HW3: Problem 1

Ian Dover

1 Part 1

1.1 Subsection A

Here is the calculation for the first outer product: [[0.43226352 0.25222353 0.48671532]
[0.10984608 0.06409462 0.12368328]
[0.42953904 0.25063381 0.48364764]].

1.2 Subsection B

The first term for the Kruskal tensor is: [[7.53169304 8.36104576]
[6.95335795 7.71902727]
[6.47565559 7.1887227]
[4.39470396 4.87862699]
[4.05724843 4.50401252]
[3.77851157 4.19458254]
[8.48045282 9.41427827]
[7.82926544 8.69138536]
[7.29138739 8.09427885]
[1.91394119 2.12469491]
[1.76697565 1.96154625]
[1.64558273 1.82678614]
[1.11677479 1.2397485]
[1.03102116 1.1445521]
[0.96018902 1.06592027]
[2.15503843 2.39234059]
[1.98955979 2.20864026]
[1.85287512 2.05690455]
[7.48422212 8.30834757]
[6.90953217 7.67037562]
[6.43484068 7.14341346]
[4.36700493 4.84787787]
[4.03167631 4.47562453]
[3.75469628 4.16814484]
[8.42700203 9.35494175]
[7.77991897 8.6366051]
[7.24543108 8.04326205]].

The second term for the Kruskal tensor is: [[-2.55595915 -3.45550892]
[-2.5740198 -3.47992588]
[-0.99973259 -1.35158063]
[-0.82170374 -1.11089593]
[-0.82750998 -1.11874563]
[-0.32139951 -0.43451354]
[-1.61396023 -2.18198087]
[-1.62536463 -2.19739896]
[-0.63128107 -0.8534555]
[4.33091368 5.85514478]
[4.36151634 5.8965178]
[1.69398464 2.29016924]
[1.39232585 1.88234401]
[1.40216416 1.89564483]
[0.54459146 0.73625615]

[2.73475515 3.69723077]
[2.7540792 3.72335577]
[1.06966649 1.44612721]
[-3.54806272 -4.79677556]
[-3.57313368 -4.83067005]
[-1.38778193 -1.87620089]
[-1.14065063 -1.54209368]
[-1.14871058 -1.55299026]
[-0.44615173 -0.60317134]
[-2.24042397 -3.02892361]
[-2.25625502 -3.05032627]
[-0.87631481 -1.18472693]].

Here is the calculation for the Kruskal tensor: [[4.97573389 4.90553684]
[4.37933814 4.23910139]
[5.475923 5.83714207]
[3.57300022 3.76773106]
[3.22973844 3.38526689]
[3.45711206 3.760069]
[6.86649259 7.23229739]
[6.20390081 6.4939864]
[6.66010632 7.24082335]
[6.24485487 7.97983969]
[6.12849198 7.85806405]
[3.33956736 4.11695539]
[2.50910064 3.12209251]
[2.43318532 3.04019693]
[1.50478047 1.80217642]
[4.88979358 6.08957136]
[4.74363899 5.93199602]
[2.92254161 3.50303177]
[3.9361594 3.51157201]
[3.33639849 2.83970557]
[5.04705875 5.26721256]
[3.22635429 3.3057842]
[2.88296573 2.92263427]
[3.30854455 3.5649735]
[6.18657807 6.32601814]
[5.52366395 5.58627883]
[6.36911627 6.85853512]].

2 Part 2

Here is the calculation for the Tucker tensor: [[[[5.10100643 5.80186261]
[4.99129859 5.53890968]
[4.80561947 5.4454022]]

[[3.48145003 3.44117511]
[2.84300047 3.59675864]
[3.19627907 3.27594982]]

[[8.4494077 5.746398]
[4.06876905 7.8071309]
[7.33749349 5.73753646]]]

[[[3.33961221 6.57606924]
[6.5368703 0.73014512]
[3.63097401 5.34938374]]

[[2.38667868 3.61945962]
[3.38294471 1.82517912]
[2.40381302 3.1553465]]

[[6.33187165 4.42028174]
[2.79251954 11.09517187]
[5.4605745 5.16818593]]]

[[[3.30654779 6.59527835]
[6.57138663 0.6350008]
[3.60973992 5.35058505]]

[[2.3663087 3.62510679]
[3.39564197 1.79103195]
[2.38946098 3.15478383]]

[[6.2934687 4.39649616]
[2.7687788 11.16696751]
[5.42644706 5.15987497]]]].

3 Part 3

In CP decomposition, the tensor is decomposed into a series of rank-1 tensors whereas in Tucker decompositon, the tensor is decomposed into a core tensor and factor matrices. CP decomposition is capable of representing any non-negative tensor
to any desired accuracy; however, Tucker decomposition is only capable of representing tensors that have a lower rank structure.
Finally, CP decomposition is less computationally intensive than Tucker decomposition.The mean-square error for Tucker decomposition is: 2.6217621054926816.

The mean-square error for CP decomposition is: 3.19421561560853