CS145 Written Assignment #1

Due Thursday April 8*

IMPORTANT: *Please make yourself a copy of your solution before turning it in. You will need it for Written Assignment #2.*

1. A store in Palo Alto decides to go hightech. Everyone knows that you are taking CS145, so you are asked to design a database for the store. After brainstorming with the store managers, you come up with the following specification:

   - The store has multiple departments, identified by their names.
   - Each department may have many employees but only one of them is the department manager.
   - Employees are identified by their names. We also need to record their salaries. Each employee may work in only one department. Managers are employees as well, although each of them also gets to manage one department.
   - The store sells various items identified by item ID's. Each item is carried by exactly one department, while each department may carry many items. For each item, we also need to keep a short description and its quantity in stock.
   - The store deals with a number of suppliers identified by their names. We need to record their addresses. Each supplier supplies an item at a particular price. A supplier may supply any number of items, and the same items could be supplied by other suppliers (probably at different prices).
   - The store receives orders identified by order ID's. Each order has a date, a shipping address, and may include different quantities of multiple items.

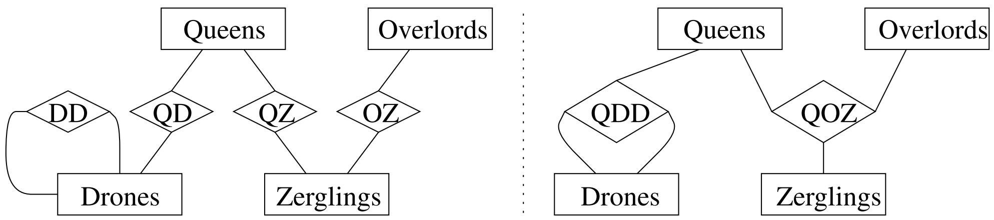
   Specify an E/R diagram for the database. Do not forget to underline key attributes and include arrowheads indicating the multiplicity of relationships.

2. (a) Your design for that Palo Alto store was an instant hit and even caught the eyes of the Terran Space Commission (apologies to Blizzard Entertainment). The Commission hires you to design an E/R diagram for a genealogical database of an alien race known as the Zerg. There are four species of Zerg: Queens, Overlords, Zerglings and Drones.

   - A Zergling is an offspring of a Queen and an Overlord. A Queen and an Overlord together can produce any number of Zerglings. Each Queen may mate with multiple Overlords, and each Overlord may mate with multiple Queens.
   - A Drone is the offspring of a Queen and another Drone. Each Drone may have only one offspring in its lifetime, although each Queen may mate with multiple Drones and thus have multiple Drone offsprings.

   One possible design uses four *binary* parent-offspring relationship sets. Another possible design uses two *ternary* parent-parent-offspring relationship sets. The (incomplete) E/R diagrams for these two designs are shown below.

*Please refer to CS145 Course Information Page (`http://www.stanford.class/cs145/info.html`) for submission instructions and late policy.

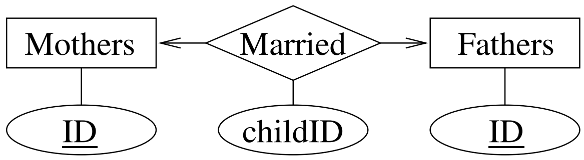


i. Complete the E/R diagrams above by adding arrowheads to indicate the multiplicity of relationships. Also put labels on the edges to indicate roles whenever necessary. You may ignore the attributes of the entity sets.

ii. Do both design faithfully capture all known facts about Zerg genealogy stated above? Or are any assumptions that cannot be encoded exactly by the arrowhead notation?

(b) The Commission asks you to do another design for an alien race known as the Protoss. Protoss uses gene-splicing technology to reproduce. Genes from one or more Protoss are combined into a new gene for the offspring; in other words, each Protoss has one or more parents. A Protoss can have any number of offsprings. Draw the E/R diagram for your design. Again, you may ignore the attributes.

(c) Impressed by your other designs, the Commission asks you to revise an old, buggy design for a human genealogical database. List at least three problems with the E/R diagram shown below, and then show your own E/R diagram. State clearly, as a part of your solution, any assumptions that you make about humans. You may assume that humans have only "ID" attributes.



3. **Personal Database Application (PDA)**

As the course progresses, your programming project will be to build a substantial database application for a real-world scenario of your choosing. You will design a schema for the database, and you will create an actual database using a relational database management system. You will populate the database with sample data, write interactive queries and modifications on the database, create programs that manipulate the database, and develop user-friendly tools for interacting with the database.

Your first step is to identify the scenario you would like to manage with your database, and to construct an ODL or entity-relationship schema design for the data. We suggest that you pick an application that you will enjoy working with, since you'll be stuck with it for the whole quarter! In previous years, students who built a database about something they were interested in—a hobby, a favorite Web site, material from another course, a research project, etc.—got the most out of this part of CS145.

Try to pick an application that is relatively substantial, but not too enormous. For example, when expressed in the entity-relationship model, you might want your design to have in the range of five or so entity sets, and a similar number of relationship sets. Note that this is a ballpark figure only! You should certainly include different kinds of relationships (e.g., many-one, many-many) and different kinds of data (strings, integers, etc.), but your application need not necessarily require advanced features such as subclassing in ODL, or weak entity sets or roles in E/R.

(a) Write a short (approximately one paragraph) description of the database application you propose to work with throughout the course. Your description should be brief and relatively informal. If there are any unique or particularly difficult aspects of your proposed application, please point them out.

(b) Specify a schema for your proposed database. Use either ODL class definitions or an entity-relationship diagram, whichever you prefer. As always, when using ODL don't forget to include keys and inverse relationships, and when using E/R don't forget to underline key attributes and include arrowheads indicating the multiplicity of relationships.

If you're having trouble thinking of an application, or if you're unsure whether your proposed application is appropriate, please feel free to consult with one of the course staff.