

Contents

1	Introduction	1
1.1	Outlook	5
2	Systems for Collaboration	7
2.1	Shared-workspace user interfaces	8
2.2	Dialogue user interfaces	11
2.3	Collaboration through dialogue interfaces	13
2.4	Collaboration through shared workspaces	18
2.5	Summary	22
3	Shared Cardspaces	23
3.1	Partial synchronization of user interfaces	24
3.2	Intelligent support	27
3.3	Shared workspaces with visual languages	34
3.4	Action messages	38
3.5	Operational semantics for card languages	41
3.6	Applications	45
3.6.1	Querying a relational database: <i>Database Query</i>	46

3.6.2	Error diagnosis for derivatives: <i>Deriv</i>	47
3.6.3	Computer player for puzzle solving: <i>Turtle Puzzle</i>	49
3.6.4	Controlling an agent in a microworld: <i>Turtle Maze</i>	50
3.6.5	Controlling turn-taking with Petri nets: <i>Petri Net</i>	53
3.7	Further Work	53
3.8	Summary	55
4	Analysis Systems	57
4.1	First approaches	57
4.1.1	The system MARCO	58
4.1.2	The system DEGREE	60
4.1.3	The system COLER	61
4.1.4	Comparison of first approaches	62
4.2	Process-oriented learner modeling	63
4.2.1	Discussion on process-oriented learner modeling	68
4.3	Plan recognition	70
4.3.1	Situation calculus	71
4.3.2	Task analysis	73
4.3.3	Discourse analysis	75
4.3.4	Discussion on plan recognition	77
4.4	Conclusions	78
4.5	Summary	79

5 Activity Recognition	81
5.1 Action-based collaboration analysis	82
5.2 Actions and operators	83
5.3 Workspace actions	87
5.4 Situations	90
5.5 Recognition of abstracted actions	93
5.6 Recognition of composed actions	95
5.7 External actions	100
5.8 Summary	102
6 Activity Hierarchy	105
6.1 Basic actions	106
6.2 Relation actions	108
6.3 Phase actions	112
6.4 Transrelation actions	113
6.5 Indicator actions	115
6.6 Sequence actions	116
6.7 Interaction actions	118
6.8 Summary	121
7 Applications and Tests	125
7.1 Example analysis	125
7.2 Applications	129
7.2.1 Turtle puzzle	130

7.2.2 Donald puzzle	134
7.2.3 Planning graph	136
7.2.4 Discussion graph	137
7.3 Visualization	139
7.4 Tests	145
7.4.1 Test setting and procedure	145
7.4.2 Evaluation of the tests	151
7.5 Summary	160
8 Discussion and Summary	161
8.1 Discussion on activity recognition	163
8.1.1 Comparison to process-oriented learner modeling	163
8.1.2 Issues concerning plan recognition	165
8.2 Discussion on the activity hierarchy	170
8.3 Major contributions	172
References	175