Analysis report examination
with CUBE

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• Parallel program analysis report exploration tools
  – Libraries for XML report reading & writing
  – Algebra utilities for report processing
  – GUI for interactive analysis exploration
    • requires Qt4

• Originally developed as part of Scalasca toolset

• Now available as a separate component
  – Can be installed independently of Scalasca or Score-P, e.g., on laptop or desktop
  – Latest release: CUBE 4.2.3 (June 2014)
Analysis presentation and exploration

• Representation of values (severity matrix) on three hierarchical axes
  – Performance property (metric)
  – Call path (program location)
  – System location (process/thread)

• Three coupled tree browsers

• CUBE displays severities
  – As value: for precise comparison
  – As colour: for easy identification of hotspots
  – Inclusive value when closed & exclusive value when expanded
  – Customizable via display modes
How is it distributed across the processes/threads?

What kind of performance metric?

Where is it in the source code? In what context?
Analysis report exploration (opening view)
Selecting the “Time” metric shows total execution time.
Distribution of selected metric for call path by process/thread
Expanding the call tree

Distribution of selected metric across the call tree

Collapsed: inclusive value
Expanded: exclusive value
Inclusive vs. Exclusive values

- **Inclusive**
  - Information of all sub-elements aggregated into single value

- **Exclusive**
  - Information cannot be subdivided further

```c
int foo()
{
  int a;
  a = 1 + 1;
  bar();
  a = a + 1;
  return a;
}
```
Selecting a call path

Vi-HPS

cube 4.1.1 livedvd2: scorep-20120913_1740_557443655223384/profile.cubex

File Display Topology Help

Absolute

- Metric tree
  - 1.63e9 Visits
  - 767.48 Time
  - 0.00 Minimum Inclusive Time
  - 48.58 Maximum Inclusive Time
  - 5.27e8 bytes_sent
  - 5.27e8 bytes_received

Call tree

- 0.01 MAIN_
  - 0.82 mpi_setup_
    - 0.00 MPI_Bcast
    - 0.00 env_setup_
    - 0.00 zone_setup_
  - 0.00 map_zones_
  - 0.00 zone_starts_
  - 0.00 set_constants_
  - 5.02 initialize_
  - 1.11 exact_rhs_
    - 0.00 timer_clear_
  - 3.67 exch_qbc_
  - 0.04 adi_
    - 39.91 compute_rhs_
    - 233.49 x_solve_
    - 239.34 y_solve_
    - 0.07 z_solve_
    - 0.04 !$omp parallel @z_solve.f:43
      - 100.67 !$omp do @z_solve.f:52
        - 2.89 lhsinit_
        - 57.70 binvcrhs_
          - 27.24 matvec_sub_
          - 36.11 matmul_sub

Absolute

- System tree
  - - generic cluster
    - - i06r01c20
      - - MPI Rank 0
        - 3.81 CPU thread 0
        - 3.70 CPU thread 1
        - 3.64 CPU thread 2
        - 3.16 CPU thread 3
      - - MPI Rank 1
        - 3.83 CPU thread 0
        - 3.29 CPU thread 1
        - 3.72 CPU thread 2
        - 3.62 CPU thread 3
      - - MPI Rank 2
        - 3.84 CPU thread 0
        - 3.58 CPU thread 1
        - 3.66 CPU thread 2
        - 3.33 CPU thread 3
      - - MPI Rank 3
        - 3.87 CPU thread 0
        - 3.66 CPU thread 1
        - 3.59 CPU thread 2
        - 3.41 CPU thread 3

Absolute

Selection updates metric values shown in columns to right
Atelier Profilage de codes de calcul OpenMP (10-11 December 2014, ECP, Paris)
subroutine binvcrhs( lhs, c, r )

implicit none

double precision pivot, coeff, lhs
dimension lhs(5,5)
double precision c(5,5), r(5)

pivot = 1.00d0/lhs(1,1)
lhs(1,2) = lhs(1,2)*pivot
lhs(1,3) = lhs(1,3)*pivot
lhs(1,4) = lhs(1,4)*pivot
lhs(1,5) = lhs(1,5)*pivot
c(1,1) = c(1,1)*pivot
c(1,2) = c(1,2)*pivot
c(1,3) = c(1,3)*pivot
c(1,4) = c(1,4)*pivot
Select flat view tab, expand all nodes, and sort by value.
Box plot shows distribution across the system; with min/max/avg/median/quartiles
Alternative display modes

Data can be shown in various percentage modes.
Important display modes

• Absolute
  – Absolute value shown in seconds/bytes/counts

• Selection percent
  – Value shown as percentage w.r.t. the selected node
    “on the left“ (metric/call path)

• Peer percent (system tree only)
  – Value shown as percentage relative to the maximum peer value
Multiple selection

Select multiple nodes with Ctrl-click

Atelier Profilage de codes de calcul OpenMP (10-11 December 2014, ECP, Paris)
Context-sensitive help available for all GUI items.
CUBE algebra utilities

- Extracting solver sub-tree from analysis report

```bash
% cube_cut -r '<<ITERATION>>' scorep_bt-mz_W_4x4_sum/profile.cubex
Writing cut.cubex... done.
```

- Calculating difference of two reports

```bash
% cube_diff scorep_bt-mz_W_4x4_sum/profile.cubex cut.cubex
Writing diff.cubex... done.
```

- Additional utilities for merging, calculating mean, etc.
  - Default output of cube _utility is a new report utility.cubex

- Further utilities for report scoring & statistics

- Run utility with “-h” (or no arguments) for brief usage info
Further information

• CUBE
  – Parallel program analysis report exploration tools
    • Libraries for XML report reading & writing
    • Algebra utilities for report processing
    • GUI for interactive analysis exploration
  – Available under New BSD open-source license
  – Documentation & sources:
    • [http://www.scalasca.org](http://www.scalasca.org)
  – User guide also part of installation:
    • `cube-config --cube-dir`/share/doc/CubeGuide.pdf
  – Contact:
    • [mailto: scalasca@fz-juelich.de](mailto:scalasca@fz-juelich.de)