



# Ontological Analysis

## 6 - Types & Roles

Nicola Guarino  
Laboratorio di Ontologia Applicata (LOA)  
Istituto di Scienze e Tecnologie della Cognizione (ISTC-CNR)  
Trento, Italy

[www.loa-cnr.it](http://www.loa-cnr.it)

### Sortal specialization

- **Type** specialization (e.g. Living being → Person)
  - New features (especially essential properties) **affect identity**
  - ICs are added while specializing types
    - Polygon: same edges, same angles
      - Triangle: two edges, one angle
    - Living being: same DNA, etc...?
      - Zebra: same stripes?
- **Role** specialization (e.g. Person → Student)
  - New features **don't affect identity**



## Roles are ‘dynamic’ and ‘antirigid’

Basic Idea (Steimann 2000): Roles have temporal/modal relations with their players

- An entity can play different roles simultaneously
  - *In 2003, B. was the Italian Prime Minister, the President of the European Union, the president of the Forza Italia party, the owner of the Mediaset company, an Italian citizen, a defendant at a legal trial.*
- An entity can cease playing a role (*antirigidity*)
  - *In 1960, B. was a piano bar singer, now he is the IPM.*
- An entity can play the same role several times, simultaneously
  - *In 2003, B. had two presidencies / was president twice.*
- A role can be played by different entities, simultaneously or at different times
  - *Today, there are 4319 Italian National Research Council researchers.*
  - *In 2000, the Italian Prime Minister was D., now it is B.*



## Roles have a relational nature

- Basic Idea (Sowa, Guarino&Welty)  
Roles imply patterns of relationships, i.e., they **depend**—via these patterns—on additional ‘external’ properties
- Which kind of dependence?
  - “Definitional” dependence (Fine 1995):  
 $P$  depends on  $Q$  iff  $Q$  is ineliminably involved in the **definition** of  $P$ .



## Dependence

- Between particulars
  - **Existential dependence** (specific/generic) (also *constant dependence*)
    - Hole/host, person/brain, person/heart
  - Historical dependence
    - Person/parent
  - Causal dependence
    - Heat/fire
- Between universals
  - **Definitional dependence**
    - $P$  depends on  $Q$  iff  $Q$  is involved in the **definition** of  $P$ .
    - Metaproperties: +D/-D



## The dual nature of roles [Masolo et al 2004]

- Basic Idea (Sowa 2000)  
Roles can be ‘predicated’ of different entities, i.e., different entities can play the same role
- Standard representation  
Roles as properties
- Social (and dynamic) aspects of roles not accounted for
  - Roles are created and disappear; are defined by conventions; are adopted and accepted by communities of agents
- Roles need to be considered **both** as properties and “first-class citizens”



## Roles are ‘properties’

- Basic Idea (Sowa 2000)  
Roles can be ‘predicated’ of different entities, i.e., different entities can play the same role
- Standard representation  
Roles represented, in some FO language, as unary predicates whose instances are their players
- Social (and dynamic) aspects of roles not accounted for
  - Roles are created and disappear; are defined by conventions; are adopted and accepted by communities of agents
- Roles need to be considered **both** as properties and “first-class citizens”

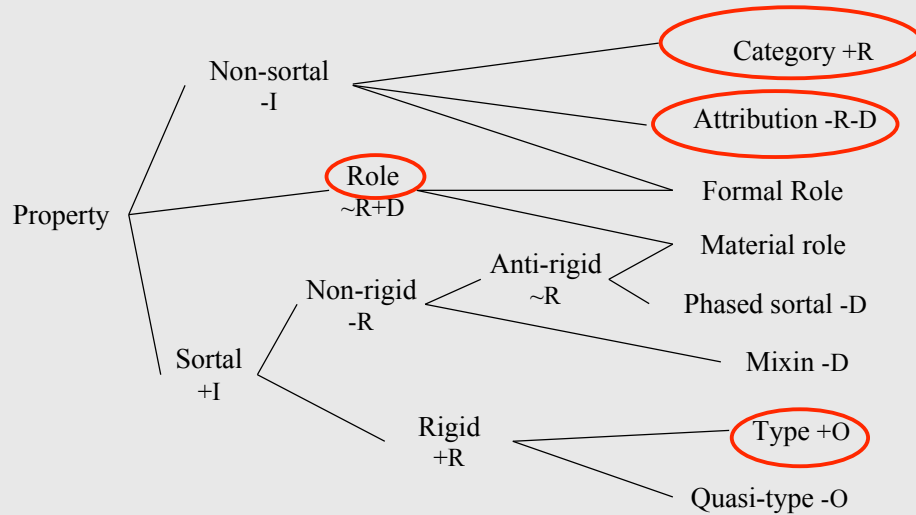


## Roles are determined by contexts

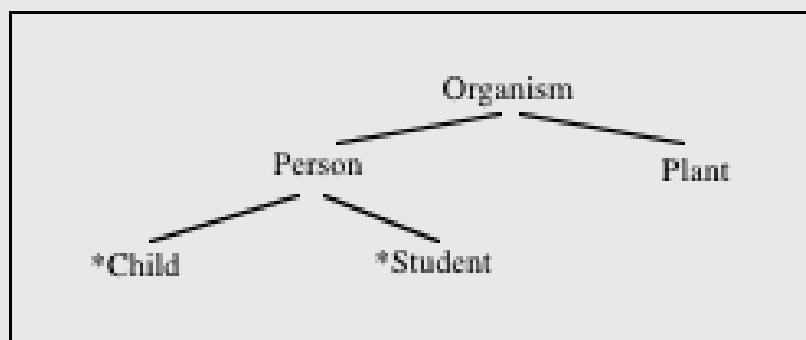
- Basic Idea  
Roles are characterized by some external entities (contexts, pattern of relationships, modalities of participation in an event, abstract descriptions of agents’ behavior in organizations, etc.)
- Context, most general notion (Searle)
- Contexts as representations of the social conventions that “define” social concepts
  - *Cognitive context*: a theory that provides definitions of concepts, to be used as background for the interpretation of certain states of affairs (McCarthy, Giunchiglia&Ghidini)
  - Dependent on communities of agents



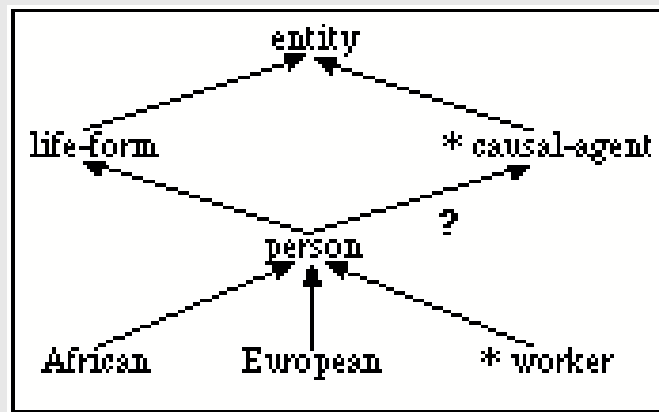
## A formal ontology of properties



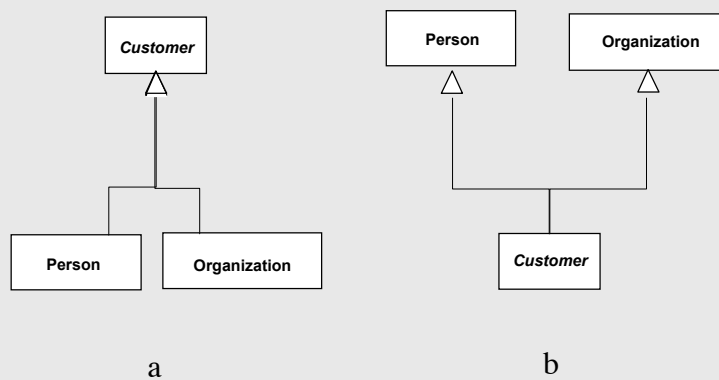
## Types, Roles, and disjointness



## Types and Roles



## What's the right model?



## The solution [Guizzardi 2005]

