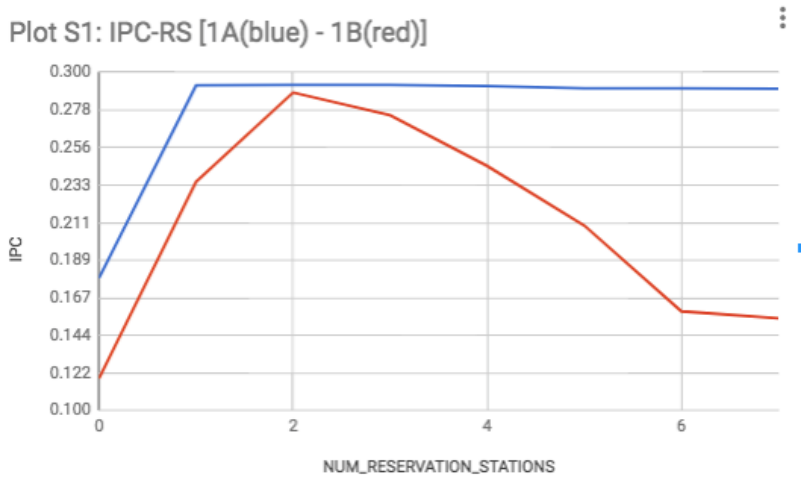
COMP 526
Mo Tang mt60

1.Plot S1

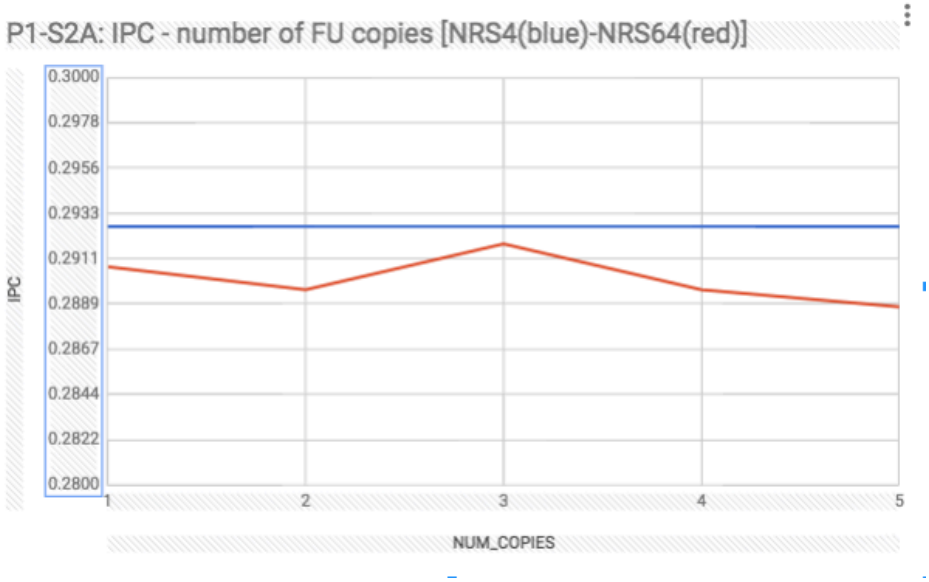
P1 - plot s1						
step 1A			LOADFP_CYCLES to 2			
RS	base-2 logarithm	Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1	0	300	1680	1681	1320	0.1784651993
2	1	300	1011	1026	651	0.2923976608
4	2	300	976	1025	615	0.2926829268
8	3	300	908	1025	541	0.2926829268
16	4	300	774	1027	392	0.2921129503
32	5	300	507	1032	98	0.2906976744
64	6	300	422	1032	0	0.2906976744
128	7	300	421	1033	0	0.2904162633
step 1B			LOADFP_CYCLES to 16			
1	0	300	2520	2521	2160	0.1190003967
2	1	300	1260	1275	900	0.2352941176
4	2	300	1010	1041	650	0.288184438
8	3	300	1007	1092	647	0.2747252747
16	4	300	1007	1226	646	0.2446982055
32	5	300	973	1432	611	0.2094972067
64	6	300	888	1890	522	0.1587301587
128	7	300	370	1940	0	0.1546391753



The Reservation stations can make the CPU to fetch and re-use a data value as soon as it is computed, instead of waiting for it to be stored in a register and re-read. Through Tomasulo's algorithm, the Reservation Station will listen on a Common Data Bus for the operand to become available, then buffers it, and begin execution of the instruction. Base on the analysis, the IPC will increase with the increasement of RS. When the cycle gets larger, obviously the IPC will decrease. When instructions are issued, they will designate the reservation station from which they want their input to read, and it gets harder when the number of Reservation stations are large, so we see a decreasement for the red curve.

2. Plot S2A

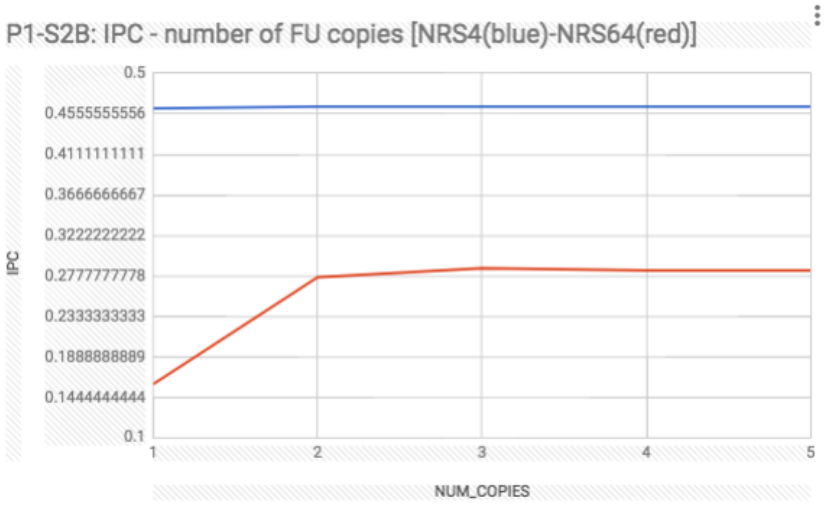
P1 plot S2A		NUM_RESERVATION_STATIONS = 4	LOADFP_CYCLES to 2			
NUM_COPIES		Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1		300	976	1025	615	0.2926829268
2		300	976	1025	615	0.2926829268
3		300	976	1025	615	0.2926829268
4		300	976	1025	615	0.2926829268
5		300	976	1025	615	0.2926829268
		NUM_RESERVATION_STATIONS = 64				
1		300	422	1032	0	0.2906976744
2		300	420	1036	0	0.2895752896
3		300	408	1028	0	0.2918287938
4		300	410	1036	0	0.2895752896
5		300	413	1039	0	0.2887391723



Each functional unit will have its own corresponding Reservation Station. The output of functional units are connected to the Common Data Bus. As said above, the Reservation Stations will listenning to the Common Data Bus when the operands are not available. In this situation, the IPC remains almost the same.

3. Plot S2B

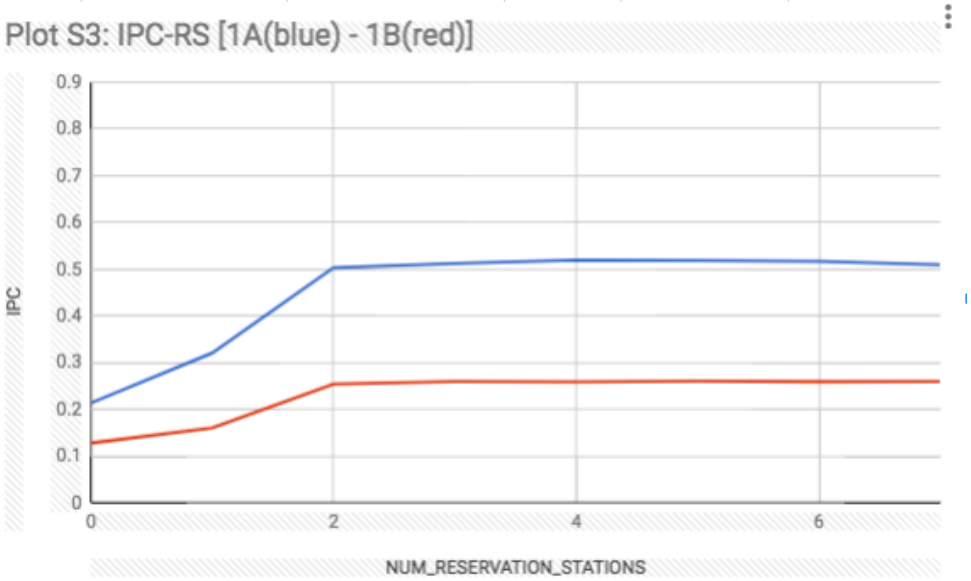
P1 plot S2B		NUM_RESERVATION_STATIONS = 4	LOADFP_CYCLES to 16			
NUM_COPIES		Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1		300	1010	1041	650	0.288184438
2		300	1007	1039	647	0.2887391723
3		300	1007	1039	647	0.2887391723
4		300	1007	1039	647	0.2887391723
5		300	1007	1039	647	0.2887391723
		NUM_RESERVATION_STATIONS = 64				
1		300	888	1890	522	0.1587301587
2		300	388	1086	0	0.2762430939
3		300	366	1049	0	0.285986654
4		300	364	1057	0	0.2838221381
5		300	364	1057	0	0.2838221381



As said above, the IPC will remains almost the same. When the LOADFP_CYCLES get larger, it takes more a time for an instruction, so the IPC will be smaller than previous situation.

4. Plot S3

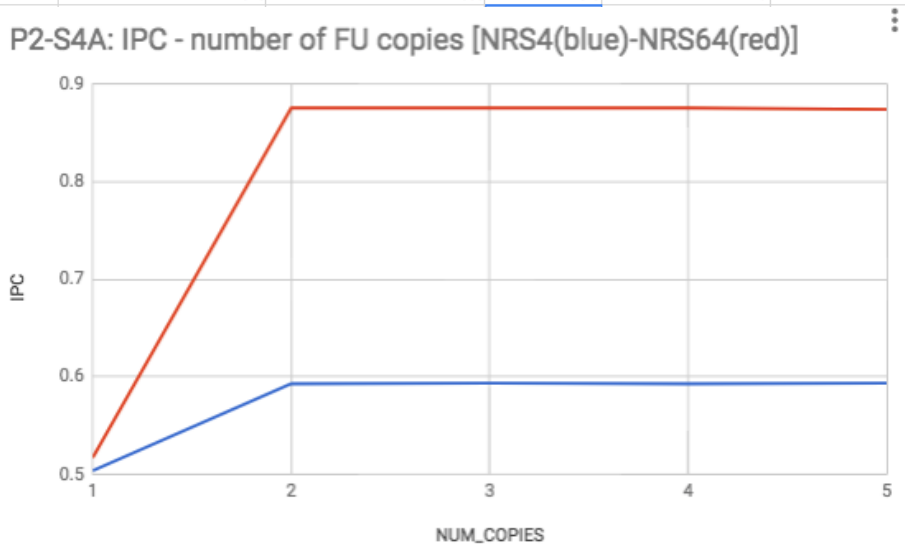
P2 - plot s3		LOADFP_CYCLES to 2				
step 1A						
RS	base-2 logarithm	Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1	0	540	2520	2521	1920	0.214200714
2	1	540	1680	1682	1080	0.3210463734
4	2	540	1054	1072	454	0.5037313433
8	3	540	1002	1053	402	0.5128205128
16	4	540	921	1039	306	0.5197305101
32	5	540	785	1041	145	0.5187319885
64	6	540	666	1044	0	0.5172413793
128	7	540	657	1060	0	0.5094339623
step 1B		LOADFP_CYCLES to 16				
1	0	540	4200	4201	3600	0.1285408236
2	1	540	3360	3362	2760	0.1606186794
4	2	540	2091	2121	1491	0.2545968883
8	3	540	2030	2078	1430	0.2598652551
16	4	540	1975	2081	1375	0.2594906295
32	5	540	1851	2070	1251	0.2608695652
64	6	540	1629	2079	1029	0.2597402597
128	7	540	1153	2073	553	0.2604920405



For program 2 , two registers are used, the blue curve is just as before. For the red curve, when the number of Reservation stations are large, the IPC wouldn't decrease as both registers will be used.

5. Plot S4A

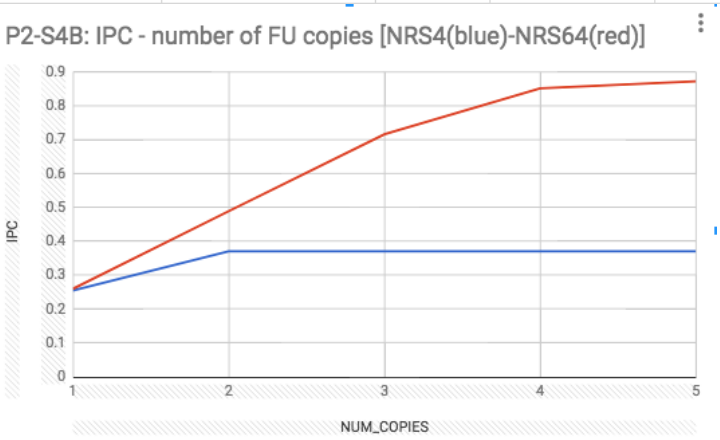
P2 plot S4A		NUM_RESERVATION_STATIONS = 4	LOADFP_CYCLES to 2			
NUM_COPIES		Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1		540	1054	1072	454	0.5037313433
2		540	898	911	298	0.5927552141
3		540	897	910	297	0.5934065934
4		540	898	911	298	0.5927552141
5		540	897	910	297	0.5934065934
		NUM_RESERVATION_STATIONS = 64				
1		540	666	1044	0	0.5172413793
2		540	600	617	0	0.8752025932
3		540	600	617	0	0.8752025932
4		540	600	617	0	0.8752025932
5		540	600	618	0	0.8737864078



As said above, the fu is related the Common Data Bus, which is the place Reservation stations listen to. For the program1, more fu won't affect the IPC because they are not utilized. But for program2 they are used and the IPC will increase. When IPC reaches its max, it will stay the same.

6. Plot S4B

P2 plot S4B		NUM_RESERVATION_STATIONS = 4	LOADFP_CYCLES to 16			
NUM_COPIES		Number Instructions Retired	times of execution completion	retirement completion	number of RSFull stall cycles	IPC
1		540	2091	2121	1491	0.2545968883
2		540	1439	1457	839	0.370624571
3		540	1439	1457	839	0.370624571
4		540	1439	1457	839	0.370624571
5		540	1439	1457	839	0.370624571
		NUM_RESERVATION_STATIONS = 64				
1		540	1629	2079	1029	0.2597402597
2		540	828	1104	228	0.4891304348
3		540	609	754	0	0.7161803714
4		540	600	634	0	0.8517350158
5		540	600	619	0	0.8723747981



In this situation, the value of IPC increases comparing with program1. The 64 Reservation stations gets larger this time because more fu are used.