

Use Case Meta-Model

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Object vs Meta-language

- 'This sentence is false'

true/false ?

Liar's Paradox

- Paradox arose because we did not , when reasoning *about* the truth of statements in a language (*the object language*), use another language *in* which to reason (*the meta language*)

Object vs Meta-language

Object language of mathematical formulae	Meta language (natural language) to reason about formulae
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$A \Rightarrow B$ *A implies B*

$B \Rightarrow C$ *B implies C*

$\therefore A \Rightarrow C$ *Therefore A implies C by transitivity*



4-Layer Meta-model Architecture

M3	Meta-MetaModel (Axioms)
M2	MetaModel
M1	Domain Model
M0	User Objects

OMG UML Meta-model

Level		
M3 Meta-MetaModel	Axioms Meta Object Facility MOF	MetaClass, MetaAttribute, MetaOperation
M2 MetaModel	Instance of a Meta-MetaModel UML CWM	Class, Attribute, Operation, Component
M1 Domain Model	Instance of MetaModel	Applicant, ApplicantStatus
M0 User Objects	Instance of Domain Model	[Applicant:BureauNumber = 'B000000013'], 'REGISTERED'



W3C XML Meta-model

Level		
M3 Meta-MetaModel hasFacetAndProperty	Axioms Attribute Schema	HasFacetAndProperty Xml (reserved attributes and entities) Xsi (reserved attributes)
M2 MetaModel SchemaOfSchemas	Instance of a Meta- MetaModel	Entities Attributes
M1 Domain Model .xsd Schema	Instance of MetaModel	Applicant, ApplicantStatus
M0 User Objects .xml	Instance of Domain Model	<Applicant BureauNumber =“B000000013> </Applicant>



Eclipse Model

Level		
M3 Meta-MetaModel Ecore	Axioms	EClass EAttribute
M2 MetaModel EMF	Instance of a Meta- MetaModel	
M1 Domain Model EMF Model	Instance of MetaModel	
M0 User Objects	Instance of Domain Model	Say java Code



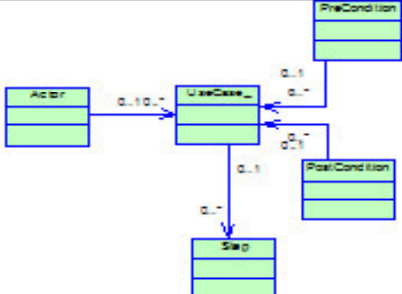


Models of computation

- Imperative/Procedural
 - Variables, Assignment statement*
 - Iteration*
 - Eg. C-family*
- Functional/Applicative
 - Absence of variables*
 - Recursion*
 - Eg. Lisp-family*
- Declarative/Logical
 - Pure what*
 - Recursion*
 - Eg. Prolog, SQL, XSLT*
- Generative/Meta
 - Higher Order*
 - Eg. STL*

M0, M1, M2 and computational Models

- Imperative – M0
- Declarative – M0, M1
- Generative – M1, M2

Model to Meta-Model

M3	<div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> MetaClass </div>		
M2	<div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> Class </div>	<div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> UseCase <ul style="list-style-type: none"> - Steps - ExtensionPoints - PreCondition - PostCondition </div>	
M1	<div style="border: 1px solid black; background-color: #e0ffe0; padding: 5px;"> Horse <ul style="list-style-type: none"> - gender - colour - name </div>	<div style="border: 2px solid blue; border-radius: 50%; width: 100px; height: 100px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> Book a Movie </div>	 <pre> classDiagram Actor --> UseCase : 0..10..* UseCase --> Step : 0..1 UseCase --> PreCondition : 0..1 UseCase --> PostCondition : 0..1 </pre>
M0			<p>Book a Movie Actor : Subscriber</p> <p>Log in Exc Subscription expired Select Movie Select Date</p>



The domain 2b modeled

Microsoft Access - [JimMain : Form]

File Edit View Insert Format Records Tools Window Help

Use Case Information

Name: Build Prototype System

Primary Actors: Application Engineer

Secondary Actors:

Goal In Context: Application Engineer Builds a prototype system to present to the customer

PreConditions: AE has proposed system specification

SuccessEndCondition: A Rough GMACS prototype system built and operational under simulation

Scope: System

Level: Summary

Trigger:

FailedEndCondition: Cannot complete system due to limitation of GMACS system

Notes:

Scenario Information

Name: Main

Exception Information

Name: Device does not exist in CM system

ReturnStep: 0

Step Information

Description: AE must create new device and enter it into CM system

Variations:

Notes (Performance/frequency etc.):

UseCase Satisfied In:

UC Generate New Revenue

- SC Main
 - ST Application Engineer Assigned to the Job
 - ST App Eng Configures a Prototype system modeled after
 - EX Prototype cannot be built GMACS cannot satisf
 - ST Application Engineer Meets with Engineering d
 - ST Application Engineer determines that GMACS c
 - ST As part of the proposal process the AE demonstrates
 - ST Application Engineer successfully addresses any Iss
 - ST Customer satisfied with prototype performance and s

UC Build Prototype System

- SC Main
 - ST AE finds and extract a similar job form Configuration
 - ST He extracts all additional devices from CM
 - EX Device does not exist in CM system
 - ST AE must create new device and enter it into CM
 - ST All new site view are created and existing ones mod
 - ST Then the DCU is configured with all required devices
 - ST System is programmed for appropriate animation an
 - ST Then system with DCU is tested under simulation
 - ST After complete system is assembled in Building 2, s
 - ST System is demonstrated to customer during accepta
 - ST Completed system configuration is logged back into

UC Generate Recurring Revenue

SC Main

Form View

Start Lotus c... Client ... D:\Gma... D:\Tree Micro... Info Sle... Address http://www.activex.com/ 10:04 AM



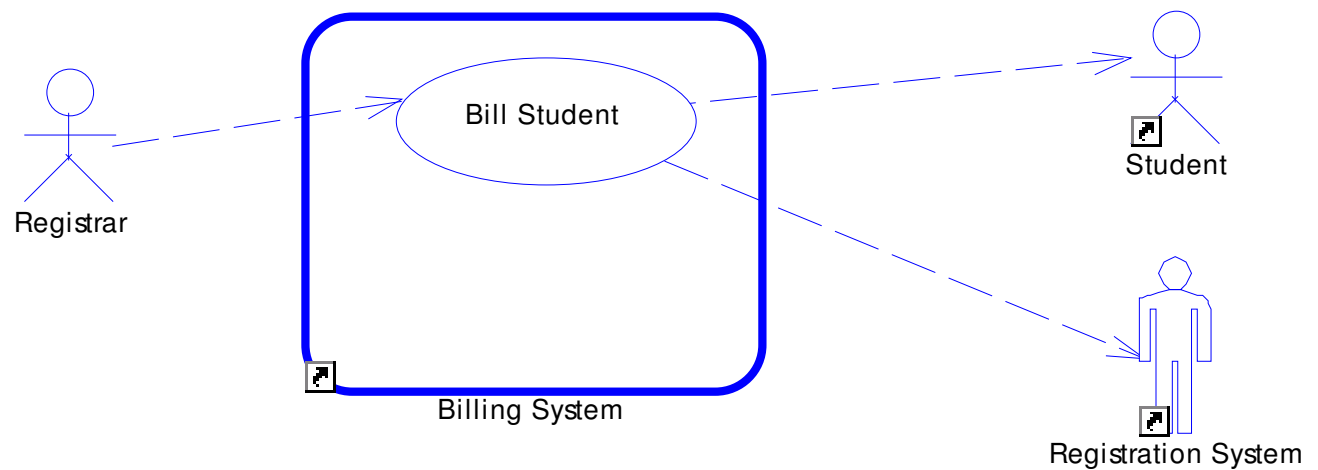
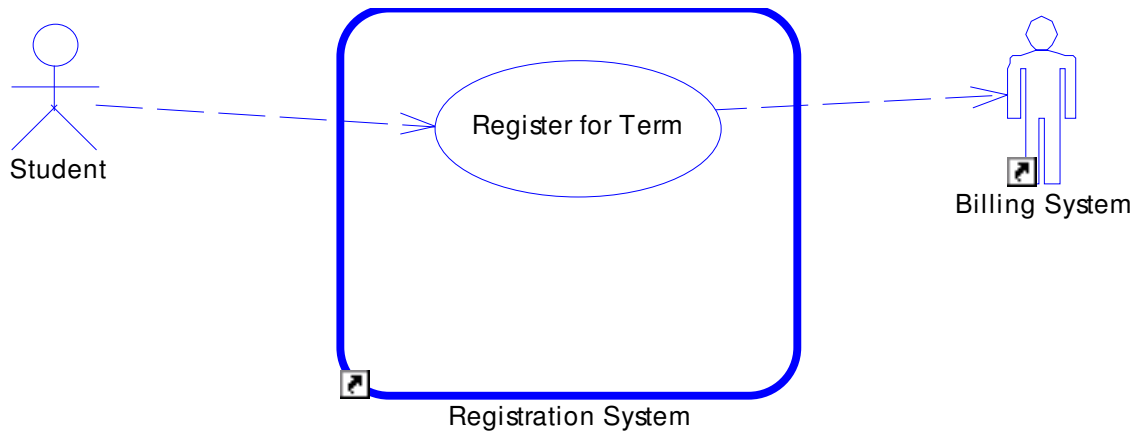
Meta-model deficiencies

- Omissions
Context/Boundary, Step/Action
- Absent behaviour
Closure, Refactoring, Estimation

Use Case behaviour

- Use Case refactoring
- Use Case estimation
- Use Case closure

One system's actor is another system with this system as actor



Use Case Points

- Function Points (Albrecht)
- Effort/Size
- Duration/Rate of Progress
Schedule
- Gustav Karner 1993
Objectory AB, Rational

Size of Context

- $UCP = uUCP * (TCF * ECF)$

- $uUCP = uUCW + uAW$

- $uUCW = \sum n_c \cdot w_c$ where $w_c = \begin{cases} 5 & \text{steps} < 4 \\ 10 & \text{4-7 steps} \\ 15 & \text{steps} > 7 \end{cases}$

- $uAW = \sum n_c \cdot w_c$ where $w_c = \begin{cases} 1 & \text{API} \\ 2 & \text{protocol} \\ 3 & \text{HCI} \end{cases}$



Adjusting for Technical & Environmental Complexity

- $UCP = uUCP * (TCF * ECF)$
- $TCF = 0.6 + 0.1TF$
- $TF = \sum wT_i \cdot cT_i$ where $wT_i, cT_i \in [0, 5]$
 $\in [0, 13*5*5]$
- $ECF = 1.4 - 0.03EF$
- $EF = \sum wE_i \cdot cE_i$ where $wE_i, cE_i \in [0, 5]$
 $\in [0, 8*5*5]$



Technical Factors

	Description	Weight
T1	Distributed	2
T2	Performance	2
T3	End User	1
...		



Environmental Factors

	Description	Weight
E1	Familiar Development process	1.5
E2	Application experience	0.5
E3	OO experience	1
...		

Duration/Rate of Progress

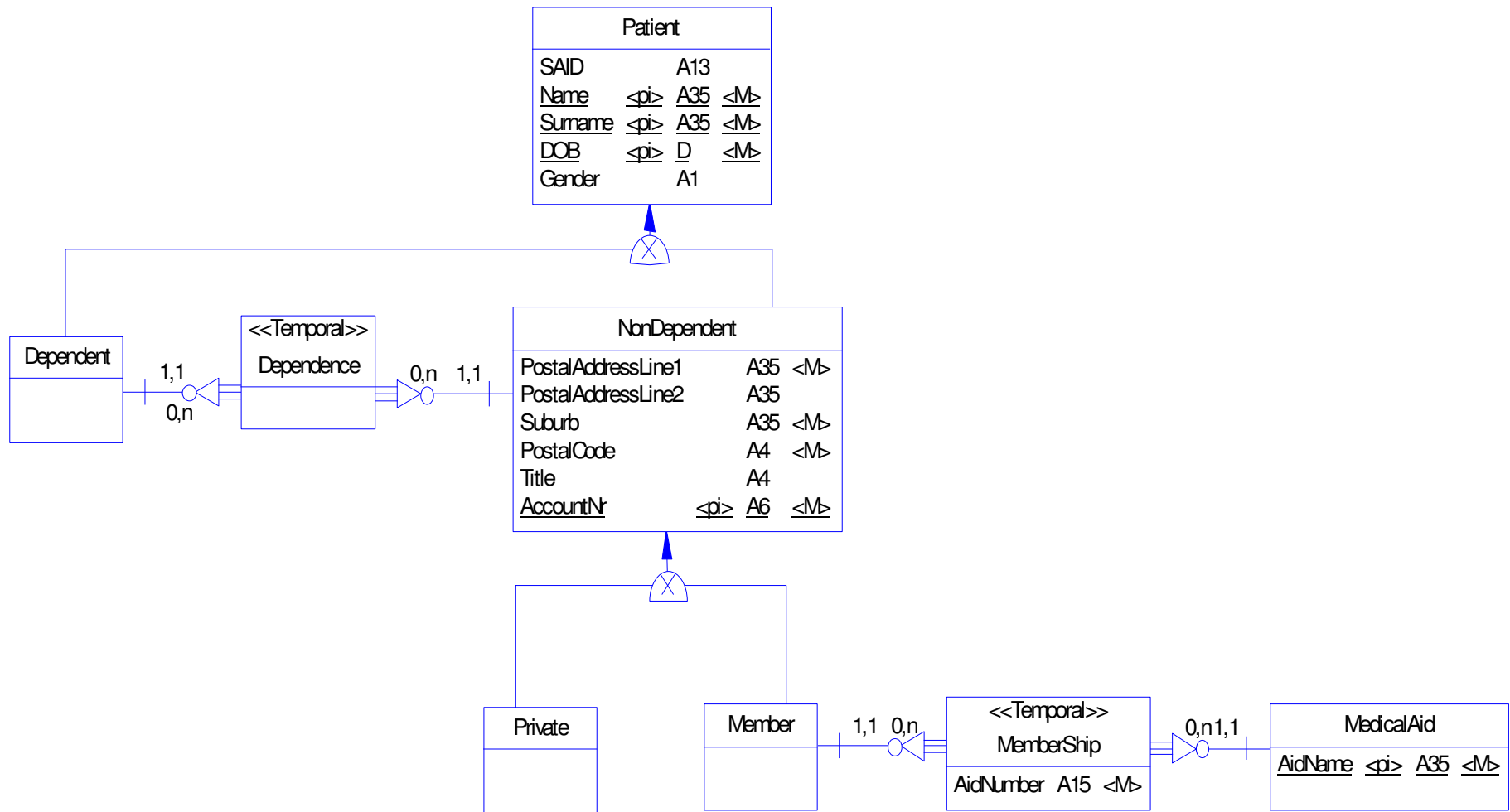
$$\begin{aligned}\text{Duration} &= (uUCW + uAW) * (TCF * ECF) * PF \\ &= uUCP * (TCF * ECF) * PF \\ &= uUCP * (TCF * ECF) * PF \\ &= UCP * PF\end{aligned}$$

- $PF \in [15h/UCP, 30h/UCP]$
 $\approx 20h/UCP$

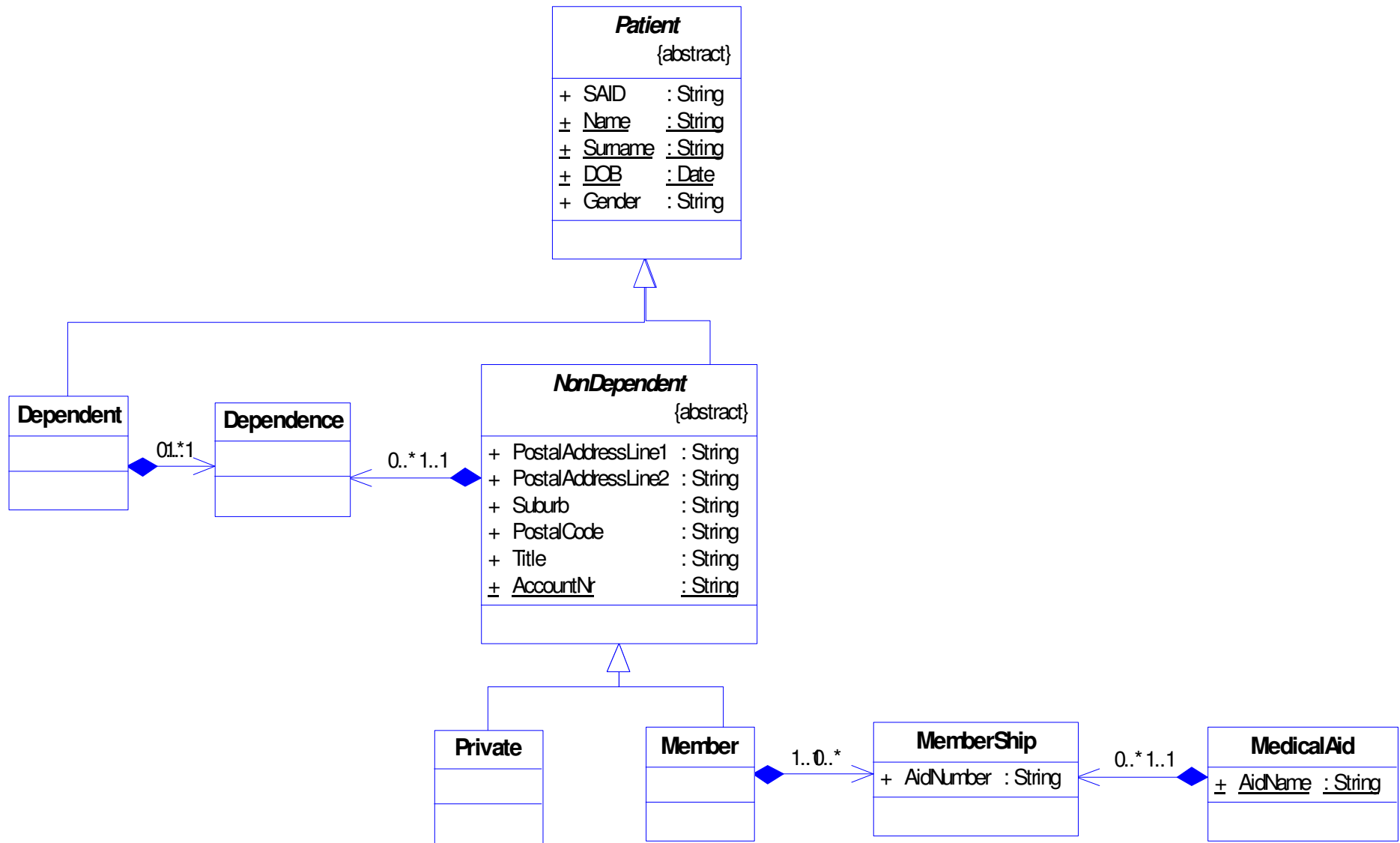
Use Case Closure

- Span/Cover/Base
Create all scenarios

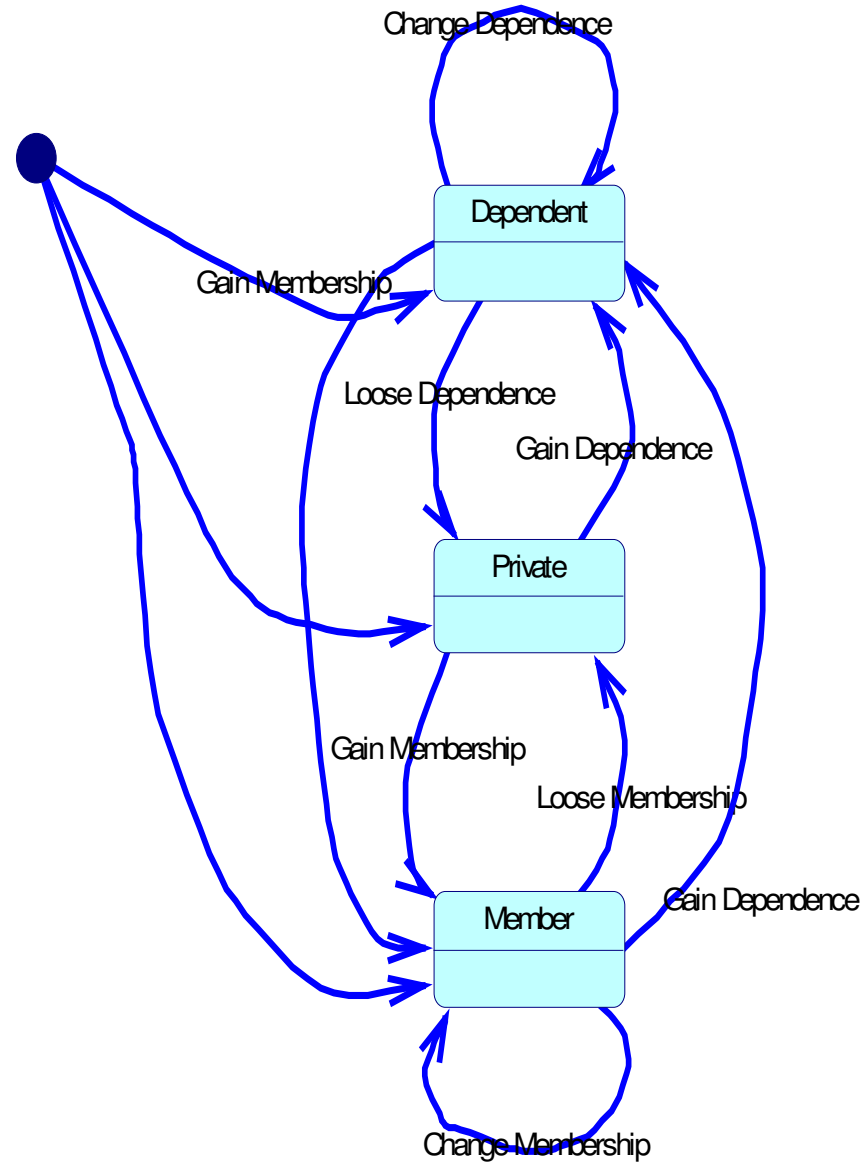
ER model with Temporal Entities



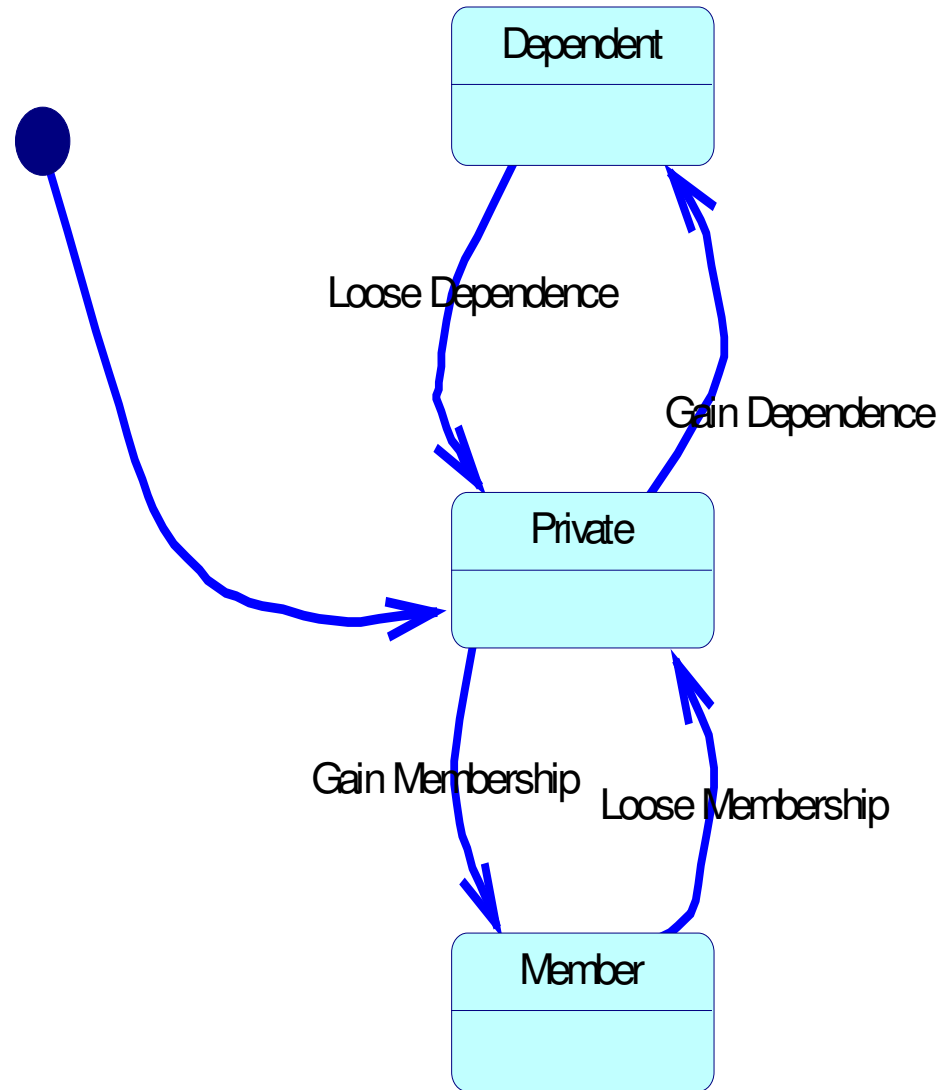
Object model with Concrete subclasses



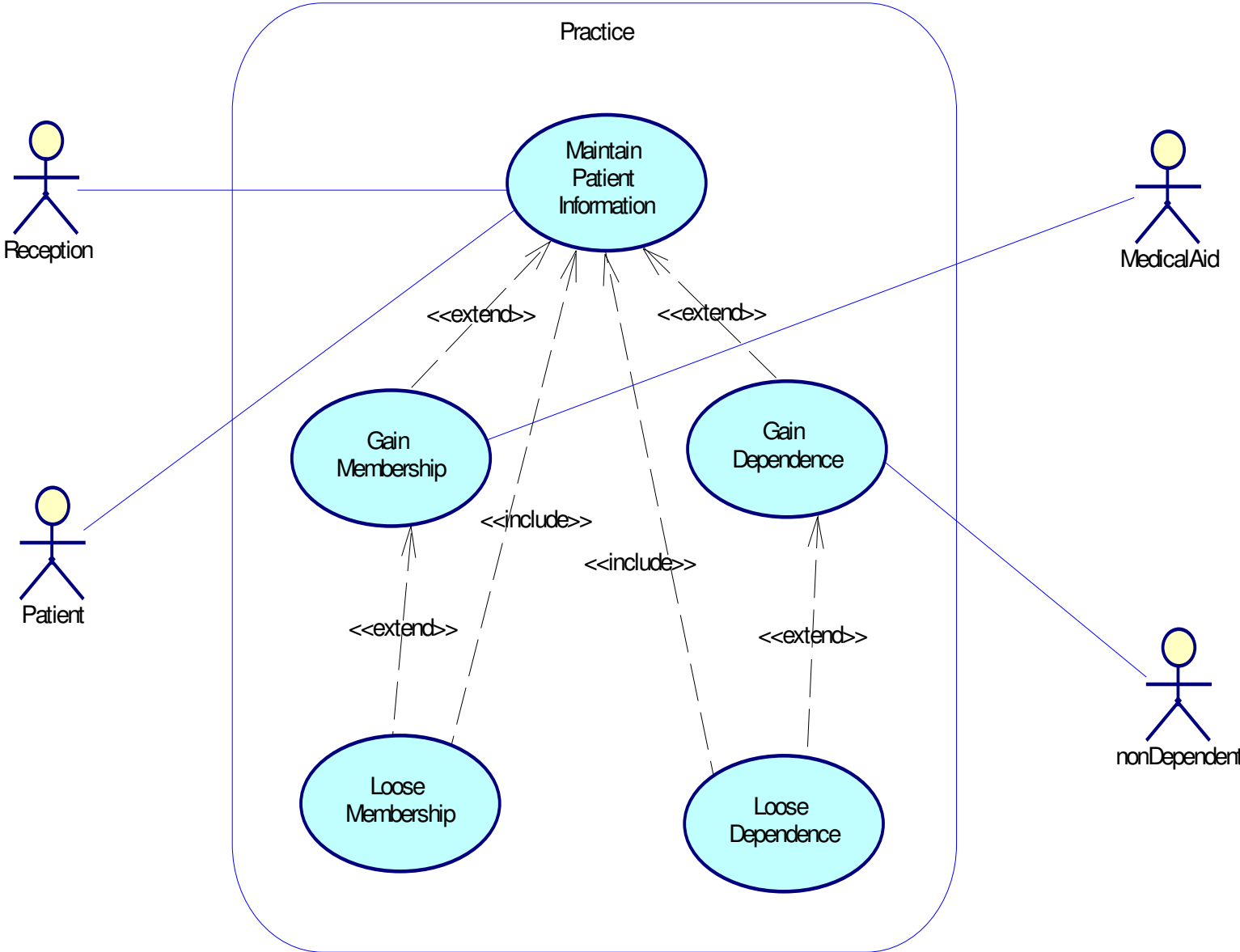
STD patient



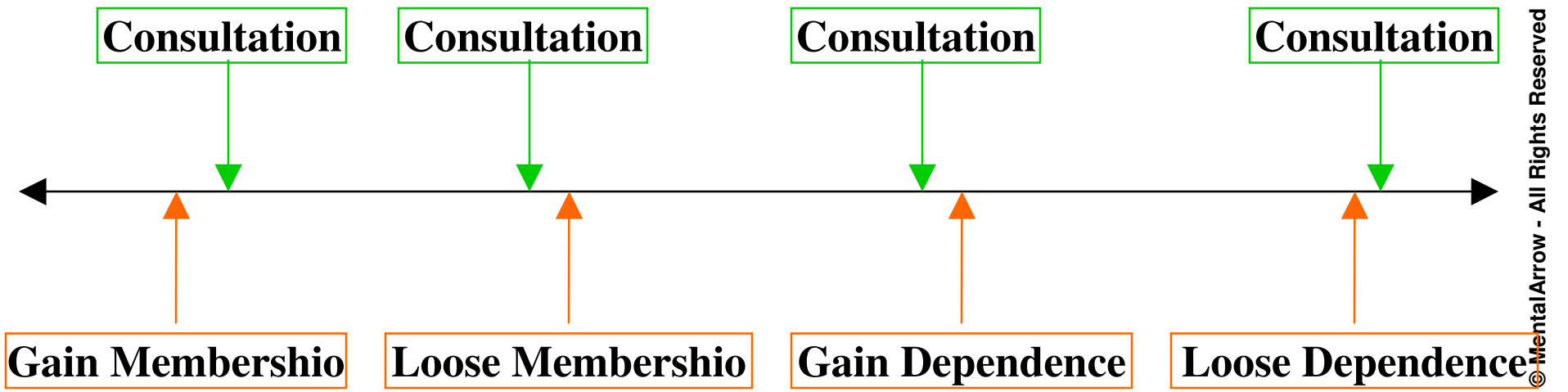
Simplified



Use Case Diagram



Test Cases



Use Case Refactoring

- Small
- Behaviour preserving
- Inverse

- Relax small, perfect inverse

- Behaviour preserving
 - Size (UCP)*
 - Closure*

Use Case Refactoring

- Context refactoring :
Partition context with use cases : Fold contexts
- Use Case Refactoring :
Steps to included use case : Fold included Use Case
Conditional steps to extended Use case :
Fold extension
Condition to exception (extension to exception handler) : Exception handler to extension