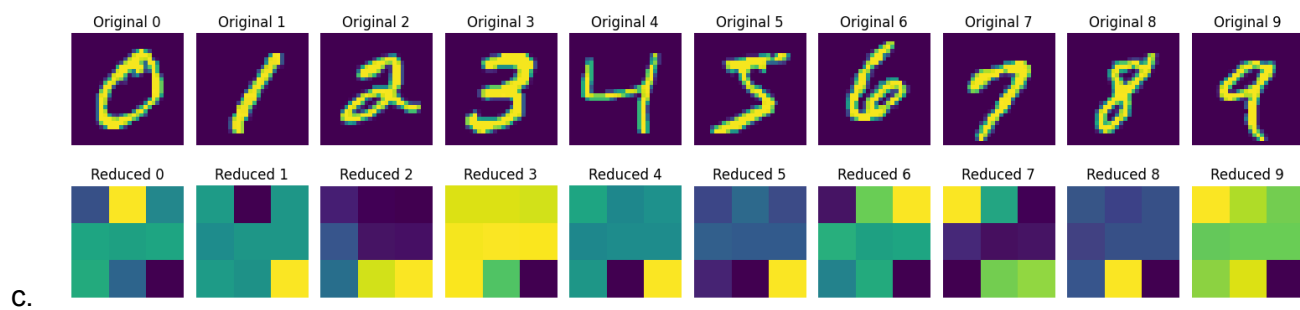


1

1.1

a. (Notebook)

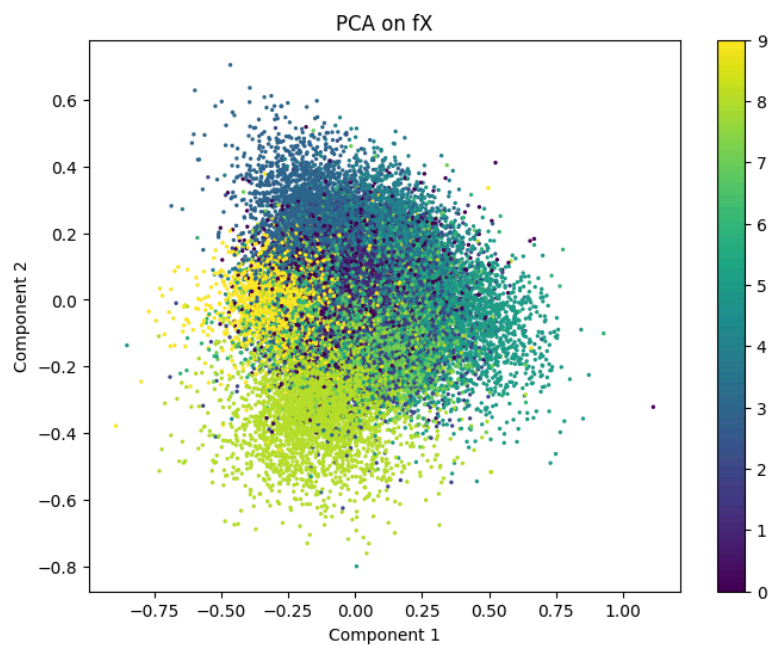
b. (Notebook)



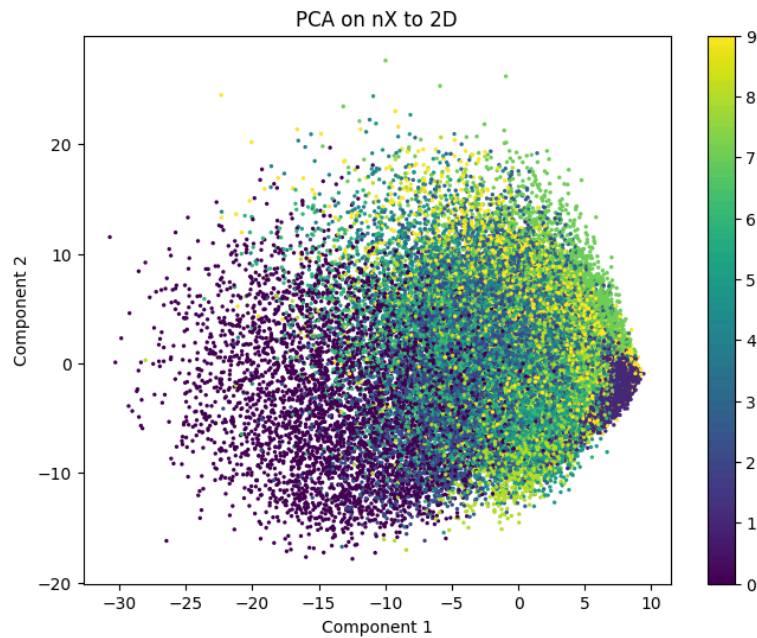
1.2

4. (Notebook)

5. Error Rate: 0.62378



6. Error Rate: 0.90316055

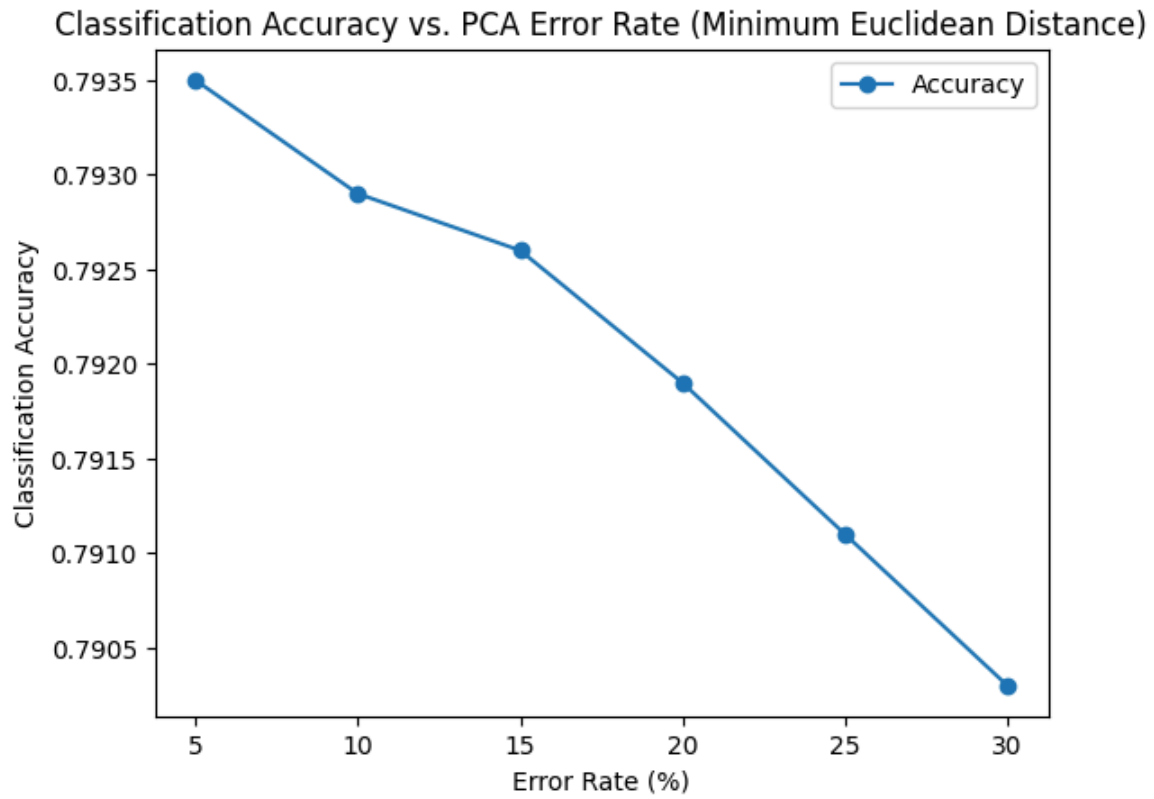


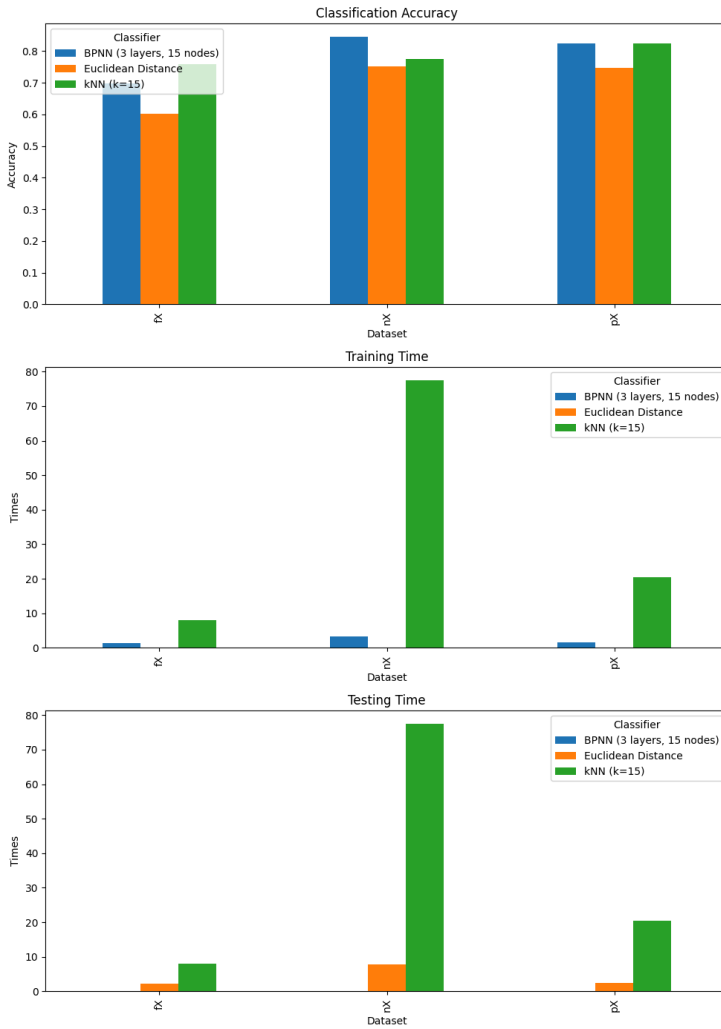
7. In FLD+PCA, we can see better class separability as classes appear more distinct, enabling clustering. With PCA alone, there is more overlap between classes, as PCA maximizes variance globally, not for each class. This highlights how reduction like FLD+PCA can improve visualization or separability over methods like PCA by itself.

8. Dimension for 10% Error Rate: 235

1.3

9.





Classification Performance:

	Classifier	Dataset	Accuracy	Train Time	Test Time
0	Euclidean Distance	nX	0.755420	0.014987	7.699192
1	Euclidean Distance	fX	0.870971	0.003245	4.171664
2	Euclidean Distance	pX	0.750232	0.002201	3.473627
3	kNN (k=15)	nX	0.779551	362.254604	362.254604
4	kNN (k=15)	fX	0.875449	39.782191	39.782191
5	kNN (k=15)	pX	0.829058	57.896135	57.896135
6	BPNN (3 layers, 15 nodes)	nX	0.838667	4.547128	0.630827
7	BPNN (3 layers, 15 nodes)	fX	0.870551	1.218038	0.082589
8	BPNN (3 layers, 15 nodes)	pX	0.820652	1.401997	0.058200

2

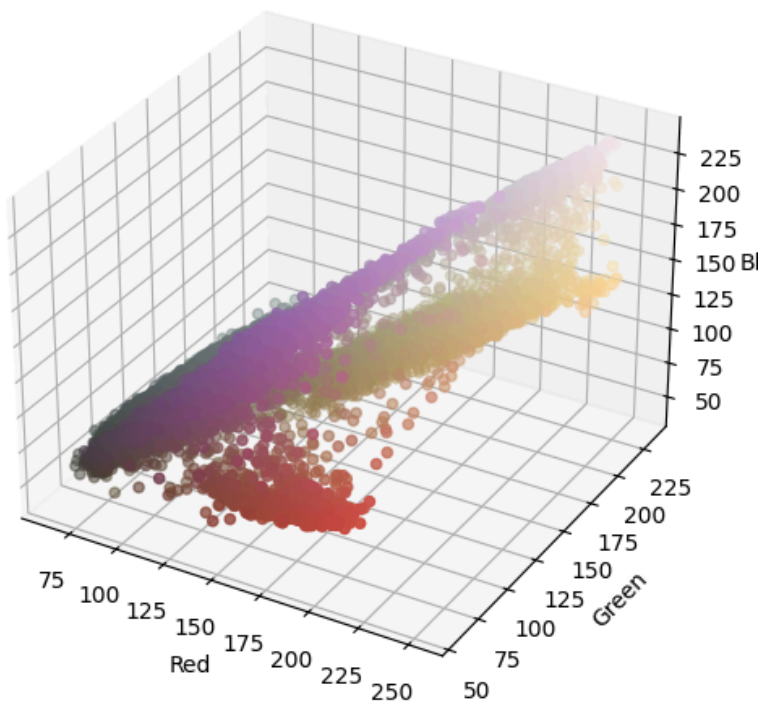
2.1

11. (Notebook)

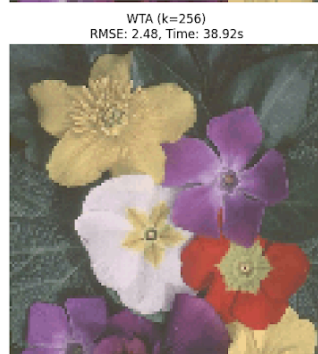
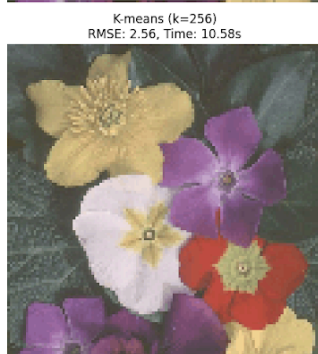
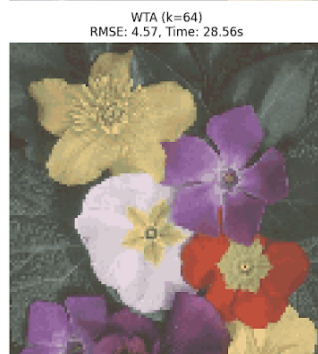
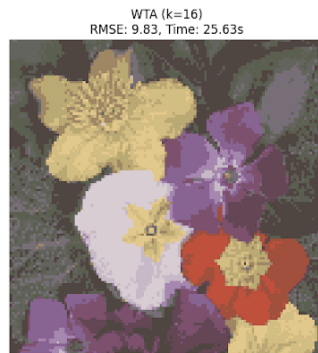
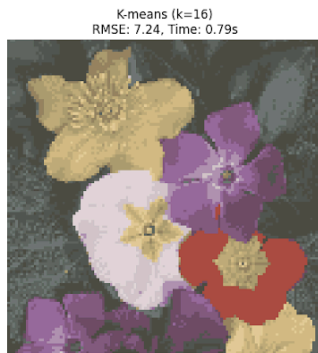
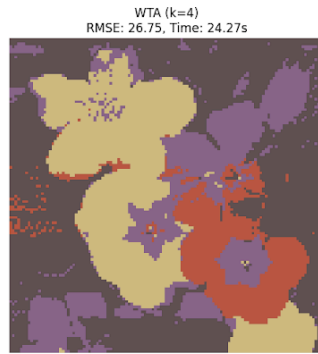
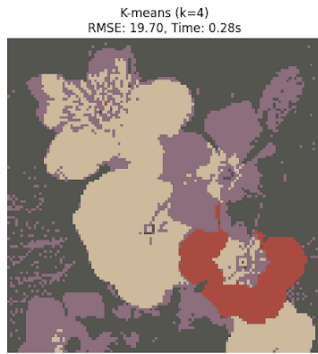
12. (Notebook)

13.

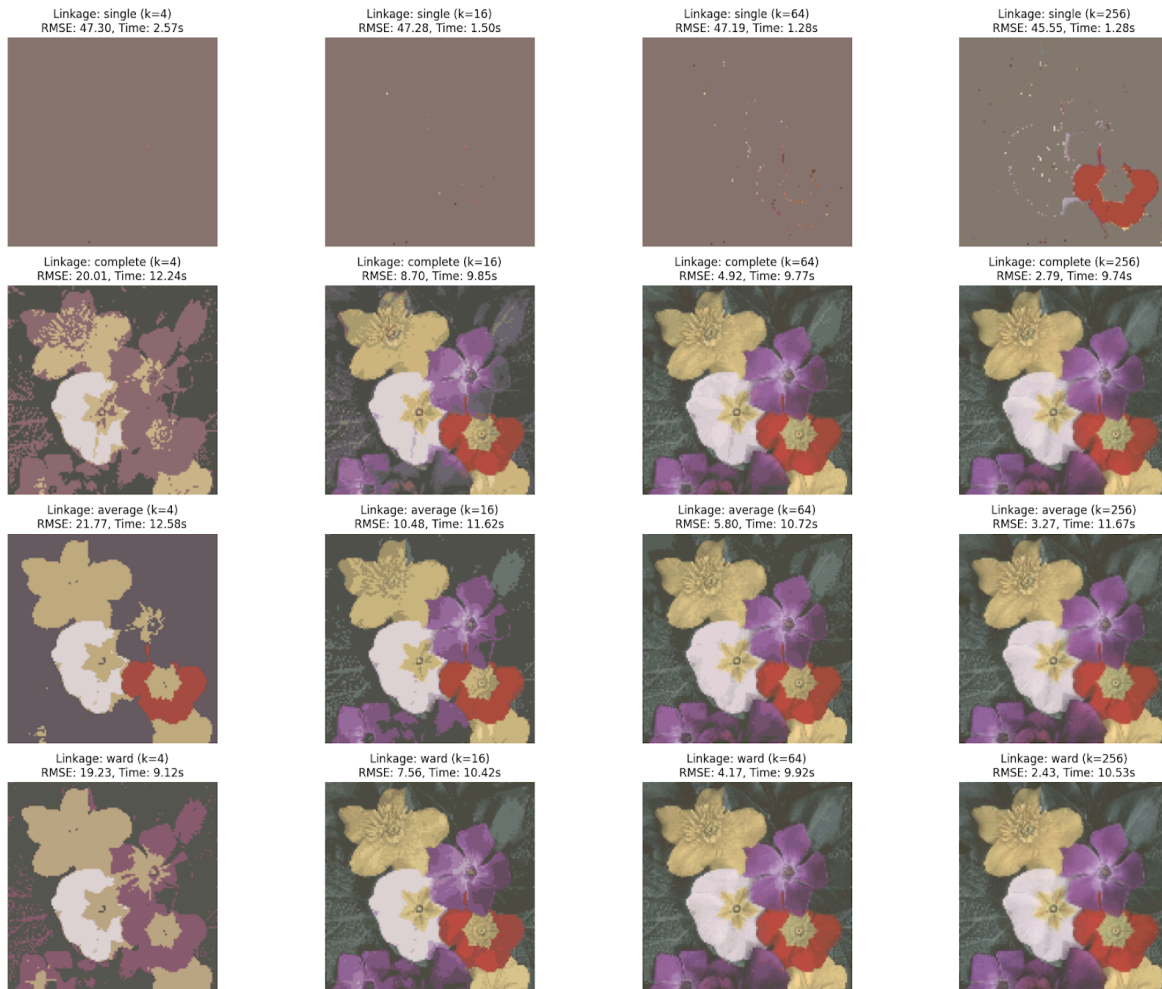
Original Image in 3D RGB



14.



2.2



I added all linkage methods to the grid to display their effects as the “best” may be subjective. Ward starts the sharpest however, others are faster. (I also wanted to demonstrate how bad single was)

16. Image Quality: k-means provides clear decent compression at low k-values and sharpens steadily, while WTA adapts quickly but may be less stable and less clear at lower k values. Hierarchical clustering captures complex structures but may be less clear at larger k values.

Run-Time: k-means is fastest by far because it uses an iterative approach that quickly converges, and WTA is slowest by far because it updates weights incrementally for each point, requiring more iterations to converge with Hierarchical being in-between due to repeated distance calculations.

RMSE: RMSE’s across the models are pretty similar by the time they reach a k of 256 however, starting off WTA is the clear loser with k-means and Hierarchical coming close with Ward Hierarchical taking a slight edge victory.