Chapter XI
Web Process Adaptation

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ABSTRACT

Adaptation is an important concept for Web processes. The author provides an overview of adaptation with respect to control theory and how it is applied to other contexts. Specifically the author focuses on open loop and closed loop adaptation. Then the cahpter discusses the current Web process standard WS-BPEL supports open loop adaptation. Finally, the author discusses an academic research framework METEOR-S, which supports closed loop adaptation.

INTRODUCTION

Adaptation refers to a system's ability to react to certain erroneous conditions or changes in the environment. In the context of a Web process, adaptation refers to the process's ability to react to errors that may occur during the execution of the process or some changes in the environment of the process that may prevent the process from fulfilling its goals. During the execution of a Web process, here are some examples of errors: (1) the supplier service may fail before the order is placed, (2) the supplier may be unable to deliver the order on time after the order is placed, (3) the supplier may be unable to deliver the order at all after the order is placed. Here are some potential changes to the environment during the execution of the process: (1) The currency of the supplier's country changes making previous order sub-optimal (2) Some other supplier offers a new discount. In all these cases, the Web process should be able to adapt.

Control theory has been to create adaptive systems that vary from highly sophisticated ap-

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plications such as flight controllers and cruise control to simple appliances such as washing machines and sprinkler systems. In this chapter, we will cover some of the basics of control theory, in particular open-loop and closed-loop controllers. The main difference between open and closed loop controllers is that open loop controllers do not monitor the environment, whereas closed loop controller do. This is particularly relevant to Web processes, because for intelligent adaptation, the Web process must monitor the environment, however current standards like WS-BPEL do not provide direct support for that. We will also discuss an academic research effort, METEOR-S that enhances WS-BPEL infrastructure to provide support for closed loop adaptation.

CONTROL THEORY BASICS

In this section, we will briefly define some basic concepts in control theory – system, controller, open and closed feedback.

System

A system is defined as an abstraction that represents a set of real world objects (shown in Figure 1). For example, you can have a system that represents an airplane. A system can consist of set of systems. For example, an airplane system consists of the navigation system, the propeller system and the cargo system. We determine a system by choosing the relevant interactions we want to consider plus choosing the system boundary or, equivalently, providing membership criteria to determine which objects are part of the system, and which objects are outside of the system and are therefore part of the environment of the system. A boundary is used to separate the system from its environment.

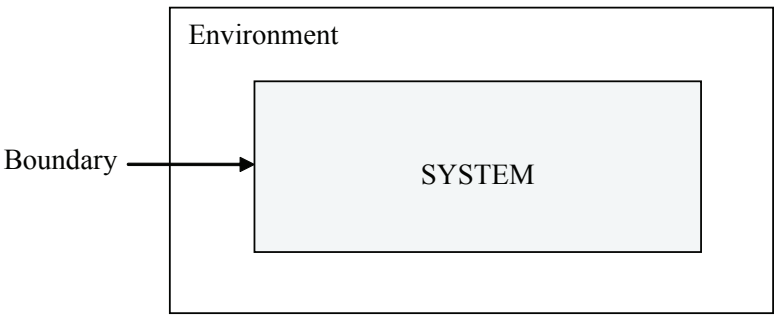
Controller

A controller (shown in Figure 2) is a device which monitors the system and/or environment and affects the behaviour of the system. For example, the heating system of a house can be equipped with a thermostat (controller) for sensing the air temperature of the house (environment) which can turn the A/C on or off when the air temperature becomes too low or too high. The controller affects the behaviour of the system based on a set of system or environment control variables. In this case, the desired temperature is the control variable.

Open and Closed Loop Controllers

An open-loop controller is a type of controller which uses only the current state and its model

Figure 1. System and boundary



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