

Table 1 summarizes the information regarding to the execution of all the compilation profiles for each program, namely the minimum, maximum, percentage difference and average values obtained for each program.

| Program            | Time (s)                            | Energy (J)                             | CPU (J)                                | Memory (J)                          | Energy/Time (J/s)                   |
|--------------------|-------------------------------------|--|--|-------------------------------------|-------------------------------------|
| binary-trees       | 3.355-7.214<br>53.5 %<br>(5.186)    | 40.843-78.631<br>48.1 %<br>(58.844)    | 37.606-72.630<br>48.2 %<br>(54.286)    | 3.231-6.029<br>46.4 %<br>(4.558)    | 10.860-12.264<br>11.4 %<br>(11.576) |
| chameneos-redux    | 7.706-9.112<br>15.4 %<br>(8.358)    | 154.74-184.101<br>15.9 %<br>(166.098)  | 149.475-178.231<br>16.1 %<br>(160.478) | 5.172-6.156<br>16.0 %<br>(5.620)    | 18.724-21.397<br>12.5 %<br>(19.888) |
| fannkuch-redux     | 21.918-58.501<br>62.5 %<br>(40.537) | 232.244-658.129<br>64.7 %<br>(443.155) | 217.685-619.299<br>64.8 %<br>(416.238) | 14.553-38.874<br>62.6 %<br>(26.917) | 10.273-11.293<br>9.0 %<br>(10.768)  |
| fasta              | 6.101-10.848<br>43.8 %<br>(8.439)   | 17.86-66.781<br>73.3 %<br>(41.991)     | 13.612-59.476<br>77.1 %<br>(36.190)    | 4.248-7.305<br>41.8 %<br>(5.801)    | 2.892-6.184<br>53.2 %<br>(4.622)    |
| k-nucleotide       | 7.113-22.755<br>68.7 %<br>(14.434)  | 81.043-245.822<br>67.0 %<br>(159.531)  | 75.857-230.399<br>67.1 %<br>(149.443)  | 5.186-15.641<br>66.8 %<br>(10.087)  | 10.744-11.730<br>8.4 %<br>(11.241)  |
| mandelbrot         | 4.624-26.755<br>82.7 %<br>(15.639)  | 42.022-320.07<br>86.9 %<br>(184.416)   | 38.910-302.269<br>87.1 %<br>(173.991)  | 3.111-17.806<br>82.5 %<br>(10.425)  | 9.086-11.967<br>24.1 %<br>(11.525)  |
| meteor             | 0.046-0.089<br>48.3 %<br>(0.068)    | 0.425-0.934<br>54.5 %<br>(0.683)       | 0.393-0.874<br>55.0 %<br>(0.637)       | 0.032-0.060<br>46.7 %<br>(0.046)    | 9.239-10.678<br>13.5 %<br>(9.967)   |
| n-body             | 3.473-25.390<br>86.3 %<br>(14.308)  | 40.966-307.182<br>86.7 %<br>(172.280)  | 38.658-290.323<br>86.7 %<br>(162.779)  | 2.307-16.859<br>86.3 %<br>(9.501)   | 11.781-12.455<br>5.4 %<br>(12.103)  |
| regex-redux        | 13.781-14.485<br>4.9 %<br>(13.872)  | 138.577-147.229<br>5.9 %<br>(140.309)  | 127.337-135.470<br>6.0 %<br>(129.019)  | 11.223-11.759<br>4.6 %<br>(11.290)  | 10.041-10.201<br>1.6 %<br>(10.114)  |
| reverse-complement | 9.941-12.537<br>20.7 %<br>(11.826)  | 15.994-24.825<br>35.6 %<br>(20.479)    | 8.366-15.736<br>46.8 %<br>(11.812)     | 7.628-9.180<br>16.9 %<br>(8.667)    | 1.423-2.224<br>36.0 %<br>(1.729)    |
| spectral-norm      | 2.438-7.156<br>65.9 %<br>(4.734)    | 21.504-86.862<br>75.2 %<br>(52.589)    | 19.884-82.113<br>75.8 %<br>(49.444)    | 1.620-4.752<br>65.9 %<br>(3.144)    | 8.817-12.149<br>27.4 %<br>(10.392)  |
| thread-ring        | 9.307-9.786<br>4.9 %<br>(9.555)     | 89.245-93.161<br>4.2 %<br>(91.362)     | 81.511-84.919<br>4.0 %<br>(83.328)     | 7.525-8.520<br>11.7 %<br>(8.034)    | 9.361-9.677<br>3.3 %<br>(9.562)     |

Table 1: Measurement results for all programs.

Considering less rigorously the results obtained by the tools for all programs, the following rankings result:

Time Ranking:

1. *Sphere Engine*;

2. *GPS;*
3. *CMake, CLion, KDevelop;*
4. *qmake, Qt Creator;*
5. *Eclipse CDT, Zinjal, CodeLite;*
6. *Qbs, DialogBlocks, NetBeans IDE, Oracle Developer Studio;*
7. *Anjuta DevStudio;*
8. *Code::Blocks, Geany, AWS Cloud9.*

#### Energy Ranking:

1. *Sphere Engine;*
2. *GPS;*
3. *CMake, CLion, KDevelop, qmake;*
4. *Qt Creator;*
5. *Eclipse CDT;*
6. *Qbs, DialogBlocks, NetBeans IDE, Oracle Developer Studio, Zinjal, CodeLite;*
7. *Anjuta DevStudio;*
8. *Code::Blocks, Geany, AWS Cloud9.*

#### Time and Energy Ranking:

1. *Sphere Engine;*
2. *GPS;*
3. *CMake, CLion, KDevelop, qmake;*
4. *Qt Creator;*
5. *Qbs, Eclipse CDT, Zinjal, CodeLite, DialogBlocks, NetBeans IDE, Oracle Developer Studio;*
6. *Anjuta DevStudio;*
7. *Code::Blocks, Geany, AWS Cloud9.*

By following the same approach for profiles, the following rankings for execution time, energy consumption, and both, are obtained:

#### Time Ranking:

1. 23, 25;
2. 24;

3. 16;
4. 22;
5. 17, 15;
6. 18, 19, 20, 14;
7. 21;
8. 13;
9. 26;
10. 5, 10, 6, 12, 9, 1, 8, 4, 7, 11, 3, 2;

#### Energy Ranking:

1. 23, 25, 24;
2. 16, 17, 14, 19;
3. 22, 15, 21, 18, 20;
4. 13;
5. 26;
6. 9, 11;
7. 7, 3, 8, 4, 10, 12, 1, 2, 6, 5;

#### Time and Energy Ranking:

1. 23, 24, 25;
2. 16;
3. 17, 14, 22, 19, 15;
4. 18, 20, 21;
5. 13;
6. 26;
7. 9, 8, 10, 11, 7, 3;
8. 1, 4, 5, 12, 2, 6;

Table 2 shows the respective mean values obtained for the different strands considering all programs analyzed. It is also indicated the percent difference compared to the default level (-Oo).

| Optimization Level | Time (s)       | Energy (J)      | CPU (J)        | Memory (J)     | Energy/Time (J/s) |
|--------------------|----------------|-----------------|----------------|----------------|-------------------|
| O <sub>0</sub>     | 16.862         | 181.611         | 169.872        | 11.739         | 10.582            |
| O <sub>1</sub>     | 8.689<br>48.5% | 85.511<br>52.9% | 79.195<br>53.4 | 6.316<br>46.2% | 10.212<br>3.5%    |
| O <sub>2</sub>     | 8.415<br>50.1% | 82.182<br>54.7% | 76.063<br>55.2 | 6.119<br>47.9% | 10.032<br>5.2%    |
| O <sub>3</sub>     | 7.644<br>54.7% | 74.058<br>59.2% | 68.485<br>59.7 | 5.573<br>52.5% | 9.872<br>6.7%     |
| O <sub>s</sub>     | 9.408<br>44.2% | 93.879<br>48.3% | 87.061<br>48.7 | 6.818<br>41.9% | 10.315<br>2.5%    |

Table 2: Optimization levels results.