Singular Value Decomposition (the SVD)

Every matrix factors into

$$A = U\Sigma V^T$$

You can find V, U with $A^T A$, AA^T respectively. We can use it to factor singular matrices.

The first application is very important. All the time in this century, we are getting matrices with data in them. Maybe in life sciences, we test a bunch of sample people for genes. We have a gene expression matrix. column for people and row for genes. And each number in the matrix is telling us how much the gene is expressed by that person. We may be searching for genes causing some disease. We are looking for the principle component. **Principle component analysis** (PCA) -- a big application in applied statistics. We get $u_1 \sigma_1 v_1^T$.