The (near-)future IEEE 1788 standard for interval arithmetic

Nathalie Revol

INRIA, AriC team
LIP, ENS de Lyon
Université de Lyon
46 allée d'Italie, 69364 Lyon Cedex 07, France
Nathalie.Revol@ens-lyon.fr

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Introduction

The standardization effort started in January 2008, at a meeting in Dagstuhl. The participants felt that interval arithmetic was mature enough to undergo the standardization process, and that this process was needed, for instance to make existing libraries interoperable. Since October 2008, where the project was launched, an intensive and sustained work has been done, through electronic means. All related work can be found on the Web page of the project [1]. The mailing list had more than 140 subscribers from 28 countries. More than 40 persons have been active in the discussions and votes. This led to a final draft which has been unanimously adopted by the working group in July 2014, and after one more year of editorial work and final ballot the standard should go through the final examination stage in June 2015.

The standard is structured into 4 levels, where level 1 is the mathematical level and level 4 is about encoding at the bit level. Level 2, *discretization*, is the central part of the standard, approximating the mathematical theory by an implementation-defined finite set of entities and operations. Level 3 is about representation issues.

Common intervals

The mathematical model, which serves as a basis for this standard, is called *common interval arithmetic*. It corresponds to the model proposed by Moore in [2]: only bounded and non-empty intervals are considered. We will detail the various operations available on these intervals: arithmetic operations, set operations, numeric and boolean functions of intervals, as well as operations on/with decorations.

Other flavors

Other mathematical models have been considered: set-based model, Kaucher/modal model in particular. These models are called *flavors*. The standard has been designed to allow a smooth integration of other models, by providing "hooks" to new models and by defining the process for submitting a new flavor.

The set-based model has been completely defined and it is, up to now, the only flavor defined in the standard. In the set-based model, the empty set and unbounded intervals are allowed. Its definition makes the second part of the draft.

We will also briefly describe some possible flavors, namely the Kaucher/modal flavor and an approach proposed by S. Rump to handle overflows and open or closed or half-open intervals.

Acknowledgement (non inclusive list)

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References

[**1**] IEEE, *P1788/D9.7 2 – Draft Standard For Interval Arithmetic*, 2015.

[**2**] R.E. Moore, *Interval analysis*, Prentice-Hall, 1966.