Laboratory for Applied Ontology

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# Conceptual modelling, ontology design, and semantic interoperability

## Lecture 9

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# Outline of the lecture

- The Social Realm
- Roles
- Social roles: a proposal
- Organizations

# The Social Realm

# Social reality and Organizations

- Starting from our birth (sometimes before!), we are inserted in a complex networks of rules and institutions, where rights and obligations are laid down by institutions like modern States, General Registry offices, schools, universities, firms, public offices, free associations, parties, hospitals, cemeteries…
- It is important to distinguish “instituted” organizations, like the Italian State, FIAT, Al Quaeda and “emergent” ones, like a group of firneds meeting at Mollie’s pub
- In the latter have roles, internal structure, rules, objectives are left implicit

# Two Senses of "Social Entity"

1. Immaterial product of a community of agents that, by means of some sort of *convention*, creates, makes use of, talks about and accepts it; e.g. *quark*, *triangle)*

2. In addition to 1., its nature intrinsically involves a network of *relations among agents* (collective intentionality, actions and deontic constraints, etc.); e.g. *money*

# Roles

# Roles in Sociology

From the Encyclopedia Britannica:

> "A role is a comprehensive **pattern of behaviour** that is socially recognized, providing a means of identifying and placing an individual in a society. […] A role remains relatively stable even though different people occupy the position […].
>
> An individual may have a unique style, but this is exhibited within the **boundaries of the expected behaviuor**. […]
>
> Role expectations include both **actions** and **qualities** […]. Individuals usually occupy several positions, which may or may not be compatible with one another."

# Roles in Linguistics

- Appellatives = temporary names for individuals, names that are defined in the context of and by a predicate or relationship
- Fillmore calls them thematic (or semantic) roles
- Tendency to move grammar into the dictionary [Pustejovsky 1995]
- In the definition of a word it is also specified which other words it may be combined with

# Fillmore's Account [Fillmore 1968]

Thematic roles are semantically motivated, their definition is given in terms of typical properties. The main thematic roles are:

1. **Agentive**: animate instigator of an event
2. **Instrumental**: inanimate force or object causally involved in the event
3. **Dative**: the being affected by the event
4. **Factitive**: the object or being resulting from the event
5. **Locative**: the location or spatial orientation of the event
6. **Objective**: anything else

# Roles in Computational Linguistics

Main goals of using semantic/thematic roles:

- To have frameworks that describe and model meaning of predicates
- To annotate free text with semantic roles
- To replace grammatical categories with semantically motivated categories

Three examples of frameworks with large annotated corpora:

1. Praguian roles
2. PropBank
3. Frame Semantics

# Roles in Object-oriented Programming and Conceptual Modeling. Main Features (1)

[Steimann 2000] lists a series of features of various notions of roles taken from literature in CS:

- A role comes with its own properties and behaviour
- Roles depend on relationships
- An object can play different roles simultaneously
- An object may play the same role several times, simultaneously
- An object may acquire and abandon roles dynamically

# Roles in Object-oriented Programming and Conceptual Modeling. Main Features (2)

6. The sequence in which roles may be acquired and relinquished can be subject to restrictions
7. Objects of unrelated types can play the same role
8. Roles can play roles
9. A role can be transferred from one object to another
10. The state of an object can be role-specific

# Roles in Object-oriented Programming and Conceptual Modeling. Main Features (3)

11. Features of an object can be role-specific
12. Roles restrict access
13. Different roles may share structure and behaviour
14. An object and its roles share identity
15. An object and its roles have different identities

[Steimann 2000]

# Roles in Ontology

[Loebe 2007] distinguishes between three types of roles:

1. **Relational roles** that correspond to the way in which an argument participates in some relation
2. **Processual Roles** that correspond to the manner in which a single participant behaves in some process
3. **Social Roles** that correspond to the involvement of a social object within some society

# Social Roles, a proposal

# Roles as ‘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 ‘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 change role (antirigidity, Guarino&Welty)
  - *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):
    "to say that an object *x* depends upon an *F* is to say that an *F* will be ineliminably involved in any **definition** of *x*."

# 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

# General Strategy

- Reify social **concepts** to be able to predicate on them
  - Social concepts and roles as *first-class-citizens*
    - **CN**(x): “x is a social concept”
- Reify contexts or concept definitions, called here **descriptions** (Gangemi)
  - Deal with the *social*, *relational*, and *contextual* nature of social concepts
  - Determine the *sense*
    - **DS**(x): “x is a description”
    - **DF**(x,y): “the concept x is defined by the description y”
- Introduce a **temporalized classification** relation to link concepts to the entities they classify
  - Account for the *dynamic behavior* of social concepts
  - Determine the *reference*
    - **CF**(x,y,t): “at the time t, x is classified by the concept y”
- Extension to “social relations” poses no problem
  - Add CF predicates of different arity

# Underlying assumptions

- Descriptions:
  - are created by intentional agents at the time of their first encoding in an expression of a 'public' language
  - cease to exist when their last physical support ceases to exist
  - have a unique semantic content (different, but semantically equivalent, expressions can be associated to the same description)
  - have an internal structure intimately related to the logical structure of their semantic contents
- Concepts:
  - are statically linked to descriptions: they cannot change their definitions
  - inherit the temporal extension of their definitions

# Links between concepts of different descriptions

- Links at the reference level: *extensional subconcept*
  - $eSB_T(x, y, t) \equiv_{df} \exists z(CF(z, x, t)) \wedge \forall z(CF(z, x, t) \rightarrow CF(z, y, t))$
  - $eSB(x,y) \equiv_{df} \forall t(eSB_T(x, y, t)) \wedge \exists t(eSB_T(x, y, t))$
- Links at the sense level: *intensional subconcept*
  - Inclusion between axiomatics, i.e., descriptions, modulo a "correspondence" between vocabularies
  - Primitive iSB(x,y): the description defining y is a sub-description of the description defining x, modulo some correspondence
  - $iSB(x,y) \rightarrow eSB(x,y)$
  - The same concept can be included twice into the same description (duplication)
  - Two concepts can be included into the same concept (merge)

# Characterizing the key features of roles

(1) Roles, as concepts, are properties

- Embedded in the CF predicate

(2) Roles are dynamic and anti-rigid

- Dynamicity embedded in the temporalization of the CF predicate
- $AR(x) \equiv_{df} \forall y,t(CF(y, x, t) \rightarrow \exists t'(PRE(y, t') \wedge \neg CF(y, x, t')))$

(3) Roles have a relational nature

- Property of being **founded** reflects a definitional dependence:

  $FD(x) \equiv_{df} \exists y,d(DF(x, d) \wedge US(y, d) \wedge$

  $\forall z,t(CF(z, x, t) \rightarrow \exists z'(CF(z', y, t) \wedge \neg P(z, z', t) \wedge \neg P(z', z, t)))$

(4) Roles, as concepts, are linked to contexts and therefore social

- Embedded in the DF predicate

$RL(x) \equiv_{df} AR(x) \wedge FD(x)$

# Relations between roles

- **Extensional Sub-concept**.

  (a) *All Italian Prime Ministers are Prime Ministers.*

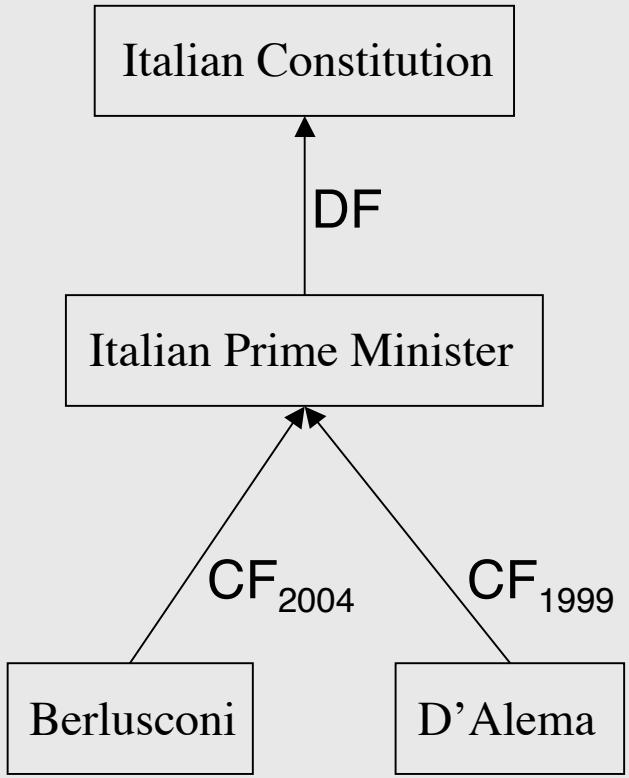
  (b) *All Italian Prime Ministers are Italian Citizens.*

- **Specialization (a).** B. is a Prime Minister ‘because’ it is the Italian PM. Being PM means that there is some specific nation to be PM of**Requirement (b).** B. must be an Italian Citizen in order to be the IPM, i.e., the definition of IPM is based on the definition of Italian Citizen.
- **Role Kind**. Not a special case of sub-concept, but a case of classification

  (c) *Italian Prime Minister is an Italian public office.*

# Example

- The Italian Constitution is a description defining the current concepts of Italian President, Italian government, Italian Prime Minister…
- B. is classified under the concept of IPM during 2004
- D. is classified under the concept of IPM during 1999
- During 2000, B. did not have all the necessary characteristics to be IPM, therefore he is not classified under this concept



# Organizations

# Why we need an ontology of organizations

- In firms, as in Public Administrations, there is a growing need to have both the organizational structure and all the knowledge about it (from rules to decisions to contracts and payments) represented in their information system in a clear and explicit way
- Most of the systems implemented so far offers *ad hoc* solutions, hardly **reusable** when the organizations encounters even slight changes
- Ontologies can offer a model general enpugh to be used by all information systems as *lingua franca*, something which is **adaptable** to different organizational contexts

# Three typical problems in ontology of organizations

- “Materiality” of organizations
- Distinction between social groups and organizations
- Change of organizations through time

# Materiality of organizations - Searle

- [Searle 1995]: how is it possible that social facts, which depend on agreements among human beings exist in a world which fundamentally is the one described by physics and natural sciences?
- According to Searle, social objects don't exist in a strict sense
  - When we talk about social objects like governments, money or universities we don't refer to entities existing in the same way as material objects exist
  - Social objects are to be considered as "placeholders for patterns of activities" described by systems of constitutive rules that Searle calls "institutions" [Smith & Searle 2003]

# Materiality of organizations - Smith

- [Smith 2002]: organizations are *physical behavioural units*, things that, not only have a life, but also occupies some physical space:

  The world is organized into separate things or bodies, but it is also organized into overlapping social and institutional zones or contexts within which human beings figure as participants. [...] persons themselves, and things in the spatial environment, are both equally caught up within entities of a new, over-arching type: […] physical-behavioural units. [...] *physical-behavioural units* are parts of reality. [...] All roles are played within behaviour settings. All organizations are composed of them.
- Organizations have thus borders, occupy regions of space and one can build a mereotopology on top of them [Smith 1999]

# Social group/organization distincition

- When we consider organizations, is it necessary to distinguish between these and the groups of agents that are part of it?
- This, that at a first glance can appear as a useless question, in some context is particularly useful.
- Example: if all people signing a contract with FIAT are requested to enter in the FIAT sporting club, we are in the presence of a single social group, but two organizations, with very different identity criteria

# Social group/organization - Gilbert (1)

- [Gilbert 1998] tried to provide some arguments in favor of the distinction between social groups and organizations
- A social group, according to Gilbert, is a plurality of persons in which everyone is aware of the fact to be linked to the others through a *joint commitment* with respect to a certain class of actions
  - Examples: a set of persons starting a conversation, or that travel together reciprocally controlling and helping one another, a set of supporters of a football team, ready to perform the “ola” at the stadium

# Social group/organization - Gilbert (2)

- Two (kafkian) examples showing this distinction:
  - An organization that has substituted one by one all its workers with automata. It is hardly possible to go on conceiving this as a social group, but it can still be considered an organization
  - Persons working together in an organization without knowing one another and without knowing the aim of the organization they work for
- At the same time Gilbert's position seems to e close to Searle's
  - There is no new type of entity, only persons with share intentions towards a certain purpose [Gilbert 1997]

# Social group/organization - Sheehy

- [Sheehy 2006] considers as ontologically existent not only persons but also social groups, that in this approach are seen as the material correlate of organizations, their *embodiement*
- Groups' materiality:
  - We take the members of an association that are also players in a football team. If we ask when the team is playing on the court where is the association, the answer cab be "there, on the court"
  - The association and the team can be in the same place at the same time keeping their identity conditions
  - According to Sheehy these are two different material objects and they are co-located in space and in time

# Organizations changing in time

- In [Ferraris 2005] there's this interesting example
  - August 26, 1926 - the AC Fiorentina is born
  - July 2002 - the AC Fiorentina goes bankrupt and ceases to exist
  - August 3, 2002 - a new association, the Florentia Viola is born
  - 2003 - The president Della Valle won the brand at the auction and the new team is called "ACF Fiorentina SpA
  - August 20, 2003 - with the augmentation of the B championship from 20 to 24 teams, the ACF Fiorentina is "recovered" for past merits
  - But, which are these merits if, legally, AC Fiorentina, Florentia Viola and ACF Fiorentina are three distinct entities?

# Organizations and time - Slater and Varzi

- Groups and organizations have different histories: think about Fiorentina before 2002:
  - The members of the team change through time and, strictly speaking, it is difficult not to admit that at every chenge the group also changes
  - On the other hand, the name that designates the different groups is always the same. How to solve this problem?
  - The solution by Slater and Varzi is strictly nominalist and searlean:

    Different groups that change through time *count as* the same team if the supporters and the society in general think about them as such

# Organiaztions changing through time (reprise)

- Now we take Firentina after 2002, from when it legally ceases to exist til now.
  - In this case, we have a further complication: not only members change, but also a social object, the AC Fiorentina, dies and a new one, the Florentia Viola is born, that is eventually substituted by a third social object, the ACF Fiorentina
  - How is it possible - Ferraris asks - to justify the continuity that judges, media and supporters attribute to Fiorentina?
  - Ferraris' hypothesis is that such continuity is embedded in *incriptions* or, better, "the being of Fiorentina is in the records, but not only the offical ones, rather those in the memory of supportrs, newspapers and televisions"

But which is the relation between inscriptions and organizations? Is there an identity, part or dependence relation?

# Dynamic analyses

- Historical analyses
  - How are organizations born?
  - What happens when an organization is born?
  - What is necessary in order for an organization to be born?
  - What kind of relation does it entertain with its founders?
  - …
- Analysis of the actions
  - How are collective actions performed?
  - Which relations do they entertain with actions of the individuals who participate in the collective action?
  - Can organizations be considered agents of some kind?
  - How can they act in the world?
  - Are they responsible for their actions?
  - What can or cannot they do?
  - …

# Static Analyses

- Which kind of relation between an organization and its members?
- What is necessary for a certain agent in order for him/her to be a member of an organization?
- Which relation between the roles of an organization and its normative layer?
- …

# Important aspects of organizations

An organization can be intended as:

- **structured/multilayered**: with a structure that is not necessarily reducible to basic roles and their interrelations;
- **designed**: created with specific functions;
- **agentive**: with mental attitudes (e.g., goals and intentions);
- **realized**: ultimately built by autonomous agents playing specific roles;
- **situated**: immersed in an environment;
- **dynamic**: its structure and its realization may change through time.

# Structured organizations (1)

- An organization is a set of **interacting roles** (at least at a specific level of refinement) [van den Broek et al., 2005].
- An organization is a **structured** entity in which agents playing roles **interact** in a specific way in order to achieve **organization-wide goals** (analysis of the relations between individual and organizational goals) [DeLoach and Matson, 2004].

# Structured organizations (2)

- An organization consists of **social structure**, i.e. roles and groups of roles, and **interaction structure**, which contains the interaction relations between the elements of the social structure [Dignum, 2004].
- "[A]n organization is **structured** through a set of roles, to which are associated deontic notions (...), that apply to the agents that are the actual holder of such roles, when playing those roles" [Pacheco and Carmo, 2003].

# Levels of description

It is possible to distinguish at least two different levels of description of organizations:

- The *abstract organization* "does not contain any reference to the real agents, i.e., it consists only of the organization roles, their links and groups, global plans and permissions/obligations. It may be seen as a kind of recipe of how should collective activity occur" [Sichman et al. 2005].

- The *concrete organization* is constituted by real agents that play the organizational roles. The concrete organization is supposed to achieve the general goals of the organization.

# Agents in organizations

Basic components of a *concrete* organization that are characterized by:

- *private/mental attitudes* (beliefs, desires, goals, intentions, etc.);
- *agency* (and capabilities);
- *interaction and communication*;
- *social dimension* (conventions, trust, delegation, expectations, etc.).

# Roles in organizations

Basic components of an *abstract* organization that are characterized by:

- the *functions*/*objectives* they have in the organization;
- the *interactions* with other roles in the organization that normally are regulated by norms (dependences, rights, obligations, powers, etc.)
- the *requirements* agents need to satisfy in order to play the role

**Note**: *competences* (assigned to roles) seem to be a sort of mixture between the three components listed above.

# Agents play roles

The ‘glue’ between the concrete and the abstract aspects of an organization is constituted by the *social commitment*:

- agents are committed in various ways to other agents to do what is specified in the positions/roles they play;
- as pointed out by many theorists (Castelfranchi, Tuomela, Searle) an emblematic case of social commitment is the *promise*;
- promises strongly depend on *trust* and *delegation* considerations;
- promises are made public and precise by means of *contracts*;
- contracts have *deontic* implications *obligations*, *rights*, *permissions*, etc.).

# Some interesting problems

How the goals of the agents relate to the functions associated to the role they play?

- If an agent can play different roles (in the same or in different organizations), how is it possible to represent the fact that the responsibilities he has depend on the role he is playing?

- In which sense the organizations act in the environment?

  - Are the organization acting through their members?
  - Do actions performed by the members have some social or institutional relevance? Do they *count-as* social or institutional actions?

# Groups

Similarly to agents, groups seem to have mental attitudes and to act/interact **but**

- there is a huge discussion about the possibility of reducing the groups' mental attitudes/actions to the ones of their members.

- some mental attitudes/actions seem to *emerge* from the complex interaction between members.

# Multilayered organizations

- Similarly to groups, the overall objectives/actions of an organization may be distinct from the sum (or composition) of all the objectives/actions of the roles and sub-organizations constituting the top organization.

- This seems to imply that the structure of a complex organization is not **flat**: it comprises not only interrelated roles but also sub-organizations with emergent objectives/capabilities, i.e. organizations are not only structured but **multi-layered**.

# Normative dimension of organizations

Some accounts consider organizations as completely made up of norms [Miller, 2007]. Without committing to such a strong position, undoubtedly, norms are central in organizations.

- There are several ways in which the normative layer affects the organization and the behavior of its members, we have already seen how they can be used in the specification of
  - roles and interactions;
  - the social commitment and the contracts agents have with respect to an organization.

# Regulative vs. Constitutive norms

- *Regulative norms* regulate antecedently existing forms of behavior.
- *Constitutive norms* 'create or define new forms of behavior' (their syntax is the *counts as* locution '*X counts as Y in C'*.)
- Roles in an organization can be intended as defined by constitutive norms that constraint the behavior of the players and the requirements they need to satisfy.

This suggests that organizations can be *designed, created, and specified* to achieve a specific objective and that norms play a central role in this process.

# The Artifact Metaphor

- Organizations can be seen as **artifacts** whose function is to constrain some collective behavior to obtain a specific objective [Tummolini and Castelfranchi, 2006].

  - As in the case of a chair, each part contributes to the main function of the chair, that is something to sit on.

  - Similarly, competences are assigned to every part of an organization (roles+sub-organizations) and they contribute (via the structure) to its general objective.

- The specification of an organization can be **refined** during the process of design.

- Organizations that are unstructured at a specific level of refinement can be structured at a deeper level.

# Designed organizations

- A designer starts by figuring out an organization with some general objectives.
- Successively, (s)he refines that organization by introducing new sub-organizations (with new objectives) linked in a specific (and possibly normative) way.
- Then, (s)he establishes how the objectives declared for the whole organization can be ‘decomposed’ into simpler objectives attributed to simpler sub-organizations.
- Finally, (s)he establishes how these sub-organizations are linked by means of institutional relations.

# Situated organizations

- We discussed the way internal components of an organization (roles and sub-organizations) can interact, **but** organizations also interact with

  - other (external) organizations to which they are necessarily related without a complete control, and
  - the physical environment.

- The network of the external interactions and the physical environment must be part of the organizational model.

- The links to external organizations can be explicitly considered at the design level.

# Dynamic organizations

Three kinds of dynamics:

- the dynamics of the realization;
- the dynamics of the structure caused by a refinement/change at the design level;
- the dynamics of the structure regulated by meta-norms.

# The dynamics of the realization

- New agents can commit to play roles in the organization.
- Old agents can leave an organization (or change role inside the same organization) or the organization can dismiss them.

Note that in this case the structure of the organization is stable.

# The dynamics of structure (due to design)

- The entire design process can be described using *operators* that determine a *transition* from a design object description to another.

- A transition at design's level happens, before any realization of the organization exists, when, for instance, the designer creates a new department to accomplish some particular objective of the organization.

# Meta-norms

- Organizations often live in a changing environment and therefore they must be flexible. Nonetheless, not all the changes should be admissible.
- In order to regulate the evolution of an organization, the designer can specify and constraint how the structure of the organization can evolve.
- The acceptable changes can be specified by **meta-norms**, i.e. norms that describe how norms can be changed.

# Desiderata for a model

We think that a framework that integrates the aspects just described in a model which:

- is a multi-layered structure
- distinguishes structure, design and realizations
- integrates top-down and bottom-up processes
- is driven by teleological considerations
- takes into consideration the environment in which the organization is situated
- can evolve through time

is very important and very difficult to develop!