University Research Group
A University research group publishes an analysis of all journal papers relating to a particular area of chemistry, namely reaction kinetics. Each paper may have one or more authors, and may discuss one or more reactions, but may appear in only one journal. Journals are identified by title, volume, and issue number, and each issue contains many papers. Each paper contains a series of references to other papers. Authors can, and usually do, contribute to a large number of papers appearing in a variety of journals. In order to reduce the work involved in preparing their analysis, the research group wishes to store sufficient information on a computer to answer queries including the following: a) Which authors have written one or more papers which discuss a particular reaction? b) Which papers either discuss a particular reaction or have been referred to by a paper which discusses that reaction?

Academic Publication
Publishers publish many different types of professional journals and books. Some publishers only publish books, some publish journals, and some publish both. No book or journal is published by more than one publisher. An author may write either books, journal articles, or both. A journal typically contains several articles, each one written by one or more authors. No article appears in more than one journal. Every book and article is reviewed by several professionals in the field who may or may not be authors as well. Of course, an author never reviews his or her own book or article. Each book reviewer and author works for and is paid by a single publisher. Article authors and reviewers are not paid, however, and thus article reviewers are never book reviewers. Authors and reviewers who are not paid by a publisher are known as independent professionals.

General Purpose Community Medical Facility
A medical worker is a doctor, nurse, paramedic, clerk, or administrator. Medical workers work in a medical facility which has a name, address, possibly a specialty area, and the name of an administrator. A patient visits a medical facility for a diagnosis of a health problem and may return for additional visits for treatment if so designated as a result of the diagnosis and if the facility has the expertise to treat the problem. Each visit is called an encounter and it must involve a patient, a medical worker, and a service. The service could be a diagnosis, treatment, checkup, or payment. A patient may be eligible for his or her company health benefits or must use pay-as-you-go. Patients who are unable to pay are not turned away, but are registered as indigent citizens and are given short-term care. Patient data includes name, ID number (ssn), address (street, city, state, zip), phone (day and evenings), employer (company) name, employer address, type of benefits eligible for, and method of payment.

Softball Complex
A business owns a softball complex. It organizes league and tournament games. People associated with this business are players, employees, or both; an employee may also be a player. Most players play for teams that compose the leagues of this organization. Teams are not allowed to register into multiple leagues. Each season consists of several leagues and teams, with
each team playing several games each season. Once a team and a league have entered the organization, they are invited to participate in each season thereafter.

**Space Federation**

The Space Federation governs 100 galactic sectors which it patrols with 25 starships assigned to approximately four sectors apiece. There are 100 cargo ships assigned the tasks of bringing fuel, equipment, and supplies to the starships. Patrolling starships are typically in service for decades, but new ships are always being developed to replace much older ones. New ships often include new and/or improved features. As a result there are many different docking mechanisms, and Cargo ships are built to dock with only one docking mechanism. Because of this, cargo ships can only service patrolling ships with the same docking mechanism. More than one cargo ship is assigned to a starship to assure continued maintenance. To aid in dispatching cargo ships and assigning crew members for relief, the Federation keeps a record of all coordinates and crew rosters for each ship. Each cargo ship belonging to the Space Federation is divided into five sections. These sections are assigned specific maintenance, navigation, and cargo manipulation duties. Each section performs an average of three different duties. Fifty crew members are assigned to a ship and each crew member works in two sections, on the average. The Federation maintains a record of personnel information for the crew.

**Starship Maintenance**

Space is not easy on starships. To keep them in top shape, the Federation maintains 10,000 space stations. Each is located at what has been determined to be an optimal set of coordinates for servicing the fleet, and each has been given the name of a famous captain. The starship manuals define 907,024 standard starship repairs. Because of their complexity and special equipment requirements, each space station is constructed to handle only 1814 of these repairs. Thus, any given repair can only take place at 500 of the stations. Approximately 800 mechanics work at each station. They are trained on 61 different repairs and are given a rating level associated with each specialty. The 2500 Federation starships show up at these various stations for routine maintenance and whenever major difficulties that cannot be fixed by the starship engineering staff occur. The Federation keeps records of these repairs.