WaveScript Benchmarks Performance Report

October 28, 2008

Machine information:
Linux chastity 2.6.22-14-generic #1 SMP Tue Feb 12 07:42:25 UTC 2008 i686 GNU/Linux

WaveScript SVN:
Revision: 3617

WaveScope Engine SVN:
(omitted for now)

1 Microbenchmarks

This section reports various microbenchmarks that stress the implementation of particular language constructs or data types.
Per-stream-element overheads

One thing that you can see, is that currently (2007.10) the C++/XStream engine has a high per-tuple (that is, per-element) on the communication channels relative to the ML backend. The `just_timer` test stresses this, doing nothing but passing a large number of unit tuples.

Focusing on scheduling overheads a bit more, we turn to the following data passing microbenchmarks. These do nothing but generate a stream of numbers, and then add up windows of those numbers. We vary the window size in the following graphs. The numbers are passed either one at a time (“raw”), or in bulk using arrays or lists.

Notes:
FFT results for Scheme above depend on whether or not it is configured to use FFTW, or a native Scheme fourier transform.

2 Language Shootout Benchmarks

This is where I will accumulate some of the small benchmarks from the language shootout. Here are some per-benchmark comments:

- **fannkuch** - “pancake flipping”. This is a translation of the gcc version of the benchmark. Tests indexed access to a small array.

3 Application Benchmarks

This section includes performance results on larger programs, namely, our current applications.

3.1 Marmot Application

We start off by looking at the original, hand-optimized marmot application that we deployed. We break it down by phase: the first three phases of the computation, followed by all three together.
3.2 Computer Vision: Background Subtraction

4 Data Representation Profiling

This is stale data for now... having sneaky problems with the datarep Makefile that are hosing regression tests. [2007.11.07]

This section includes an analysis of the efficiency of different data representations under different back-ends. This should theoretically be run on different hardware platforms as well (such as the ARM-based ensboxes).
4.1 Arrays of Arrays

Arrays of arrays are notable because they cannot generally be flattened (the inner arrays will always be pointers). In the future we may look at tentative flattening based on profiling data. But first, here are the times for repeatedly allocating an array of arrays, and for repeatedly folding the values in an array of arrays.

Next we look at allocating arrays of tuples and vice versa. We look at both square sizes and at highly skewed dimensions. This is limited by not being able to make tuples very large.

Then we do examine folding over arrays of tuples and tuples of arrays.
A Appendix: Raw numbers for above graphs

Microbenchmarks

## Real or User time for each benchmark/backend
## LD_PRELOAD:
## NOSUDO:
## NICE:
Benchmark mltonO3 c2boehm c2boehmseglist c2 c2seglist c2def c2defseglist
just_timer 2564.000 2544.000 2552.000 2508.000 2528.000 5040.000 5032.000
readfile_bigwins 3712.000 484.000 1092.000 1296.000 3728.000 312.000 832.000
printing_lists 2764.000 912.000 940.000 912.000 864.000 820.000 872.000
conv_SigsegArr 2268.000 376.000 7272.000 856.000 5768.000 28.000 6568.000
fft 100.000 820.000 916.000 904.000 852.000 900.000 800.000

Language Shootout:

## Real or User time for each benchmark/backend
## LD_PRELOAD:
## NOSUDO:
## NICE:
Benchmark c2
fannkuch2 4316.000

Application Benchmarks:

## Real or User time for each benchmark/backend
## LD_PRELOAD:
## NOSUDO:
## NICE:
Benchmark mltonO3 c2boehm c2boehmseglist c2 c2seglist c2def c2defseglist
run_first_phase 7252.000 11785.000 4140.000 7540.000 5552.000 7444.000 3944.000
run_first_phase 7252.000 11785.000 4140.000 7540.000 5552.000 7444.000 3944.000
## Running benchmark marmot1.bench for 100 tuples.
## Running benchmark marmot2.bench for 150 tuples.
## Running benchmark marmot3.bench for 14 tuples.
## Running benchmark marmot_all.bench for 20 tuples.
run_3phases 9457.000 5868.000 4860.000 5644.000 5348.000 5588.000 4816.000

## Real or User time for each benchmark/backend
## LD_PRELOAD:
## NOSUDO:
## NICE:
Benchmark mltonO3 c2boehm c2 c2def
## Running benchmark bgsub3.bench for 10 tuples.
bgSub3_integer 10221.000 8649.000 10281.000 7720.000

### B Appendix: Additional system information

Top results before running benchmarks:

top - 14:23:09 up 98 days, 22:57, 5 users, load average: 0.99, 0.99, 0.75
Tasks: 193 total, 2 running, 191 sleeping, 0 stopped, 0 zombie
Cpu(s): 25.7%us, 2.9%sy, 0.8%ni, 70.1%id, 0.2%wa, 0.2%hi, 0.2%si, 0.0%st
Mem: 2073956k total, 1448884k used, 625072k free, 154136k buffers
Swap: 14996668k total, 34748k used, 14961920k free, 850284k cached

<table>
<thead>
<tr>
<th>PID</th>
<th>USER</th>
<th>PR</th>
<th>NI</th>
<th>VIRT</th>
<th>RES</th>
<th>SHR</th>
<th>S</th>
<th>%CPU</th>
<th>%MEM</th>
<th>TIME+</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>27509</td>
<td>newton</td>
<td>20</td>
<td>0</td>
<td>2496</td>
<td>1100</td>
<td>784</td>
<td>R</td>
<td>2.10</td>
<td>0.1</td>
<td>0:00.01</td>
<td>top</td>
</tr>
<tr>
<td>1</td>
<td>root</td>
<td>21</td>
<td>0</td>
<td>2948</td>
<td>1856</td>
<td>532</td>
<td>S</td>
<td>0.1</td>
<td>0:07.80</td>
<td>init</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>root</td>
<td>11</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>kthreadd</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:05.56</td>
<td>migration/0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>R</td>
<td>0.0</td>
<td>0:14.72</td>
<td>ksoftirqd/0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>watchdog/0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:04.75</td>
<td>migration/1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:03.98</td>
<td>ksoftirqd/1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>watchdog/1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:01.78</td>
<td>events/0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.04</td>
<td>events/1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.02</td>
<td>khelper</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:01.61</td>
<td>kblockd/0</td>
<td></td>
</tr>
</tbody>
</table>

Top results after running benchmarks:

top - 14:43:34 up 98 days, 23:17, 5 users, load average: 1.06, 1.05, 0.95
Tasks: 193 total, 1 running, 192 sleeping, 0 stopped, 0 zombie
Cpu(s): 25.7%us, 2.9%sy, 0.8%ni, 70.1%id, 0.2%wa, 0.2%hi, 0.2%si, 0.0%st
Mem: 2073956k total, 1420824k used, 653132k free, 78768k buffers
Swap: 14996668k total, 34748k used, 14961920k free, 921704k cached

<table>
<thead>
<tr>
<th>PID</th>
<th>USER</th>
<th>PR</th>
<th>NI</th>
<th>VIRT</th>
<th>RES</th>
<th>SHR</th>
<th>S</th>
<th>%CPU</th>
<th>%MEM</th>
<th>TIME+</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>root</td>
<td>18</td>
<td>0</td>
<td>2948</td>
<td>1856</td>
<td>532</td>
<td>S</td>
<td>0.1</td>
<td>0:07.80</td>
<td>init</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>root</td>
<td>11</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>kthreadd</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:05.56</td>
<td>migration/0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>R</td>
<td>0.0</td>
<td>0:14.72</td>
<td>ksoftirqd/0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>watchdog/0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:04.75</td>
<td>migration/1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:03.98</td>
<td>ksoftirqd/1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>root</td>
<td>RT</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.00</td>
<td>watchdog/1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:01.78</td>
<td>events/0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.04</td>
<td>events/1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.02</td>
<td>khelper</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:01.61</td>
<td>kblockd/0</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>root</td>
<td>12</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0.0</td>
<td>0:00.04</td>
<td>kblockd/1</td>
<td></td>
</tr>
</tbody>
</table>