Affine Arithmetic

Jun Inoue

February 19, 2008

1 Project Proposal

Two of the papers I am planning to present on describe the application of affine arithmetic, which appears to be a promising tool to leverage in my long-delayed work on floating point error analysis. Based on these papers, I propose for my project a tutorial on error analysis using affine arithmetic.

2 An Affine Arithmetic Primer

Affine arithmetic represents uncertainty in the input or output of a computation by symbols that are more or less treated as random variables, such as the ε_i in

$$\hat{x} = x + c_0\varepsilon_0 + c_1\varepsilon_1 + \cdots + c_n\varepsilon_n.$$

By assigning explicit variables to represent different error terms, we can track how different sources of error affect the result. I hope to learn and/or develop more concrete techniques for using such expressions in error analyses.

3 Applications

My project will use the following applications for illustrating and demonstrating the use of affine arithmetic.

FFT I will present several subtly different implementations of FFT and see whether affine arithmetic is able to detect the relative superiority/inferiority of the implementations in terms of numerical accuracy.

Elementary Transcendentals I will analyze some implementations of elementary transcendental or irrational functions and show what guarantees can be derived from them.