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The Double Category of Lax Presheaves

A study of representables for double categories shows that they are lax functors into a double category of sets whose vertical arrows are spans. This leads to a Yoneda embedding into a double category of lax presheaves with horizontal morphisms called natural transformations (generalizing lax transformations) and vertical morphisms called modules (generalizing profunctors). This double category is the foundation upon which two-dimensional model theory will be built, and it is important to establish its basic properties. The most urgent questions surround the composition of modules. Does it exist? Is it associative? Etc. In the course of discussing these questions, several double category constructions of independent interest will arise.