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Evolving Biomedical Ontologies in "Knowledge-Ecologies": A Proposal for an Agent Based Approach

Abstract: The sheer volume of biomedical research threatens to overwhelm, not only the capacity of individuals, but also that of the research community as a whole, to effectively process this information. The NIH Roadmap "New Pathways" statement (http://nihroadmap.nih.gov/newpathways/index.asp) has emphasized the need for integrative and multi-disciplinary research, including the advancement of bioinformatics, and more specifically, the development of biomedical ontologies to form the basis for classifying and organizing this information. The National Center for Biomedical Ontology (http://bioontology.org/) currently curates 62 biomedical ontologies via BioPortal (http://bioontology.org/tools/portal/bioportal.html). However, there is a growing recognition of the limitations of these ontology projects, namely that any "fixed" biomedical ontology is necessarily incomplete and is likely not to be robust to the incorporation of new discoveries/viewpoints. Thus far attempts to address this issue have focused on either developing means of concatenating existing ontologies, or developing an "Ur"-language that will encapsulate existing ontologies. I propose a different approach: rather than attempting to build a comprehensive biomedical ontology, I favor a means of dynamic ontology evolution by which ontological structures "arise" or "emerge" from the course of standard research practice (i.e. publishing papers in the biomedical corpus). I propose developing "knowledge-ecologies" with an agent-based architecture by which biomedical terms are treated as objects that 1) have certain attributes and 2) can have various relationships with other objects. The objects, their attributes and their potential relationships are extracted from the biomedical corpus using automated text analysis tools. Using a hill-climbing aggregation model, terms would cluster into classification groups depending upon user input parameters, generating "custom" ontologies for a particular use. An open-source framework would allow the development a knowledge landscape where ontologies could compete, merge and evolve based on various "use-niches" within the biomedical research community. This in turn will form the informatic base for dynamic knowledge representation models intended to evolve community-wide knowledge.