CA hw4 report

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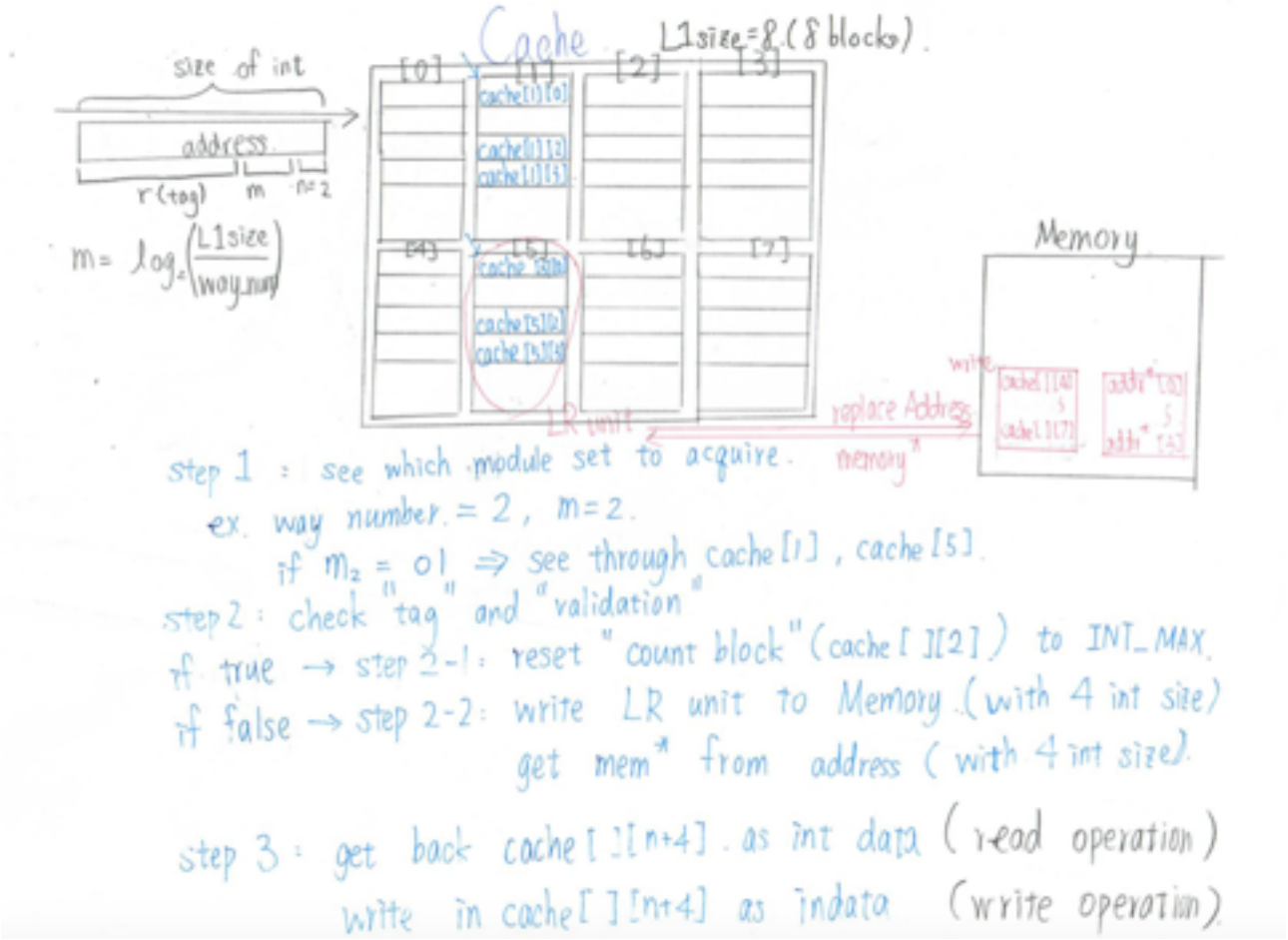
Q1: Please draw the flow chart to describe the read/write behavior of your cache. Start from address sent to cache, and end in return data. Vice versa.
A:



Q2: Please modify the test bench, and compare the hit rate and miss rate of different structure of cache (direct-mapped, 2-way, 4-way, or fully-associative).
Q2-1: Build a table of hit/miss as TABLE I/II for both quicksort and mergesort.
A:

hit /miss	direct-mapped	2-way	4-way	fully-associative
quick sort	88.99% / 10.01%	91.19% / 8.81%	91% / 9%	91% / 9%
merge sort	80.5% / 19.5%	84.99% / 15.01%	86.97% / 13.03%	86.84% / 13.16%

Q2-2: Discuss why there's difference of hit rate between different structures?
A:
一般來說，提升associativity會降低miss rate，也就是會提升hit rate，但同時也會有將地memory access的速度，以及報酬遞減(diminishing return)的現象。這是由於conflict misses常常會存在於direct map 或2-way 得結構中，但在fully associative得結構中就會被完全消除。

Q2-3: Is hit rate keeps going up as the way_number goes up, why or why not?

A:
在way number 從1提升到2或是從2提升到4的時候，hit rate都會有較明顯的進步，但是超過4之後，進步幅度就變小，而且可能會出現virtual aliasing的效應，反而會降低hit rate。

Q3: Please describe the difference between quicksort algorithm and merge sort algorithm.
Q3-1: What the computation complexity of quicksort and merge sort algorithm?
A:
quick sort 和merge sort 在best situation 跟 average situation的情況下分別都有big omega(nlogn)跟big theta(nlon)的時間複雜度，但在worst situation情況下，quick sort的時間複雜度big O(n^2)，merge sort則時O(nlogn)。而在空間複雜度上來說，merge sort 是 O(n)，quick sort 是 O(logn)。

Q3-2: Which algorithm has the higher hit rate? Why?
A:
quick sort 和 merge sort 最大的差別就是，quick sort可以以in place的形式處理序列，而merge sort需要另闢空間來儲存次序列(sub-sequence)。quick sort的locality of reference 對cache performance帶來的好處就是，我可以對memory中的同一個位置去取值(getMem)，亦即我只有在第一次存值的時候需要去memory中抓值，剩下的instructions 都可以從cache中取值即可，亦即可以提升hit rate。而merge sort 在另開新的array的時候，就需要去memory中取值，就會降低hit rate。