1541 Project 1

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Notes about tables:

The tables are color coded where red is the smallest number, yellow is the middle, and green is the largest. Although slightly counterintuitive, but hopefully no less readable, this means that the best performance is in red and the worst is in green.

Data for size 64 hash table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| TRACE NAME |  | Prediction Method - 0 | Prediction Method - 1 | Percent Improvement: (Method 0 - Method 1) / Method 0 | Prediction Method - 2 | Percent Improvement: (Method 0 - Method 2) / Method 0 |
| sample.tr |  | 1625 | 1633 | -0.492307692 | 1628 | -0.184615385 |
| sample1.tr |  | 2036448 | 1930650 | 5.195222269 | 1931267 | 5.164924417 |
| sample2.tr |  | 1905766 | 1875057 | 1.611373065 | 1867550 | 2.005282915 |
| sample3.tr |  | 2115927 | 2102172 | 0.650069686 | 2088474 | 1.297445517 |
| sample4.tr |  | 6058130 | 5907871 | 2.480286821 | 5887283 | 2.820127663 |
| sample\_large1.tr |  | 179428164 | 173558171 | 3.271500343 | 171910134 | 4.189994387 |
| sample\_large2.tr |  | 194292230 | 190081856 | 2.167031589 | 189016538 | 2.715338642 |

Analysis:

The first sample, sample.tr, did not benefit much from the branch predictors despite the fact that it had a repeated loop because there were many structural hazards that forced NOPs to appear in lieu of the squashed instructions. With the branch no-ops, these hazards were avoided.

The rest of the traces experienced some level of improvement from the branch predictors, with sample1.tr receiving over a 5% increase in efficiency. The two bit predictor in most cases was more successful. The complexity of added states allows it to be more flexible with branches that flip flop more often, however in some cases performance could take a very slight hit because it will take two branches to correct a wrong prediction.

Data for different hash table sizes:

1. 1 bit prediction:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TRACE NAME | 32 bit | 64 bit | Percent Improvement: (32 bit - 64 bit) / 32 bit | 128 bit | Percent Improvement: (32 bit - 128 bit) / 32 bit |
| sample.tr | 1633 | 1633 | 0 | 1633 | 0 |
| sample4.tr | 5910725 | 5907871 | 0.048285109 | 5902270 | 0.143045058 |
| sample\_large1.tr | 173568792 | 173558171 | 0.006119188 | 172113225 | 0.83861101 |
| sample\_large2.tr | 190087976 | 190081856 | 0.003219562 | 190084482 | 0.001838096 |

1. 2 bit prediction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TRACE NAME | 32 bit | 64 bit | Percent Improvement: (32 bit - 64 bit) / 32 bit | 128 bit | Percent Improvement: (32 bit - 128 bit) / 32 bit |
| sample.tr | 1628 | 1628 | 0 | 1628 | 0 |
| sample4.tr | 5890986 | 5887283 | 0.062858747 | 5879200 | 0.200068376 |
| sample\_large1.tr | 171921878 | 171910134 | 0.00683101 | 170474636 | 0.841802112 |
| sample\_large2.tr | 189026296 | 189016538 | 0.005162245 | 189022690 | 0.001907671 |

We only tested the larges three traces because the size of the branch prediction table should only come into effect with traces with enough branches to cause table evictions. To illustrate this, we showed that the cycle numbers for the sample.tr are the same for each prediction table size. The 32 bit table was the worst in all cases, and the 128 bit table improved on the 64 bit table drastically in sample4.tr and sample\_large1.tr, but was marginally worse in sample\_large2.tr. The improvement loss could have resulted from an improbable mapping of branch addresses that caused more evictions.