~~we~~ we Know that the way to obtain the components is eigendecomposition of the covariance matrix. Details are given below-

~~But there is a trick to do it.~~

$$Z = P D P^{-1}$$

P is the eigenvector of Z

where Z is the covariance matrix

Use the first r components of D

But, there is a trick -
we can just use SVD

① first, mean center the data X and get X'

$$X' = X - \mu$$

② Apply SVD on X'

$$\cancel{X' = PD}$$

$$X' = U \Sigma V^T$$

$U \rightarrow$ eigenvector of $X'X'^T$

$V \rightarrow$ eigenvector of $X'^T X'$

$\Sigma \rightarrow$ diagonal matrix and diagonal values are eigenvalues of $X'X'^T$

As we already did step (1), we get eigenvector of the co-variance matrix $X'X'^T$.

This eigenvector matrix is U.

So, this is a trick to do PCA.

1. centralize data
2. Apply SVD on the centralized data. U matrix is the eigenvector matrix

You can use first r eigenvectors based on highest r eigenvalues.

This results into a form i.e.,

Truncated - SVD (tSVD