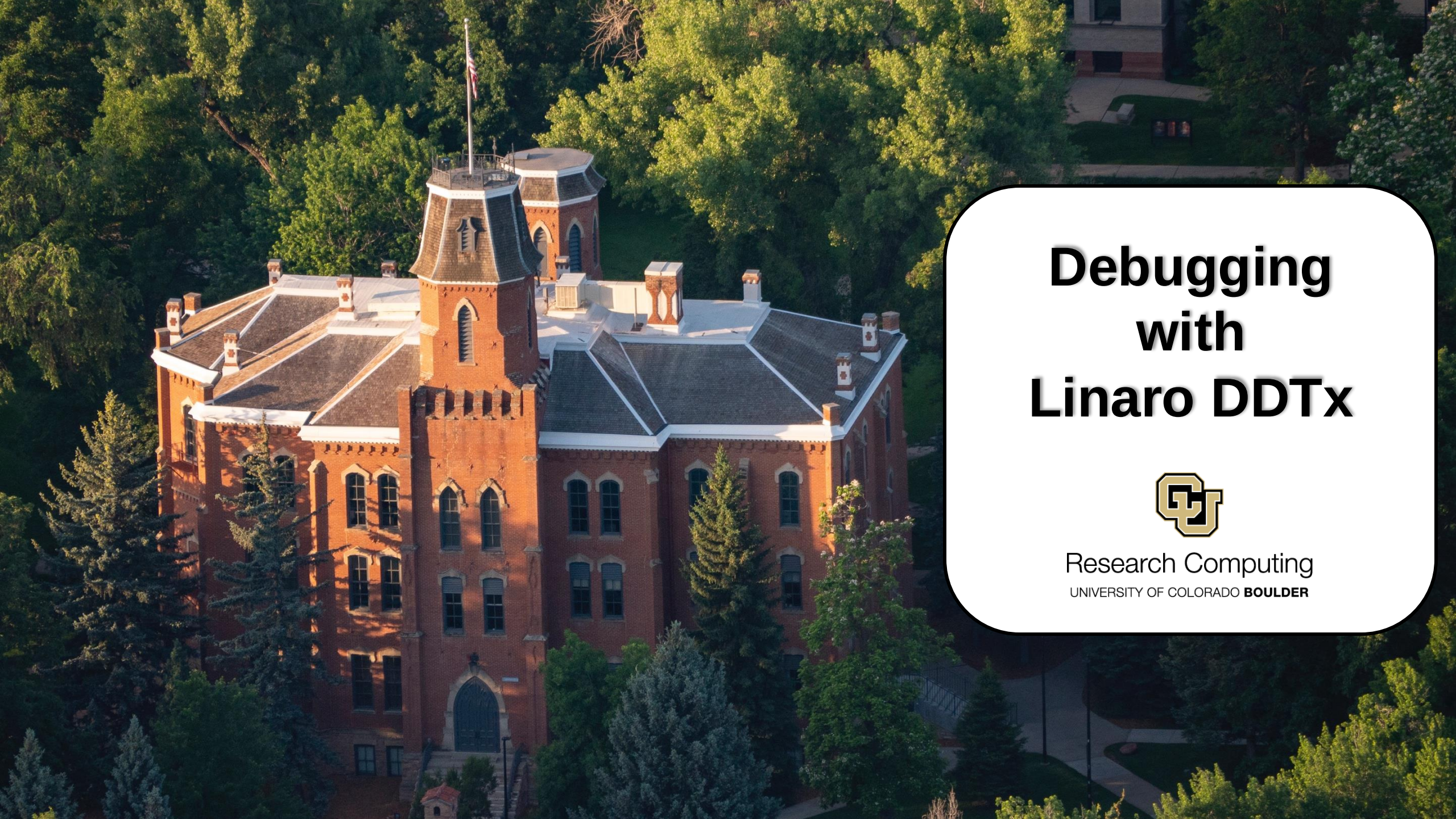


Debugging with Linaro DDTx

Research Computing

UNIVERSITY OF COLORADO **BOULDER**

Website: www.rc.colorado.edu

Documentation: https://curc.readthedocs.io

Helpdesk: rc-help@colorado.edu

Survey: http://tinyurl.com/curc-survey18

Meet the User Support Team

Layla Freeborn

Brandon Reyes

Andy Monaghan

Michael Schneider

John Reiland

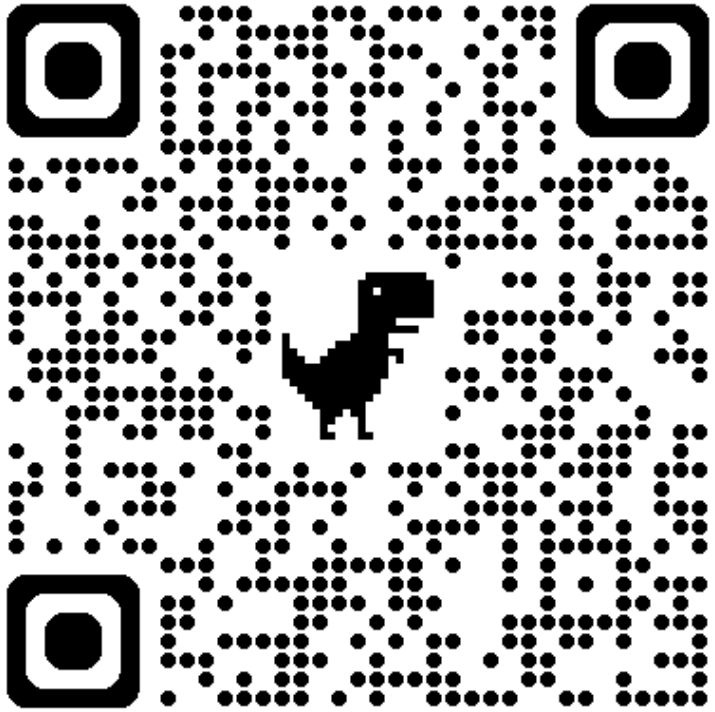
Dylan Gottlieb

Mohal Khandelwal

Ragan Lee

Slides

https://github.com/ResearchComputing/debugging_with_linaro_ddt_rc



Debugging with VS Code

Instructor:

Research Computing

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Slides:

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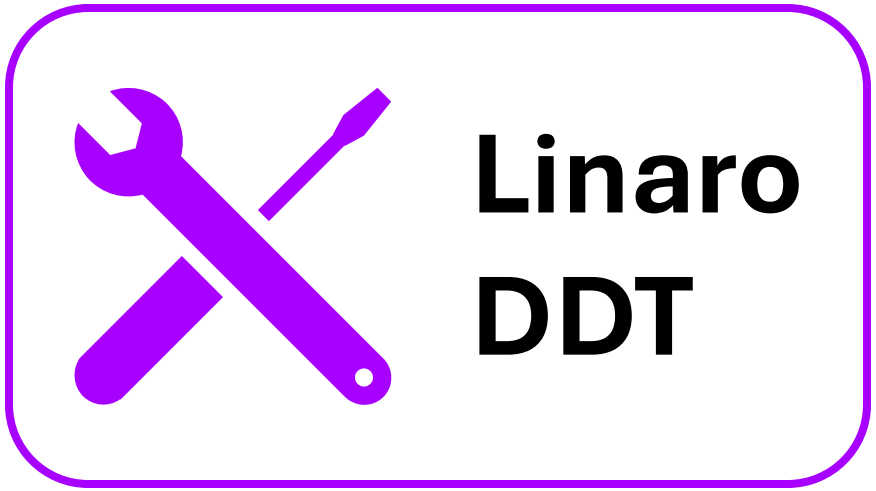
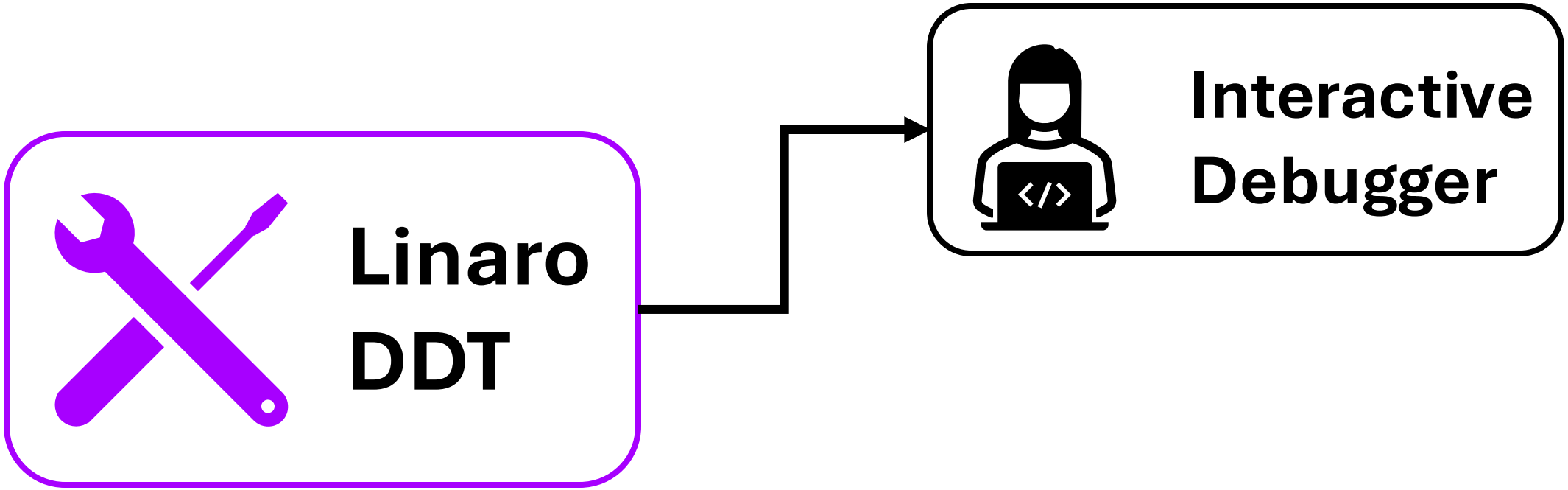
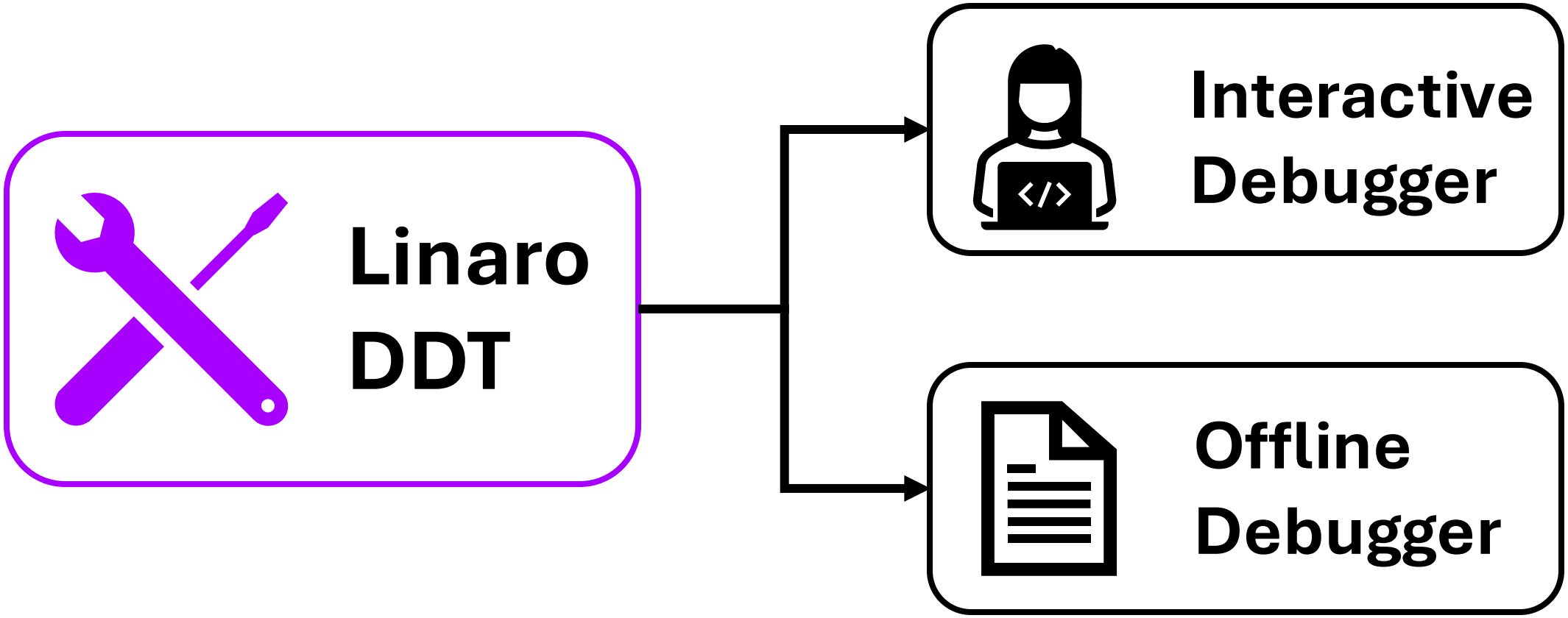
Overview



Overview



Overview



Preparing for Linaro DDT

1. Load modules

```
ml <compiler> <mpi-library> linaroforge
```

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ml intel/2022.1.2 impi linaroforge
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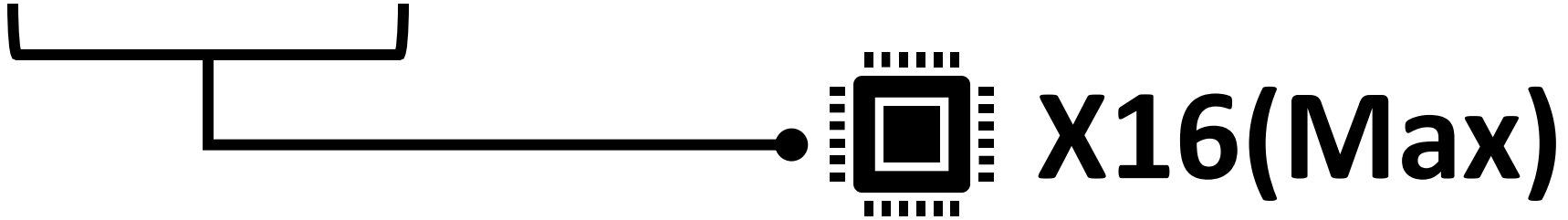
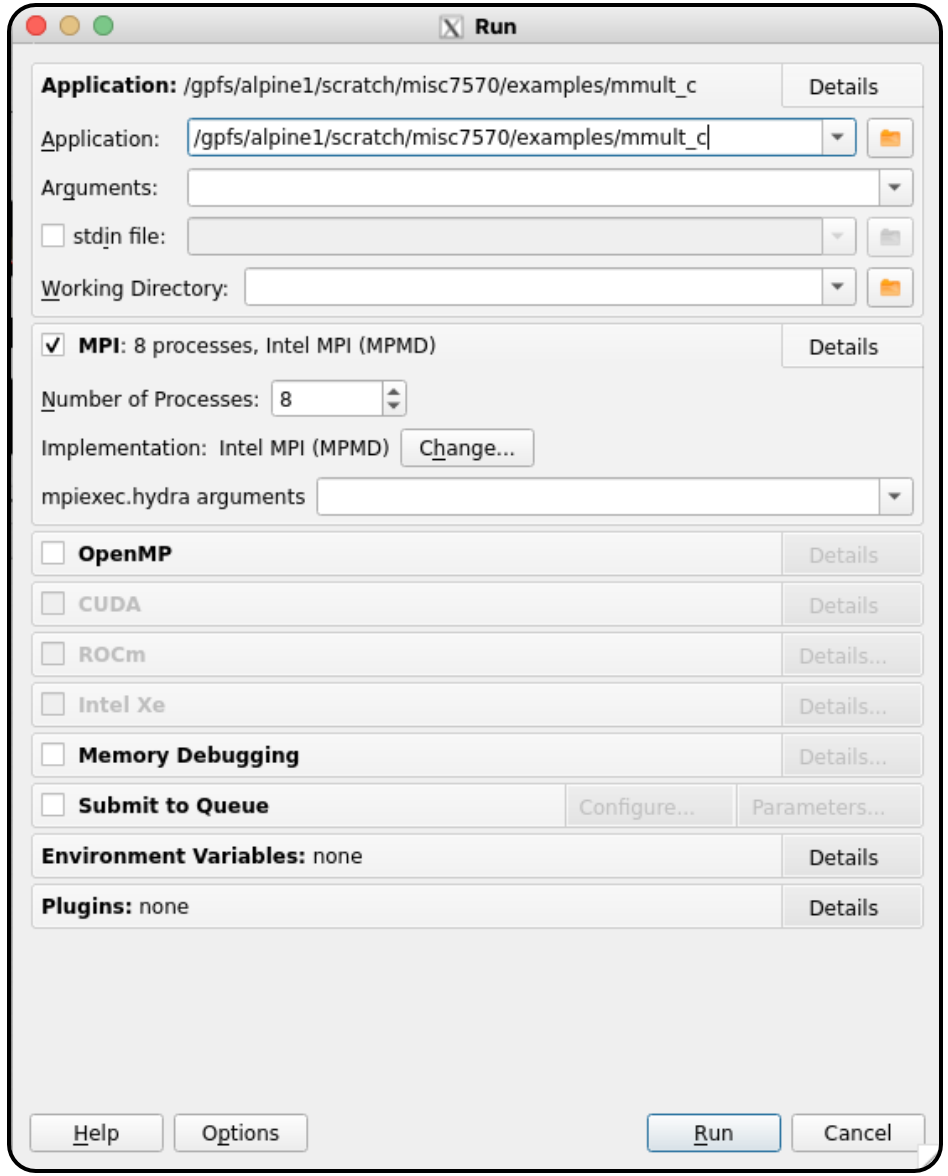
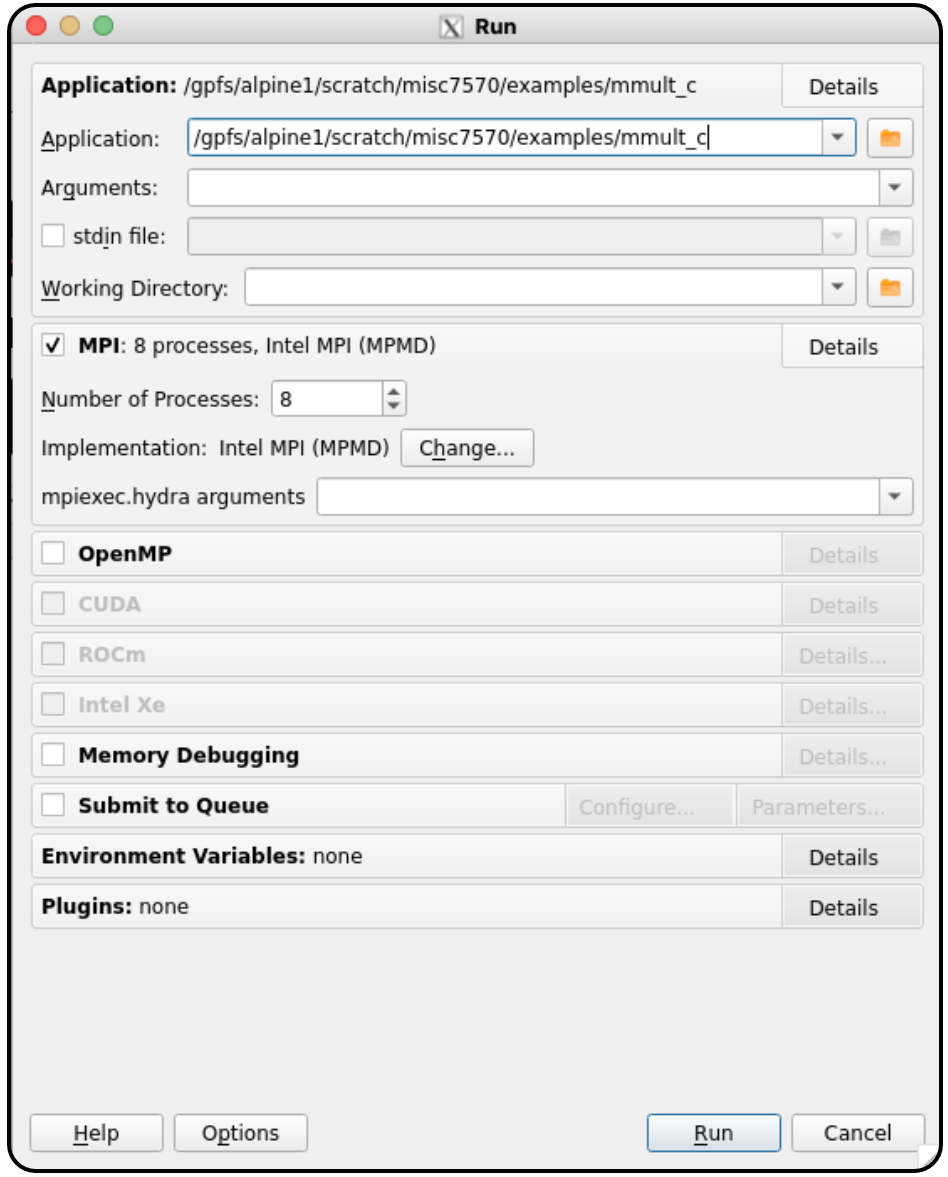




Program Location & Settings



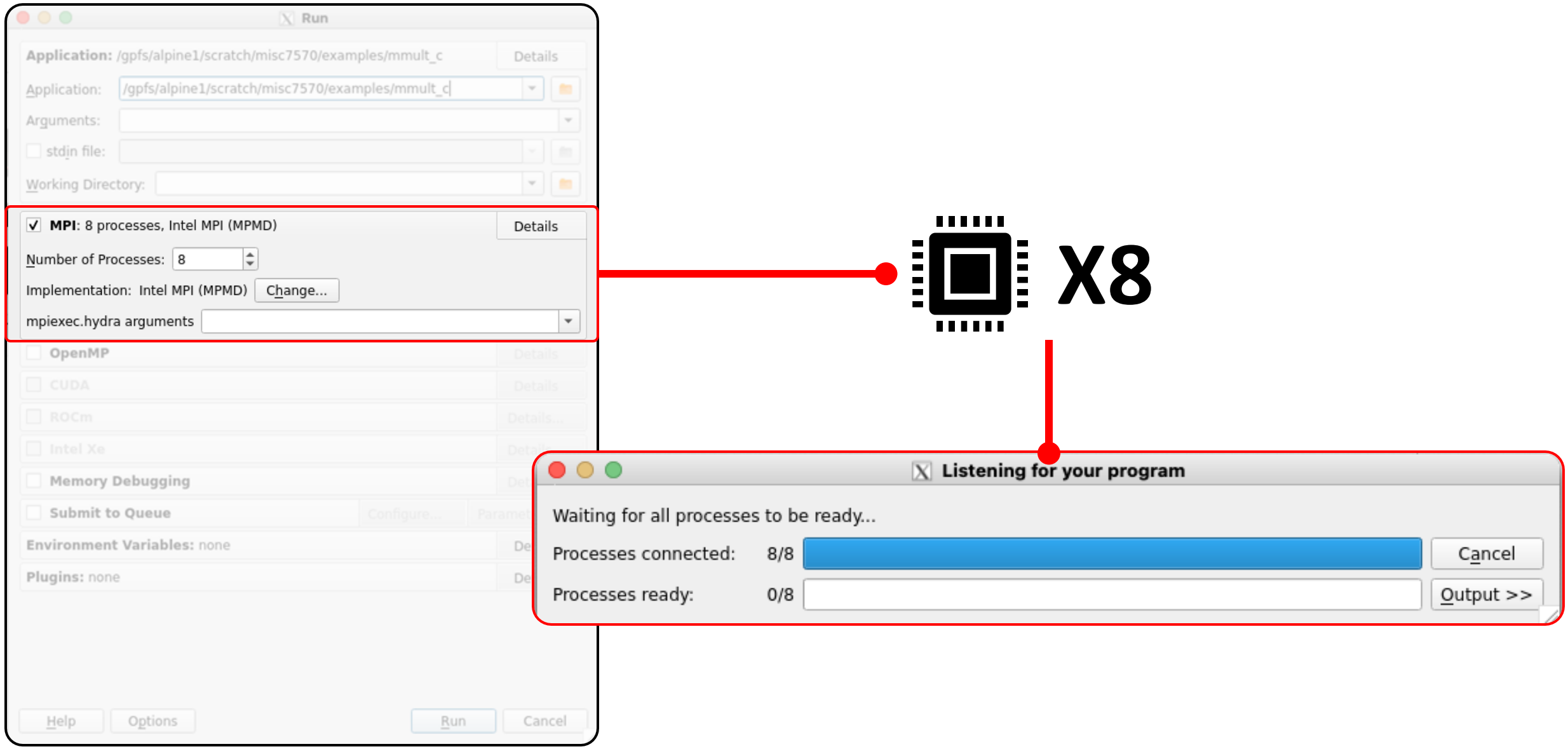
Program Location & Settings

MPI Settings

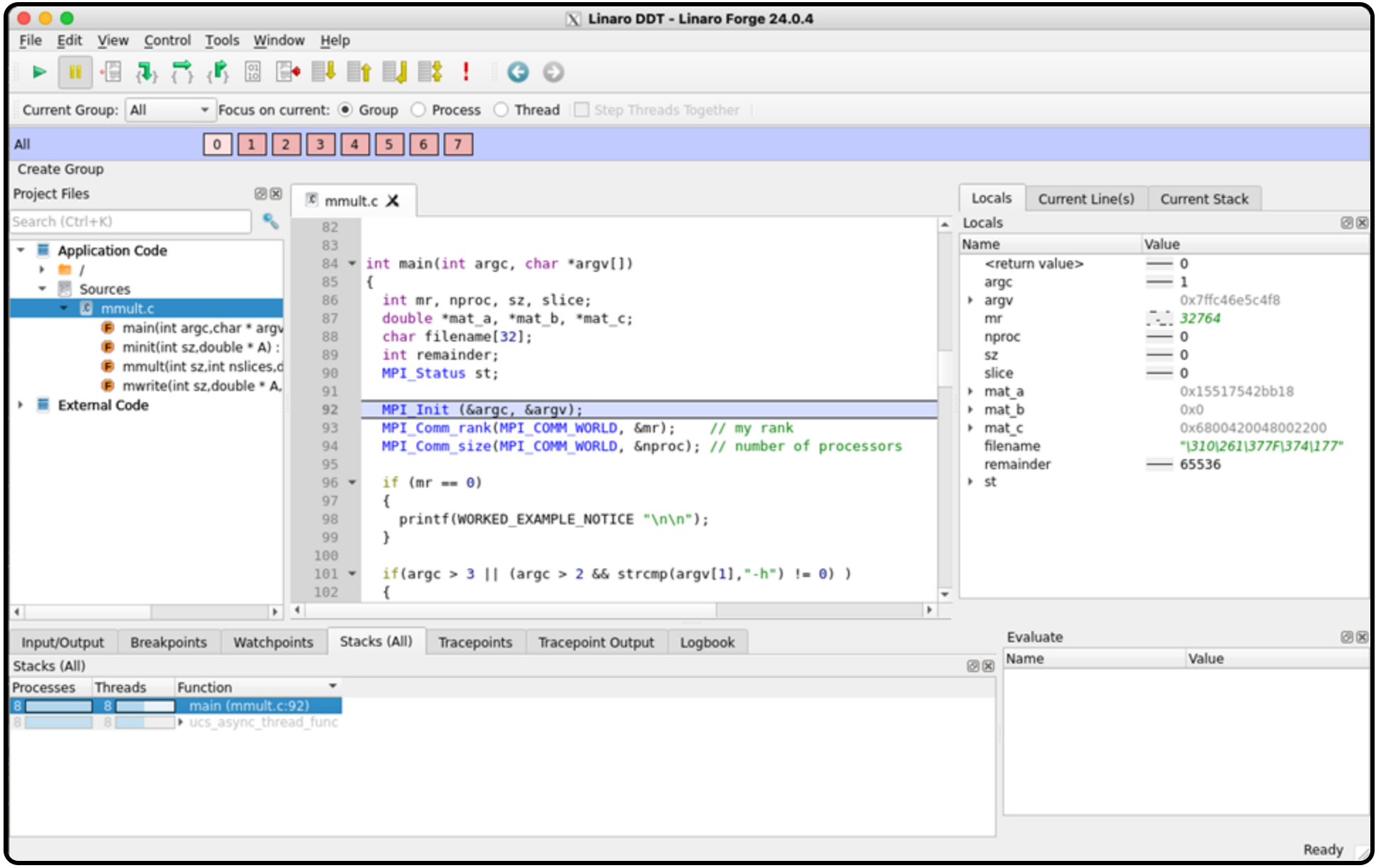
Program Location & Settings

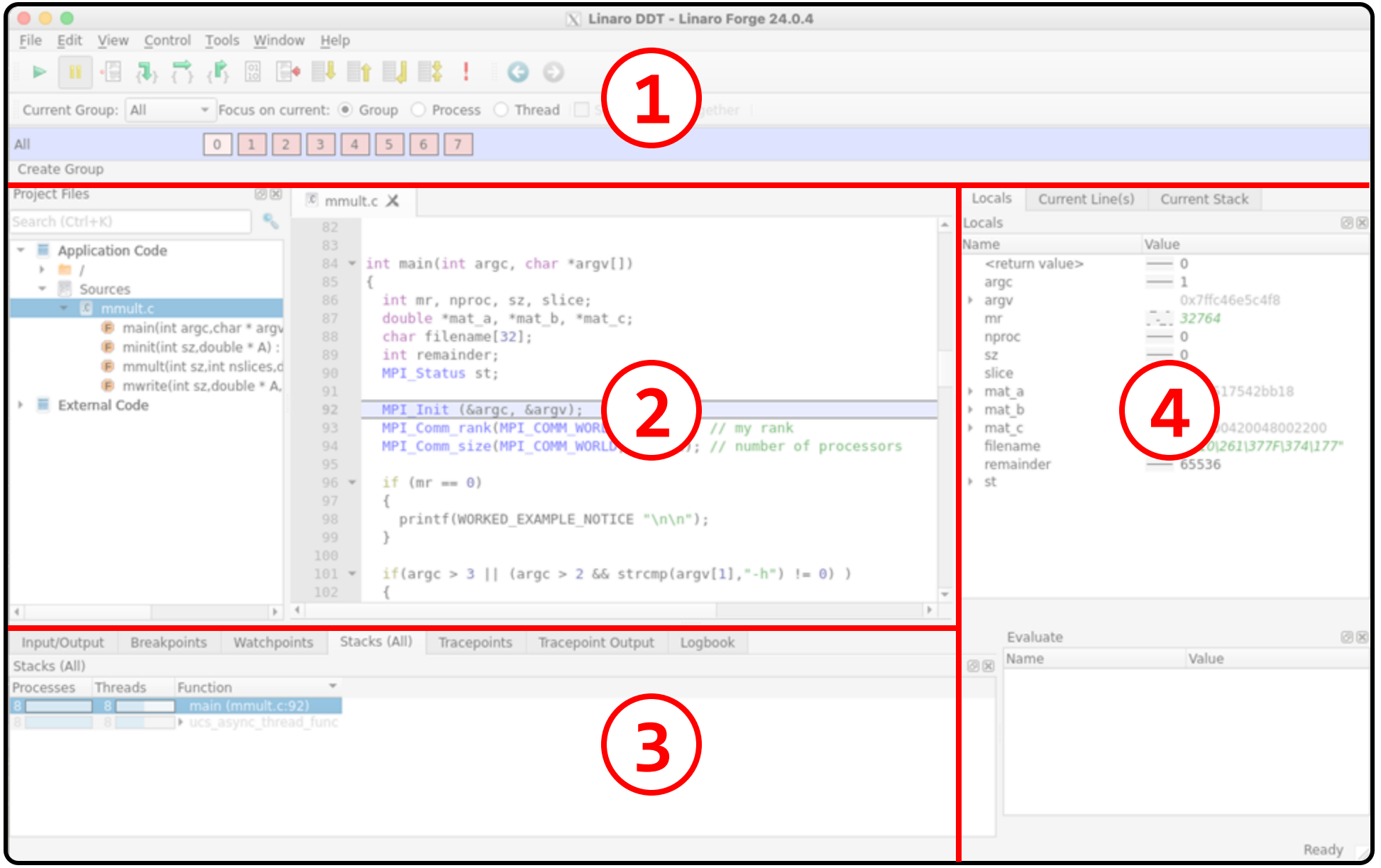
MPI Settings

Enable Memory Debugging & Profiling


Run
Application: /gpfs/alpine1/scratch/misc7570/examples/mmult_c
Details
Application: /gpfs/alpine1/scratch/misc7570/examples/mmult_c
Arguments:
stdin file:
Working Directory:
MPI: 8 processes, Intel MPI (MPMD)
Details
Number of Processes: 8
Implementation: Intel MPI (MPMD)
Change...
mpiexec.hydra arguments
OpenMP
CUDA
ROCm
Intel Xe
Memory Debugging
Submit to Queue
Environment Variables: none
Plugins: none
Help
Options
Run
Cancel
X8
Listening for your program
Waiting for all processes to be ready...
Processes connected: 8/8
Cancel
Processes ready: 0/8
Output >>

Linaro DDT


Linaro DDT - Linaro Forge 24.0.4
File Edit View Control Tools Window Help
Current Group: All Focus on current: Group Process Thread Step Threads Together
All 0 1 2 3 4 5 6 7
Create Group
Project Files
Search (Ctrl+K)
Application Code
/
Sources
mmult.c
main(int argc,char * argv
minit(int sz,double * A) :
mmult(int sz,int nslices,d
mwrite(int sz,double * A,
External Code
mmult.c
82
83
84 int main(int argc, char *argv[])
85 {
86 int mr, nproc, sz, slice;
87 double *mat_a, *mat_b, *mat_c;
88 char filename[32];
89 int remainder;
90 MPI_Status st;
91
92 MPI_Init (&argc, &argv);
93 MPI_Comm_rank(MPI_COMM_WORLD, &mr); // my rank
94 MPI_Comm_size(MPI_COMM_WORLD, &nproc); // number of processors
95
96 if (mr == 0)
97 {
98 printf(WORKED_EXAMPLE_NOTICE "\n\n");
99 }
100
101 if(argc > 3 || (argc > 2 && strcmp(argv[1],"-h") != 0))
102 {
Locals Current Line(s) Current Stack
Locals
Name Value
<return value> 0
argc 1
argv 0x7ffc46e5c4f8
mr 32764
nproc 0
sz 0
slice 0
mat_a 0x15517542bb18
mat_b 0x0
mat_c 0x6800420048002200
filename "\310\261\377F\374\177"
remainder 65536
st
Input/Output Breakpoints Watchpoints Stacks (All) Tracepoints Tracepoint Output Logbook
Stacks (All)
Processes Threads Function
8 8 main (mmult.c:92)
8 8 ucs_async_thread_func
Evaluate
Name Value
Ready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File Edit View Control Tools Window Help
Current Group: All
Focus on current: Group Process Thread
All 0 1 2 3 4 5 6 7
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mat_a 17542bb18
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filename 0\261\377F\374\177"
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Input/Output Breakpoints Watchpoints Stacks (All) Tracepoints Tracepoint Output Logbook
Stacks (All)
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8 8 main (mmult.c:92)
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Evaluate
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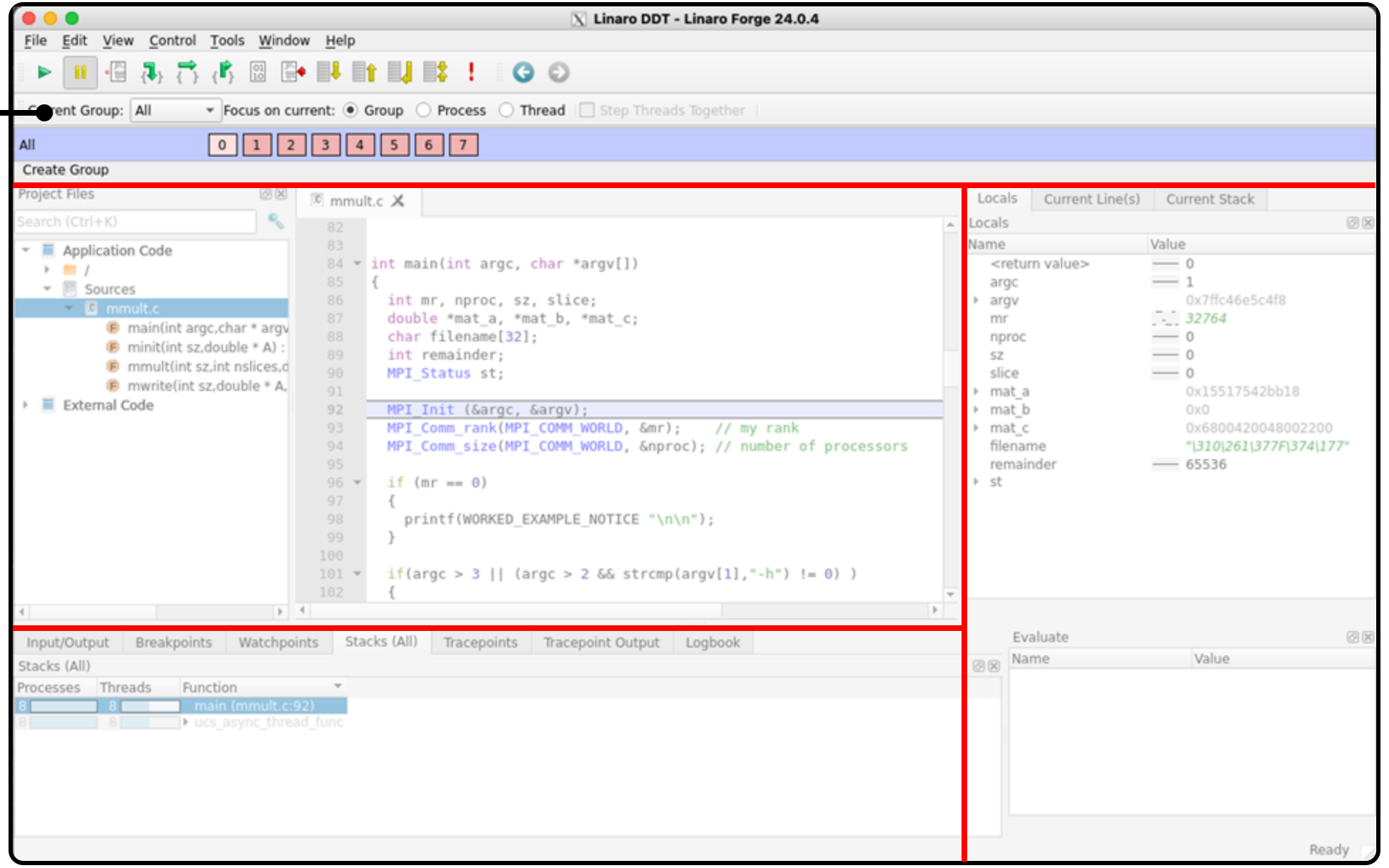
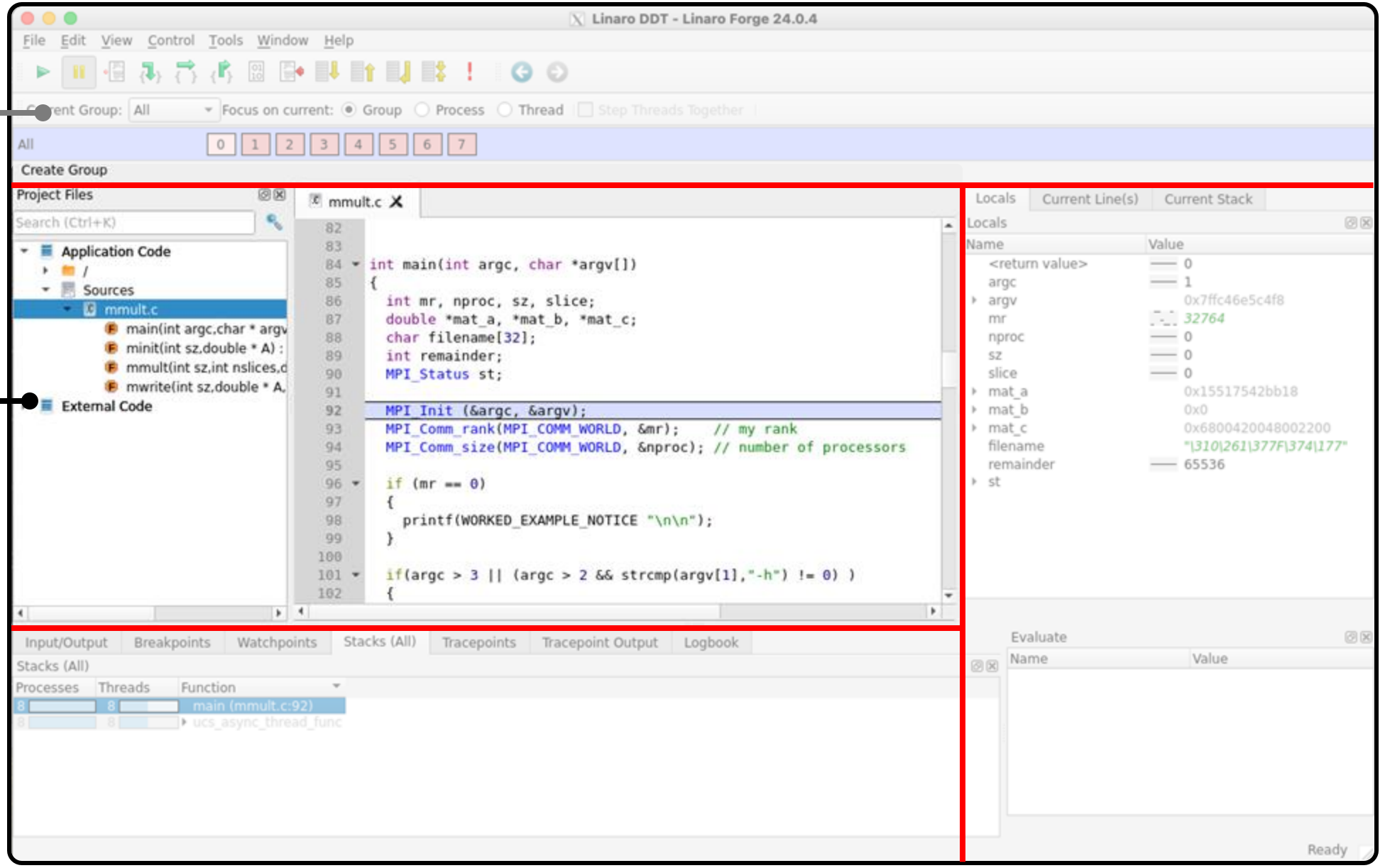
Debugger Controls



Debugger Controls

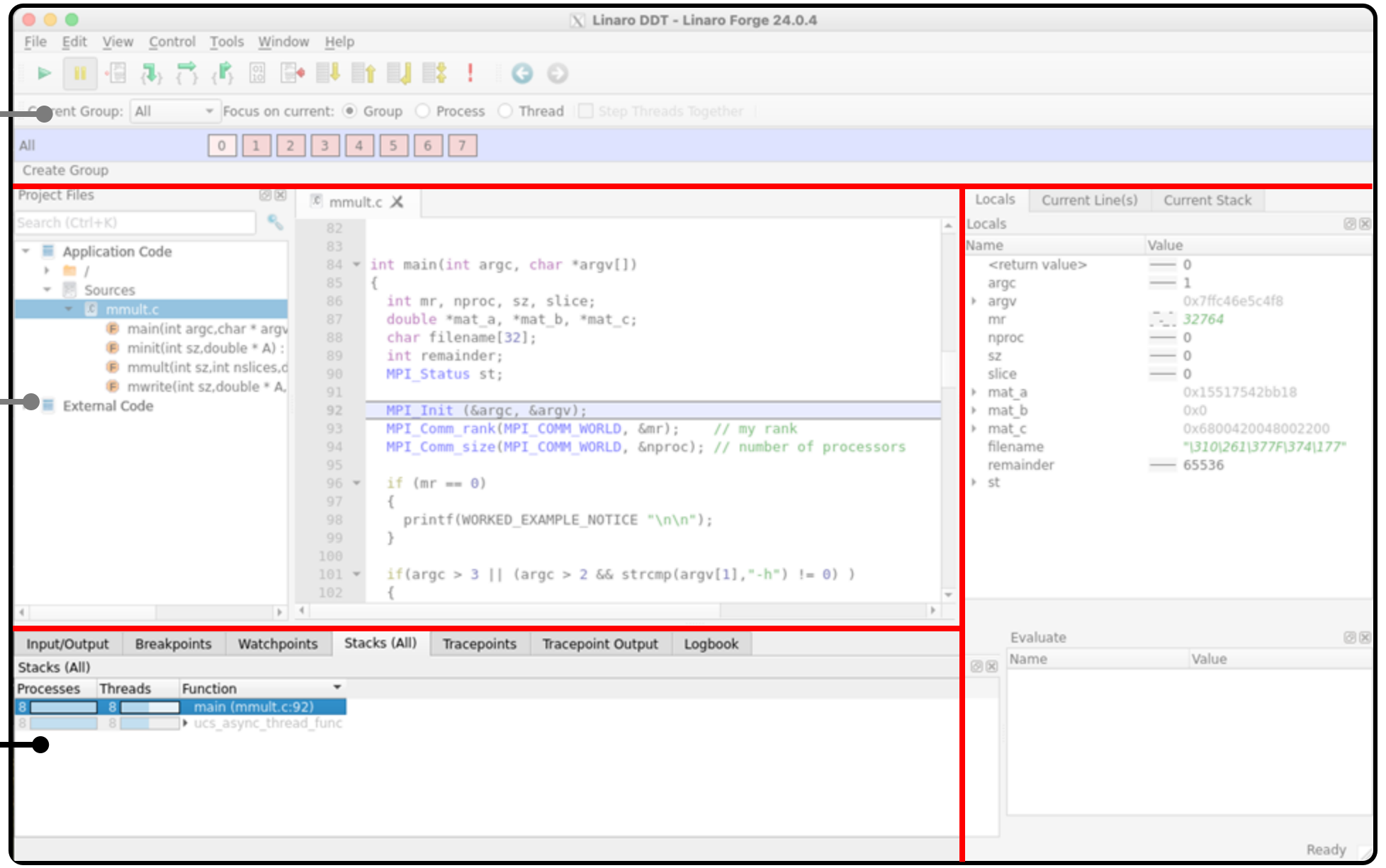
Code Editor



Debugger Controls

Code Editor

“Point” Controls



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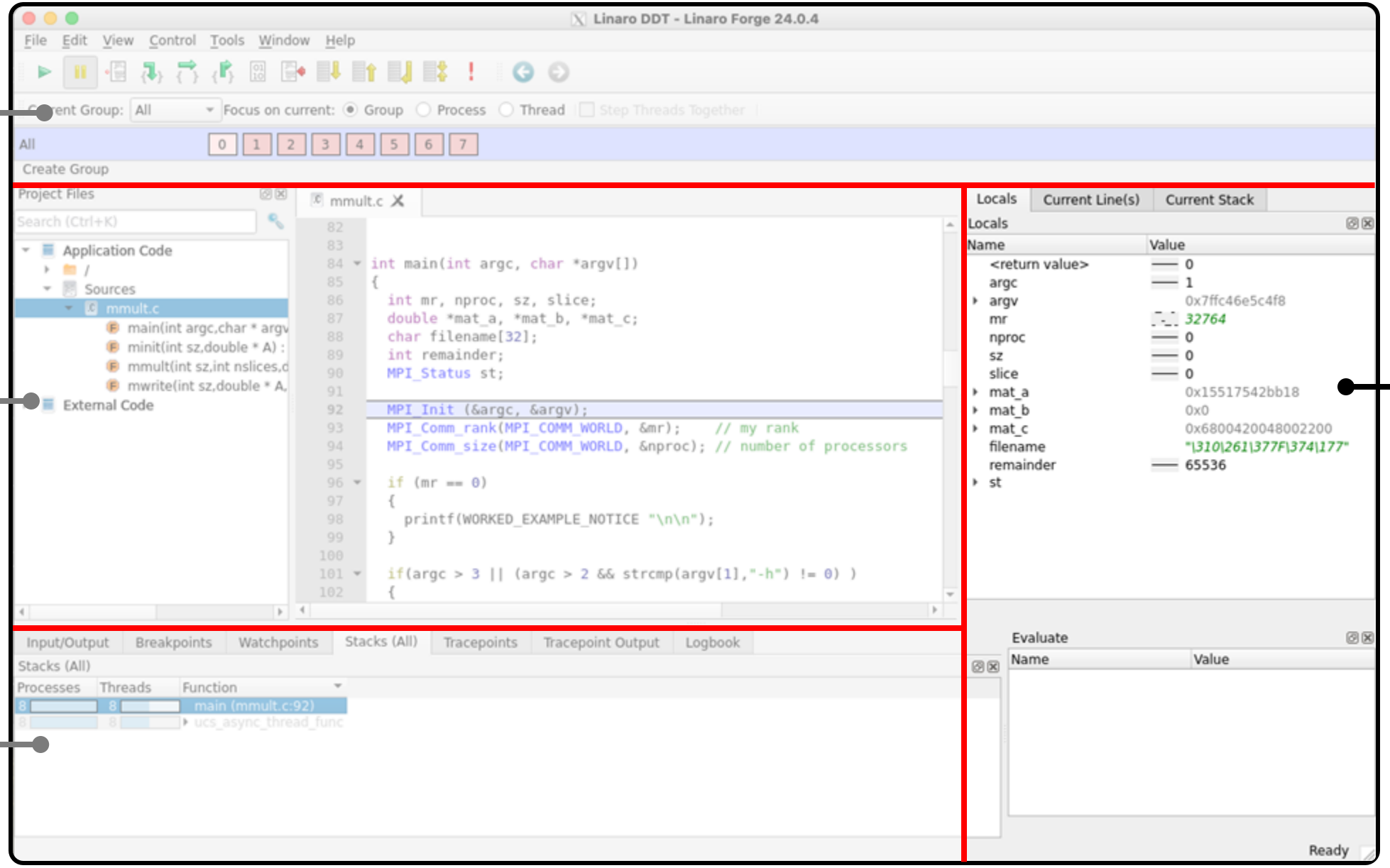
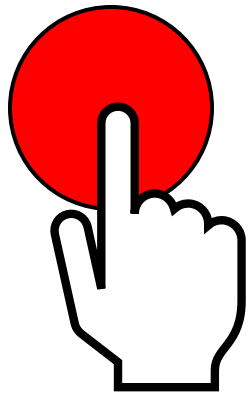


Variables, Data

The 3 “points” of Debugging

Breakpoint



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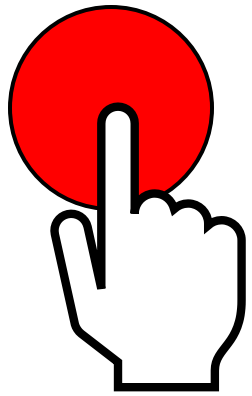
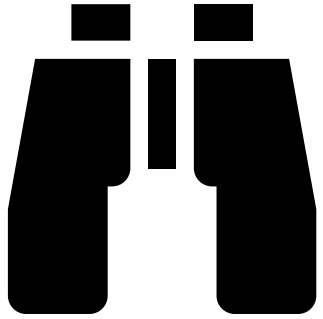


Watchpoint



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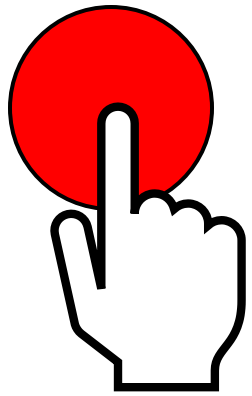
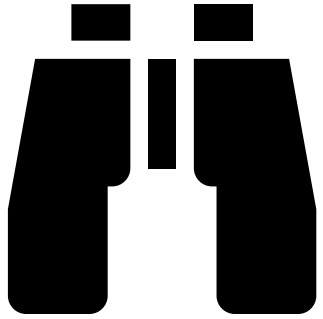
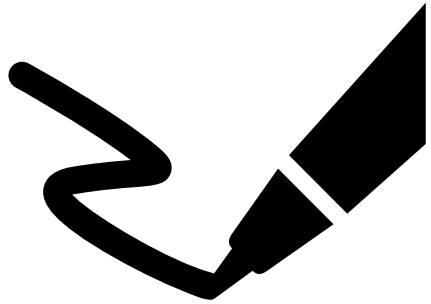


Watchpoint



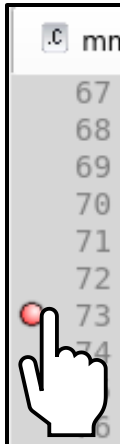
Tracepoint



Breakpoints

mmult.c

```
67  for(int i=0; i<sz/nslices; i++)
68  {
69    for(int j=0; j<sz; j++)
70    {
71      double res = 0.0;
72
73      for(int k=0; k<sz; k++)
74      {
75        res += A[i*sz+k]*B[k*sz+j];
76      }
77
78      C[i*sz+j] += res;
79    }
80  }
```



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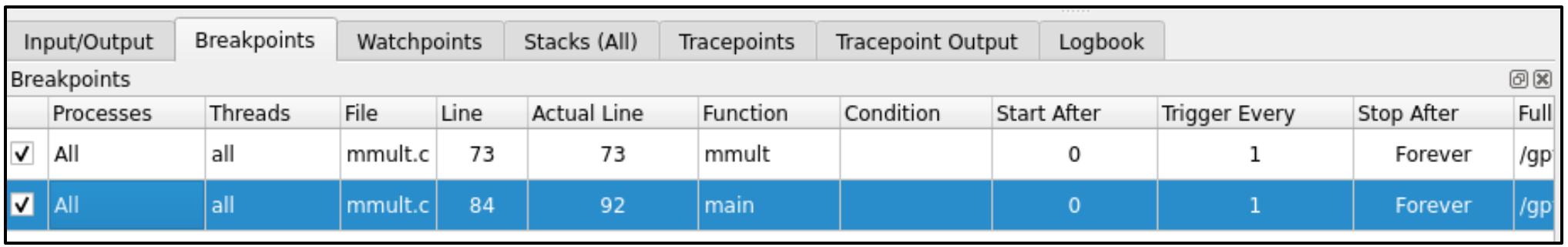

	Processes	Threads	File	Line	Actual Line	Function	Condition	Start After	Trigger Every	Stop After	Full
☑	All	all	mmult.c	73	73	mmult		0	1	Forever	/gp
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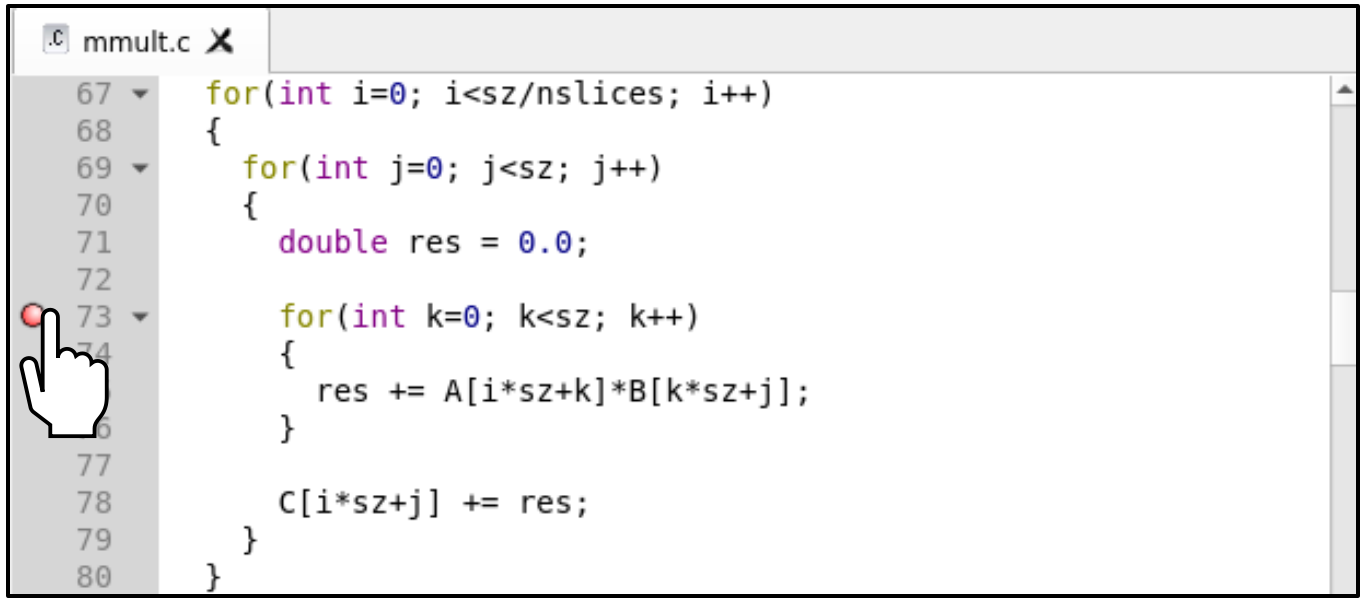
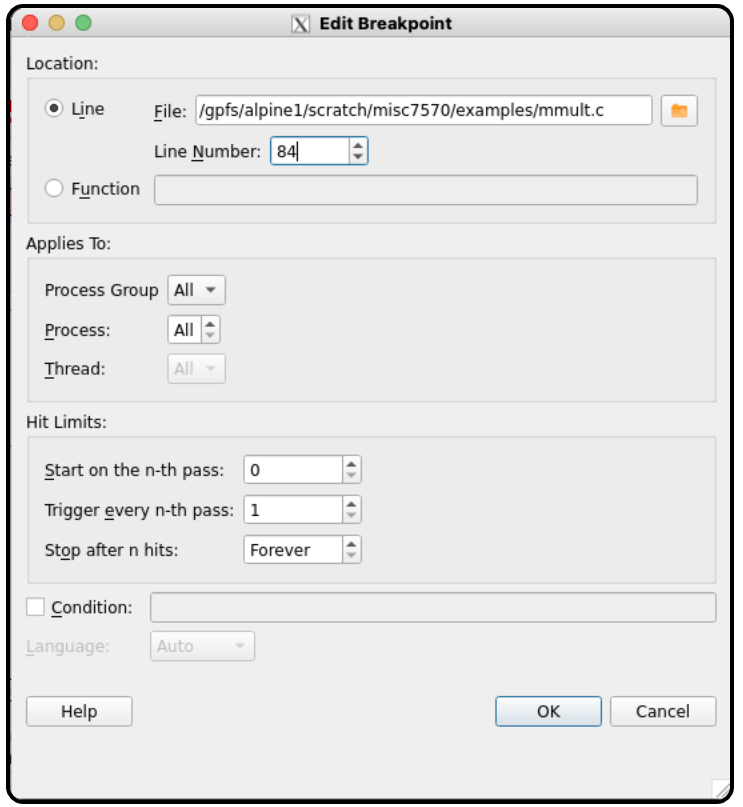
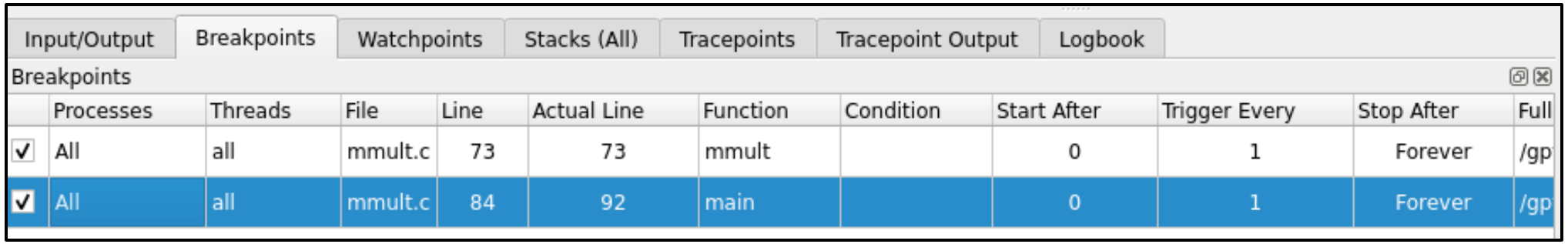
Breakpoints







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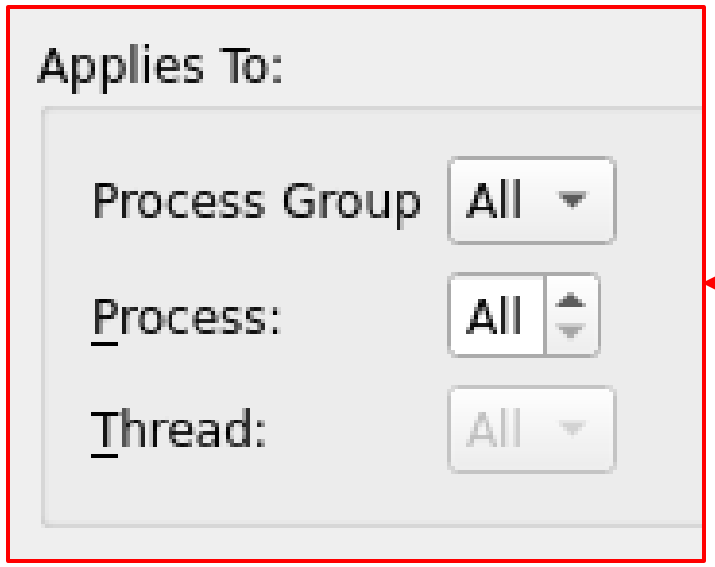
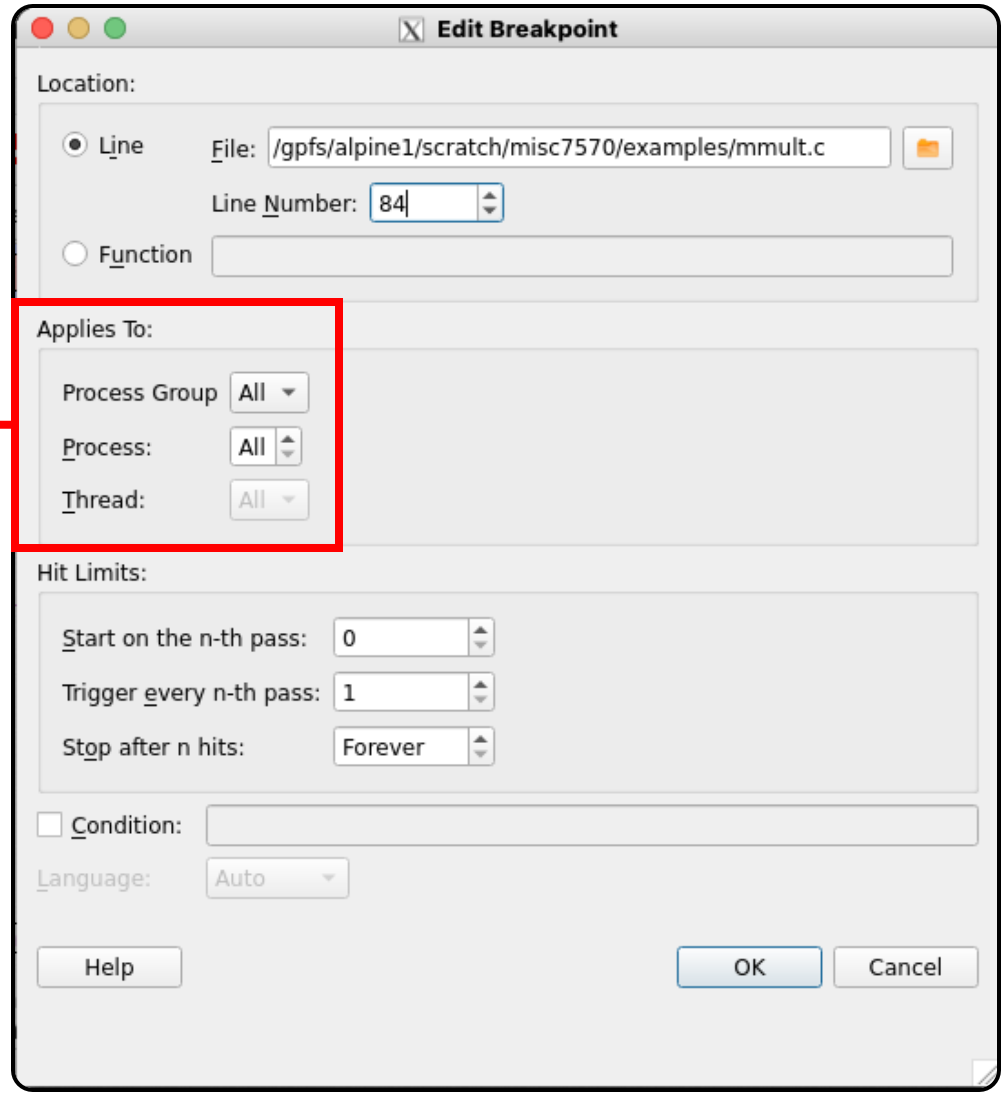
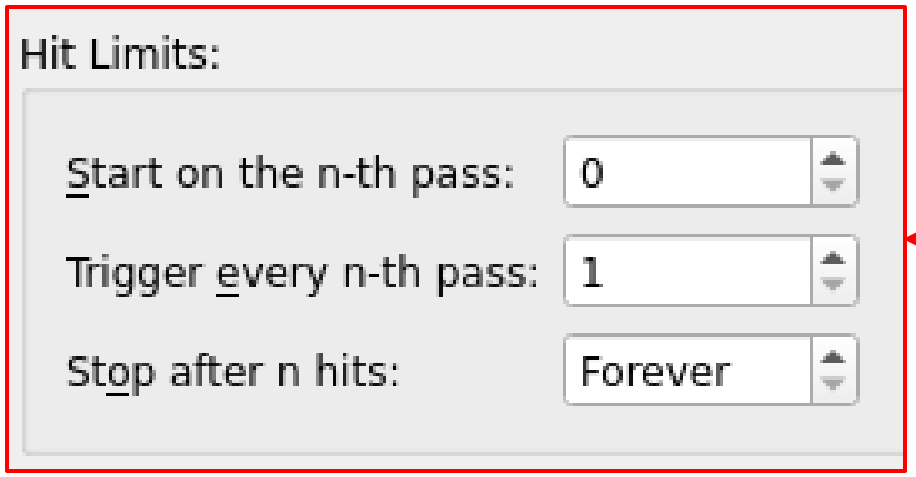
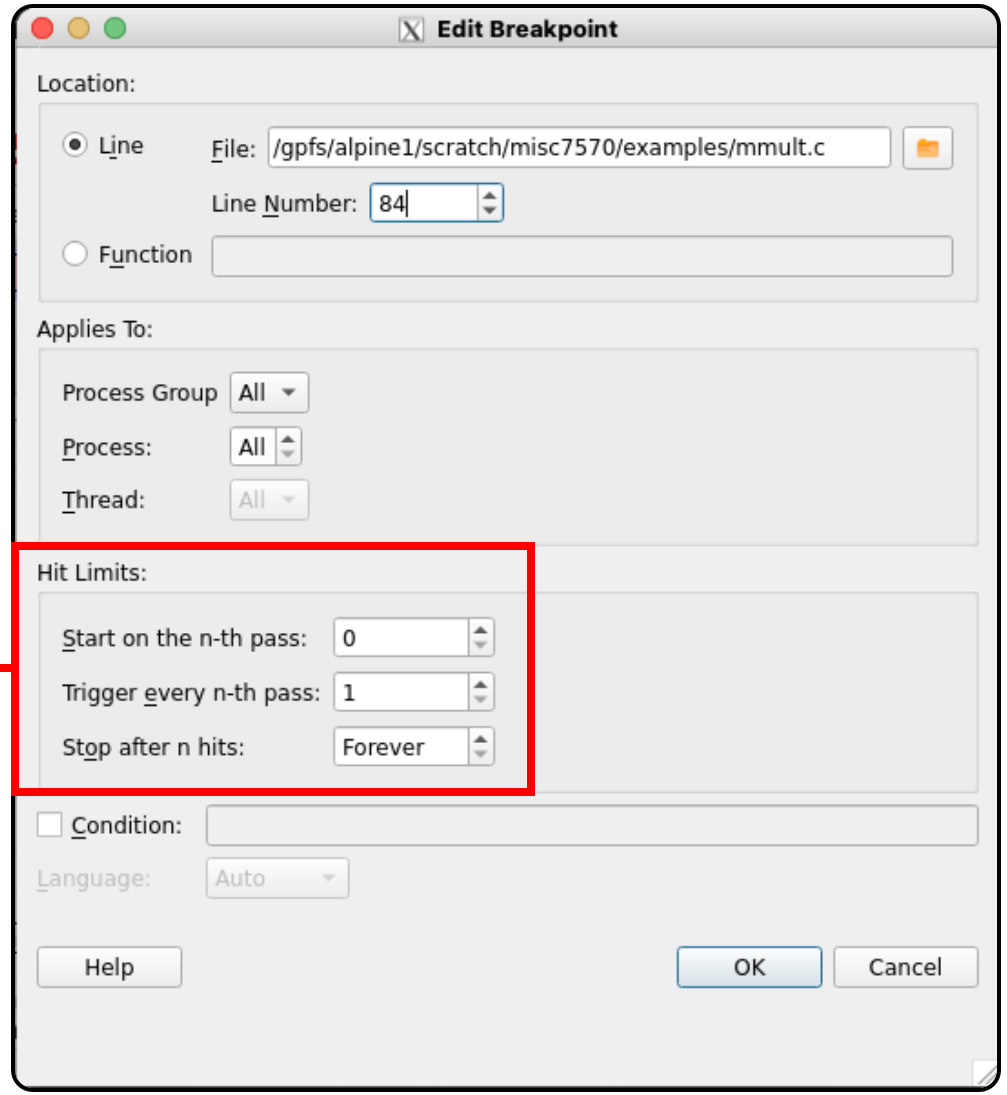


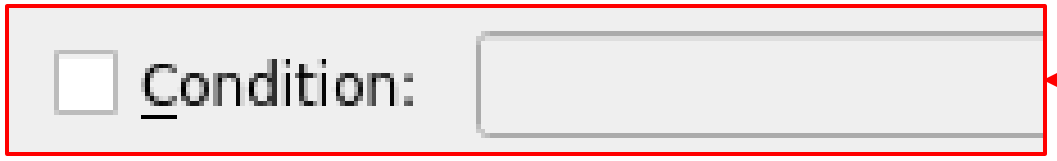


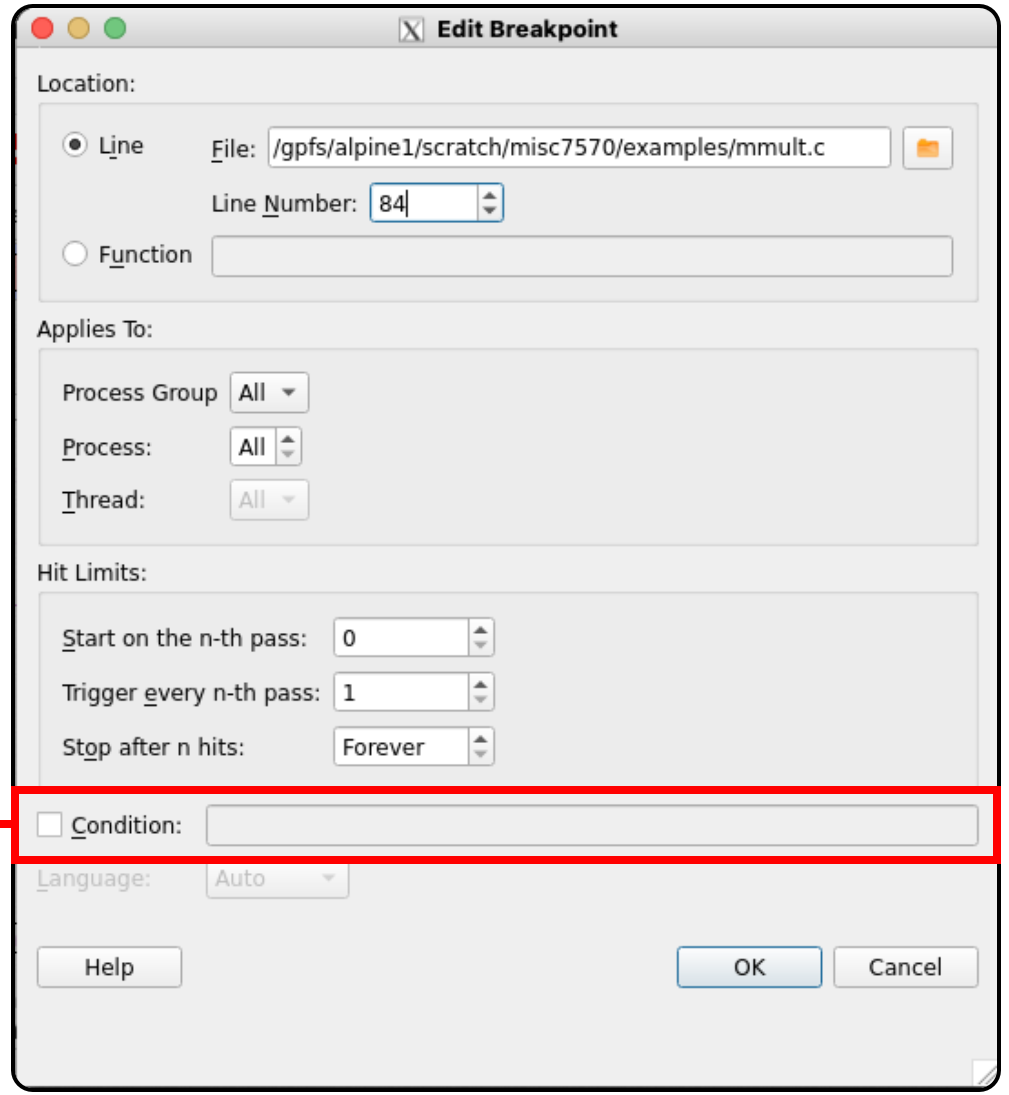
Breakpoints



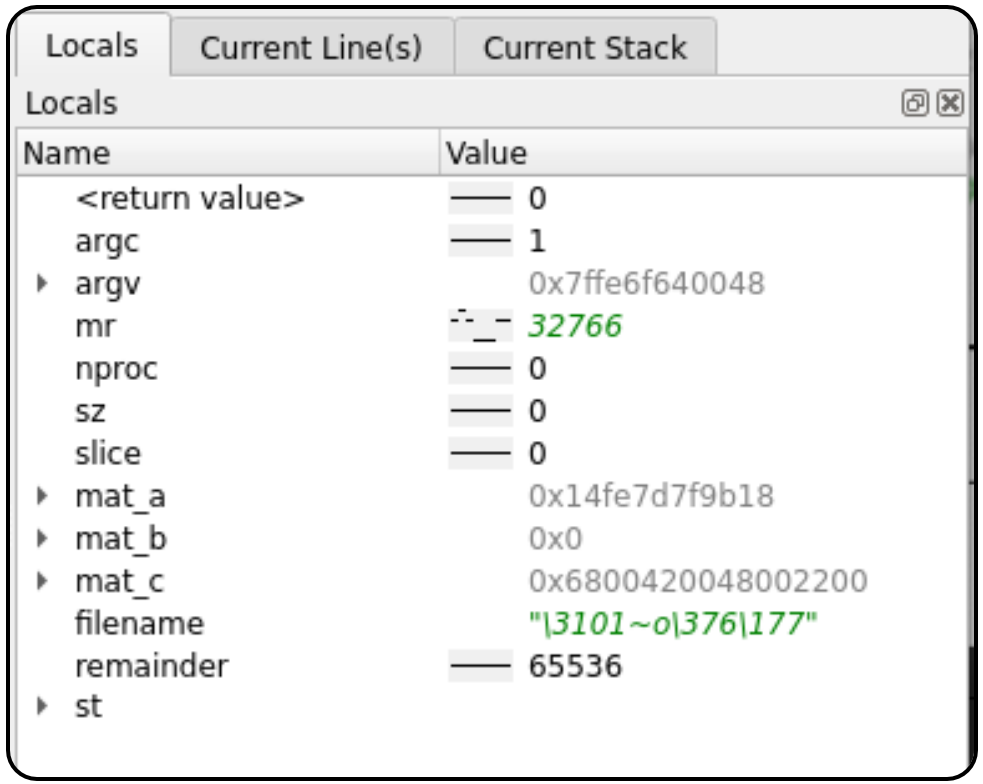


Breakpoints





Variable Sparkline



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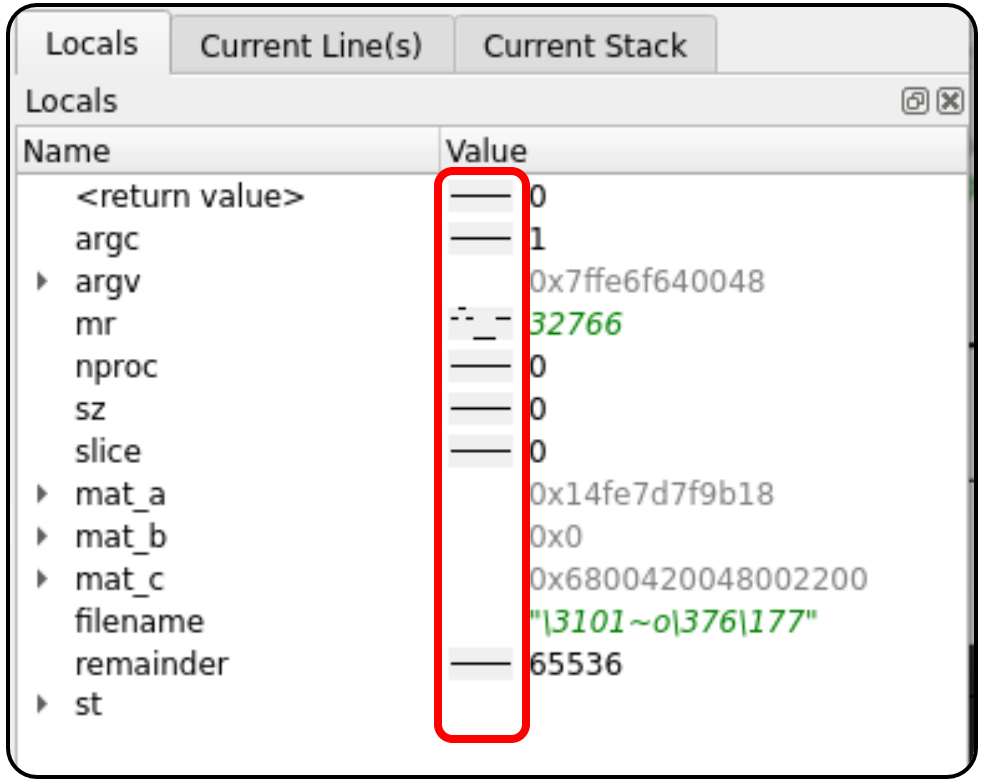

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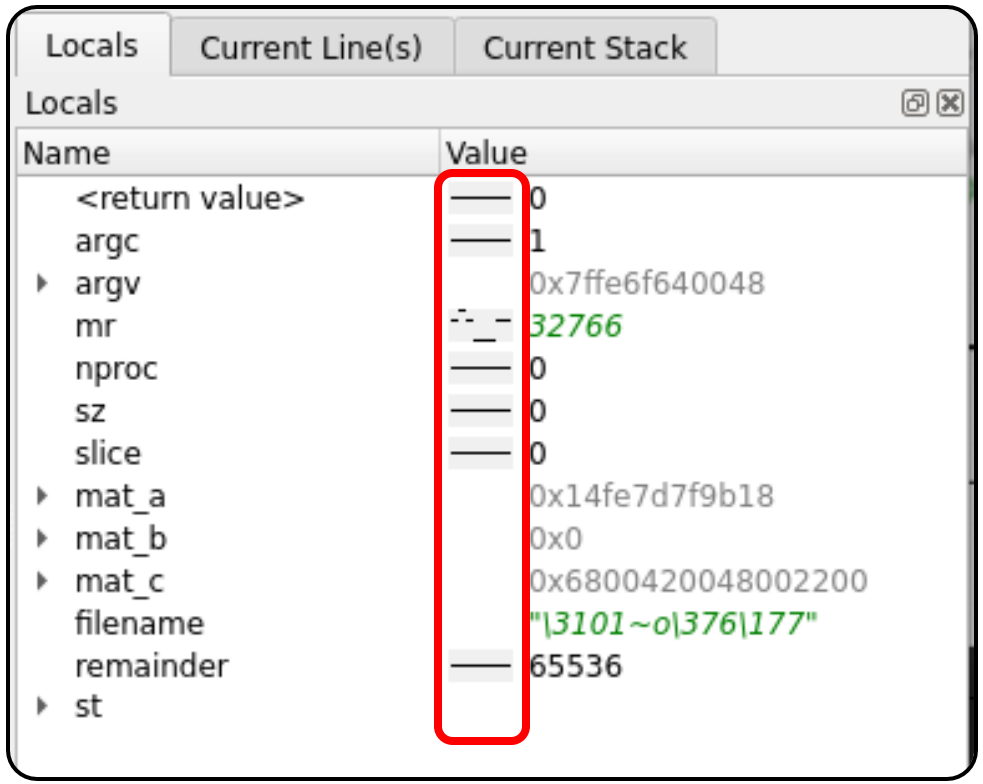
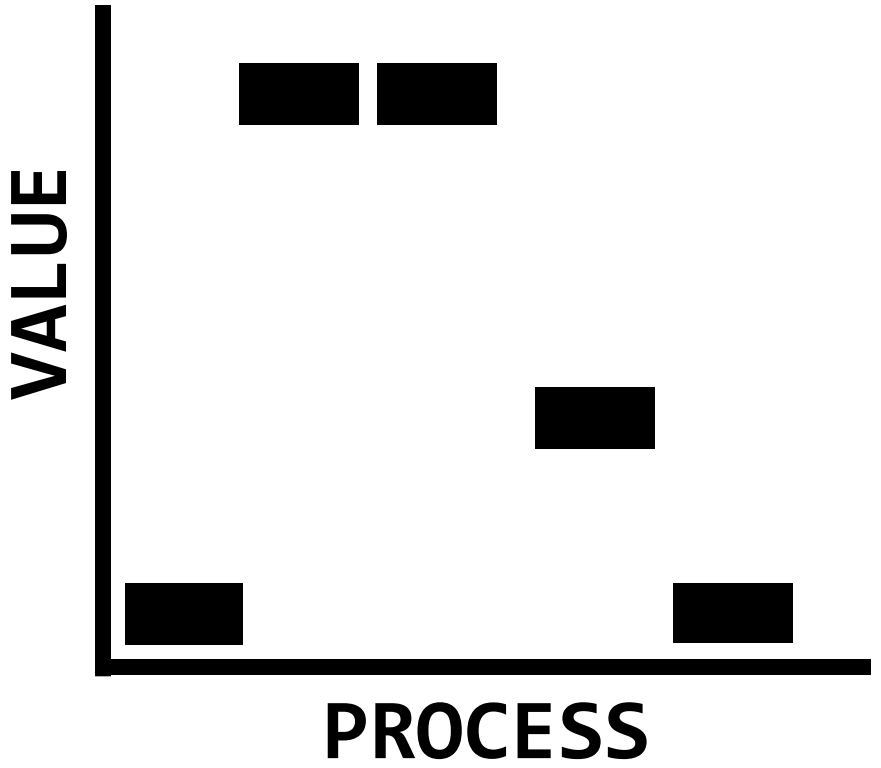
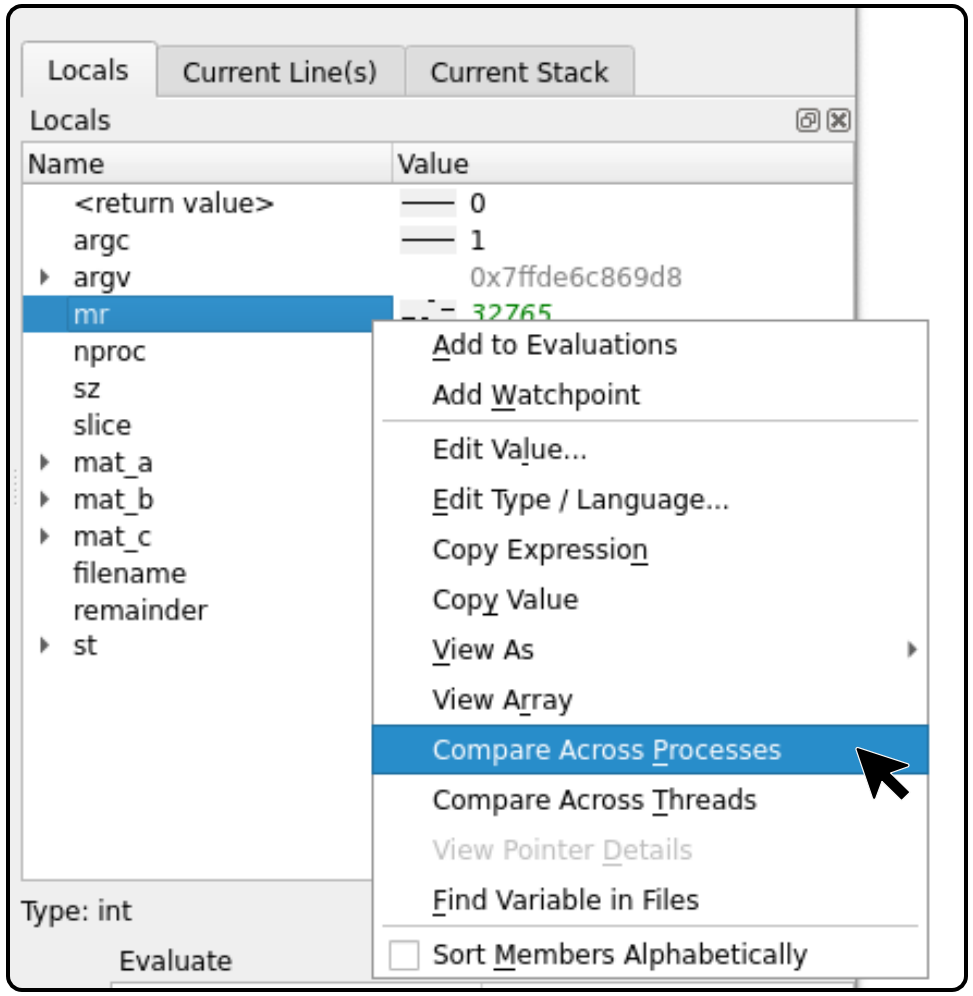
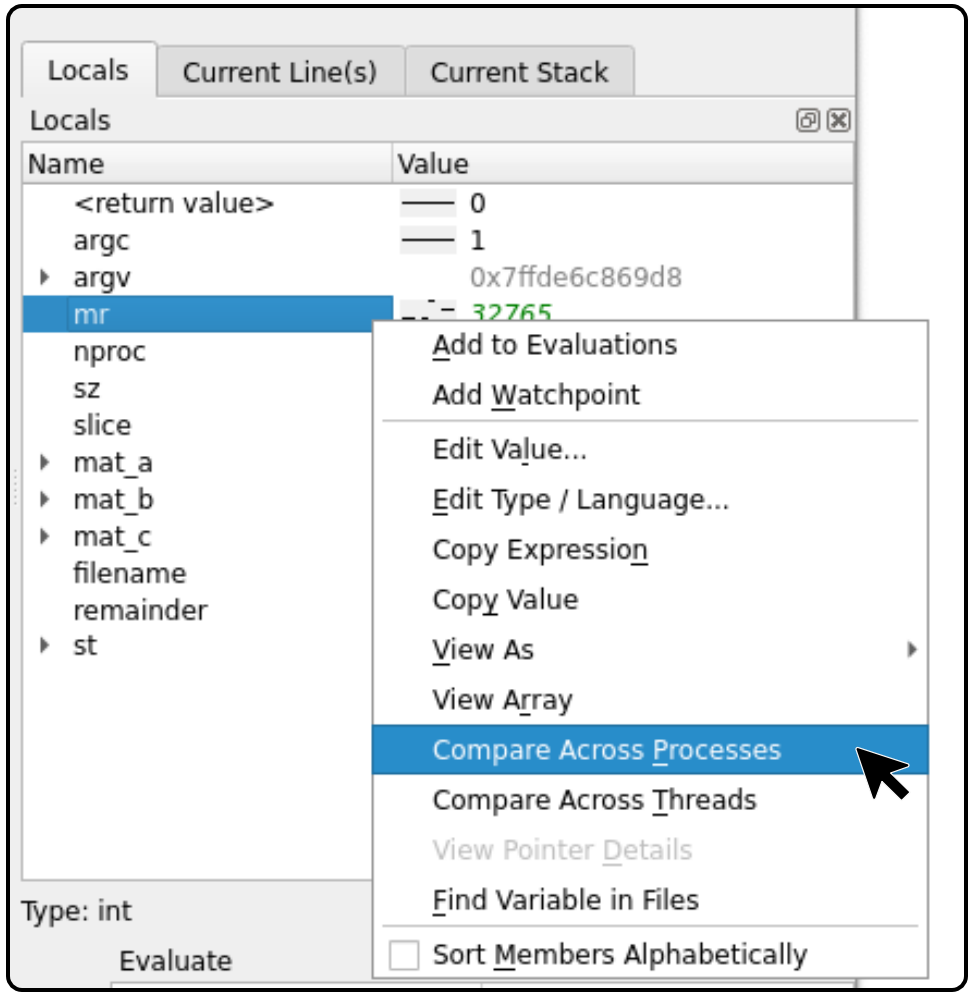


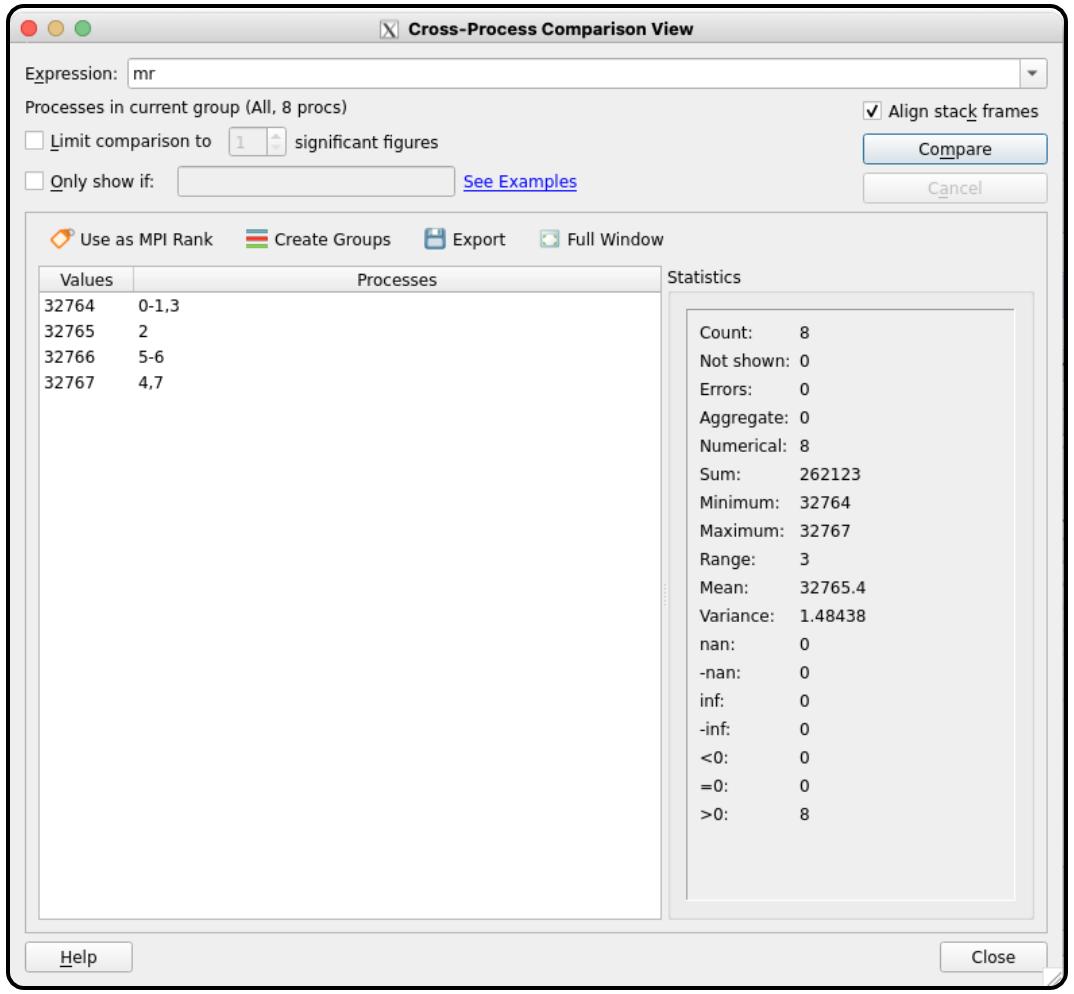


Variable Comparison



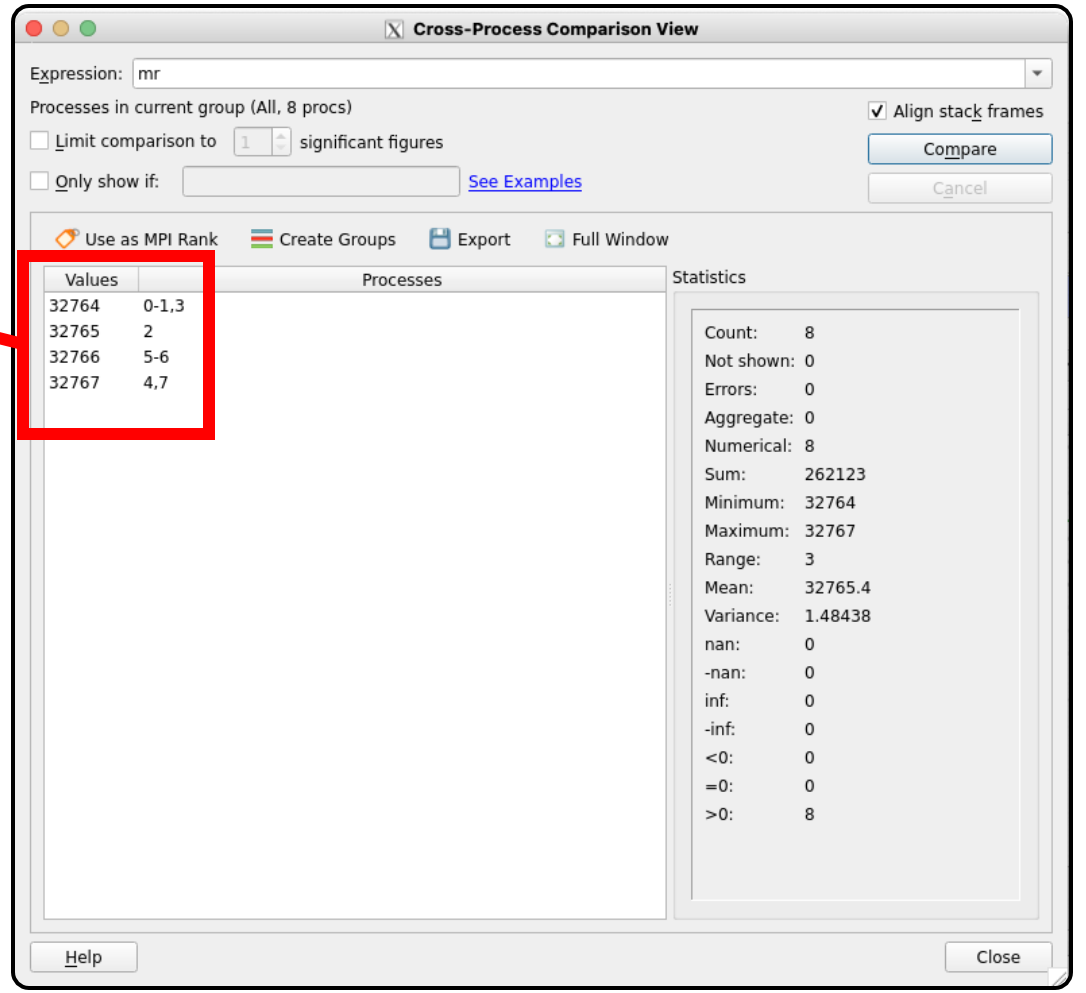
Variable Comparison



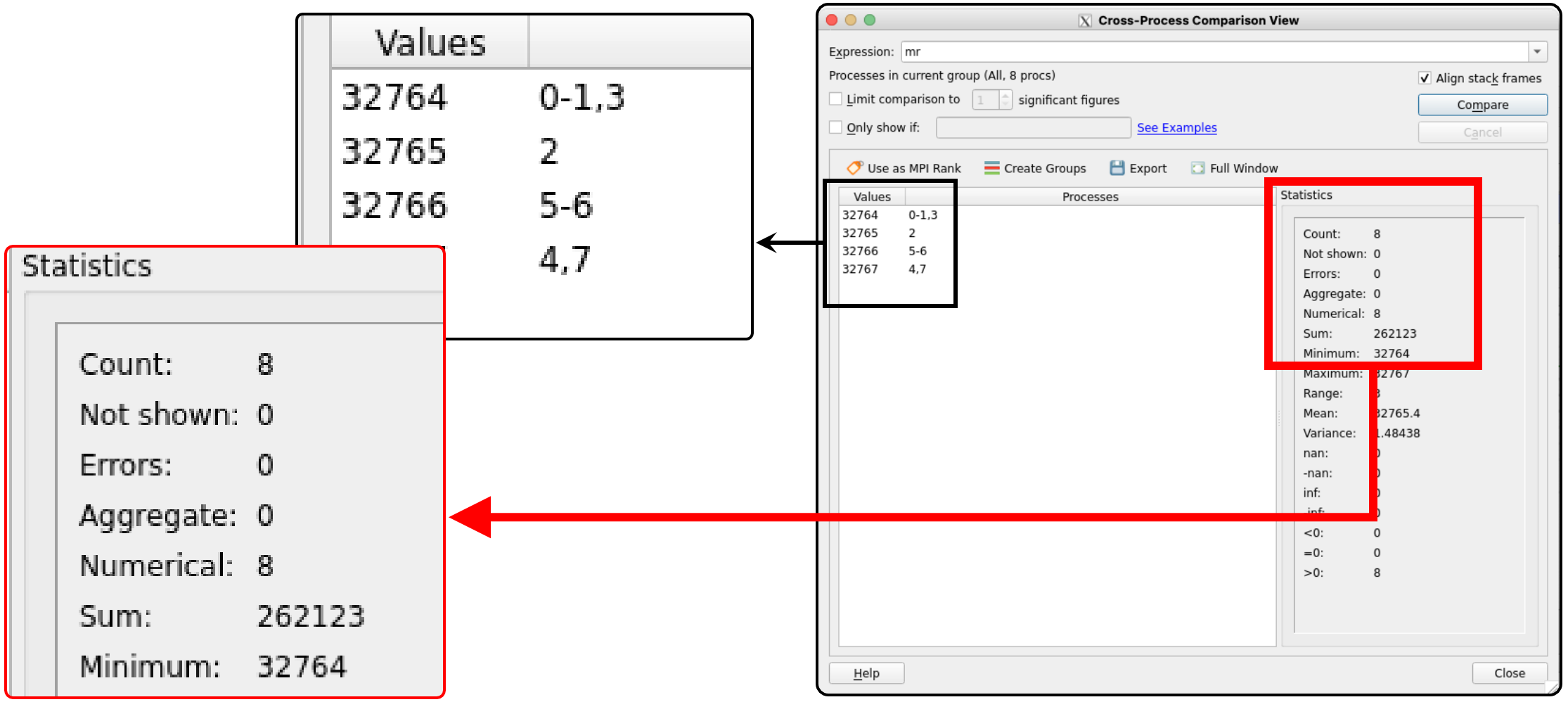


Variable Comparison

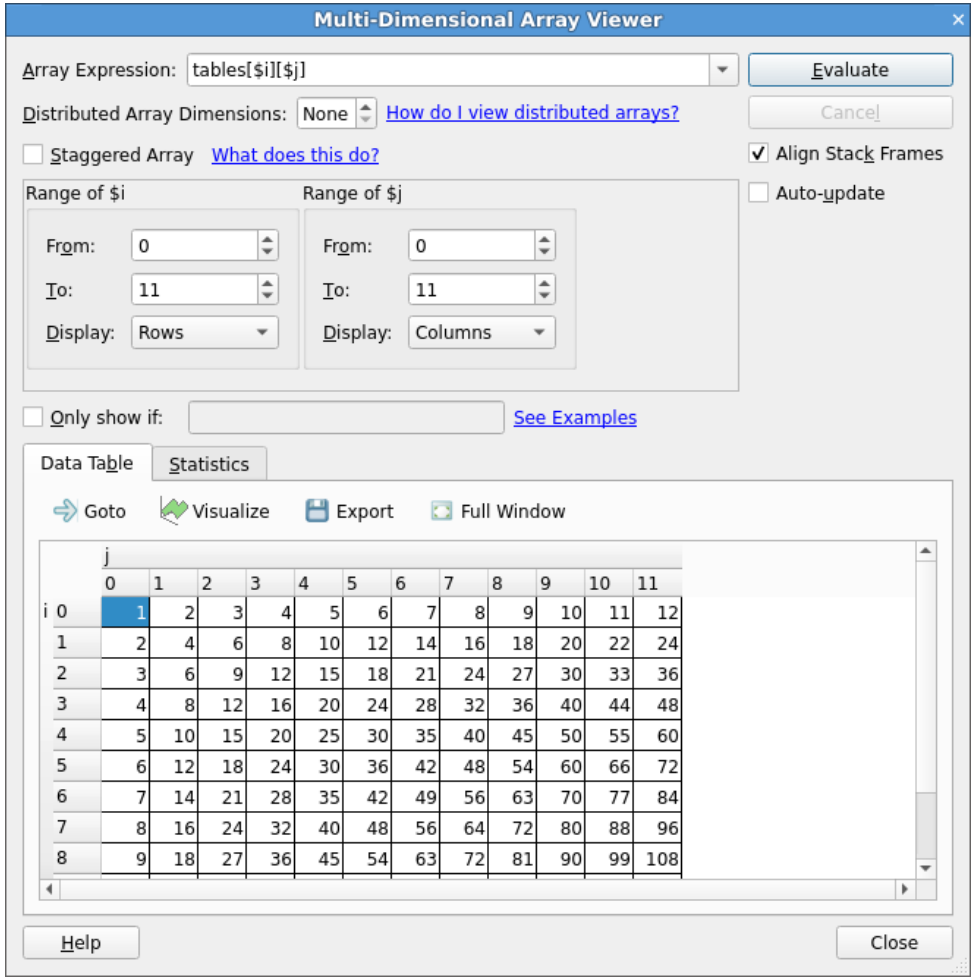
Values	
32764	0-1,3
32765	2
32766	5-6
32767	4,7



Variable Comparison

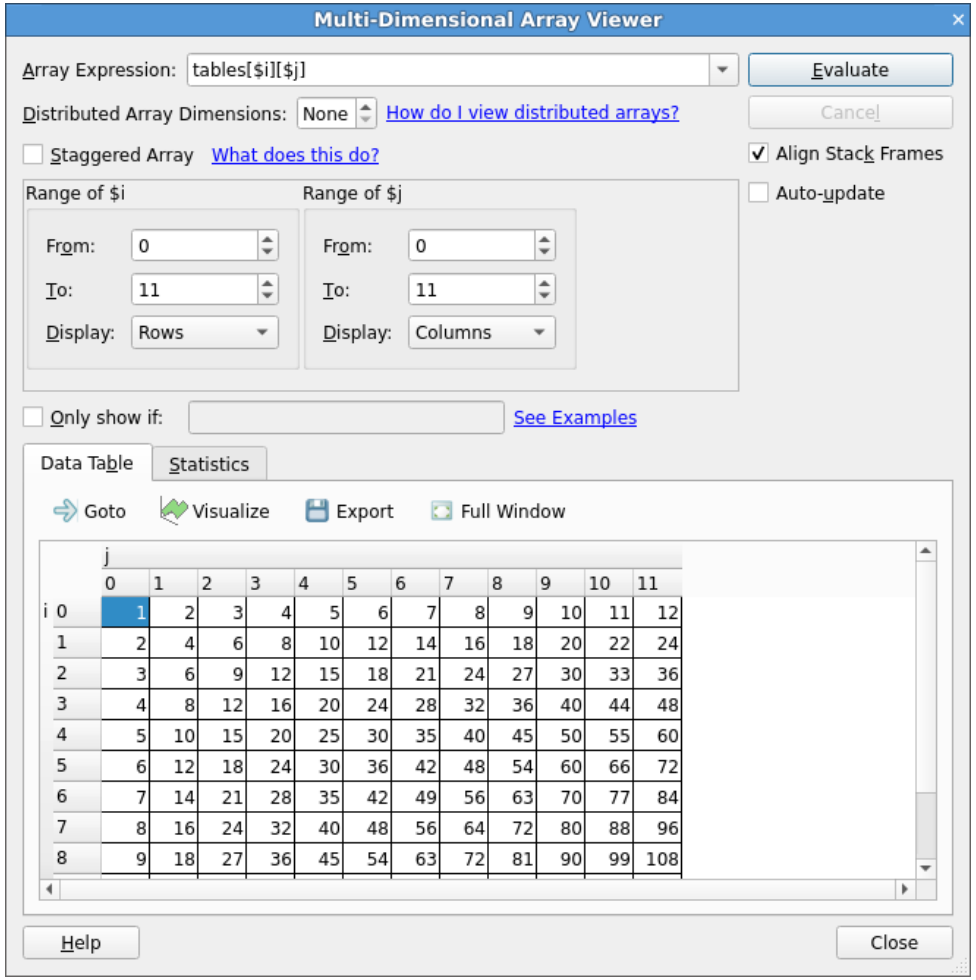


View MD Arrays

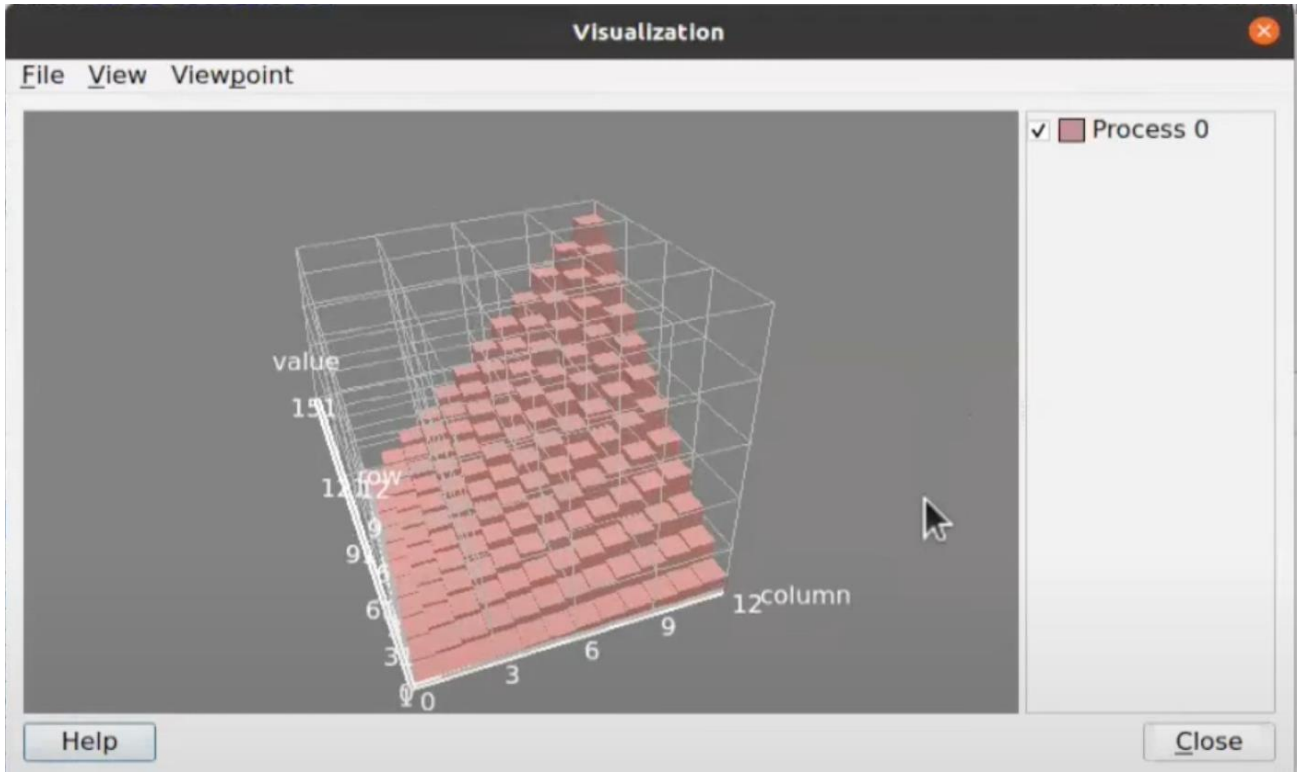


i \ j	0	1	2	3	4	5	6	7	8	9	10	11
0	1	2	3	4	5	6	7	8	9	10	11	12
1	2	4	6	8	10	12	14	16	18	20	22	24
2	3	6	9	12	15	18	21	24	27	30	33	36
3	4	8	12	16	20	24	28	32	36	40	44	48
4	5	10	15	20	25	30	35	40	45	50	55	60
5	6	12	18	24	30	36	42	48	54	60	66	72
6	7	14	21	28	35	42	49	56	63	70	77	84
7	8	16	24	32	40	48	56	64	72	80	88	96
8	9	18	27	36	45	54	63	72	81	90	99	108

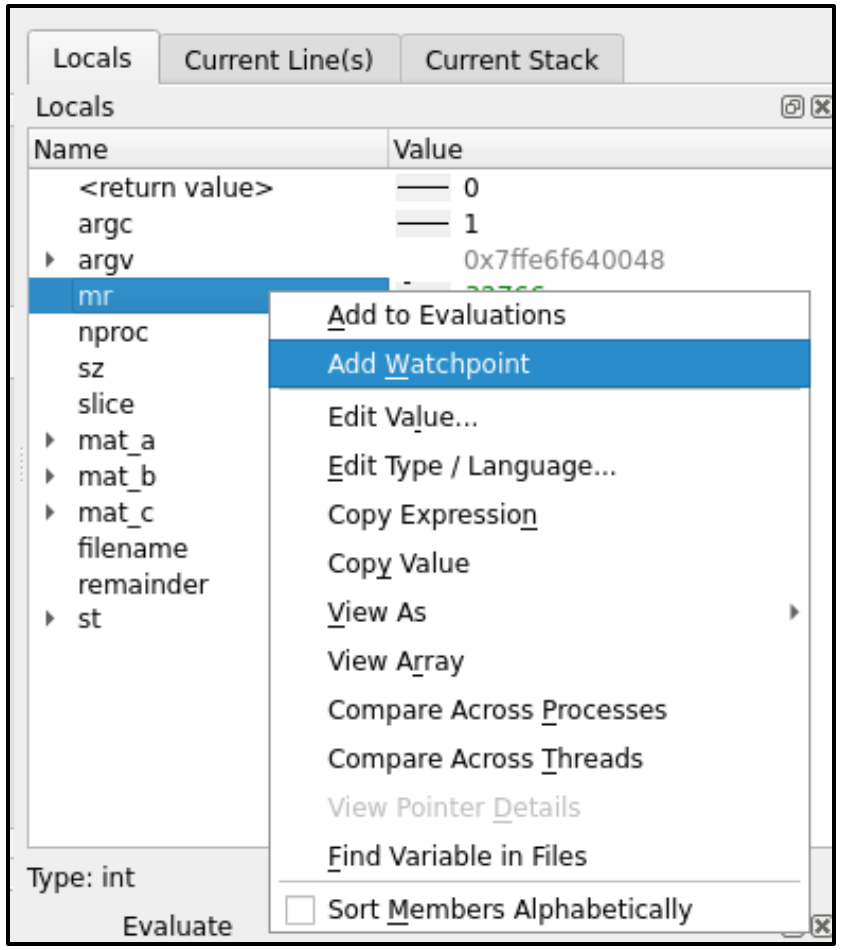
View MD Arrays



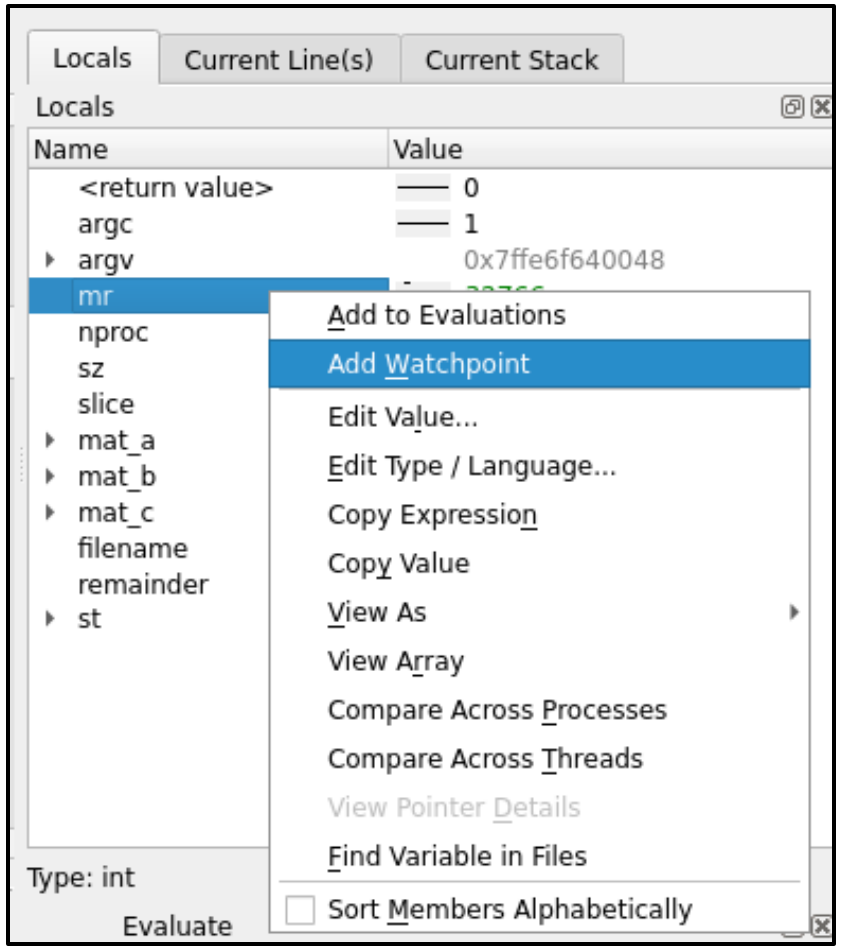
i \ j	0	1	2	3	4	5	6	7	8	9	10	11
0	1	2	3	4	5	6	7	8	9	10	11	12
1	2	4	6	8	10	12	14	16	18	20	22	24
2	3	6	9	12	15	18	21	24	27	30	33	36
3	4	8	12	16	20	24	28	32	36	40	44	48
4	5	10	15	20	25	30	35	40	45	50	55	60
5	6	12	18	24	30	36	42	48	54	60	66	72
6	7	14	21	28	35	42	49	56	63	70	77	84
7	8	16	24	32	40	48	56	64	72	80	88	96
8	9	18	27	36	45	54	63	72	81	90	99	108

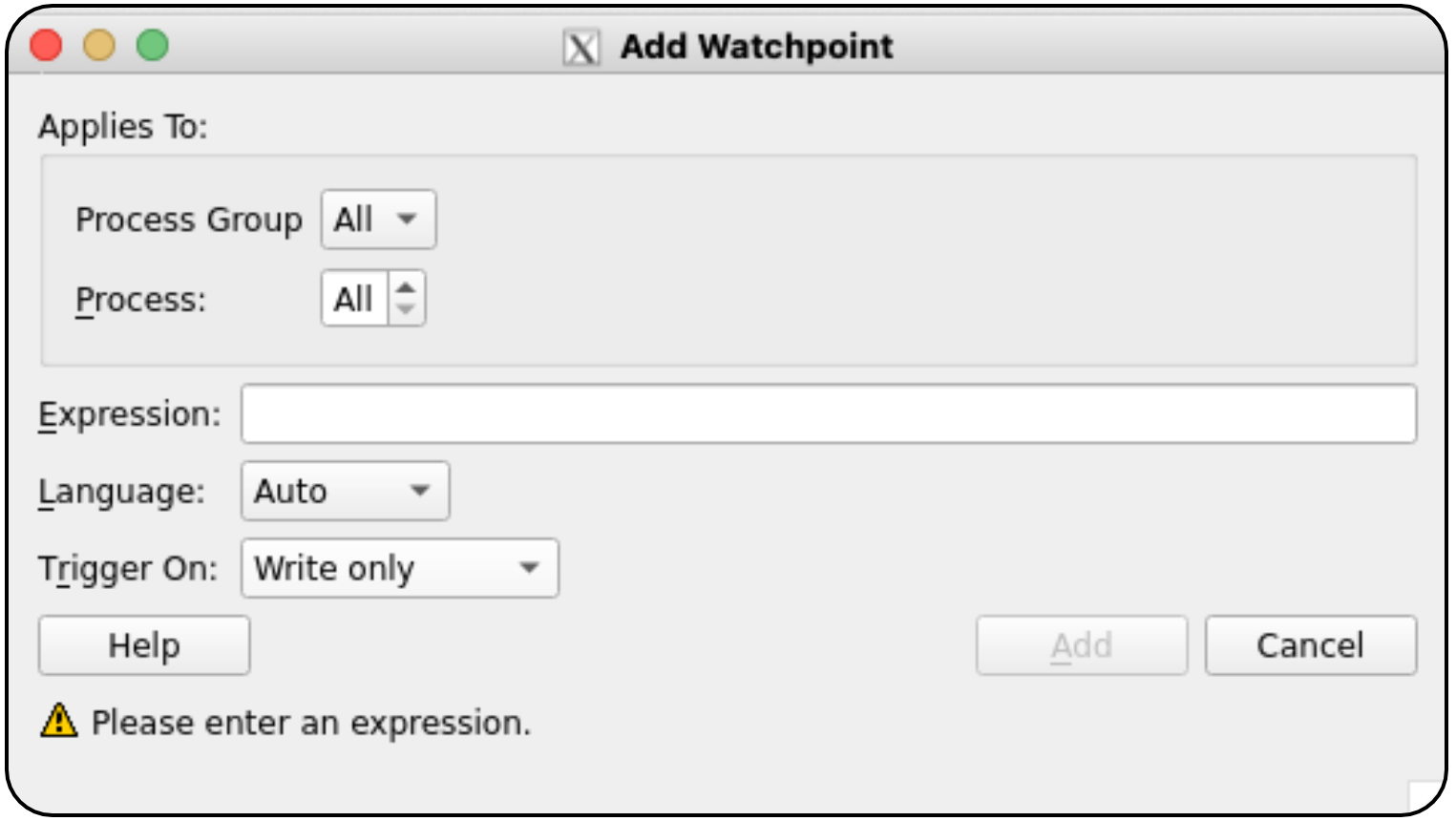


Watchpoints

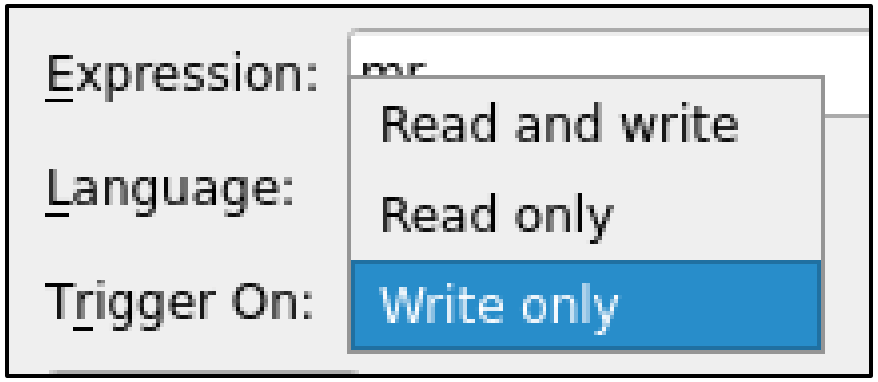


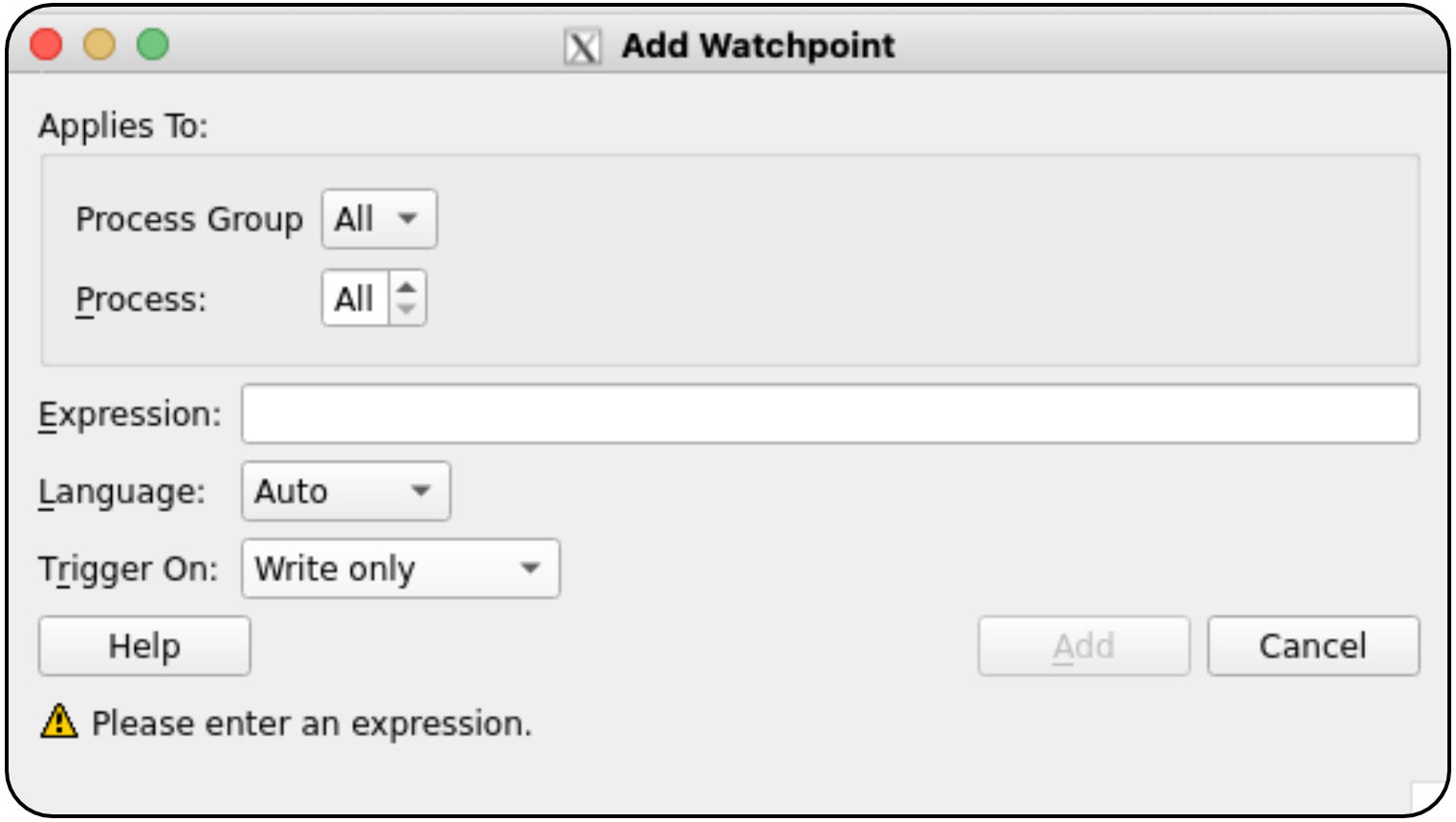
Watchpoints



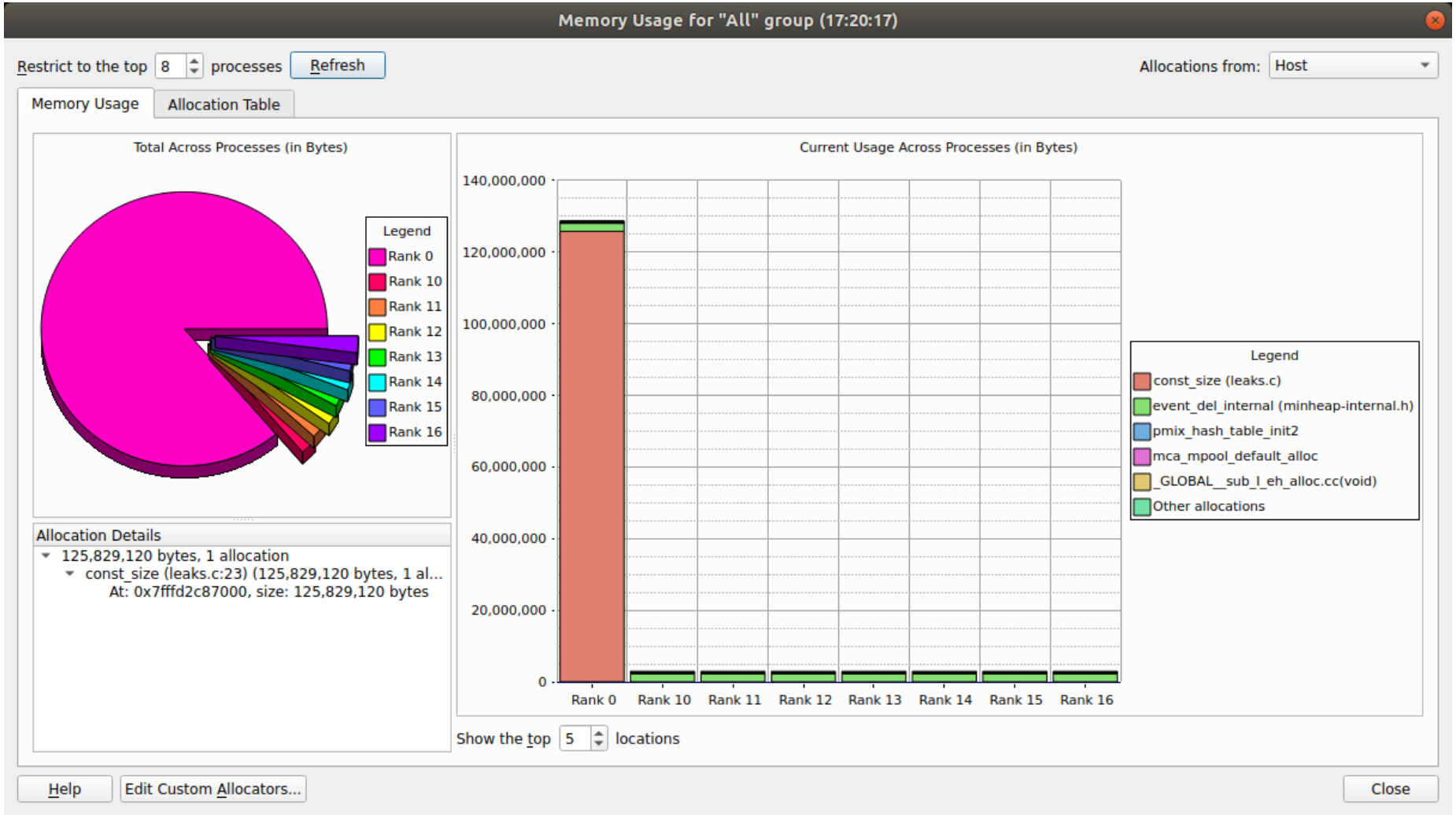


Watchpoints





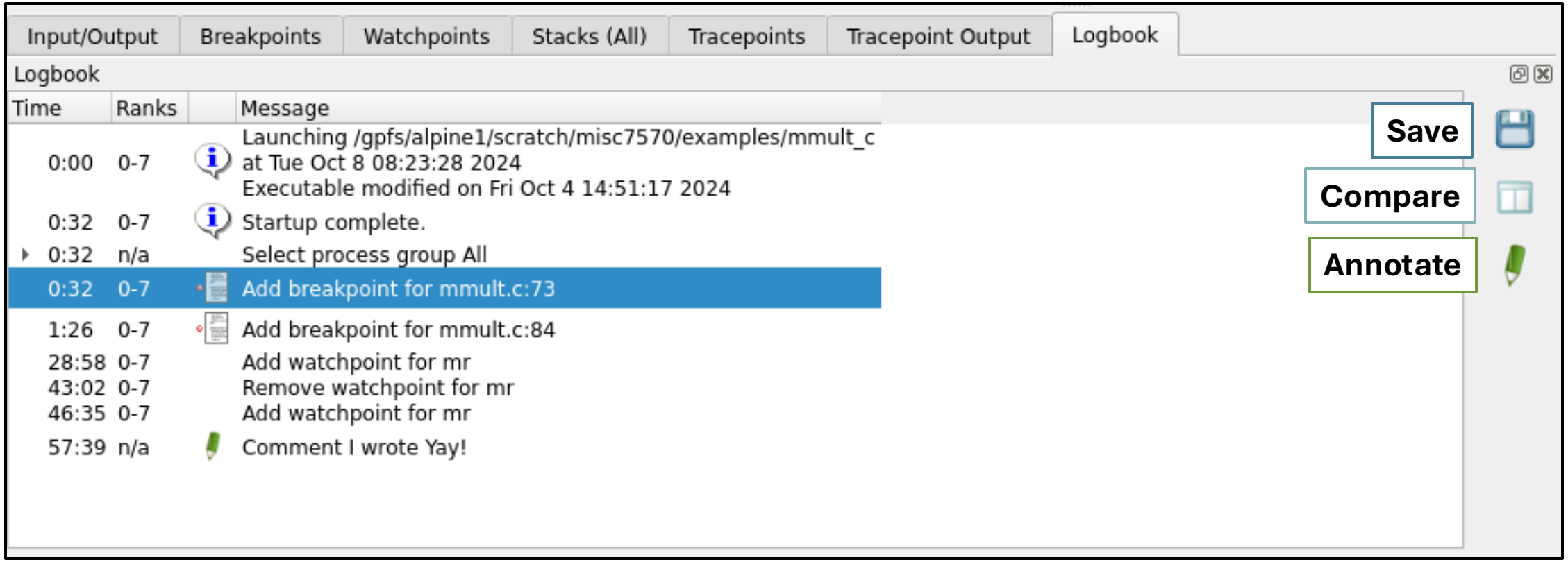
Memory Debugger



Tracepoints

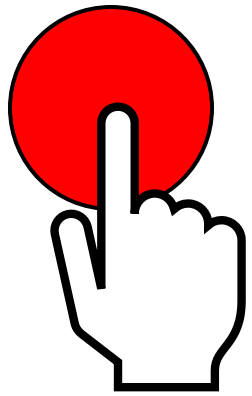
Tracepoint	Processes	Values logged
subdomain (subdomain.f90:59)	16, ranks 0-15	ny: — **16** nx: — **16** nz: — **64**
blts (blts.f90:58)	1, rank 0	m: **1** iend: **16** ldmz: **64** k: **2** ldmx: **16** i: **2** ldz: ist: **2** j: **2** ldmy: **16**
blts (blts.f90:58)	1, rank 0	m: **2** iend: **16** ldmz: **64** k: **2** ldmx: **16** i: **2** ldz: ist: **2** j: **2** ldmy: **16**
blts (blts.f90:58)	1, rank 0	m: **3** iend: **16** ldmz: **64** k: **2** ldmx: **16** i: **2** ldz: ist: **2** j: **2** ldmy: **16**
blts (blts.f90:58)	1, rank 0	m: **4** iend: **16** ldmz: **64** k: **2** ldmx: **16** i: **2** ldz: ist: **2** j: **2** ldmy: **16**

Logbook

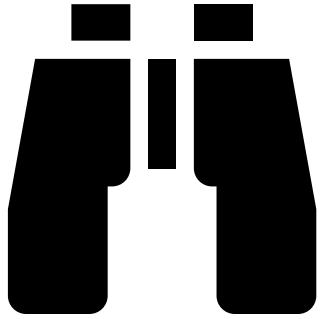

Input/Output
Breakpoints
Watchpoints
Stacks (All)
Tracepoints
Tracepoint Output
Logbook
Logbook
Time
Ranks
Message
0:00 0-7 Launching /gpfs/alpine1/scratch/misc7570/examples/mmult_c
at Tue Oct 8 08:23:28 2024
Executable modified on Fri Oct 4 14:51:17 2024
0:32 0-7 Startup complete.
0:32 n/a Select process group All
0:32 0-7 Add breakpoint for mmult.c:73
1:26 0-7 Add breakpoint for mmult.c:84
28:58 0-7 Add watchpoint for mr
43:02 0-7 Remove watchpoint for mr
46:35 0-7 Add watchpoint for mr
57:39 n/a Comment I wrote Yay!
Save
Compare
Annotate

When to use each “point”

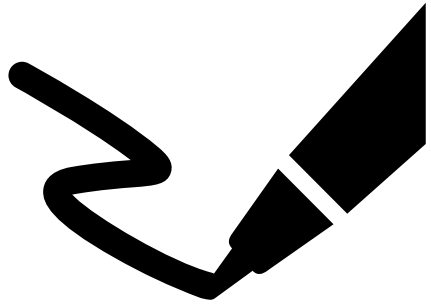
Breakpoint



Watchpoint



Tracepoint

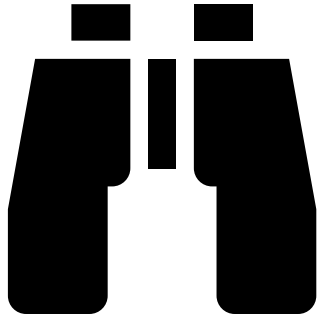


When to use each “point”

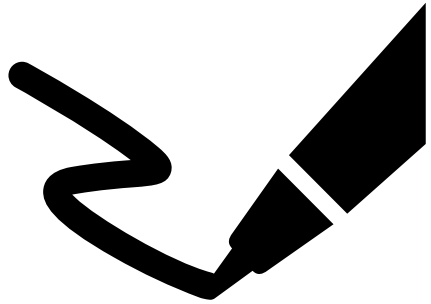
Breakpoint

Observe
Code
Location

Watchpoint



Tracepoint



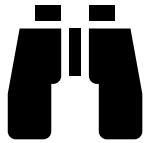
When to use each “point”

Breakpoint

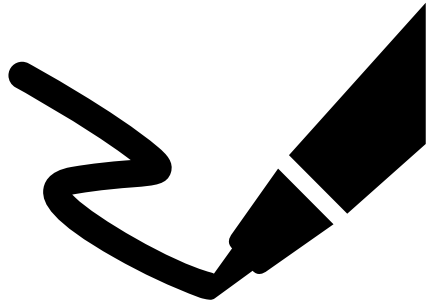
Observe
Code
Location

Watchpoint

Observe
Data
Location



Tracepoint



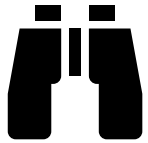
When to use each “point”

Breakpoint

Observe
Code
Location

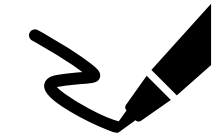
Watchpoint

Observe
Data
Location



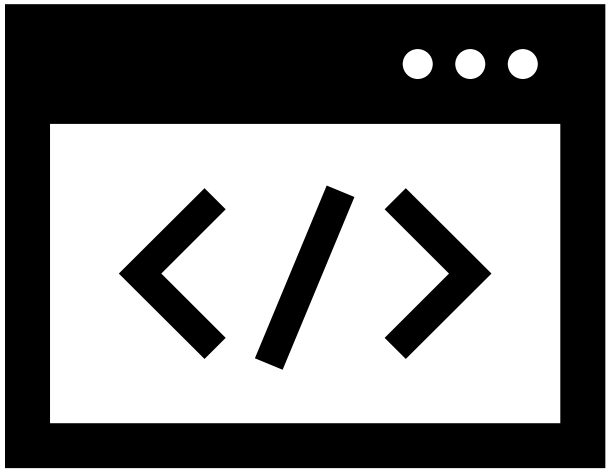
Tracepoint

Record
Code
Location



Offline Debugging

```
$ ddt --offline mpiexec –n <Num-Proc> <Program> <Arguments>
```



Offline Debugging

Debugging /gpfs/alpine1/scratch/misc7570/examples/mmult_c

Messages | Tracepoints | Output

Messages

[+] Expand All [-] Collapse All

#	Type	Time	Processes	Message
1	ℹ	0:00.000	n/a	Launching mpiexec -n 8 ./mmult_c at Thu Oct 3 10:51:52 2024
2	ℹ	0:04.071	n/a	No debug symbols were loaded for the glibc library. It is recommended you install the glibc debug symbols.
3	ℹ	0:06.648	n/a	No debug symbols were loaded for the glibc library. It is recommended you install the glibc debug symbols.
4	ℹ	0:09.313	0-7	Startup complete.
5		0:09.314	n/a	Select process group All
6	ℹ	0:11.991	n/a	Debugging : mpiexec -n 8 ./mmult_c MPI implementation : Auto-Detect (Intel MPI (MPMD)) * number of processes : 8 * number of nodes : 2 Memory debugging enabled : No
7	▶	0:11.992	0-7	Play
8	⚠	0:12.056	0-7	Process stopped in mmult (mmult.c:75) with signal SIGSEGV (Segmentation fault). Reason/Origin: address not mapped to object (attempt to access invalid address)
9				Additional Information ▶ Stacks ▶ Current Stack

Offline Debugging

```
$ ddt --offline mpiexec –n <Num-Proc> <Program> <Arguments>
```

Additional Command Line Options:

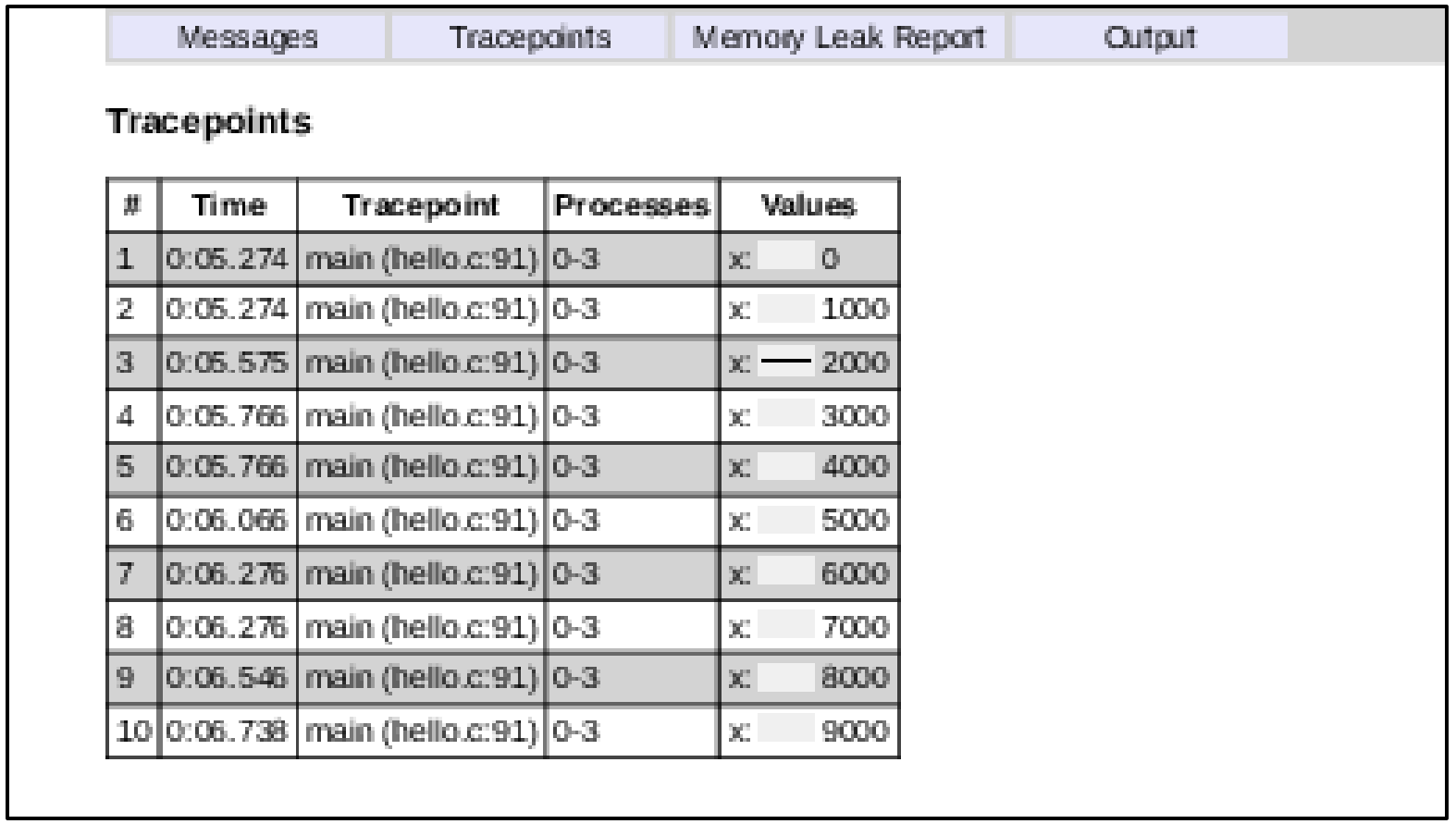
--session=SESSIONFILE

--mem-debug[=(fast/balanced/thorough/off)]

--snapshot-interval=MINUTES

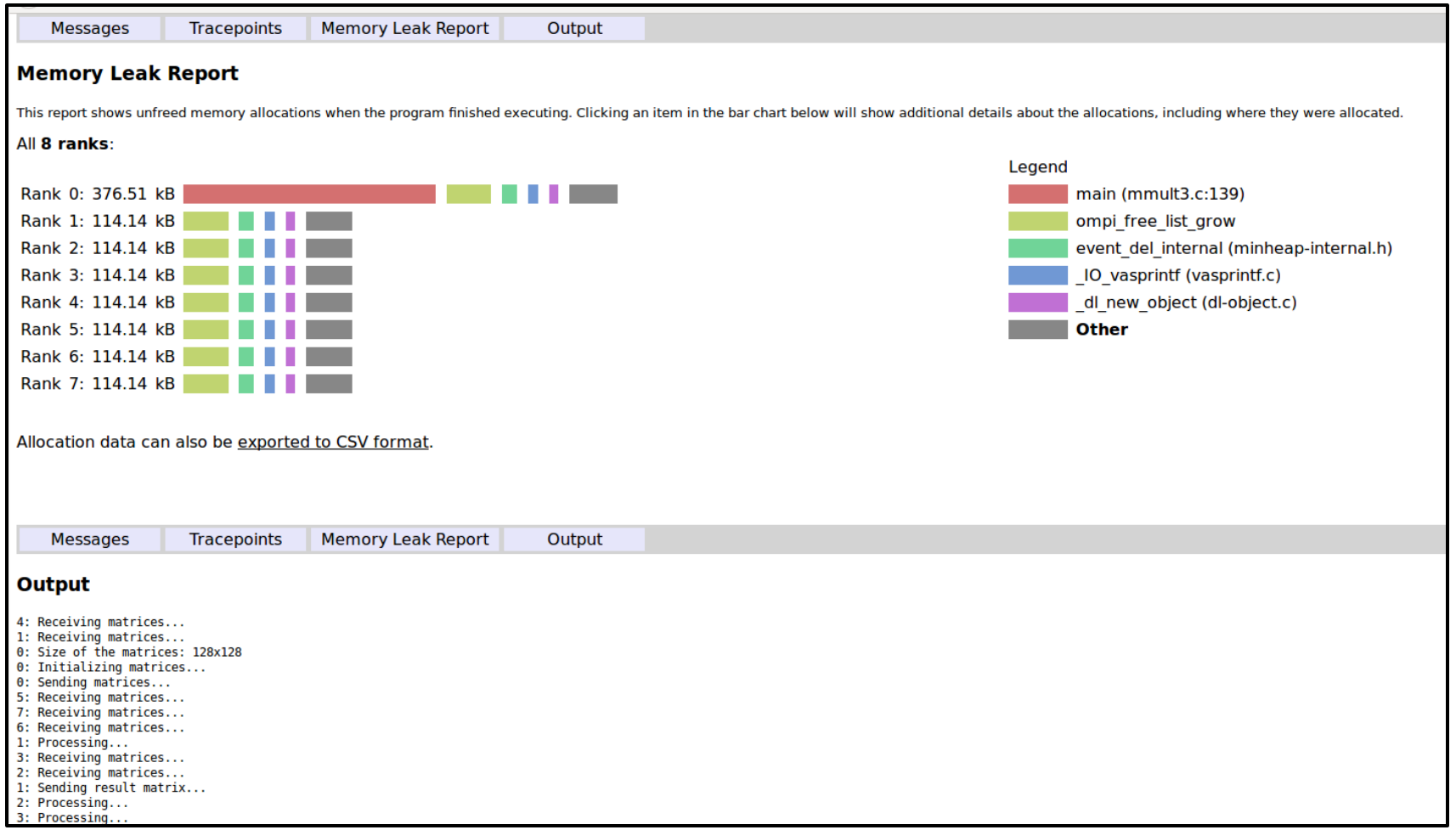
--trace-at=LOCATION[,N:M:P],VAR1,VAR2,...] [if CONDITION]

Offline Debugging - Tracepoint



#	Time	Tracepoint	Processes	Values
1	0:05.274	main (hello.c:91)	0-3	x: 0
2	0:05.274	main (hello.c:91)	0-3	x: 1000
3	0:05.575	main (hello.c:91)	0-3	x: 2000
4	0:05.766	main (hello.c:91)	0-3	x: 3000
5	0:05.766	main (hello.c:91)	0-3	x: 4000
6	0:06.066	main (hello.c:91)	0-3	x: 5000
7	0:06.276	main (hello.c:91)	0-3	x: 6000
8	0:06.276	main (hello.c:91)	0-3	x: 7000
9	0:06.546	main (hello.c:91)	0-3	x: 8000
10	0:06.738	main (hello.c:91)	0-3	x: 9000

Offline Debugging – Memory Leak



Survey and feedback

http://tinyurl.com/curc-survey18