Real Roots Isolation of Polynomials

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1 ABSTRACT

Computing the real roots of univariate polynomial is one of fundamental tasks in numeric and computer algebra. Usual root-finding algorithms for computing the real roots of a polynomial may produce some real roots, but cannot generally certify having found all real roots.

In this project, we implemented a basic real roots isolation program based on Budan's Theorem and Continued Fraction Method. Both methods are developed from Descartes' rule of signs. Then we compare the running time of these two methods and get the conclusion that TODO.

2 INTRODUCTION

One of the most fundamental scientific computation is to computing the real roots of polynomials. For the polynomials with low order, like quadratic or cubic, we can using formula to get roots directly. However, according to the Abel–Ruffini theorem[1], there is no solution in radicals to general polynomial equations of degree of five or higher with arbitrary coefficients. Therefore, general root-finding algorithms are needed for general polynomials.

However, the usual root-finding algorithms, like Newton Method, cannot generally certify having found all real roots. Especially, if such algorithms does not find any root, one cannot know if there is real roots or not. In order to get all real roots, real-root isolation is useful. Real-root isolation can generate intervals, which contain only one real root of the polynomial, so that no real root will be missed.

3 SQUARE-FREE DECOMPOSITION

4 BUDAN'S THEOREM

5 CONTINUED FRACTION METHOD

6 EXPERIMENTATION

7 CONCLUSION

REFERENCES

[1] Raymond G. Ayoub. 1980. Paolo Ruffini's Contributions to the Quintic. *Archive for History of Exact Sciences* 23, 3 (1980), 253–277. http://www.jstor.org/stable/41133596

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