Asked after class on March 5, 2019:

"What are some applications of eigenvectors and eigenvalues?"

Answer:

https://math.stackexchange.com/questions/1520832/real-life-examples-for-eigenvalues-eigenvectors

https://en.wikipedia.org/wiki/Eigesnvalues_and_eigenvectors

See section 8 in the Wiki article. Some of the stack exchange references are copied below.

-Dr G

Here are just some of the many uses of eigenvectors and eigenvalues:

- Using singular value decomposition for image compression. This is a note explaining how you can compress and image by throwing away small eigenvalues. It takes an 8 megapixel image of an Allosaurus, and shows how the image looks after compressing by selecting 1, 10, 25, 50, 100 and 200 of the largest eigenvalues of a matrix that represents the image.
- Deriving Special Relativity is more natural in the language of linear algebra. In fact, Einstein's second postulate really states that "Light is an eigenvector of the Lorentz transform." This document discuses the derivation in detail.
- Spectral Clustering. Whether it's in plants and biology, medical imaging, business and marketing, understanding the connections between fields on Facebook, or even criminology, clustering is an extremely important part of modern data analysis. It allows people to find important subsystems or patterns inside noisy data sets. One such method is spectral clustering which uses the eigenvalues of an adjacency matrix representing the graph of a network.
- Dimensionality Reduction/PCA. The principal components correspond to the largest eigenvalues of $AT$and this yields the least squared projection onto a lower dimensional subspace. The eigenvectors become the basis for the subspace. Dimension reduction is used in machine learning and data analysis as it allows one to understand the source of the variation in the data.
- Low rank factorization for collaborative prediction. This what Netflix does (or once did) to predict what rating you'll have for a movie you have not yet watched. It uses the singular value decomposition (SVD), a further development of eigenvalues and eigenvectors. The method throws away the smallest eigenvalues to identify the ranking..
- The Google Page Rank algorithm. The eigenvector q for eigenvalue=1 of the graph of the internet is how the pages are ranked. This eigenvector q is the steady-state vector of a markov chain x[k+1] = Px[k], briefly the steady-state q satisfies Pq=q and the largest components of q determine the hits for the google search.