

ization is applied before adaptation. We begin with this analysis because the use of feedback in the mechanism of adaptation is at least 30 years old, and adaptation is commonly viewed as the primary function of feedback. Therefore, the existing literature on developing and using feedback in IR systems deals primarily with adaptation.

We begin the discussion by clarifying some of the details that explain the need for adaptation in IR systems and by stating some requirements for the creation of the mechanism of adaptation. Then we will be able to discuss the algorithms that effectively implement adaptation.

9.2

Some Questions for Constructing Adaptive IR Systems

Feedback in its general form is a mechanism that attempts to minimize the difference between the goal of the action and its result. We already mentioned that the goal of information retrieval (its goal of action) is satisfaction of POIN. But the quality of its satisfaction of POIN depends on how fully the IR system takes into account the properties of POIN, and one of the main properties of POIN is its constant change (the character of this change is not known) and the absence of clear boundaries (which, as a rule, prevents the clear expression of POIN). Therefore, the result of a search should be constantly corrected (adapting to the user's POIN) in the process of the user's interaction with the system. In other words, the system should have a mechanism that determines the difference between the actual user's POIN, which the system is trying to satisfy, and the representation of POIN that is currently available to the system. Such a mechanism is the mechanism of adaptation, which allows the system to adjust to the user's POIN. Because, in discussing the structure of IR systems (in Chapter 4) we gave a detailed analysis for the necessity of adaptation and also analyzed the nature and necessity of feedback in the IR system, we will not repeat it here. Remember, however, that the existence of the problem of adaptation in IR systems does not make these systems adaptive. It is necessary to create a mechanism of feedback that deals with the process of adaptation. The creation of such a mechanism requires the knowledge of *what to control* and *how to control*. To answer these questions, we need to look at the structure of the controllable system, which in our case is the IR system in Figure 4.8.

Now let us discuss how the object of control (OC) interacts with the mechanism of control (MC). Which elements of OC can be controlled? Clearly, we can control OC (i.e., change the system's output) by affecting every element of OC, which is indicated in Figure 4.8 by dotted lines. Let us look at how we can affect different elements of OC.

9

Control and Feedback in IR Systems

9.1

Introduction

As we discussed in Chapter 4, when developing an IR system it is necessary to think of it as a controllable system. This viewpoint follows from the definition of the function of an IR system and from its structure, which makes the system capable of fulfilling this function. The function of an IR system leads to its requirement for an optimal search, and optimization, as is well known, is one of the problems of control. In Chapter 4 we also showed that the properties of POIN (documentary IR systems are created to satisfy POIN) require the existence within the IR system of a mechanism that allows the system to adapt to existing POIN, and adaptation is also a problem of control.

In discussing the systems approach in Chapter 1, we mentioned that the study of the process of control is mainly concentrated in such scientific fields as cybernetics (Wiener, 1961). We remind the reader that cybernetics studies not all systems but only controllable systems, and the originality and strength of the cybernetic approach to control lies in its use of the general principle applicable to systems—the principle of feedback. Because any system with feedback is controllable and because feedback is necessary for realizing such processes as adaptation and optimization, we used the cybernetic approach in describing the structure of IR systems; that is, an IR system was considered a cybernetic system and, as explained in Chapter 1, any controllable system is by definition cybernetic. Therefore, the origins of feedback in IR systems, its character, and its properties were described in Chapter 4.

This chapter deals primarily with the construction of those elements of an IR system that assume the existence of feedback—that is, the construction of mechanisms of adaptation and optimization—and it presents algorithms realizing the mechanism of control (review the MC element in Figure 4.8). The chapter starts with an analysis of the mechanism of adaptation, even though, as we mentioned in describing the structure of an IR system, the mechanism of optim-