The nonnegative inverse eigenvalue problem

Supervisor: Dr.Anthony Cronin

Undergraduates are used to finding the eigenvalues and eigenvectors for low-dimensional matrices, first by hand and perhaps later, for larger n, numerically with the aid of software. The **nonnegative inverse eigenvalue problem** is, as the name suggests, an inverse problem to the one of finding eigenvalues. Here is the objective to find the entry-wise nonnegative nxn matrix (if it exists!) for which a given list of n complex numbers is the list of eigenvalues.

The problem was first posed back in 1938 by Kolmogorov and solved for real lists with just one positive number in 1949 by Suleimanova. The general problem for n=3 was solved in 1978 by Loewy and London, for n=4 by Laffey and Meehan in 1997 and for trace zero 5x5 matrices by the same authors in 1999. Amazingly the problem is still open for n>4 despite this being a very active area of research throughout the world.

The aim of this project would be to get an appreciation for the techniques used to solve the low dimensional cases and to make progress on related problems such as Monov's conjecture, which asks which 'nonnegative properties' does the derivative of a 'nonnegative' characteristic polynomial inherit.