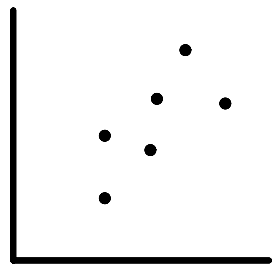
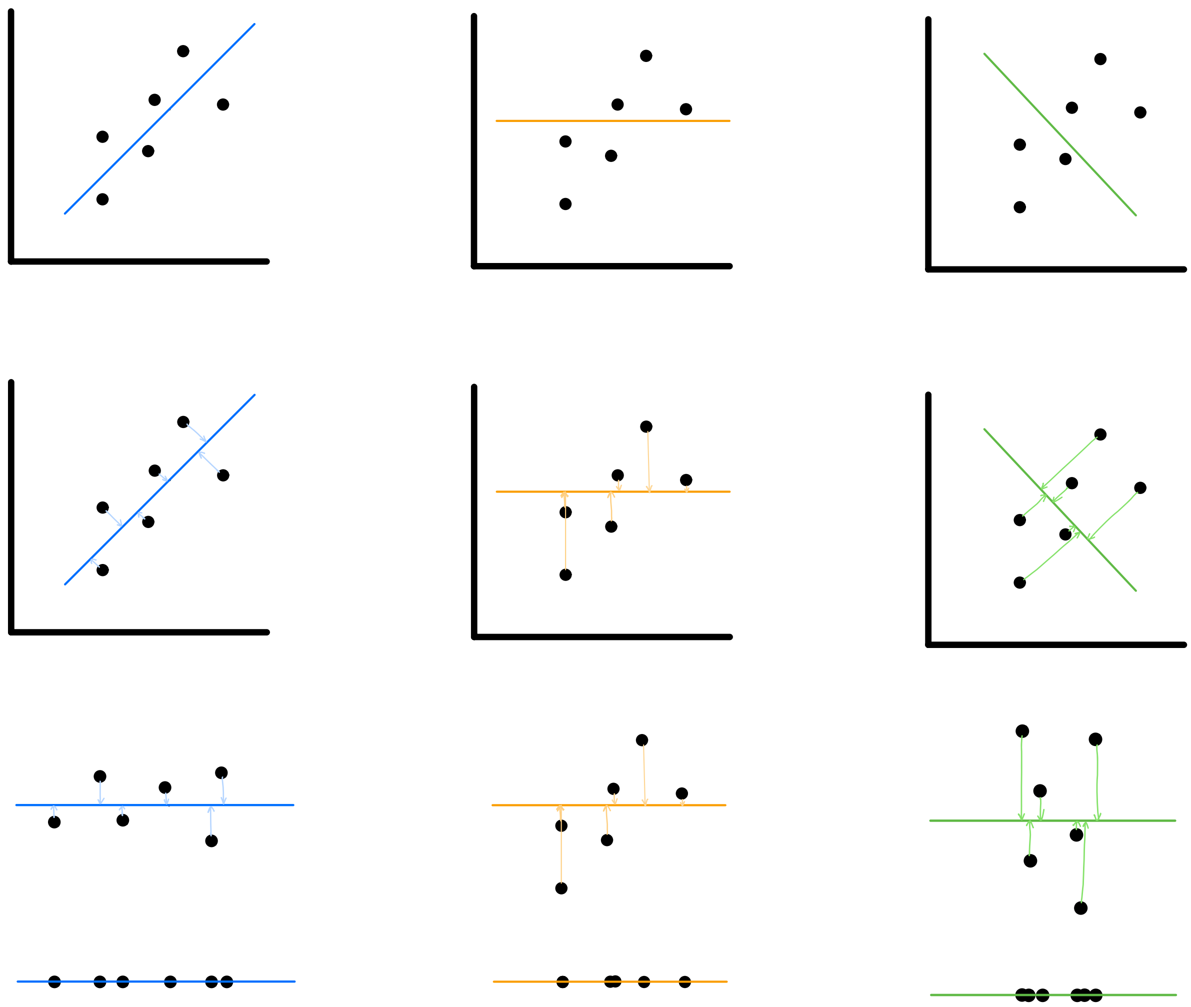
PRINCIPAL COMPONENTS ANALYSIS ILLUSTRATION

ORIGINAL DATA

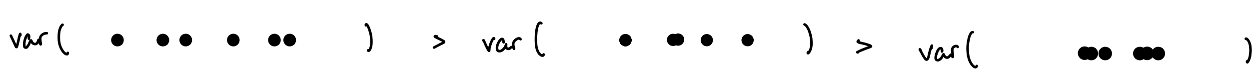


PCA searches over all possible hyperplanes to find the one that maximizes the variance of the projected data
"directions"

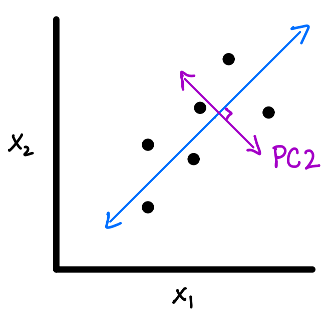
Ex. CANDIDATE HYPERPLANE 1 CANDIDATE HYPERPLANE 2 CANDIDATE HYPERPLANE 3



DATA PROJECTED ONTO HYPERPLANE



ORIGINAL DATA

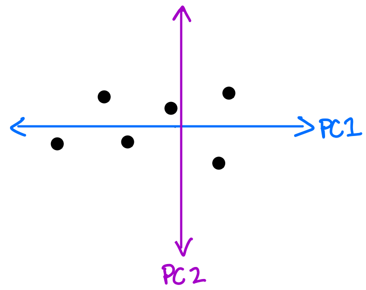


PC1 (direction that maximizes variance)

PC2 (direction that maximizes variance subject to being orthogonal to all higher PCs)
"next best direction"

PCA

PRINCIPAL COMPONENTS PLOT



INTERPRETING PCA:

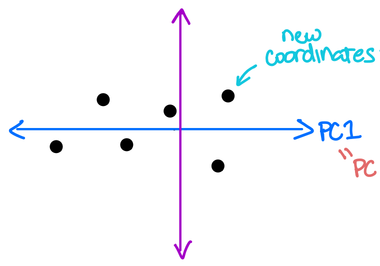
Since PCA is essentially a linear projection method, it is by far the most interpretable dimension reduction method

★ PCs are a weighted linear combination of $X_1, X_2, \dots, X_p$

Ex. If $PC1 = 0.4X_1 + 0.6X_2$, then X_2 is "more important" or "contributes more" to PC1 than X_1

TERMINOLOGY:

PRINCIPAL COMPONENTS PLOT



Moreover, in PCA, we can also measure the proportion of variance explained by each PC_k

← the k^{th} PC

$$PVE_k = \frac{\text{variance of data projected on } PC_k}{\text{total amount of variance in } X}$$

⇝ SCREE PLOT: