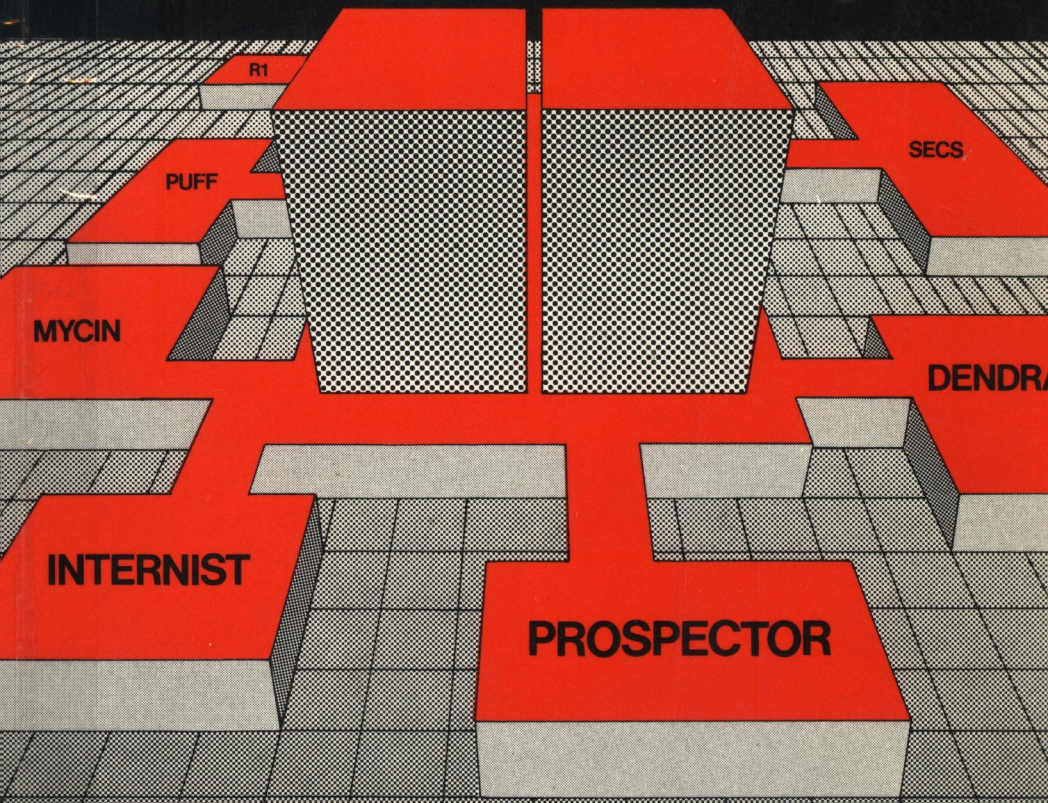
NCC PUBLICATIONS

EXPERT SYSTEMS

CONCEPTS AND EXAMPLES



JL ALTY AND MJ COOMBS

Contents

Page

Preface

Acknowledgements

PART I BACKGROUND CONCEPTS 15

1 Traditional Data Processing and Expert Systems 17

1.1 Introduction 17
1.2 The Representation Problem 17
1.3 Knowledge Representation 19
1.4 The Traditional Approach 23
1.5 An Alternative Representation for Classes, Relations and Rules 28
1.6 An Alternative Control Structure – Production Systems 29
1.7 Control Structures and Domain Dependence 31
1.8 Other Limitations of the Traditional Approach 33
1.9 The Way Ahead 36

2 Fundamentals of Predicate Calculus and Logical Inference 37

2.1 Introduction 37
2.2 Predicate Calculus and the Representation of Knowledge 39
2.3 Logical Inference 43
2.4 Problems with Predicate Calculus for Knowledge Processing 49

3 Computational Approaches to Representation and Control 53

3.1 The Shift to Knowledge-Based Systems 53
3.2 LISP – A Language for Programming Knowledge-Based Systems 57
3.3 The Representation of Domain Knowledge 60
3.4 Problems of Control 76

PART II EXAMPLES OF EXPERT SYSTEMS 83

4 Expert Systems and Expert Problem-Solvers 85

4.1 Knowledge-Based Problem-Solving 85
4.2 A Classification Scheme for Expert Systems 89

5 The Handling of Uncertain Evidence – MYCIN and PROSPECTOR 93

5.1 Introduction 93
5.2 MYCIN (EMYCIN) Overview 94
5.3 PROSPECTOR Overview 103
5.4 Conclusions 115

6 Associative and Causal Approaches to Diagnosis – INTERNIST and CASNET 119

6.1 Introduction 119
6.2 The INTERNIST Project 120
6.3 CASNET 129

7 Reducing Large Search Spaces Through Factoring – Heuristic DENDRAL and Meta-DENDRAL 137

7.1 Processing Large Search Spaces 137
7.2 The Application Task 138
7.3 Heuristic DENDRAL 142
7.4 Meta-DENDRAL 146

8 Handling Large Search Spaces Through the Use of Abstraction – R1 and MOLGEN 153

8.1 Levels of Description in a Search Space 153
8.2 R1 155

8.3 R1 Conclusions 161
8.4 MOLGEN 161
8.5 MOLGEN Conclusions 175

9 Further Developments in Expert Systems 177

9.1 The Automation of Predicate Logic 177
9.2 Some Advantages of Predicate Logic 189
9.3 Developments in Expert Systems 191

Bibliography 195

Index 201