

Contents

1	Introduction	1
1.1	Motivation and Goals	5
1.2	Research Contributions	7
1.3	Organization	8
2	Definition of Terms	11
2.1	Graphs	11
2.2	Graph Editors	13
3	Related Work: Graph Editors	15
3.1	Special-Purpose Graph Editors	16
3.2	General-Purpose Graph Editors	23
3.3	Extendible Graph Editors	26
3.4	Summary	33
4	Layout Algorithms and Layout Constraints	35
4.1	Related Work	35
4.1.1	Planar Graphs	38
4.1.2	Undirected Graphs	39
4.1.3	Trees	40
4.1.4	Directed Graphs	41
4.2	Layout Constraints	45
4.2.1	Low-Level Constraints	47
4.2.2	Constraint Manager	47
4.2.3	Three-Dimensional Constraints	48
4.2.4	Integration with Layout Algorithms	49
4.2.5	Examples	50
4.2.6	Results	53
4.3	Layout Stability	53
4.3.1	Examples	55
4.3.2	Results	69

5 Graphical Abstraction	73
5.1 Related Work	73
5.2 Subgraph Abstraction	76
5.2.1 Representation	76
5.2.2 Definition	80
5.2.3 Examples	81
5.2.4 Results	81
5.3 Edge Concentration	81
5.3.1 Representation	82
5.3.2 Definition	83
5.3.3 The Complexity of the Edge Concentration Problem	84
5.3.4 An Approximate Solution	86
5.3.5 Examples	90
5.3.6 Results	99
6 Persistence	101
6.1 Related Work	102
6.1.1 Overview of Methods to Achieve Persistence	102
6.1.2 External Formats for Graph-Based Tools	104
6.1.3 External Formats for Other Tools	106
6.2 GRL: An External Representation for Graph-Based Tools	109
6.3 Language Extension	113
6.4 Examples	114
6.5 Results	117
7 Extendibility	119
7.1 Related Work	119
7.2 An Object-Oriented Graph Editor	121
7.2.1 Graph Class	122
7.2.2 Node Class	124
7.2.3 Edge Class	125
7.3 AGENT: A Tool to Automate Extendibility	125
7.3.1 Input Routines	127
7.3.2 Output Routines	127
7.3.3 Menu Routines	127
7.3.4 Constructors and Destructors	127
7.3.5 Class Hierarchy	128
7.3.6 Exception List	128
7.4 Example	129
7.5 Results	131

8	EDGE: An Extendible Graph Editor	133
8.1	Graph Layout	135
8.2	Graphical Abstraction	136
8.2.1	Subgraph Abstraction	136
8.2.2	Edge Concentration	137
8.3	Persistence	137
8.4	Extendibility	138
8.4.1	Changing Visual Appearance	138
8.4.2	Interfacing EDGE with an Existing Application	139
8.4.3	Integrating EDGE with a New Application	139
8.5	Implementation	139
8.6	Examples	140
8.6.1	A Browser for Entity-Relationship Diagrams	140
8.6.2	A Tool for Visualizing Software Configurations	141
8.6.3	A PERT Chart Editor	143
8.6.4	A Call Graph Animator	145
8.6.5	A Directory Editor	146
8.6.6	A Logic Simulator	148
8.7	Results	150
9	Summary and Future Research	153
9.1	Graph Layout	153
9.2	Graphical Abstraction	156
9.3	Persistence	158
9.4	Extendibility	159
9.5	Other Areas	160
10	Conclusion	163
Appendix		167
A	EBNF Grammar for GRL	167
Bibliography		171
Index		183