



Ontological Engineering 101

DAML + OIL Workshop

February 19-20 2002



THE UNIVERSITY
MANCHESTER

Why Ontology ?

Goal: Describe the world

Problem 1: The world is big

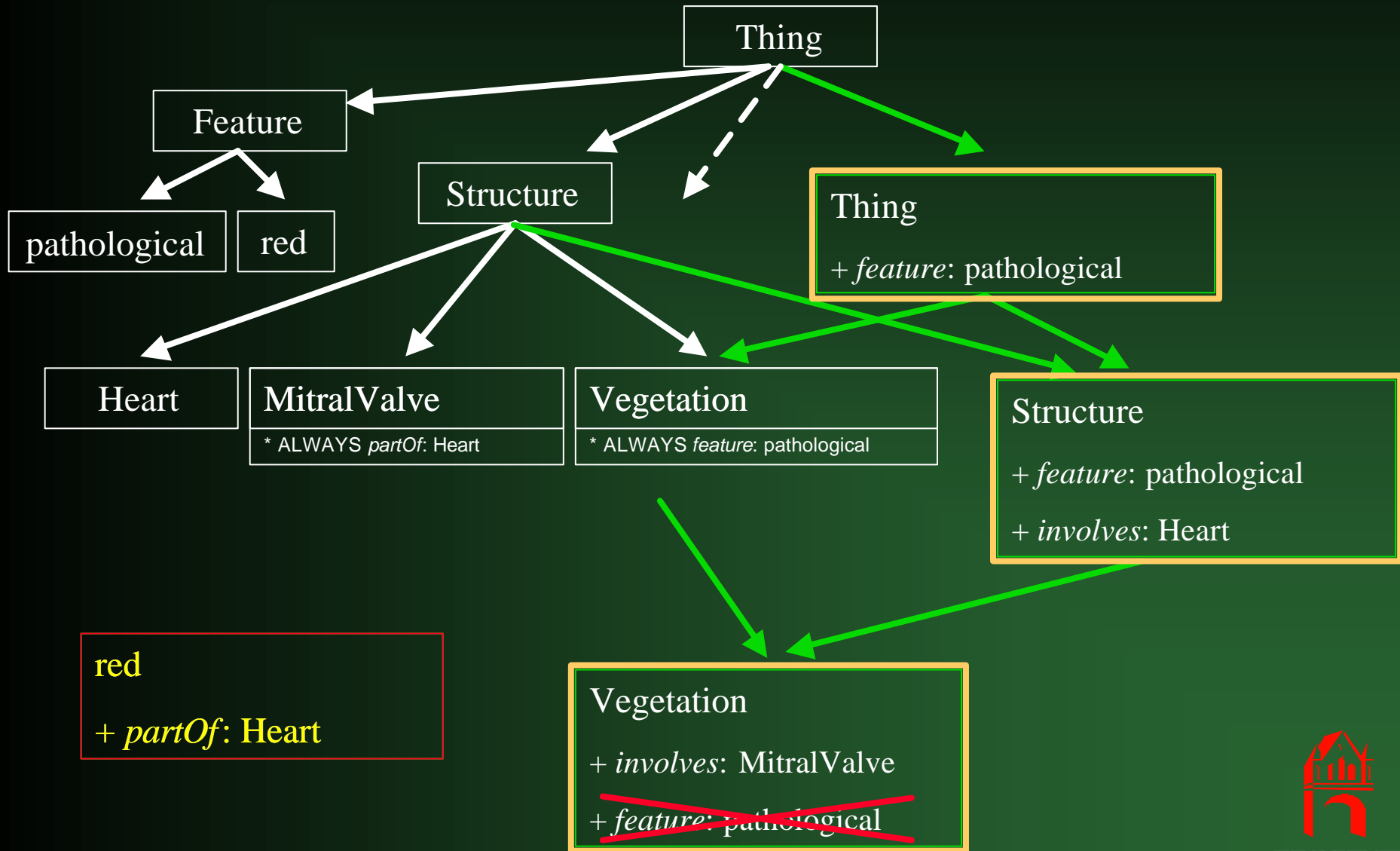


Case Study 1: The exploding bicycle

- 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



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



Goodbye to picking lists...

Structured Data Entry

File Edit Help

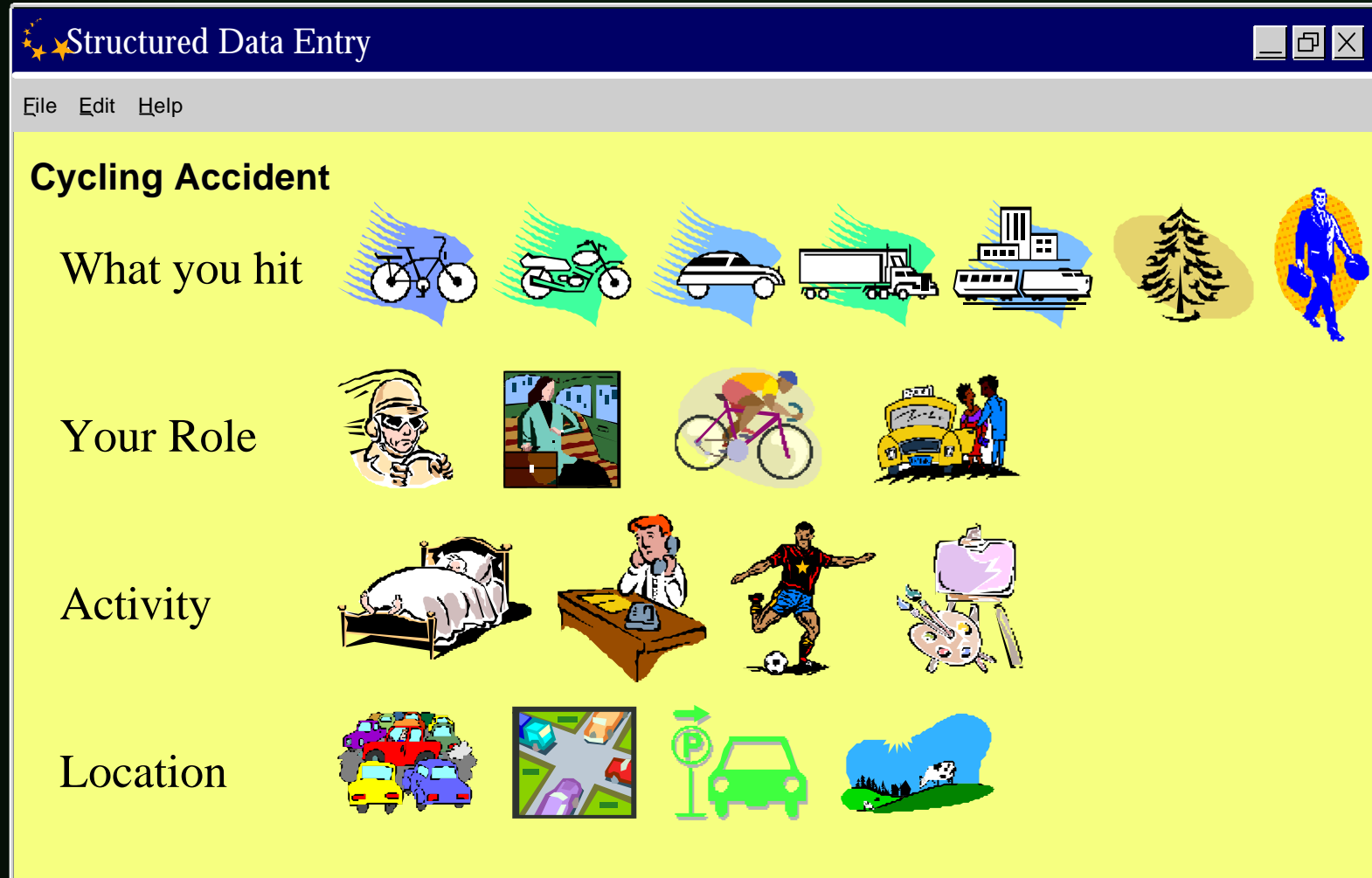
Cycling Accident

What you hit

Your Role

Activity

Location



...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



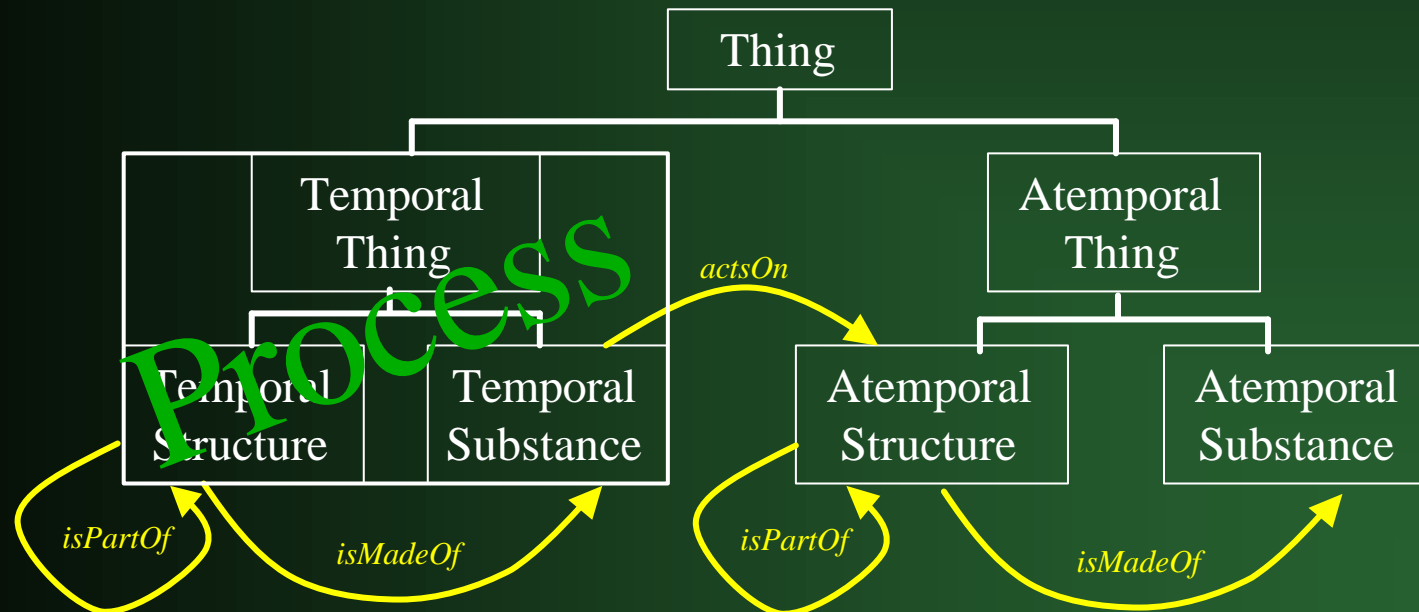
Basic Ontological Issues: Taxonomic Principles

- 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)
 - ↳ 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



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)

Food

Cake, Flour, Sugar,

- Links

- Links can be compositional:
 - hasFeature LinkFlavour hasState
 - \Rightarrow beware semantic redundancy of links

isMadeOf

- Compositions

- Anything that isn't a primitive
- Canonical forms

(Food *isMadeOf* Sugar)

- Properties

- Defining: necessary & sufficient
- Asserted: existential to class. Reciprocal vs Unidirectional
- Inherited
- Complete Property Set = Defining \cup Asserted \cup Inferred

isMadeOf Flour

isMadeOf Sugar



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 \Rightarrow 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



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



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



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





Issues

Down the road



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



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 interaction / 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 ?
 - Constrains what you do
- Think about delivery and your user
 - How to make it look familiar ?
 - Need for navigational hierarchies



Coding Confusion: An example



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





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