SYSC 4001 L2 - Team Submission

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06 Oct 2025

Part II – Design and Implementation of an Interrupts Simulator

Github Link: https://github.com/TASelwyn/SYSC4001 A1

The interrupt service routine time constant is the total amount of time that the processor spends handling an interrupt, executing the corresponding handler code, and resuming normal program flow. As this time constant increases, the system spends an increasing portion of its resources servicing interrupts rather than execution user-level instructions, resulting in a measurable increase in total execution time.

From running numerous simulations with various different ISR routine constants, the linear relationship between the ISR routine time constant and the total program execution time was made apparent. For each trace, increasing the ISR time constant (e.g. from 40 to 200) resulted in an increased total execution time. The proportionality holds for all tested context save time constants, although the actual value of execution time differs slightly depending on the context save overhead. This is to be anticipated, because the ISR is executed during every instance of the interrupt, and must complete first before the CPU proceeds to the main task. The longer the ISR, the longer the CPU remains in kernel mode, which prevents user processes and other interrupts. The system latency thus increases, and the total time spent by a complete interrupt cycle also grows.

1	# Trace #	# Context save time constant	# ISR routine time constant	# Total execution tim	e # CPU time	# Switch to kernel time	# Context switch time	e # Find vector time	# Load address time	# ISR tin	ne # Return interrupt time	# 10 dela	lays
1	1	ı	10	40	2770	788	10	100	10	10	400	10	1442
1	1	ı	10	70	3070	788	10	100	10	10	700	10	1442
1	1	I	10	110	3470	788	10	100	10	10	1100	10	1442
1	1	ı	10	130	3670	788	10	100	10	10	1300	10	1442
1	1	ı	10	160	3970	788	10	100	10	10	1600	10	1442
	1	ı	10	200	4370	788	10	100	10	10	2000	10	1442
1	1	ı	20	40	2870	788	10	200	10	10	400	10	1442
1	1	ı	20	70	3170	788	10	200	10	10	700	10	1442
1	1	I	20	110	3570	788	10	200	10	10	1100	10	1442
1	1	ı	20	130	3770	788	10	200	10	10	1300	10	1442
1	1	I	20	160	4070	788	10	200	10	10	1600	10	1442
1	1	ı	20	200	4470	788	10	200	10	10	2000	10	1442
1	1	I	30	40	2970	788	10	300	10	10	400	10	1442
1 1 20 130 130 280 788 10 300 10 10 300 13 3140 13 344 14 1 3 3 3 3 3 3 4 4 4 4	1	I	30	70	3270	788	10	300	10	10	700	10	1442
1	1	I	30	110	3670	788	10	300	10	10	1100	10	1442
1 30 200 4470 788 10 300 10 10 200 10 144 144 15 15 15 15 15	1	I	30	130	3870	788	10	300	10	10	1300	10	1442
1	1	I	30	160	4170	788	10	300	10	10	1600	10	1442
10	1	1	30	200	4570	788	10	300	10	10	2000	10	1442
1	2	2	10	40	1694	414	6	60	6	6	240	6	956
1	2	2	10	70	1874	414	6	60	6	6	420	6	956
1	2	2	10	110	2114	414	6	60	6	6	660	6	956
1	2	2	10	130	2234	414	6	60	6	6	780	6	956
1	2	2	10	160	2414	414	6	60	6	6	960	6	956
1	2	2	10	200	2654	414	6	60	6	6	1200	6	956
2	2	2	20	40	1754	414	6	120	6	6	240	6	956
2 20 130 2294 414 6 120 6 6 780 6 95 2 20 160 2474 414 6 120 6 6 960 6 95 2 20 20 200 274 414 6 120 6 6 120 6 95 2 30 40 1814 414 6 180 6 6 240 6 95 2 30 70 1994 414 6 180 6 6 420 6 95 2 30 130 2234 414 6 180 6 6 780 6 95 2 30 160 234 414 6 180 6 6 780 6 95 2 30 160 40 19075 3491 6 66 6 6 <td>2</td> <td>2</td> <td>20</td> <td>70</td> <td>1934</td> <td>414</td> <td>6</td> <td>120</td> <td>6</td> <td>6</td> <td>420</td> <td>6</td> <td>956</td>	2	2	20	70	1934	414	6	120	6	6	420	6	956
2 20 160 2474 414 6 120 6 6 960 6 95 2 20 20 200 2714 414 6 120 6 6 1200 6 95 2 30 40 1814 414 6 180 6 420 6 95 2 30 10 1934 414 6 180 6 420 6 95 2 30 110 2234 414 6 180 6 6 780 6 95 2 30 150 2334 414 6 180 6 6 780 6 95 2 30 150 2334 414 6 180 6 6 780 6 95 2 30 10 40 19075 3491 6 60 6 6 6 42	2	2	20	110	2174	414	6	120	6	6	660	6	956
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2 30 130 2354 414 6 180 6 6 780 6 95 2 30 160 2534 414 6 180 6 6 960 6 95 2 30 200 2774 414 6 180 6 6 1200 6 95 3 10 40 19075 3491 66 660 66 66 2640 66 1202 3 10 70 21955 3491 66 660 66 66 4620 66 1202 3 10 10 130 2595 3491 66 660 66 66 4620 66 1202 3 10 150 2695 3491 66 660 66 66 1350 66 1202 3 10 20 2963 3491 66 660 66 <td>2</td> <td>2</td> <td>30</td> <td>70</td> <td>1994</td> <td>414</td> <td>6</td> <td>180</td> <td>6</td> <td>6</td> <td>420</td> <td>6</td> <td>956</td>	2	2	30	70	1994	414	6	180	6	6	420	6	956
2 30 160 2534 414 6 180 6 6 960 6 95 2 30 200 2774 414 6 180 6 6 1200 6 95 3 10 40 19075 3491 66 660 66 66 2640 66 1202 3 10 70 21955 3491 66 660 66 66 4620 66 1202 3 10 110 23695 3491 66 660 66 66 7260 66 1202 3 10 150 25915 3491 66 660 66 66 1320 66 1202 3 10 160 2695 3491 66 660 66 1320 66 1202 3 10 20 40 1973 3491 66 660 66	2	2	30	110	2234	414	6	180	6	6	660	6	956
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	3	3	20	200	30295	3491	66	1320	66	66	13200	66	12020

# Trace #	# Context save time constant	# ISR routine time constant	# Total execution time	# CPU time	# Switch to kernel time	# Context switch time	# Find vector time	# Load address time	# ISR time	# Return interrupt time	# IO delays	
3	30	40	20395	3491	66	1980	66	66	2640	66	5 12	020
3	30	70	22375	3491	66	1980	66	66	4620	66	5 12	020
3	30	110	25015	3491	66	1980	66	66	7260	66	5 12)20
3	30	130	26335	3491	66	1980	66	66	8580	66	5 12)20
3	30	160	28315	3491	66	1980	66	66	10560	66	5 12)20
3	30	200	30955	3491	66	1980	66	66	13200	66	5 12)20
4	10	40	19318	3867	68	680	68	68	2720	68	3 11	779
4	10	70	21358	3867	68	680	68	68	4760	68	111	779
4	10	110	24078	3867	68	680	68	68	7480	68	11	779
4	10	130	25438	3867	68	680	68	68	8840	68	3 11	779
4	10	160	27478	3867	68	680	68	68	10880	68	11	779
4	10	200	30198	3867	68	680	68	68	13600	68	11	779
4	20	40	19998	3867	68	1360	68	68	2720	68	11	779
4	20	70	22038	3867	68	1360	68	68	4760	68	3 11	779
4	20	110	24758	3867	68	1360	68	68	7480	68	3 11	779
4	20	130	26118	3867	68	1360	68	68	8840	68	3 11	779
4	20	160	28158	3867	68	1360	68	68	10880	68	3 11	779
4	20	200	30878	3867	68	1360	68	68	13600	68	3 11	779
4	30	40	20678	3867	68	2040	68	68	2720	68	3 11	779
4	-		22718	3867	68	2040	68	68	4760	68	11	779
4	30		25438	3867	68	2040	68	68		68	3 11	779
4			26798	3867	68	2040	68	68		68		
4	30	160	28838	3867	68	2040	68	68		68	3 11	179
4	30	200	31558	3867	68	2040	68	68		68	3 11	779
5			21248	3958	72		72			72		
5			23408	3958	72		72	72		72		
5			26288	3958	72		72	72		72		
5	10		27728	3958	72	720	72	72		72		
5			29888	3958	72		72			72		402
5			32768	3958	72		72	72		72		402
5			21968	3958	72		72	72		72		
5	20		24128	3958	72	1440	72	72		72		
5			27008	3958	72		72	72		72		
5			28448	3958	72		72	72		72		
5			30608	3958	72		72			72		402
5	25		33488	3958	72		72	72		72		402
5			22688	3958	72		72			72		
5	30		24848	3958	72	2160	72	72		72		
5			27728	3958	72		72			72		
5	30		29168	3958	72		72	72		72		402
5			31328	3958	72		72	72		72		402
5	30	200	34208	3958	72	2160	72	72	14400	72	2 13	402

Increasing ISR time and its effects on total execution time

