Attributes or Types? What are the Fundamental Frame Elements?

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The introduction of frames as a cognitively plausible format of knowledge representation led to a paradigm shift in cognitive science, artificial intelligence and other disciplines (cf. Minsky 1975, Fahlmann 1977, Barsalou 1992): Concepts were no longer represented as atomic units but as complex structures built up recursively of attributes with structured values. In recent years, based on the frame hypothesis that all representations in the human cognitive system correspond to frames, a new interest has developed towards a frame theory that is cognitively adequate and empirically founded as well as formally rigid (cf. Löbner 2011, Petersen & Werning 2007, Vosgerau & Seuchter & Petersen 2012).

In the talk we will develop a formal frame theory that follows Petersen (2007) and Petersen & Osswald (2012) in regarding frames as a generalization of classical typed feature structures (cf. Carpenter 1992): Frames are defined as recursive attribute-value structures that are restricted by type signatures. In contrast to feature structures, frames do not necessarily exhibit a root. Thus frames can be represented by connected directed graphs with labeled arcs and nodes of which one is marked a being the central node of the frame. This is the node which represents the objects referred to by the frame (in feature structures this node is always a root of the graph). The nodes are labeled with types and the arcs with attributes. It is assumed that attributes assign unique values and thus correspond to functional relations. The task of the type signature is to restrict the class of admissible frames by providing the set of types and defining the domains and ranges of the attributes.

After giving a short introduction to frame theory we will focus on the ontological status of the frame elements and especially on the role of the type signature. Two questions will be central: First, how are attributes and types related to each other? And second, is it appropriate to handle types for qualities, classes and instances in a uniform way? In the classical theory of typed feature structures, attributes and types are defined as disjoint sets and all types are treated alike.

Guided by the considerations in Guarino (1992), Petersen (2007) drops the artificial distinction between attributes and types and claims that the attribute set is merely a subset of the type set. It follows that attributes are a special kind of types which may occur in two different roles: as names of binary functional relations between types and as types themselves. In our talk we will drop the distinction between attributes and types too, but investigate the problem from a radically attribute-centered perspective which takes attributes as the most basic units and defines types as being based on them. This view paves the way for a natural model-theoretic interpretation of attributes and types and thus for a model-theoretic semantics of type signatures and frames: Given a universe of instances, attributes are partial functions and types can be seen as labels for intersection sets of domains and ranges of attribute functions. It follows that instances are not types themselves and that the type hierarchy is simply a hierarchy based on set inclusion.

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