

Optimization assignment — Eigen 2

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Real eigenvalues, orthogonal eigenvectors A real matrix can have all eigenvalues and orthogonal eigenvectors iff it is real symmetric. So, in this case, we will need $c = 5$, and d can be any value.

Orthonormal vectors as column combinations To find three orthonormal vectors from the columns, we need the column vectors to span the 3-D space. If they do not, we will not be able to find three vectors which are orthonormal. This can be checked by checking that $|A| \neq 0$, or

$$\begin{vmatrix} 1 & 2 & 0 \\ 2 & d & c \\ 0 & 5 & 3 \end{vmatrix} = 1(3d - 5c) - 2(10 - 0) + 0 \neq 0$$
$$3d - 5c - 20 \neq 0$$