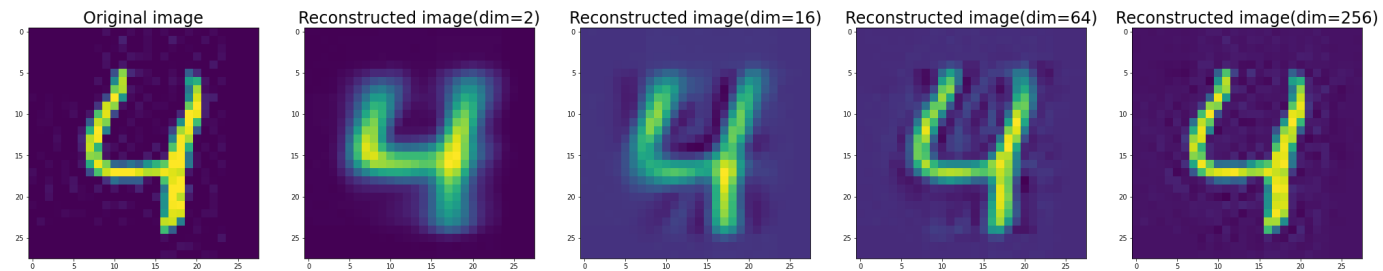


MLSP Course HW3

Problem 1

- Image Visualization:



- Discussion:

- As we can see, when we preserve less dimensions(like dim=2), we are actually use features that are “shared” by all images, so it look less like original image
- On the other side, the more dimension we preserve, the more alike it is comparing to original images

Problem 2

- Implementation:

- To approach NMF, one common solution is to adapt Lee and Seung’s multiplicative update rule[<https://papers.nips.cc/paper/2000/file/f9d1152547c0bde01830b7e8bd60024c-Paper.pdf> (<https://papers.nips.cc/paper/2000/file/f9d1152547c0bde01830b7e8bd60024c-Paper.pdf>)], as demestrated below:

1. Initialize H and W

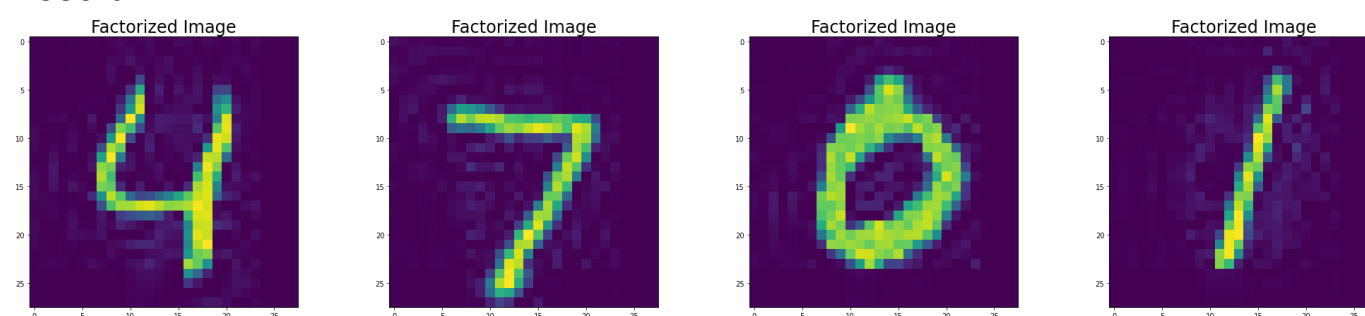
2. Update H by:
$$\mathbf{H}_{[i,j]}^{n+1} \leftarrow \mathbf{H}_{[i,j]}^n \frac{((\mathbf{W}^n)^T \mathbf{V})_{[i,j]}}{((\mathbf{W}^n)^T \mathbf{W}^n \mathbf{H}^n)_{[i,j]}}$$

3. Update W by:

$$\mathbf{W}_{[i,j]}^{n+1} \leftarrow \mathbf{W}_{[i,j]}^n \frac{(\mathbf{V}(\mathbf{H}^{n+1})^T)_{[i,j]}}{(\mathbf{W}^n \mathbf{H}^{n+1} (\mathbf{H}^{n+1})^T)_{[i,j]}}$$

4. Repeat until converge

- Result:



- Discussion:

- As the dataset is composed of 4 hand-writing images, we set W 's column number and H 's row number into 4
- As the result shown, the numbers are successfully and clearly factorized, eventhough $V - WH$ still not globally optimal