

Complex structures on a torus

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We start with the classical theory of representations of a torus, each such representation is given by a group $G = \langle A, B \rangle$ of linear transformations of the complex plane, where $A(z) = z + 1$, and $B(z) = z + t$, where t is a complex number with positive imaginary part. We discuss the connection with the classical modular group, $\text{PSL}(2, \mathbb{Z})$. We look at the connection with algebraic curves of the form $w^2 = (z - a)(z - b)(z - c)(z - d)$, and then ask: "For which values of t is the corresponding algebraic curve real". If time permits, we then take a bite out of the donut (or bagel) and look at both the corresponding euclidean structures and the complete hyperbolic structures, on a torus with one boundary component. Here again, we ask: which such structures are related to real algebraic curves.

