Contents

Introduction v

I Automated Program Correction 1

1 A Multiparadigm Correction Scheme 3
1.1 Exploiting debugger outcomes . . . 4
1.2 Inductive learning . . . 5
1.3 Correction scheme . . . 6

2 Preliminaries 9
2.1 Foundations . . . 9
2.1.1 Terms and equations . . . 9
2.1.2 Substitutions and syntactic unification . . . 10
2.1.3 $\mathcal{V}$-Herbrand base and program semantics . . . 11
2.2 Programs as term rewriting systems . . . 11
2.3 The narrowing relation . . . 12
2.4 Conditional programs and narrowing . . . 14

3 Correction of Functional Logic Programs 17
3.1 Denotation of functional logic programs . . . 19
3.2 Diagnosis of declarative programs . . . 20
3.3 Correction method . . . 21
3.3.1 Automatic generation of positive and negative example sets . . . 21
3.3.2 Specialization operators . . . 22
3.3.3 Top-down correction algorithm . . . 23
3.3.4 Correctness of the algorithm . . . 24
3.4 Improving the algorithm . . . 25
3.5 Automated correction system . . . 29
3.5.1 Experimental evaluation . . . 30

4 Correction of First-Order Functional Programs 31
4.1 Denotation of functional programs . . . 33
4.1.1 Concrete semantics . . . 33
4.1.2 Abstract semantics . . . 35
4.2 The correction problem . . . 36
4.3 How to generate example sets automatically . . . 36
4.4 Example-guided unfolding . . . 37

4.4.1 The unfolding operator 38
4.4.2 The top-down correction algorithm 39
4.4.3 Correctness of algorithm TDCorrectorF 42

II Web Site Verification 45

5 A Language for Verifying Web sites 47
5.1 Basic notions 48
5.2 Denotation of Web sites 51
5.3 Web specification language 53
5.4 Partial rewriting 56
5.4.1 Page simulations 56
5.4.2 Rewriting Web page templates 59
5.5 The verification framework 61
5.5.1 Detecting correctness errors 61
5.5.2 Detecting completeness errors 64
5.6 Implementation 71

Conclusions 73

A Context Sensitive Rewriting and Over-Generality 77
A.1 Deciding over-generality by context sensitive rewriting 77
A.1.1 Context Sensitive Rewriting 77
A.1.2 Testing $\mathcal{R} \vdash E^+$ 78
A.1.3 Extending the decision algorithm to CTRSs 81

B Some technicalities 83
B.1 Proofs of the technical results of Chapter 3 83
B.2 Proofs of the technical results of Chapter 4 87
B.3 Proofs of the technical results of Chapter 5 91

Bibliography 101