Some time early in life we encounter long division: first with integers, and later with polynomials in one variable. By studying the quotients and remainders gotten from iterating long division of polynomials, we are surprised to meet old friends from calculus. This in turn gives a new and unusual perspective on binary expressions for integers, or more generally prime-base expansions. This talk will be accessible to anyone who has done long division and taken calculus, and should be interesting to anyone intrigued by algebra, geometry, decimals, and/or number theory.