MNIST

MNIST is a set of 28x28 pixel images of handwritten digits.

Each image(matrix of grayscale values) is flattened into a 28 \* 28 = 784 dimensional vector.

Fourier Transform

Great explanation and visualization of Fourier transform

<https://www.youtube.com/watch?v=spUNpyF58BY>

finds component signatures in complex signals

PCA

University of Washington professor summarizes PCA

<https://www.youtube.com/watch?v=fkf4IBRSeEc>

University of Nottingham professor explains PCA (Computerphile)

<https://www.youtube.com/watch?v=TJdH6rPA-TI>

statistical interpretation of the singular value decomposition

finds the axis along which dimensionality can be reduced while maximally preserving variance

this axis is called a principal component

process consists of continually determining principal components orthogonal to the previous principal component until an orthogonal axis is unavailable

SVD

University of Washington professor explains singular value decomposition

<https://youtu.be/gXbThCXjZFM>

reduces data into “key features”, most dominant correlations

usually first step in dimensionality reduction

data-driven generalization of a fourier transform

allows you to solve ax = b systems for non square A

University of Washington professor summarizes the mathematical basis of SVD

<https://youtu.be/xy3QyyhiuY4>

ex. take a data set consisting of images of faces.

flatten these matrices into column vectors, and push them into a matrix

then decompose that matrix into sub-matrices U, sigma, and V transpose

U contains information about the column space of original data matrix

sigma contains information about the weights of the columns of U and V^T

V^T contains information about the rows of the original data matrix

columns are hierarchically arranged such that each column is more important than the column to its right

Multidimensional Scaling

Geneticist explains principal coordinate analysis and multidimensional scaling (StatQuest)

<https://youtu.be/GEn-_dAyYME>

Video contains another explanation of MDS, not as helpful

<https://youtu.be/8QLlz-NvfxA>

calculate the distance between each subject

if you calculate linear distance and plot, also called principle coordinate analysis

you can come up with other visualizations by changing how you measure the distance between subjects

uses cost function which quantifies the degree to which the original distances in a data set are compromised when dimensionality is reduced

sammon’s Mapping

Visualization of Sammon’s Mapping

<https://www.youtube.com/watch?v=HSsrJC_KCKk>

a version of multidimensional scaling wherein local structure is valued greater than global structure, i.e. if two points are close together, the cost of separating is higher.

t-SNE

Geneticist explains t-SNE (StatQuest)

<https://www.youtube.com/watch?v=NEaUSP4YerM>

find a way to project data into a low dimensional space such that clustering is preserved

map higher dimensional data to a lower dimensional space, then deploy algorithm which checks how close data points are in the higher dimensional space, and cause them to attract or repel accordingly in the lower dimensional space