SYSC4001A (L1 - 6) Assignment 1

Part 2: Design and Implementation of an Interrupts Simulator

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4 A	В	C	D	E	F	G		- I	J	K	L	M	1
	Time	1	Activity	Time if CPU	Time if IO	Time if overhead							
2	0	51	CPU Burst	51	l	0	0	Total running time:	2458				
3	51	1	switch to kernel mode	()	0	1	total running time if CPU:	190				
4	52	10	context saved	()	0	10	total running time if IO:	2216				
5	62	1	find vector 14 in memory position 0x001C	()	0	1	total running time if overhead:	52				
6	63	1	load address 0X0165 into the PC	()	0	1						
7	64	40	SYSCALL: run the ISR (device driver)	()	40	0	Percentage of usage(CPU)	8%				
8	104	40	transfer data from device to memory	()	40	0	Percentage of usage(IO)	90.15%				
9	144	376	check for errors	() 3	376	0	Percentage of usage(overhead)	2.12%				
10	520	39	CPU Burst	39	9	0	0						
11	559	1	switch to kernel mode	()	0	1						
2	560	10	context saved	()	0	10						
13	570	1	find vector 14 in memory position 0x001C	()	0	1						
14	571	1	load address 0X0165 into the PC	()	0	1						
15	572	40	END_IO: run the ISR(device driver)	()	40	0						
16	612	416	check device status	() 4	116	0						
.7	1028	72	CPU Burst	72	2	0	0						
18	1100	1	switch to kernel mode	()	0	1						
19	1101	10	context saved	()	0	10						
20	1111	1	find vector 19 in memory position 0x0026	()	0	1						
21	1112	1	load address 0X0765 into the PC	()	0	1						
22	1113	40	SYSCALL: run the ISR (device driver)	()	40	0						
23	1153	40	transfer data from device to memory	()	40	0						
24	1193	572	check for errors	() 5	572	0						
15	1765	28	CPU Burst	28	3	0	0						
6	1793	1	switch to kernel mode	()	0	1						
7	1794	10	context saved	()	0	10						
28	1804	1	find vector 19 in memory position 0x0026	()	0	1						
29	1805	1	load address 0X0765 into the PC	()	0	1						
30	1806	40	END_IO: run the ISR(device driver)	()	40	0						
31	1846	612	check device status	() 6	512	0						
32													
save/restore context swtich:	10												
ISR per activity time:	40												
5 vector number at index 19	652												
6 vector number at index 14	456												
37 38													
39													

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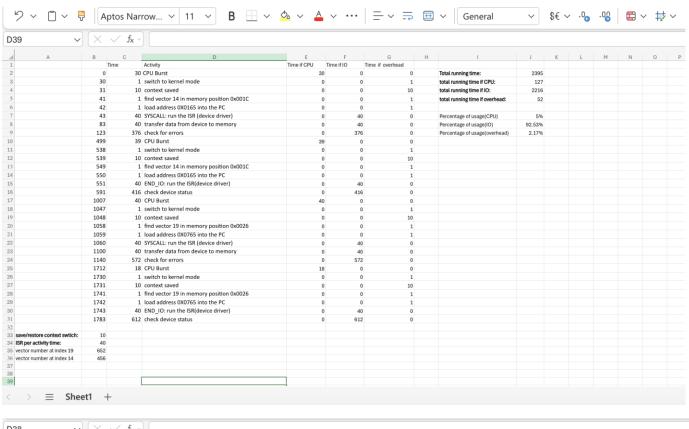
C26 ~	\times \checkmark :	f _x ~ 1									
I .											
A A	B C	Activity	E F Time if CPU Time if IO	Time	G H if overhead	I	J	K	L	М	
2	o nime	51 CPU Burst	51	0	o vernead	Total running time:	2498				
3	51	1 switch to kernel mode	0	0	1		190				
4		20 context saved	0			total running time if CPU:					
5	52			0	20	total running time if IO:	2216				
	72	1 find vector 14 in memory position 0x001C	0	0	1	total running time if overhead:	92				
6	73	1 load address 0X0165 into the PC	0	0	1						
7	74	40 SYSCALL: run the ISR (device driver)		40	0	Percentage of usage(CPU)	8%				
8	114	40 transfer data from device to memory		40	0	Percentage of usage(IO)	88.71%				
9	154	376 check for errors		376	0	Percentage of usage(overhead)	3.68%				
10	530	39 CPU Burst	39	0	0						
11	569	1 switch to kernel mode	0	0	1						
12	570	20 context saved	0	0	20						
13	590	1 find vector 14 in memory position 0x001C	0	0	1						
14	591	1 load address 0X0165 into the PC	0	0	1						
15	592	40 END_IO: run the ISR(device driver)	0	40	0						
16	632	416 check device status	0 4	116	0						
17	1048	72 CPU Burst	72	0	0						
18	1120	1 switch to kernel mode	0	0	1						
19	1121	20 context saved	0	0	20						
20	1141	1 find vector 19 in memory position 0x0026	0	0	1						
21	1142	1 load address 0X0765 into the PC	0	0	1						
22	1143	40 SYSCALL: run the ISR (device driver)	0	40	0						
23	1183	40 transfer data from device to memory	0	40	0						
24	1223	572 check for errors	0 5	572	0						
25	1795	28 CPU Burst	28	0	0						
26	1823	1 switch to kernel mode	0	0	1						
27	1824	20 context saved	0	0	20						
28	1844	1 find vector 19 in memory position 0x0026	0	0	1						
29	1845	1 load address 0X0765 into the PC	0	0	1						
30	1846	40 END_IO: run the ISR(device driver)	0	40	0						
31	1886	612 check device status		312	0						
32	2000	0.000.000.000.000									
33 save/restore context swtich:	20										
34 ISR per activity time:	40										
35 vector number at index 19	652										
36 vector number at index 14	456										
37											
38											
39											

B34 ~	X V	f _x ~	40										
_ A	В	С	D		F			Н	1	J	K	L	М
1	Time		Activity	Time if CPU	Time if IO	T	ime if overhead						
2	0	51	CPU Burst		51	0	0		Total running time:	2538			
3	51	1	switch to kernel mode		0	0	1		total running time if CPU:	190			
4	52	30	context saved		0	0	30		total running time if IO:	2216			
5	82	1	find vector 14 in memory position 0x001C		0	0	1		total running time if overhead:	132			
6	83	1	load address 0X0165 into the PC		0	0	1						
7	84	40	SYSCALL: run the ISR (device driver)		0	40	0		Percentage of usage(CPU)	7%			
8	124	40	transfer data from device to memory		0	40	0		Percentage of usage(IO)	87.31%			
9	164	376	check for errors		0	376	0		Percentage of usage(overhead)	5.20%			
10	540	39	CPU Burst		39	0	0						
11	579	1	switch to kernel mode		0	0	1						
12	580	30	context saved		0	0	30						
13	610	1	find vector 14 in memory position 0x001C		0	0	1						
14	611	1	load address 0X0165 into the PC		0	0	1						
15	612	40	END_IO: run the ISR(device driver)		0	40	0						
16	652		check device status		0	416	0						
17	1068	72	CPU Burst		72	0	0						
18	1140	1	switch to kernel mode		0	0	1						
19	1141	30	context saved		0	0	30						
20	1171		find vector 19 in memory position 0x0026		0	0	1						
21	1172		load address 0X0765 into the PC		0	0	1						
22	1173	40	SYSCALL: run the ISR (device driver)		0	40	0						
23	1213		transfer data from device to memory		0	40	0						
24	1253		check for errors		0	572	0						
25	1825		CPU Burst		28	0	0						
26	1853		switch to kernel mode		0	0	1						
27	1854		context saved		0	0	30						
28	1884		find vector 19 in memory position 0x0026		0	0	1						
29	1885		load address 0X0765 into the PC		0	0	1						
30	1886		END IO: run the ISR(device driver)		0	40	0						
31	1926		check device status		0	612	0						
32	1520	OIL	oned acree status			011	Ů						
33 save/restore context swtich:	30												
34 ISR per activity time:	40												
35 vector number at index 19	652												
36 vector number at index 14	456												
37													
38													
39													

Workbook Statistics

A	ВС		D	E	F	G	1	H I	J	K	L	М	N	0	Р
	Time	Activity		Time if CPU	Time if IO	Time if overhead									
	0	51 CPU Burst				0	0	Total running time:	2458						
	51	1 switch to kerne	l mode			0	1	total running time if CPU:	190						
1	52	10 context saved					10	total running time if IO:	2216						
5	62		n memory position 0x001C			0	1	total running time if overhead:	52						
6	63	1 load address 0				0	1								
7	64	130 SYSCALL: run th			0 13		0	Percentage of usage(CPU)	8%						
8	194		om device to memory		0 13		0	Percentage of usage(IO)	90.15%						
9	324	196 check for error	S		0 19		0	Percentage of usage(overhead)	2.12%						
0	520	39 CPU Burst				0	0								
1	559	1 switch to kerne	l mode			0	1								
2	560	10 context saved					10								
3	570		n memory position 0x001C		-	0	1								
14	571	1 load address 0			-	0	1								
15	572	130 END_IO: run th			0 13		0								
6	702	326 check device st	atus		0 32		0								
7	1028	72 CPU Burst				0	0								
8	1100	1 switch to kerne	l mode			0	1								
9	1101	10 context saved			-		10								
0)	1111		n memory position 0x0026			0	1								
1	1112	1 load address 0				0	1								
2	1113		ne ISR (device driver)		0 13		0								
13	1243		om device to memory		0 13		0								
4	1373	392 check for error	S		0 39		0								
5	1765	28 CPU Burst				0	0								
6	1793	1 switch to kerne	l mode		-	0	1								
7	1794	10 context saved			-		10								
8	1804		n memory position 0x0026			0	1								
9	1805	1 load address 0				0	1								
0	1806	130 END_IO: run th			0 13		0								
1	1936	522 check device st	atus		0 52	2	0								
32															
3 save/restore context swtich:	10 130														
4 ISR per activity time: 5 vector number at index 19	130 652														
6 vector number at index 19	456														
7	400														
8															
39															

- If we change the value of save/restore context time from 10, to 20, and to 30 (the image of excel is very similar to simulation outputs on the GitHub), the total running time of system will be increased from 2458 to 2498, and to 2538. However, the percentage of time of overhead is also increased steadily from 2.12% to 5.20%. That means that increasing save/restore context time will increase the overhead time in the system. Also, overhead time is always managed by the operating system, and they always do useless work in the process of system while OS keeps manage them.
- When we tried to increase the ISR activity time from 40 to 130, the total interrupts handling time became huge due to post-processing of interrupt. It causes some delays in the CPU execution, and it also delays further processing. Also, the time of checking errors will be decreased as there was an increase in some activities within the process of ISR. Thus, there will be limited time for hardware device to check errors before executing the next instruction via the CPU. However, when the total time of activities time is larger than delays time of device on vector table, it will delay the whole execution time and stops the process of checking the errors by hardware device.
- If we tried to vary the value of the save/restore context time from 10ms to 30ms, it will delay the overall execution time while the total time of running process is increased due to increased save/restore context time. Also, save/restore context is also a part of context switch and takes up the time of overhead in the whole process. Time of overhead is also useless in the overall execution time of the process as operating system just manages it in the whole process. On the other hand, when we tried to vary the ISR activity time from 60 ms to 130ms, the whole execution time is unchanged while it only causes some delays in activities within the process of ISR. But the whole process will delay if the total activity time within ISR is larger than time of delays in vector device time (mainly based on the preset value of ISR activity time).



A A	ВС	D	E	F	G	Н		J	K	L	М	N	0	Р
L	Time	Activity	Time if CPU	Time if IO	Time if overhead									
2	0	20 CPU Burst	20	0	0	0	Total running time:	2351						
3	20	1 switch to kernel mode		0	0	1	total running time if CPU:	83						
4	21	10 context saved	(0	0	10	total running time if IO:	2216						
5	31	1 find vector 14 in memory position 0x001C		0	0	1	total running time if overhead:	52						
6	32	1 load address 0X0165 into the PC	(D	0	1								
7	33	40 SYSCALL: run the ISR (device driver)	(0 .	10	0	Percentage of usage(CPU)	4%						
8	73	40 transfer data from device to memory		0	10	0	Percentage of usage(IO)	94.26%						
9	113	376 check for errors		0 3	76	0	Percentage of usage(overhead)	2.21%						
10	489	25 CPU Burst	25	5	0	0								
11	514	1 switch to kernel mode	(D	0	1								
12	515	10 context saved		0	0	10								
13	525	1 find vector 14 in memory position 0x001C		0	0	1								
14	526	1 load address 0X0165 into the PC	(0	0	1								
15	527	40 END_IO: run the ISR(device driver)		0	10	0								
.6	567	416 check device status	(0 4	16	0								
17	983	25 CPU Burst	25	5	0	0								
18	1008	1 switch to kernel mode	(0	0	1								
19	1009	10 context saved	(0	0	10								
20	1019	1 find vector 19 in memory position 0x0026	(0	0	1								
21	1020	1 load address 0X0765 into the PC	(D	0	1								
22	1021	40 SYSCALL: run the ISR (device driver)	(0	10	0								
23	1061	40 transfer data from device to memory	(0	10	0								
24	1101	572 check for errors	(0 5	72	0								
25	1673	13 CPU Burst	13	3	0	0								
26	1686	1 switch to kernel mode	(D	0	1								
27	1687	10 context saved	(D	0	10								
18	1697	1 find vector 19 in memory position 0x0026	(D	0	1								
29	1698	1 load address 0X0765 into the PC	(0	0	1								
10	1699	40 END_IO: run the ISR(device driver)		0	10	0								
31	1739	612 check device status	(0 6	12	0								
32														
33 save/restore context swtich:	10													
4 ISR per activity time:	40													
5 vector number at index 19	652 456													
36 vector number at index 14	456													
18														
39														

• When we have a faster CPU in the process, the whole execution time can be reduced as the CPU finished executing job earlier and other process can start earlier as well. Also, the percentage of usage of overhead time is increased when CPU in the process becomes faster (can be seen from the above two tables). That is because the process with overhead time is not related to the process of CPU execution while the process with overhead time always did something that is not useful for system functions. When the running time of overhead is unchanged, the whole execution time is reduced, and the value of percentage becomes larger.

GitHub Repository:

https://github.com/toast23/SYSC4001_A1.git