Chapter 8

Generalization and Instantiation

As this term is most commonly used, a generalization is an “all” statement, to the effect that all objects of a certain general kind possess a certain property.

E.J. Lowe (1983)

While discussing Aggregation and Exhibition, we talked about entire groups of objects or processes – any scientific paper, any employee, any running. However, what if we wanted to consider the example of a specific paper, written by a certain John Doe? Or if we wanted to consider a group of employees, namely managers, who receive a certain salary out of the range of salaries available for the company? Perhaps we would like to discuss running in a marathon, as opposed to just any kind of running? We need to be able to pay particular attention to a specialized group, which belongs to a more general group, or even a specific instance out of a class of objects. As its name clearly points out, Generalization-Specialization is the relation between a general and a specialized case of a thing. Classification-Instantiation links between a class of things and a unique instance from the class. Since these two of the four fundamental relations are important to systems modeling, we consider them in more detail now; and since they are intimately related, they are explained together in this chapter.

8.1 Generalization-Specialization: Introduction

Let us first consider several simple examples to set the stage for discussing Generalization-Specialization, or “gen-spec”\(^1\). Recall that the first time we encountered the gen-spec relationship was in the wedding system introduced in Chapter 1, where we saw that

\begin{center}
**Man and Women are Persons.**
\end{center}

The Person is the general case, while Man and Woman are its special cases. Other examples are “Dog and Cat are Pets.\(^2\), “Pascal, Java, and C++ are Programming Languages.\(^3\), “Airplane and Car are Vehicles.\(^4\), and “Ketchup and Mustard are Condiments.”

\(^1\) The shorthand term “gen-spec” is borrowed from Coad and Yourdon (1991).
8.1.1 Specialization Symbol and Sentence

The symbol of the Generalization-Specialization relation is the equilateral white triangle. As Figure 8.1 shows, it denotes the fact that the two objects Digital Camera and Analog Camera are specializations of Camera.

![Figure 8.1. Camera and its Analog Camera and Digital Camera specializations](image)

The OPL paragraph of Figure 8.1 could be:

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Digital Camera is a Camera.
Analog Camera is a Camera.
(Specialization sentences)
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Better yet, these two OPL sentences can be joined into one:

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Digital Camera and Analog Camera are Cameras.
(Plural specialization sentence)
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A more “professional” way of expressing the last sentence might have been “Digital Camera and Analog Camera specialize Cameras.” However, sticking to the principle of keeping the OPL language as natural and as simple as possible, OPL uses the clearer and more intuitive reserved phrases “is a” or “are” rather than “specializes” or “specialize”. As for the reserved word generalizes, OPL would rather use a more common word, too. Unfortunately however, no simpler adequate English word can replace generalizes in the top-to-bottom direction of the Generalization-Specialization relation. We could use “can be”, but this phrase is reserved for states in a state enumeration sentence. Another option is “stands for,” but it does not really capture the semantics of generalizes.

Any number of specializations is possible. The following is an example of three specializing objects:

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Cucumber is a Vegetable.
Tomato is a Vegetable.
Carrot is a Vegetable.
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