

## 179.art, Ref470

### Datasets profile vs. Reference Dataset

The following are the profiles for the 179.art, ref470 benchmark. For more details about our profile development and dataset reduction methodology, refer to the paper by AJ KleinOsowski and David J. Lilja, "MinneSPEC: A New SPEC Benchmark Workload for Simulation-Based Computer Architecture Research", Computer Architecture Letters, Volume 1, June 2002. This paper is available in electronic form at <http://www.arctic.umn.edu/~lilja/minnespec/index.html>



[http:// www.arctic.umn.edu](http://www.arctic.umn.edu)

### Function level execution profile at optimization level O0

The following table contains function execution profiles and goodness-of-fit chi-squared statistic values for the train, test, and large (LgRed) reduced datasets as compared to the full SPEC reference datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. This data was gathered with the gprof profiling utility. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall execution time spent in the stated function (in the Function column). Numbers in the Train Chi, Test Chi, and LgRed Chi are the terms of the chi-squared statistic for the stated function (in the function column).

| Function          | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |
|-------------------|-------|-------|--------------|-------|-------------|-------|--------------|
| match             | 80.26 | 48.22 | 12.79        | 4.61  | 71.30       | 14.48 | 53.91        |
| train_match       | 14.33 | 39.74 | 45.06        | 86.31 | 361.56      | 68.65 | 205.91       |
| reset_nodes2      | 1.96  | 1.85  | 0.01         | 0.08  | 1.80        | 0.63  | 0.90         |
| simtest2          | 1.72  | 1.51  | 0.03         | 0.08  | 1.56        | 0.41  | 1.00         |
| weightadj         | 0.47  | 2.67  | 10.30        | 2.72  | 10.77       | 5.33  | 50.25        |
| reset_nodes       | 0.40  | 1.97  | 6.16         | 1.42  | 2.60        | 3.20  | 19.60        |
| simtest           | 0.36  | 1.69  | 4.91         | 2.21  | 9.51        | 3.42  | 26.01        |
| g                 | 0.18  | 0.87  | 2.65         | 1.16  | 5.34        | 1.63  | 11.68        |
| internal_mcount   | 0.17  | 0.64  | 1.30         | 0.94  | 3.49        | 1.85  | 16.60        |
| scan_recognize    | 0.10  | 0.55  | 2.03         | 0.03  | 0.05        | 0.09  | 0.00         |
| sqrt              | 0.01  | 0.01  | 0.00         | 0.00  | 0.01        | 0.03  | 0.04         |
| init_bu           | 0.01  | 0.01  | 0.00         | 0.11  | 1.00        | 0.03  | 0.04         |
| loadimage         | 0.01  | 0.06  | 0.25         | 0.07  | 0.36        | 0.09  | 0.64         |
| sim_other_objects | 0.01  |       | 0.01         |       | 0.01        |       | 0.01         |
| Sum               | 99.99 | 99.79 | 85.48        | 99.74 | 469.36      | 99.84 | 386.60       |
|                   | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |

90% Confidence level (14 entries) = 19.812

### Function level execution profile at optimization level O1

The following table contains function execution profiles and goodness-of-fit chi-squared statistic values for the train, test, and large (LgRed) reduced datasets as compared to the full SPEC reference datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. This data was gathered with the gprof profiling utility. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall execution time spent in the stated function (in the Function column). Numbers in the Train Chi, Test Chi, and LgRed Chi are the terms of the chi-squared statistic for the stated function (in the function column).

| Function          | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |
|-------------------|-------|-------|--------------|-------|-------------|-------|--------------|
| match             | 80.78 | 46.38 | 14.65        | 4.50  | 72.03       | 13.42 | 56.17        |
| train_match       | 14.51 | 40.04 | 44.92        | 83.23 | 325.46      | 65.43 | 178.69       |
| simtest2          | 1.57  | 1.27  | 0.06         | 0.04  | 1.49        | 0.45  | 0.80         |
| weightadj         | 0.81  | 4.12  | 13.53        | 4.50  | 16.81       | 7.13  | 49.31        |
| reset_nodes2      | 0.79  | 0.75  | 0.00         | 0.00  | 0.79        | 0.08  | 0.64         |
| g                 | 0.38  | 1.39  | 2.68         | 2.33  | 10.01       | 3.64  | 27.97        |
| simtest           | 0.37  | 1.76  | 5.22         | 2.04  | 7.54        | 3.71  | 30.15        |
| internal_mcount   | 0.35  | 1.95  | 7.31         | 2.25  | 10.31       | 3.94  | 36.82        |
| scan_recognize    | 0.19  | 0.71  | 1.42         | 0.00  | 0.19        | 0.23  | 0.01         |
| reset_nodes       | 0.15  | 1.09  | 5.89         | 0.45  | 0.60        | 1.29  | 8.66         |
| _mcount           | 0.02  | 0.11  | 0.41         |       | 0.02        | 0.15  | 0.85         |
| init_bu           | 0.02  | 0.07  | 0.13         | 0.16  | 0.98        | 0.08  | 0.18         |
| .umul             | 0.01  | 0.11  | 1.00         | 0.12  | 1.21        | 0.08  | 0.49         |
| rand              | 0.01  |       | 0.01         |       | 0.01        |       | 0.01         |
| sim_other_objects | 0.01  |       | 0.01         |       | 0.01        |       | 0.01         |
| _brk_unlocked     | 0.01  | 0.07  | 0.36         | 0.04  | 0.09        | 0.15  | 1.96         |
| Sum               | 99.98 | 99.82 | 97.60        | 99.66 | 447.55      | 99.78 | 392.72       |
|                   | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |

90% Confidence level (16 entries) = 22.307

## Function level execution profile at optimization level O2

The following table contains function execution profiles and goodness-of-fit chi-squared statistic values for the train, test, and large (LgRed) reduced datasets as compared to the full SPEC reference datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. This data was gathered with the gprof profiling utility. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall execution time spent in the stated function (in the Function column). Numbers in the Train Chi, Test Chi, and LgRed Chi are the terms of the chi-squared statistic for the stated function (in the function column).

| Function        | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |
|-----------------|-------|-------|--------------|-------|-------------|-------|--------------|
| match           | 81.56 | 47.63 | 14.12        | 4.58  | 72.66       | 13.30 | 57.13        |
| train_match     | 15.02 | 42.00 | 48.46        | 85.87 | 334.20      | 68.12 | 187.72       |
| simtest2        | 1.00  | 0.96  | 0.00         | 0.12  | 0.77        | 0.23  | 0.59         |
| weightadj       | 0.62  | 2.96  | 8.83         | 3.41  | 12.56       | 5.91  | 45.14        |
| reset_nodes2    | 0.57  | 0.56  | 0.00         | 0.00  | 0.57        | 0.08  | 0.42         |
| simtest         | 0.33  | 1.37  | 3.28         | 1.64  | 5.20        | 3.50  | 30.45        |
| internal_mcount | 0.33  | 1.89  | 7.37         | 2.07  | 9.17        | 3.97  | 40.15        |
| g               | 0.22  | 1.15  | 3.93         | 1.41  | 6.44        | 3.11  | 37.96        |
| reset_nodes     | 0.15  | 0.56  | 1.12         | 0.31  | 0.17        | 0.78  | 2.65         |
| scan_recognize  | 0.13  | 0.52  | 1.17         | 0.00  | 0.13        | 0.54  | 1.29         |
| init_bu         | 0.02  | 0.07  | 0.13         | 0.16  | 0.98        | 0.00  | 0.02         |
| _mcount         | 0.01  | 0.04  | 0.09         | 0.08  | 0.49        |       | 0.01         |
| _brk_unlocked   | 0.01  |       | 0.01         | 0.12  | 1.21        |       | 0.01         |
| .umul           | 0.01  | 0.15  | 1.96         | 0.08  | 0.49        | 0.16  | 2.25         |
| Sum             | 99.98 | 99.86 | 90.47        | 99.85 | 445.04      | 99.70 | 405.80       |
|                 | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |

90% Confidence level (14 entries) = 19.812

### **Function level execution profile at optimization level O3**

The following table contains function execution profiles and goodness-of-fit chi-squared statistic values for the train, test, and large (LgRed) reduced datasets as compared to the full SPEC reference datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. This data was gathered with the gprof profiling utility. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall execution time spent in the stated function (in the Function column). Numbers in the Train Chi, Test Chi, and LgRed Chi are the terms of the chi-squared statistic for the stated function (in the function column).

| Function          | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |
|-------------------|-------|-------|--------------|-------|-------------|-------|--------------|
| match             | 82.04 | 48.39 | 13.80        | 4.55  | 73.19       | 14.29 | 55.95        |
| train_match       | 15.21 | 43.08 | 51.07        | 88.18 | 350.07      | 73.11 | 220.41       |
| simtest2          | 0.75  | 1.08  | 0.15         | 0.04  | 0.67        | 0.08  | 0.60         |
| weightadj         | 0.68  | 3.31  | 10.17        | 4.39  | 20.24       | 7.39  | 66.21        |
| reset_nodes2      | 0.63  | 0.42  | 0.07         | 0.00  | 0.63        | 0.42  | 0.07         |
| simtest           | 0.32  | 1.73  | 6.21         | 1.56  | 4.81        | 2.61  | 16.39        |
| reset_nodes       | 0.16  | 0.58  | 1.10         | 0.37  | 0.28        | 0.59  | 1.16         |
| scan_recognize    | 0.12  | 0.77  | 3.52         | 0.04  | 0.05        | 0.42  | 0.75         |
| internal_mcount   | 0.03  | 0.23  | 1.33         | 0.16  | 0.56        | 0.25  | 1.61         |
| main              | 0.02  | 0.08  | 0.18         | 0.21  | 1.81        | 0.00  | 0.02         |
| .umul             | 0.01  | 0.12  | 1.21         | 0.16  | 2.25        | 0.42  | 16.81        |
| _brk_unlocked     | 0.01  | 0.04  | 0.09         | 0.16  | 2.25        | 0.08  | 0.49         |
| sim_other_objects | 0.01  |       | 0.01         |       | 0.01        |       | 0.01         |
| Sum               | 99.99 | 99.83 | 88.92        | 99.82 | 456.82      | 99.66 | 380.47       |
|                   | Ref   | Train | Train<br>Chi | Test  | Test<br>Chi | LgRed | LgRed<br>Chi |

90% Confidence level (13 entries) = 18.549

**Instruction Mix profile at optimization level o0**

The following table contains instruction mix breakdown and goodness-of-fit chi-squared statistic values for the train, test, and large reduced (LgRed) datasets, as compared to the full SPEC dataset. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall instructions of the stated instruction type (in the Inst Type column). Numbers in the Train Chi, Test Chi, and LgRed Chi columns are the terms of the chi-squared statistic for the stated instruction type (in the Inst Type column).

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O0 program

| Inst type            | Ref   | Train  | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |
|----------------------|-------|--------|-----------|-------|----------|--------|-----------|
| load                 | 36.84 | 36.21  | 0.01      | 36.09 | 0.02     | 36.12  | 0.01      |
| store                | 6.37  | 6.63   | 0.01      | 5.95  | 0.03     | 6.82   | 0.03      |
| unconditional branch | 3.41  | 3.10   | 0.03      | 3.32  | 0.00     | 3.09   | 0.03      |
| conditional branch   | 5.22  | 4.33   | 0.15      | 4.86  | 0.02     | 4.09   | 0.24      |
| int computation      | 43.65 | 44.43  | 0.01      | 44.72 | 0.03     | 44.14  | 0.01      |
| fp computation       | 4.50  | 5.30   | 0.14      | 5.05  | 0.07     | 5.75   | 0.35      |
| trap                 | 0.00  | 0.00   | 0.00      | 0.00  | 0.00     | 0.00   | 0.00      |
| Sum                  | 99.99 | 100.00 | 0.36      | 99.99 | 0.16     | 100.01 | 0.67      |
|                      | Ref   | Train  | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |

90% Confidence level (7 entries) = 10.645

**Instruction Mix profile at optimization level o1**

The following table contains instruction mix breakdown and goodness-of-fit chi-squared statistic values for the train, test, and large reduced (LgRed) dataset, as compared to the full SPEC dataset. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall instructions of the stated instruction type (in the Inst Type column). Numbers in the Train Chi, Test Chi, and LgRed Chi columns are the terms of the chi-squared statistic for the stated instruction type (in the Inst Type column).

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O1 program

| Inst type            | Ref    | Train  | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |
|----------------------|--------|--------|-----------|-------|----------|--------|-----------|
| load                 | 17.78  | 18.46  | 0.03      | 19.96 | 0.27     | 18.59  | 0.04      |
| store                | 5.82   | 6.63   | 0.11      | 5.81  | 0.00     | 6.54   | 0.09      |
| unconditional branch | 0.38   | 0.83   | 0.53      | 0.61  | 0.14     | 1.22   | 1.86      |
| conditional branch   | 15.97  | 13.03  | 0.54      | 14.04 | 0.23     | 12.21  | 0.89      |
| int computation      | 46.39  | 45.36  | 0.02      | 45.93 | 0.00     | 44.48  | 0.08      |
| fp computation       | 13.66  | 15.69  | 0.30      | 13.64 | 0.00     | 16.96  | 0.80      |
| trap                 | 0.00   | 0.00   | 0.00      | 0.00  | 0.00     | 0.00   | 0.00      |
| Sum                  | 100.00 | 100.00 | 1.54      | 99.99 | 0.64     | 100.00 | 3.74      |
|                      | Ref    | Train  | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |

90% Confidence level (7 entries) = 10.645

**Instruction Mix profile at optimization level o2**

The following table contains instruction mix breakdown and goodness-of-fit chi-squared statistic values for the train, test, and large reduced (LgRed) datasets, as compared to the full SPEC dataset. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall instructions of the stated instruction type (in the Inst Type column). Numbers in the Train Chi, Test Chi, and LgRed Chi columns are the terms of the chi-squared statistic for the stated instruction type (in the Inst Type column).

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O2 program

| Inst type            | Ref    | Train | Train Chi | Test  | Test Chi | Lgred | LgRed Chi |
|----------------------|--------|-------|-----------|-------|----------|-------|-----------|
| load                 | 18.80  | 20.10 | 0.09      | 21.43 | 0.37     | 20.34 | 0.13      |
| store                | 6.31   | 7.39  | 0.18      | 6.30  | 0.00     | 7.33  | 0.16      |
| unconditional branch | 0.04   | 0.21  | 0.72      | 0.23  | 0.90     | 0.45  | 4.20      |
| conditional branch   | 17.31  | 14.53 | 0.45      | 15.24 | 0.25     | 13.68 | 0.76      |
| int computation      | 42.29  | 39.58 | 0.17      | 41.55 | 0.01     | 38.24 | 0.39      |
| fp computation       | 15.26  | 18.18 | 0.56      | 15.24 | 0.00     | 19.95 | 1.44      |
| trap                 | 0.00   | 0.00  | 0.00      | 0.00  | 0.00     | 0.00  | 0.00      |
| Sum                  | 100.01 | 99.99 | 2.18      | 99.99 | 1.53     | 99.99 | 7.08      |
|                      | Ref    | Train | Train Chi | Test  | Test Chi | Lgred | LgRed Chi |

90% Confidence level (7 entries) = 10.645



**Instruction Mix profile at optimization level o3**

The following table contains instruction mix breakdown and goodness-of-fit chi-squared statistic values for the train, test, and large reduced (LgRed) datasets, as compared to the full SPEC dataset. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. \*90% Conf = Critical value of the chi-squared statistic at the 90 percent confidence level. Numbers in the Ref, Train, Test, and LgRed columns are the percent of overall instructions of the stated instruction type (in the Inst Type column). Numbers in the Train Chi, Test Chi, and LgRed Chi columns are the terms of the chi-squared statistic for the stated instruction type (in the Inst Type column).

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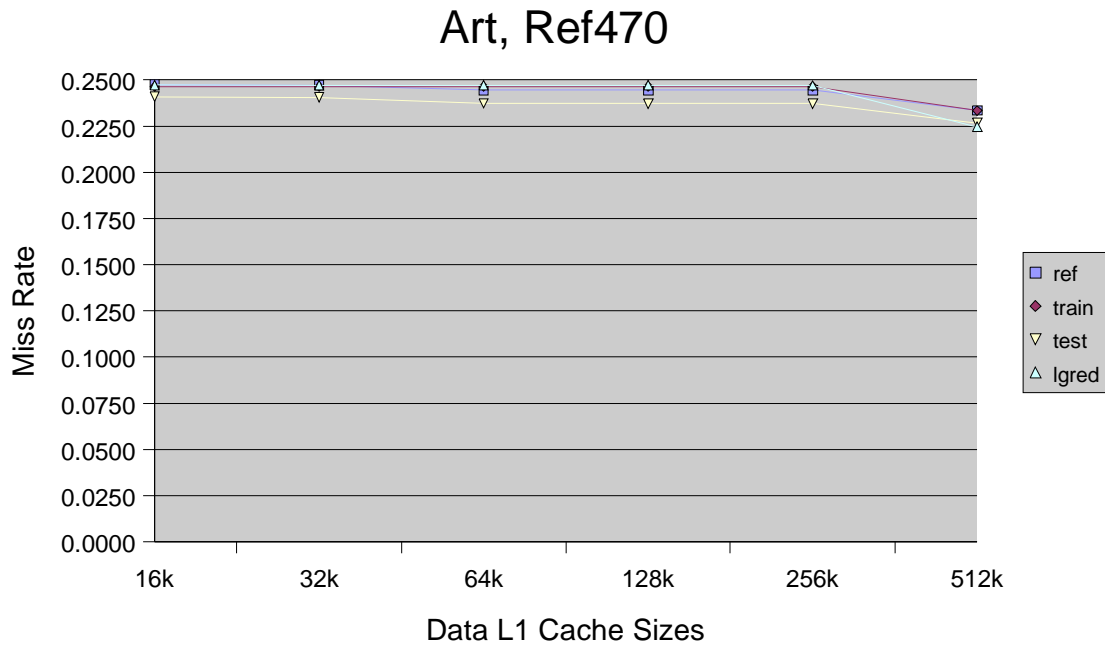
O3 program

| Inst type            | Ref   | Train | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |
|----------------------|-------|-------|-----------|-------|----------|--------|-----------|
| load                 | 18.73 | 19.73 | 0.05      | 21.04 | 0.28     | 19.51  | 0.03      |
| store                | 6.33  | 7.52  | 0.22      | 6.43  | 0.00     | 7.62   | 0.26      |
| unconditional branch | 0.00  | 0.01  | 0.00      | 0.00  | 0.00     | 0.01   | 0.00      |
| conditional branch   | 17.36 | 14.78 | 0.38      | 15.54 | 0.19     | 14.23  | 0.56      |
| int computation      | 42.27 | 39.45 | 0.19      | 41.44 | 0.02     | 37.89  | 0.45      |
| fp computation       | 15.30 | 18.50 | 0.67      | 15.54 | 0.00     | 20.74  | 1.93      |
| trap                 | 0.00  | 0.00  | 0.00      | 0.00  | 0.00     | 0.00   | 0.00      |
| Sum                  | 99.99 | 99.99 | 1.52      | 99.99 | 0.50     | 100.00 | 3.25      |
|                      | Ref   | Train | Train Chi | Test  | Test Chi | Lgred  | LgRed Chi |

90% Confidence level (7 entries) = 10.645

## Cache profile

The following chart shows level 1 data cache miss rates for the ref, train, test, and LgRed datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. This data was gathered with the sim-cache simulator from the SimpleScalar suite. Miss rate is stated as the ratio of level 1 misses to total level 1 accesses.



### ***Instruction Counts for all Datasets***

The following table shows the instruction counts and estimated simulation time for the reference (Ref), train, test, and large reduced (LgRed) datasets. Note: Medium (MdRed) and small (SmRed) reduced input sets are not available for this benchmark. Instruction counts are from the simulated benchmark, compiled at optimization level O0 and run with each input dataset. Estimated simulation times are calculated using a 45,000 instructions per second factor. This factor was determined by observing the simulation rate of a simulator similar to sim-outorder, run on a machine similar to the SPEC 2000 reference machine (a 333 Mhz Sparc).

|                                    | <u>Ref</u> | <u>Train</u> | <u>Test</u> | <u>LgRed</u> |
|------------------------------------|------------|--------------|-------------|--------------|
| Instruction Count<br>(in millions) | 200764     | 17434        | 15763       | 7741         |
| Simulation Time<br>(in hours)      | 1239.3     | 107.6        | 97.3        | 47.8         |