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Relational Models Revisited

A **flacos** is a full subcategory of the category of topological spaces and continuous maps which contains all Alexandroff spaces, and is closed under locally closed subspaces, coproducts and quotients. Such a category is topological over **Set** with products $X \otimes Y$ finer than the topological product.

Each subfunctor G of the filter functor induces a flacos $\mathbf{Top}_G$. Barr's relational models (1970) are revamped in the sense that when G is the ultrafilter functor, $\mathbf{Top}_G$ is all spaces whereas when G is the identity functor (principal ultrafilters), $\mathbf{Top}_G$ is Alexandroff spaces (= preordered sets and monotone maps). This recaptures Barr's two main examples, without using monad structure.

When G is a submonad of the ultrafilter monad, $\mathbf{Top}_G$ is a full subcategory of relational $\mathbf{G}$-models which contains all G-algebras. Such algebras X are topologically characterized by being *compact* (i.e., $X \otimes Y \to Y$ is closed for all Y) and *Hausdorff* (i.e., the diagonal is closed in $X \otimes X$). When GX is the submonad of ultrafilters which possess a countable member, $\mathbf{Top}_G$ is spaces with countable tightness and the algebras can be equationally presented using countable operations. The free countably-generated such algebra provides a counterexample to settle a question in topology posed in the 1970s.