

**Introduction to Symbolic Computation for Engineers**

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## **ACKNOWLEDGEMENTS**

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# PROGRAMME

1. SYMBOLIC COMPUTATION: **INTRODUCTION AND MOTIVATION.**
2. PROGRAMMING SYSTEMS IN COMPUTATIONAL MATHEMATICS: —→ **MAPLE.**
3. INTRODUCTION TO THE COMPLEXITY OF ALGORITHMS.
4. SYMBOLIC ALGORITHMS IN LINEAR ALGEBRA: **BAREISS METHOD.**
5. SYMBOLIC RESOLUTION OF SYSTEM OF ALGEBRAIC EQUATIONS:  
**RESULTANTS AND GROEBNER BASIS.**

# REFERENCES

## BASIC

1. **Rincón F., García A, Martínez M.A.** *Cálculo Científico con Maple.* Rama (1995).
2. **Soto M.J., Vicente J.L.** *Algebra Lineal con Matlab y Maple.* Prentice Hall (1995).
3. **Sendra J.R., Pérez Díaz S., Sendra J., Villarino C.** (2009). *Introducción a la computación simbólica y facilidades Maple.* Addlink Media (2009). ISBN: 987-84-612-9191-5  
<http://www.addlink.es/go/IalCSyFM.htm>

## ADVANCED

1. **Davenport J.H., Siret Y., Tournier E., (1988):** *Computer Algebra: Systems and Algorithms for Algebraic Computation.* **Academic Press. London .**
2. **von zur Gathen J., Gerhard J., (1999):** *Modern Computer Algebra.* **Cambridge University Press, New York.**
3. **Geddes K. O., Czapor S.R, Labahn G., (1992):** *Algorithms for Computer Algebra.* **Kluwer Academic Publishers.**
4. **Mishra B., (1993):** *Algorithmic Algebra.* **Springer Verlag.**
5. **Sendra J.R., Winkler F., Pérez-Diaz S., (2007).** *Rational Algebraic Curves: A Computer Algebra Approach.* **Series: Algorithms and Computation in Mathematics, Vol. 22. Springer Verlag.**
6. **Winkler F.** *Polynomial Algorithms in Computer Algebra.* **Springer Verlag (1996).**

# **1.-SYMBOLIC COMPUTATION: INTRODUCTION AND MOTIVATION.**

**Based on the book of Winkler F. *Polynomial Algorithms in Computer Algebra*.  
Springer Verlag (1996).**

# WHAT IS SYMBOLIC COMPUTATION ?

*Lady Ada Augusta, Countess Lovelace, wrote about the “Babbage’s analytical engine“:*

*Many people who are not conversant with mathematical studies imagine that because the business [ Babbage’s analytical engine] is to give its results in numérical notation, the nature of its process must consequently be arithmetical rather than algebraic and analytical. This is an error. The engine can arrange and combine its numerical quantities exactly as if they were letters or any other general symbols; and, in fact, it might bring out its results in algebraic notation...(siglo XIX)*

## *EACA: Red Temática de Cálculo Simbólico, Álgebra Computacional y Aplicaciones:*

*The Symbolic Calculation or Formal Calculation (in English Symbolic Computation, and in French Calcul Formel) is defined as a modern area of research of interdisciplinary character, that is placed in the common area of action of Mathematics and the Sciences of Computation, and whose principal assignment is the development, construction and analysis of effective algorithms that manipulate symbolic objects capable of being represented in a computer, with special emphasis in the calculations corresponding to objects of mathematical entity and with a view to his applications, not only in the own Mathematics, but also in other branches of the Science (as Physics, Chemistry, Biology, etc) and even in the Industry (electrical networks, shaped of cars, networks of transport, geometric tolerance, computer aided geometric design, robotics) .....*



## **An attempt of definition:**

**Symbolic Algebraic Computation is that part of computer science which designs, analyzes, implements, and applies algebraic algorithms.**

- **In contrast to numerical computation the emphasis is on computing with symbols representing mathematical concepts.**
- **We are dealing with exact mathematical descriptions of geometric objects and both the input and the output of algorithms are exact.**
- **That does not mean that we will not need numerical algorithms any more. Both forms of scientific computation have their merits and they should be combined in a computational environment.**