Accrual Failure Detectors

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Abstract

Failure detection is a fundamental building block for ensuring fault tolerance in distributed systems. Failure detector is a distributed entity and is consist of the set of failure detector modules. Each module outputs the set of suspected processes. Failure detectors are basic components to solve agreement problems (e.g., consensus, atomic broadcast, atomic commitment), especially in asynchronous distributed systems. There are lots of approaches and implementations in failure detectors. However, providing flexible failure detection in off-the-shelf distributed systems is difficult.

Practical solutions to failure detection rely on some adaptive mechanism to cope with the unpredictability of networking conditions. However, they lack the necessary flexibility to provide failure detection as a system-wide service. In particular, traditional solutions take a "one size fits all" approach, which prevents them from simultaneously supporting several distributed applications with very diverse QoS requirements.

In this dissertation, we present a novel approach, called accrual failure detectors, that addresses the flexibility issue. Accrual failure detectors are fundamental approaches for detecting failures in point-to-point communication with a pair of nodes or processes. Conventional failure detectors provide information of a boolean nature (i.e., suspect or not suspect). In contrast, accrual failure detectors provide a value to express the confidence that a given process has crashed. If the process actually crashes, the value accrues until eventually reaching any given threshold set by applications, hence we named our failure detectors "Accrual failure detectors". On the other hand, each application has own threshold respect to its requirement. It suspects some process itself according to the threshold and the value given by the failure detector module.

In the dissertation, we describe the concept and the definition of accrual failure detectors. Then we present mechanisms and implementations of two instances of accrual failure detectors, the φ-failure detector and the κ-failure detector. We also show our measurement of our failure detectors and comparison of these failure detectors and other adaptive failure detectors.

Key Words: **failure detectors, large-scale distributed systems, distributed agreement problems, fault tolerance, computer network**