The main thing is presumably that AATAAT is symmetric. For symmetric matrices one has the [Spectral Theorem](http://en.wikipedia.org/wiki/Spectral_theorem) which says that we have a basis of eigenvectors and every eigenvalue is real.

AATAAT is positive semi-definite, and in a case in which AA is a column matrix, it will be a rank 1 matrix and have only one non-zero eigenvalue which equal to ATAATA and its corresponding eigenvector is AA. The rest of the eigenvectors are the null space of AA i.e. λTA=0λTA=0.