

Contents

1. Computational Methods in Classical Physics	
By J.G. Zabolitzky	1
1.1 Preface	1
1.2 Motion of a Classical Point-Like Particle	1
1.3 Short Course in FORTRAN Programming Methodology ...	9
1.4 Methods of Higher Accuracy (and Efficiency)	12
1.5 Finding Extremal Points of Motion	29
1.6 Statics and Dynamics of Strings	43
1.7 Dynamics of Strings	49
1.8 Literature	53
2. Monte Carlo Simulations in Statistical Physics	
By D. Stauffer	55
2.1 Introduction	55
2.2 Random Numbers	57
2.3 Ising Model	60
2.4 Cellular Automata (Q2R and Creutz)	64
2.5 Diffusion and Percolation	68
2.6 Eden Clusters	71
2.7 Kauffman Model	74
2.8 Summary	77
2.9 Appendix: Principles of Vector Computing	78
2.10 References	81
Notes Added to the Second Edition	81
3. Reduce for Beginners. Six Lectures on the Application of Computer-Algebra (CA). By V. Winkelmann and F.W. Hehl	83
Introduction	83
Lecture 1	85
1.1 A first interactive Reduce session	85
1.2 What can CA do for you?	88
1.3 The Reduce character set	90
1.4 Integers, rational and real numbers	91

1.5 Variables named by identifiers	91
1.6 A Reduce program, a follow-up of commands	92
1.7 Assign a temporary result to a variable	93
1.8 Homework	94
 Lecture 2	 95
2.1 Built-in operators	95
2.2 Manipulating Reduce expressions amounts to manipulating formulae	97
2.3 The process of evaluation in Reduce	98
2.4 Repeatedly doing something: Loops	100
2.5 Loops and lists	102
2.6 Multidimensional objects: Arrays	103
2.7 Homework	104
 Lecture 3	 105
3.1 The conditional statement	105
3.2 Combining several statements I: The group statement	106
3.3 Combining several statements II: The compound statement	107
3.4 Some elementary mathematical functions	109
3.5 Differentiation with DF	109
3.6 Integration with INT	111
3.7 Substitution with SUB	112
3.8 Homework	112
 Lecture 4	 114
4.1 Operators that act on lists	114
4.2 Right and left-hand-side of an equation	115
4.3 Solving (non-)linear equations	115
4.4 Retrieving parts of polynomials and rational functions	116
4.5 To make decisions with boolean operators	118
4.6 Writing messages	118
4.7 How to define your own operators	119
4.8 LET rules	120
4.9 Homework	122
 Lecture 5	 124
5.1 Extended LET rules	124
5.2 Examples: Factorials and binomial coefficients	125
5.3 Clearing LET rules	127
5.4 Creating non-commutative algebras, symmetric and antisymmetric operators	128
5.5 Procedures for repeated use of commands	130

5.6 A procedure for l'Hospital's rule and a caveat	131
5.7 Homework	133
Lecture 6	135
6.1 Linear algebra package: Matrices	135
6.2 Calculus of exterior differential forms in EXCALC	138
6.3 Turning switches on and off	142
6.4 Reordering expressions	144
6.5 On Reduce input and output	145
6.6 Generating Fortran programs	146
6.7 Concluding remarks	147
6.8 Homework	147
References	149
Appendix	150
A.1 Where can you buy Reduce?	150
A.2 Some additional exercises (preliminary)	151
 4. Appendix: A Short Introduction to FORTRAN	
By D. Stauffer	153