



Summary: Activity analysis for reverse-mode differentiation of (CUDA) GPU kernels

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13.11.2025

Main goals

- Removing excessive atomicAdd's
- Reworking Varied Analysis using VarData

atomicAdd

```
__global__ void kernel_call(double *out, double *in) {  
    int index = threadIdx.x + blockIdx.x * blockDim.x;  
    out[index] = in[index];  
}  
  
void fn(double *out, double *in) {  
    kernel_call<<<1, 16>>>(out, in);  
}
```

```
{  
    out[index0] = _t2;  
    double _r_d0 = _d_out[index0];  
    _d_out[index0] = 0.;  
    atomicAdd(&_d_in[index], _r_d0);  
}  
  
    _d_in[index] += _rd0;
```

How did it do?

- Primitive example with single atomic: up to 5x
- LULESH: up to 5%

Problem size = 875

Elapsed time = 0.07316 (s)	Elapsed time = 0.06990 (s)
Grind time (us/z/c) = 83.611429 (per dom)	Grind time (us/z/c) = 78.856
FOM = 11.960087 (z/s)	FOM = 12.681343 (z/s)

Problem size = 31408

Elapsed time = 0.62164 (s)	Elapsed time = 0.60175 (s)
Grind time (us/z/c) = 19.792478	Grind time (us/z/c) = 19.159195
FOM = 50.524257 (z/s)	FOM = 52.194259 (z/s)

atomicAdd

 **Add liveness check for removing atomics** ✓

#1483 by ovdiiuv was merged on Aug 13 • Approved

 **Don't create CUDA atomics for basic indices** ✓

#1441 by ovdiiuv was merged on Aug 4 • Approved

 **Recompute the values of CUDA built-in index functions** ✓

#1430 by ovdiiuv was merged on Jul 7 • Approved

Varied Analysis

- Reimplemented using VarData
- Added support for pointers and OOP
- Enabled VA on all gradient tests numerically

Varied Analysis

 **Move TBR infrastructure to AnalysisBase** ✓

#1456 by ovdiuv was merged on Aug 14 • Approved

 **Check if m_AnalysisDC is valid** ✓

#1459 by ovdiuv was merged on Aug 2 • Approved

 **Reimplement VA using AnalysisBase infrastructure** ✓

#1508 by ovdiuv was merged on Sep 7 • Approved

 **Add support for OOP and enable respective numerical tests** ✓

#1612 by ovdiuv was merged 2 weeks ago • Approved

 **Fix range-based loops and add early traverse for regular loops in VA** ✓

#1536 by ovdiuv was merged on Sep 18 • Approved

questions?