

# Contents

<b>1</b>	<b>Discovering Lisp</b> . . . . .	1
1.1	Introduction . . . . .	1
1.2	Why Lisp? . . . . .	1
1.3	A Short History on Lisp . . . . .	4
1.4	The NewLisp Implementation . . . . .	7
1.5	A Quick Start Using NewLisp . . . . .	8
1.6	Using Variables . . . . .	13
1.7	As a Summary . . . . .	17
	References . . . . .	17
<b>2</b>	<b>Lists Everywhere</b> . . . . .	19
2.1	Introduction . . . . .	19
2.2	Atoms and Lists . . . . .	20
2.3	First and Rest . . . . .	24
2.4	Building Lists . . . . .	26
2.5	Some Geometry and then Some Art, Too . . . . .	30
2.6	A World Full of Queues . . . . .	38
2.7	Rotate, Extend and Flat . . . . .	42
2.8	As a Summary . . . . .	45
	References . . . . .	48
<b>3</b>	<b>Functions in Lisp</b> . . . . .	49
3.1	Introduction . . . . .	49
3.2	Starting Functions with Three Simple Examples and then Came Map . . . . .	50
3.3	Managing Lists with User Defined Functions . . . . .	55
3.4	The Discovery of Conditional Structures . . . . .	58
3.4.1	From Predicates to If-Then-Else Structures . . . . .	58
3.4.2	A Note About Functional Programming . . . . .	62

- 3.4.3 Robust Functions from the Use of Conditional Programming . . . . . 64
- 3.4.4 Solving Multiple Conditions Without Using If . . . . . 67
- 3.5 The Discovery of Loop Structures . . . . . 71
  - 3.5.1 While Computing . . . . . 71
  - 3.5.2 Other Looping Structures . . . . . 77
- 3.6 Recursion Is Based on Recursion . . . . . 81
- 3.7 A Note on Lambda Expressions . . . . . 87
- 3.8 As a Summary . . . . . 89
- References . . . . . 91
- 4 Lisp Programming.** . . . . . 93
  - 4.1 Introduction . . . . . 93
  - 4.2 From Montecarlo with Love . . . . . 94
    - 4.2.1 Declaring Global Variables. . . . . 95
    - 4.2.2 Throwing the Ball and Checking Results . . . . . 96
    - 4.2.3 Betting and Playing . . . . . 99
    - 4.2.4 Building a Simple User Interface . . . . . 102
    - 4.2.5 Putting It All Together. . . . . 105
  - 4.3 Messier Was a French Astronomer . . . . . 109
    - 4.3.1 Opening and Loading Databases in CSV Format. . . . . 111
    - 4.3.2 Querying the Database. . . . . 113
    - 4.3.3 Updating the Database. . . . . 115
    - 4.3.4 Modifying the Database. . . . . 116
    - 4.3.5 Filtering the Database . . . . . 120
    - 4.3.6 Performing Simple Statistics. . . . . 122
    - 4.3.7 Saving the Database . . . . . 123
  - 4.4 A Word on Function Design for This Chapter . . . . . 125
  - 4.5 As a Summary . . . . . 125
  - References . . . . . 127
- 5 From Crisp Sets to Fuzzy Sets** . . . . . 129
  - 5.1 Introduction . . . . . 129
  - 5.2 A Review of Crisp (Classical) Sets . . . . . 129
    - 5.2.1 Definition of Sets and the Concept of Belonging. . . . . 130
    - 5.2.2 Subsets . . . . . 131
    - 5.2.3 Union, Intersection, Complement and Difference. . . . . 134
    - 5.2.4 Set Properties . . . . . 139
    - 5.2.5 Cartesian Product and Relations . . . . . 140
  - 5.3 Moving Towards Fuzzy Sets . . . . . 143
    - 5.3.1 The “Fuzzy Sets” Paper. . . . . 144
    - 5.3.2 Union, Intersection and Complement of Fuzzy Sets. . . . . 149
    - 5.3.3 Fuzzy Sets Properties. . . . . 155
    - 5.3.4 Fuzzy Relations . . . . . 158

5.4	Membership Degrees: An Example Application in Medicine. . . . .	161
5.5	As a Summary . . . . .	166
	References . . . . .	167
<b>6</b>	<b>From Fuzzy Sets to Linguistic Variables. . . . .</b>	<b>169</b>
6.1	Introduction . . . . .	169
6.2	Towards Geometrical Characteristic Functions . . . . .	170
6.3	From Geometry to FuzzyLisp . . . . .	174
6.4	Support, Nucleus and Alpha-Cuts . . . . .	180
6.5	Fuzzy Sets with Discrete Characteristic Functions . . . . .	186
6.6	Revisiting Complement, Union and Intersection of Fuzzy Sets . . .	193
6.7	Fuzzy Numbers. . . . .	197
	6.7.1 Fuzzy Numbers Arithmetic. . . . .	198
	6.7.2 More Numerical Operations on Fuzzy Sets. . . . .	206
	6.7.3 Fuzzy Averaging. . . . .	209
6.8	Linguistic Variables. . . . .	212
6.9	Fuzzy Databases . . . . .	220
6.10	As a Summary . . . . .	225
	References . . . . .	227
<b>7</b>	<b>Fuzzy Logic. . . . .</b>	<b>229</b>
7.1	Introduction . . . . .	229
7.2	The Beginning of Logic. . . . .	230
7.3	Modern Bivalent Logic . . . . .	231
7.4	Fuzzy Logic . . . . .	234
7.5	Logical Connectives in Fuzzy Propositions. . . . .	236
7.6	Fuzzy Hedges. . . . .	242
7.7	Fuzzy Systems from Fuzzy Propositions . . . . .	248
	7.7.1 Fuzzy Rule-Based Systems. . . . .	251
	7.7.2 Defuzzification . . . . .	252
7.8	Modeling FRBS with FuzzyLisp. . . . .	258
7.9	Fuzzy Logic in Motor Racing: Scoring in Regularity Rallies . . . .	270
7.10	FRBS Using Fuzzy Sets with Discrete Membership Functions . . .	279
7.11	As a Summary . . . . .	283
	References . . . . .	287
<b>8</b>	<b>Practical Projects Using FuzzyLisp. . . . .</b>	<b>289</b>
8.1	Introduction . . . . .	289
8.2	Landing the Eagle: Simulation and Fuzzy Control in Engineering . . . . .	290
	8.2.1 Fuzzy Control. . . . .	294
	8.2.2 Controlling the Eagle. . . . .	296
	8.2.3 Interpreting Results . . . . .	303
8.3	Double Stars in Astronomy: Speech Synthesis . . . . .	306
	8.3.1 Generating Suitable Linguistic Variables . . . . .	310
	8.3.2 Managing Linguistic Expressions . . . . .	323

- 8.4 Spirometry Analysis in Medicine: Floating Singletons . . . . . 330
  - 8.4.1 Introducing Floating Singletons. . . . . 332
  - 8.4.2 Modeling Pulmonary Obstruction with FuzzyLISP . . . . . 334
- 8.5 As a Summary . . . . . 344
- References . . . . . 346
  
- Appendix A: NewLisp Versus Common Lisp . . . . . 347**
  
- Appendix B: Glossary of FuzzyLisp Functions . . . . . 353**



<http://www.springer.com/978-3-319-23185-3>

A Practical Introduction to Fuzzy Logic using LISP

Argüelles Méndez, L.

2016, XV, 370 p. 109 illus., 1 illus. in color., Hardcover

ISBN: 978-3-319-23185-3