SYSC 4001 L2 – Team Submission

Group 35:

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06 Oct 2025

Part II – Design and Implementation of an Interrupts Simulator

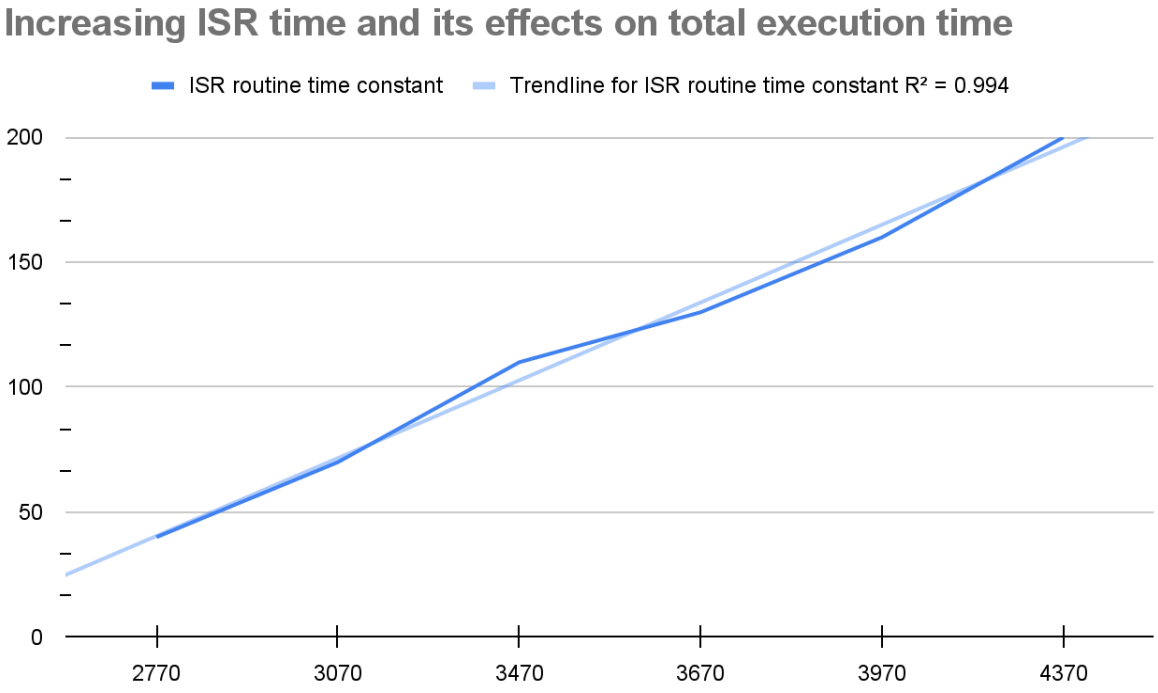
Github Link: https://github.com/TASelwyn/SYSC4001_A1

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.

# 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
1	10	40	2770	788	10	100	10	10	400	10	1442
1	10	70	3070	788	10	100	10	10	700	10	1442
1	10	110	3470	788	10	100	10	10	1100	10	1442
1	10	130	3670	788	10	100	10	10	1300	10	1442
1	10	160	3970	788	10	100	10	10	1600	10	1442
1	10	200	4370	788	10	100	10	10	2000	10	1442
1	20	40	2870	788	10	200	10	10	400	10	1442
1	20	70	3170	788	10	200	10	10	700	10	1442
1	20	110	3570	788	10	200	10	10	1100	10	1442
1	20	130	3770	788	10	200	10	10	1300	10	1442
1	20	160	4070	788	10	200	10	10	1600	10	1442
1	20	200	4470	788	10	200	10	10	2000	10	1442
1	30	40	2970	788	10	300	10	10	400	10	1442
1	30	70	3270	788	10	300	10	10	700	10	1442
1	30	110	3670	788	10	300	10	10	1100	10	1442
1	30	130	3870	788	10	300	10	10	1300	10	1442
1	30	160	4170	788	10	300	10	10	1600	10	1442
1	30	200	4570	788	10	300	10	10	2000	10	1442
2	10	40	1694	414	6	60	6	6	240	6	956
2	10	70	1874	414	6	60	6	6	420	6	956
2	10	110	2114	414	6	60	6	6	660	6	956
2	10	130	2234	414	6	60	6	6	780	6	956
2	10	160	2414	414	6	60	6	6	960	6	956
2	10	200	2654	414	6	60	6	6	1200	6	956
2	20	40	1754	414	6	120	6	6	240	6	956
2	20	70	1934	414	6	120	6	6	420	6	956
2	20	110	2174	414	6	120	6	6	660	6	956
2	20	130	2294	414	6	120	6	6	780	6	956
2	20	160	2474	414	6	120	6	6	960	6	956
2	20	200	2714	414	6	120	6	6	1200	6	956
2	30	40	1814	414	6	180	6	6	240	6	956
2	30	70	1994	414	6	180	6	6	420	6	956
2	30	110	2234	414	6	180	6	6	660	6	956
2	30	130	2354	414	6	180	6	6	780	6	956
2	30	160	2534	414	6	180	6	6	960	6	956
2	30	200	2774	414	6	180	6	6	1200	6	956
3	10	40	19075	3491	66	660	66	66	2640	66	12020
3	10	70	21055	3491	66	660	66	66	4620	66	12020
3	10	110	23695	3491	66	660	66	66	7260	66	12020
3	10	130	25015	3491	66	660	66	66	8580	66	12020
3	10	160	26995	3491	66	660	66	66	10560	66	12020
3	10	200	29635	3491	66	660	66	66	13200	66	12020
3	20	40	19735	3491	66	1320	66	66	2640	66	12020
3	20	70	21715	3491	66	1320	66	66	4620	66	12020
3	20	110	24355	3491	66	1320	66	66	7260	66	12020
3	20	130	25675	3491	66	1320	66	66	8580	66	12020
3	20	160	27655	3491	66	1320	66	66	10560	66	12020
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	12020
3	30	70	22375	3491	66	1980	66	66	4620	66	12020
3	30	110	25015	3491	66	1980	66	66	7260	66	12020
3	30	130	26335	3491	66	1980	66	66	8580	66	12020
3	30	160	28315	3491	66	1980	66	66	10560	66	12020
3	30	200	30955	3491	66	1980	66	66	13200	66	12020
4	10	40	19318	3867	68	680	68	68	2720	68	11779
4	10	70	21358	3867	68	680	68	68	4760	68	11779
4	10	110	24078	3867	68	680	68	68	7480	68	11779
4	10	130	25438	3867	68	680	68	68	8840	68	11779
4	10	160	27478	3867	68	680	68	68	10880	68	11779
4	10	200	30198	3867	68	680	68	68	13600	68	11779
4	20	40	19998	3867	68	1360	68	68	2720	68	11779
4	20	70	22038	3867	68	1360	68	68	4760	68	11779
4	20	110	24758	3867	68	1360	68	68	7480	68	11779
4	20	130	26118	3867	68	1360	68	68	8840	68	11779
4	20	160	28158	3867	68	1360	68	68	10880	68	11779
4	20	200	30878	3867	68	1360	68	68	13600	68	11779
4	30	40	20678	3867	68	2040	68	68	2720	68	11779
4	30	70	22718	3867	68	2040	68	68	4760	68	11779
4	30	110	25438	3867	68	2040	68	68	7480	68	11779
4	30	130	26798	3867	68	2040	68	68	8840	68	11779
4	30	160	28838	3867	68	2040	68	68	10880	68	11779
4	30	200	31558	3867	68	2040	68	68	13600	68	11779
5	10	40	21248	3958	72	720	72	72	2880	72	13402
5	10	70	23408	3958	72	720	72	72	5040	72	13402
5	10	110	26288	3958	72	720	72	72	7920	72	13402
5	10	130	27728	3958	72	720	72	72	9360	72	13402
5	10	160	29888	3958	72	720	72	72	11520	72	13402
5	10	200	32768	3958	72	720	72	72	14400	72	13402
5	20	40	21968	3958	72	1440	72	72	2880	72	13402
5	20	70	24128	3958	72	1440	72	72	5040	72	13402
5	20	110	27008	3958	72	1440	72	72	7920	72	13402
5	20	130	28448	3958	72	1440	72	72	9360	72	13402
5	20	160	30608	3958	72	1440	72	72	11520	72	13402
5	20	200	33488	3958	72	1440	72	72	14400	72	13402
5	30	40	22688	3958	72	2160	72	72	2880	72	13402
5	30	70	24848	3958	72	2160	72	72	5040	72	13402
5	30	110	27728	3958	72	2160	72	72	7920	72	13402
5	30	130	29168	3958	72	2160	72	72	9360	72	13402
5	30	160	31328	3958	72	2160	72	72	11520	72	13402
5	30	200	34208	3958	72	2160	72	72	14400	72	13402


Increasing ISR time and its effects on total execution time
ISR routine time constant
Trendline for ISR routine time constant R² = 0.994
200
150
100
50
0
2770
3070
3470
3670
3970
4370