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*On the complexity of the cogrowth sequence*

Given a finitely generated group  $G$  with generating set  $S$  consider the number of words of length  $n$  over the alphabet  $S$  equal to one. This defines the cogrowth sequence, and is related to excursions on Cayley graphs.

We survey the surprising connections between the structure of the group, and properties of this sequence. We show that the cogrowth sequence is not P-recursive when  $G$  is an amenable group of superpolynomial growth and 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.