## COIT20247 - Database Design & Development
Tutorial – Conceptual modelling (Basic)

Theory questions

Answer each of the questions below. You should be able to answer most of these questions within about 3 to 5 sentences. Refer to the lecture slides to find the important points about each of these questions. Keep to the point and be sure to *answer the question that has been asked*. For example, if you are asked "What is the definition of a database?" then explain the important concepts in the definition a database; **don't** say how wonderful databases are.

1. What is the difference between an **entity type** and an **entity instance**? Be sure to define each one and make the difference between them clear.

2. What is the difference between a **relationship type** and a **relationship instance**? Be sure to define each one and make the difference between them clear.

3. What is the difference between **attributes** and **values**? Be sure to define each one and make the difference between them clear.

4. Using the entity types *Student* and *Course* from the lecture slides, give examples each of *entity type, entity instance*, *relationship type, relationship instance, attribute* and *value*.

5. Using the ER model given below as an example, explain what is meant by **maximum cardinality** and **minimum cardinality**.
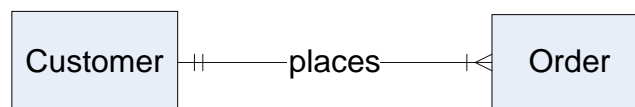
6. Is the relationship in the ER model above a one-to-one (1:1), one-to-many (1:M) or many-to-many (M:M) relationship? Why?

7. What is a **unique identifier**? Think about any orders or bookings that you have placed lately, or any invoices that you have received. What was the unique identifier used on the invoice/order/booking? Are you a member of any clubs or video stores? What identifier is used to uniquely identify you?

8. What syntax is used to represent an associative entity? The unique identifier for an associative entity is a combination of what?

9. Review the guidelines for naming and defining entities on your text book.

10. Review the guidelines for naming and defining attributes on your text book.

Case Study 0 – Best books

Read the following case study.

>*Best Books* is an online book store. Customers can log on to the *Best Books* web page and browse the catalogue of books. Before a customer can place an order, they must sign up as a customer. To sign up, they must enter their customer name, postal address and contact phone number. The system will automatically give them a unique Customer ID.
>
>Once they have signed up, customers can place orders. When a customer places an order, the order is given a unique Order ID by the system. The system records the order date and the total amount of the order.
>
>Customers can order many books on a single order, but an order must contain at least one book or else it would be an empty order.
>
>Each book has a unique Book ID. For each book, the *title*, *author*, *year of publication* and *cost* are recorded.

Draw an ER model to represent the information required to run Best Books. To help you get started on your very first ER modelling problem, answer the questions below. These questions refer to the case study and are intended to help you pick out the important information needed to develop your ER model.

1) In the case study, *customer*s place *order*s. Draw this as two entities and a relationship.
    a) Now you must work out the cardinality. Answer the questions below to help you work out the cardinality of this relationship.
    b) A *single order* is placed by _____ and only _____ customer
        i) Does it make sense to have an order without a corresponding customer? No. So the minimum cardinality must be 1, not 0.
        ii) Does it make sense to have a single order placed by multiple customers? No. So the maximum cardinality must be *one*.
    c) A single customer can place _____ orders, and over time may place _____ orders
        i) Notice how a customer must sign up before they place an order *but* there is nothing to say that they *have* to place an order. So it would be possible for a customer to sign up but then never order anything. So the minimum cardinality must be 0.
        ii) However, once a customer has signed up, they could place many orders as time passes. So the maximum cardinality must be *many*.
    d) Don't forget to name the relationship.

2) An order is for books. Add this to your ER model so far.
    a) Now you must work out the cardinality. Answer the questions below to help you work out the cardinality of this relationship.
    b) A single order must contain _____ book and may contain _____ books
        i) Does it make sense to have an order zero books in it? No, so again the minimum cardinality must be 1.
        ii) Remember that someone might ask for several books on the same order.
        iii) Don't forget to name the relationship

c) A single book might appear on _____ orders or _____ orders
   i) It's possible that there may be a book that has never been ordered. So the minimum cardinality should really be 0.
   ii) A single book might be ordered on many different orders – so the maximum cardinality must be *many*
   iii) So the maximum cardinality of this relationship is *many-to-many*

3) Add appropriate attributes for each entity.

4) For *each book* on *each order*, it is necessary to record the quantity ordered and the subtotal.
   i) You can't record *quantity ordered* in the Book entity. (Why not?)
   ii) You can't record *quantity ordered* in the Order entity. (Why not?)
   iii) So where else can it go? Have a look at the contents about associative entities on the lecture slides and textbook. Pay particular attention to the order and orderline entities.
   iv) Convert this relationship to an *associative entity* and add the *quantity ordered* and *subtotal* in the appropriate place.

Case Study 1 – Real estate

Now you're on your own. Draw ER model for the case study given below. If you were running this business, what things would you need to keep a record of? What relationships do you need? For example, for each customer, you need to know what orders they have placed – this is a relationship. What attributes must be recorded for each of the entities? Remember to read/determine your cardinality in the right way.

Prepare an ERD for a real estate firm that lists property for sale. Also prepare a definition for each entity type and attribute on your diagram. The following describes this organisation:

- The firm has a number of sales offices in several states. Attributes of sales office include OfficeID (identifier) and Location.
- Each sales office is assigned one or more employees. Attributes of employee include EmployeeID (identifier) and EmployeeName. An employee must be assigned to only one sales office.
- The firm lists property for sale. Attributes of property include PropertyID (identifier) and Location.
- Each unit of property must be listed with one and only one of the sales offices. A sales office may have any number of properties listed or may have no properties listed.
- Each property has one or more owners. Attributes of owners are OwnerID (identifier) and OwnerName. An owner may own one or more units of property. An attribute of the relationship between property and owner is PercentOwned.

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Final things to note…

The case studies given to you here are deliberately written in a way that makes the necessary information fairly clear. For example, we have explicitly told you that "Each property has one or more owners". This makes the data modelling exercise comparatively easy. You will find the assignment a little harder because this sort of information will not be quite so explicit. If you go on to be a systems analyst or database designer, you will find it more challenging still – users and clients rarely tell you what you need to know in a convenient, easy-to-understand way.   In fact, one of the most challenging (and rewarding) aspects of being a database designer is being able to pick the necessary entities and attributes from a very confusing description given to you by the end users. This skill is characteristic of *expert* data modellers and must be developed over time. In the meantime, we will start with more manageable case studies and try to build you up to that level with lots of practice.

In almost all ER modelling cases, there is more than one "right answer". For any given case, there will be an infinite number of ways to model it that are *most definitely <u>wrong</u>* – a "wrong" model simply will not allow the business to work in the way described. However, there may be several different ways to model the data that *will* work and usually there will be different advantages and disadvantages associated with each one. Learning to tell the advantages and disadvantages of each way is again something that comes with time and practice. The only way you will get better at this is with practice, practice, practice.

Finally, keep in mind that the skills you learn *developing* data models and databases will also be crucial in *using* data models and databases. Most IT professionals have to interact with databases in one way or another, and the more you understand these things, the easier it will be.

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