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A formal derivation for the Blasius similarity solution for flat-plate boundary layer HAO LIN, Department of Mechanical and Aerospace Engineering, Rutgers, The State University of New Jersey — The Blasius solution is a classical solution for a laminar boundary layer attached to a semi-infinite flat plate. The key of the solution strategy is to reduce the boundary layer equations, which are PDEs, to a set of ODEs, using a similarity variable transform. Conceptually, the similarity suggests that the velocity profile in each transverse cross-section appears "self-similar". In many classical text books and typical classroom lectures on fluid mechanics, the existence of the similarity solution is argued heuristically. The similarity variable is defined *a priori* so as to collapse the PDEs. It appears somewhat mystical that the PDEs can be perfectly reduced via such an approach. Here we present a rigorous derivation for the existence of a similarity solution, which naturally arises from the fact that there is no apparent streamwise length scale for a semi-infinite plate. Conversely, a similarity solution cannot exist if the plate size is finite. This derivation can be useful in fluids education, in topics including similarity, scaling arguments, and boundary layer theory.

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