

Example: matmult.f90

- Instrumentation through pdt parser/tau instrumentor command

```
f95parse matmult.f90
```

```
tau_instrumentor matmult.pdb matmult.f90 -o matmult.inst.f90 -f select.tau
```

- Instrumentation through tau compiling wrapper

```
tau_f90.sh -optKeepFiles matmult.f90 -f select.tau
```

- Event-based sampling approach

```
compile application code with -g
```

```
run application code with tau_exec -ebs
```

Example: matmult.inst.f90

```
!*****
!   matmult.f90 - simple matrix multiply implementation
!*****
subroutine initialize(a, b, n)
  double precision a(n,n)
  double precision b(n,n)
  integer n

! first initialize the A matrix

  call TAU_PROFILE_TIMER(profiler, '
&INITIALIZE [{matmult.f90} {4,18}]')

  call TAU_PROFILE_START(profiler)
  call TAU_PROFILE_TIMER(t_10, '
&Loop: INITIALIZE [{matmult.f90} {10,9}-{14,14}]')
  .....

end subroutine initialize

subroutine multiply_matrices(answer, buffer, b, matsize)
  double precision buffer(matsize), answer(matsize)
  double precision b(matsize, matsize)
  integer i, j
! multiply the row with the column
  .....
  call TAU_PROFILE_START(t_31)
  do loop for .....
    answer(i) = answer(i) + buffer(j)*b(j,i)
  call TAU_PROFILE_STOP(t_31)
  .....
end subroutine multiply_matrices
```

```
program main
  .....
  parameter (SIZE_OF_MATRIX = 1000)
  double precision a(SIZE_OF_MATRIX,SIZE_OF_MATRIX)
  double precision b(SIZE_OF_MATRIX,SIZE_OF_MATRIX)
  double precision c(SIZE_OF_MATRIX,SIZE_OF_MATRIX)
  double precision buffer(SIZE_OF_MATRIX), answer(SIZE_OF_MATRIX)
  .....
  call TAU_PROFILE_INIT()
  call TAU_PROFILE_TIMER(profiler, 'MAIN [{matmult.f90} {39,15}]')
  call TAU_PROFILE_START(profiler)
  call TAU_PROFILE_TIMER(t_71, 'Loop: MAIN [{matmult.f90} {71,9}-{74,14}]')
  .....
  call MPI_INIT( ierr )
  call MPI_COMM_RANK( MPI_COMM_WORLD, myid, ierr )
  call MPI_COMM_SIZE( MPI_COMM_WORLD, maxpe, ierr )

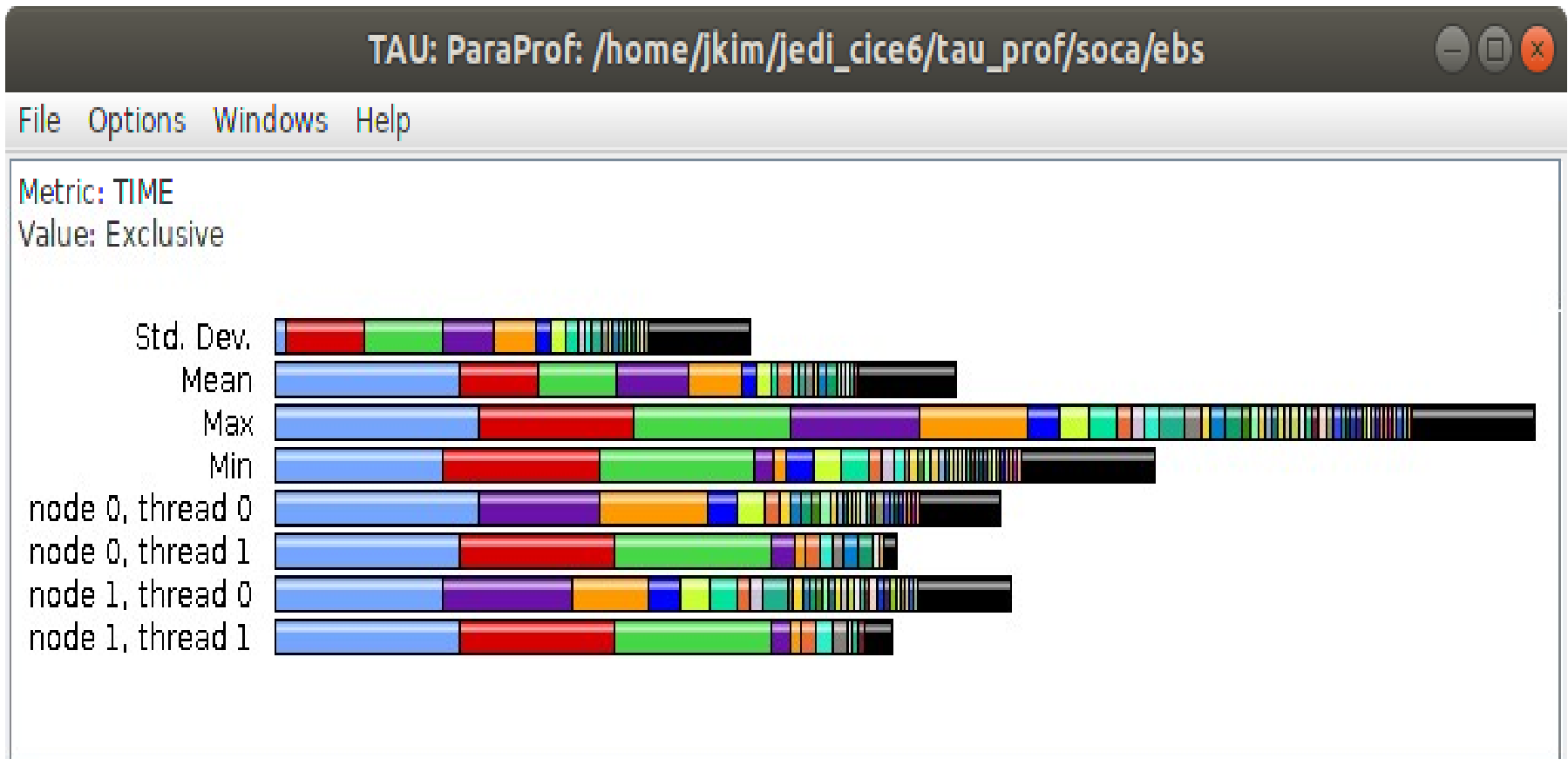
  call initialize(a, b, matsize)

  call TAU_PROFILE_START(t_71)
  do loop for .....
    call MPI_BCAST(b(1,i), matsize, MPI_DOUBLE_PRECISION, master, &
      MPI_COMM_WORLD, ierr)
  call TAU_PROFILE_STOP(t_71)
  .....
  call TAU_PROFILE_START(t_77)
  do loop for .....
    buffer(j) = a(i,j)
    call MPI_SEND(buffer, matsize, MPI_DOUBLE_PRECISION, i, &
      i, MPI_COMM_WORLD, ierr)
  call TAU_PROFILE_STOP(t_77)
  .....
end program main
```

Example: JEDI-SOCA 3dvar ctest case

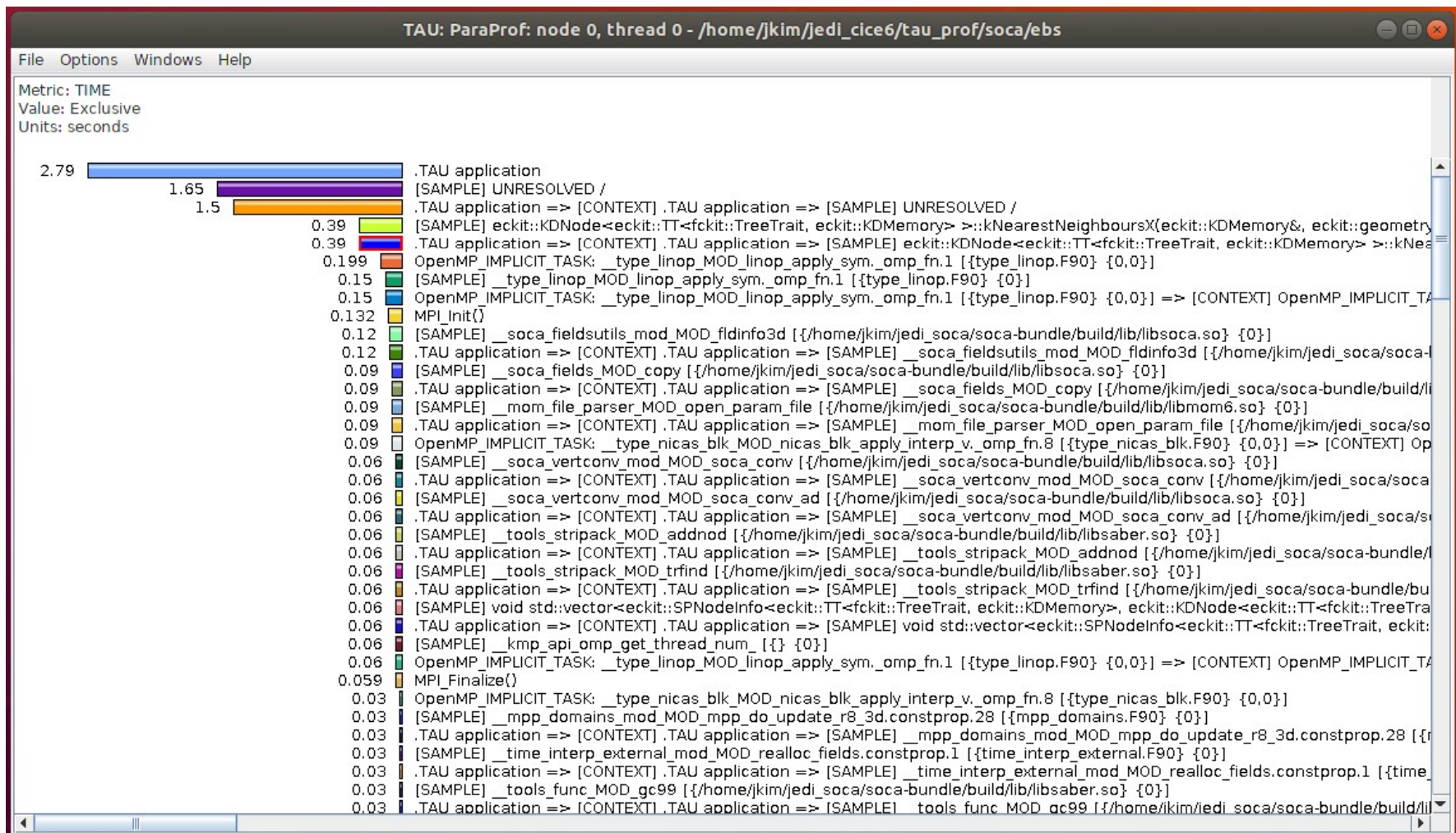
- Main data window for stacked bar

```
mpiexec -np 2 tau_exec -ebs soca_3dvar.x testinput/3dvar_soca.yml
```



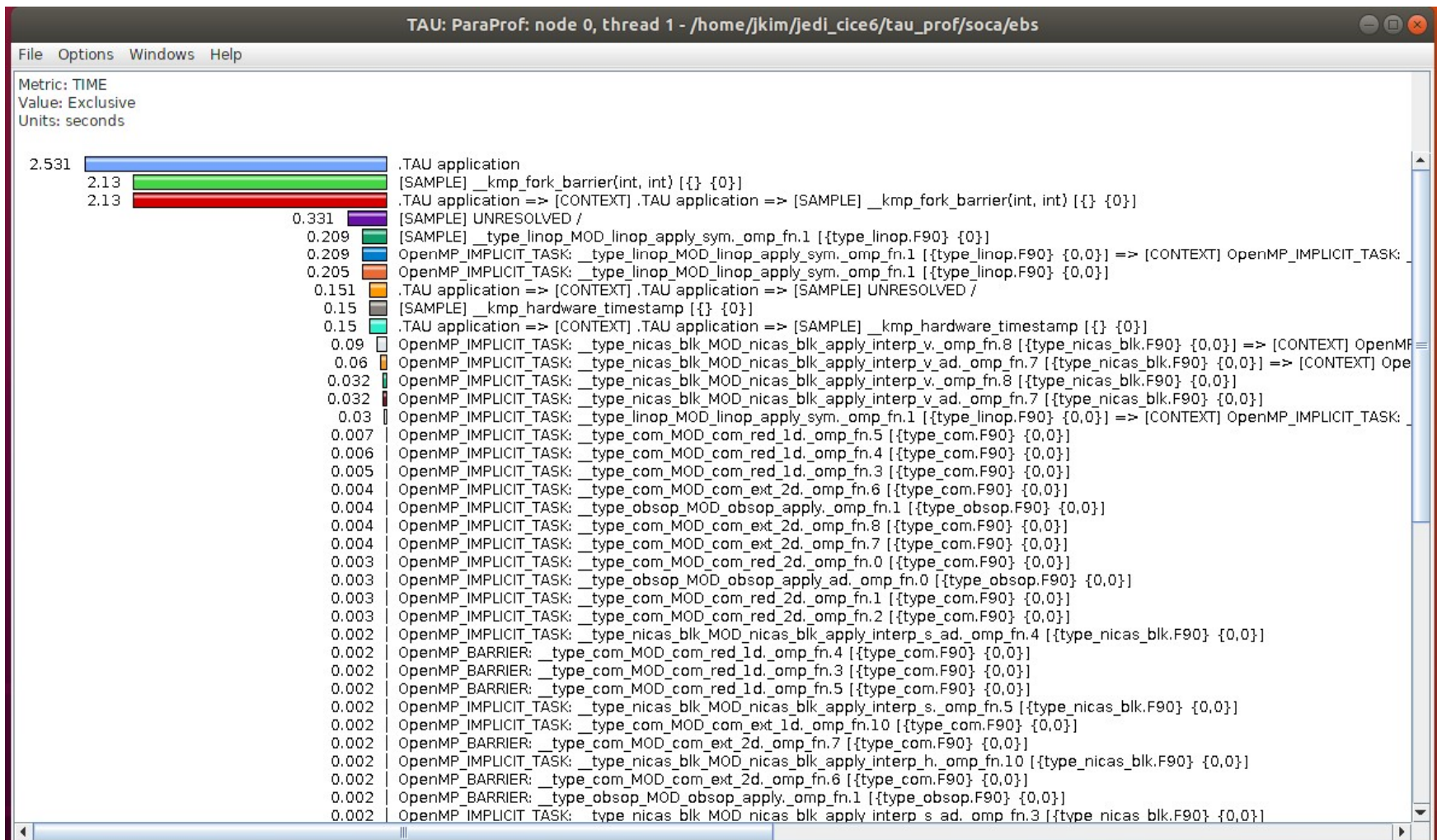
Example: JEDI-SOCA 3dvar ctest case

- Individual thread view
eckit:KDMemory, openmp type_linop



Example: JEDI-SOCA 3dvar ctest case

- Individual openmp thread view
openmp type_linop, type_nicas_blk



Example: JEDI-SOCA 3dvar ctest case

- tau_exec -memory or export TAU_TRACK_MEMORY_LEAKS=1
- no memory issue in soca routines but some memory leak detections

```
emacs@jkim-Laptop-15
File Edit Options Buffers Tools Help
Save Undo
1 3.234 3.234 3.234 0 Increase in Heap Memory (KB) : MPI_Isend()
0 0 0 0 0 Increase in Heap Memory (KB) : MPI_Recv()
0 0 0 0 0 Increase in Heap Memory (KB) : MPI_Wait()
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_com_MOD_com_ext_1d._omp
$ _fn.11
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_com_MOD_com_ext_1d._omp
$ _fn.11 => OpenMP_BARRIER: __type_com_MOD_com_ext_1d._omp_fn.11
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_com_MOD_com_red_2d._omp
$ _fn.0
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_nicas_blk_MOD_nicas_blk
$ _apply_interp_v._omp_fn.8
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_nicas_blk_MOD_nicas_blk
$ _apply_interp_v._omp_fn.8 => OpenMP_BARRIER: __type_nicas_blk_MOD_nicas_blk_apply_interp_v._omp_fn.8
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_nicas_blk_MOD_nicas_blk
$ _apply_interp_v_ad._omp_fn.7
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_nicas_blk_MOD_nicas_blk
$ _apply_interp_v_ad._omp_fn.7 => OpenMP_BARRIER: __type_nicas_blk_MOD_nicas_blk_apply_interp_v_ad._omp_fn.7
0 0 0 0 0 Increase in Heap Memory (KB) : OpenMP_IMPLICIT_TASK: __type_obsop_MOD_obsop_apply._
$ omp_fn.1 => OpenMP_BARRIER: __type_obsop_MOD_obsop_apply._omp_fn.1
1 13.82 13.82 13.82 1.686E-07 Increase in Heap Memory (KB) : OpenMP_PARALLEL_REGION: __type_com_MOD_com_ext_2d.o
$ omp_fn.6
1.165E+05 1.6E+07 1 700.1 6.803E+04 MEMORY LEAK! Heap Allocate : .TAU application
16 744 64 348.5 243.9 MEMORY LEAK! Heap Allocate : MPI_Finalize()
4 72 8 42 30.13 MEMORY LEAK! Heap Allocate : MPI_Group_incl()
542 1.587E+04 1 316.6 990.1 MEMORY LEAK! Heap Allocate : MPI_Init()
14 4192 100 1011 1103 MEMORY LEAK! Heap Allocate : OpenMP_PARALLEL_REGION: __type_com_MOD_com_ext_2d._omp
$ _fn.0
12 1 1 1 0 Memory Error! Allocation of zero bytes
12 1 1 1 0 Memory Error! Allocation of zero bytes : .TAU application
149 5232 4 1088 1521 Message size for all-gather
4859 2.017E+04 4 16.87 410 Message size for all-reduce
3877 3360 0 998.8 1261 Message size for all-to-all
501 3.072E+04 4 1.249E+04 1.246E+04 Message size for broadcast
-:--- tmp 24% L?? (Fundamental)
```