

CS 617 Object Oriented Systems

Lecture 16

Part-Whole Relationship

3:30-5:00 pm, Mon Thu 13, 2008

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Outline

- 1 Part-Whole Relationship (Meronymy)
- 2 Winston's Classification
- 3 Non-Meronymic Relations
- 4 Part-whole relation in OOPLs and OOAD

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Some Important Interobject Relationships

- An object uses another external possibly shared object for its own functionality
- An object uses and exclusively owns another for its own functionality
- An object delegates some of its responsibilities to another
- An object is simply in relation with another (may not need its services)

Semantics of the Part-Whole Relation

What do we mean when we say one is a part of the other?

Harish part of CSE department, CSE dept part of IIT, ink part of pen, engine part of car, slice part of bread, swallowing part of eating, batting part of cricket, statement is partly right, sledging part of cricket.. Let's understand various connotations of

part-whole relations..

They make impact on design and implementation.

Properties of Part-whole relations

- Are they always transitive?
- Are parts deleted when the whole is deleted?
- Are parts shared by many wholes?
- Can parts and the whole be of the same kind?
- Is the structure among parts important for the whole?
- Does the whole derive its functionality from the functionality of its parts?..

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Winston's Classifiers

- Is the relation of parts to the whole **functional**?
 - functional parts are restricted in their spatial or temporal locations e.g. piston has to be located at a specific place inside the engine
- Are parts **homeomerous**?
 - homeomerous parts are of the same kind as that of the whole
- Are parts and the whole **separable**?
 - separable parts can in principle be separated from the whole in a given context

Winston's Classes

- Component-Integral Object
- Member-Collection
- Portion-Mass
- Stuff-Object
- Feature-Activity
- Place-Area

Component-Integral Object

Functional	Homeomerous	Separable
Y	N	Y

Examples: piston-engine, motor-fan, windings-transformer, wheels-car, refrigerator-kitchen, chapters-book

- components are not haphazardly arranged
- the structural relations define whole's behavior
- some components may be optional
- integral object may not be extensive (i.e. they may not occupy same physical space as in phonology part of linguistics)
- pieces are not parts in this relation (e.g. cut a piston into two pieces)

Member Collection

Functional	Homeomeric	Separable
N	N	Y

Examples: tree part of a forest, ship part of fleet, harin part of mtech1, element part of a set

- members not required to have a structural arrangement –
nile,ganges,jamuna are all rivers, but Nile-river is not a part-whole relation
- classes are determined based on similarity among members, and collections based on spatial proximity or social connections (groups)

Portion Mass

Functional	Homeomerous	Separable
N	Y	Y

Examples: slice part of cake, a part of the drink, a gram is part of a kilogram

- parts are similar to each other and to the whole
- portions are of masses, extensive objects, physical dimensions
- the sense is that of 'some of', which is not the sense in component-integral object (e.g. some of my apple is okay, but is engine is some of the car?-only in portion mass sense!)
- portions occur at arbitrary boundaries: standard measurements can be applied (length,weight,time..)
- broken pieces of a component-object assembly are like

Stuff-Object

Functional	Homeomerous	Separable
N	N	N

Examples: bike is partly steel, water is partly hydrogen

- expressed using the phrase 'is partly'
- water without hydrogen is not water: stuff cannot be separated without the whole altering the identity of the whole
- whereas lens is not partly glass, but made up of glass
- tomato is component (ingredient) of salad and not stuff as described above
- ingredients (separable without altering whole's identity) vs. constituents

Feature Activity

Functional	Homeomeric	Separable
Y	N	N

Examples: paying part of shopping, bidding part of bridge playing, swallowing part of eating

- features or phases of activities
- cannot use phrase 'w has p' as in bicycles have pedals (and not shopping has paying)
- otherwise it's similar to component-object
- structure among stages in an activity

Place Area

Functional	Homeomeric	Separable
N	Y	N

Examples: Kerala part of India, Powai part of North Bombay,
boundary-line part of cricket ground

- places are not parts by virtue of functional contribution to the whole
- place is similar to its area and to every other place in the area as all are areas
- places cannot be separated

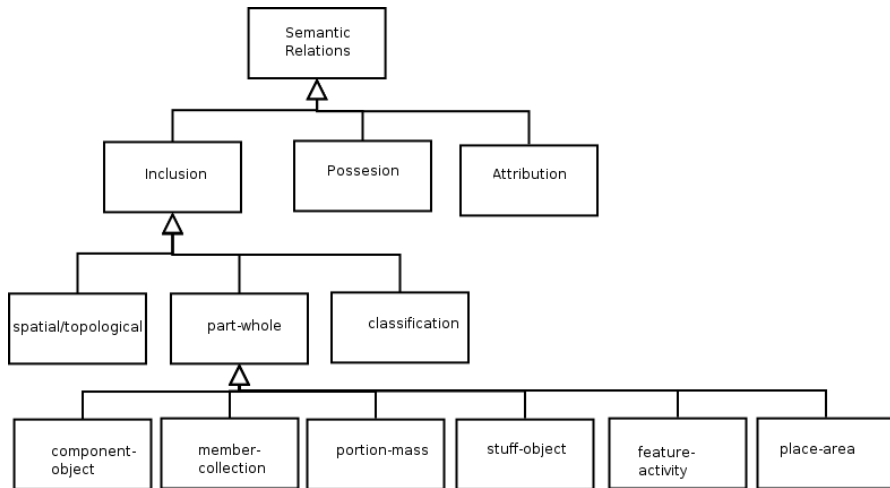
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Non-Meronymic Relations

- Topological Inclusion: The tomato is in the fridge, buyer is in the shop
 - Some topological inclusions are Meronymic since the parts are connected and contribute to functionality
- Class inclusion: fear, happiness are emotions, cars are vehicles (is kind of)
- Attribution: building is tall, coal burns, joke was funny, novel is serious
- Attachment: earrings attached to ears (non-part), fingers attached to hand (part-whole)
- Ownership: the author has copyright, tom *has* a house, (not as in car has engine)

Winston's Classification



Transitivity Problem

- piston part of engine part of car
- hari's finger part of hari, hari part of cse → ?
- door has a handle, house has a door → house has a handle?

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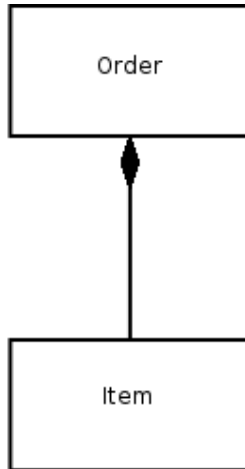
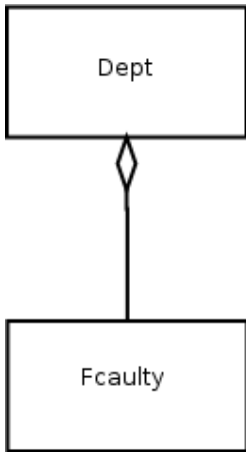
OOPLs and OOAD

Does a pointer represent a part-whole?

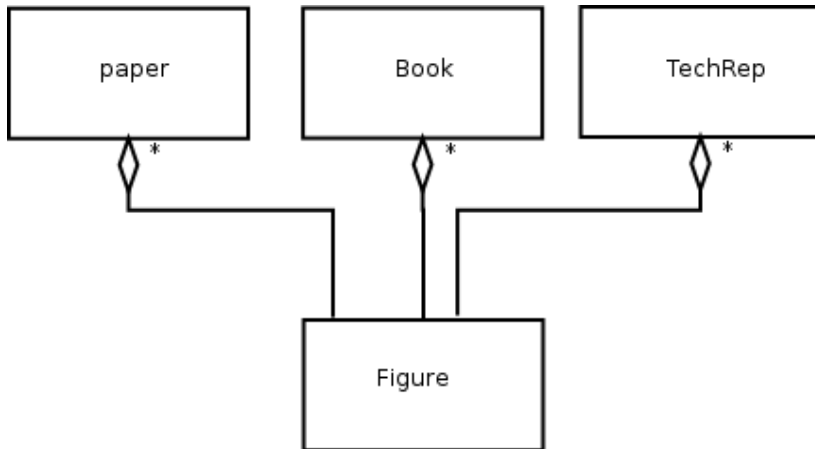
What relations are used to capture the properties of part-whole relations?

- UML: Hollow diamond (aggregation) vs. filled diamond (composition)
- Composition is stronger than aggregation.
- Composition is responsible to manage the components, their allocation and deallocation
- Aggregation may be used for convenience when association is an alternative

UML Aggregation Vs. composition



Sharing Parts



A Partonomy Example

