作业(3)： Memory

截至时间：2022.12.9/周五 23:59:59
提交方式：超算习堂（https://easyhpc.net/course/157）

Q1-Sol:

a. 92 + 7x4 = 120
b. 1 + 10% x (10 + 20%x120) = 1 + 0.1x(34) = 4.4
c. 1 + 10% x (10 + 20%x92) = 1 + 0.1x(28.4) = 3.84
d. 1 x 60% + 2 x 40% + 10% x (10 + 20%x120) = 1.4 + 3.4 = 4.8
e. Yes, still useful. Way prediction results in faster cache access with hit time as direct mapped instead of associative. Thus, if the access time is longer (rather than the super-fast 1cycle), then way prediction can greatly help shorten the access time.

Q2-Sol:

Configuration	A	B	C	D
Cache size	32KB	64KB	16KB	8KB
Block size	16B	128B	32B	64B
Associativity	Direct-mapped	8-way associative	16-way associative	Fully associative
Address bits used for indexing	[14:4]	[12:7]	[9:5]	/
Address bits used for tagging	[63:15]	[63:13]	[63:10]	[63:6]
total # of bits in all tag arrays	51x2K	53x512	56x512	60x128
total # of bits in all data arrays	8x32K	8x64K	8x16K	8x8K

Q3-Sol:

a. (64b/4 x 2Gb) x 4 x 4 = 64GB; (64b/8 x 4Gb) x 4 x 4 = 64GB; (64b/16 x 8Gb) x 4 x 4 = 64GB
b. 1200 MHz x 2 x 64b x 4 = 76.8 GB/s
c.

Row being accessed	Arrival time at memory controller	Open-page	Close-page
X	10ns	50ns	50ns
Y	75ns	135ns	115ns
X	150ns	210ns	190ns
X	210ns	230ns	250ns
X	250ns	270ns	290ns
Y	300ns	360ns	340ns

Q4-Sol:

a. The second-level cache is 1 MB and has a 128B block size.
b. The miss penalty of the second-level cache is approximately 105 ns.
c. The second-level cache is 8-way set associative.
d. The main memory is 512 MB.
e. Walking through pages with a 16B stride takes 946 ns per reference. With 250 such references per page, this works out to approximately 240 ms per page.