

debugging/ltrace

Ltrace

Basic Usage

- Set up build environment

```
module purge
module add compiler/gnu
```

- Build `stream` benchmark

```
gcc -Ofast -march=native -fopenmp stream.c -o stream -lm
```

- Set up OpenMP environment

```
export OMP_NUM_THREADS=4
export OMP_PROC_BIND=TRUE
export OMP_PLACES=cores
```

- Trace all function calls of benchmark `stream`

```
ltrace ./stream
```

- Ltrace

- Filter for `alloc` and `free` functions calls within the `stream` binary (ignoring these calls within libraries).
- Discard standard output

```
OMP_NUM_THREADS=1 \
ltrace \
  --demangle \
  -e *alloc*@stream+free@stream \
  ./stream \
  >/dev/null
```

```
stream->aligned_alloc(64, 0x4c4b400, 0x7f68d8, 1)
stream->aligned_alloc(64, 0x4c4b400, 0x147acb1a8040, 0x147acb1a8000)
stream->aligned_alloc(64, 0x4c4b400, 0x147ac655c040, 0x147ac655c000)
stream->free(0x147acb1a8040)
```

```
stream->free(0x147ac655c040)
stream->free(0x147ac1910040)
```

-> memory allocation and free for vectors a, b and c

- Ltrace
 - Filter for `alloc` and `free` functions calls within the stream binary (ignoring these calls within libraries).
 - Trace child processes to follow OpenMP Threads.
 - Only count matching function calls.

```
OMP_NUM_THREADS=2 \
ltrace \
  -f \
  --demangle \
  -e *alloc*@stream+free@stream \
  -c \
  ./stream >/dev/null
```

% time	seconds	usecs/call	calls	function
55.62	0.006587	1097	6	free
37.91	0.004490	748	6	aligned_alloc
6.47	0.000766	766	1	exit_group
100.00	0.011843		13	total

-> Each OpenMP Thread does its own memory allocation and free

Usage scenarios with OpenMPI

- Set up build environment

```
module purge
module add \
  compiler/gnu \
  mpi/openmpi
module add devel/strace
```

- Build rank_league benchmark

```
mpicc -O2 -march=native rank_league.c -o rank_league
```

- Ltrace all MPI ranks to individual files (e.g. for comparison)

```
mpirun -np 4 bash -c \
  'ltrace -o ltrace.out.${OMPI_COMM_WORLD_RANK} \
  ./rank_league'
ll -h ltrace.out.*
```

```
-rw-r--r-- 1 bq0742 hk-project-scs 191K May  5 11:05 ltrace.out.0
-rw-r--r-- 1 bq0742 hk-project-scs 188K May  5 11:05 ltrace.out.1
-rw-r--r-- 1 bq0742 hk-project-scs 188K May  5 11:05 ltrace.out.2
-rw-r--r-- 1 bq0742 hk-project-scs 188K May  5 11:05 ltrace.out.3
```

- Ltrace

- Only on first MPI rank (e.g. for data reduction)
- Redirect trace to file

```
mpirun -np 4 bash -c \
'if [[ ${OMPI_COMM_WORLD_RANK} -eq 0 ]]; then
    exec ltrace -o ltrace.out \
        ./rank_league
else
    exec ./rank_league
fi'
```

```
ll -h ltrace.out
```

```
-rw-r--r-- 1 bq0742 hk-project-scs 191K May  5 11:20 ltrace.out
```

- Ltrace

- Only on first MPI rank (e.g. for data reduction)
- Count calls to MPI functions

```
mpirun -np 4 bash -c \
'if [[ ${OMPI_COMM_WORLD_RANK} -eq 0 ]]; then
    exec ltrace -c -e *MPI* \
        ./rank_league
else
    exec ./rank_league
fi'
```

% time	seconds	usecs/call	calls	function
32.58	1.344215	1344215	1	MPI_Finalize
28.26	1.165933	1165933	1	MPI_Init
18.16	0.749022	936	800	MPI_Isend
17.42	0.718733	898	800	MPI_Irecv
2.75	0.113337	14167	8	MPI_Waitall
0.38	0.015681	15681	1	exit_group
0.15	0.006058	757	8	MPI_Sendrecv
0.13	0.005490	686	8	MPI_Wtime
0.09	0.003766	941	4	MPI_Barrier
0.04	0.001478	492	3	MPI_Recv
0.02	0.000697	697	1	MPI_Comm_size
0.02	0.000671	671	1	MPI_Get_processor_name
0.01	0.000581	581	1	MPI_Comm_rank