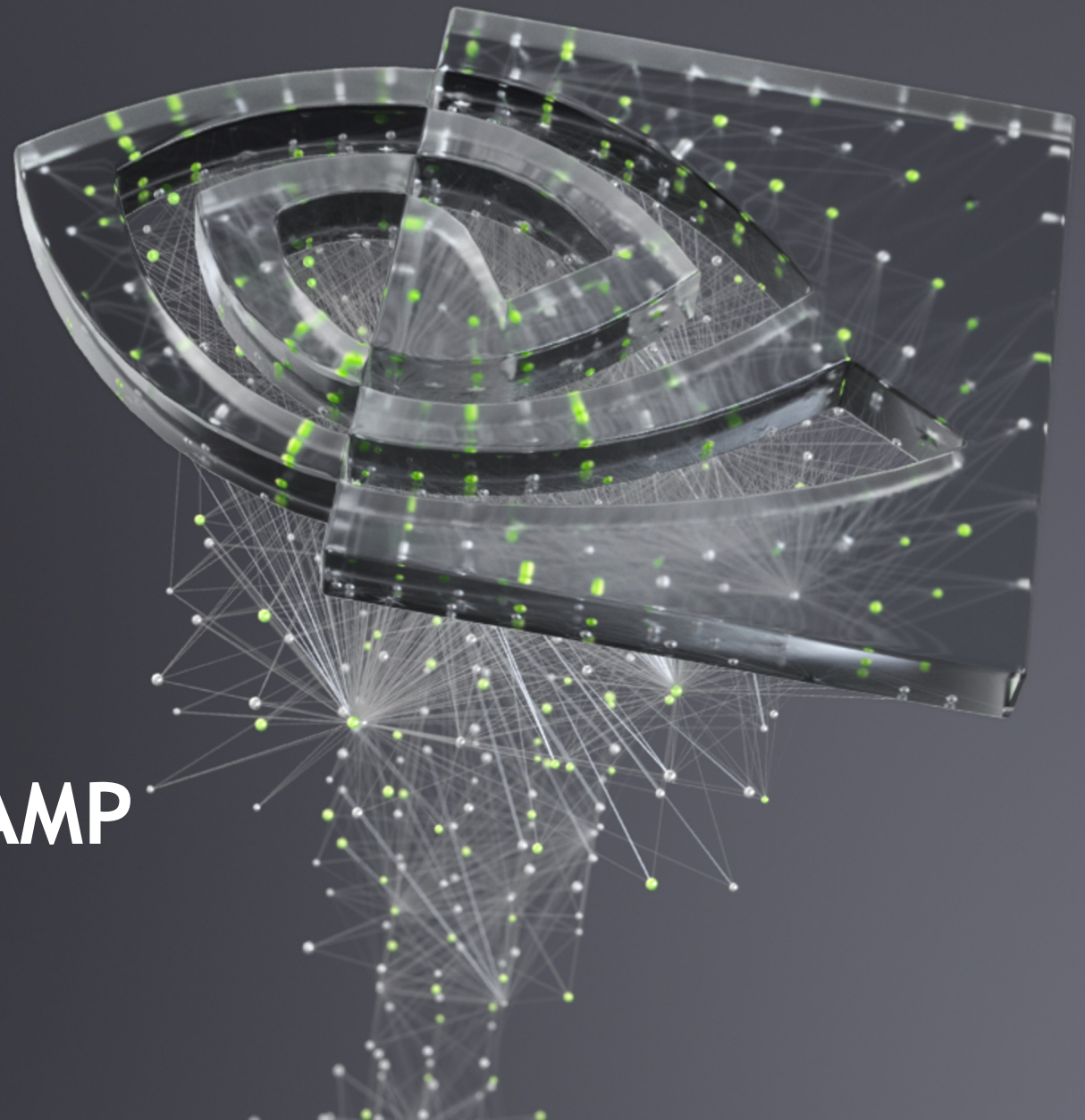
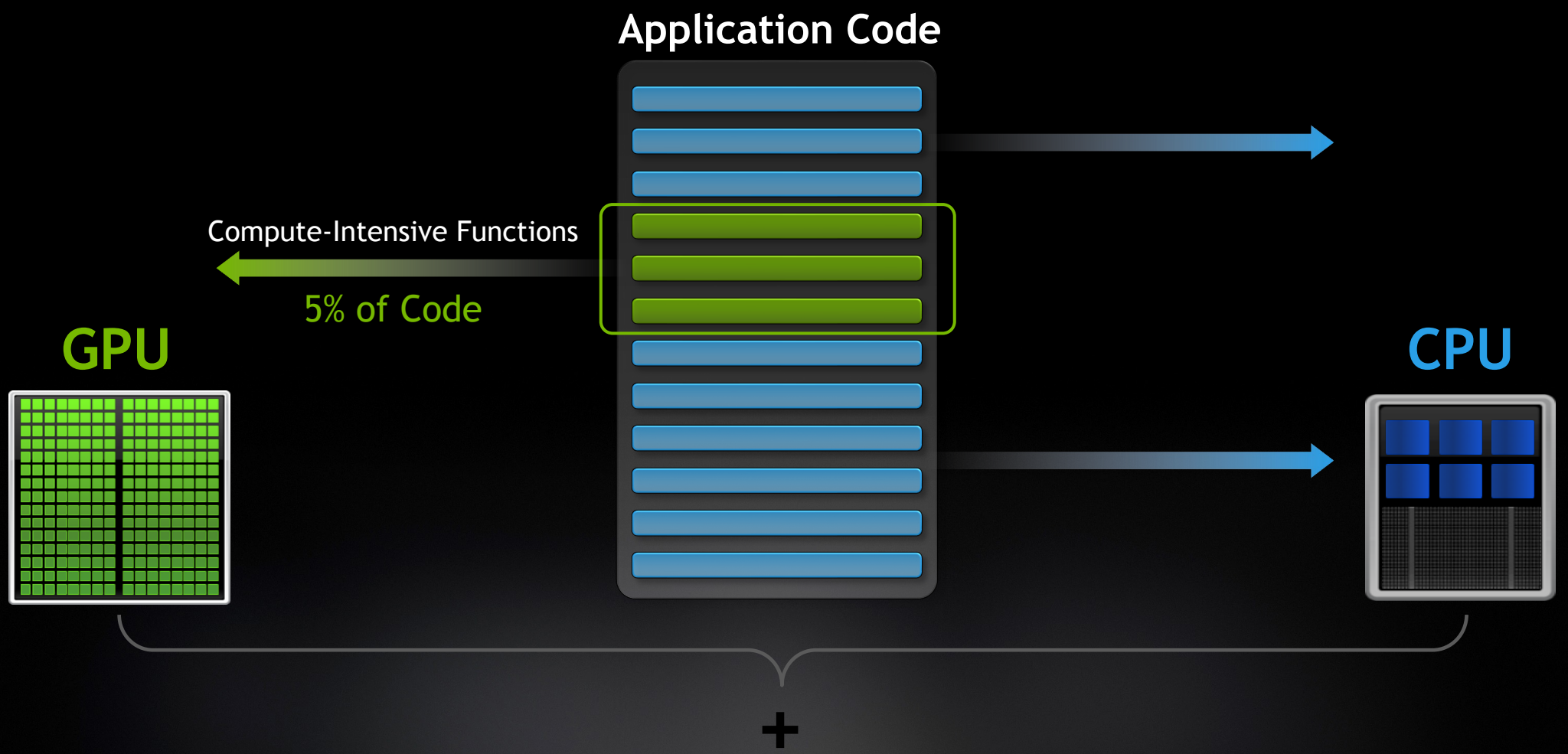


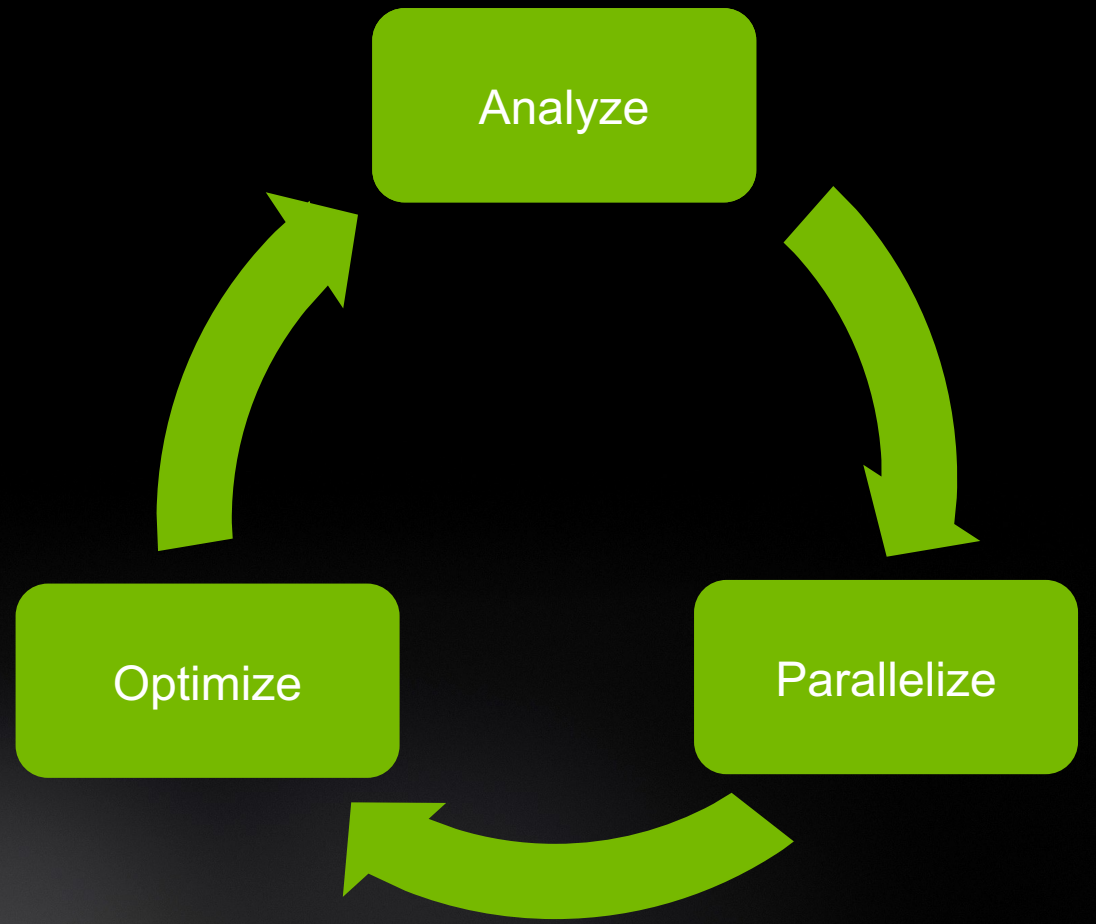
N-WAYS GPU BOOTCAMP
CONCLUSION

How GPU Acceleration Works



development CYCLE

- **Analyze** your code to determine most likely places needing parallelization or optimization.
- **Parallelize** your code by starting with the most time consuming parts and check for correctness.
- **Optimize** your code to improve observed speed-up from parallelization.



GPU Programming in 2023 and beyond

Math Libraries | Standard Languages | Directives | CUDA

```
std::transform(par, x, x+n, y, y,
    [=](float x, float y) {
        return y + a*x;
});
```

```
do concurrent (i = 1:n)
   y(i) = y(i) + a*x(i)
enddo
```

```
#pragma acc data copy(x,y)
{

...

std::transform(par, x, x+n, y, y,
    [=](float x, float y) {
        return y + a*x;
});

...

}
```

```
__global__
void saxpy(int n, float a,
           float *x, float *y) {
  int i = blockIdx.x blockDim.x +
          threadIdx.x
  if (i < n) y[i] += a*x[i];
}

int main(void) {
  cudaMallocManaged(&x, ...);
  cudaMallocManaged(&y, ...);
  ...
  saxpy<<<(N+255)/256,256>>>(...,x, y)
  cudaDeviceSynchronize();
  ...
}
```

GPU Accelerated C++ and Fortran

Incremental Performance Optimization with Directives

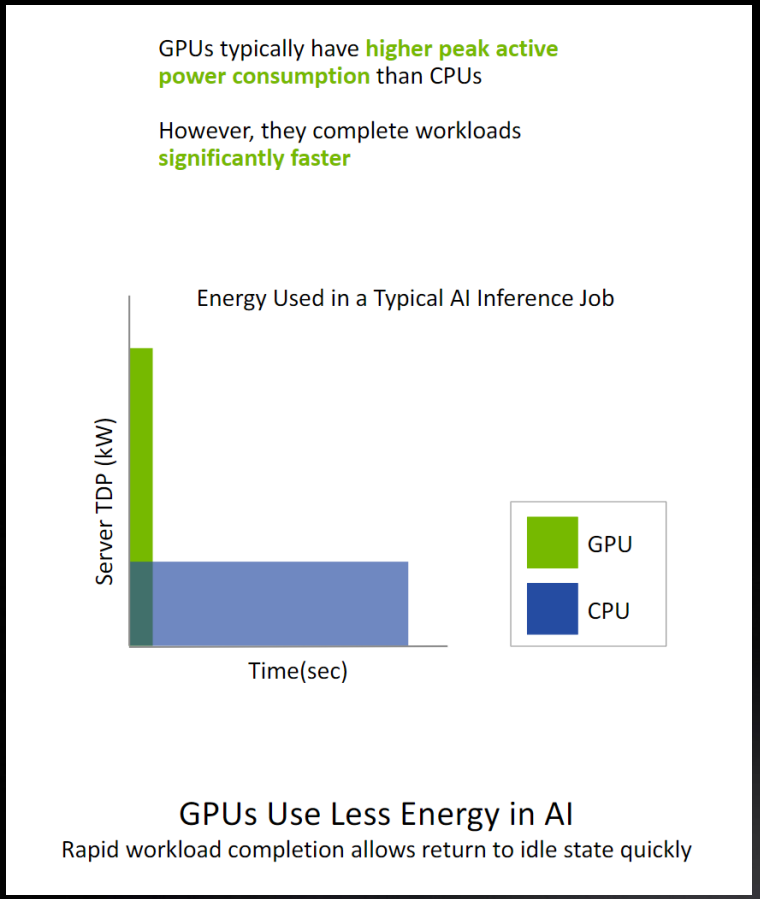
Maximize GPU Performance with CUDA C++/Fortran

GPU Accelerated Math Libraries

MATERIALS

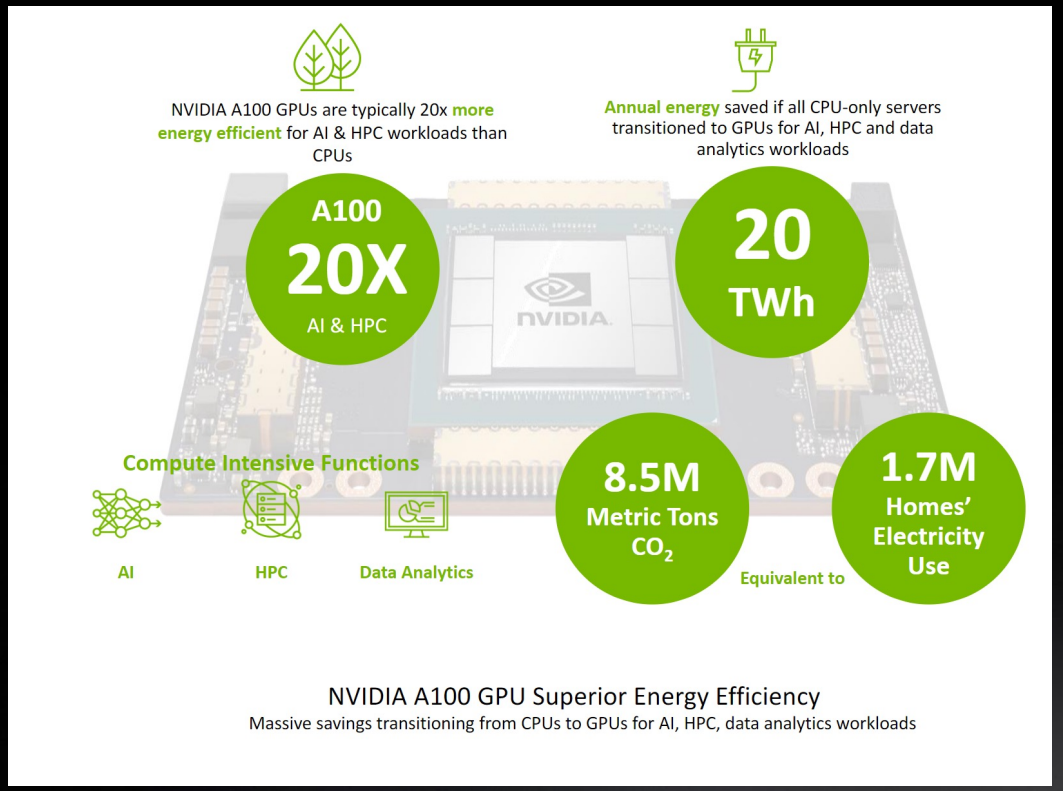
- NWAYS bootcamp
  - openhackathons-org/nways_accelerated_programming (github.com)
- OPENACC API
  - API (openacc.org)
- CUDA best practice guide
  - CUDA Best Practices (nvidia.com)
- CUDA Programming guide
  - CUDA C++ Programming Guide (nvidia.com)

ENERGY SAVING



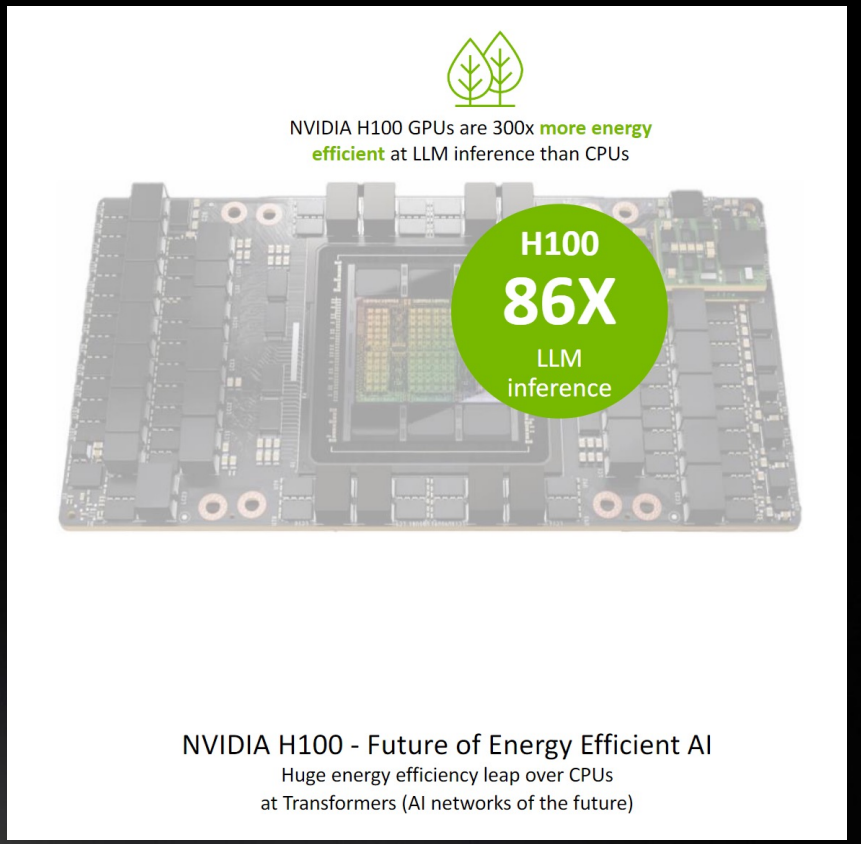
- Speed up is the most important advantage for GPU.
- Energy saving is another advantage for GPU computing in comparison to CPU.

ENERGY SAVING



NVIDIA A100 GPU Superior Energy Efficiency

Massive savings transitioning from CPUs to GPUs for AI, HPC, data analytics workloads

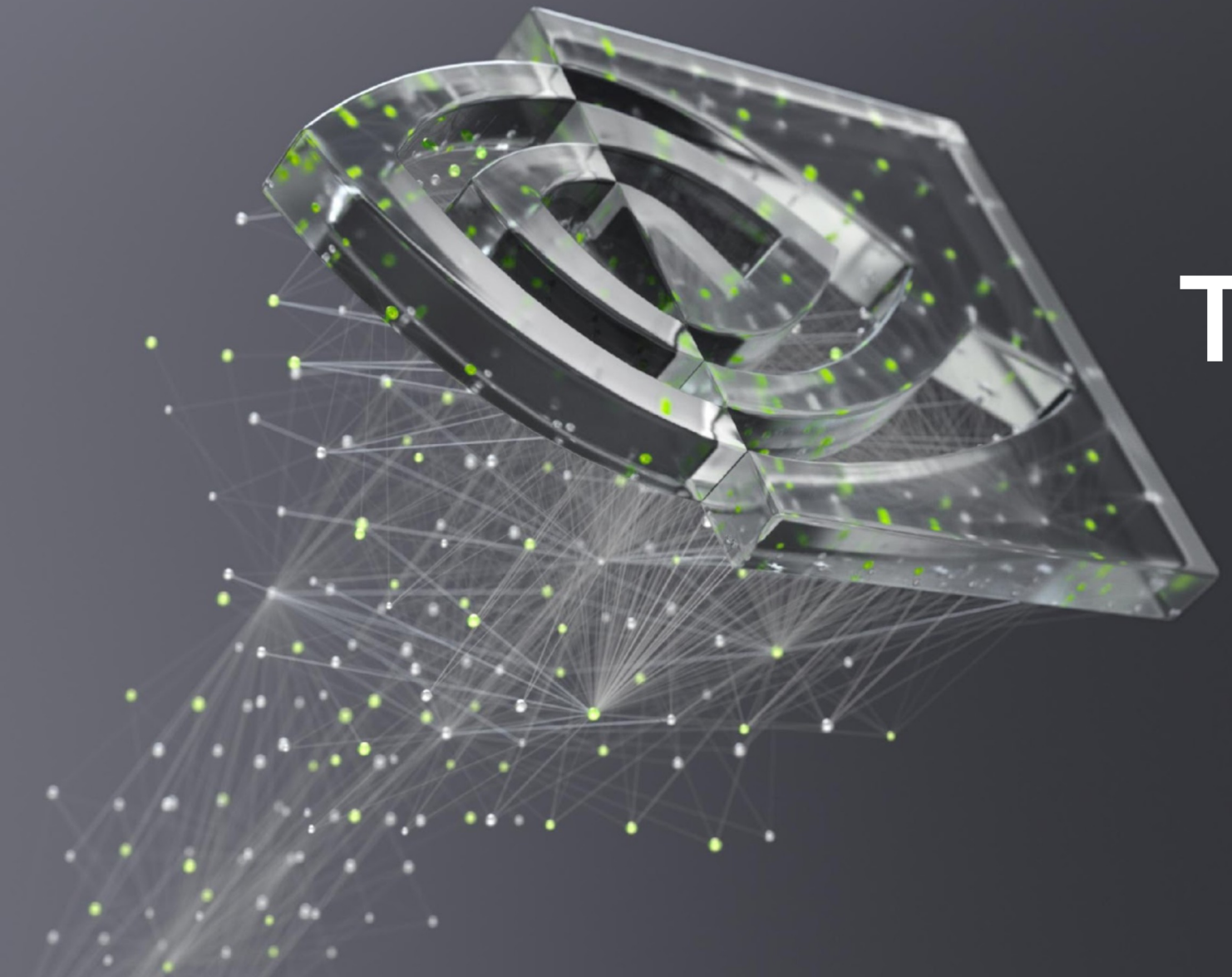


NVIDIA H100 - Future of Energy Efficient AI

Huge energy efficiency leap over CPUs
at Transformers (AI networks of the future)

2023 11/27-12/08 OpenACC Hackathon

https://www.openhackathons.org/s/siteevent/a0C5e000005VZLiEAO/se000160



THANK YOU

NVIDIA