Abstract

Ever increasing amounts of information are available in digital form for use in existing and emerging applications. Data sources, formats and descriptions are accessible in a diversity unimaginable a few years ago. This information seldom comes with a complete specification or schema, even though much of it contains some regular structure. Existing specifications or ontologies, developed separately from the data, are of no direct benefit in organizing such volumes of data. Tools are needed to assist domain experts linking information from diverse and changing sources.

This dissertation presents the SKEIN system which is designed around an algebraic framework. SKEIN is a suite of tools for managing semantic heterogeneity between information sources. The presentation focuses on one large scale repository developed using the algebra. This repository, or nexus, is a graph of dictionary terms related by their definitions as extracted from an on-line Oxford English Dictionary resource. Two algorithms over the nexus provide assistance to experts in domain interoperation. ArcRank computes the most relevant arcs between terms, building on an extension of PageRank. All Pairs Similarity uses ArcRank values to compute which terms have the most similar link structure.

The nexus is a directed labeled graph, four times the size of two other lexical repositories, WordNet from Princeton U. and MindNet from Microsoft Research, but required orders of magnitude less development and maintenance effort. The operators used to build the repository are generic and apply equally well to thesauri, encyclopedias, and other dictionaries. The use of the nexus reduces the effort expended by the expert in matching terms between other sources. Given the task of pairing up English language pages of NATO government websites, SKEIN achieved 70% of the matches obtained by a human expert, without generating any false matches. The nexus and assorted algorithms, when used in the context of the SKEIN system, constitute the first steps towards the systematic interoperation of heterogeneous data sources.
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