Schedulability test for a jobset using Deadline Monotonic algorithm

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INTRODUCTION

For the Real-Time Operating System (ROS01) course taught at Rotterdam University of Applied Science the authors have to prove they understand the theory of RTOS scheduling and can analyse a jobset for a real time system. After the analysis of the jobset the authors should conclude if the jobset if schedulable according to the Deadline Monotonic algorithm.

The schedulability tests assume that the jobset will be executed on a uniprocessor system where tasks are preemtable. It also assumes that that there is no context-switching time. It also assumes that the execution of the scheduler does not require the processor, that is, the scheduler runs on another specialized processor.

The system has 4 different kind of shared resources k. Every shared resource k has a maximum hold time it may be claimed C_k. These 4 different shared resources with their respective maximum hold time are given in Table **??**.

k	C_k
1	8
2	20
3	10
4	40

Table 1. Characteristics of the available shared resources

This document uses task characteristics letters compatible with the letters defined by Cheng in Task T_i has a maximum computation time c_i, a deadline d_i and a period p_i. The characteristics of the various real-time tasks in this system can be seen in Table **??**.

i	p_i	d_i	c_i	Uses shared resource
1	400	360	90	R2, R3, R1
2	600	580	50	R4
3	800	400	30	R1
4	700	420	40	R2
5	200	170	100	R4, R3

Table 2. Characteristics of the different tasks

The goal of this document is to prove whether the given real-time tasks in Table **??** are Deadline Monotonic schedulable taking into account the shared resources in Table **??**. What now follows is the outline for the rest of this document. Section 1 uses a couple of simple schedulability tests not taking the shared resources into account.

1 SIMPLE SCHEDULABILITY TESTS

For the reader who is not familiar with the term schedulability test, a schedulability test is used to validate that a given application can satisfy its specified deadlines when scheduled according to a specific scheduling algorithm[4]. For the reader who is not familiar with the term schedulabe utilization, the schedulable utilization is the maximum utilization allowed for a set of tasks that will guarantee a feasible scheduling for the task set[4]. Now we can represent the first schedulability test. Give a set of n independent, preemptable and period tasks on a uniprocessor, let U be the total utilization of this task set. A necessary and sufficient condition for feasible scheduling of this task set is Equation 1

$$U = \sum_{i=1}^{n} \frac{c_i}{p_i} \leq 1 \qquad \text{Equation 1.}$$

Using Equation 1 we can use the task characteristics from Table ?? and calculate the utilization. If the calculated utilization is greater than 1 we can conclude that the CPU should do more calculations in a time unit than possible and this jobset is not schedulable. Equation 2 contains the elaboration.

$$U = \sum_{i=1}^{5} \frac{c_i}{p_i} = \frac{90}{400} + \frac{50}{600} + \frac{30}{900} + \frac{40}{700} + \frac{100}{200} \approx 0.90 \Rightarrow 0.90 \leq 1 \qquad \text{Equation 2.}$$

Since the CPU utilization is less than 1 we can conclude that the jobset may be schedulable.

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2 SUMMARY