

International HPC Summer School 2023: Performance analysis and optimization

Score-P – A Joint Performance Measurement Run-Time
Infrastructure for Periscope, Scalasca, TAU, and Vampir

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Hands-on: NPB-MZ-MPI / BT



Performance analysis steps

- 0.0 Reference preparation for validation
- 1.0 Program instrumentation
 - 1.1 Summary measurement collection
 - 1.2 Summary analysis report examination
- 2.0 Summary experiment scoring
 - 2.1 Summary measurement collection with filtering
- 3.0 Trace measurement with filtering
 - 3.1 Event trace examination & analysis

Recap: Local installation

- VI-HPS tools not yet installed system-wide
 - Enable and load local tool installations
 - Required for each shell session

```
% module use /jet/home/zhukov/ihpcss23/modules/  
% module load scalasca/2.6-intel_openmpi
```

- Copy tutorial sources to your working directory

```
% cd $PROJECT  
% tar zxvf /jet/home/zhukov/ihpcss23/tutorial/NPB3.3-MZ-MPI.tar.gz  
% cd NPB3.3-MZ-MPI
```


NPB-MZ-MPI / BT instrumentation

```
#-----  
# The Fortran compiler used for MPI programs  
#-----  
#MPIF77 = mpif77  
  
# Alternative variants to perform instrumentation  
...  
MPIF77 = scorep mpif77  
  
# This links MPI Fortran programs; usually the same as ${MPIF77}  
FLINK    = $(MPIF77)  
...
```

- Edit config/make.def to adjust build configuration
 - Modify specification of compiler/linker: MPIF77

Uncomment the Score-P
compiler wrapper
specification

NPB-MZ-MPI / BT instrumented build

```
% make clean

% make bt-mz CLASS=C NPROCS=8
cd BT-MZ; make CLASS=C NPROCS=8 VERSION=
make: Entering directory 'BT-MZ'
cd ../sys; cc -o setparams setparams.c -lm
../sys/setparams bt-mz 8 C
scorep mpif77 -c -O3 -fopenmp bt.f
[...]
cd ../common; scorep mpif77 -c -O3 \
-fopenmp timers.f
scorep mpif77 -O3 -fopenmp \
-o ../bin.scorep/bt-mz_C.8 \
bt.o initialize.o exact_solution.o exact_rhs.o set_constants.o \
adi.o rhs.o zone_setup.o x_solve.o y_solve.o exch_qbc.o \
solve_subs.o z_solve.o add.o error.o verify.o mpi_setup.o \
../common/print_results.o ../common/timers.o
Built executable ../bin.scorep/bt-mz_C.8
make: Leaving directory 'BT-MZ'
```

- Return to root directory and clean-up
- Re-build executable using Score-P compiler wrapper

Summary measurement collection

```
% cd bin.scorep
% cp ../jobscript/bridges2/scorep.sbatch.C.8 .
% less scorep.sbatch.C.8

...
# Score-P measurement configuration
#export SCOREP_EXPERIMENT_DIRECTORY=\
#scorep_bt-mz_${CLASS}_${PROCS}x${OMP_NUM_THREADS}_profile
#export SCOREP_FILTERING_FILE=../config/scorep.filt
#export SCOREP_TOTAL_MEMORY=65M
#export SCOREP_METRIC_PAPI=PAPI_TOT_INS,PAPI_TOT_CYC
#export SCOREP_ENABLE_TRACING=true

scalasca -analyze mpirun \
"--map-by ppr:${TASKS_PER_SOCKET}:socket:pe=${SLURM_CPUS_PER_TASK} \
-n ${SLURM_NTASKS}" $EXE

% sbatch scorep.sbatch.C.8
```

- Change to the directory containing the new executable before running it with the desired configuration
- Check settings

Leave these lines commented out for the moment

- Submit job

Measurement configuration: scorep-info

```
% scorep-info config-vars --full
SCOREP_ENABLE_PROFILING
  Description: Enable profiling
  [...]
SCOREP_ENABLE_TRACING
  Description: Enable tracing
  [...]
SCOREP_TOTAL_MEMORY
  Description: Total memory in bytes for the measurement system
  [...]
SCOREP_EXPERIMENT_DIRECTORY
  Description: Name of the experiment directory
  [...]
SCOREP_FILTERING_FILE
  Description: A file name which contain the filter rules
  [...]
SCOREP_METRIC_PAPI
  Description: PAPI metric names to measure
  [...]
SCOREP_METRIC_RUSAGE
  Description: Resource usage metric names to measure
  [...] More configuration variables ...]
```

- Score-P measurements are configured via environmental variables

Summary measurement collection

```
% less profile-C.8-<job_id>.out
```

```
NAS Parallel Benchmarks (NPB3.3-MZ-MPI) - BT-MZ MPI+OpenMP Benchmark
```

```
Number of zones:      8 x      8
```

```
Iterations: 200      dt:    0.000300
```

```
Number of active processes:      8
```

```
Use the default load factors with threads
```

```
Total number of threads:      48  (  6.0 threads/process)
```

```
Calculated speedup =      47.97
```

```
Time step      1
```

```
[... More application output ...]
```

- Check the output of the application run
- Compare run time of reference and this run
- What was a run time dilation?

BT-MZ summary analysis report examination

```
% ls -l
bt-mz_C.8
scorep.sbatch.C.8
profile-C.8-<jobid>.err
profile-C.8-<jobid>.out
scorep_bt-mz_C_8x6_profile/

% ls scorep_bt-mz_C_8x6_sum/
MANIFEST.md
profile.cubex
scorep.cfg
```

```
% cube profile.cubex
```

```
[Cube GUI showing summary analysis report]
```

- Creates experiment directory including
 - Description of metadata (MANIFEST.md)
 - The analysis report that was collated after measurement (profile.cubex)
 - A record of the measurement configuration (scorep.cfg)
- Interactive exploration with Cube

Hint:

Copy 'profile.cubex' to your laptop using 'scp' to improve responsiveness of GUI