Subject: "Strict" mode for floating-point arithmetic
From: Van Snyder
Reference: Ada Reference Manual (see http://www.ada-auth.org/∼acats/arm.html), Section G.2.

Number

TBD

Title

"Strict" mode for floating-point arithmetic.

Submitted By

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Status

For consideration.

Basic Functionality

Provide a specification that within a range of executable statements, arithmetic and intrinsic elementary functions conform to strict rules of accuracy.

Rationale

The Fortran standard presently specifies only that arithmetic operations on and intrinsic functions of floating-point numbers are approximate. It provides no specification what that means. Some processors sacrifice accuracy for speed, while others do the opposite. In some applications, it would be important to users to control which policy applies.

Estimated Impact

Minor changes in Sections 7 and 13.

Detailed Specification

Provide a specification that within a range of executable statements, arithmetic and intrinsic elementary functions conform to strict rules of accuracy. It would also make sense to specify the treatment of signed zeroes within that range, while it might not make sense to do so outwith it. It should be allowed that a processor's relaxed mode conforms to the standard's strict requirements.

One syntactic way to do this is with an attribute for subprograms. Another is as a construct. It would be useful to have both; if only one is acceptable, I prefer the construct. An attribute for objects is a bad idea because it raises the question what happens if an operator has two operands with different strictness, and would require specifications how to propagate strictness.

The Ada standard specifies a strict numeric mode in section G.2. The foundation for it is the *fundamental interval*, which for any number is bounded by the two consecutive floating-point numbers that surround it. Accuracy of arithmetic operations and intrinsic elementary functions is specified in terms of that interval, and the radix and round-off level (epsilon) for floating-point numbers.

The specification amounts to a little over seven pages in the Ada standard, and this includes the requirements for Complex arithmetic. The same could be done in the Fortran standard.

History