Coding theory and related combinatorics

Relinde Jurrius

Coding theory is the answer to the problem of noise in digital communication: think about a scratch on a CD, a GSM signal that is disrupted by atmospheric disturbances, or magnets that influence the data stored on a hard disk. The idea behind coding theory is to add some redundant information to a digital message. If part of the message gets changed or lost during communication, there will still be enough information left to reconstruct the message. So an error-correcting code is a set of "codewords", where the words are vectors over a finite field. The more the codewords "look different", the better the code is at correcting errors.

Nowadays, a lot of digital communication is not transmitted through a single channel, but through a network of channels: for example a wireless network on campus, or the Internet. This requires new methods for error correction, studied by the new field of network coding. The codes used in network coding have their own way for codewords to "look different".

Codes as mathematical objects relate to a lot of other objects in combinatorics, such as designs and matroids. For codes over the classic communication channel, much research is done on the topic. The rise of network coding gives the opportunity to find which combinatorial objects relate to network codes. It turns out that the situation is often a so-called q-analogue of the case for classical codes.