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Limits of group algebras for growing symmetric groups and wreath products

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Let $S(\infty)$ denote the group of all finite permutations of the set $\mathbb{N} := \{1, 2, \ldots\}$; this group is countable. Although the set of all its irreducible unitary representations is far too large to have any hope to describe it, it is possible to define in a natural way a subclass of *tame* representations, which in many ways behave similarly to representations of finite permutation groups $S(n)$.

It is well-known that group algebras provide a very useful tool to study representations of finite groups. However, if we consider the group algebra $\mathbb{C}[S(\infty)]$, we will notice that it is too small to be of much use: for example, its centre is trivial, while the centre of the group algebra $\mathbb{C}[S(n)]$ can separate irreducible representations. Our aim is to construct a completion of the group algebra $\mathbb{C}[S(\infty)]$ that can separate irreducible tame representations of $S(\infty)$.

This algebra, which we will call the virtual group algebra, is obtained by taking large-n limits of the finite-dimensional group algebras $\mathbb{C}[S(n)]$ in the tame representations of $S(\infty)$. We describe the structure of the virtual group algebra, which reveals a connection with Drinfeld-Lusztig degenerate affine Hecke algebras.

Finally, we extend the results to wreath products $G \wr S(\infty)$ with arbitrary finite groups G.