NC State University

Department of Electrical and Computer Engineering

ECE 463/563 (Prof. Rotenberg)

Project #3: Dynamic Instruction Scheduling

REPORT TEMPLATE (Version 1.0)

by

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NCSU Honor Pledge: "I have neither given nor received unauthorized aid on this project."

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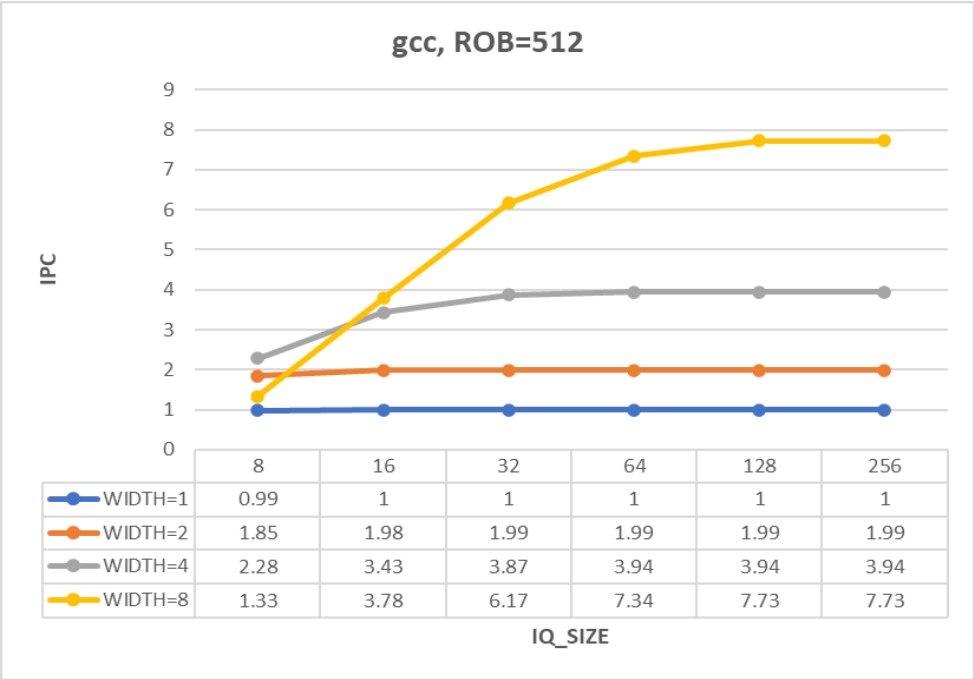
(sign by typing your name)

Course number: 563

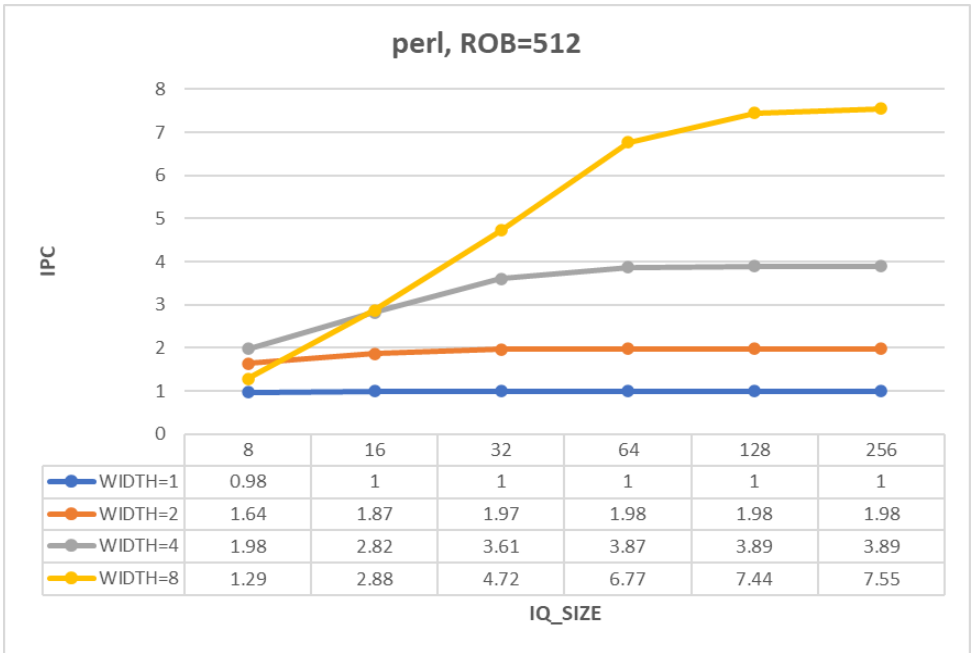
A. Large ROB, effect of IQ_SIZE

GRAPH “gcc, ROB=512”



	8	16	32	64	128	256
WIDTH=1	0.99	1	1	1	1	1
WIDTH=2	1.85	1.98	1.99	1.99	1.99	1.99
WIDTH=4	2.28	3.43	3.87	3.94	3.94	3.94
WIDTH=8	1.33	3.78	6.17	7.34	7.73	7.73

GRAPH “perl, ROB=512”



	8	16	32	64	128	256
WIDTH=1	0.98	1	1	1	1	1
WIDTH=2	1.64	1.87	1.97	1.98	1.98	1.98
WIDTH=4	1.98	2.82	3.61	3.87	3.89	3.89
WIDTH=8	1.29	2.88	4.72	6.77	7.44	7.55

1. **Graph Analysis:**

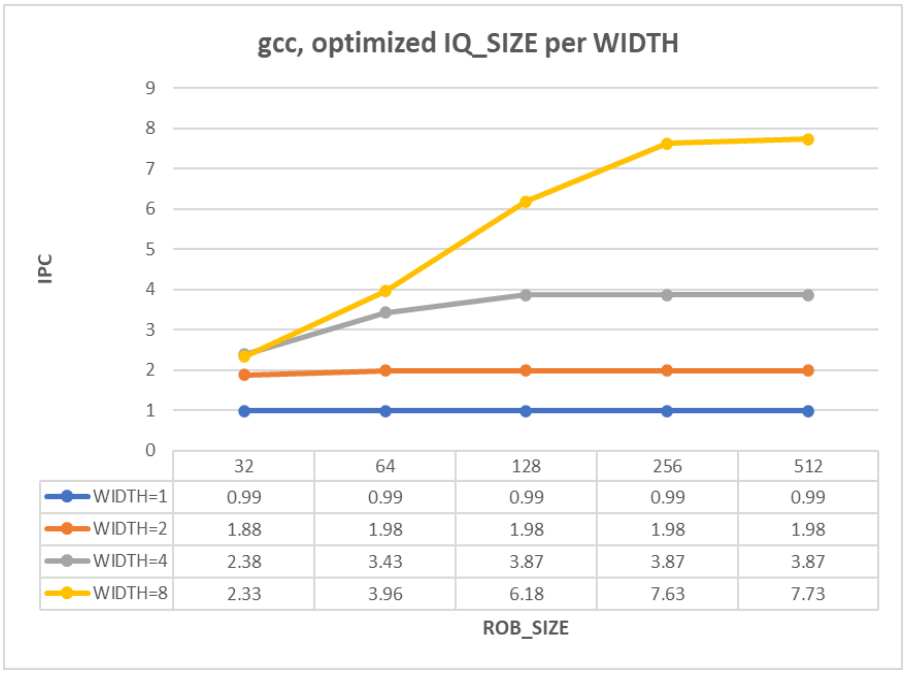
	"Optimized IQ_SIZE per WIDTH" Minimum IQ_SIZE that still achieves within 5% of the IPC of the largest IQ_SIZE	
	gcc	perl
WIDTH = 1	8	8
WIDTH = 2	16	32
WIDTH = 4	32	64
WIDTH = 8	128	128

2. **Discussion:**

   - The goal of a superscalar processor is to achieve an IPC that is close to WIDTH, which is the peak theoretical IPC of the processor. As we increase WIDTH, we observe that a larger IQ is needed to achieve this goal. This is because, with greater WIDTH, the IQ needs to look farther in the dynamic instruction stream to find more independent instructions that can issue in parallel to WIDTH execution lanes, each cycle.
   - For WIDTH=8, perl's "optimized IQ_SIZE" is equal to gcc's "optimized IQ_SIZE".
     Why might this be the case?
     a. Perhaps perl has a similar number of data-dependent instructions within a fixed window of instructions, such that it may look the same distance in the dynamic instruction stream to get the same number of independent instructions as gcc.
     b. Perhaps perl has a similar number of long-latency instructions within a fixed window of instructions as compared to gcc.
     c. All of the above: both a and b are plausible explanations.
     Answer: <c>

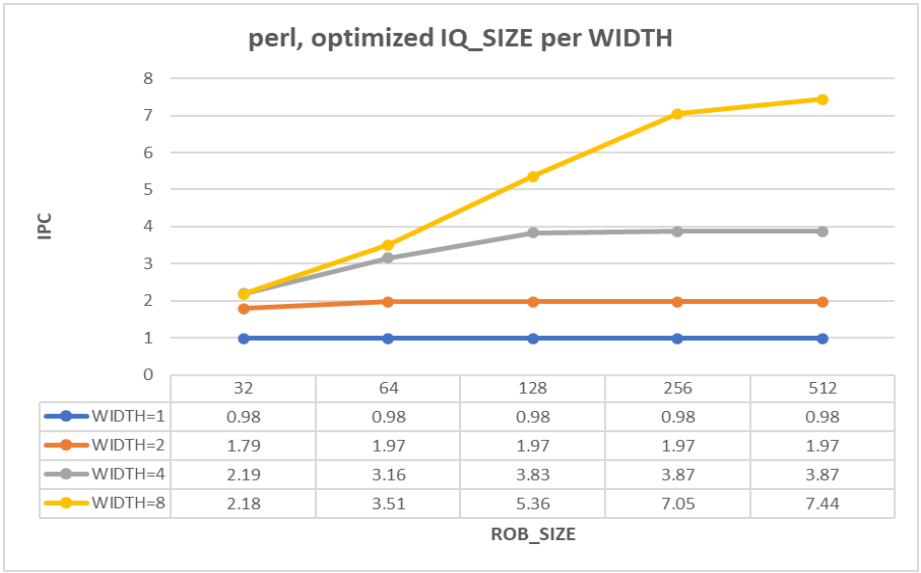
B. Effect of ROB_SIZE

GRAPH "gcc, optimized IQ_SIZE per WIDTH"



	32	64	128	256	512
WIDTH=1	0.99	0.99	0.99	0.99	0.99
WIDTH=2	1.88	1.98	1.98	1.98	1.98
WIDTH=4	2.38	3.43	3.87	3.87	3.87
WIDTH=8	2.33	3.96	6.18	7.63	7.73

GRAPH "perl, optimized IQ_SIZE per WIDTH"



	32	64	128	256	512
WIDTH=1	0.98	0.98	0.98	0.98	0.98
WIDTH=2	1.79	1.97	1.97	1.97	1.97
WIDTH=4	2.19	3.16	3.83	3.87	3.87
WIDTH=8	2.18	3.51	5.36	7.05	7.44