

# APPLICATIONS OF AUTOMATA THEORY AND ALGEBRA

Via the Mathematical Theory of Complexity to  
Biology, Physics, Psychology, Philosophy, and Games

John Rhodes



Edited by Christopher L. Nehaniv

Foreword by Morris W. Hirsch



World Scientific

## Contents

<i>Foreword to Rhodes' Applications of Automata Theory and Algebra</i>	vii
Morris W. Hirsch	
<i>Editorial Preface</i>	xiii
Chrystopher L. Nehaniv	
<i>Prologue: Birth, Death, Time, Space, Existence, Understanding, Science, and Religion</i>	1
John Rhodes	
1. Introduction	7
2. What is Finite Group Theory?	9
Bibliography . . . . .	14
3. A Generalization of Finite Group Theory to Finite Semigroups	15
Bibliography . . . . .	33
4. A Reformulation of Physics	35
Bibliography . . . . .	54
5. Automata Models and the Complexity of Finite State Machines	55
Part I. The Prime Decomposition Theorem . . . . .	55
Part II. Complexity of Finite State Machines . . . . .	67
Bibliography . . . . .	76
Appendix to Chapter 5 . . . . .	77

*Applications of Automata Theory and Algebra*

Bibliography . . . . .	108
6. Applications	111
Introduction . . . . .	111
Part I. Analysis and Classification of Biochemical Reactions . .	114
Bibliography . . . . .	175
Part II. Complexity of Evolved Organisms . . . . .	176
Appendix to Part II . . . . .	195
Bibliography . . . . .	201
Part III. The Lagrangian of Life . . . . .	203
A. The Laws of Growing and Evolving Organisms . . . . .	203
Bibliography . . . . .	219
B. Complexity, Emotion, Neurosis and Schizophrenia . . .	220
Bibliography . . . . .	239
Part IV. Complexity of Games . . . . .	241
Bibliography . . . . .	256
<i>Index</i>	257