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*Enumerating excursions on Cayley graphs*

Given a finitely generated group with generating set  $S$ , we study the cogrowth sequence, which is the number of words of length  $n$  over the alphabet  $S$  that are equal to one. This is related to the probability of return for walks in a Cayley graph with steps from  $S$ . This talk will survey the connections between the structure of the group, and properties of the cogrowth sequence via the nature of its generating function. We will then show that the cogrowth sequence is not P-recursive when  $G$  is an amenable group of superpolynomial growth, answering a question of Garrabant and Pak. In addition, we compute the exponential growth of the cogrowth sequence for certain infinite families of free products of finite groups and free groups. Work in collaboration with Jason Bell and Haggai Liu