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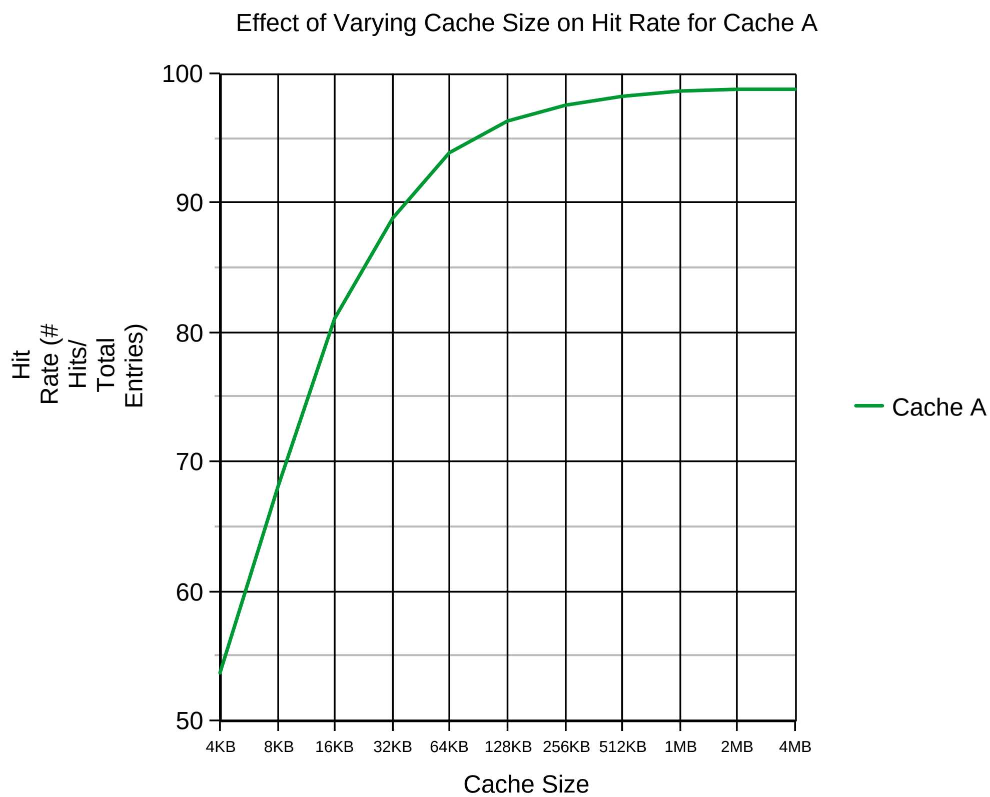
Effect of Cache Size on Hit Rate

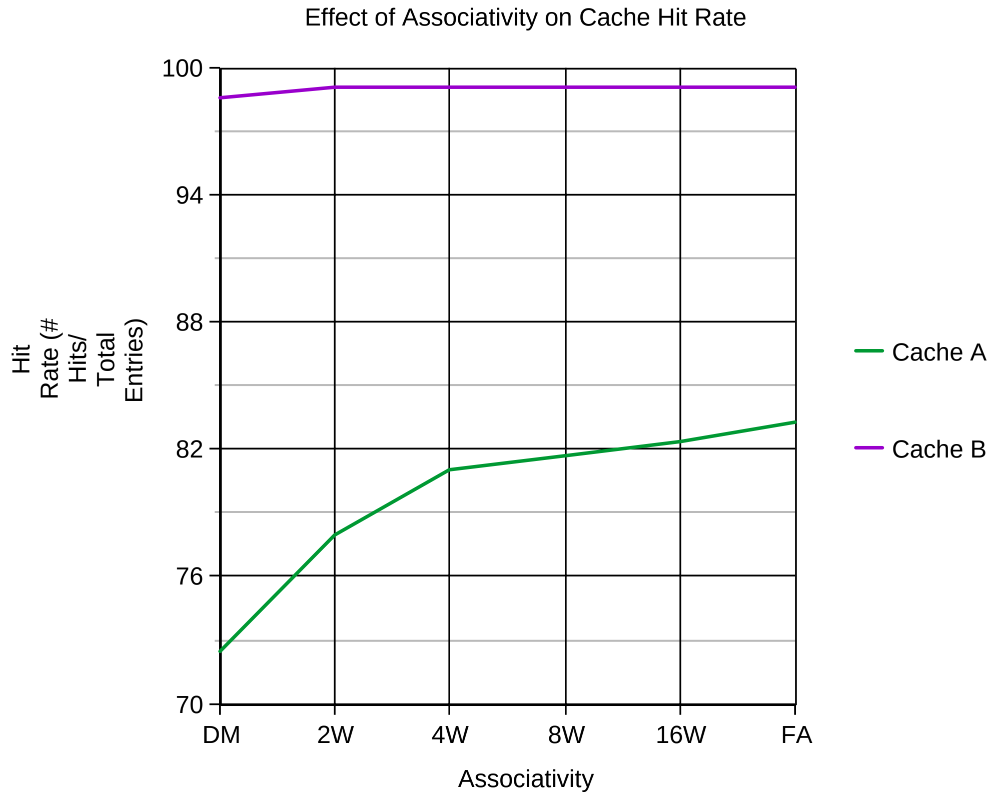


If we look at the above graph we can see that increasing the size of the cache did increase the rate of hits. From $4KB$ to around $64KB$ we see a trend of an increasing hit rate. However past this, we begin to see diminishing returns before it settles at close to a 98% hit rate. From this we can make some important observations.

First we can see that increasing the size of the cache does have the benefit of increasing the rate of hits. At some point however, the hit rate levels off, so increasing the size does not bring as great a benefit. In terms of actual hardware, it would be increasingly costly to increase size due to fact that at some point adding more memory ceases to have a noticable effect.

The effect that size had on access time was not significant the with simulator we used. However there was a very slight increase in time, as the cache size increased, meaning that at some point increasing the size would create delays in access times, which would defeat the purpose of a cache.

Effect of Associativity on Hit Rate

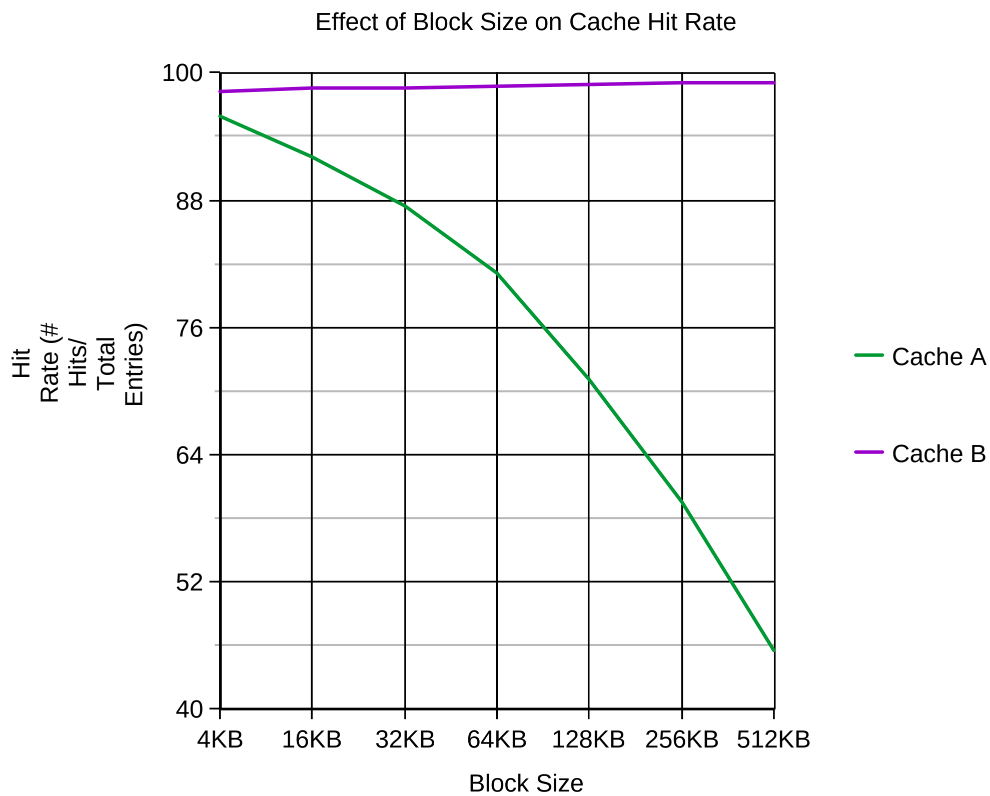


To test the effect of that associativity has on cache performance we tested two separate caches; Cache A was of size $4KB$ and cache B was of size $64KB$. We fixed the size and and block size of Cache A and B at ($16KB$, 64bytes) and ($16MB$, 512bytes) respectively.

If we look at cache A we can see a general upward trend for the hit rate as the associativity increases. There was greater growth betwee the direct mapped and 4 way associative caches, before it slowed down. However it did not show a clear stop to the growth.

If we look at cache B however, we see a much different trend. The hit rate on the larger cache begins much higher and levels of very quickly. This is probably due to the relatively few number of evictions that the larger cache would have to perform compared to the smaller cache A. From a hardware standpoint, it would make little sense to increase the associativity of a larger cache beyond 2 way associative. The effect it has on hit rate is, for all intents and purposes, non existant. The extra cost of hardware outwieghs any gain we might receive from adding the extra associativity. It makes more practical sense to increase the associativity of the smaller cache instead. We see a much more noticable growth in hit rate which may well justify the added hardware cost.

Effect of Block Size of Hit Rate



To test the effect that increasing the block size of a cache has on cache performance, we used the same caches A and B as before. This time we fixed their associativity at 4 way associative and 16 way associative respectively, and varied their block size.

In the above graph we see two very distinct trends. First we will look at cache A. Immediately we see the hit rate of the cache decrease with the increase in block size. We see that the hit rate drops by roughly 20% every time we double the block size twice. What is most likely occuring is that for a small cache such as this one, as we increase the size, a larger amount of memory is being stored in one block. So when we attempt to find it it gets lost among all the other stored data blocks, which forces the cache to go to memory to search for it.

For cache B we see that little happens as we increase the block size. The first time we double the block size, the rate increases by a small amount, but beyond that there is little change in hit rate, no matter how many times that we double it.

From a practical standpoint, we can infer that increasing the block size of a smaller size cache will only have a negative effect on the hit rate. So we should not dedicate extra hardware to increasing the block size. We can make the same conclusion about the larger cache for a different reason. The larger cache sees little improvement which could justify the cost of increasing the blocksize.