

Volume 2 / **Seminumerical Algorithms**

THE ART OF COMPUTER PROGRAMMING

Technische Hochschule Darmstadt	
FACHBEREICH INFORMATIK	
B I B L I O T H E K	
Inventar-Nr.:	<u>2416</u>
Sachgebiete:	_____
Standort:	_____

Reading, Massachusetts · Menlo Park, California · London · Don Mills, Ontario

CONTENTS

Chapter 3—Random Numbers

3.1. Introduction	1
3.2. Generating Uniform Random Numbers	9
3.2.1. The Linear Congruential Method	9
3.2.1.1. Choice of modulus	11
3.2.1.2. Choice of multiplier	15
3.2.1.3. Potency	21
3.2.2. Other Methods	25
3.3. Statistical Tests	34
3.3.1. General Test Procedures for Studying Random Data	35
3.3.2. Empirical Tests	54
*3.3.3. Theoretical Tests	69
3.3.4. The Spectral Test	82
3.4. Other Types of Random Quantities	100
3.4.1. Numerical Distributions	101
3.4.2. Random Sampling and Shuffling	121
*3.5. What is a Random Sequence?	127
3.6. Summary	155

Chapter 4—Arithmetic

4.1. Positional Number Systems	162
4.2. Floating-Point Arithmetic	180
4.2.1. Single-Precision Calculations	180
4.2.2. Accuracy of Floating-Point Arithmetic	195
*4.2.3. Double-Precision Calculations	210
4.2.4. Statistical Distribution	218
4.3. Multiple-Precision Arithmetic	229
4.3.1. The Classical Algorithms	229
*4.3.2. Modular Arithmetic	248
*4.3.3. How Fast Can We Multiply?	258
4.4. Radix Conversion	280
4.5. Rational Arithmetic	290
4.5.1. Fractions	290
4.5.2. The Greatest Common Divisor	293
*4.5.3. Analysis of Euclid's Algorithm	316
4.5.4. Factoring into Primes	339

4.6. Polynomial Arithmetic	360
4.6.1. Division of Polynomials	363
*4.6.2. Factorization of Polynomials	381
4.6.3. Evaluation of Powers	398
4.6.4. Evaluation of Polynomials	422
*4.7. Manipulation of Power Series	444
Answers to Exercises	452
Appendix A—MIX	565
1. Description of MIX	565
2. The MIX Assembly Language	584
Appendix B—Tables of Numerical Quantities	596
1. Fundamental Constants (decimal)	596
2. Fundamental Constants (octal)	597
3. Harmonic Numbers, Bernoulli Numbers, Fibonacci Numbers.	598
Appendix C—Index to Notations	600
Index and Glossary	605