
Ontological
Engineering 101
DAML + OIL Workshop
February 19-20 2002
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Why Ontology ?

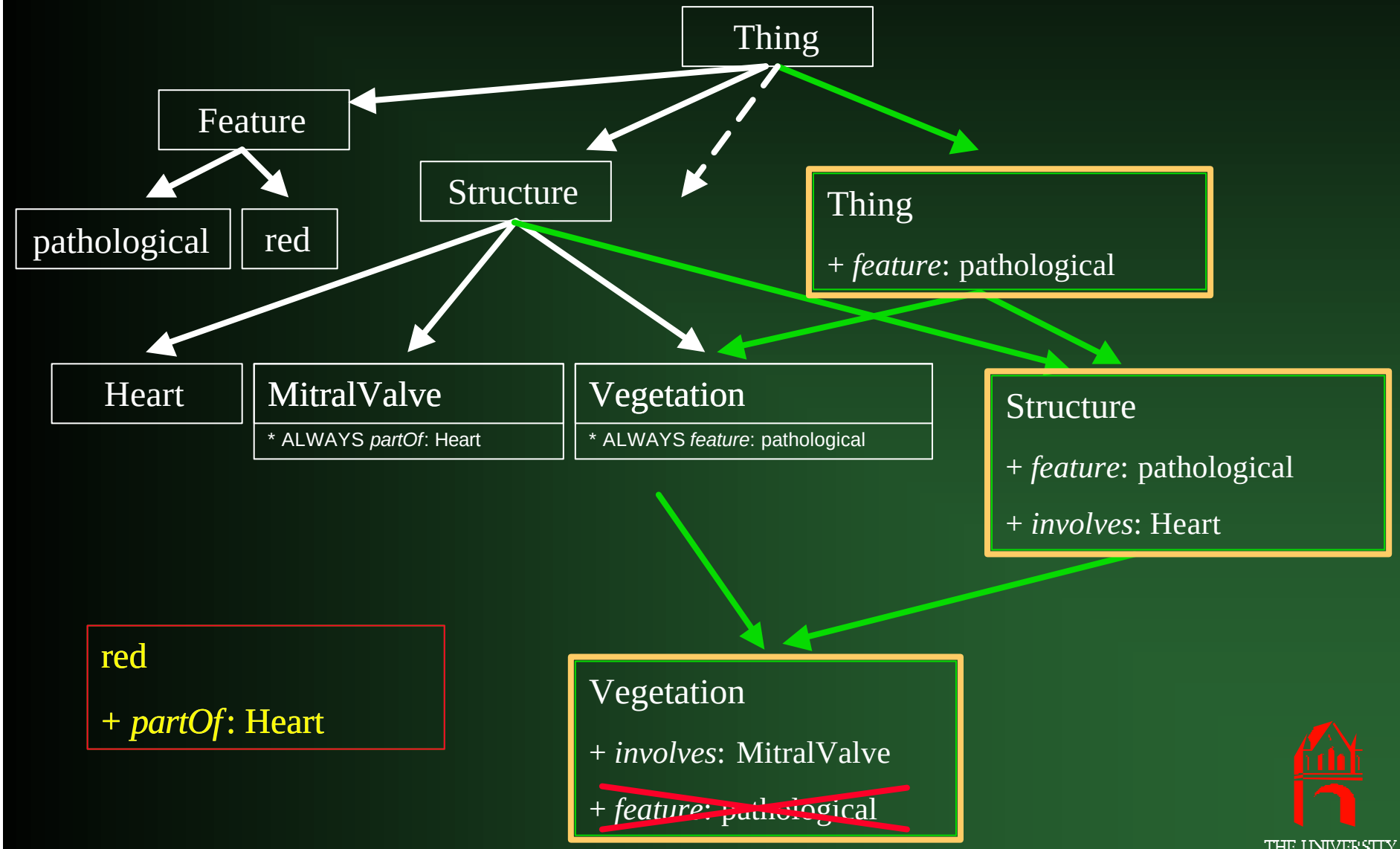
Goal: Describe the world

Problem 1: The world is big

Case Study 1: The exploding bicycle

- ICD-9 (E826) 8
- READ-2 (T30..) 81
- READ-3 87
- ICD-10 (V10-19) 587
- V31.22 Occupant of three-wheeled motor vehicle injured in collision with pedal cycle, person on outside of vehicle, nontraffic accident, while working for income
- W65.40 Drowning and submersion while in bath-tub, street and highway, while engaged in sports activity
- X35.44 Victim of volcanic eruption, street and highway, while resting, sleeping, eating or engaging in other vital activities

Description Logics: A crash course



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Defusing the exploding bicycle: 500 codes in pieces

- 10 things to hit…
  - Pedestrian / cycle / motorbike / car / HGV / train / unpowered vehicle / a tree / other
- 5 roles for the injured…
  - Driving / passenger / cyclist / getting in / other
- 5 activities when injured…
  - resting / at work / sporting / at leisure / other
- 2 contexts…
  - In traffic / not in traffic

V12.24 Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, unspecified pedal cyclist, nontraffic accident, while resting, sleeping, eating or engaging in other vital activities

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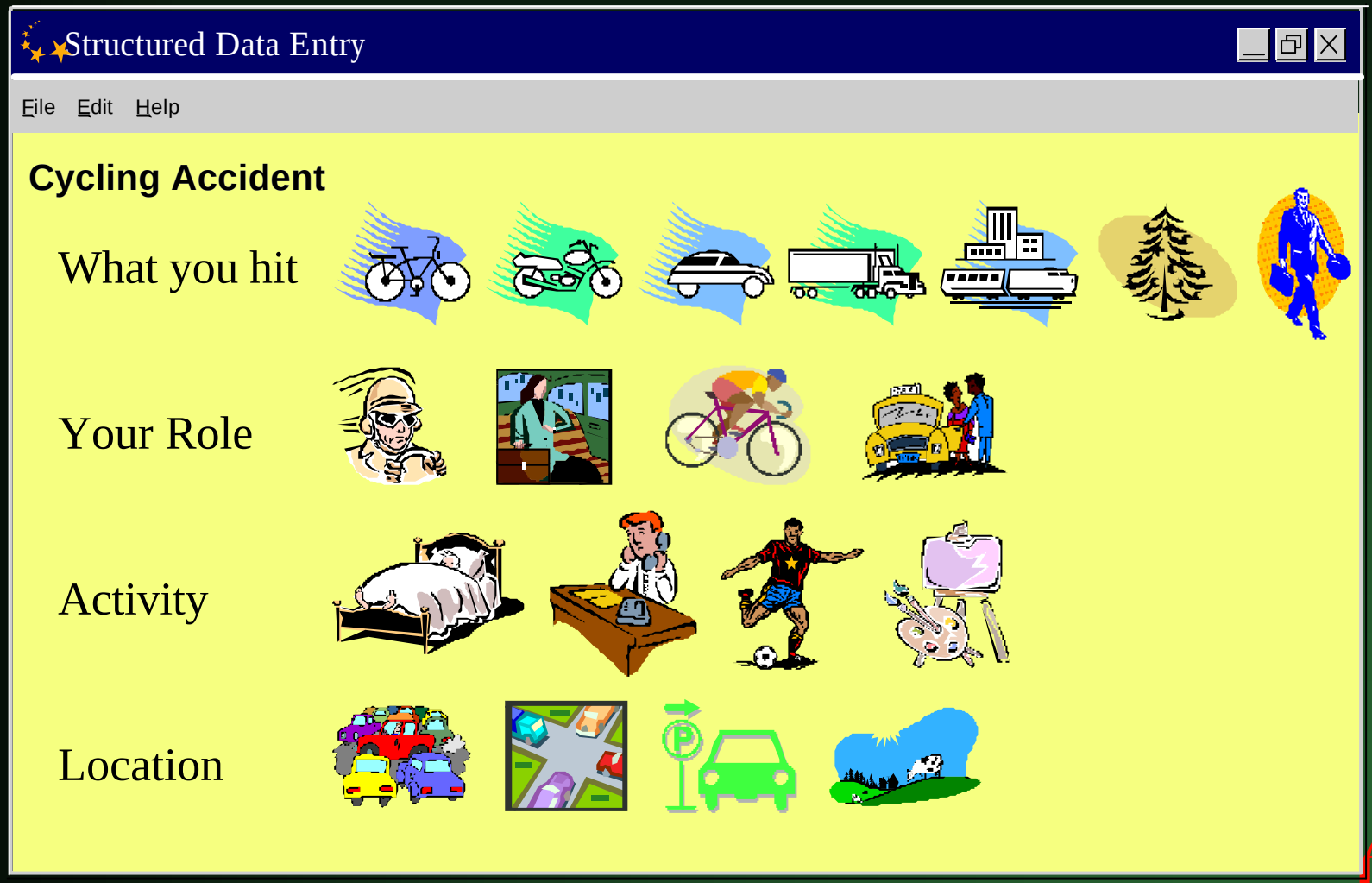
Goodbye to picking lists…



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…hello to new challenges

- How do you classify things?
  - ‘stenosis *of* mitral valve’ and ‘lesion *of* heart’
  - ‘vegetation *on* leaflet *of* mitral valve’ ?
- When are two things the same ?
  - ‘Inflammation of Liver’ vs ‘Hepatitis’
- Are there any illegal combinations?
  - ‘fractured eyebrow causing donkey’
- Are any combinations redundant?
  - ‘finger which is part of hand’
  - ‘finger’


Issues
Starting out
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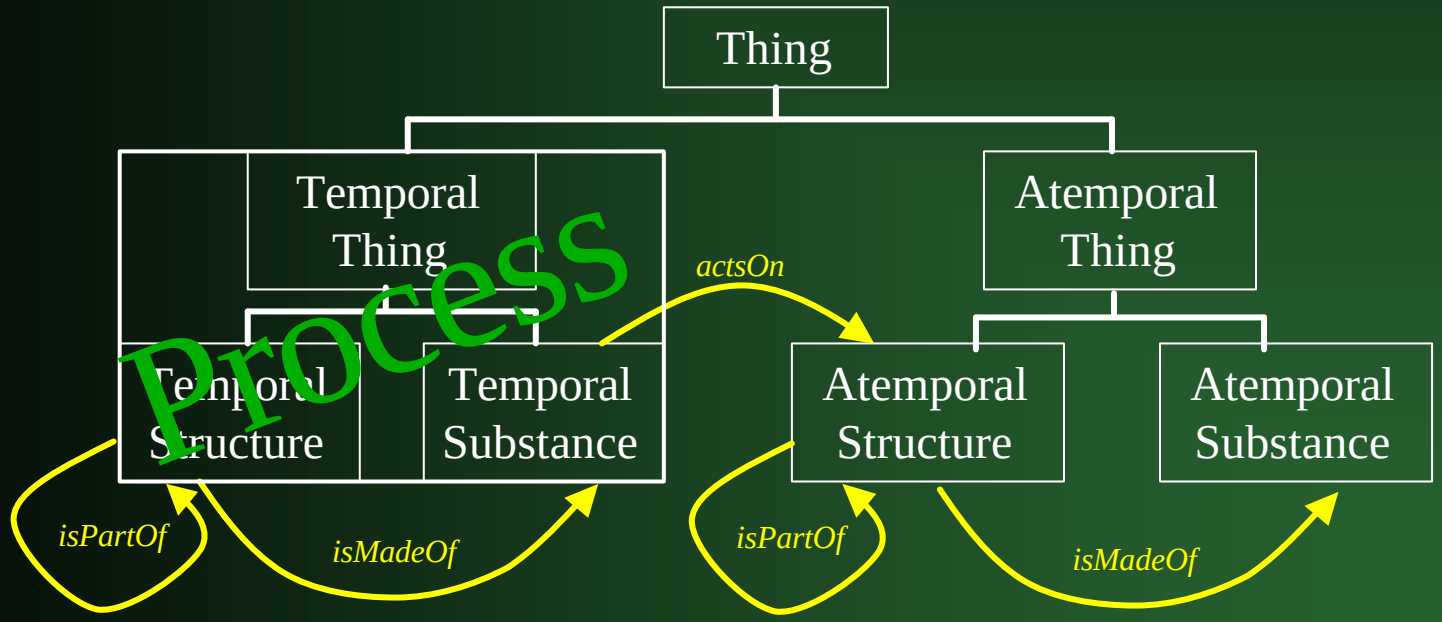
Basic Ontological Issues: Taxonomic Principles

- Modular taxonomies are the goal
  - primary method to achieve maintainability / scalability
- Disjoint primitive taxonomies are therefore the ideal
  - if not disjoint (ie more than one primitive parent)
    - Þ taxonomies need 'untangling'
- Therefore:
  - Independent primitive concept lists are disjoint and open
    - E.g. list of known diseases is just that: those we know about as of today.
  - Modifying primitive concept lists are disjoint and closed / covering
    - E.g. open / closed; mild/moderate/severe
- Note: OilEd requires disjointness to be declared

Basic Ontological Issues: Top Ontologies

- Beware words and labels
- Basic split is temporal



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Basic Ontological Issues: Tools of trade

- Primitives
  - All natural kinds are primitives
  - Not all primitives are natural kinds
    - Formalism may not support all defining properties (qv)
- Links
  - Links can be compositional:
    - hasFeature LinkFlavour hasState
    - ⇒ beware semantic redundancy of links
- Compositions
  - Anything that isn't a primitive
  - Canonical forms
- Properties
  - Defining: necessary & sufficient
  - Asserted: existential to class. Reciprocal vs Unidirectional
  - Inherited
  - Complete Property Set = Defining ∪ Asserted ∪ Inferred

Food

Cake, Flour, Sugar,

isMadeOf

(Food *isMadeOf* Sugar)

isMadeOf Flour

isMadeOf Sugar

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Basic Ontological Issues: Common Bear Traps

- Formalism restricts what can be said
  - Don’t torture it e.g. no negation; no shared variables
- Semantic Redundancy
  - More than one way to say ⇒ equivalence
  - Risk for links as well as concepts
    - [hasColour] vs [hasFeature Colour hasState]
- Ambiguity
- Default Reasoning
  - Birds fly, except penguins, ostriches and Dodos
- Partonomy and transitivity
- Spatial reasoning

Basic Ontological Issues: Common Bear Traps

- Structure vs Process
  - Ulcer vs Ulceration
- Substance vs Structure
  - Glucose (mass weight, chemical structure)
- Changed state vs Change in state
  - Increased vs Increasing
- Selectors
  - Left hand: ‘left’ not actually a spatial signifier
- Numbers, ranges
  - Concrete domains


Exercise
Arlig, Adel, Applad & Friends
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Modelling / Browsing Exercise
IKEA Kitchen

Doors:

30, 40, 50, 60 cm doors

Door Styles: Arlig (white MDF)
Adel (solid birch, birch veneer or cream MDF)
Applad (yellow / blue / white MDF)
Stat (white MDF)
Kvadrat (white MDF / beech)
Rejal (antique / pine)
Nexus (birch)
Abstrakt (white / blue / green MDF)

All doors: glass or solid

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IKEA Kitchen

Faktum Floor Cabinets:

- high: 40 or 60 cm
- low: 30, 40, 50, 60, 80
- 90x90cm corner unit

Faktum Wall Cabinets:

- 30, 40, 50, 60, 80
- 60x60 cm corner unit

Accessories:

- Shelves 30, 40, 50, 60, 80 cm
- Handles: Plural, Tjabbe, Ryck, Maskulinum, Adverb

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Engineering Goals

Kitchen with white doors

Cupboards with Wood Doors

30cm floor cabinet with 60cm door

40cm Cabinets with birch door and Plural handles

Maintainable source files

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Advanced Ontological Issues: Complexity

(Soreness *which*
actsSpecificallyOn (Signal *which* <
isSpecificConsequenceOf (TransducingProcess *which*
isSpecificFunctionOf PainReceptorCell)
isConsequenceOf (Conduction *which* <
hasUniqueAssociatedDisplacement (Displacement *which*
isDisplacementFrom Throat)
isSpecificFunctionOf Nerve
actsSpecificallyOn ElectricalEnergy >) >))

…which is a sore throat. Knowledge is fractal

Need: Language Generation; Intermediate representation

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Advanced Ontological Issues: Confusion

- Concept labels can be ambiguous: tonsil, bladder
- Documentation
  - Textual Definitions
    - Not authored
    - Not used
  - Extensional Definitions
    - Relied upon by authors (but will users see them ?)
    - But NB subject to confusion due to misclassification
- Arbitrary Ontological Choices
  - How to ensure other authors / users make same choice ?
  - Need for ‘constraints’ = metamodel

Advanced Ontological Issues: Maintenance

- Maintenance
  - Large ontology necessarily collaborative undertaking
  - Need way to make editing task comprehensible (and shareable)
  - Multiuser environments, coupling strategies
  - Source sharing, organisation, training
- Performance and Scaling
  - What can be done depends on how long an interation / experiment requires
- Working Method
  - Iterate, test, iterate, test, iterate, test

Advanced Ontological Issues: Delivery

- Philosophical perfection does not guarantee utility
- Inevitably complex
  - But useless if too confusing
  - How to systematically simplify / guide ?
  - Contrains what you do
- Think about delivery and your user
  - How to make it look familiar ?
  - Need for navigational hierarchies

Coding Confusion: An example

Suitcase	X	X		X		X				
Luggage							X			
Attache case			X							
Model Person		X		X		X				
Woman	X			X	X		X	X		
Adults			X							
Headcloth				X	X					
Cloth	X	X					X			
Scarf						X				
Standing				X	X	X	X	X		
Background			X	X						
Brown	X	X	X	X	X					
Blue		X	X	X						
Chemise				X						
Dress					X	X	X	X		
Tunics			X							
Clothes		X								
Brass Instrument				X	X		X			
French Horn		X								
Horn						X				
Tuba	X		X							

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