CSC311 Assignment 1: Printed Output

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Question 1

Question 1(a):

```
[[0.5507979  0.70814782 0.29090474 0.51082761 0.89294695]
 [0.89629309 0.12558531 0.20724288 0.0514672  0.44080984]
 [0.02987621 0.45683322 0.64914405 0.27848728 0.6762549 ]
 [0.59086282 0.02398188 0.55885409 0.25925245 0.4151012 ]]
```

Question 1(b):

```
[[0.28352508]
 [0.69313792]
 [0.44045372]
 [0.15686774]]
```

Question 1(d):

```
[[ 0.26727282  0.42462274  0.00737966  0.22730252  0.60942187]
 [ 0.20315517 -0.56755261 -0.48589504 -0.64167072 -0.25232807]
 [-0.41057751  0.01637951  0.20869033 -0.16196644  0.23580118]
 [ 0.43399508 -0.13288586  0.40198635  0.10238471  0.25823346]]
```

Question 1(e):

```
[0.28352508 0.69313792 0.44045372 0.15686774]
```

Question 1(f):

[[0.5507979 0.70814782 0.29090474 0.28352508 0.89294695]
 [0.89629309 0.12558531 0.20724288 0.69313792 0.44080984]
 [0.02987621 0.45683322 0.64914405 0.44045372 0.6762549]
 [0.59086282 0.02398188 0.55885409 0.15686774 0.4151012]]

Question 1(g):

[[0.57442982 0.42462274 0.00737966 0.22730252 0.60942187]
 [0.9003808 -0.56755261 -0.48589504 -0.64167072 -0.25232807]
 [1.08959777 0.01637951 0.20869033 -0.16196644 0.23580118]
 [0.71572183 -0.13288586 0.40198635 0.10238471 0.25823346]]

Question 1(h):

[[0.5507979 0.70814782 0.29090474 0.28352508 0.89294695]
 [0.89629309 0.12558531 0.20724288 0.69313792 0.44080984]
 [0.02987621 0.45683322 0.64914405 0.44045372 0.6762549]]

Question 1(i):

[[0.70814782 0.28352508]
 [0.12558531 0.69313792]
 [0.45683322 0.44045372]
 [0.02398188 0.15686774]]

Question 1(j):

[[-0.59638732 -0.34510242 -1.23475942 -1.26045469 -0.1132281]
 [-0.10948781 -2.07476999 -1.57386385 -0.36652628 -0.81914169]
 [-3.51069274 -0.78343689 -0.43210063 -0.81994991 -0.3911852]
 [-0.52617141 -3.73045663 -0.58186686 -1.85235226 -0.87923294]]

Question 1(k):

9.087621365532033

Question 1(l):

[0.89629309 0.70814782 0.64914405 0.69313792 0.89294695]

Question 1(m):

2.7263225002245983

Question 1(n):

[[1.57884629 -0.35284012 -0.187686 -0.3942709 0.26913377]
[1.03478465 0.23371525 0.04918167 0.0088431 0.51378681]
[1.46099184 -0.05772761 0.26157029 -0.11477974 0.42237427]
[1.37914438 -0.28663212 -0.17972284 -0.4355982 0.14225624]
[1.94377489 0.08489845 0.1003952 -0.14691625 0.69960743]]

Question 1(o):

[[2.22648013]]

Question 2

Question 2(c):

Execution time of matrix_poly for a 100x100 matrix is: 1.5412499904632568

Execution time of vectorized code for a 100x100 matrix is: 0.0

Magnitude of the difference matrix for a 100x100 matrix is: 1.4535030042104203e-11

Execution time of matrix_poly for a 300x300 matrix is: 41.37988829612732

Execution time of vectorized code for a 300x300 matrix is: 0.0029799938201904297

Magnitude of the difference matrix for a 300x300 matrix is: 1.7369472572107675e-09

Execution time of matrix_poly for a 1000x1000 matrix is: 1727.2512502670288

Execution time of vectorized code for a 1000x1000 matrix is: 0.08295273780822754

Magnitude of the difference matrix for a 1000x1000 matrix is: 8.023592818062752e-05

Question 3

Question 3(d):

Values of (a, b) for fitted line from training data: (3.129414619191207, 4.719354385844762)

Values of (a, b) for fitted line from testing data: (3.3117407058745165, 4.687131059314431)

Training error: 0.8557483910540564

Test error: 0.9278738305069357

Question 4

Question 4 (a):

Value of the weight vector: [0.01694442 1.49601981 0.03738886]

Value of the bias term: -2.6250489555396475

Question 4 (b):

accuracy 1 (using score) is: 0.856

accuracy 2 (using weight vector and bias term) is: 0.856

The difference of accuracy1 and accuracy2: 0.0

Question 5

Question 5(e):

The final weight vector is: [-0.00332769 0.16186767 -0.0019816]

The final bias term is: 0.2702639362894349

Number of iterations performed: 101

The learning rate is: 0.1

Weight vector of Question 4 is: [0.01694442 1.49601981 0.03738886]

Bias term of Question 4 is: -2.6250489555396475

Question 6

Question 6(c)i:

Validation Accuracy for 5 & 6: [0.9899736147757255, 0.9905013192612138, 0.9905013192612138, 0.9899736147757255, 0.9905013192612138, 0.9894459102902374, 0.9894459102902374, 0.9889182058047493, 0.9889182058047493, 0.9883905013192612]

Testing Accuracy for 5 & 6: [1.0, 0.9975, 0.996, 0.9955, 0.9955, 0.9935, 0.9935, 0.993, 0.993, 0.993]

Question 6(c)iii:

Best value of K for digits 5 & 6: 3

Validation accuracy for digits 5 & 6 at k=3 is: 0.9905013192612138

Test accuracy at for digits 5 & 6 at k=3 is: 0.9929729729729729

Question 6(d):

Question 6(d-c)i:

Validation Accuracy for digits 4 & 7: [0.9961593855016803, 0.9971195391262602, 0.9971195391262602, 0.9971195391262602, 0.9975996159385502,

0.9975996159385502, 0.9971195391262602, 0.9966394623139703, 0.9966394623139703, 0.9961593855016803]

Testing Accuracy for digits 4 & 7: [1.0, 0.9995, 0.998, 0.998, 0.9975, 0.9975, 0.9975, 0.996, 0.996, 0.996]

Question 6(d-c)iii:

Best value of K for digits 4 & 7: 9

Validation accuracy for digits 4 & 7 at k=9 is: 0.9975996159385502

Test accuracy for digits 4 & 7 at k=9 is: 0.9965174129353234