

DSE 210: Worksheet #8 - Matrix Factorization

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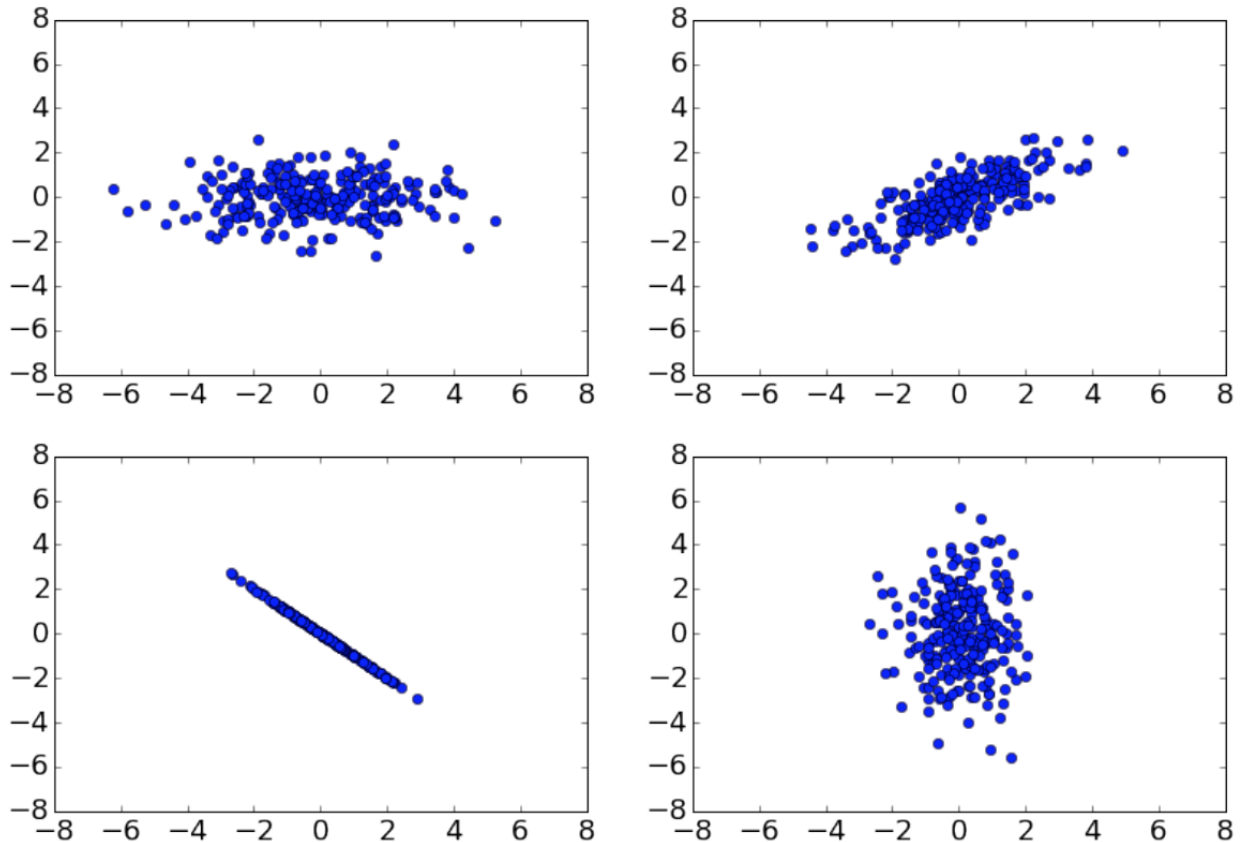
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Problem 1

$\left\{ \begin{bmatrix} 3 \\ 4 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \right\}$ is not an orthonormal basis, because $\left\| \begin{bmatrix} 3 \\ 4 \\ 0 \end{bmatrix} \right\| = \sqrt{3^2 + 4^2 + 0^2} = \sqrt{25} = 5 \neq 1$.

Problem 2



Problem 3

- (a)
- U is $p \times 2$
 - U^T is $2 \times p$
 - UU^T is $p \times p$
 - $u_1 u_1^T$ is $p \times p$
- (b)
- $x \mapsto (u_1 \cdot x, u_2 \cdot x)$ is the projection of x onto the 2-dimensional subspace defined by u_1, u_2
 - $x \mapsto (u_1 \cdot x)u_1 + (u_2 \cdot x)u_2$ is the projection of x as a p -dimensional vector onto the subspace defined by u_1, u_2
 - $x \mapsto U^T x$ is the projection of x on to the 2-dimensional subspace defined by u_1, u_2 (same as $x \mapsto (u_1 \cdot x, u_2 \cdot x)$)
 - $x \mapsto UU^T x$ is the projection of x as a p -dimensional vector onto the subspace defined by u_1, u_2 (same as $x \mapsto (u_1 \cdot x)u_1 + (u_2 \cdot x)u_2$)

Problem 4

See Worksheet7_8.ipynb notebook at <https://github.com/mas-dse/jsw037/tree/master/DSE210>.