

# Inf1B Data and Analysis

## Tutorial 1 (week 3)

19 January 2009

- Please answer questions 1–6 of this worksheet in advance of the tutorial, and bring with you all work, including printouts of any computer work. Tutorials cannot function properly unless you do the work in advance.
- Please also think about the (**Tutorial Discussion**) question.
- Data & Analysis tutorial exercises are not assessed, but are a compulsory and important part of the course. If you do not do the exercises then you are unlikely to pass the exam.
- Attendance at tutorials is obligatory; please let your tutor know if you cannot attend.
- *Required Reading:* Chapter 2 of ‘Database Management Systems’ (Raghu Ramakrishnan and Johannes Gehrke, 2003). This chapter can be found online on Google Books (<http://books.google.com/>).

## Introduction

In this tutorial you are required to design an Entity Relationship Model for a database based on a description of the scenario. You should read the description carefully, making a note of all the candidate entities you think are involved, and of their attributes. Think about the relationships between the entities as you do this. The tutorial consists of answering a series of questions about your design and producing a final ER diagram for it.

# An Inter-University Gliding Competition

The scenario is that you are organising an inter-university gliding competition, and you have decided to design a database to keep track of the administration of the competition.<sup>1</sup>

A number of universities have each entered a team in the competition (known as a Task Week), and one of the things you need to keep track of is whether or not they have paid the entry fee. Each university team consists of a variable number of people who will take part in the competition; everybody who competes must be a member of one of the teams.

The pilots will have different levels of experience. Some will be pre-solo, which means they can only fly as second pilot (“P2”) in a two-seater glider. They can still compete for their team in this capacity, as long as there is an instructor flying with them as pilot-in-charge (“P1”). Pilots who are of cross-country standard can fly as P2 just like pre-solo people, but may also fly solo in any kind of aircraft. A pilot flying solo is always P1 of course. Instructors can fly solo in single- or two-seater gliders, or as P1 in a two-seater with a less experienced pilot. If two instructors are flying together they will simply decide between them who is P1 and who is P2.

There are a number of different types of glider involved in the competition. Some are two-seaters, such as K7, K13, K21 and DG505. The rest are single-seaters; their types include K8, Pirat, DG300, Discus and LS4. There may be more than one glider of a particular type, but every glider can be distinguished by its callsign — a short string which is used to identify it in radio communications. Typical callsigns include “MF”, “P19”, “FNS” and “CPG”.

The competition is organised around “tasks”, which are routes that each competing glider must attempt to fly around. On each competition day a task is set for the pilots to fly in their gliders. The task is defined by choosing a set of “turning points” taken from a list available from the BGA (British Gliding Association). There are almost a thousand such turning points defined for the UK, and each has a unique “trigraph” or three-letter acronym to identify it. For example, “STI” is for Stirling and “LOM” is the Lake of Menteith. The competition is being held at Portmoak Airfield (about 30 miles north of Edinburgh), which is “POR”. The task-setter will decide on a suitable task for each competition day, which will involve trying to glide from the starting point at the airfield around one, two or more turning points. For example, a set like “POR, STI, MVN” would define a triangle of just over 100km, with the corners at Portmoak, Stirling and Methven (which is near Perth). For the purposes of this exercise we will assume that competitors are allowed to fly around the turning points in any order they choose. As well as specifying the trigraph, the BGA list of turning points gives the latitude and longitude of each turning point, so their positions can be precisely identified on a map.

Sometimes competitors can gain an unfair advantage by starting off much higher than other gliders, or by happening to pick a better time of day. The task-setter can therefore attach conditions to each task, specifying the maximum starting height allowed and the earliest time at which a glider can start.

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<sup>1</sup>Gliders are aeroplanes without engines, designed for maximal efficiency in extracting the energy freely available in the air, and (on a good day) using it to fly hundreds of kilometres.

### Question 1 - Determining of possible entity-sets

What are the candidate entity sets you would consider in order to build your ER model? Is it possible to map these entity sets directly and unambiguously from the information given, or is there more than one possibility for modelling these entity sets? Choose your final set of entity sets from the candidates, making sure to include both 'Person' and 'Glider', and justify your answer in as much detail as possible.

### Question 2 - Defining attributes for a given entity-set

At this point you will have decided your sets of entities that can be used to design the ER diagram. For this question, focus on just the two entity sets below:

- Person
- Glider

What are the attributes you can assign to each of these given the available information? What are the attribute types?

The scenario told you that a pilot can fly a glider in crew capacity either P1 or P2. Is this an attribute? If not, what is it? If it is an attribute, does it belong to Person or to Glider or to neither of them? If it belongs to neither, where does it feature in the ER design? Explain your reasoning fully.

Note: In order to draw your diagram you will need to decide the attributes for *all* your ER objects. You do not need to list them all here, but they must appear on your final diagram.

### Question 3 - Describing relationships

Describe the relationships between the entities you defined in the first question and give them names. What kinds of relationships are there? *one-to-one*? *one-to-many*? *many-to-many*? Are there any weak entities in your model? Are there any key constraints? Do any of the relationships involve full participation?

### Question 4 - Defining primary keys

What are the primary keys for each entity in your model? Explain briefly why you chose them.

## Question 5 - Drawing the diagram

Draw the diagram representing your ER model. Use the conventions given in the lecture slides.

## Question 6 - Using dia

Draw the ER diagram you created in Question 5 using the `dia` application on the DICE machines. Follow the instructions below to use `dia`.

1. Start `dia`. Either go to the main menu on your `dice` desktop (by clicking on the icon at the bottom-left corner of the screen) and select the option for `Dia Diagram Editor` from the `Graphics` menu, or type `dia` at the command line in a terminal window. (You can run it in the background by typing “`dia &`” — ask your demonstrator if you don’t know what this means.)
2. You will see a diagram window and a `Diagram Editor` window with tool buttons. In the middle of the tool buttons window there is a pull-down menu (which may be labelled `Misc` or `Assorted` initially). Click on that menu and select the option `ER`, either from the list if it’s present, or from the `Other Sheets` sub-menu. Once you’ve done this, you will see a set of buttons for drawing entities, relationships and so on, just below the pull-down menu.
3. The blue lines on the diagram window are page-delimiters. By default they are set as size A4 with portrait orientation. You may prefer using landscape orientation for this task. To change the orientation use the `File - Page Setup...` menu option.
4. To draw an Entity, select the `Entity` drawing tool (first one on the left, denoted with a square labelled “E”) and click anywhere on the diagram window. Double click on the Entity you just created and explore the different options you can use for customising entities. Once you have played with these options, set the final name of this entity to be `Glider`.
5. In the same way, but using the `Attribute` tool (a circle with the letter “A”) define the attributes for this entity. When you double click on a defined attribute you also have a number of options for customisation. Spend some time exploring these as well.
6. In order to connect objects, select the icon with two parallel lines and then click on the screen. Then click and drag (while keeping mouse button pressed) on one of the green ends of the line and connect it to one of the objects (when you see a red line around the object it means the connection is made and you can release the mouse). Do the same for the other end of the line. The small square in the middle of the line allows you to change the shape of the line. Notice that the connection lines will follow if you move the objects around — this makes it easy to lay your diagram out neatly.
7. If you prefer a straight line connection to a zig-zag, use the `Line` button from the top part of the tools window. You can also add arrows and change the width of lines using the options at the bottom of the window. These are useful for showing key dependencies and total participation relationships. Experiment with these options.

8. There is also a tool for drawing relationships (the button icon contains a letter “R”). Explore how it works and define the relationships between entities.
9. Build up your gliding ER diagram by adding and connecting all the entities, attributes and relationships from the model you designed in the tutorial.
10. Editing tips:
  - (a) *Deleting*: If you want to delete an object, click on it and press the **delete** key. You can also undo the last action performed, by clicking **Edit - Undo**.
  - (b) *Scaling*: Objects created in **dia** by default are quite large; you will want to make them smaller for printing. The simplest way to achieve this is to lay out your diagram on the screen without worrying about the size, and then — once it is complete — use the **File - Page Setup...** menu, **Scaling** option, and scale the diagram to fit in a single page (i.e. 1 x 1).
11. To print your diagram, use the **File - Print Diagram...** menu.

You may choose to work on this task during one of the drop-in labs, where you will be able to ask a demonstrator for help. Drop-in labs are daily in the afternoons in Computer Lab West on level 5, Appleton Tower.

### **(Tutorial Discussion) - Thinking around the model**

Do not alter your diagram for this question, but describe in outline changes that you might make (such as adding certain attributes to particular entities or relationships).

Imagine you really are running a gliding competition. Is there anything you think is missing from the scenario — any other information that you would like to collect and add to your model? Explain what you would add and why. Could your model be easily altered to include new information or would you need a major redesign?