Code Runtime Results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Index Size (bits)** | **Block Size (words)** | **Associativity** | **Cashe Size** | **Branch Prediction** | **Cashe Miss Rate** | **CPI** |
| 7 | 1 | 1 | 7168 | FALSE | 0.006943 | 1.279393 |
| 6 | 2 | 1 | 5632 | FALSE | 0.004238 | 1.254102 |
| 6 | 4 | 1 | 9664 | FALSE | 0.001422 | 1.227070 |
| 6 | 1 | 2 | 7296 | FALSE | 0.005577 | 1.265978 |
| 5 | 2 | 2 | 5696 | FALSE | 0.002872 | 1.240689 |
| 5 | 4 | 2 | 9728 | FALSE | 0.001422 | 1.227070 |
| 5 | 1 | 4 | 7424 | FALSE | 0.005577 | 1.265978 |
| 4 | 2 | 4 | 5760 | FALSE | 0.002872 | 1.240689 |
| 4 | 4 | 4 | 9792 | FALSE | 0.001422 | 1.227070 |
| 7 | 1 | 1 | 7168 | TRUE | 0.006943 | 1.076080 |
| 6 | 2 | 1 | 5632 | TRUE | 0.004238 | 1.051017 |
| 6 | 4 | 1 | 9664 | TRUE | 0.001422 | 1.024171 |
| 6 | 1 | 2 | 7296 | TRUE | 0.005577 | 1.062671 |
| 5 | 2 | 2 | 5696 | TRUE | 0.002872 | 1.037608 |
| 5 | 4 | 2 | 9728 | TRUE | 0.001422 | 1.024171 |
| 5 | 1 | 4 | 7424 | TRUE | 0.005577 | 1.062671 |
| 4 | 2 | 4 | 5760 | TRUE | 0.002872 | 1.037608 |
| 4 | 4 | 4 | 9792 | TRUE | 0.001422 | 1.024171 |

There are a few key data trends that are pertinent to mention. Because of the nature of the system, as the size of the block size increases, the overall cache size increases as well. This is important to note because one can notice the trend between a larger cache size and a lower cache miss rate and CPI overall. Although one can note that a larger cache size is a downside to a system in terms of memory usage, significant performance increases can be had as a result. When looking directly at the cache size, cache miss rate, and CPI, an inverse correlation can be observed. As the cache size increases, both the cache miss rate and CPI decrease. This is an important statistic to consider because if one uses more memory for a cache, one can increase the CPI of the system by a considerable amount.

Another important aspect to consider is whether to have a pipeline with branch prediction or not. The same statistics and concepts explained above still apply when the pipeline isn’t predicting branches, but when it starts to do this, significant performance increases are exhibited. The cache miss rate isn’t exactly affected, but the overall CPI increases even further. With the same size cache, branch prediction lowers the CPI even more so. Although this has a tradeoff of having to delay the system in event of incorrect prediction, the overall benefit to the CPI is sufficient enough to incur this penalty to reap the rewards of a lower CPI.