# Designing Systems Programs

Technische Hochschule Darmstadt
FACHBEREICH INFORMATIK
BIBLIOTHEK
Inventar-Nr.: 1271
Sachgebiete:
Standort:

**Richard L. Gauthier**
*R.L.G. Associates, Inc.*

**Stephen D. Ponto**
*System Industries, Inc.*

*Prentice-Hall, Inc., Englewood Cliffs, New Jersey*

# contents

**1. Introduction** 1

## A. Techniques in Logic 3

**2. Recursion** 5
2.1 Parameter tracking 6
2.2 Algorithm structure 6
2.3 Tracking order 8
2.4 Stack memory 8

2.5 Algorithm examples 9
2.5.1 Factorial example 9
2.5.2 Permutation example 13
2.6 Summary 16
2.7 Exercises 17

**3. Polish strings** **18**
3.1 Standard expression form 19
3.2 Polish form 21
3.3 Polish evaluation algorithm 24
3.4 Summary 30
3.5 Exercises 30

**4. Syntax directed methods** **32**
4.1 Diagramming 33
4.2 Formal syntax definition 35
4.2.1 Order 36
4.2.2 Combination 36
4.2.3 Recursion 37
4.2.4 Common phrases 37
4.3 Automatic parsing 38
4.3.1 Bottom to top parsing 38
4.3.2 Top to bottom parsing 40
4.3.3 Computer based parsing 41
4.4 Syntax problems in automatic parsing 44
4.4.1 Ordering of alternatives 45
4.4.2 Circular definitions 45
4.5 Summary 46
4.6 Exercises 46

**5. Programming languages** **48**
5.1 Symbol declaration 49
5.2 Constant declaration 52
5.3 Expression declaration 53

5.4 Expression conversion to Polish form 60
5.4.1 Syntax considerations 62
5.4.2 Infix to Polish algorithm 63
5.4.3 Parenthetical expressions 66
5.4.4 Addition of operators 67
5.5 Coded format 73
5.6 Coding a complete language 77
5.7 Summary 81
5.8 Exercises 82

**6. Syntax driven algorithms 83**
6.1 Syntax tables 84
6.2 Syntax driver 85
6.3 Text processing 90
6.4 Repeat processing 90
6.5 Coded conversion processing 91
6.6 Summary 97
6.7 Exercises 97

**B. Techniques in Data Management 99**

**7. Data presentation 101**
7.1 Tables 102
7.2 Lists 102
7.3 Logical structure 103
7.4 Maintenance 105
7.4.1 Insertion 105
7.4.2 Deletion 105
7.4.3 Storage efficiency 108
7.5 Summary 111
7.6 Exercises 111

**8. Search structures** **112**
8.1 Choosing a search structure 113
8.2 Linear search 113
8.2.1 Data structure 114
8.2.2 Search mechanism 114
8.2.3 Insert mechanism 114
8.2.4 Delete mechanism 115
8.3 Binary search 116
8.3.1 Data structure 116
8.3.2 Search mechanism 116
8.3.3 Insert mechanism 118
8.3.4 Delete mechanism 120
8.4 Unbalanced tree search 121
8.4.1 Data structure 121
8.4.2 Search mechanism 122
8.4.3 Insert mechanism 125
8.4.4 Delete mechanism 126
8.5 Balanced tree search 127
8.5.1 Data structure 127
8.5.2 Search mechanism 130
8.5.3 Insert mechanism 130
8.5.4 Mathematical notation 132
8.5.5 Assignment notation 133
8.5.6 Balance algorithm 134
8.5.7 Insert timing 141
8.5.8 Delete mechanism 141
8.5.9 Delete timing 143
8.5.10 Mathematical notation for the balance after delete algorithm 144
8.5.11 Mathematical algorithms 144
8.6 Hash total search 151
8.7 Summary 154
8.8 Exercises 156

**C. System Application** **159**

**9. Definition of a sample compiler system** **161**
9.1 Program variables 162

9.2 Program expressions 162
9.2.1 Operator priorities 163
9.2.2 Parenthetical usage 164
9.3 Functions 164
9.4 Statements 165
9.4.1 Assignment statement 165
9.4.2 GO TO statement 165
9.4.3 DO statements 166
9.4.4 Input/output statements 169
9.4.5 IF clause 170
9.5 Program example 171
9.6 System syntax 173
9.7 Programmer interaction 174
9.8 Summary 174

**10. Elements of design 176**
10.1 Task segmentation 176
10.1.1 Logically complete segments 177
10.1.2 Segment delineation 178
10.2 Development plan 179
10.2.1 Manpower allocation 179
10.2.2 Implementation 179
10.2.3 System modularity 180
10.3 Summary 180
10.4 Exercises 180

**11. Sample system design 182**
11.1 Processing philosophy 182
11.1.1 Direct approach 183
11.1.2 Interpretive approach 183
11.1.3 Choosing an approach 184
11.2 Phase structure 185
11.3 Phase delineation 185
11.3.1 Parsed statement formats 186
11.3.2 Block chart 190
11.4 Parsing phase 191
11.4.1 Acceptance module 192

11.4.2 Parser module 192
11.4.3 Control 193
11.5 Interpretive phase 194
11.5.1 Interpreter module 194
11.5.2 Function module 194
11.5.3 Control 195
11.6 System block chart 196
11.7 Summary 198
11.8 Exercises 198

**12. Sample system implementation 199**
12.1 Parsing phase 200
12.1.1 Control module 200
12.1.2 Acceptance module 201
12.1.3 Parser module 201
12.2 Interpretive phase 223
12.2.1 Control module 224
12.2.2 Function module 224
12.2.3 Interpreter module 225
12.2.4 Driver subroutine 226
12.2.5 Statement subroutines 229
12.2.6 Expression subroutine 233
12.2.7 Summary 253
12.3 System summary 253
12.4 Exercises 253

**13. Summary 255**

**Answers to exercises 259**

**Index 271**