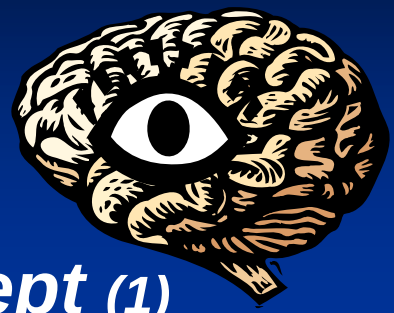
Derivation of the HL7 RIM Ontology

A Top-Down Methodology

Concept - "a thing in the minds eye"

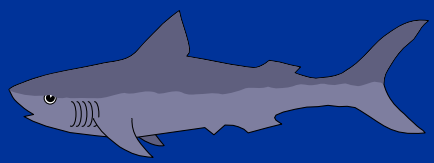
Hmmm - "Frank needs an ace of hearts"

The Concept Challenge



- marine animal
- eats smaller things
- nice to eat

Concept (1)



Symbols
(Many)

"Frank the Shark" (in English)

Thing (1)
Can't put the "thing" on this slide since the instance exists only in physical space

Adapted from Charlie Mead & the Semantic Triangle

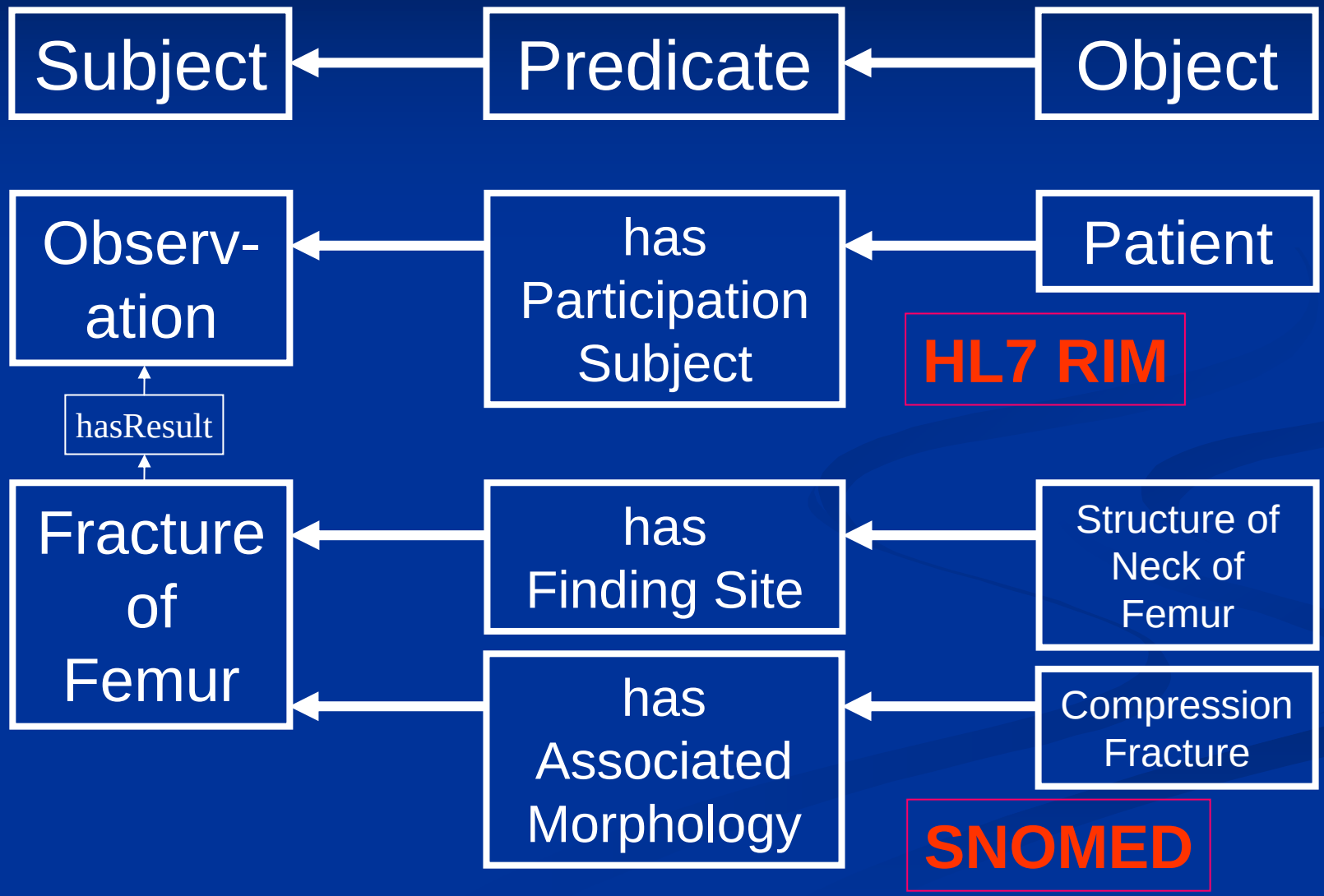
Predicate Logic in RDF, RIM, and SNOMED

RDF:

RIM:

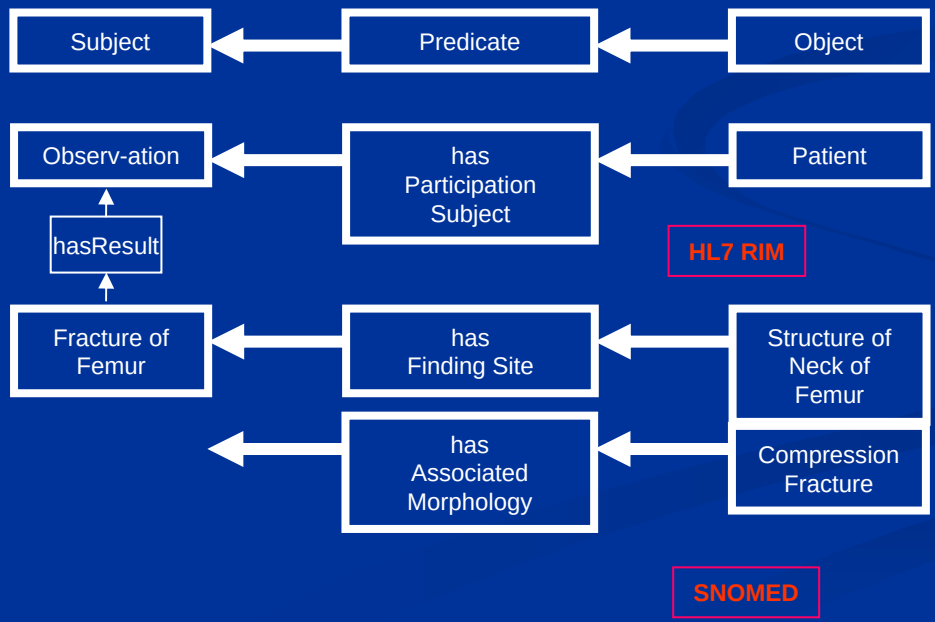
SNOMED:

SNOMED in the HL7 RIM



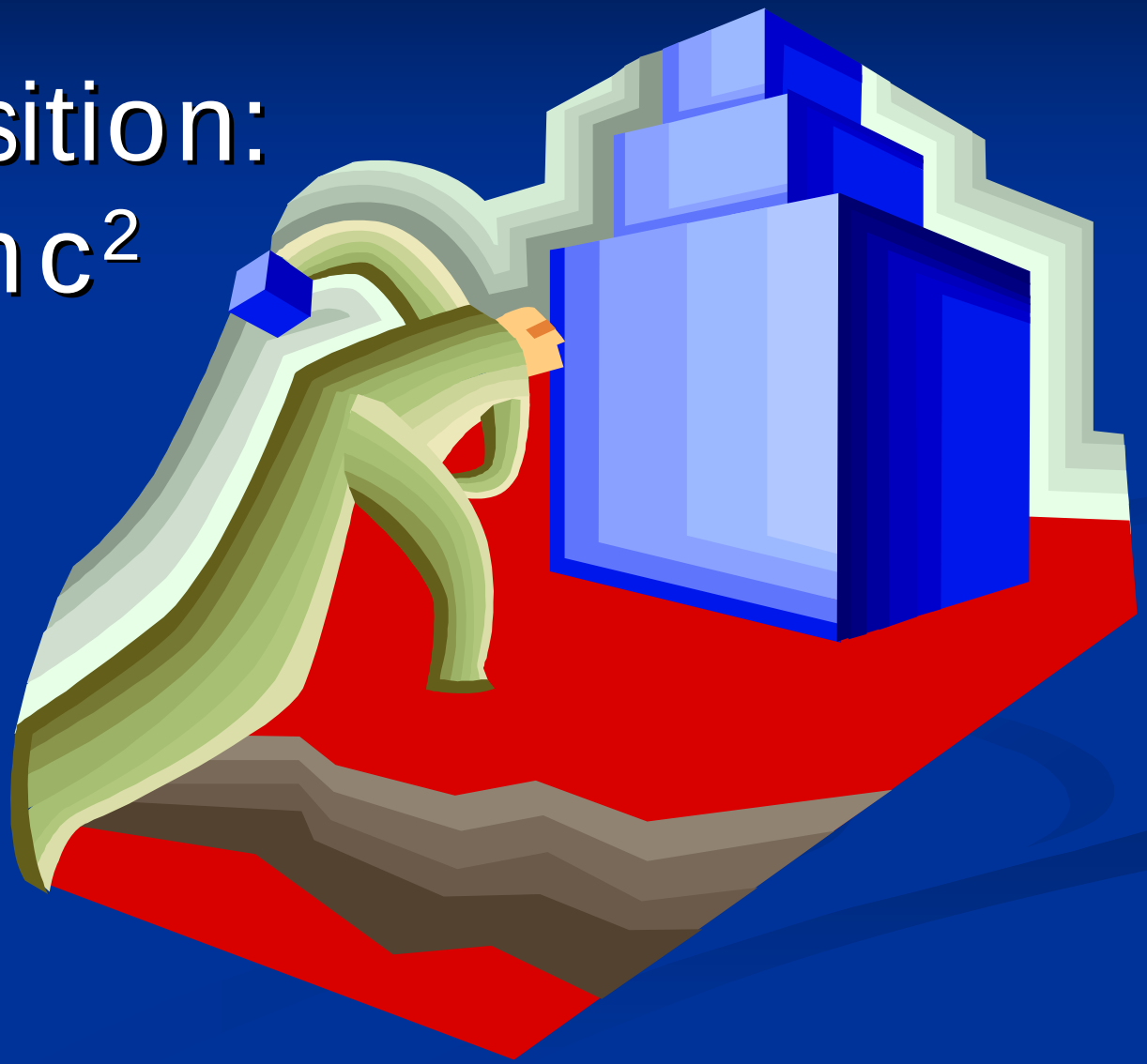
Propositions & Assertions

- Propositions in RDF triples
  - Subject | Predicate | Object
  - Propositions may be true or false
- Assertions are believed by the author to be true

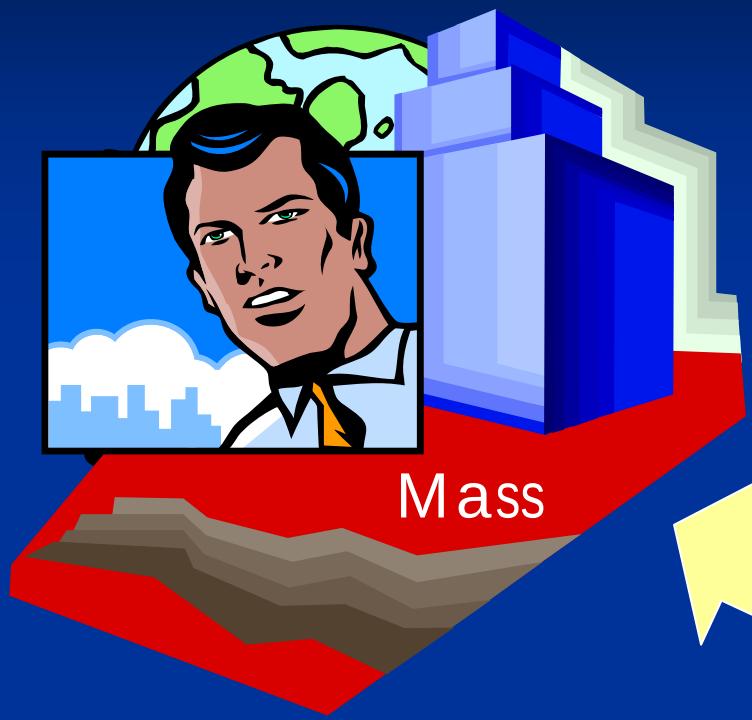


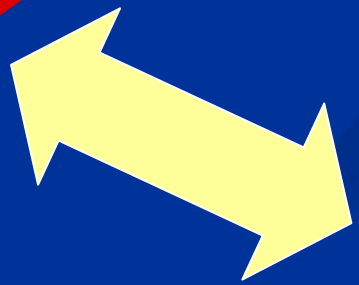
Ontologies: Mass & Energy

Proposition:
$e=mc^2$

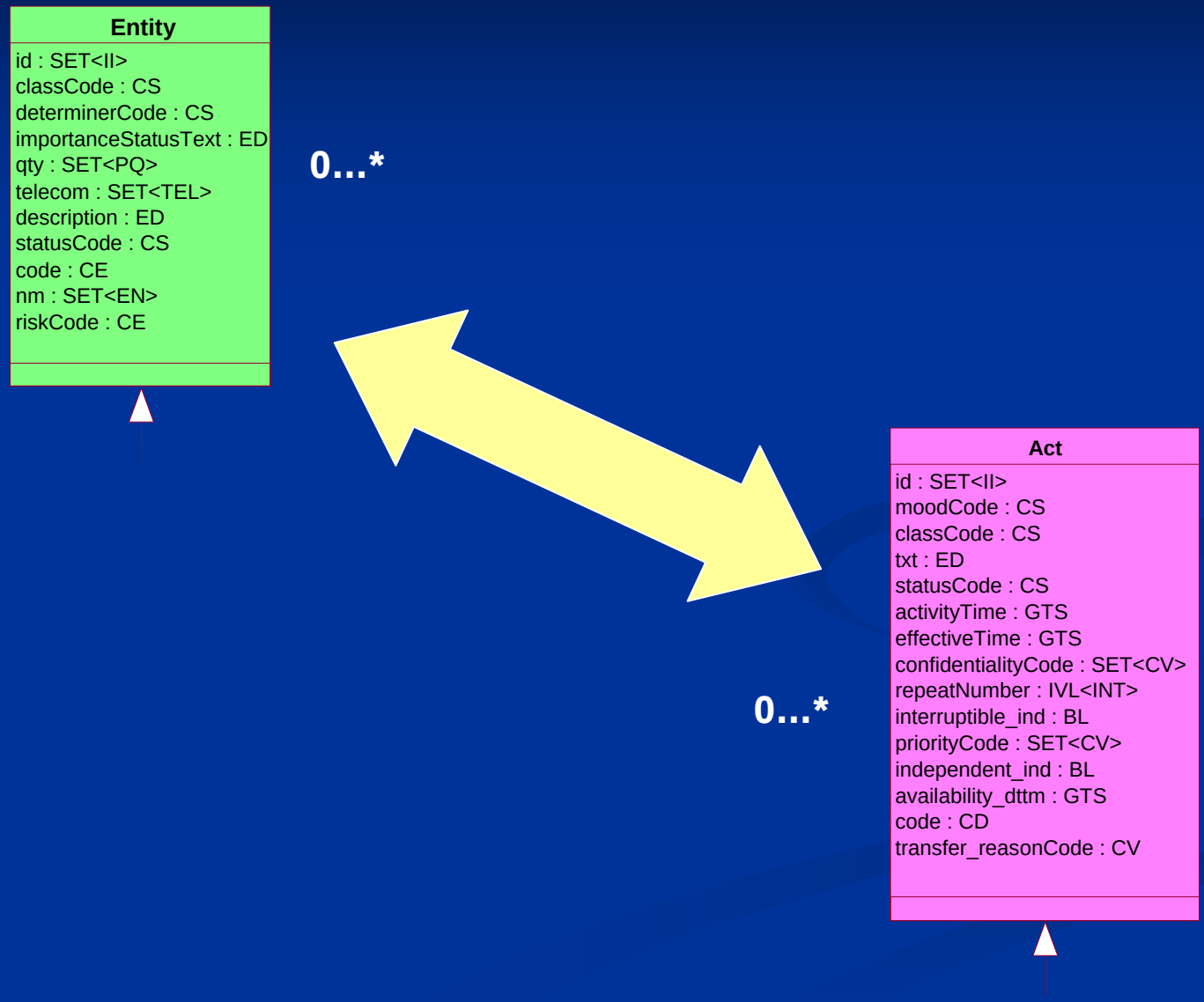


Mass and Energy ($e=mc^2$)



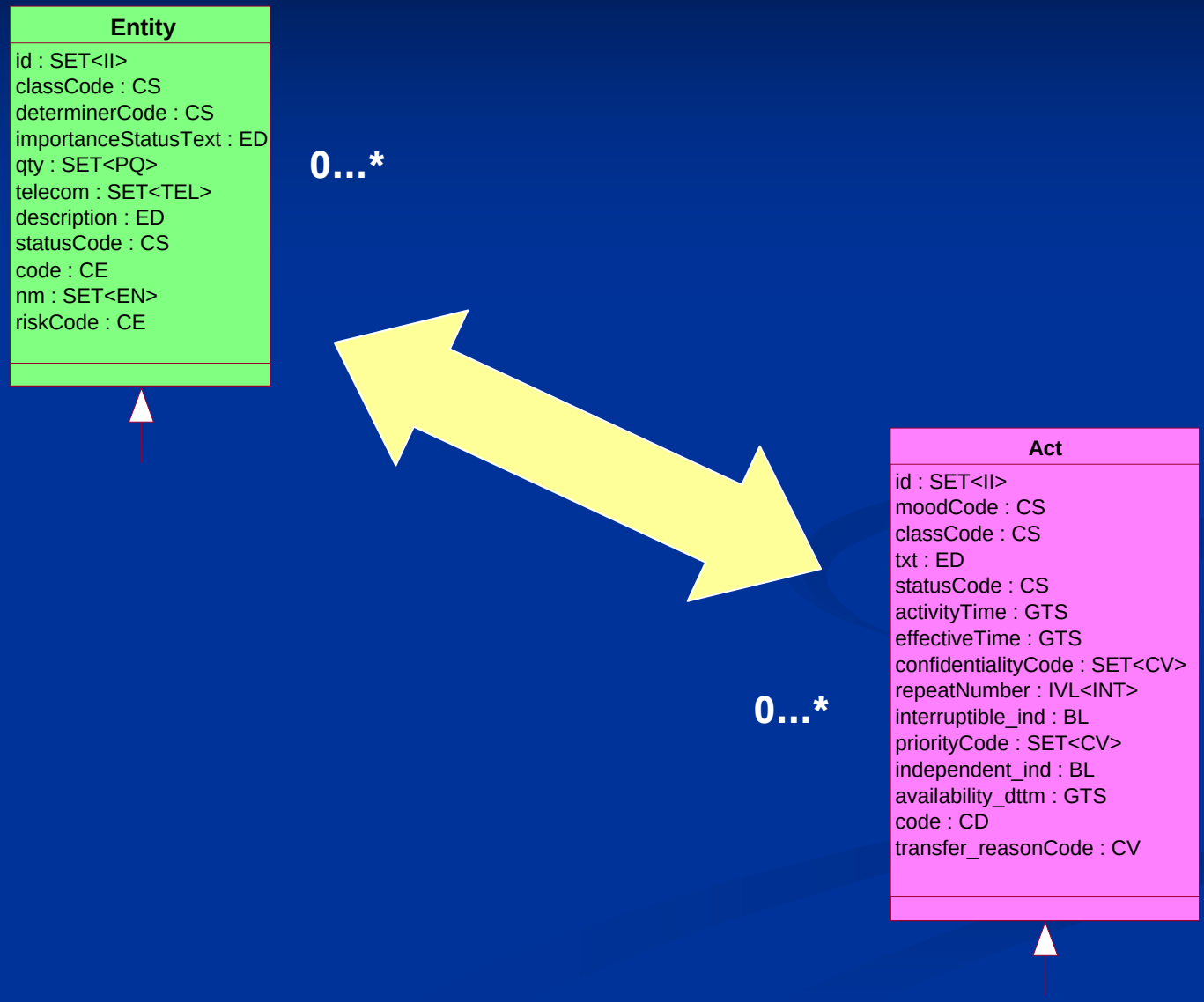


Analogy: Mass to Entity/Energy to Act

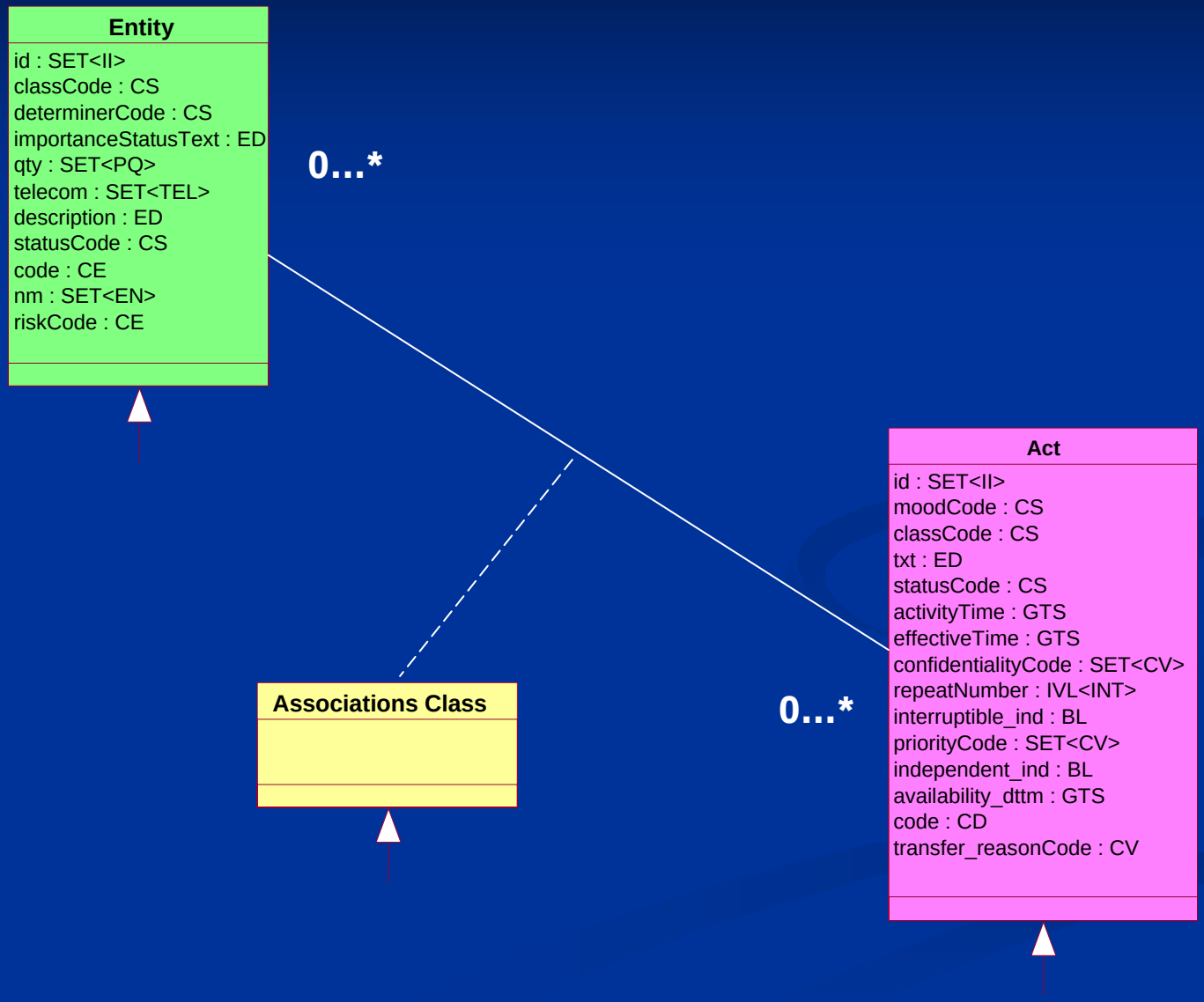


Ontologies: Materials & Labor

Proposition:
Cost = Materials + Labor



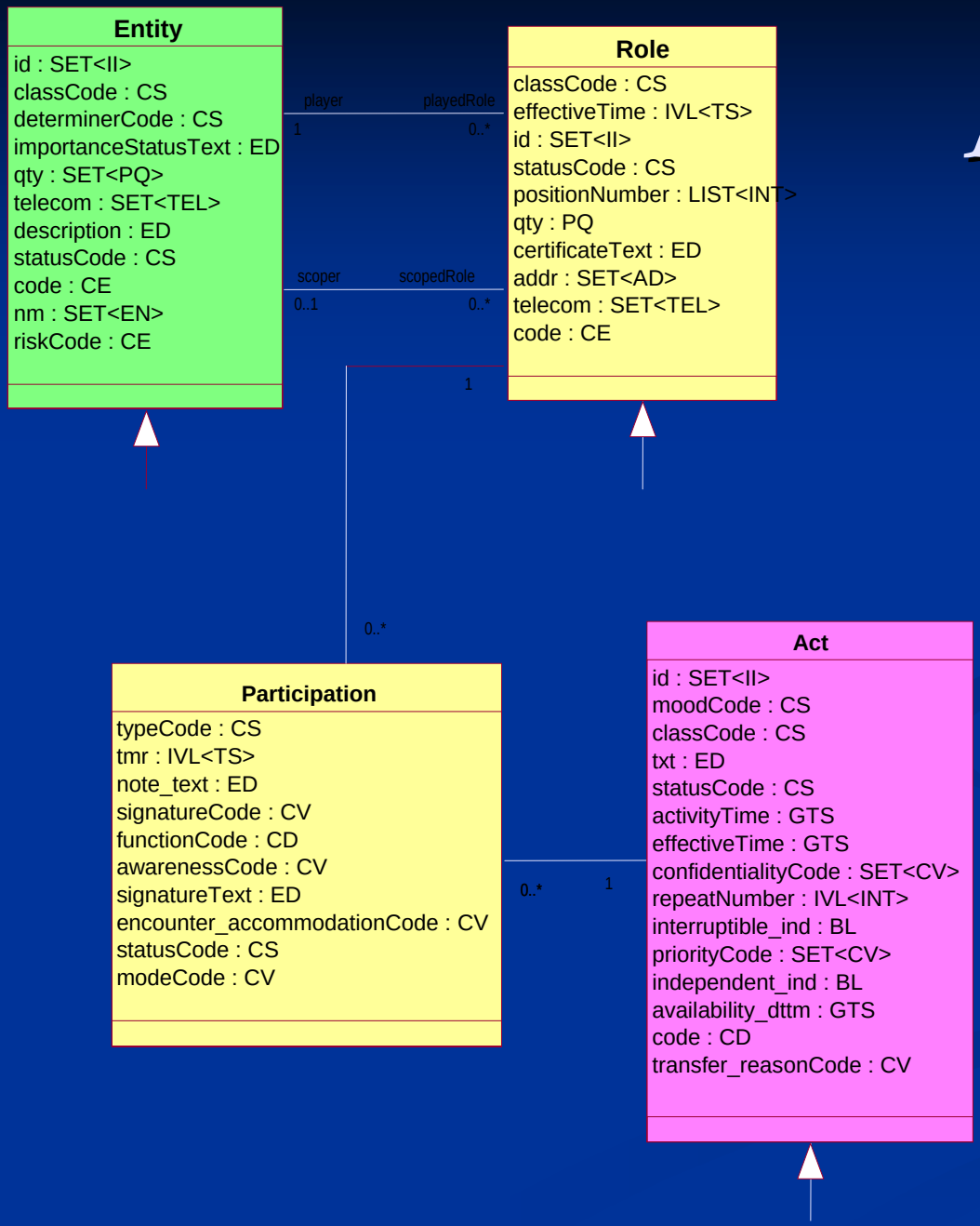
Association Class



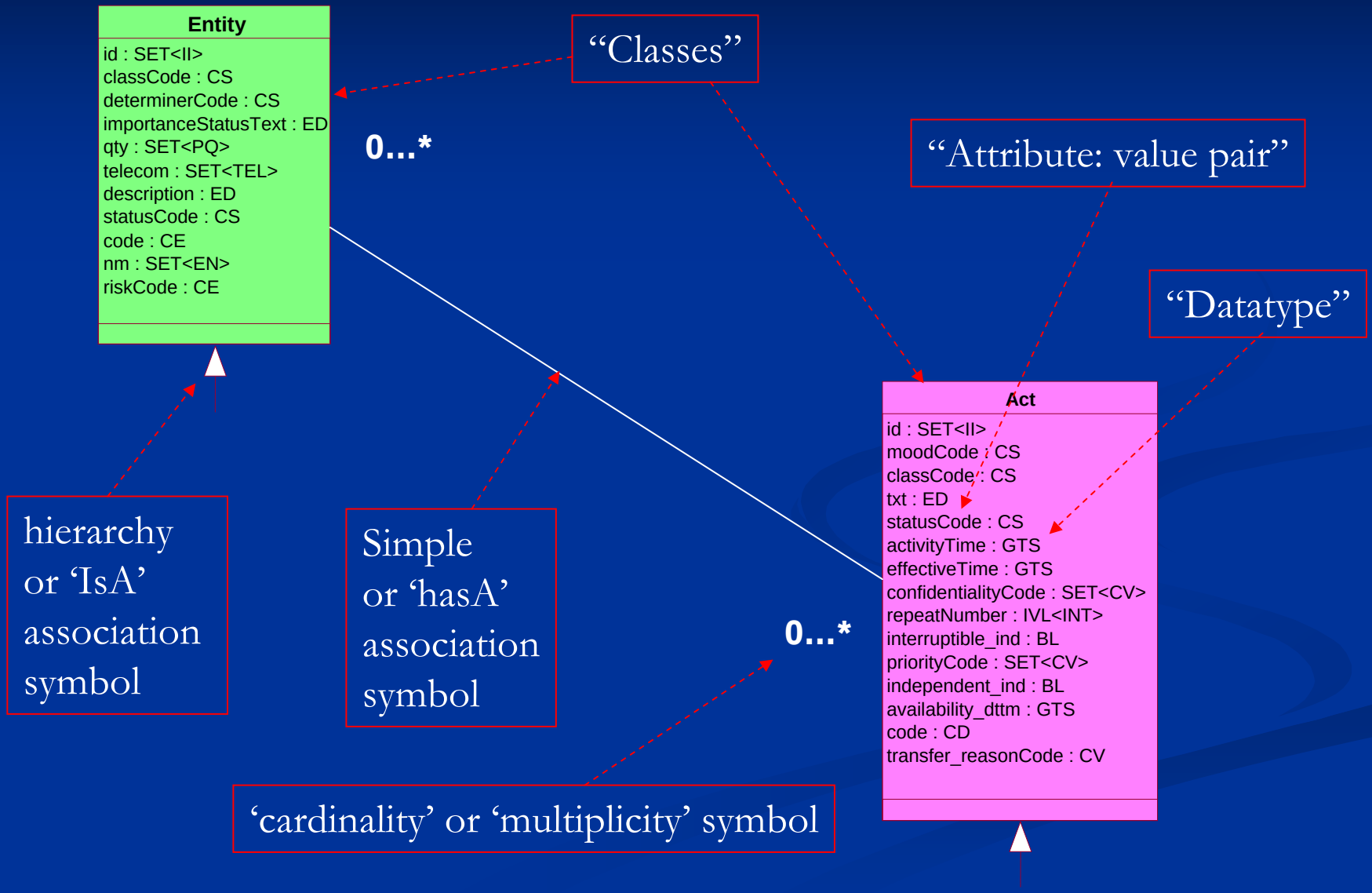
RIM - Backbone

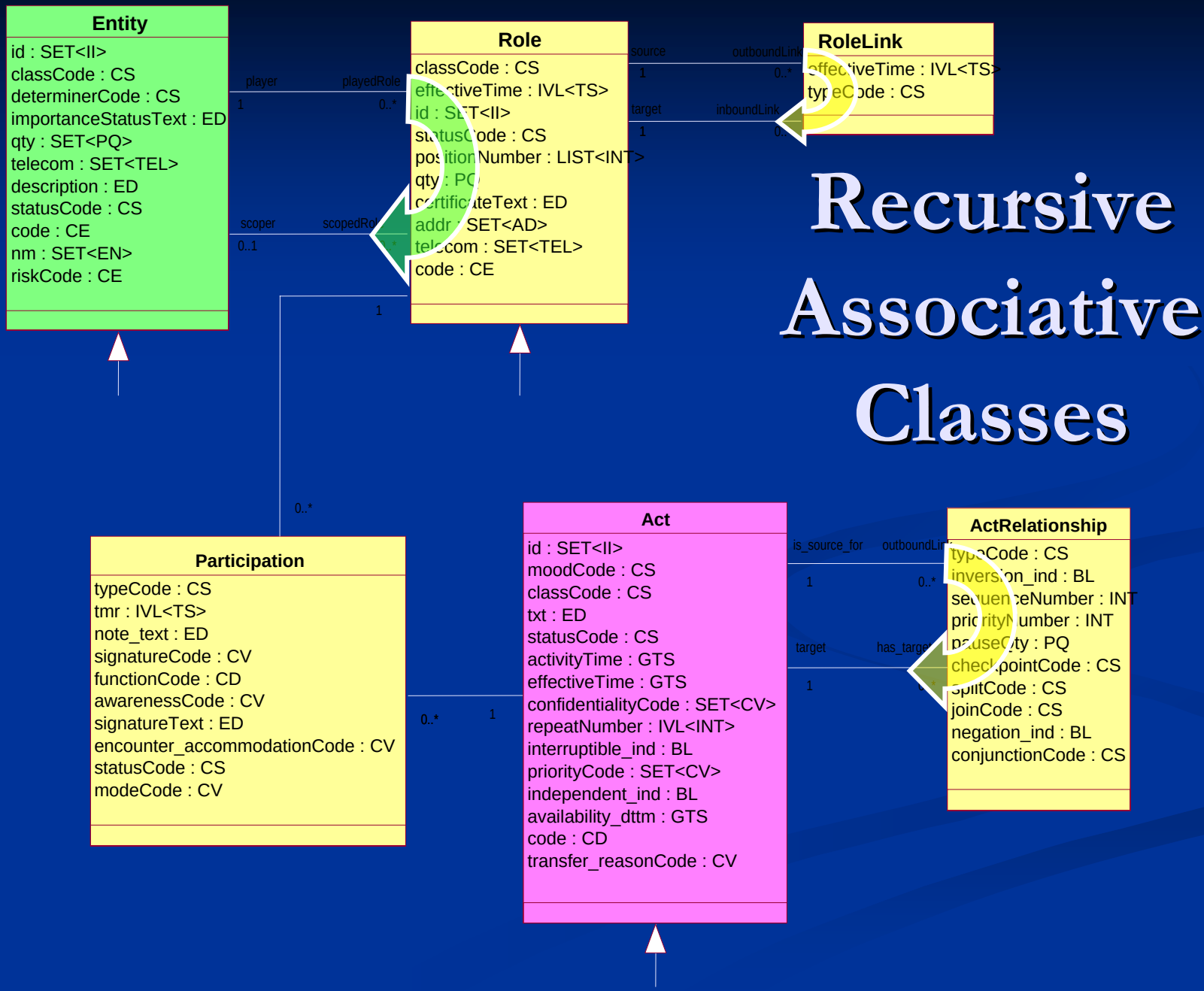
- **Entity**
  - People, Places, Physical Things
- **Associations**
  - Roles & Relationships
- **Act**
  - Collections of Events

Associative Classes

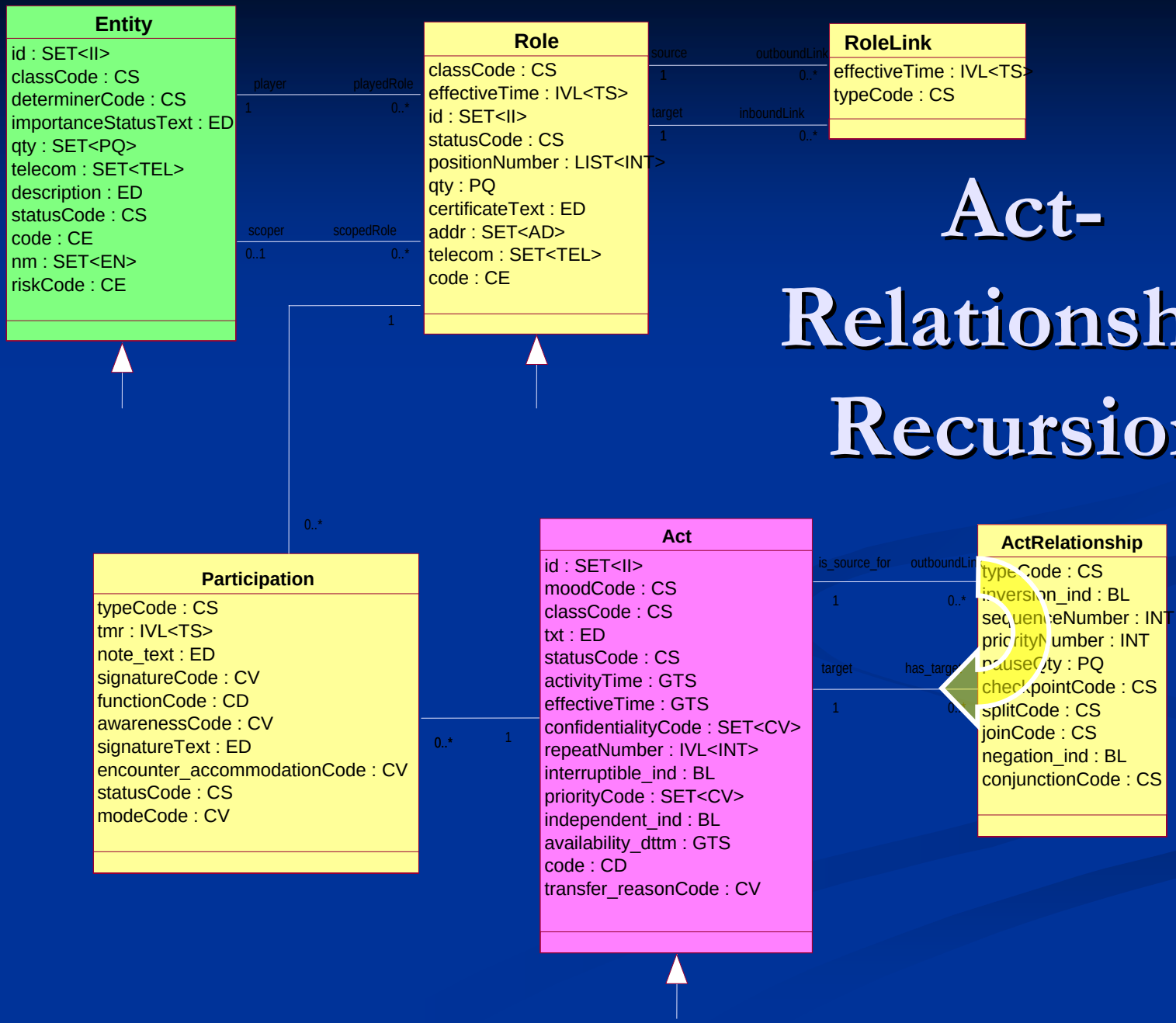


Review of UML Terms



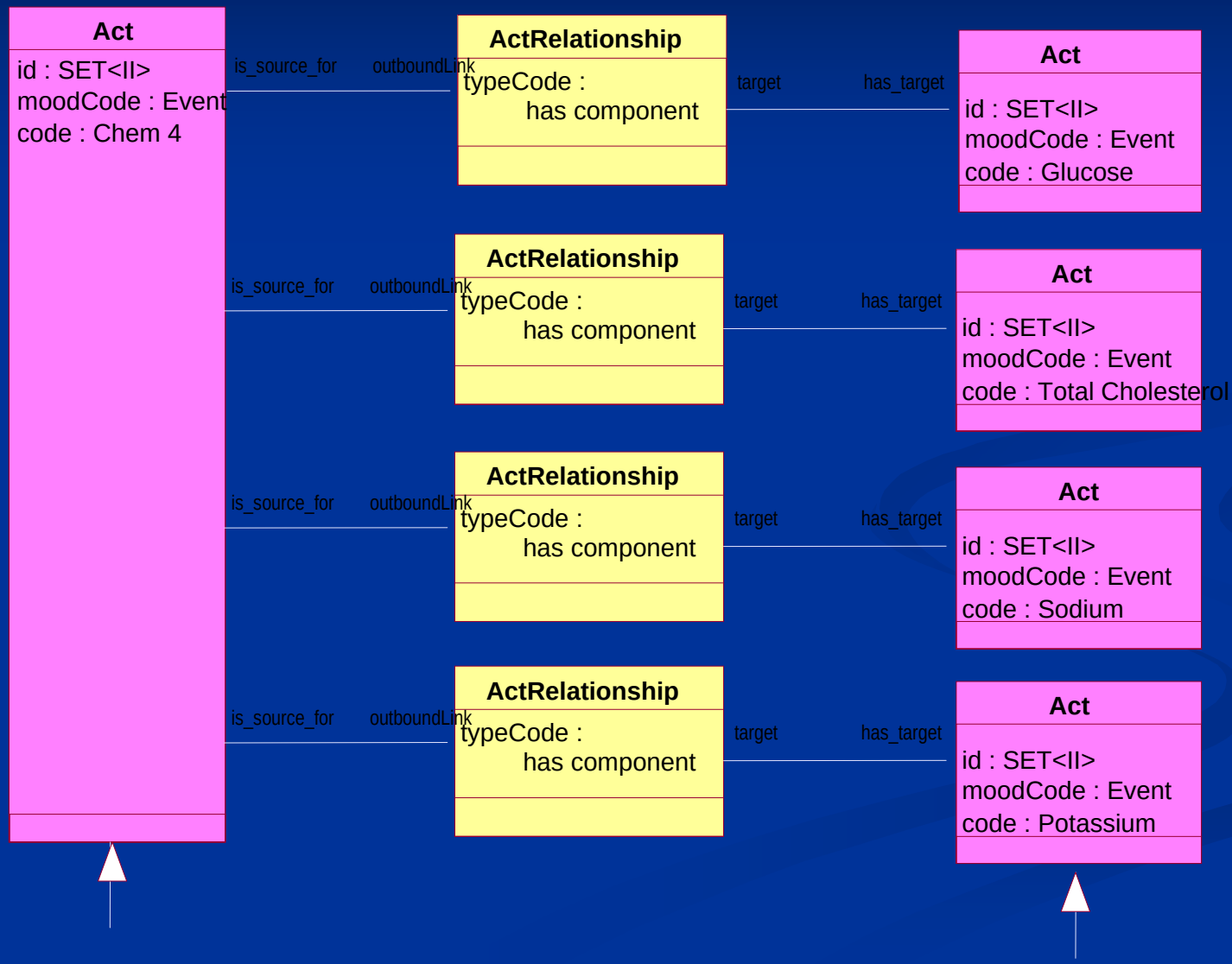

Entity
id : SET<II>
classCode : CS
determinerCode : CS
importanceStatusText : ED
qty : SET<PQ>
telecom : SET<TEL>
description : ED
statusCode : CS
code : CE
nm : SET<EN>
riskCode : CE
player
playedRole
1
0..*
scoper
scopedRo
0..1
Role
classCode : CS
effectiveTime : IVL<TS>
id : SET<II>
statusCode : CS
positionNumber : LIST<INT>
qty : PQ
certificateText : ED
addr : SET<AD>
telecom : SET<TEL>
code : CE
source
outboundLink
target
inboundLink
RoleLink
effectiveTime : IVL<TS>
typeCode : CS
Recursive
Associative
Classes
Participation
typeCode : CS
tmr : IVL<TS>
note_text : ED
signatureCode : CV
functionCode : CD
awarenessCode : CV
signatureText : ED
encounter_accommodationCode : CV
statusCode : CS
modeCode : CV
Act
id : SET<II>
moodCode : CS
classCode : CS
txt : ED
statusCode : CS
activityTime : GTS
effectiveTime : GTS
confidentialityCode : SET<CV>
repeatNumber : IVL<INT>
interruptible_ind : BL
priorityCode : SET<CV>
independent_ind : BL
availability_dttm : GTS
code : CD
transfer_reasonCode : CV
is_source_for
outboundLink
target
has_target
ActRelationship
typeCode : CS
inversion_ind : BL
sequenceNumber : INT
priorityNumber : INT
pauseQty : PQ
checkpointCode : CS
splitCode : CS
joinCode : CS
negation_ind : BL
conjunctionCode : CS

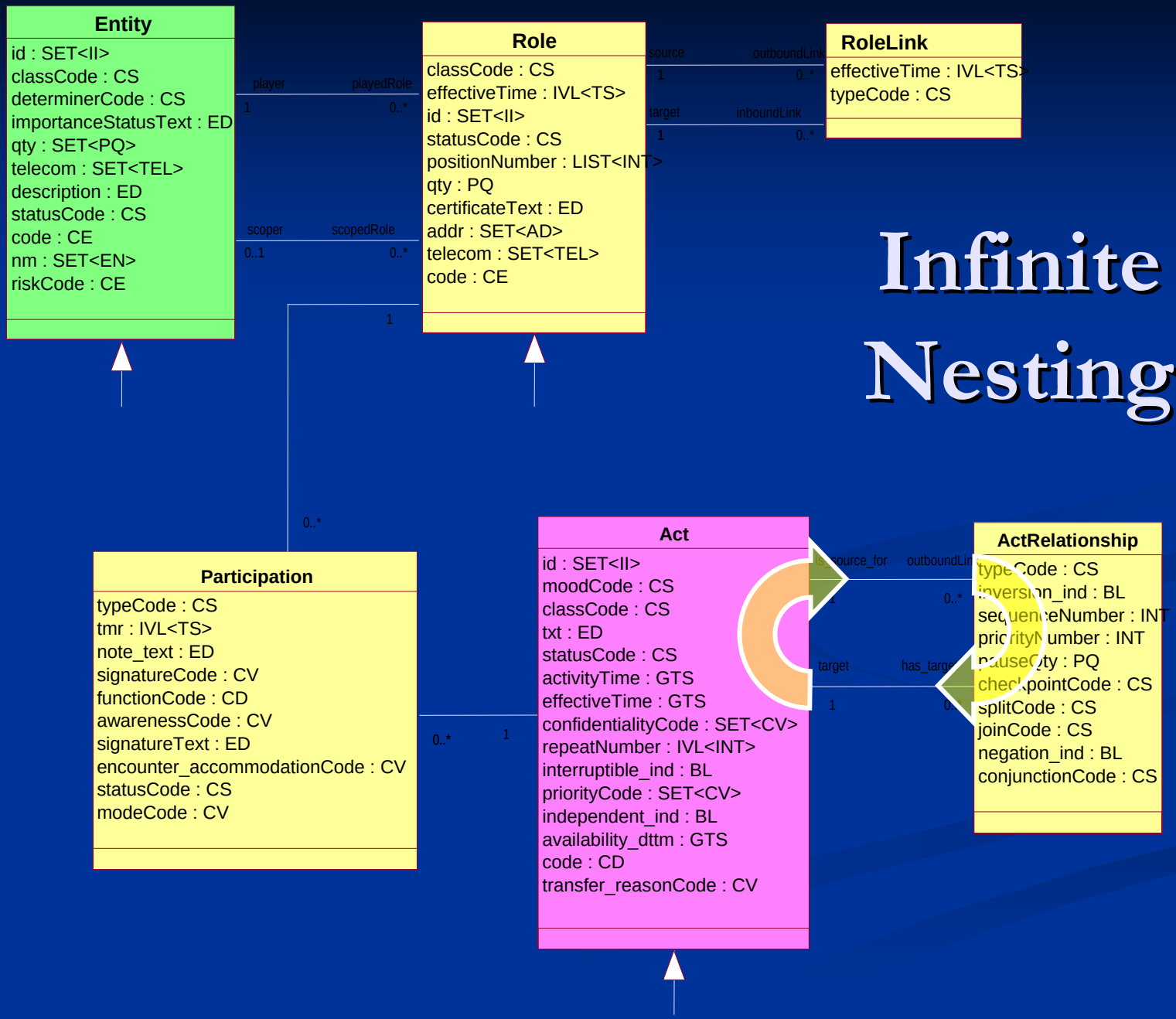
Act-Relationship Recursion



ActRelationship Recursions

*Classes, Instances of Classes, & Instance Diagrams

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description : ED
statusCode : CS
code : CE
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riskCode : CE
player
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scoper
scopedRole
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0..*
Role
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source
outboundLink
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0..*
target
inboundLink
1
0..*
RoleLink
effectiveTime : IVL<TS>
typeCode : CS
1
0..*
Infinite
Nesting
Participation
typeCode : CS
tmr : IVL<TS>
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signatureCode : CV
functionCode : CD
awarenessCode : CV
signatureText : ED
encounter_accommodationCode : CV
statusCode : CS
modeCode : CV
0..*
0..*
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Act
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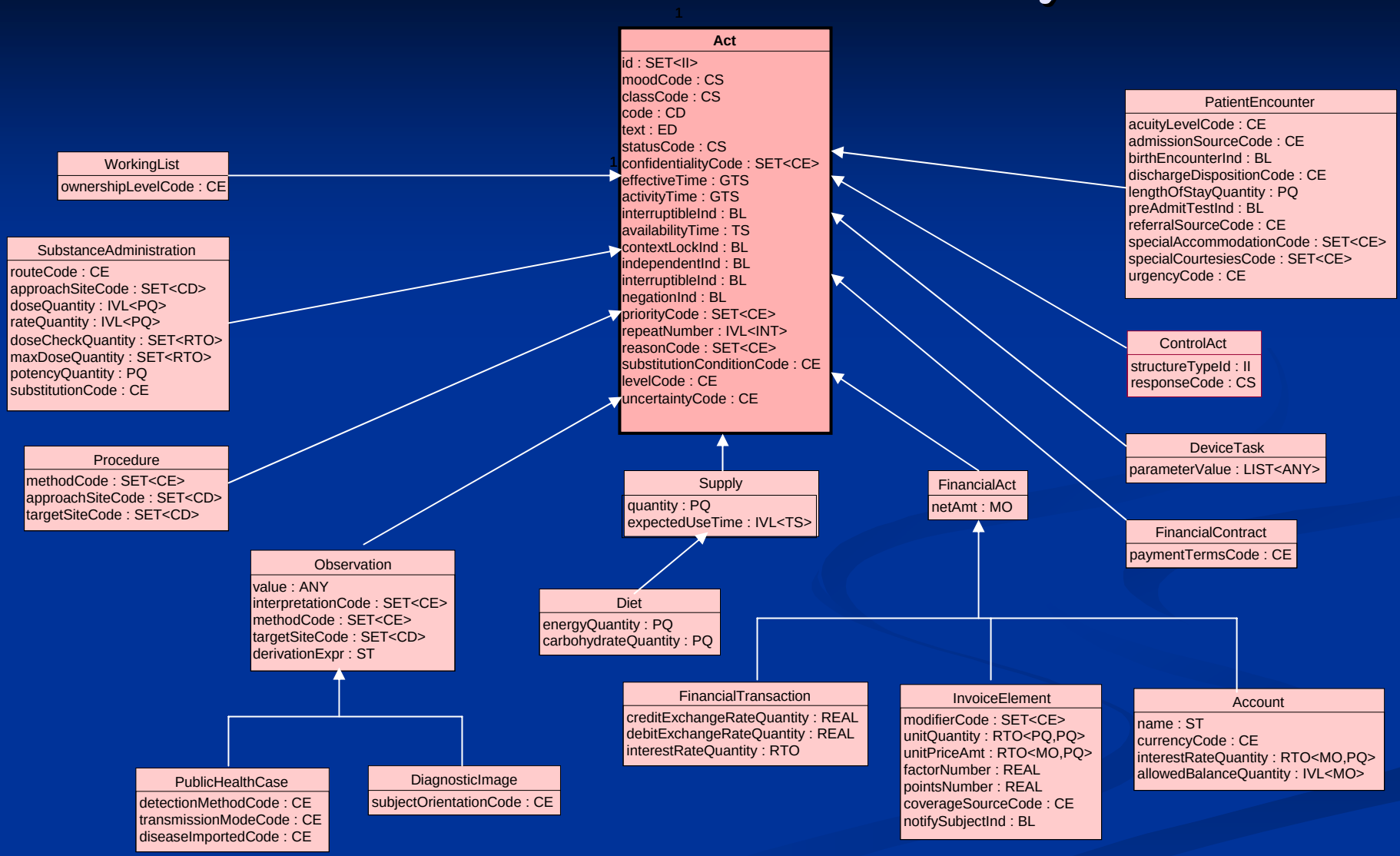
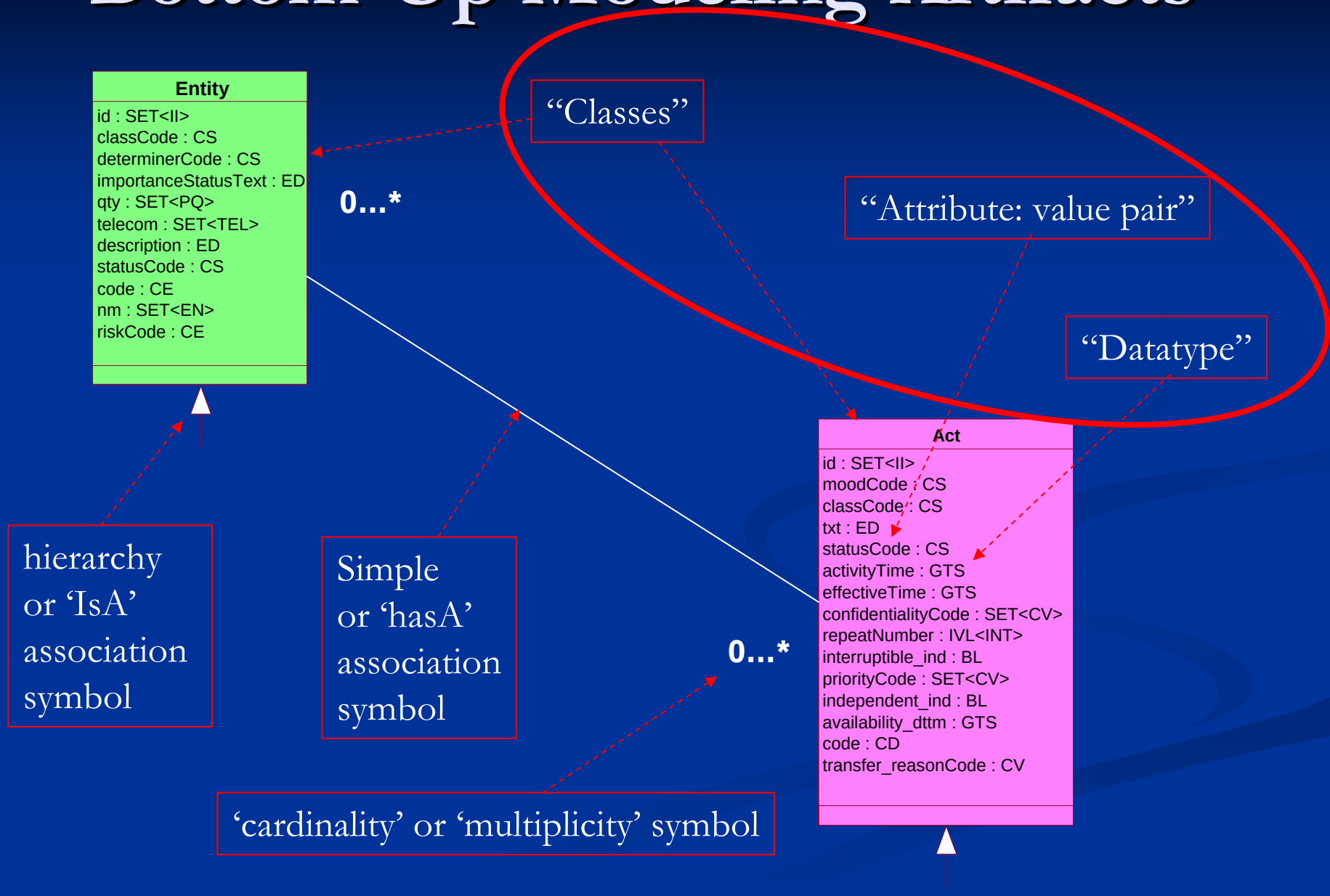
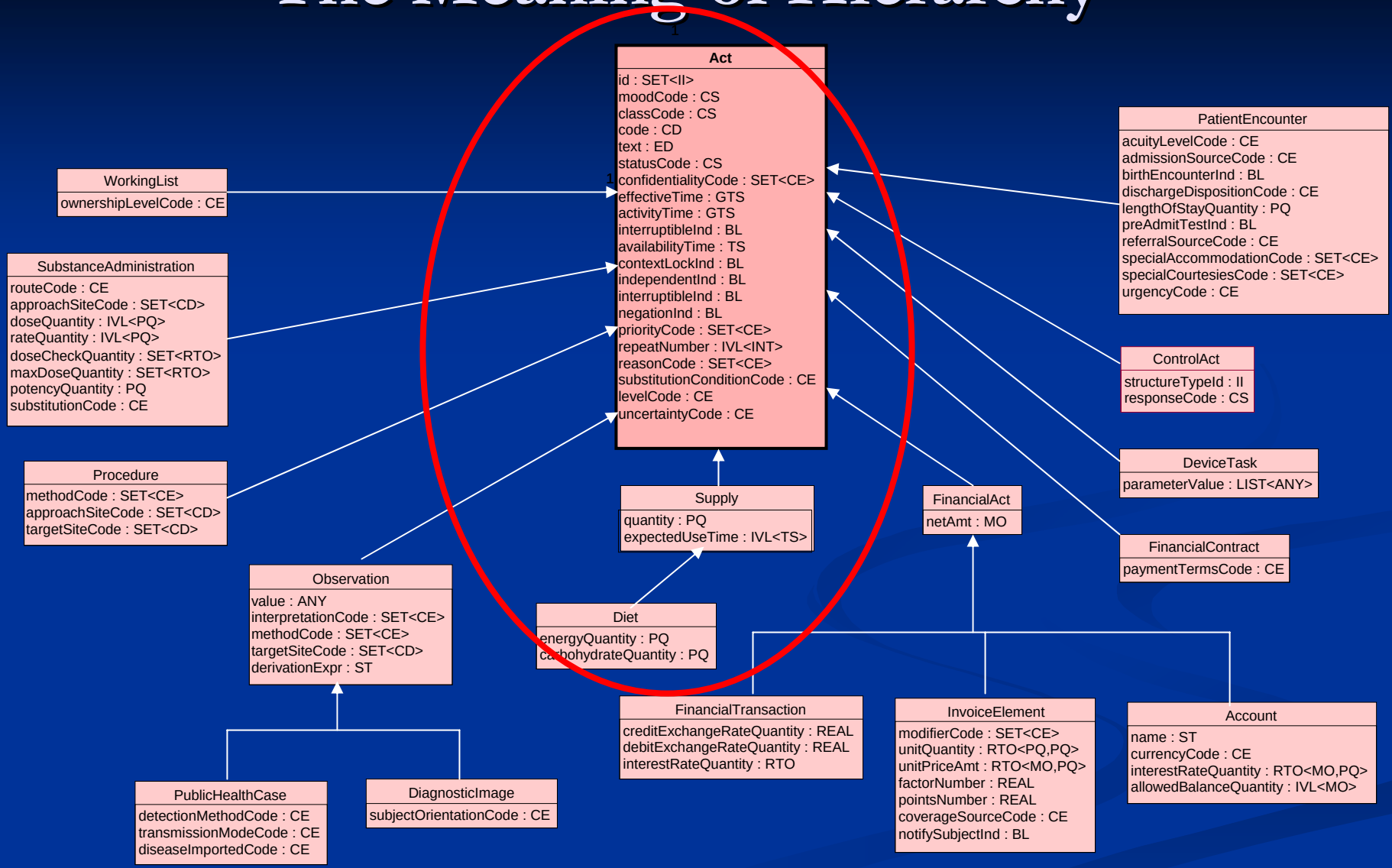
HL7 RIM Act Hierarchy



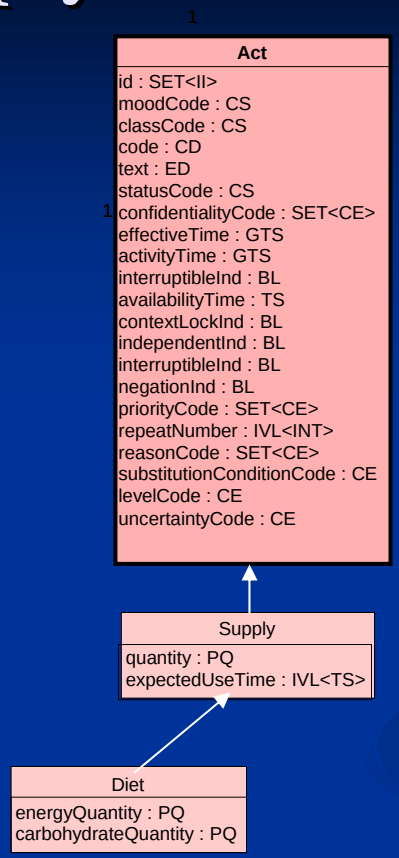
Bottom-Up Modeling Artifacts



The Meaning of Hierarchy

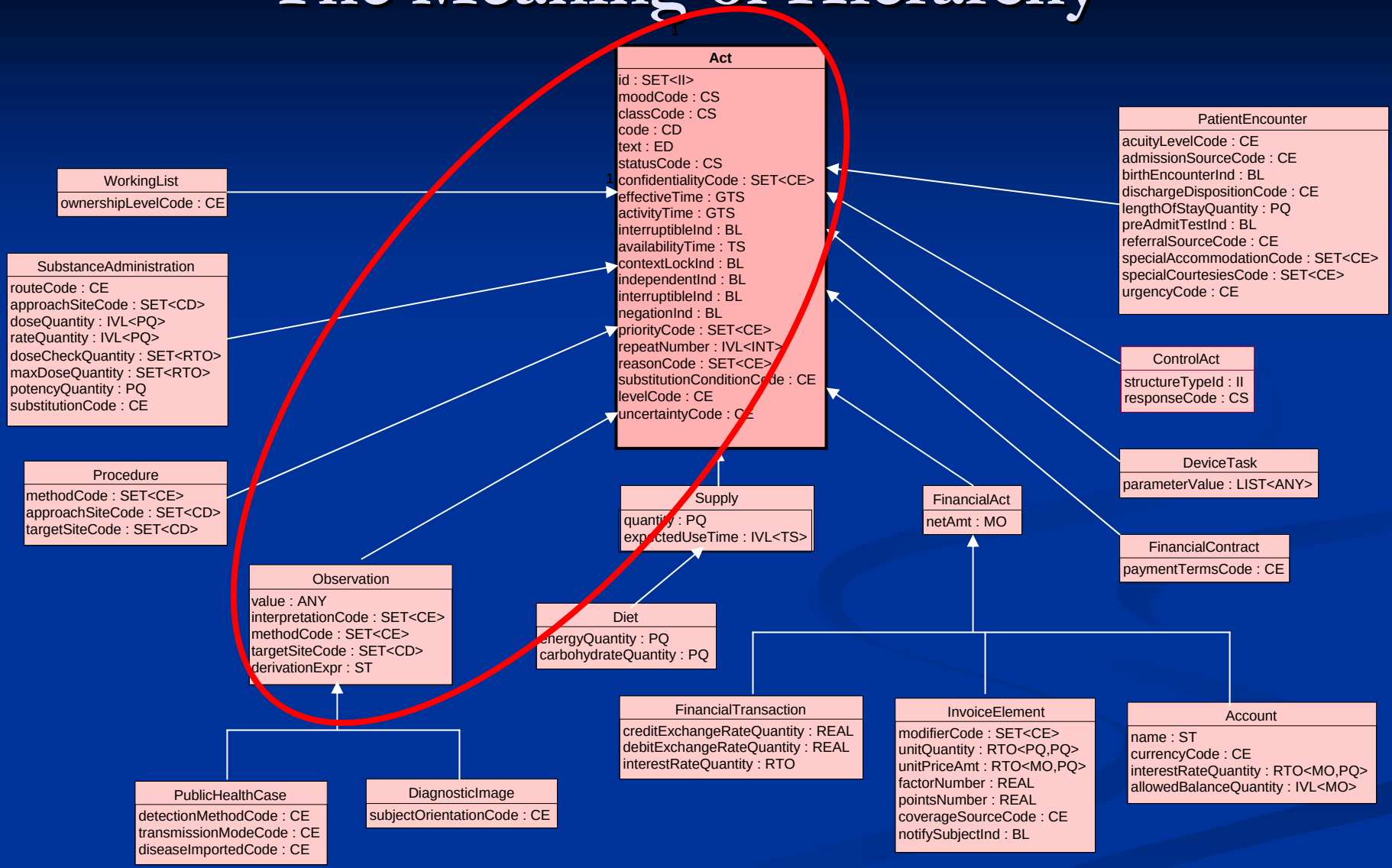


Act-Supply-Diet Hierarchy

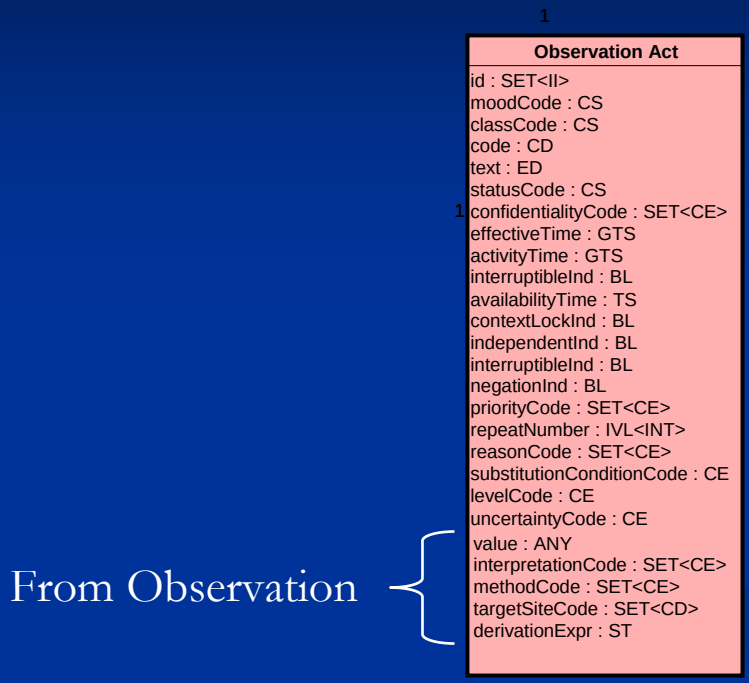


Diet Act Combines Attributes in Hierarchy

The Meaning of Hierarchy

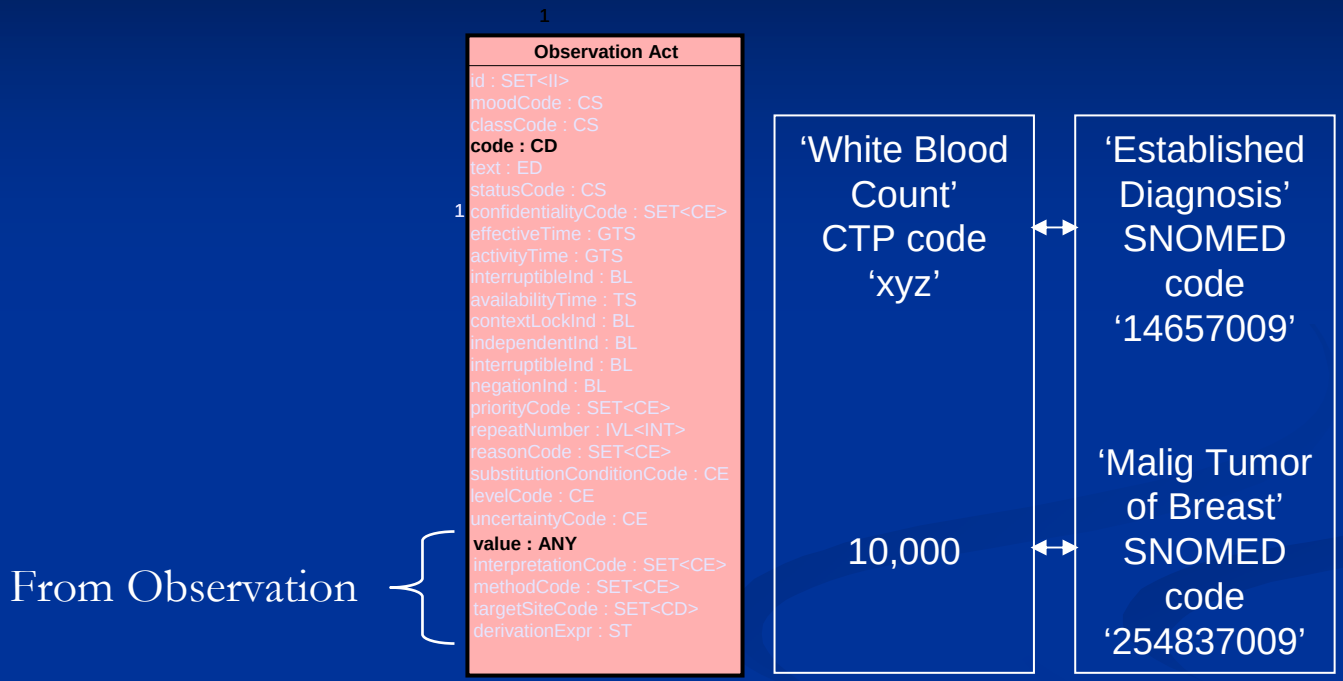


Observation Act = Act Attributes + Observation Attributes



Observation.code / Observation.value

What is the Question? / What is the Answer?



Sample Glossary

Source Term	Term Source	Storyboard Sentence	Nominalized Verb	General Dictionary Definition	Domain Dictionary Definition	Inferred Question	SNOMED CT	Lexical Match	Meaning Match
Christine	Storyboard: Single-word Term	Christine, age 46, was recently diagnosed with stage II breast cancer.		not applicable	Not Applicable	What was the name?			
diagnosed	Storyboard: Single-word Term	Christine, age 46, was recently diagnosed with stage II breast cancer.	diagnosis	The act or process of determining the nature and cause of a disease or injury through examination of the patient	The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, and review of laboratory data	What was the diagnosis?		**Establish-ed diagnosis 14657009**	
breast cancer	Storyboard: Multi-word Term	Christine, age 46, was recently diagnosed with stage II breast cancer.		none	none	What was the diagnosis?			**254837009 Malignant tumour of breast**
RN	Activity Diagram: Role			A graduate trained nurse who has passed a state registration examination and has been licensed to practice nursing	A nurse who has graduated from an accredited school of nursing and licensed to practice by a state authority			**224535009 Registered nurse**	
reviews chart	Activity Diagram: Action State		chart review	Review: An inspection or examination for purposes of evaluation	Chart: A recording, in tabular form, of clinical data relating to a case			**Review of 55210009**	**medical records review, 312853008**
requests education appointment	Activity Diagram: Action State		education appointment request					**Patient education 311401005**	
request	Activity Diagram: Flow Class								

What is an Information Model?

- Describes Relationships Between Concepts (in UML)
  - Class concepts
  - Attribute concepts
  - Association concepts
  - Data-type concepts
- Provides Data-type Links to Vocabulary Concepts
  - SNOMED
  - LOINC
  - ICNP
  - …..
- Not a Data Model!
  - Not concerned with application performance in a relational database
  - Not concerned with ease of application programming
  - Is concerned with communicating knowledge of domain

What is an Information Model?

- Describes Relationships Between Concepts (in UML)
  - Class concepts
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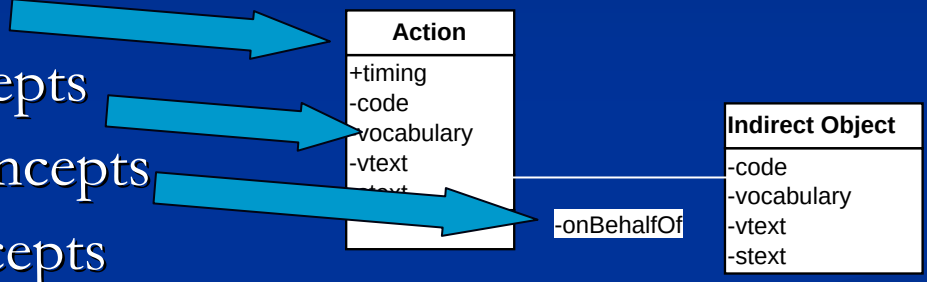
  - Data-type concepts



- Provides Data-type Links to Vocabulary Concepts
  - SNOMED
  - LOINC
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  - …..

Building an Information Model

--an iterative process

- Identify Basic Concepts
- Define Basic Concepts in Glossary
- Identify Relationships Between Concepts
  - Attributes
  - Multiplicities
  - Associations
- Abstract Basic Concepts into Hierarchies
  - Identify attributes that can be shared
  - Define Abstract Concepts in Glossary

Identify Basic Concepts

- Subjects (actors)
  - Patient
  - Nurse
  - Physician
  - Patient care aide
  - …
- Verbs
  - Asked
  - Reviewed
  - Decided
  - Printed
  - Moved
  - Documented
  - Spoke
  - Verbalized
  - Assess
  - …
- Objects
  - Patient
  - Strategies
  - Breast cancer
  - Nausea
  - Vomiting
  - Intervention
  - Video
  - …

Identify Abstract Concepts

Subjects = "Persons"
Subjects = "Do'ers"

- Subjects (actors)
  - Patient
  - Nurse
  - Physician
  - Patient care aide
  - …

Verbs = "Actions"

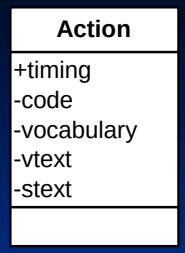
- Verbs
  - Asked
  - Reviewed
  - Decided
  - Printed
  - Moved
  - Documented
  - Spoke
  - Verbalized
  - Assess
  - …

Objects = "?"

- Objects
  - Patient
  - Strategies
  - Breast cancer
  - Nausea
  - Vomiting
  - Intervention
  - Video
  - …

Define Abstract Concepts in Glossary

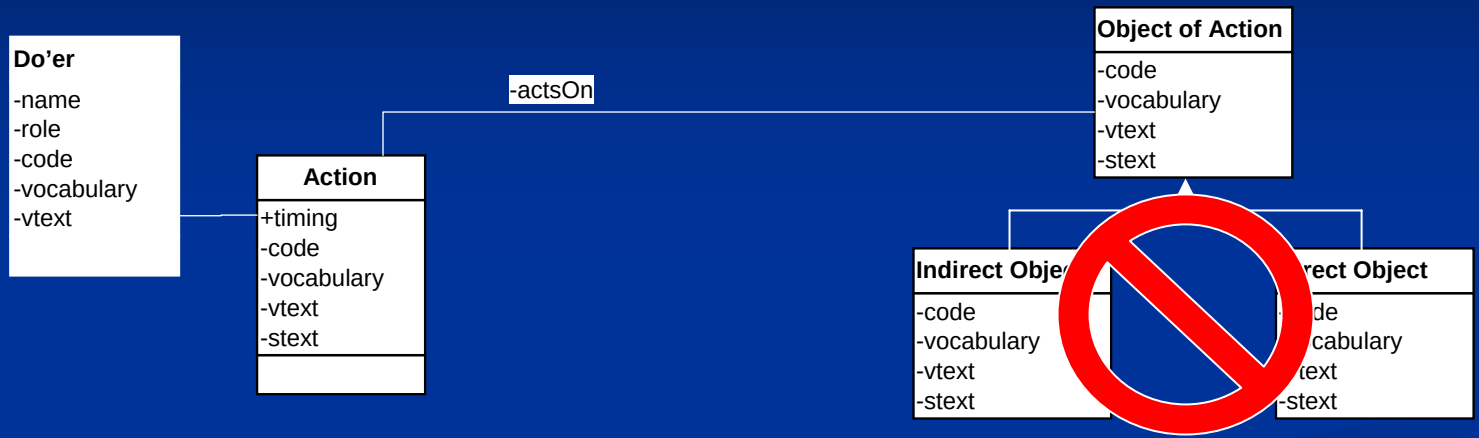
- Do'er is someone who performs an action
- Action is a word that describes what a do'er is doing to the object
- Object is a direct object or an indirect object of a sentence
- A direct object of a sentence is the thing being done to
- An indirect object of a sentence is the ….



Data-Types

- What "kinds of" values can an attribute have?
  - Timing (date-timestamps; frequency text; etc)
  - Code (alphanumeric text strings from code field of published vocabulary)
  - Vocabulary (string with official identifier for published vocabulary)
  - Vtext (string with English text corresponding to code in published vocabulary)
  - Stext (string with exact text from storyboard)

Identify Relationships Between Concepts



- Do'ers
  - Patient
  - Nurse
  - Physician
  - Patient care aide
  - …
- Actions
  - Asked
  - Reviewed
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  - Printed
  - Moved
  - Documented
  - Spoke
  - Verbalized
  - Assess
  - …
- Objects (direct & indirect)
  - Patient
  - Strategies
  - Breast cancer
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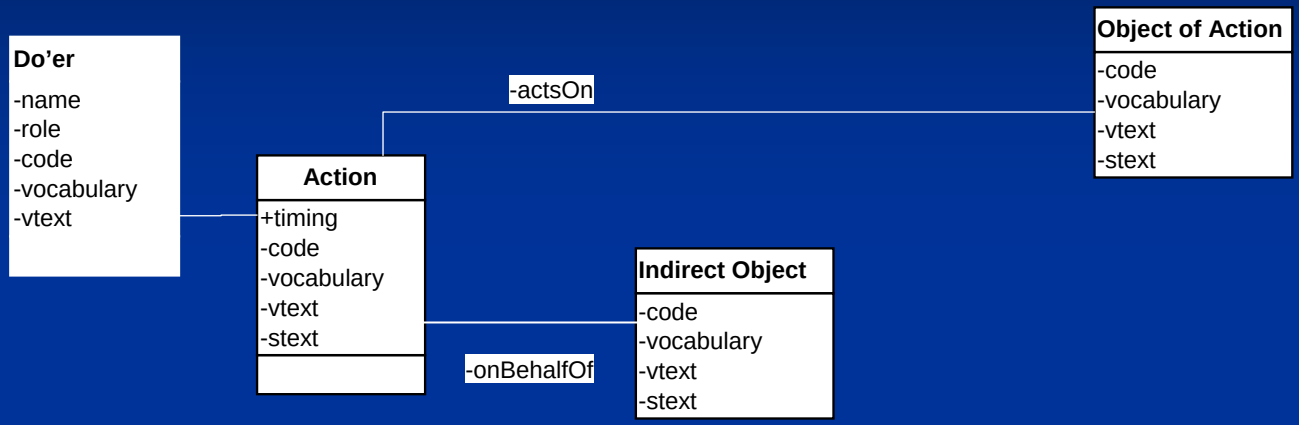
  - Video
  - …

Identify Relationships Between Concepts



- Do'ers
  - Patient
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- Actions
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  - …
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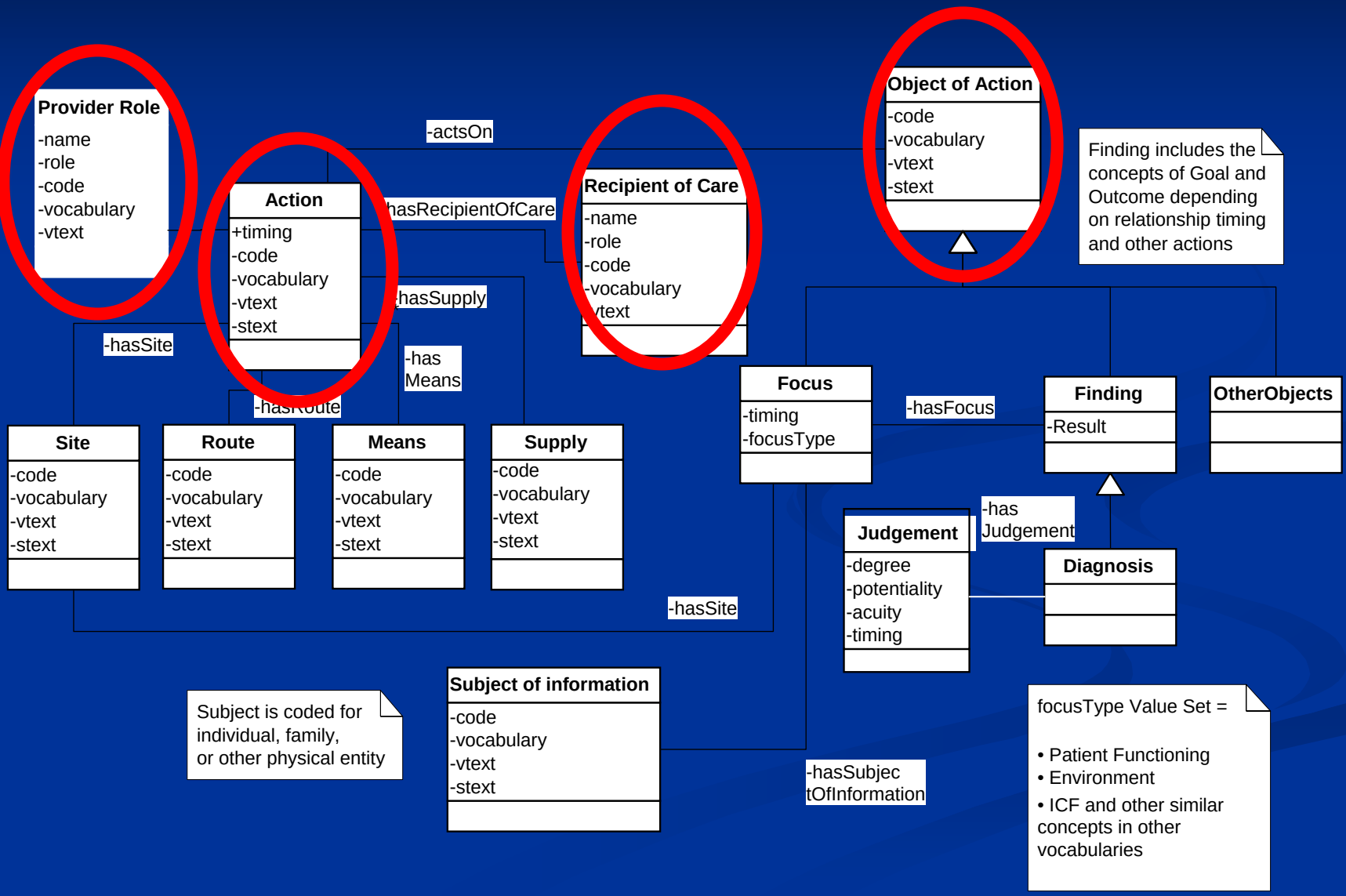
  - Vomiting
  - Intervention
  - Video
  - …

Storyboard Information Model Instance Diagrams

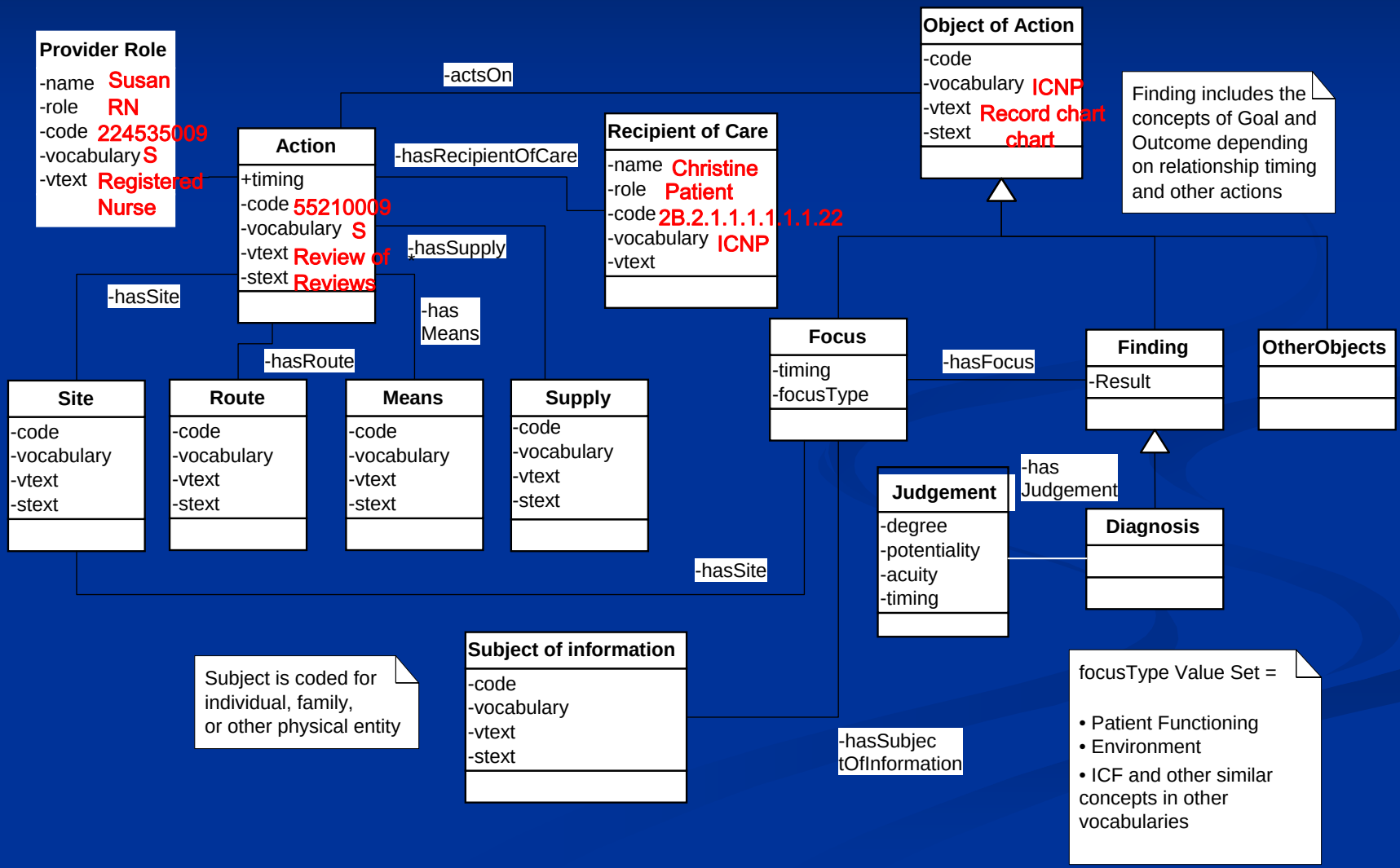
- Test the combination of Information Model and vocabularies against the storyboard
- Use the Storyboard Glossary to provide the vocabulary for the instance diagrams

Nursing Domain Information Model



Example Instance Diagram

"Susan , an RN , reviews Christine's chart"

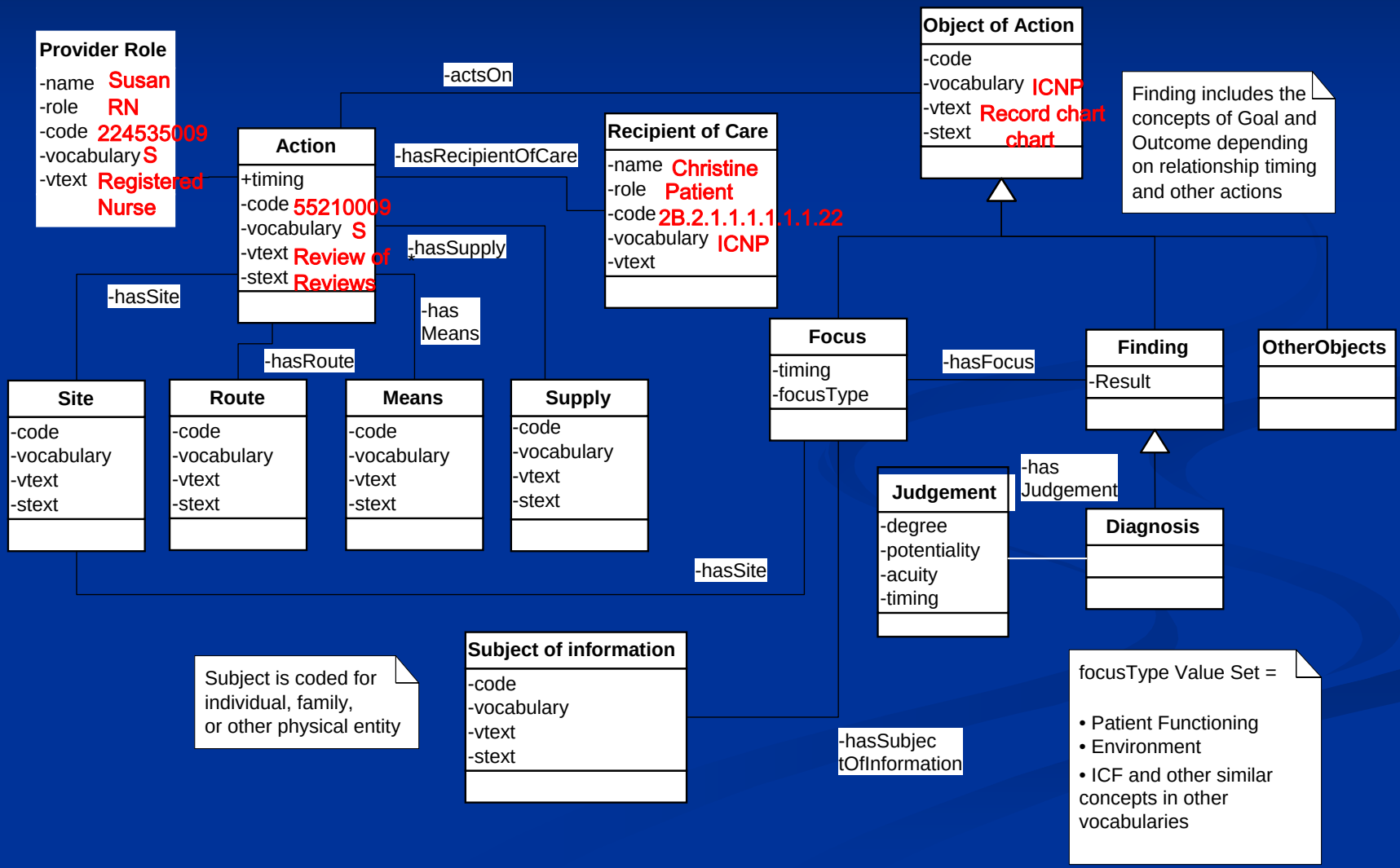


Mapping from Nursing to HL7

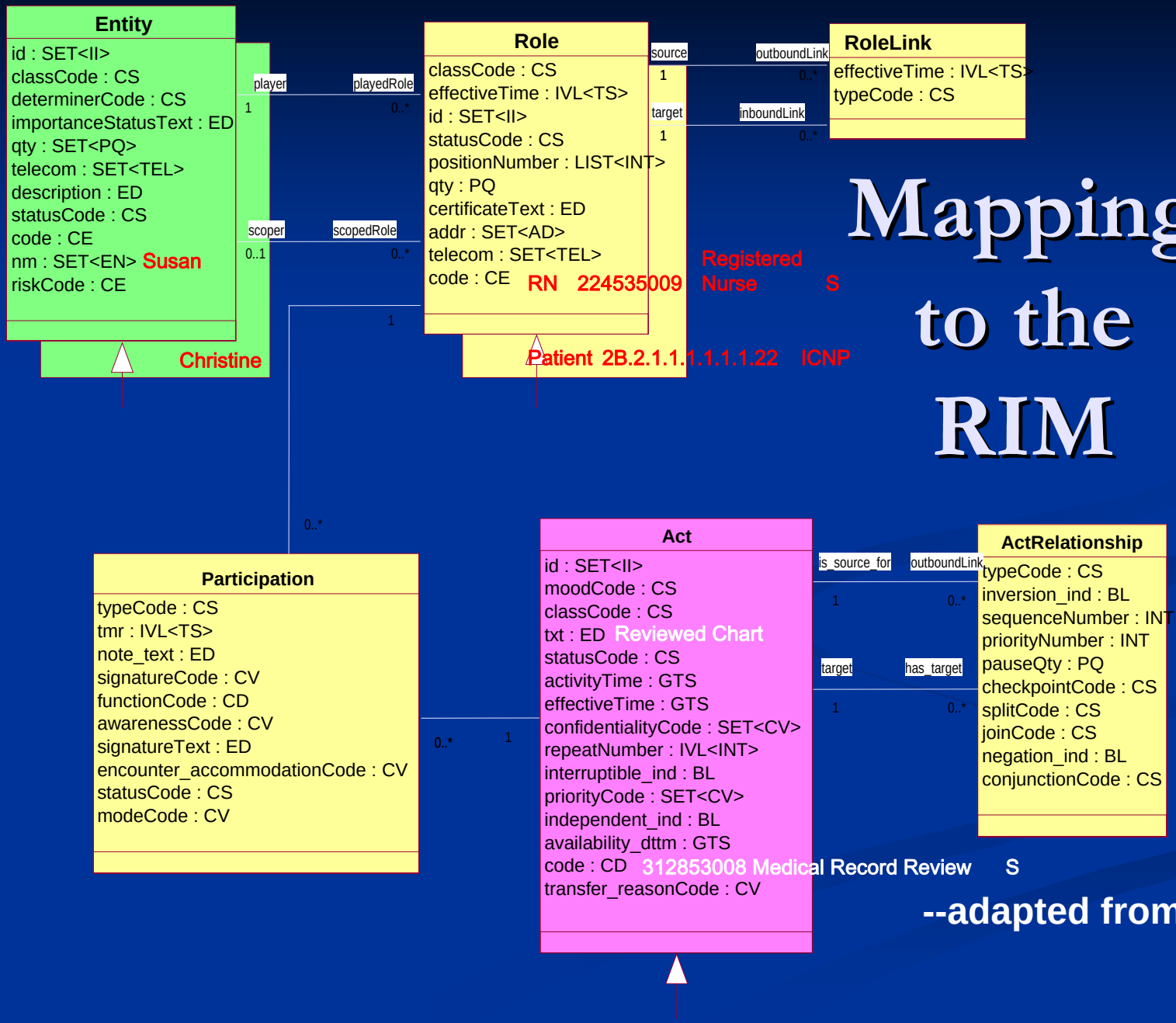
From Nursing Domain	To HL7 RIM
Provider Role	Entity (Person) + Role
Care Recipient	Entity (Person) + Role
Action + Object of Action	Act
Supply	Material
Diagnosis.result	Observation.value
Finding.result	Observation.value
Route	SubstAdmin.routeCode

Example Instance Diagram

"Susan , an RN , reviews Christine's chart"



Mapping to the RIM



--adapted from RIM V1.18