Generators and Relations and Geometry

Professor Daniel Bump

Abstract

The group $SL(2, \mathbb{Z})$ of $2 \times 2$ integer matrices of determinant one has two generators

$$S = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}, \quad T = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}.$$  

They satisfy $S^4 = (ST)^3 = I$ and no other relations except those that can be deduced from these. We can prove this geometrically using a simple but powerful idea. We will look at other applications of this idea to groups like the symmetric group. These belong to a class of groups called “Coxeter groups” and the idea leads to many interesting applications.

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