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Building Noetherian domains using completions

Over the past sixty years many important examples of Noetherian domains have been constructed using a technique developed by Akizuki in the 1930s and Nagata in the fifites. The rings constructed are intersections of the form $L \cap \widehat{R}/I$; that is, an intersection of a homomorphic image of a completion of a well-understood and well-behaved Noetherian domain R with an extension field of the fraction field of R. (Often R is taken to be a polynomial ring in two variables over a field and the completion can be considered as a power series ring.)

We analyze this technique in a general way and show how flatness is crucial to whether an intersection $A := L \cap \widehat{R}/I$ is Noetherian and can be computed easily. We also give some results concerning excellence of such an intersection.