ORM 2 Graphical Notation

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Construct	Examples	Description/Notes	
Entity Type	Country or Country	Named soft rectangle, named hard rectangle, or named ellipse. The soft rectangle shape is the default.	
Value Type	CountryCode or CountryCode or CountryCode	Named, dashed, soft rectangle (or hard rectangle or ellipse).	
Entity type with popular reference mode	Country (.code) Company (.name) Building (.nr)	Abbreviation for injective reference relationship to value type, e.g. Country Coun	
Entity type with unit- based reference mode	Height (cm:) Mass (kg:) Salary (USD:) Price (EUR:) Height (cm: Length) Salary (USD: Money) Price (EUR: Money)	Abbreviation for reference type, e.g. Height cmValue	
Entity type with general reference mode	Book (ISBN) Website (URL) WebLink (URL)	Abbreviation for reference type, e.g. Book ISBN has / is of ISBN	
Independent Object Type	Country! (CountryCode!)	Instances of the type may exist, without playing any elementary fact roles	
External Object Type	Address^	This notation is tentative (yet to be finalized)	
Predicate (unary, binary, ternary, etc.)	smokes was born in speaks very well played for in on ate	Ordered set of 1 or more role boxes with at least one predicate reading in mixfix notation. If shown, object placeholders are denoted by "". If placeholders are not shown, unaries are in prefix and binaries are in infix notation.	
Duplicate type or predicate shape	Person StateCode was born in	If an object type or predicate shape is displayed more than once (on the same page or different pages) it is shadowed.	
Unary fact type	Person smokes	The smokes role may be played by instances of the Person object type	
Binary fact type	Person Country was born in Car Person employee Company employer made Person Person Person Person Person Person Person Person Person Person Person Person Person	By default, predicate readings (binary or longer) are read left-to-right or top-to-bottom. An arrow-tip is used to display a different reading direction. Role names may be displayed in square brackets beside their role. Forward and inverse readings for binaries may be shown together, separated by "/".	

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Ternary fact type	Sport Person Person Date Country Introduced Introdu	Role names may be added in square brackets. Arrow-tips are used to reverse the default left-right or top-down reading order. Reading orders other than forward and reverse are shown using named placeholders.	
Quaternary fact type	City Date Person Food in on ate	The above notes for the ternary case apply here also. Fact types of higher arity (number of roles) are also permitted.	
Objectification (a.k.a. nesting)	"Enrolment!" Student Course enrolled in Grade resulted in	The enrolment fact type is objectified as an entity type whose instances can play roles. In this example, the objectification type is independent, so we can know about an enrolment before the grade is obtained.	
Internal uniqueness constraint (UC) on unaries	Person Person smokes	These are equivalent (by default, predicates are assumed to be populated with sets, so no whole fact may be duplicated).	
Internal UC on binaries	Gender Person was born in Country Language Person Gountry Language Person is president of Country	The examples show the 4 possible patterns: 1:n (one-to-many); n:1 (many-to-one); m:n (many-to-many); 1:1 (one-to-one0	
Internal UC on ternaries. For <i>n</i> -aries (n > 1) each UC must span at least <i>n</i> -1 roles	Place Competition Sport Person played for	The first example has two, 2-role UCs: the top UC forbids ties; the other UC ensures that each team gets only place per competition (a dotted line excludes its role from the UC). The second example has a spanning UC (many-to-many-to-many).	
Simple mandatory role constraint	Person was born in Country was born in Country	The example constraint means that each person was born in some country. The mandatory role dot may be placed at either end of the role connector.	
Inclusive-or constraint (disjunctive mandatory role)	Visitor Passport DriverLicence	The constraint is displayed as a circled dot connected to the constrained roles. The example constraint means that each visitor referenced in the model must have a passport or a driver licence (or both).	
Preferred internal UC	Country Code has / is of	A double bar on a UC indicates it underlies the preferred reference scheme.	

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External UC (double-bar indicates preferred identifier)	StateCode StateCode StateCode StateName StateName	Here, each state is primarily identified by combining its country and state code. Each combination of country and state name also applies to only one state.	
Object Type Value	Gender (.code) $\{M', F'\}$ Rating (.nr) $\{1, 2, 3, 4, 5, 6, 7\}$	Enumerations	
Constraint		Ranges are inclusive of end values by default. Round brackets are used to exclude an end value. Square brackets may be added to explicitly declare inclusion, e.g. the constraint on PositiveScore may also be specified as {(0100]}.	
	ExtremeTemperature (°C:) {-10020, 40100} (SQLchar) {'a''z', 'a''Z', 'y''2', 'y''2', '\dots'}	Multiple combinations are allowed.	
Role value constraint	Person (.name) Age (y:) {0}	As for object type value constraints, but connected to the constrained role. Here, an age of a person must be at most 140 years.	
Subset constraint	is cancer prone enrolled in Course smokes for obtained	The arrow points from the subset end to the superset end (e.g. if a person smokes then that person is cancer prone). The role sequences at both ends must be compatible. A connection to the junction of 2 roles constrains that role pair.	
Join subset constraint	Advisor (.nr) (.code)	The constrained role pair at the superset end is projected from a role path that involves a conceptual join on Language. The constraint declares that if an advisor serves in a country then that advisor must speak a language that is often used in that country.	
Exclusion constraint	is married authored Person Book is widowed reviewed	These constraints mean that no person is both married and widowed, and no person reviewed and authored the same book. Exclusion may apply between 2 or more compatible role sequences, possibly involving joins.	
Exclusive-or constraint	is male Academic Academic is female is contracted till	An exclusive-or constraint is simply the conjunction of an inclusive-or constraint and an exclusion constraint. Also known as an xor constraint.	

Construct	Examples	Description/Notes
Equality constraint	has systolic- Patient BloodPressure has diasystolic-	This constraint means that a patient's systolic BP is recorded if and only if his/her diastolic BP is recorded. An equality constraint may apply between 2 or more compatible role sequences, possibly involving joins.
Derived fact type, and derivation rule	[languageSpoken] Person Language Speaks NrLanguages *For each Person, nrLanguages = count(languageSpoken).	A fact type is either asserted, derived, or semiderived. A derived fact type is marked with an asterisk "*". A derivation rule is supplied. A double asterisk "**" indicates derived and stored (eager evaluation).
Semiderived fact type, and derivation rule	is a parent of Person Person if Person ₁ is a grandparent of Person ₂ if Person ₁ is a parent of some Person ₃ who is a parent of Person ₂ . is a grandparent of +	A fact type is semiderived if some of its instances may be derived, and some of its instances may be simply asserted. It is marked by "+" (half an asterisk). "++"indicates semiderived and stored (eager evaluation for derived instances).
Subtyping	Person (.nr) Student (.nr) Student Employee Lecturer	All subtypes are proper subtypes. An arrow runs from subtype to supertype. A solid arrow indicates a path to the subtype's preferred identifier (e.g. here, student employees are primarily identified by their employee number). A dashed arrow indicates the supertype has a different preferred identifier.
Subtyping constraints	Animal TeamMember Person Dog Cat Player Coach Male Person Person	A circled "X" indicates the subtypes are mutually exclusive. A circled dot indicates the supertype equals the union of the subtypes. The combination (xor constraint) indicates the subtypes partition the supertype (exclusive and exhaustive).
Subtype derivation status	Person Person Gender (.code) ('M', 'F') MalePerson *Each MalePerson is a Person who is of Gender 'M'.	A subtype may be
	Ferson Feach derived Grandparent is a Person who is a parent of some Person who is a parent of some Person.	If the subtype is asserted, it has no mark appended and has no derivation rule. If the subtype derived or semiderived, a derivation rule is supplied.

Construct	Examples	Description/Notes
Internal frequency constraint	Panel Second Sec	This constrains the number of times an occurring instance of a role or role sequence may appear in each population. Here: each jury has exactly 12 members; each panel that includes an expert includes at least 4 and at most 7 experts; each expert reviews at most 5 papers; each paper that is reviewed is reviewed by at least 2 experts; and each department and year that has staff numbers recorded in the quaternary appears there twice (once for each gender).
External frequency constraint	is by Student Enrollment	The example constraint has the following meaning. In this context, each combination of student and course relates to at most two enrolments (i.e. a student may enroll at most twice in the same course)
Ring constraints	A Irreflexive	A ring predicate <i>R</i> is locally reflexive if and only if, for all <i>x</i> and <i>y</i> , <i>xRy</i> implies <i>xRx</i> . E.g. "knows" is locally but not globally reflexive. Reflexive, symmetric and transitive properties may also be enforced using semiderivation rather than by constraining asserted fact types. The example constrains the subtyping relationship in ORM to be both acyclic (no cycles can be formed by a chain of subtyping connections) and strongly intransitive (no object type <i>A</i> can be both a direct subtype of another type <i>B</i> and an indirect subtype of <i>B</i> , where indirect subtyping means there is a chain of two or more subtyping relationships that lead from <i>A</i> to <i>B</i>). Ring constraints may be combined only if they are compatible, and one is not implied by the other. ORM tools ensure that only legal combinations are allowed.
Value- comparison constraints	e.g. started on [startdate] Project Date ended on [enddate]	The example constraint verbalizes as: For each Project, existing enddate >= startdate.

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Object cardinality constraint	$\#=1$ $\#\leq 100$ President Senator	The example constraints ensure there is exactly one president and at most 100 senators (at any given time),
Role cardinality constraint		The example constraint ensures that at most one politician plays the role of president (at any given time).
Deontic constraints	Uniqueness • • • Mandatory • • Subset, Equality, Exclusion • • Subset, Equality, Exclusion • Sub	Unlike alethic constraints, deontic constraint shapes are colored blue rather than violet. Most include "o" for "obligatory". Deontic ring constraints instead use dashed lines. In the parenthood example, the alethic frequency constraint ensures that each person has at most two parents, the alethic ring constraint ensures that parenthood is acyclic, and the deontic ring constraint makes it obligatory for parenthood to be strongly intransitive.
Textual constraints	{Exec', 'NonExec'} Rank (.code) Employee (.nr) uses 1, 2 CompanyCar (.regNr) 1 Each Employee who has Rank 'NonExec' uses at most one CompanyCar. 2 Each Employee who has Rank 'Exec' uses some CompanyCar.	First-order constraints with no graphic notation may be expressed textually in the FORML 2 language. These examples use footnoting to capture a restricted uniqueness constraint and a restricted mandatory role constraint.
Objectification display options: link fact types, and compact display.	Student enrolled in course is in is in Enrolment!	Internally, link fact types connect objectified associations to their component object types. By default, display of link fact types is suppressed. If displayed, link predicate shapes use dashed lines instead of solid lines. Objectification object types may also be displayed without their defining components, using an object type shape containing a small predicate shape, as shown in this Enrolment example.