

# On the Quiver Presentation of the Descent Algebra of the Symmetric Group

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We describe a presentation for the descent algebra of the symmetric group  $\mathfrak{S}_n$  as a quiver with relations. This presentation arises from a new construction of the descent algebra as a homomorphic image of an algebra of forests of binary trees which can be identified with a subspace of the free Lie algebra. In this setting, we provide a new short proof of the known fact that the quiver of the descent algebra of  $\mathfrak{S}_n$  is given by restricted partition refinement. Moreover, we describe certain families of relations and conjecture that for fixed  $n \in \mathbb{N}$ , the finite set of relations from these families that are relevant for the descent algebra of  $\mathfrak{S}_n$  generates the ideal of relations, and hence yields an explicit presentation by generators and relations of the algebra.

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