.018 -0.226 0.597 -0.262 0.043]

[-0.037 -0.042 -0.154 0.353 0.197 -0.211 -0.844 -0.231]

[ 0.483 -0.109 0.036 0.332 0.22 0.611 0.138 -0.449]]

Scoring phrase:

Y~:

[ 0.5 4. -0.25 3. 4.5 0.5 -2. 1.75]

W =

[1.508 2.98 1.027]

[7.895164247569233, 3.36654399883552, 7.023789468377841, 5.507596435478498]

Emin = **3.36654399883552**

Scoring phrase:

Y~:

[-2.5 2. 0.75 1. -0.5 1.5 -4. -0.25]

W =

[ 4.384 3.266 -0.7 ]

[10.148891565092217, 1.1102230246251565e-16, 6.92820323027551, 8.660254037844386]

Emin = **1.1102230246251565e-16**

Scoring phrase:

Y~:

[ 1.5 -4. 0.75 1. -0.5 -0.5 -1. -2.25]

W =

[-2.361 1.718 1.976]

[5.1044628445923825, 7.4199421110830865, 8.429444876848308, 1.4337157779086354]

Emin = **1.4337157779086354**

Scoring phrase:

Y~:

[ 1.5 -3. 0.75 0. -1.5 0.5 -1. 0.75]

W =

[-0.958 0.223 0.578]

[4.519521770919681, 6.279018795784652, 6.279018795784655, 3.228943641164548]

Emin = **3.228943641164548**

**13.**

question 13.a

B matrix =

[[ 1. -2. 1. 2.]

[-1. 2. 3. 3.]

[ 1. 2. 0. 1.]

[-1. -1. 1. 1.]

[-1. -2. 3. -2.]

[ 1. 2. 1. 0.]]

B matrix after mean = 0

[[-0.75 -3.75 -0.75 0.25]

[-2.75 0.25 1.25 1.25]

[-0.25 0.75 -1.25 -0.25]

[-3. -3. -1. -1. ]

[-3. -4. 1. -4. ]

[ 0. 1. 0. -1. ]]

Covariance matrix =

[[ 2.54 0.08 -0.29 2.33 2.58 -0.67]

[ 0.08 1.79 -0.17 0.83 0.58 -0.17]

[-0.29 -0.17 0.38 0. -0.42 0.17]

[ 2.33 0.83 0. 3.33 4. -0.33]

[ 2.58 0.58 -0.42 4. 7. 0. ]

[-0.67 -0.17 0.17 -0.33 0. 0.33]]

deltaScoreMatrix 13A :

**[[-1.56 -0.82 1.99 -0.5 ]**

**[-1.15 -2.51 0.39 0.81]]**

13b

B1 matrix =

[[-1. -2. -1. 0.]

[ 2. 1. 3. 2.]

[ 1. 2. 0. 3.]

[ 2. 3. 1. 1.]

[-1. 2. 3. 1.]

[ 0. 1. -1. -2.]]

B1 matrix after mean = 0

[[-2.75 -3.75 -2.75 -1.75]

[ 0.25 -0.75 1.25 0.25]

[-0.25 0.75 -1.25 1.75]

[ 0. 1. -1. -1. ]

[-3. 0. 1. -1. ]

[-1. 0. -2. -3. ]]

Covariance matrix =

[[ 5.38 -0.29 -0.29 0.12 1.21 2.25]

[-0.29 0.38 -0.29 -0.38 0.04 -0.58]

[-0.29 -0.29 0.88 0.04 -0.38 -0.42]

[ 0.12 -0.38 0.04 0.5 0. 0.83]

[ 1.21 0.04 -0.38 0. 1.83 0.67]

[ 2.25 -0.58 -0.42 0.83 0.67 2.33]]

deltaScoreMatrix 13B:

**[[-1.7 -1.82 1.51 -0.74]**

**[ 0.26 -1.17 0.48 -1.22]]**

Y1

Score from 13a:

0.8799097965132561

Score from 13b:

0.7951786277309016

**Benign**

Y2

Score from 13a:

0.22640558738688443

Score from 13b:

0.44946056556721437

**Malware**

Y3

Score from 13a:

3.3048021499024713

Score from 13b:

2.9987218693970266

**Benign**

Y4

Score from 13a:

2.421184489046632

Score from 13b:

2.1755883801859213

**Benign**

17.

U1: [0.164 0.628 0.26 0.539 0.464 0.075] U2: [0.244 0.107 0.802 0.428 0.137 0.29 ]

**a) Vector u1 has the greatest positive impact on the projection space is 0.6278 at index 2**

**a) Vector u2 has the greatest negative impact on the projection space is 0.8017 at index 3**

17.b

**L1 = [ 0.332 1.269 -0.526 -1.089 0.937 0.152]**

**L2 = [ 0.272 0.119 -0.891 0.476 -0.153 -0.323]**

**L3 = [-0.061 0.253 0.341 0.296 0.314 -0.61 ]**

L1^2 + L2^2 = [0.184 1.624 1.072 1.412 0.901 0.127]

L2^2 + L3^2 = [0.078 0.078 0.911 0.314 0.122 0.477]

L1^2 + L3^2 = [0.114 1.673 0.393 1.274 0.977 0.396]

17.c

[0.184 1.624 1.072 1.412 0.901 0.127]

L1^2 + L2^2 = [0.184 1.624 1.072 1.412 0.901 0.127]

**The most important feature is at index 2 with value 1.6235181691720009**

**The less important feature is at index 6 with value 0.12735950745599997**

REFERENCES

1. M. Stamp, “Introduction to Machine Learning with Applications in Information Security.”
2. Steven A.Cohen and Matthew W.Granade, “Models will run the world”