

A High Level Specification of Distributed Termination in Z

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Abstract

This report presents a specification of a system of communicating processes which can be either active or idle. It defines termination of this system to be when all processes are idle.

The purpose of this report is to demonstrate the use of Z to specify a small problem in distributed systems. Together with Discussion Document No. 4 it also demonstrates the process of refinement in Z.

Let N be the number of processes, numbered 1 to N . A Process is considered to be either **active** or **idle**.

$Id \cong 1..N$
 $activity \cong \{active, idle\}$

Process _____
| *status : activity* |
|_____

There are N Processes, arranged in a graph.

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Graph

$node : Id \rightarrow Process$ { the N processes }
 $edges : Id \leftrightarrow Id$ { the graph }

{ there are no trivial cycles in the graph }

$\forall i : Id \bullet (i, i) \notin edges$

{ the graph is connected }

$\forall i : Id \bullet edges^*(i) = Id$

{ edges are listed one way only }

$edges \cap edges^{-1} = \{ \}$

We get some arbitrary graph and initialize the Graph to make all nodes active.

Graph_{INIT}

Graph

$e? : Id \leftrightarrow Id$

$edges = e?$

$\forall i : Id \bullet node(i).status = active$

Active processes send messages

SendMsg

$\Delta Graph$

$to?, from? : Id$

{ Is the from node active? }

$node(from?).status = active$

{ are the from and to nodes connected? }

$(from?, to?) \in edges \cup edges^{-1}$

{ send the message }

$(node' = node \vee$

$node' = node \oplus \{to? \mapsto (active)\})$

$edges' = edges$

An active process can become idle at any time.

Passivate

$\Delta Graph$

$victim? : Id$

$node(victim?).status = active$

$node' = node \oplus \{victim? \mapsto idle\}$

The system terminates when all the nodes are idle.

Termination

$\exists \text{Graph}$

$\forall i : Id \bullet \text{node}(i).\text{status} = \text{idle}$

