Ontological Design Patterns:
Flexiblity and Reuse of Molecular Biological Information

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I address the problem of increasing the flexibility and reusability of molecular biological information organized as an ontology. An ontology provides a semantic repository used to order information concepts and terminology in molecular biology for the purpose of linking databases, improving data transfer, and analysing scientific texts. An ontology makes fundamental concepts, meanings, and relationships of information explicit and describes their constraints in an application area [1]. The designer of an ontology 1) selects terms out of the scientific vocabulary, 2) groups the selected terms, 3) organizes the terminological groups into a hierarchy, 4) and defines the relationships between the nodes of the hierarchy. Thereby, the difficulties are 1) to understand the meaning of the selected terms in all relevant contexts, 2) to define the appropriate size and granularity of the terminological groups, 3) to specify the interfaces between the terminological groups and the information inherited within the hierarchy, and 4) to determine application-specific key relationships out of all terminological relationships. The designed ontology should be specific to the problem at hand but also general enough to address future problems and requirements in order to avoid redesign. To decrease these difficulties of ontology design and to increase the adaptability of a designed ontology to future demands, it is important to recognize abstractions that emerge during design. On such a higher level of abstraction of ontology design, Ontological Design Patterns (ODPs) can be defined and applied which describe simple, elegant, flexible and reusable solutions to specific problems. For instance, 1) the "Mask ODP" describes how to represent complete ontological subsystems as terms, 2) the "UnspecificTerm ODP" describes how to manage huge numbers of terms at fine granularities, and 3) the "AddDynamicInfo ODP" attaches additional information and meaning to a term dynamically. The conceptual creation and implementation of ODPs is work intensive. The principle idea of ODPs is to encapsulate changing semantic and scientific concepts, such as concentrating or delegating functionality. ODPs name, abstract, and identify ontological design structures, collaborating terms, and related information. They vary in their granularity and level of abstraction, and they can be related to each other or combined based on their communication and collaboration. [This project was supported by the Komission für Lehre und Forschung at the University of Basel (Switzerland), and the Swiss National Foundation: Forschungskommission der Universität Basel.]

[1] Altman R.B, Karp P.D., Musen M.A, Schulze-Kremer S. (1998). Tutorial: Ontologies for Molecular Biology. The Sixth International Conference on Intelligent Systems for Molecular Biology. Montréal, Canada.