Chapter 13

Constraint Limited Generalization: Acquiring Procedures from Examples

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13.1 Introduction

Much of the work on learning in AI can be viewed as an attempt to understand the problem of generalization in a variety of domains. Much of it has been concept learning—acquiring descriptions of some concept from descriptions of particular examples of the concept. Winston and Michalski have provided a set of standard heuristics for concept acquisition which are applicable in a wide range of domains. Mitchell has formulated general-

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ization as a search through a space of possible descriptions.

Finding a generalization of a set of example descriptions is an unconstrained problem—there are usually many descriptions which are valid generalizations of the examples. In any interesting domain, the number of possible generalizations is too great to consider them all. Mitchell reduces the number of descriptions that must be considered by characterizing all the possible generalizations by just the maximally specific and maximally general generalizations. This only works in simple domains, and would fail completely if unconstrained disjunctions are allowed in the descriptions. The task, therefore, is to retain only the useful generalizations and eliminate the others. Whether we retain one or several generalizations, some principles are needed to guide our choice. This paper provides four such principles:

**Domain Constrained Generalizations:** All possible constraints from the domain should be used to eliminate possible generalizations and reduce the search space.

**Undesirability Ordering:** There must be some ordering on the space of possible descriptions that represents their relative desirability.

**Goal Limited Generalization:** Given an undesirability ordering, always choose the lowest generalization that satisfies the goal of the generalization.

**Context Limited Generalization:** Given an undesirability ordering, stop searching for a generalization when the descriptions are more undesirable than is justified by the context of the items being generalized.

These principles are best discussed in the context of a particular generalization task. Therefore the next section will describe a system called PMA\(^4\) for acquiring procedures by generalizing from examples which is based on these principles. The section following will discuss the principles in more detail using examples from the system.

### 13.2 Acquiring procedures from examples

In the standard concept acquisition task, a teacher provides the learner with a series of examples (and possibly non-examples) of a concept. The learner must generalize these examples to obtain a description of the concept from which the examples were derived.

\(^4\)Procedure Matcher and Acquirer