

## Portland State University – ECE 587/687

### Solution Key for Homework 2

a) Out of order issue (compare in-order vs. out-of-order)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
In-order	0.0800	0.1134
Out-Of-Order	0.7056	1.0000

b) Pipeline width (compare 1-wide, 2-wide, 4-wide, 6-wide, and 8-wide)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
1-wide	0.4066	0.5762
2-wide	0.5504	0.7800
4-wide	0.6569	0.9310
6-wide	0.6919	0.9806
8-wide	0.7056	1.0000

c) Pipeline length (compare lengths of 5, 10, 15, and 30)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
Pipe length = 5	0.8779	1.2442
Pipe length = 10	0.8141	1.1538
Pipe length = 15	0.7549	1.0699
Pipe length = 30	0.6215	0.8808

Note that the shallow pipelines have higher IPC but that does not necessarily translate into performance. In real machines, a shallow pipeline will have a slower clock speed than a deep pipeline.

d) Branch prediction strategies (compare always not taken, always taken, bimodal, and 2-level adaptive predictors)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
always not taken	0.2652	0.3759
always taken	0.2666	0.3778
bimodal	0.6277	0.8896
2-level adaptive	0.6108	0.8656

e) Instruction cache size (compare 4KB, 16KB, 32KB, and 64KB)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
4KB	0.3393	0.4809
16KB	0.4429	0.6277
32KB	0.5580	0.7908
64KB	0.7056	1.0000

f) Data cache size (compare 4KB, 8KB, 16KB, and 32KB, all 4-way set associative)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
4KB	0.6655	0.9432
8KB	0.6868	0.9734
16KB	0.6996	0.9915
32KB	0.7056	1.0000

g) Data cache associativity (compare 1-way, 2-way, 4-way, 8-way, all 32KB)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
1-way	0.6885	0.9758
2-way	0.7034	0.9969
4-way	0.7056	1.0000
8-way	0.7057	1.0001

h) L2 cache size (compare 128KB, 256KB, 512KB, and 1MB)

<b>Configuration</b>	<b>IPC</b>	<b>Speedup</b>
128KB	0.4967	0.7039
256KB	0.6477	0.9179
512KB	0.6986	0.9901
1MB	0.7056	1.0000