CS 5530 / 6530 Database Systems

Autumn 1998
Gary Lindstrom
Wei Tao

ASSIGNMENT 1: THE ENTITY-RELATIONSHIP MODEL

CS 5530: 100 points; **CS 6530**: 130 points
Due 10:45am, Wednesday, September 9

1 (25 points)

This question deals with the airline database entity-relationship diagram shown in Figure 1.

1. **(15 points)** Extend this E-R database design to include catering data, i.e., *meal service*.
   - A meal is associated with a set of dishes.
   - A dish has a name, cost and fat content.
   - Each flight is associated with at most one meal.
   - If a departure is associated with a flight which is associated with a meal, then this departure is also associated with at most one employee who is known to have cooked the meal served on this departure.
2. **(10 points)** Answer the following questions about your E-R design:
   - Does your E-R design express all and only the database instances characterized above? If some valid instances are not permitted, or some invalid instances are permitted, describe them.
   - Assign a primary key to each of your entity sets.
   - Which, if any, of your entity sets should be weak?

2 (25 points)

This question deals with the department store entity-relationship diagram shown in Figure 2.

1. **(7 points)** For each entity set, define a primary key. Justify your choice in each case in a sentence or two.

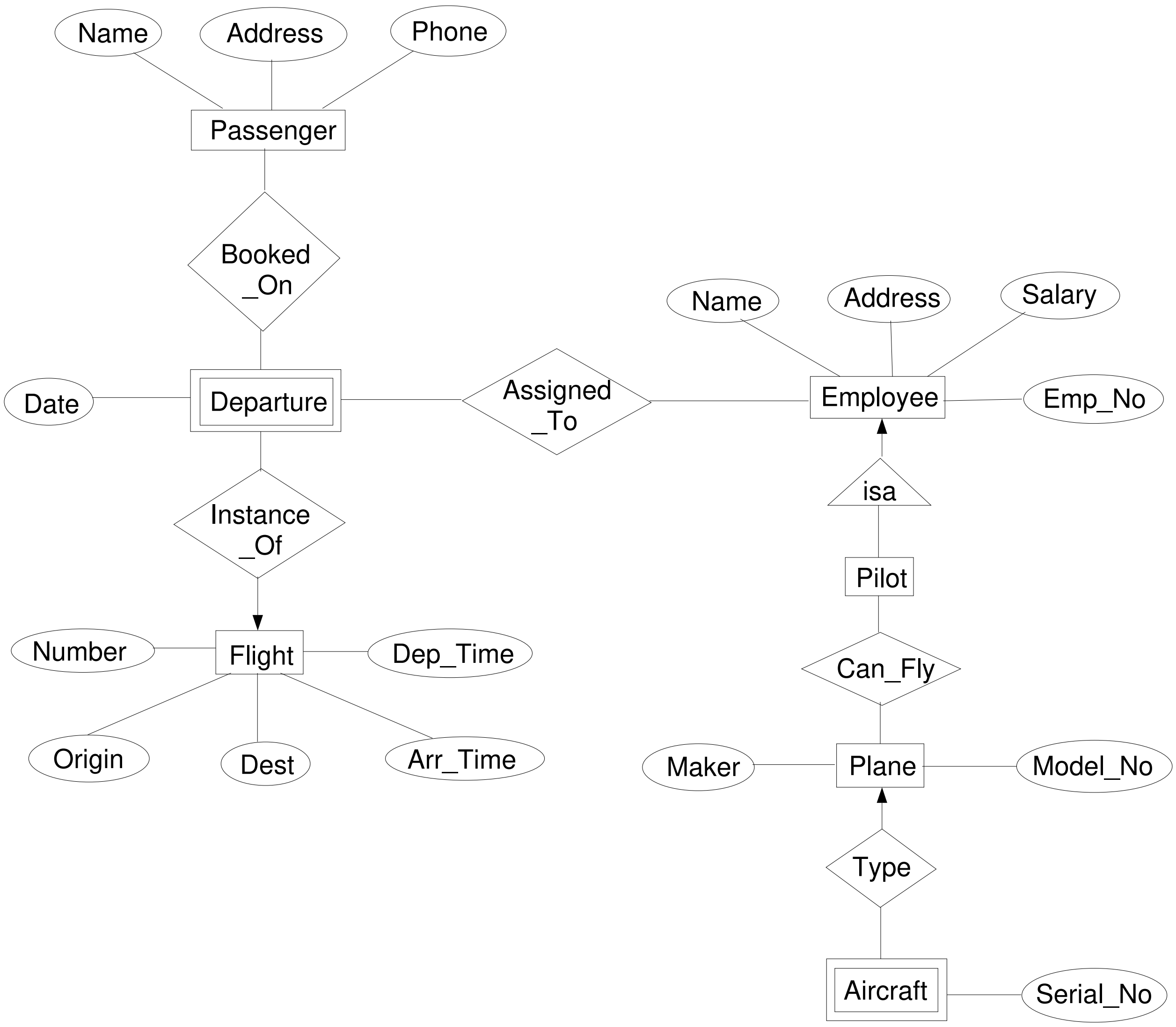

Figure 1: Airline database

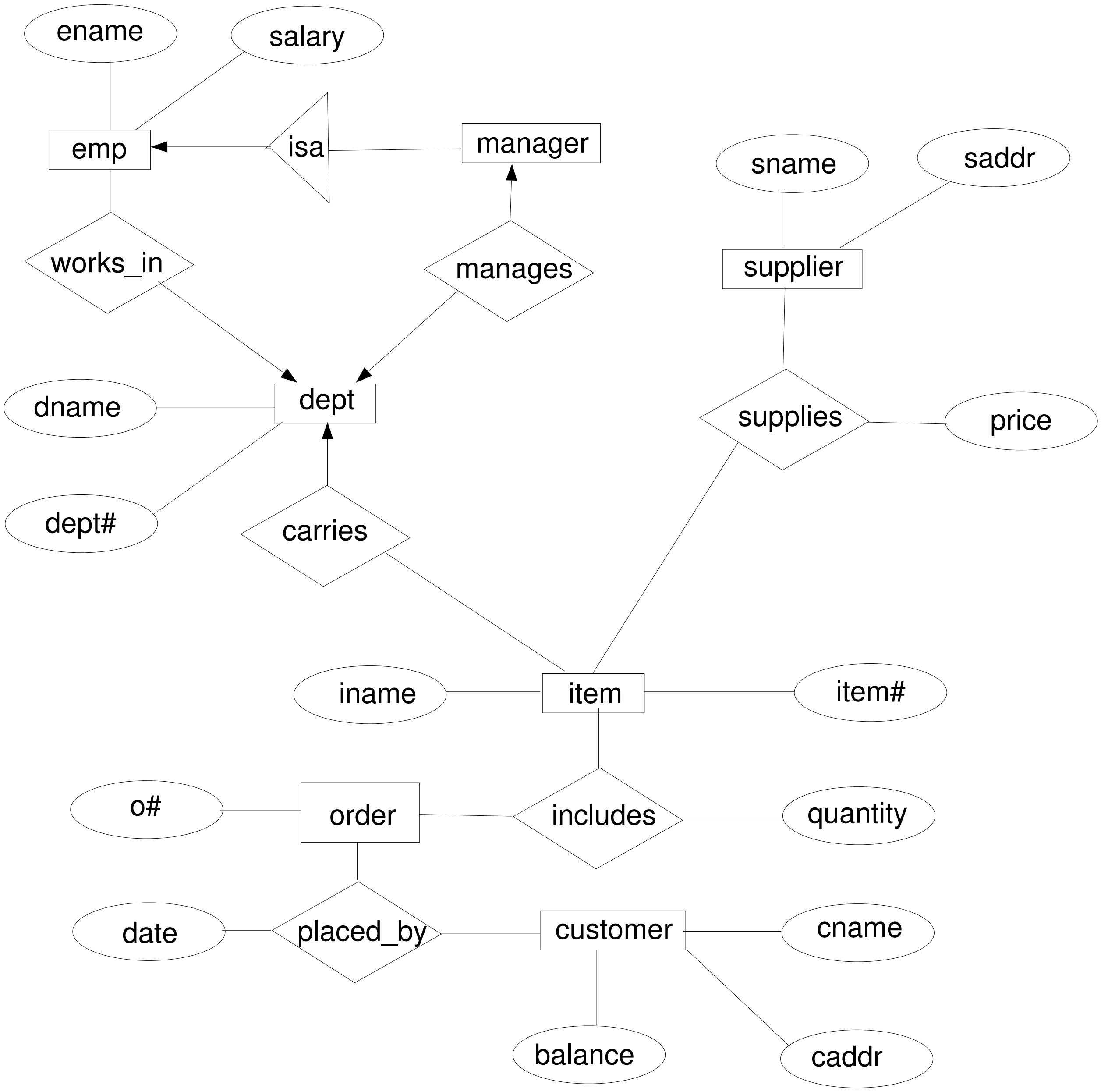

Figure 2: Department store E-R design.

2. **(6 points)** Which, if any, of the entity sets should be weak? Justify your answer in a sentence or two.

3. **(6 points)** Explain the purpose of the descriptive attribute *date* in the *placed_by* relationship. Explain the effect of including it, or not, in the primary key of *order*. Similarly, explain the effect of including it, or not, in the primary key of *customer*.

4. **(6 points)** Do the same for the descriptive attribute *price*, the relationship *supplies* and entity sets *supplier* and *item*.

3 (25 points)

Consider the following set of requirements for a university database used to maintain student grade reports (transcripts).

- The university records each student's name, social security number (SSN), address, phone, birthdate, major department, and degree program (B.A., B.S., etc.). An SSN uniquely designates a student.
- Each department is described by a name, department code, office number, office phone, and college. Name and code values each uniquely characterize a department.
- Each course has a course name, description, course number, number of quarter hours credit, and offering department. The combination of a course number and an offering department uniquely designates a course.
- Each section has an instructor, quarter, year, course and section number. The section number distinguishes different sections of the same course that are taught during the same quarter and year.
- A grade report has a student, section, and grade. The combination of a student and section uniquely characterizes a grade report.

Your answer should include:

1. **(16 points)** Your E-R diagram.
2. **(3 points)** All entity set candidate keys.
3. **(3 points)** Relationship functionalities.
4. **(3 points)** Weak entity sets, along with the strong entity sets upon which they depend.

State all assumptions that you make in devising your solution.

4 (25 points)

Extend your solution to Question 3 to include (i) room scheduling, and (ii) course cross listing.

- Rooms have building names, numbers, and seating capacities. Rooms are uniquely designated by the combination of a building name and a number. Course sections are booked into rooms at particular class periods (assume the latter is a single attribute abstracting both day(s) of the week and start/end times, which you do not need to model).
- Course cross listing means that a course can have more than one course number and offering department. However, all cross listings of a course have the same course name, description, and number of quarter hours of credit. The sections of a cross listed course do not vary by course number or offering department. Example: if CS 5710 is cross listed as EE 5710, then section 1 of CS 5710 in Autumn 1998 will have the same instructor, room, and class period as does section 1 of EE 5710 in Autumn 1998.

Your answer should include:

1. (**16 points**) Your E-R diagram.
2. (**3 points**) All entity set candidate keys.
3. (**3 points**) Relationship functionalities.
4. (**3 points**) Weak entity sets, along with the strong entity sets upon which they depend.

State all assumptions that you make in devising your solution.

[Extra Question For CS 6530 Students]

5 (30 points)

Fig. 3 shows an initial attempt at an E-R design for a horse breeding database.

1. **(4 points)** Both relationships are shown to be many-to-many. Is this appropriate in both cases? Why or why not?
2. **(4 points)** Neither of the entity sets are weak. Is this appropriate in both cases? Why or why not?
3. **(8 points)** Redraw the E-R diagram in Fig. 3 to incorporate the redesigns (if any) that you advocate in your answers to Questions 1 and 2 above.

   Represent the resulting database design as a collection of tables. For each table:

   (a) List all foreign keys and the tables which they reference.

   (b) Select a primary key, and state any assumptions underlying that selection.

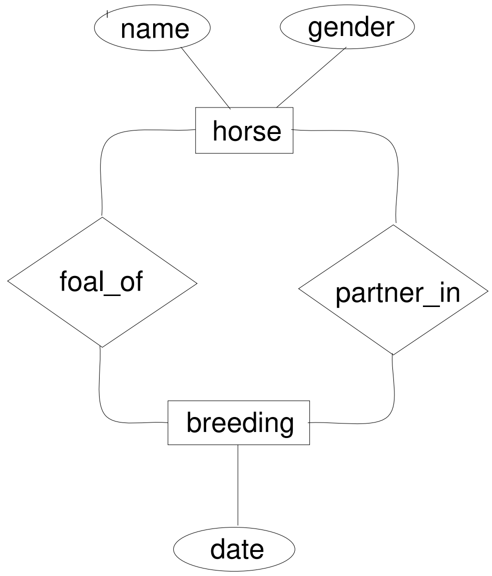

Figure 3: Horse breeding database.

4. **(14 points)** Suppose the horse attribute gender is intended to represent two possibilities: stallion (male) and mare (female).

   (a) **(9 points)** Construct an alternative database design (E-R diagram) which enforces the constraint that each breeding involves exactly two horses — one stallion and one mare.

   (b) **(5 points)** Compare your design with the original design in the following two respects:

      i. *Representational power:* Is there valid data which can be represented by one design and not the other?

      ii. *Representational precision:* Is there invalid data which is excluded by one design but not the other?