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CONSTRUCTING FREE RESOLUTIONS OF COHOMOLOGY ALGEBRAS

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We define the $\mathcal{H}(\mathcal{R})$-algebra of a space as the algebraic object consisting of the graded cohomology groups of the space with coefficients in a general ring $\mathcal{R}$, together with all primary cohomology operations on these groups, subject to the relations between the operations. This structure can be encoded as a functor from the category $\mathcal{H}(\mathcal{R})$ containing products of Eilenberg–MacLane spaces over $\mathcal{R}$ to the category of pointed sets.

The free $\mathcal{H}(\mathcal{R})$-algebras are the $\mathcal{H}(\mathcal{R})$-algebras of a product of Eilenberg–MacLane spaces. In this thesis we show how to construct free simplicial resolutions of $\mathcal{H}(\mathcal{R})$-algebras using the free and underlying functors.

Given a space X, we also construct a cosimplicial space such that the cohomology of this cosimplicial space is a free simplicial resolution of the $\mathcal{H}(\mathcal{R})$-algebra of X. For $\mathcal{R} = \mathbb{F}_p$, the finite field on p elements, this cosimplicial resolution fits the E^2 page of a spectral sequence and we give convergence results under certain finiteness restrictions on X. For $\mathcal{R} = \mathbb{Z}$, the integers, a similar result is not obtained and the reasons for this are given.

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