**CHI CHIEH WENG**

# OpenCL Array Multiply, Multiply–Add, and Multiply–Reduce

**Array Multiply**

| | | | | Local Work Size | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 16 | 32 | 64 | 128 | 256 | 512 |
| 1024 | 0.021 | 0.023 | 0.023 | 0.023 | 0.022 | 0.018 | 0.024 |
| 2048 | 0.046 | 0.036 | 0.046 | 0.046 | 0.044 | 0.045 | 0.045 |
| 4096 | 0.092 | 0.07 | 0.093 | 0.092 | 0.091 | 0.092 | 0.089 |
| 8192 | 0.115 | 0.176 | 0.184 | 0.188 | 0.184 | 0.148 | 0.182 |
| 16384 | 0.342 | 0.355 | 0.281 | 0.375 | 0.365 | 0.292 | 0.374 |
| 32768 | 0.651 | 0.704 | 0.701 | 0.569 | 0.571 | 0.564 | 0.716 |
| 65536 | 1.105 | 1.27 | 1.35 | 1.359 | 1.415 | 1.111 | 1.453 |
| 131072 | 1.834 | 2.047 | 2.293 | 2.186 | 2.799 | 2.879 | 2.878 |
| 262144 | 1.116 | 1.28 | 1.354 | 1.411 | 1.424 | 1.079 | 1.437 |
| 524288 | 1.837 | 1.741 | 2.039 | 2.718 | 2.809 | 2.849 | 2.873 |
| 1048576 | 2.653 | 3.556 | 4.317 | 5.062 | 5.338 | 5.065 | 5.361 |
| 2097152 | 3.372 | 5.094 | 6.91 | 6.927 | 9.509 | 9.394 | 8.862 |
| 4194304 | 3.629 | 6.375 | 9.24 | 7.707 | 13.373 | 14.652 | 11.998 |
| 8388608 | 4.175 | 7.384 | 11.93 | 16.997 | 21.145 | 20.007 | 21.188 |

*(Row labels on the left are under "Global Dataset Size")*



Performance vs. Global Dataset Size and Local Work Size

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Performance vs. Local Work Size and Global Dataset Size
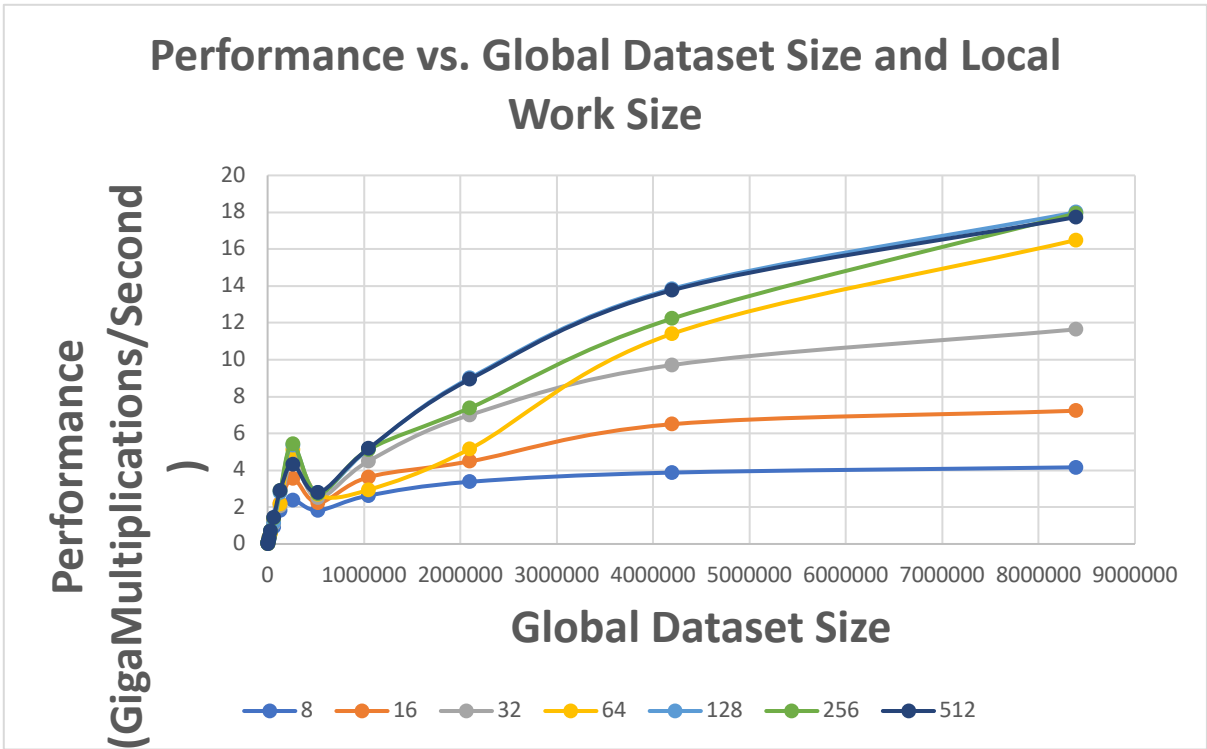


Performance vs. Local Work Size and Global Dataset Size
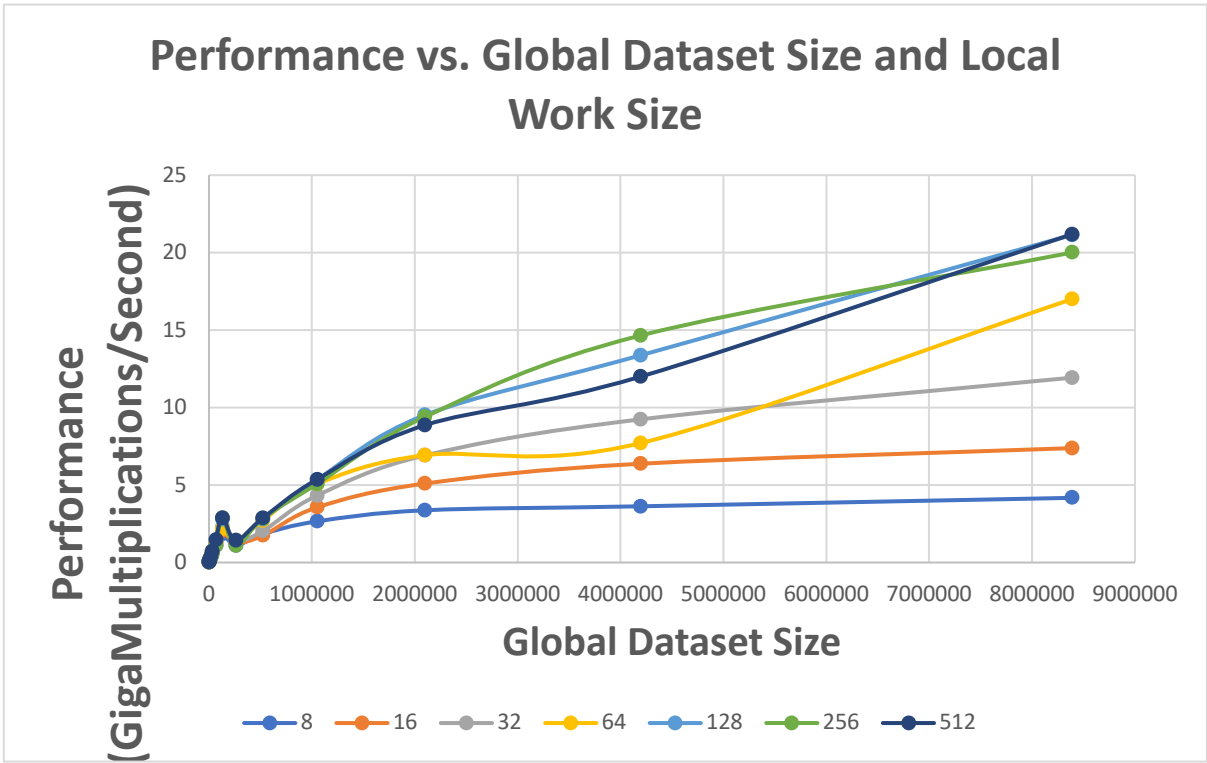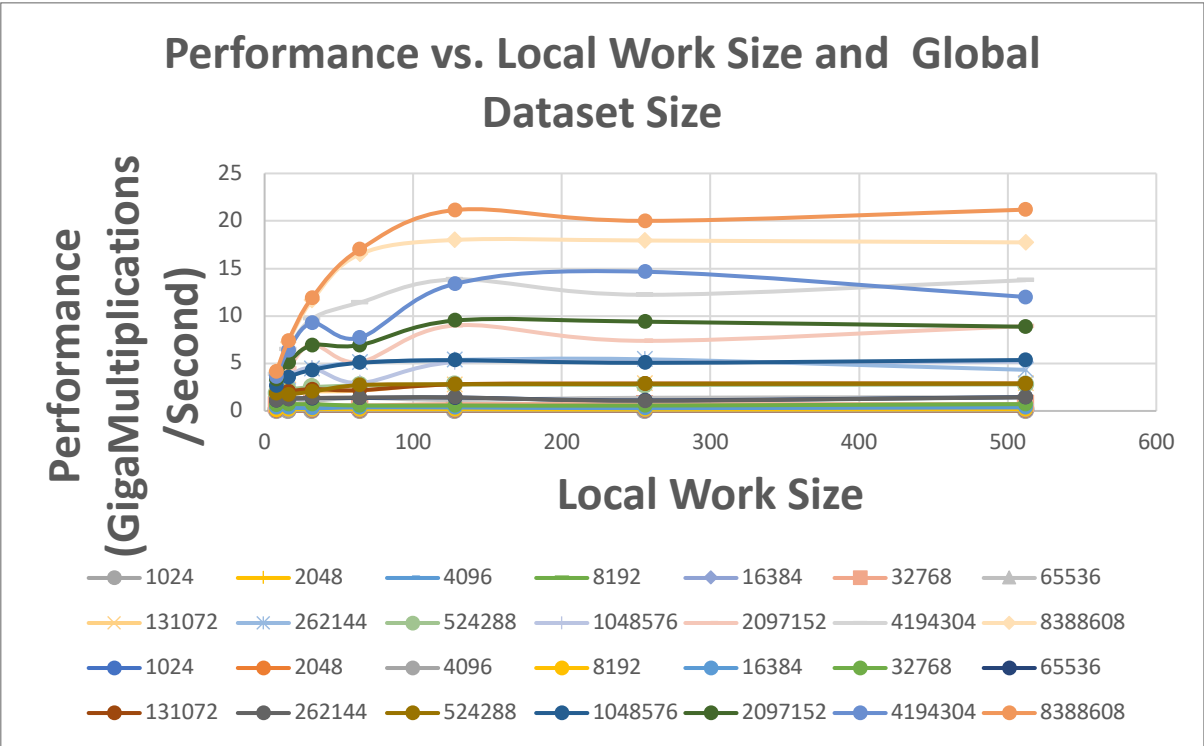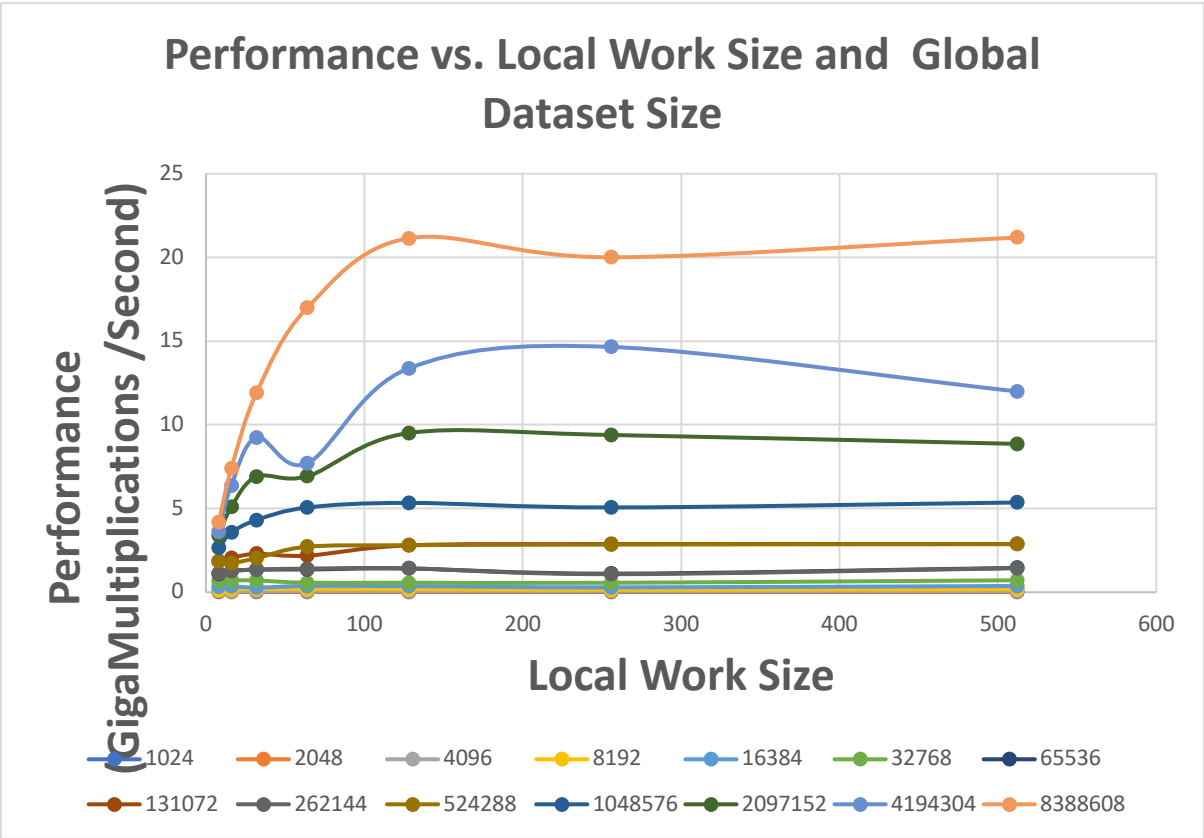
**Max Performance:** 21.188 GigaMultiplications/Second with Global Dataset Size of 8,388,608 and Local Work Size of 512

**Array Multiply – Add**

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| | | | Local Work Size | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 16 | 32 | 64 | 128 | 256 | 512 |
| 1024 | 0.021 | 0.023 | 0.023 | 0.023 | 0.023 | 0.018 | 0.023 |
| 2048 | 0.035 | 0.044 | 0.044 | 0.035 | 0.035 | 0.044 | 0.035 |
| 4096 | 0.09 | 0.088 | 0.09 | 0.092 | 0.089 | 0.089 | 0.091 |
| 8192 | 0.173 | 0.179 | 0.178 | 0.18 | 0.178 | 0.177 | 0.177 |
| 16384 | 0.338 | 0.351 | 0.298 | 0.362 | 0.289 | 0.364 | 0.368 |
| 32768 | 0.638 | 0.669 | 0.68 | 0.573 | 0.713 | 0.707 | 0.715 |
| 65536 | 0.925 | 1.259 | 1.083 | 1.371 | 1.158 | 1.388 | 1.442 |
| 131072 | 1.804 | 2.206 | 2.076 | 2.146 | 2.8 | 2.877 | 2.902 |
| 262144 | 2.383 | 3.57 | 4.484 | 5.105 | 5.367 | 5.436 | 4.327 |
| 524288 | 1.829 | 2.242 | 2.499 | 2.682 | 2.785 | 2.731 | 2.789 |
| 1048576 | 2.627 | 3.629 | 4.501 | 2.94 | 5.15 | 5.121 | 5.185 |
| 2097152 | 3.373 | 4.481 | 6.996 | 5.154 | 8.997 | 7.378 | 8.933 |
| 4194304 | 3.873 | 6.498 | 9.707 | 11.399 | 13.838 | 12.225 | 13.763 |
| 8388608 | 4.159 | 7.229 | 11.644 | 16.494 | 17.999 | 17.939 | 17.74 |

*Global Dataset Size (row labels at left)*



Performance vs. Global Dataset Size and Local Work Size

**Max Performance:** 17.999 GigaMultiplications/Second with Global Dataset Size of 8,388,608 and Local Work Size of 128

**Multiply+Reduce application**

| Global Dataset Size | Local Work Size | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | 8 | 16 | 32 | 64 | 128 | 256 | 512 |
| 1024 | 0.022 | 0.023 | 0.018 | 0.022 | 0.022 | 0.018 | 0.022 |
| 2048 | 0.044 | 0.041 | 0.045 | 0.045 | 0.046 | 0.044 | 0.045 |
| 4096 | 0.087 | 0.088 | 0.09 | 0.07 | 0.089 | 0.09 | 0.089 |
| 8192 | 0.172 | 0.177 | 0.182 | 0.139 | 0.176 | 0.178 | 0.18 |
| 16384 | 0.331 | 0.355 | 0.343 | 0.297 | 0.306 | 0.286 | 0.357 |
| 32768 | 0.488 | 0.686 | 0.717 | 0.704 | 0.574 | 0.702 | 0.733 |
| 65536 | 1.114 | 1.21 | 1.329 | 1.358 | 1.414 | 1.108 | 1.137 |
| 131072 | 1.751 | 2.154 | 2.491 | 2.627 | 2.805 | 2.847 | 2.708 |
| 262144 | 0.871 | 1.241 | 1.351 | 1.375 | 1.431 | 1.427 | 1.387 |
| 524288 | 1.819 | 2.253 | 2.52 | 2.685 | 2.634 | 2.81 | 1.35 |
| 1048576 | 2.653 | 3.656 | 4.286 | 5.067 | 4.212 | 5.287 | 4.196 |
| 2097152 | 3.376 | 4.574 | 6.22 | 8.607 | 9.063 | 7.758 | 9.526 |
| 4194304 | 3.815 | 6.331 | 9.619 | 12.406 | 14.764 | 14.858 | 14.802 |
| 8388608 | 4 | 7.354 | 11.821 | 17.058 | 20.784 | 21.165 | 19.003 |



Performance vs. Global Dataset Size and Local Work Size

Performance vs. Local Work Size and Global Dataset Size