How to get numerical convergence
out of instable algorithms

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The following theorem is well known: consistency and global stability imply numerical convergence. Unfortunately, many algorithms which arise in the numerical solution of (ordinary or partial) differential equations are globally instable, but locally stable. Using appropriate termination criteria one finds that consistency and local stability are already sufficient for convergence. The rate of convergence is investigated. The connection to the Dahlquist theory is explained. The numerical solution of a simple initial value problem by using a highly unstable difference formula is treated as an example. These results can be found in:

K. Nickel: Stability and convergence of numeric algorithms, Parts I and II. Technical Notes BN-785 February 1974 and BN-788 March 1974. Institute for Fluid Dynamics and Applied Mathematics; University of Maryland, College Park/ Maryland, USA.