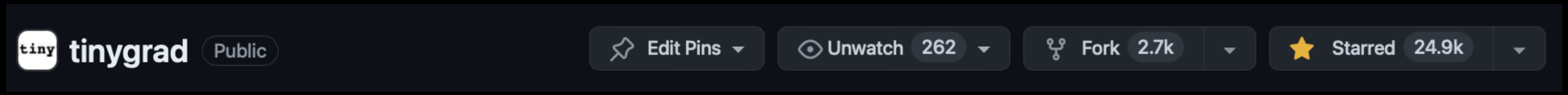
the tiny corp

“commoditize the petaflop”

tinygrad, a deep learning framework

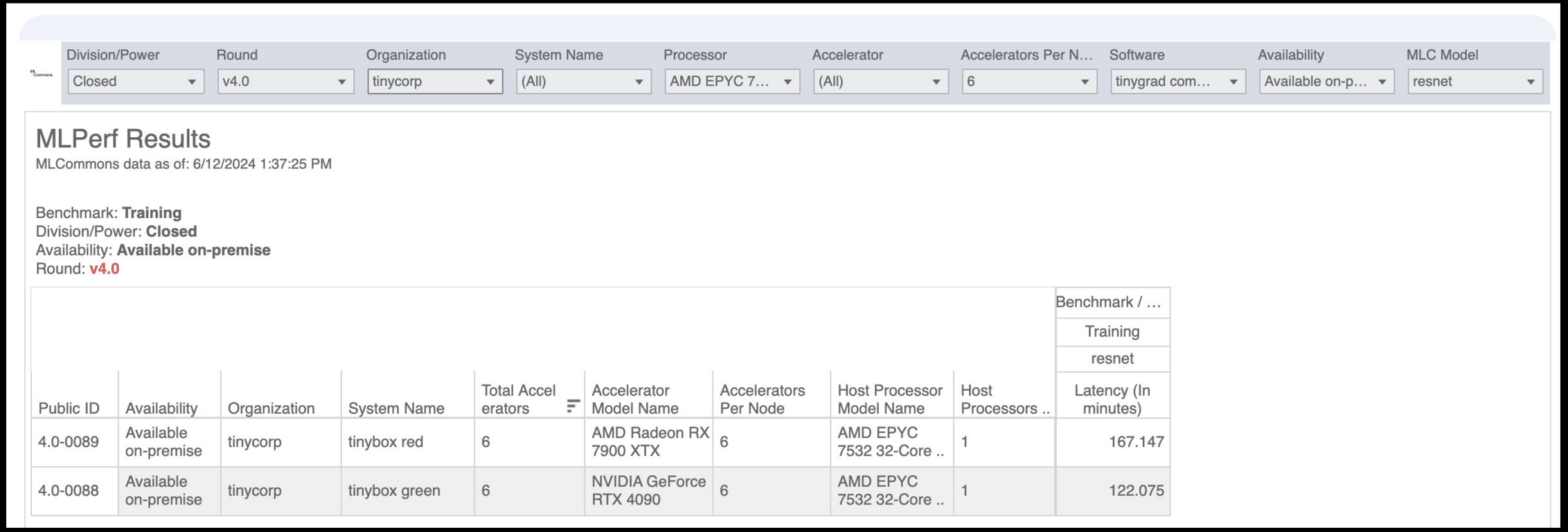
- If you don’t have market share, you’ll have to build the framework yourself
- Pure Python, < 8000 lines
- Torch-like frontend
- Supports NVIDIA/AMD without CUDA or ROCm runtime



tinybox, a petaflop for the home

- 6x 7900XTX or 4090
- 144 GB, fits unquantized LLaMA-3 70B
- Quiet!
- $15,000 or $25,000
- Shipping now

together, MLPerf



Division/Power	Round	Organization	System Name	Processor	Accelerator	Accelerators Per N…	Software	Availability	MLC Model
Closed	v4.0	tinycorp	(All)	AMD EPYC 7…	(All)	6	tinygrad com…	Available on-p…	resnet

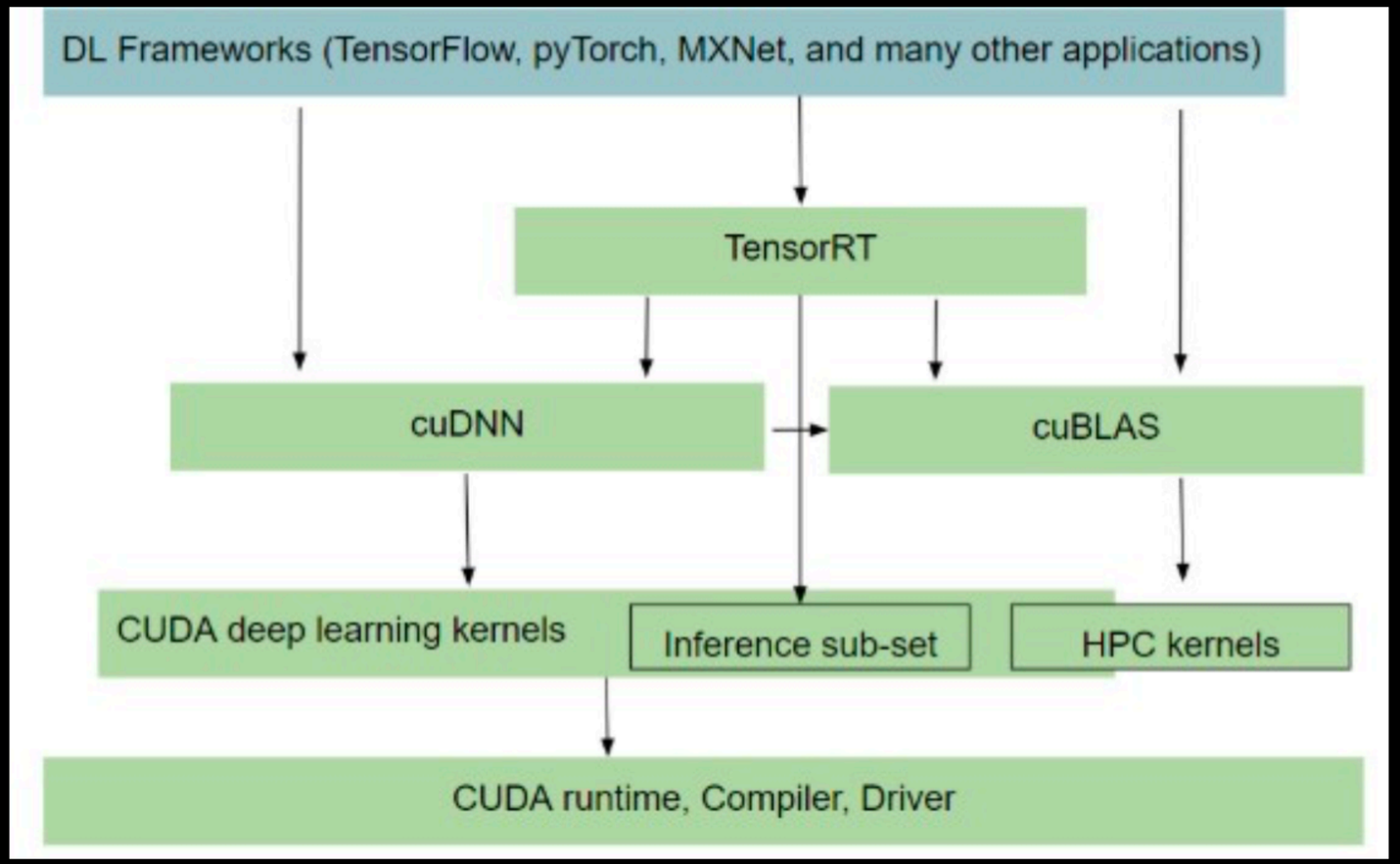
MLPerf Results

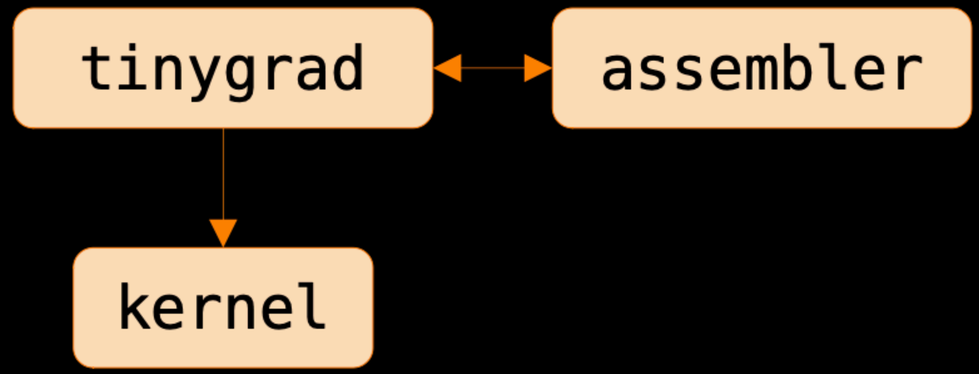
MLCommons data as of: 6/12/2024 1:37:25 PM

Benchmark: **Training**
Division/Power: **Closed**
Availability: **Available on-premise**
Round: **v4.0**

									Benchmark / …
									Training
									resnet
Public ID	Availability	Organization	System Name	Total Accelerators	Accelerator Model Name	Accelerators Per Node	Host Processor Model Name	Host Processors ..	Latency (In minutes)
4.0-0089	Available on-premise	tinycorp	tinybox red	6	AMD Radeon RX 7900 XTX	6	AMD EPYC 7532 32-Core ..	1	167.147
4.0-0088	Available on-premise	tinycorp	tinybox green	6	NVIDIA GeForce RTX 4090	6	AMD EPYC 7532 32-Core ..	1	122.075

No Dependencies (makes it easy to port)

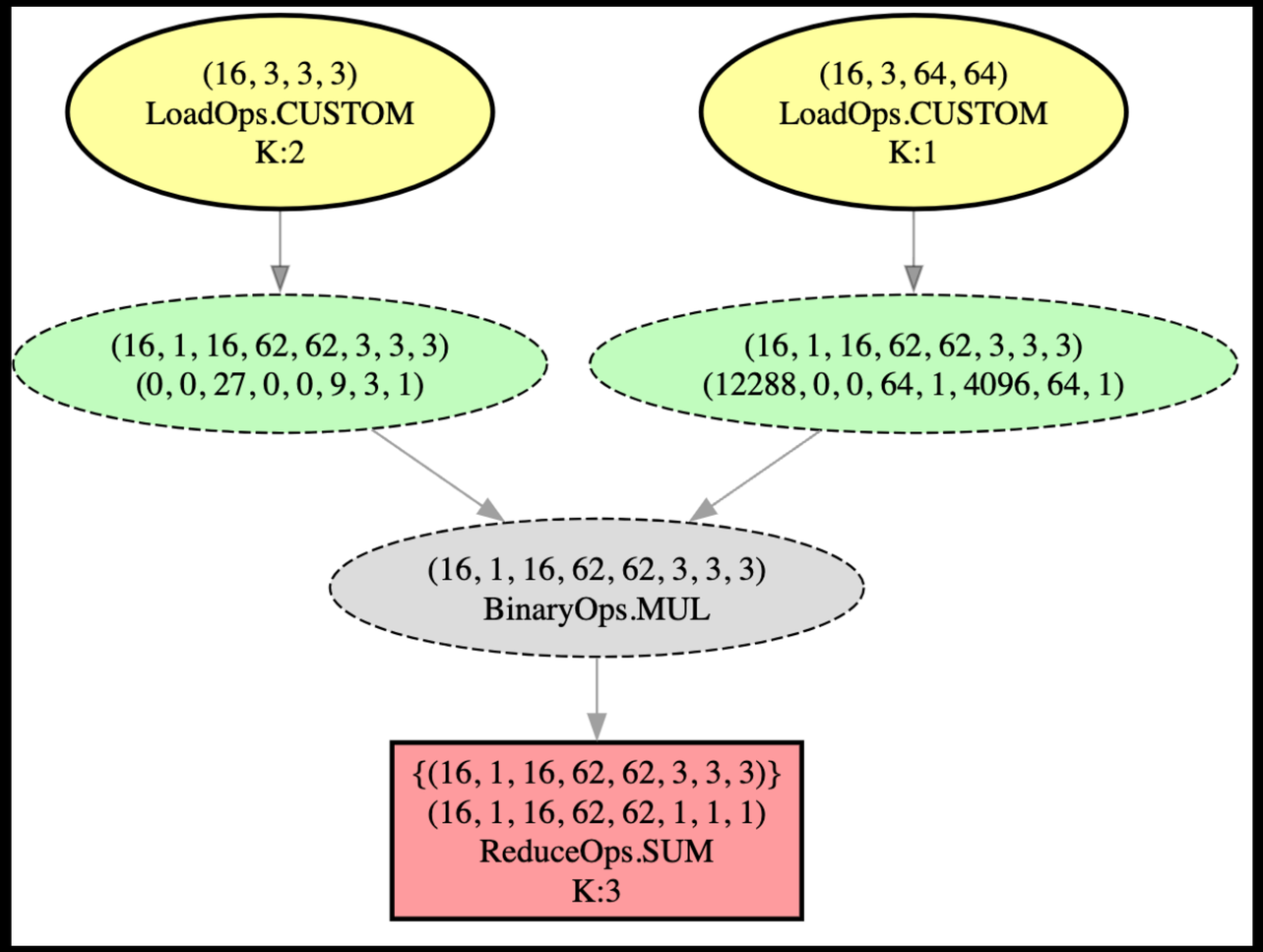




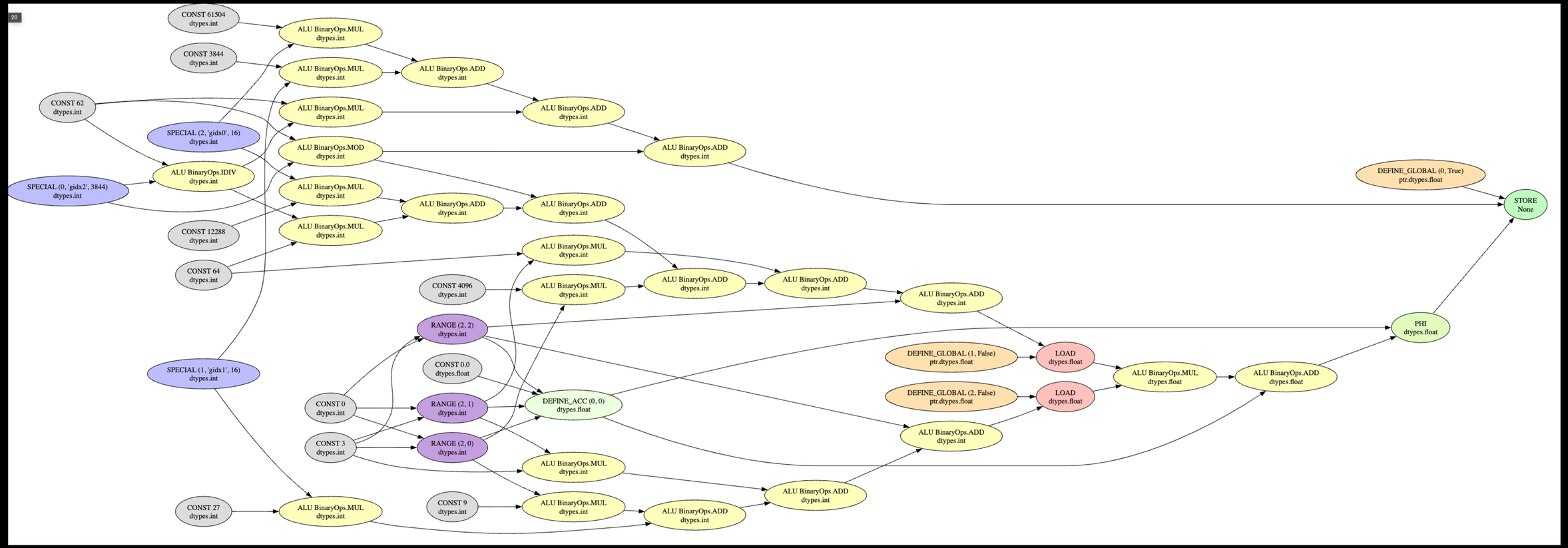
A Conv2D

```
diane@blak:~/tinygrad$
diane@blak:~/tinygrad$ GPU=1 NOOPT=1 DEBUG=4 python3 -c "from tinygrad import Tensor; Tensor.rand(16,3,64,64).conv2d(Tensor.rand(16,3,3,3)).numpy()"
opened device NPY from pid:65238
CLDevice: got 1 platforms and 1 devices
opened device GPU from pid:65238
*** CUSTOM     1 custom_random                          arg   1 mem  0.00 GB
*** CUSTOM     2 custom_random                          arg   1 mem  0.00 GB
  0 ┏━ BufferOps.STORE MemBuffer(idx=0, dtype=dtypes.float, st=ShapeTracker(views=(View(shape=(16, 1, 16, 62, 62, 1, 1, 1), strides=(61504, 0, 3844,
  1 ┗━┓ ReduceOps.SUM (5, 6, 7)
  2   ┗━┓ BinaryOps.MUL None
  3     ┣━ BufferOps.LOAD MemBuffer(idx=1, dtype=dtypes.float, st=ShapeTracker(views=(View(shape=(16, 1, 16, 62, 62, 3, 3, 3), strides=(12288, 0, 0
  4     ┗━ BufferOps.LOAD MemBuffer(idx=2, dtype=dtypes.float, st=ShapeTracker(views=(View(shape=(16, 1, 16, 62, 62, 3, 3, 3), strides=(0, 0, 27, 0
__kernel void r_16_16_62_62_3_3_3(__global float* data0, const __global float* data1, const __global float* data2) {
  int gidx2 = get_group_id(0); /* 3844 */
  int gidx1 = get_group_id(1); /* 16 */
  int gidx0 = get_group_id(2); /* 16 */
  int alu0 = (gidx2/62);
  int alu1 = (gidx2%62);
  float acc0 = 0.0f;
  for (int ridx0 = 0; ridx0 < 3; ridx0++) {
    for (int ridx1 = 0; ridx1 < 3; ridx1++) {
      for (int ridx2 = 0; ridx2 < 3; ridx2++) {
        float val0 = data1[(gidx0*12288)+(alu0*64)+alu1+(ridx0*4096)+(ridx1*64)+ridx2];
        float val1 = data2[(gidx1*27)+(ridx0*9)+(ridx1*3)+ridx2];
        acc0 = ((val0*val1)+acc0);
      }
    }
  }
  data0[(gidx0*61504)+(gidx1*3844)+(alu0*62)+alu1] = acc0;
}
*** GPU        3 r_16_16_62_62_3_3_3                    arg   3 mem  0.00 GB tm   5233.62us/     5.23ms (   10.15 GFLOPS,    0.90 GB/s)
opened device CLANG from pid:65238
*** CLANG      4 copy    3.94M,   CLANG <- GPU          arg   2 mem  0.01 GB tm   1361.87us/     6.60ms (    0.00 GFLOPS,    2.89 GB/s)
avg:     8.06 GFLOPS     1.31 GB/s          total:     4 kernels     0.05 GOPS     0.01 GB     6.60 ms
diane@blak:~/tinygrad$
```

A Conv2D (graphed)



A Conv2D (lowered)



The Bitter Lesson (28x faster)

- Search to explore different ways to optimize
- Use the fastest one

```
diane@blak:~/tinygrad$ BEAM=2 GPU=1 DEBUG=2 python3 -c "from tinygrad import Tensor; Tensor.rand(16,3,64,64).conv2d(Tensor.rand(16,3,3,3)).numpy()"
opened device NPY from pid:65828
CLDevice: got 1 platforms and 1 devices
opened device GPU from pid:65828
*** CUSTOM     1 custom_random                          arg   1 mem  0.00 GB
*** CUSTOM     2 custom_random                          arg   1 mem  0.00 GB
   0.00s:                 from   1 ->   1 actions   16   16   62   62    3    3    3
   0.34s:       326.75 us from  26 ->  26 actions   16   62   62   16    3    3    3
   1.02s:        43.58 us from  46 ->  46 actions    4   62   62   16    4    3    3    3
   1.80s:        43.58 us from  41 ->  38 actions    4   62   62   16    4    3    3    3
hc     : 4 31 31 4 2 2 3 4 4 3 3        :   163.21 us  <  beam2  : 4 62 62 16 4 3 3 3            :   171.62 us
*** GPU        3 r_4_31_31_4_2_2_3_4_4_3_3              arg   3 mem  0.00 GB tm    183.83us/     0.18ms (   289.06 GFLOPS,    25.70 GB/s)
opened device CLANG from pid:65828
*** CLANG      4 copy    3.94M,   CLANG <- GPU          arg   2 mem  0.01 GB tm   1132.58us/     1.32ms (     0.00 GFLOPS,     3.48 GB/s)
avg:    40.37 GFLOPS     6.58 GB/s          total:     4 kernels     0.05 GOPS     0.01 GB     1.32 ms
diane@blak:~/tinygrad$
```

Get Started

- tinygrad runs almost everywhere, try it!
- docs.tinygrad.org
- Our goal is to build chips, but first, the software.