As globalization initiatives continue to expand, there is an increasing need for sophisticated software to support “intelligent” applications. These systems are knowledge intensive in that they require access to large amounts of domain knowledge to compliment public and organization-specific knowledge. Examples include those systems that support the semantic Web, Web queries, Web services, heterogeneous databases, and multiagent systems. One way to support the development of sophisticated systems is through the incorporation of domain knowledge into systems design. Domain ontologies specify concepts, relationships between concepts, and inference rules for an application domain (e.g., travel reservation, soccer, gourmet food). Ontologies, in general, are increasingly needed for software design, including information sharing among heterogeneous data sources, interpreting unstructured data on the Web, creating and evaluating conceptual models, Web queries, and others.

With the exception of the DAML ontologies (DARPA [Defense Advanced Research Projects Agency] Agent Markup Language; http://www.daml.org) for the semantic Web, there are not many libraries of domain ontologies available for general use. It has been suggested that it is necessary to automate the development of domain ontologies in order to mitigate this problem. Besides the efforts to develop individual ontologies, there has been great interest in developing upper level or large-scale ontologies. These are intended to be domain independent and provide a way to capture and represent the semantics of the real world in order to support knowledge-intensive software applications. To make these ontologies useful, however, we need to understand the current state of the art and suggest how to improve them.

The Cyc ontology (http://research.cyc.com), considered an upper level ontology, is a knowledge repository developed to capture and represent common sense. It contains more than 2.2 million assertions (facts and rules) describing more than 250,000 terms, including 15,000 predicates. A full version of the Cyc ontology, called ResearchCyc, has been released for the scientific community. It contains both intensional information (entity types, relationship types, integrity constraint) and
extensional information (representation of individuals and their relationship to space, time, and human perception). ResearchCyc represents knowledge through microtheories. A microtheory represents a domain and all of its valid assertions. Every assertion must be attached to one or more microtheories.

It has been argued that generally it is difficult to use a knowledge base as large as ResearchCyc. One of the problems is discovering whether the information that one is looking for is defined in the ontology. Doing so manually is difficult because ResearchCyc has only a textual interface accessed using a browser. It does not provide any facility to query and understand its knowledge. The deficiencies in the linguistic knowledge of ResearchCyc make the searching process more difficult. Even if we are able to find the knowledge we are looking for, the problem is the large amount of knowledge retrieved. This makes it impossible to automate any process without using heuristics to automatically discard the information that is irrelevant for a particular context or to infer its semantics. Hence, it is imperative that we provide better documentation and user-friendly tools for browsing and navigating the content of large ontologies such as ResearchCyc. Further research is needed to design and implement such tools and interfaces for improving efficiency.

This issue of IJIIT contains four articles discussing the following topics: federated information systems using agents, designing multiagent systems using $\gamma$-calculus, content-based image classification and retrieval, and the philosophical foundations of information modeling. The lead article by Thomas, Yoon, and Redmond titled “Extending Loosely Coupled Federated Information Systems Using Agent Technology” discusses how software agents can be used to design information systems that are loosely coupled. They use a FIPA-compliant (Foundation for Intelligent Physical Agents) agent development platform in developing such a system. They conclude that there are no clear architectural standards that define how an agent community can effortlessly adapt to operate in a federated information system (FIS) where new content sources are constantly added or changes are made to existing content sources. They present a framework based on the semantic Web vision to address extensibility in a loosely coupled FIS.

Lin, in his article titled “From Logic Specification to $\gamma$-Calculus: A Method for Designing Multiagent Systems,” discusses a novel approach for designing multiagent systems (MASs). This approach synthesizes the architectural specifications of the MAS in $\gamma$-calculus based on the logic specifications of the system. By enabling the transformation of logic specifications to operational specifications, the method allows the design of an MAS to be focused at the architectural definition level. It also facilitates logical deduction on the behaviors of the MAS in an incremental fashion.

In the third article titled “Content-Based Image Classification and Retrieval: A Rule-Based System Using Rough-Sets Framework,” Ali presents an interesting approach for image classification and retrieval. It uses rough sets for feature reduction, classification, and retrieval of images in a content-based image-retrieval
A salient aspect of the approach is that segmentation and detailed object representation are not required. In order to obtain better retrieval results, image texture features are combined with color features to form a powerful discriminating feature vector for each image. Texture features from the co-occurrence matrix are extracted, represented, and normalized in an attribute vector, and the rough-set dependency rules are generated directly from the real-value attribute vector. The classification and retrieval performances are measured using the recall-precision measure.

The last article by Artz, titled “Philosophical Foundations of Information Modeling,” provides a philosophical grounding for the practice of information modeling by introducing the following four key metaphysical concepts: the concept of identity, the problem of universals, teleology, and the correspondence vs. coherence views of truth. These concepts are first explained and then their relevance to information modeling is examined. The author also discusses the implications for the practice of information modeling.