

Assignment 1: Part II Report

SYSC4001: Operating Systems

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GitHub Repository Link: https://github.com/rameenrahman/SYSC4001_A1

1.0 Introduction

A simulator of an interrupt system was implemented. The simulator logs CPU bursts and interrupt handling, such as kernel switching, context saving, vector lookup, and IRET. The analysis assesses how the context-save time, ISR activity time, vector sizes, and CPU burst durations influence total runtime and interrupts.

The context save time was changed from 10ms to 20ms to 30ms to see the influence of the context save time on the interrupt process. The ISR activity time was also changed to different times between 40ms and 200ms.

2.0 Background

Each input trace line has the form [<Activity>, <Value>], where Activity would either be CPU, SYSCALL, or END_IO. For example, for [CPU, n], the simulator would do a CPU burst for n ms. For SYSCALL, x and END_IO, x, the simulator would perform the interrupt sequence, which involves switching to kernel mode, saving context (10, 20, 30ms), finding the vector in the memory, loading the ISR address, ISR body activities, and IRET. The output format is <start time>, <duration>, <message> into an output file execution_txt.

Inputs: trace_txt, vector_table.txt, device_table.txt

Configurable parameters:

Context save time: 10, 20, 30 ms

ISR Activity size: 40, 80, 120, 160, 200 ms

Vector size: 2, 4

3.0 Analysis

Effect of context-save time: Increasing the context-save time increases the total interrupt overhead linearly by the number of interrupts.

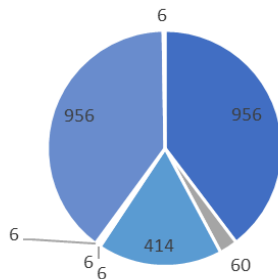
Effect of ISR activity size: Changing the activity size would only affect the level of detail in the ISR body, while the total ISR time would still remain equal, so overall runtime is unchanged.

Effect of vector entry size: Vector size only changes the computed vector address reported, and does not affect timing.

Comparing ISR Activity Size Differences

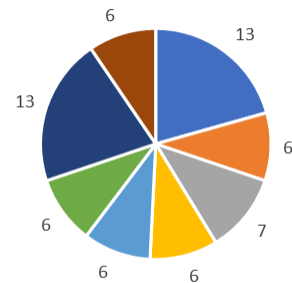
ISR Activity Size: 80 ms

Time Division - trace2.txt: SAVE = 10 ISR = 80



■ device driver ■ context saved ■ CPU burst ■ find vector
■ IRET ■ load address ■ store information ■ switch to kernel

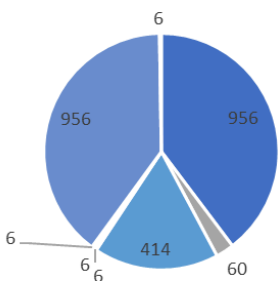
Number of Lines - trace2.txt: SAVE = 10 ISR = 80



■ device driver ■ context saved ■ CPU burst ■ find vector
■ IRET ■ load address ■ store information ■ switch to kernel

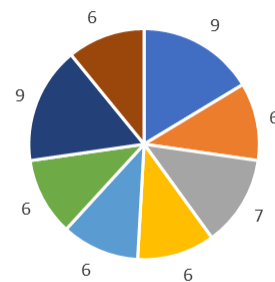
ISR Activity Size: 120 ms

Time Division: trace2.txt: SAVE = 10 ISR = 120



■ device driver ■ context saved ■ CPU burst ■ find vector
■ IRET ■ load address ■ store information ■ switch to kernel

Number of Lines: trace2.txt: SAVE = 10 ISR = 120



■ device driver ■ context saved ■ CPU burst ■ find vector
■ IRET ■ load address ■ store information ■ switch to kernel

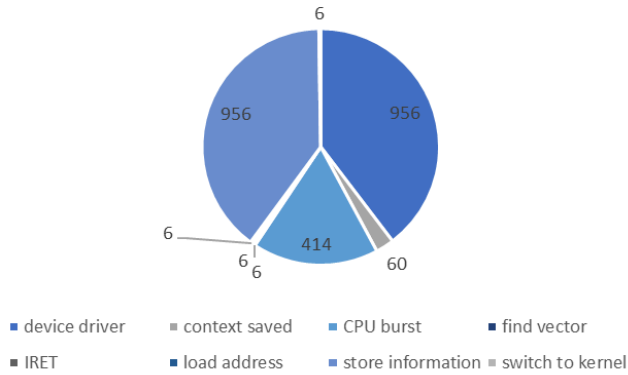
The above four graphs represent the data from an output file (trace2.txt) where the context save time (controlled variable) was set to 10 ms, and the ISR activity time (independent variable) varied; with the first row of graphs observing an activity time of 80 ms, and the second row an activity time of 120 ms. The graphs on the left show the time each activity took, while the graphs on the right show the number of lines each activity took in the output file.

When comparing these graphs, it can be observed that the only difference changing the ISR activity size made was affecting the level of detail, as mentioned earlier, in other words, the number of lines, specifically, for calling the device driver and storing information in memory: when the activity size was 80 ms, the number of lines was 13, whereas when the activity size was 120, the number of lines was 9. It makes sense that the larger the activity size, the lower the number of lines.

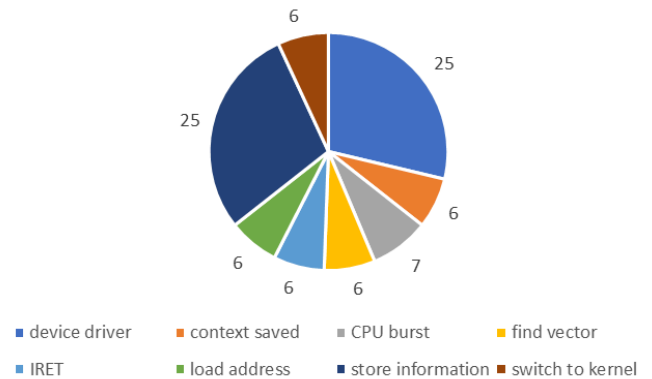
Comparing Context Save Time Differences

Context Save Time: 10 ms

Time Division: trace2.txt: SAVE = 10 ISR = 40

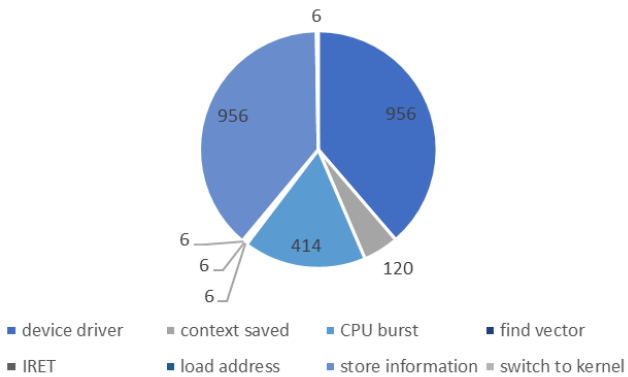


Number of Lines: trace2.txt: SAVE = 10 ISR = 40

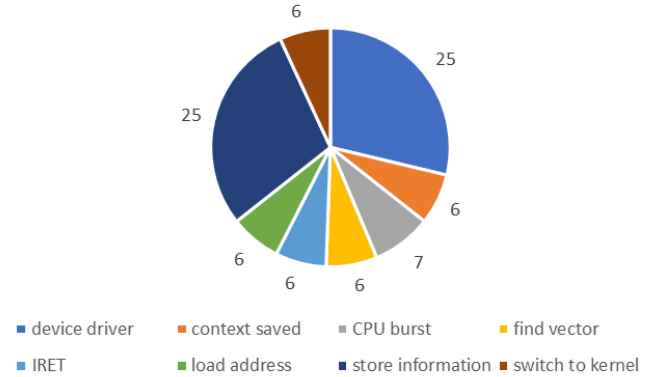


Context Save Time: 20 ms

Time Division: trace2.txt: SAVE = 20 ISR = 40



Number of Lines: trace2.txt: SAVE = 20 ISR = 40



Similarly to the previous set of four graphs, the above four graphs show the time each activity took on the left, the number of lines each activity took on the right, and a variance in an independent variable between the two rows, in this case being the context save time instead of the ISR activity size. In the above graphs, the ISR activity size (controlled variable) was set to 40 ms, while the context save time (independent variable) varied from 10 ms to 20 ms. When comparing the four graphs, it can be observed that the context save time only affected how much time it took to save context (left graphs), taking a total of 60 ms when the context save time was 10 ms and 120 ms when the context save time was 20 ms. It makes sense that the time it takes per activity of saving context, the larger the total time.