

ISO/IEC 19501 :2005-04 (E)

Information technology_ - Open Distributed Processing_ - Unified Modeling Language (UML) Version 1.4.2

- 1 Scope 1
- 2 Normative references 1
 - 2.1 Identical Recommendations | International Standards 1
- 3 General Information2
 - 3.1 Description 2
 - 3.2 Outside the Scope of the UML 3
 - 3.2.1 Programming Languages 3
 - 3.2.2 Tools 3
 - 3.2.3 Process 3
 - 3.3 Primary Artifacts of the UML 4
 - 3.3.1 UML-defining Artifacts 4
 - 3.3.2 Development Project Artifacts 4
 - 3.4 Motivation to Define the UML 5
 - 3.4.1 Why We Model 5
 - 3.4.2 Industry Trends in Software 5
 - 3.4.3 Prior to Industry Convergence 6
 - 3.5 Goals of the UML 6
 - 3.5.1 Comparing UML to Other Modeling Languages 8
 - 3.5.2 Features of the UML 8
 - 3.6 UML - Past, Present, and Future 10
 - 3.6.1 UML 0.8 - 0.91 10
 - 3.6.2 UML Partners 11
 - 3.6.3 UML - Present and Future 11
- 4 UML Semantics 13
 - Part 1 - Background**
 - 4.1 Introduction 13
 - 4.1.1 Purpose and Scope 13
 - 4.1.2 Approach 13
 - 4.2 Language Architecture 14
 - 4.2.1 Four-Layer Metamodel Architecture 14
 - 4.2.2 Package Structure..... 15
 - 4.3 Language Formalism 17
 - 4.3.1 Levels of Formalism 17
 - 4.3.2 Package Specification Structure 18
 - 4.3.3 Use of a Constraint Language 19
 - 4.3.4 Use of Natural Language 19
 - 4.3.5 Naming Conventions and Typography 20
 - Part 2 - Foundation**
 - 4.4 Foundation Package 20
 - 4.5 Core 21
 - 4.5.1 Overview 21
 - 4.5.2 Abstract Syntax 21
 - 4.5.3 Well-Formedness Rules 51
 - 4.5.4 Detailed Semantics 63

4.6	Extension Mechanisms	69
4.6.1	Overview	69
4.6.2	Abstract Syntax	71
4.6.3	Well-Formedness Rules	74
4.6.4	Detailed Semantics	76
4.6.5	Notes	77
4.7	Data Types	78
4.7.1	Overview	78
4.7.2	Abstract Syntax	78

Part 3 - Behavioral Elements

4.8	Behavioral Elements Package	85
4.9	Common Behavior	85
4.9.1	Overview	85
4.9.2	Abstract Syntax	85
4.9.3	Well-Formedness Rules	96
4.9.4	Detailed Semantics	101
4.10	Collaborations	103
4.10.1	Overview	103
4.10.2	Abstract Syntax	104
4.10.3	Well-Formedness Rules	111
4.10.4	Detailed Semantics	115
4.10.5	Notes	118
4.11	Use Cases	119
4.11.1	Overview	119
4.11.2	Abstract Syntax	119
4.11.3	Well-Formedness Rules	122
4.11.4	Detailed Semantics	124
4.11.5	Notes	128
4.12	State Machines	128
4.12.1	Overview	128
4.12.2	Abstract Syntax	128
4.12.3	Well-FormednessRules	136
4.12.4	Detailed Semantics	140
4.12.5	Notes	148
4.13	Activity Graphs	152
4.13.1	Overview	152
4.13.2	Abstract Syntax	152
4.13.3	Well-Formedness Rules	156
4.13.4	Detailed Semantics	159
4.13.5	Notes	160

Part 4 - General Mechanisms

4.14	Model Management	161
4.14.1	Overview	161
4.14.2	Abstract Syntax	161
4.14.3	Well-Formedness Rules	165
4.14.4	Semantics	170
4.14.5	Notes	174

5 UML Notation Guide	177
Part 1 - Background	
5.1 Introduction	177
Part 2 - Diagram Elements	
5.2 Graphs and Their Contents	178
5.3 Drawing Paths	178
5.4 Invisible Hyperlinks and the Role of Tools	179
5.5 Background Information	179
5.5.1 Presentation Options	179
5.6 String	179
5.6.1 Semantics	179
5.6.2 Notation	179
5.6.3 Presentation Options	180
5.6.4 Examples	180
5.6.5 Mapping	180
5.7 Name	180
5.7.1 Semantics	180
5.7.2 Notation	180
5.7.3 Example	180
5.7.4 Mapping	181
5.8 Label	181
5.8.1 Semantics	181
5.8.2 Notation	181
5.8.3 Presentation Options.....	181
5.8.4 Example	181
5.9 Keywords	181
5.10 Expression	182
5.10.1 Semantics	182
5.10.2 Notation	182
5.10.3 Examples	182
5.10.4 Mapping	182
5.10.5 OCL Expressions	182
5.10.6 Selected OCL Notation	183
5.10.7 Examples	183
5.11 Note	183
5.11.1 Semantics	183
5.11.2 Notation	183
5.11.3 Presentation Options	183
5.11.4 Example	184
5.11.5 Mapping	184
5.12 Type-Instance Correspondence	184
Part 3 - Model Management	
5.13 Package	186
5.13.1 Semantics	186
5.13.2 Notation	186

5.13.3 Presentation Options	186
5.13.4 Style Guidelines	187
5.13.5 Example	187
5.13.6 Mapping	188
5.14 Subsystem	188
5.14.1 Semantics	188
5.14.2 Notation	188
5.14.3 Presentation Options	189
5.14.4 Example	190
5.14.5 Mapping	193
5.15 Model	193
5.15.1 Semantics	193
5.15.2 Notation	193
5.15.3 Presentation Options	193
5.15.4 Example	194
5.15.5 Mapping	194

Part 4 - General Extension Mechanisms

5.16 Constraint and Comment	195
5.16.1 Semantics	195
5.16.2 Notation	195
5.16.3 Example	196
5.16.4 Mapping	196
5.17 Element Properties	197
5.17.1 Semantics	197
5.17.2 Notation	197
5.17.3 Presentation Options	198
5.17.4 Style Guidelines	198
5.17.5 Example	198
5.17.6 Mapping	198
5.18 Stereotypes	199
5.18.1 Semantics	199
5.18.2 Notation	199
5.18.3 Examples	200
5.18.4 Mapping	200

Part 5 - Static Structure Diagrams

5.19 Class Diagram	201
5.19.1 Semantics	201
5.19.2 Notation	201
5.19.3 Mapping	201
5.20 Object Diagram	201
5.21 Classifier	201
5.22 Class	202
5.22.1 Semantics	202
5.22.2 Basic Notation	202
5.22.3 Presentation Options	202
5.22.4 Style Guidelines	203
5.22.5 Example	203

5.22.6 Mapping	203
5.23 Name Compartment	204
5.23.1 Notation	204
5.23.2 Mapping	204
5.24 List Compartment	204
5.24.1 Notation	204
5.24.2 Presentation Options.....	205
5.24.3 Example	206
5.24.4 Mapping	206
5.25 Attribute	207
5.25.1 Semantics	207
5.25.2 Notation	207
5.25.3 Presentation Options	208
5.25.4 Style Guidelines	209
5.25.5 Example	209
5.25.6 Mapping	209
5.26 Operation	209
5.26.1 Semantics	209
5.26.2 Notation	209
5.26.3 Presentation Options	210
5.26.4 Style Guidelines	211
5.26.5 Example	211
5.26.6 Mapping	211
5.27 Nested Class Declarations.....	212
5.27.1 Semantics	212
5.27.2 Notation	212
5.27.3 Mapping	212
5.28 Type and Implementation Class.....	212
5.28.1 Semantics	212
5.28.2 Notation	213
5.28.3 Example	213
5.28.4 Mapping	213
5.29 Interfaces	214
5.29.1 Semantics	214
5.29.2 Notation	214
5.29.3 Example	214
5.29.4 Mapping	215
5.30 Parameterized Class (Template.....	215
5.30.1 Semantics	215
5.30.2 Notation	215
5.30.3 Presentation Options.....	216
5.30.4 Example	216
5.30.5 Mapping	216
5.31 Bound Element	217
5.31.1 Semantics	217
5.31.2 Notation	217
5.31.3 Style Guidelines	217
5.31.4 Example	217
5.31.5 Mapping	217
5.32 Utility	218

5.32.1 Semantics	218
5.32.2 Notation	218
5.32.3 Example	218
5.32.4 Mapping	218
5.33 Metaclass	218
5.33.1 Semantics	218
5.33.2 Notation	218
5.33.3 Mapping	219
5.34 Enumeration	219
5.34.1 Semantics	219
5.34.2 Notation	219
5.34.3 Mapping	219
5.35 Stereotype Declaration	219
5.35.1 Semantics	219
5.35.2 Notation	219
5.35.3 Mapping	222
5.36 Powertype	222
5.36.1 Semantics	222
5.36.2 Notation	222
5.36.3 Mapping	222
5.37 Class Pathnames	223
5.37.1 Notation	223
5.37.2 Example	223
5.37.3 Mapping	223
5.38 Accessing or Importing a Package	223
5.38.1 Semantics	223
5.38.2 Notation	224
5.38.3 Example	224
5.38.4 Mapping	224
5.39 Object	225
5.39.1 Semantics	225
5.39.2 Notation	225
5.39.3 Presentation Options	225
5.39.4 Style Guidelines	226
5.39.5 Variations	226
5.39.6 Example	226
5.39.7 Mapping	226
5.40 Composite Object	226
5.40.1 Semantics	226
5.40.2 Notation	227
5.40.3 Example	227
5.40.4 Mapping	227
5.41 Association	227
5.42 Binary Association	228
5.42.1 Semantics	228
5.42.2 Notation	228
5.42.3 Presentation Options	229
5.42.4 Style Guidelines	229
5.42.5 Options	229
5.42.6 Example	229

5.42.7 Mapping	230
5.43 Association End	230
5.43.1 Semantics	230
5.43.2 Notation.....	230
5.43.3 Presentation Options.....	232
5.43.4 Style Guidelines	232
5.43.5 Example	232
5.43.6 Mapping	233
5.44 Multiplicity	233
5.44.1 Semantics	233
5.44.2 Notation.....	233
5.44.3 Style Guidelines	233
5.44.4 Example	233
5.44.5 Mapping	234
5.45 Qualifier	234
5.45.1 Semantics	234
5.45.2 Notation	234
5.45.3 Presentation Options.....	234
5.45.4 Style Guidelines	234
5.45.5 Example	235
5.45.6 Mapping	235
5.46 Association Class.....	235
5.46.1 Semantics	235
5.46.2 Notation	235
5.46.3 Presentation Options.....	235
5.46.4 Style Guidelines	235
5.46.5 Example	236
5.46.6 Mapping	236
5.47 N-ary Association	236
5.47.1 Semantics	236
5.47.2 Notation	236
5.47.3 Style Guidelines	237
5.47.4 Example	237
5.47.5 Mapping	237
5.48 Composition	237
5.48.1 Semantics	237
5.48.2 Notation.....	238
5.48.3 Design Guidelines	238
5.48.4 Example	239
5.48.5 Mapping	240
5.49 Link	240
5.49.1 Semantics	240
5.49.2 Notation	240
5.49.3 Example	241
5.49.4 Mapping	241
5.50 Generalization	241
5.50.1 Semantics	241
5.50.2 Notation	241
5.50.3 Presentation Options	242
5.50.4 Mapping	244

5.51	Dependency	245
5.51.1	Semantics	245
5.51.2	Notation.....	245
5.51.3	Presentation Options.....	246
5.51.4	Example	246
5.51.5	Mapping	247
5.52	Derived Element	247
5.52.1	Semantics	247
5.52.2	Notation	247
5.52.3	Style Guidelines	247
5.53	InstanceOf	247
5.53.1	Semantics	247
5.53.2	Notation.....	248
5.53.3	Mapping	248

Part 6 - Use Case Diagrams

5.54	Use Case Diagram	248
5.54.1	Semantics	248
5.54.2	Notation.....	248
5.54.3	Example	249
5.54.4	Mapping	249
5.55	Use Case	249
5.55.1	Semantics	249
5.55.2	Notation	250
5.55.3	Presentation Options.....	250
5.55.4	Style Guidelines	250
5.55.5	Mapping	250
5.56	Actor	250
5.56.1	Semantics	250
5.56.2	Notation	250
5.56.3	Presentation Options.....	250
5.56.4	Style Guidelines	251
5.56.5	Mapping	251
5.57	Use Case Relationships	251
5.57.1	Semantics	251
5.57.2	Notation.....	251
5.57.3	Example	252
5.57.4	Mapping	252
5.58	Actor Relationships	252
5.58.1	Semantics	252
5.58.2	Notation	252
5.58.3	Example	253
5.58.4	Mapping	253

Part 7 - Interaction Diagrams

5.59	Collaboration	253
5.59.1	Semantics	253
5.60	Sequence Diagram	254
5.60.1	Semantics	254

5.60.2 Notation	254
5.60.3 Presentation Options	255
5.60.4 Example	256
5.60.5 Mapping	258
5.61 Object Lifeline	260
5.61.1 Semantics	260
5.61.2 Notation	260
5.61.3 Presentation Options	260
5.61.4 Example	261
5.61.5 Mapping	261
5.62 Activation.....	261
5.62.1 Semantics	261
5.62.2 Notation	261
5.62.3 Example	262
5.62.4 Mapping	262
5.63 Message and Stimulus.....	262
5.63.1 Semantics	262
5.63.2 Notation	262
5.63.3 Presentation options	262
5.63.4 Example	264
5.63.5 Mapping	264
5.64 Transition Times.....	264
5.64.1 Semantics	264
5.64.2 Notation	264
5.64.3 Presentation Options.....	264
5.64.4 Example	264
5.64.5 Mapping	264

Part 8 - Collaboration Diagrams

5.65 Collaboration Diagram	264
5.65.1 Semantics	264
5.65.2 Notation	265
5.65.3 Example	266
5.65.4 Mapping	267
5.66 Pattern Structure	267
5.66.1 Semantics	267
5.66.2 Notation	268
5.66.3 Mapping	270
5.67 Collaboration Contents.....	270
5.67.1 Semantics	271
5.67.2 Notation.....	271
5.67.3 Mapping	272
5.68 Interactions.....	272
5.68.1 Semantics	272
5.68.2 Notation	273
5.68.3 Mapping	273
5.68.4 Example	273
5.69 Collaboration Roles	273
5.69.1 Semantics	273
5.69.2 Notation	273

5.69.3 Presentation options	274
5.69.4 Example	275
5.69.5 Mapping	275
5.70 Multiobject	275
5.70.1 Semantics	275
5.70.2 Notation	275
5.70.3 Example	276
5.70.4 Mapping	276
5.71 Active object	276
5.71.1 Semantics	276
5.71.2 Notation	276
5.71.3 Example	277
5.71.4 Mapping	277
5.72 Message and Stimulus	277
5.72.1 Semantics	277
5.72.2 Notation	278
5.72.3 Presentation Options	280
5.72.4 Example	280
5.72.5 Mapping	280
5.73 Creation/Destruction Markers	281
5.73.1 Semantics	281
5.73.2 Notation	281
5.73.3 Presentation options	281
5.73.4 Example	281
5.73.5 Mapping	282

Part 9 - Statechart Diagrams

5.74 Statechart Diagram	282
5.74.1 Semantics	282
5.74.2 Notation	282
5.74.3 Mapping	283
5.75 State	283
5.75.1 Semantics	283
5.75.2 Notation	283
5.75.3 Mapping	285
5.76 Composite States	285
5.76.1 Semantics	285
5.76.2 Notation	285
5.76.3 Examples	286
5.76.4 Mapping	287
5.77 Events	287
5.77.1 Semantics	287
5.77.2 Notation	288
5.77.3 Example	289
5.77.4 Mapping	289
5.78 Simple Transitions	289
5.78.1 Semantics	289
5.78.2 Notation	290
5.78.3 Example	290
5.78.4 Mapping	290

5.79	Transitions to and from Concurrent States	291
5.79.1	Semantics	291
5.79.2	Notation	291
5.79.3	Example	291
5.79.4	Mapping	291
5.80	Transitions to and from Composite States	291
5.80.1	Semantics	291
5.80.2	Notation	292
5.80.3	Presentation Options	292
5.80.4	Example	292
5.80.5	Mapping	293
5.81	Factored Transition Paths	294
5.81.1	Semantics	294
5.81.2	Notation	294
5.81.3	Examples	294
5.82	Submachine States	295
5.82.1	Semantics	295
5.82.2	Notation	296
5.82.3	Example	296
5.82.4	Mapping	297
5.83	Synch States	297
5.83.1	Semantics	297
5.83.2	Notation	297
5.83.3	Example	297
5.83.4	Mapping	297

Part 10 - Activity Diagrams

5.84	Activity Diagram	298
5.84.1	Semantics	298
5.84.2	Notation	298
5.84.3	Example	299
5.84.4	Mapping	300
5.85	Action State	300
5.85.1	Semantics	300
5.85.2	Notation	300
5.85.3	Presentation options	300
5.85.4	Example	300
5.85.5	Mapping	300
5.86	Subactivity state	300
5.86.1	Semantics	300
5.86.2	Notation	301
5.86.3	Example	301
5.86.4	Mapping	301
5.87	Decisions	301
5.87.1	Semantics	301
5.87.2	Notation	301
5.87.3	Example	302
5.87.4	Mapping	302
5.88	Call States	302

5.88.1 Semantics	302
5.88.2 Notation	302
5.88.3 Example	302
5.88.4 Mapping	303
5.89 Swimlanes	303
5.89.1 Semantics	303
5.89.2 Notation.....	303
5.89.3 Example	304
5.89.4 Mapping	304
5.90 Action-Object Flow Relationships	304
5.90.1 Semantics	304
5.90.2 Notation.....	305
5.90.3 Example	306
5.90.4 Mapping	306
5.91 Control Icons	306
5.91.1 Notation	307
5.91.2 Mapping	308
5.92 Synch States	308
5.93 Dynamic Invocation	309
5.93.1 Semantics	309
5.93.2 Notation	309
5.93.3 Mapping	309
5.94 Conditional Forks	309

Part 11 - Implementation Diagrams

5.95 Component Diagram	310
5.95.1 Semantics	310
5.95.2 Notation.....	310
5.95.3 Example	311
5.95.4 Mapping	312
5.96 Deployment Diagram	312
5.96.1 Semantics	312
5.96.2 Notation.....	312
5.96.3 Example	313
5.96.4 Mapping	313
5.97 Node	313
5.97.1 Semantics	313
5.97.2 Notation.....	314
5.97.3 Example	314
5.97.4 Mapping	315
5.98 Component.....	315
5.98.1 Semantics	315
5.98.2 Notation.....	316
5.98.3 Example	316
5.98.4 Mapping	317
6 UML Example Profiles	319

6.1	Introduction	319
6.2	Summary of Profile.....	319
6.3	Stereotypes and Notation	320
6.3.1	Use Case Stereotypes	320
6.3.2	Analysis Stereotypes	321
6.3.3	Design Stereotypes.....	322
6.3.4	Implementation Stereotypes	323
6.3.5	Class Stereotypes	324
6.3.6	Association Stereotypes	325
6.4	Well-Formedness Rules	325
6.4.1	Generalization	326
6.4.2	Containment.....	326

Example 2 - UML Profile for Business Modeling

6.5	Introduction	326
6.6	Summary of Profile.....	326
6.7	Stereotypes and Notation	327
6.7.1	Use Case Stereotypes	327
6.7.2	Organization Stereotypes	328
6.7.3	Class Stereotypes	329
6.7.4	Association Stereotypes.....	331
6.8	Well-Formedness Rules	332
6.8.1	Generalization	332
7	UML Model Interchange	333
7.1	Overview	333
7.2	Model Interchange Using XMI.....	353
7.3	Model Interchange Using CORBA IDL	355
8	Object Constraint Language Specification	357
8.1	Overview	357
8.1.1	Why OCL?.....	357
8.1.2	Where to Use OCL.....	357
8.2	Introduction	358
8.2.1	Legend	358
8.2.2	Example Class Diagram.....	358
8.3	Relation to the UML Metamodel.....	359
8.3.1	Self.....	359
8.3.2	Specifying the UML context	359
8.3.3	Invariants	360
8.3.4	Pre- and Postconditions.....	360
8.3.5	Package context	361
8.3.6	General Expressions	361
8.4	Basic Values and Types	361
8.4.1	Types from the UML Model.....	362
8.4.2	Enumeration Types	362
8.4.3	Let Expressions and «definition» Constraints.....	362
8.4.4	Type Conformance.....	363
8.4.5	Re-typing or Casting	364

8.4.6	Precedence Rules	364
8.4.7	Use of Infix Operators	364
8.4.8	Keywords	365
8.4.9	Comment	365
8.4.10	Undefined Values	365
8.5	Objects and Properties	366
8.5.1	Properties	366
8.5.2	Properties: Attributes	366
8.5.3	Properties: Operations	366
8.5.4	Properties: Association Ends and Navigation	367
8.5.5	Navigation to Association Classes	368
8.5.6	Navigation from Association Classes	369
8.5.7	Navigation through Qualified Associations	370
8.5.8	Using Pathnames for Packages	370
8.5.9	Accessing overridden properties of supertypes	370
8.5.10	Predefined properties on All Objects	371
8.5.11	Features on Classes Themselves	372
8.5.12	Collections	373
8.5.13	Collections of Collections	374
8.5.14	Collection Type Hierarchy and Type Conformance Rules	374
8.5.15	Previous Values in Postconditions	374
8.6	Collection Operations	375
8.6.1	Select and Reject Operations	375
8.6.2	Collect Operation	377
8.6.3	ForAll Operation	378
8.6.4	Exists Operation	378
8.6.5	Iterate Operation	379
8.6.6	Iterators in Collection Operations	380
8.6.7	Resolving Properties	380
8.7	The Standard OCL Package	380
8.8	Predefined OCL Types	381
8.8.1	Basic Types	381