

## 4 Designing Methods for Complex Class Hierarchies

In this lab we will focus on designing methods for class hierarchies with several mutual references.

Here it is extremely important that you follow the design recipe very closely: make examples that show you what computation is needed, write detailed templates to see what computation is already available and what is still needed, make wish lists and design helper methods when the problem requires that another class provides some information for you. Follow the inheritance and containment arrows.

Use the lecture notes for the employee class hierarchy as a guide for how to organize the program, how to define the templates, and how to organize the tests.

### 4.1 Soccer League

You are given the class definition and some sample data for classes that represent information about a youth soccer league. The league keeps a list of teams as follows. Each team is represented by its captain, the team name, and a list of additional players on the team. The captain is also considered to be a player. We also record the age of every player.

- A. Write down on a paper the names of all teams, for each team list its players, and the name of its captain.
- B. Design the method `count` that counts the total number of players in this league. Design the templates as you go along.
- C. Design the method `listAll` that produces a list of all players in this league.

### 4.2 Evaluating Spreadsheet Cells

For this problem you will use the classes that represent the values in the cells of a spreadsheet. For each cell we record the row and column where the cell is located, and the data stored in that cell. The data can either be a numerical (integer) value or a formula. Each formula can be one of three possible functions: `plus`, `minus`, or `times` and involves two other cells in the computation.

A. Make an example of the following spreadsheet segment:

	A	B	C	D	E
1	7	4	3	2	5
2	- A1 E1	+ B1 C1			* A2 D1
3		+ B2 B1			- B3 D1
4		+ B3 B2			- B4 D1
5		+ B4 B3			* A2 E4

- B. Design the method `value` that computes the value of this cell.
- C. Design the method `countFun` that computes the number of function applications needed to compute the value of this cell.
- D. Design the method `countPlus` that computes the number of `Plus` applications needed to compute the value of this cell.

**Make sure you design templates, use helper methods, and follow the containment and inheritance arrows in the diagram.**

### 4.3 Mobile Design

Start the work on the first problem of the homework assignment that involves *mobiles*. Make sure you understand the problem. Start with the drawing.