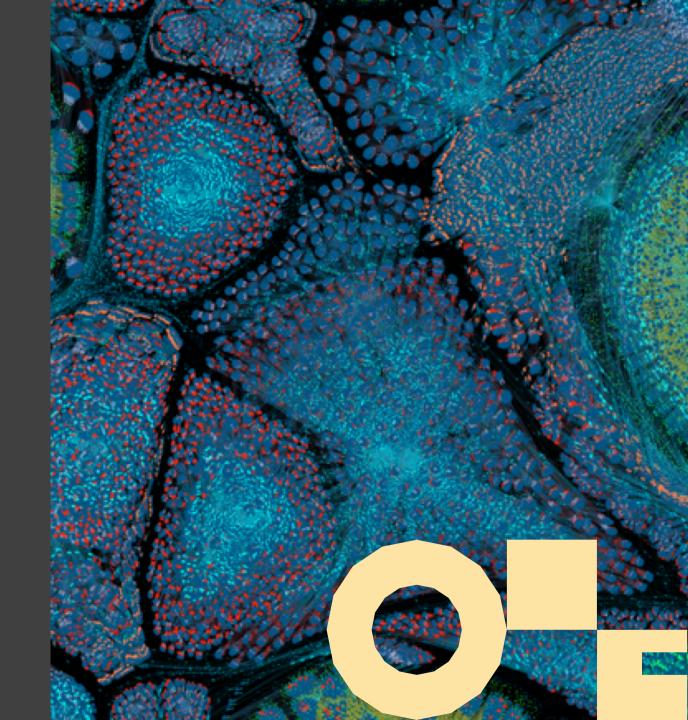
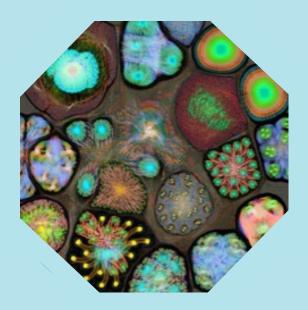
GRAFHCORE





ABOUT US...

Technology



Processors and software solutions designed for AI

IPU-Processor PCIe Cards and Poplar[®] software stack >\$310m in funding

SAMSUNG

Investors

pitango

Merian

GLOBAL INVESTORS

Microsoft

BMW i VENTURES

SOFINA

draperesprit Foundation

Amadeus Capital

SEQUOIA 🖳

DELL

BOSCH

Products





2



200+ TEAM & GROWING FAST

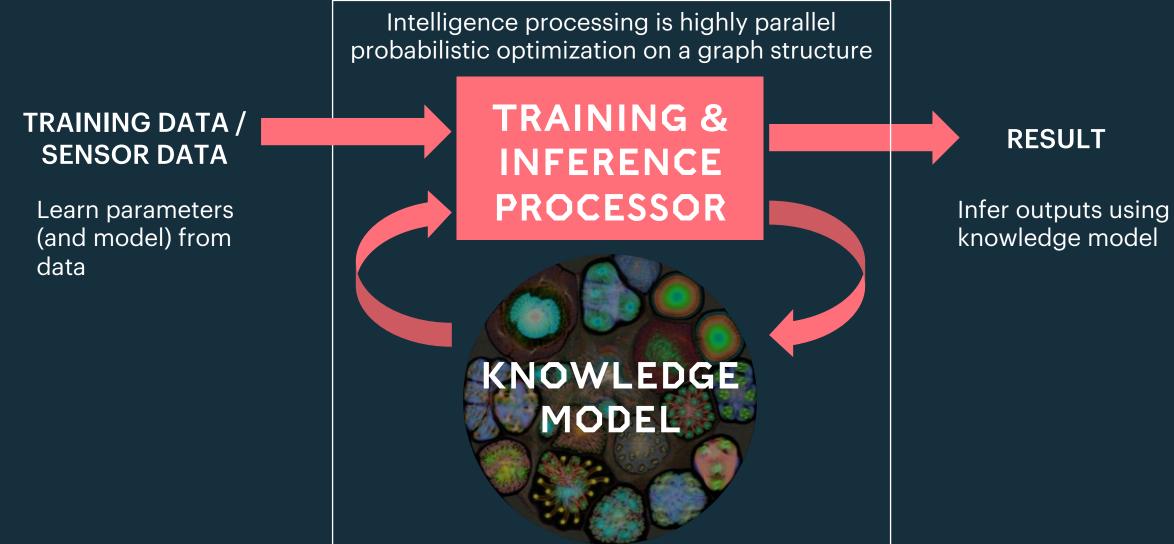
BRISTOL, LONDON, PALO ALTO AUSTIN, SEATTLE OSLO, BEIJING



OUR IPU LETS INNOVATORS CREATE THE NEXT BREAKTHROUGHS IN MACHINE INTELLIGENCE

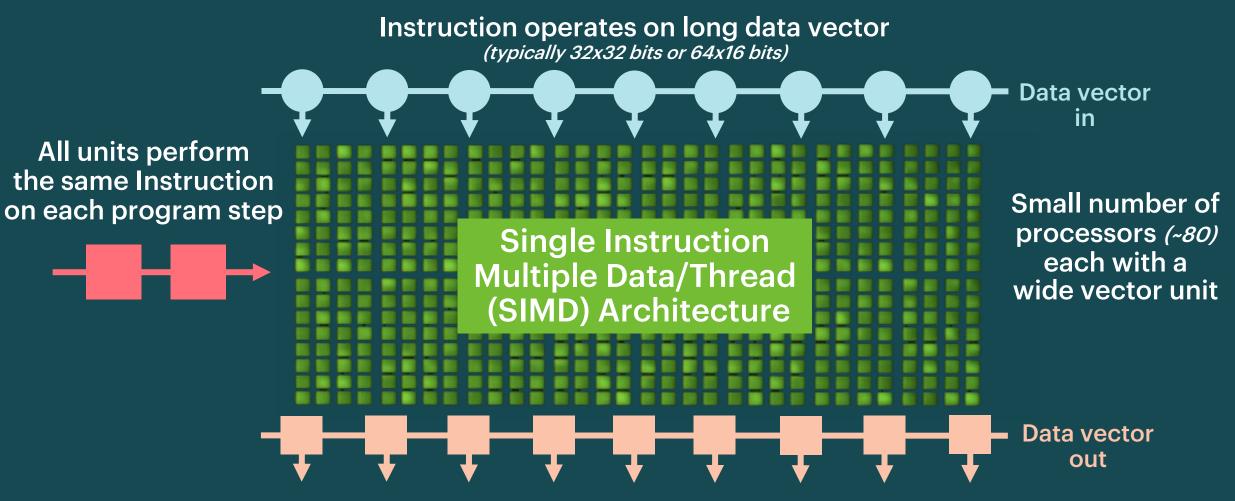


A COMPLETELY NEW WORKLOAD





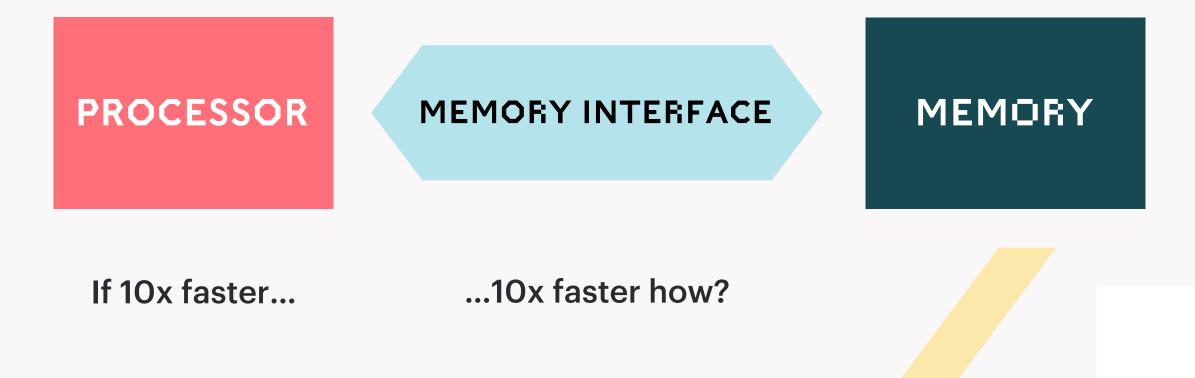
TODAY'S PARALLEL MACHINES ARE INFLEXIBLE



Only efficient for large blocks of dense data / large mini-batches

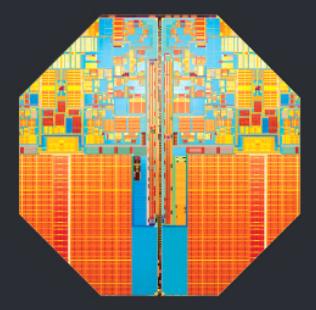


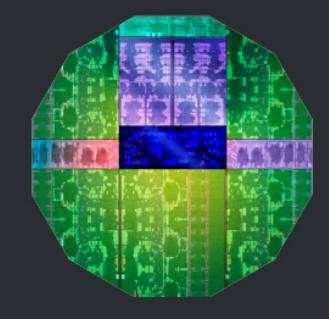
MEMORY BANDWIDTH IS LIMITING PERFORMANCE

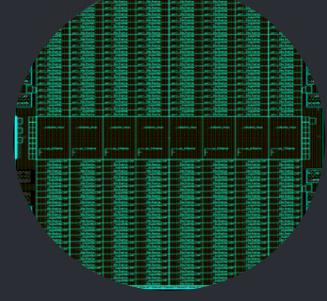




A NEW PROCESSOR IS REQUIRED







CPU Apps and Web Scalar

GPU Graphics and HPC Vector

IPU Machine Intelligence Graph



IPU ADVANTAGE

MASSIVE PERFORMANCE LEAP

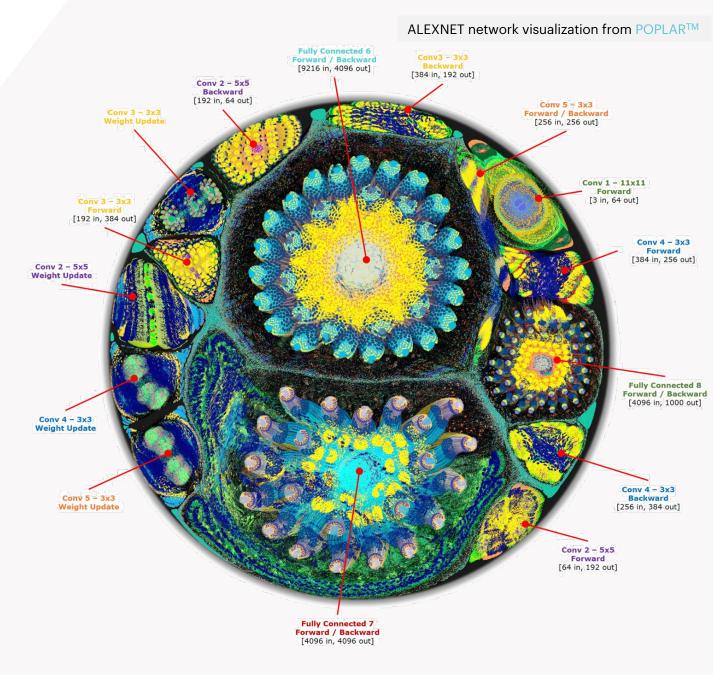
- up to 100x faster on training and inference
- model held inside the processor
- 100x memory bandwidth

MUCH MORE FLEXIBLE

- every network type supported efficiently
- latency reduced by over 10x

EASIER TO USE

- seamless ML framework support
- Poplar[®] software stack



COLOSSUS GC2

The world's most complex processor chip with 23.6 billion transistors

10x IPU-LINKSTM 320GB/s chip-to-chip bandwidth

300MB IN-PROCESSOR-MEMORY™

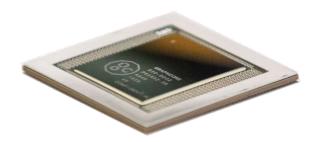
45TB/s memory bandwidth per chip the whole model held inside the processor

PCIe Gen4 x16 64GB/s bi-directional host communication bandwidth

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1,216 independent IPU-CORESTM each with IN-PROCESSOR-MEMORYTM tile > 100GFLOPS per IPU-CORETM > 7,000 programs executing in parallel

8TB/s all to all IPU-EXCHANGETM non-blocking, any communication pattern





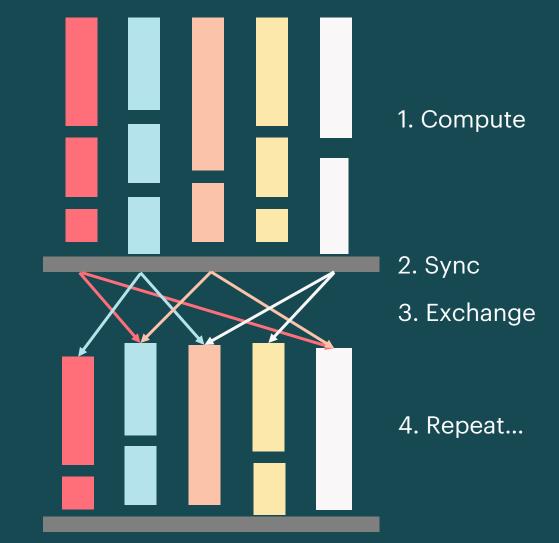
BRIDGING PARALLEL HARDWARE TO SOFTWARE

IPU is the world first BSP processor

Bulk Synchronous Parallel (BSP) compute | synchronize | exchange

Easy to program no live locks or dead locks

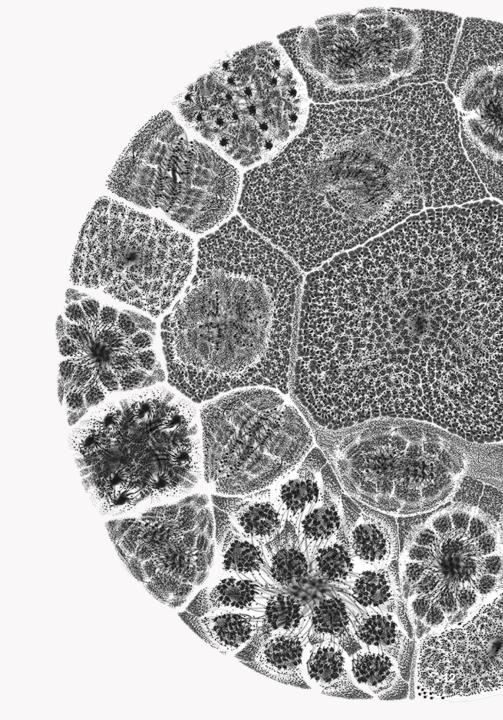
Widely used in compute clusters: Google | Facebook | ...





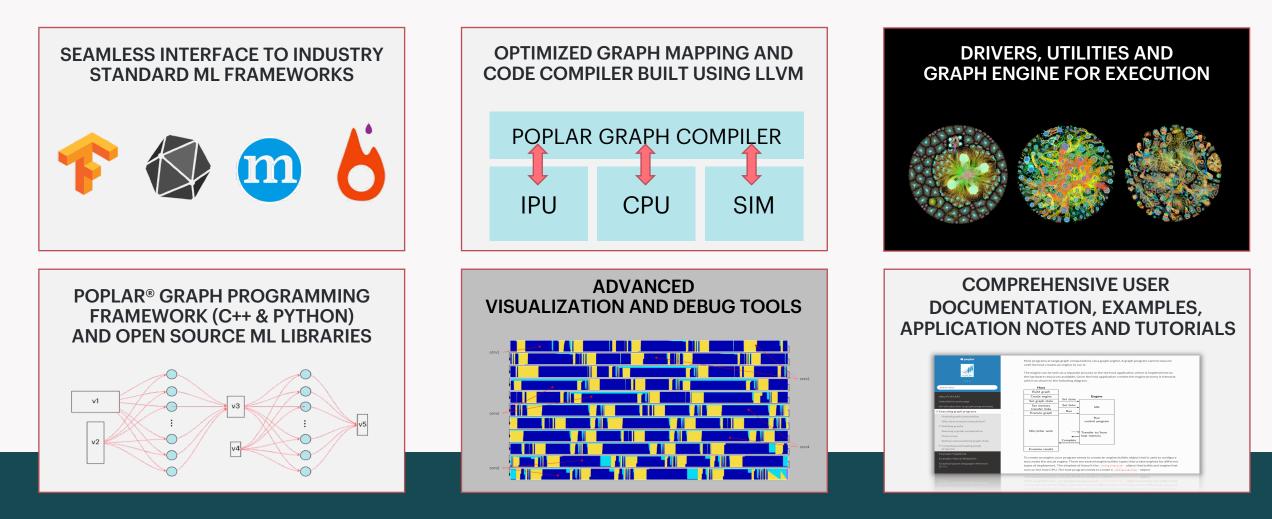
POPLAR[®]

Software stack





POPLAR® Software stack



Bc

DEVELOP YOUR MODEL USING INDUSTRY STANDARD ML FRAMEWORKS

[ensorBoard		SCALARS			GRAPHS
Fit to screen	Main Graph			Aı	uxiliary Node
Download PNG <u> </u>	Denet D-		014	denta denta able,1	dientDesc
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Optimized support for inference and training



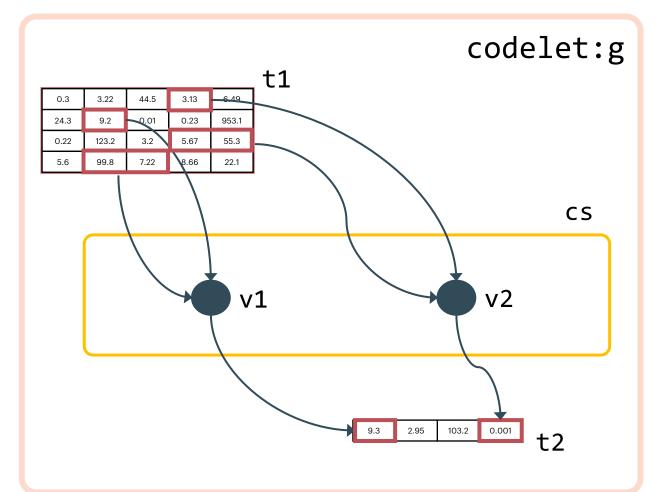
Highly optimized open source libraries partition work and data efficiently across IPU devices

C / C++ and Python language bindings								
poputil popops		poplin	poprandom	popnn				
Utility functions for building graphs	Pointwise and reduction operators	Matrix multiply and convolution functions	Random number generation	Neural network functions (activation fns, pooling, loss)				
POPLAR®								

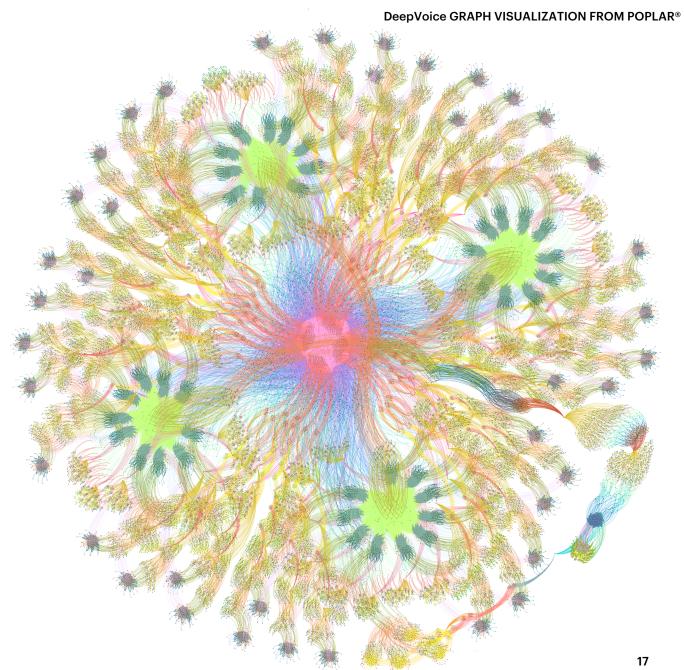


POPLAR® C++ / PYTHON, GRAPH FRAMEWORK LETS YOU MODIFY OR CREATE YOUR OWN LIBRARY ELEMENTS

```
Graph g(device);
g.addCodelets("codelets.cpp");
Tensor t1 = g.addTensor("float", {4, 5});
Tensor t2 = g.addTensor("float", {4});
ComputeSet cs = g.addComputeSet("myComputeSet")
VertexRef v1 = g.addVertex(cs, "AdderVertex");
VertexRef v2 = g.addVertex(cs, "AdderVertex");
g.connect(t1[1][1], v1["x"]);
g.connect(t1.slice({3, 1}, {4, 3}), v1["y"]);
g.connect(t2[0], v1["z"]);
g.connect(t1[0][3], v2["x"]);
g.connect(t1.slice({2, 2}, {3, 4}), v2["y"]);
g.connect(t2[3], v2["z"]);
g.setTileMapping(t1.slice({0, 0}, {4, 2}), 0);
g.setTileMapping(t1.slice({0, 2}, {4, 5}), 1);
g.setTileMapping(t2, 2);
g.setTileMapping(v1, 0);
g.setTileMapping(v2, 1);
```



POPLIBSTM and **POPLAR®** expand ML Framework output to a full compute graph.









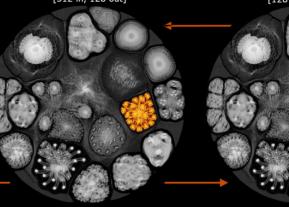
conv2 - 1x1 [256 in, 64 out]

conv2 - 3x3 54 in, 64 out] **conv2 -** 1x1 [64 in, 256 out]

conv3 – 1x1 [256 in, 128 out]

POPLAR® MAPS AND COMPILES GRAPH TO IPUs

conv3 – 1x1 512 in, 128 out]



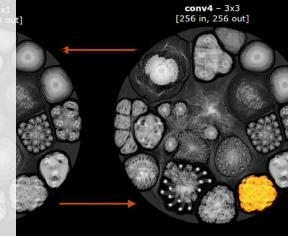
conv4 – 1x1 256 in, 1024 out]

POPLAR® GRAPH COMPILER:

Load balances code across processor cores Allocates data to 'In-Processor-Memory' Orchestrates data exchanges

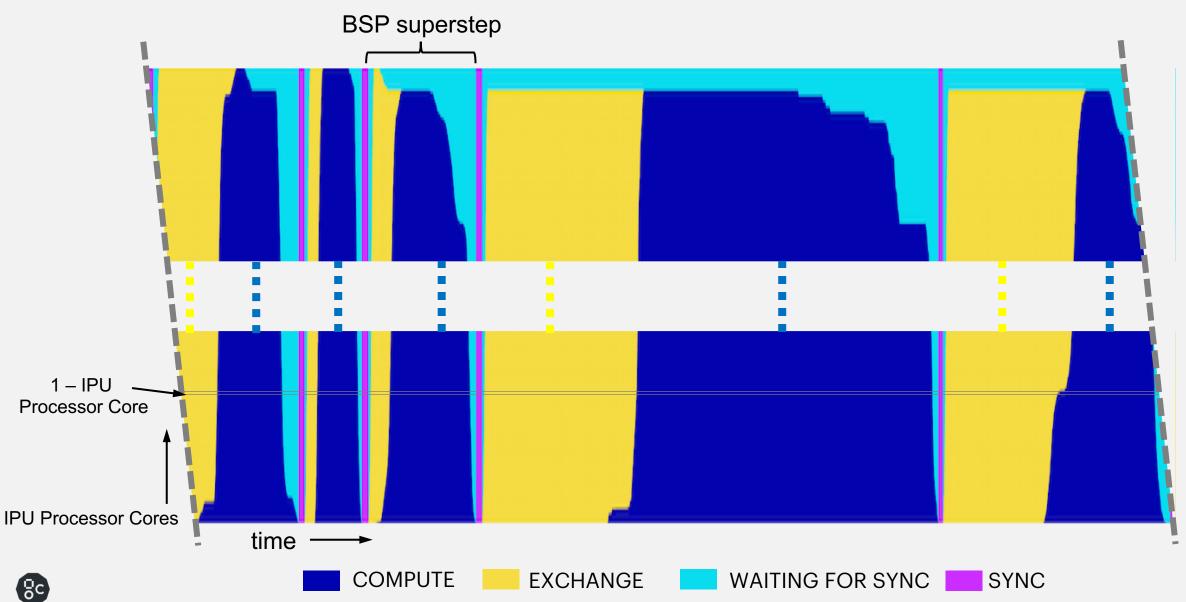
POPLAR® GRAPH ENGINE:

executes graph under BSP on IPU or multiple IPUs

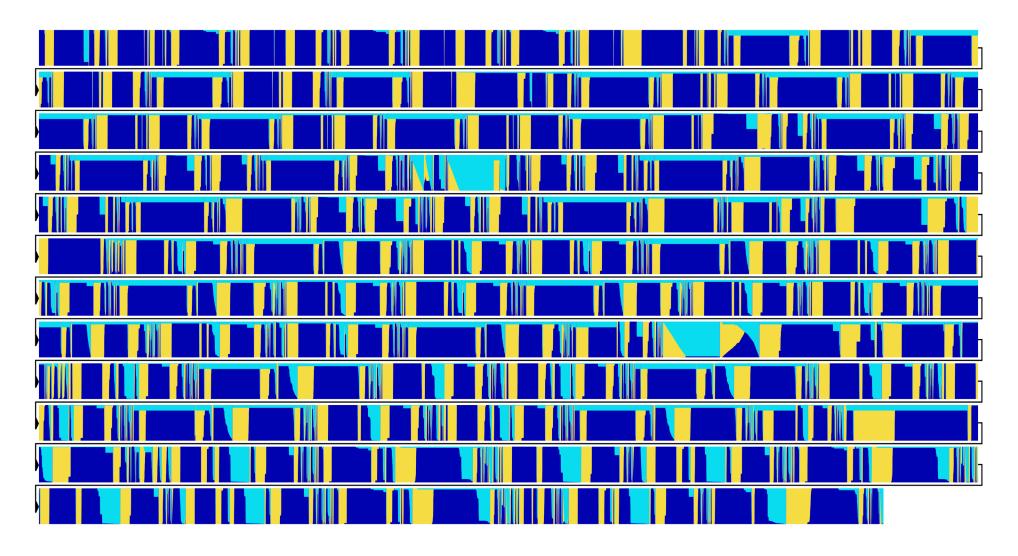


Fully Connected [2048 in, 1000 out]

ADVANCED VISUALIZATION AND DEBUG TOOLS



EXAMPLE BSP TRACE : RESNET-50 TRAINING



EXCHANGE

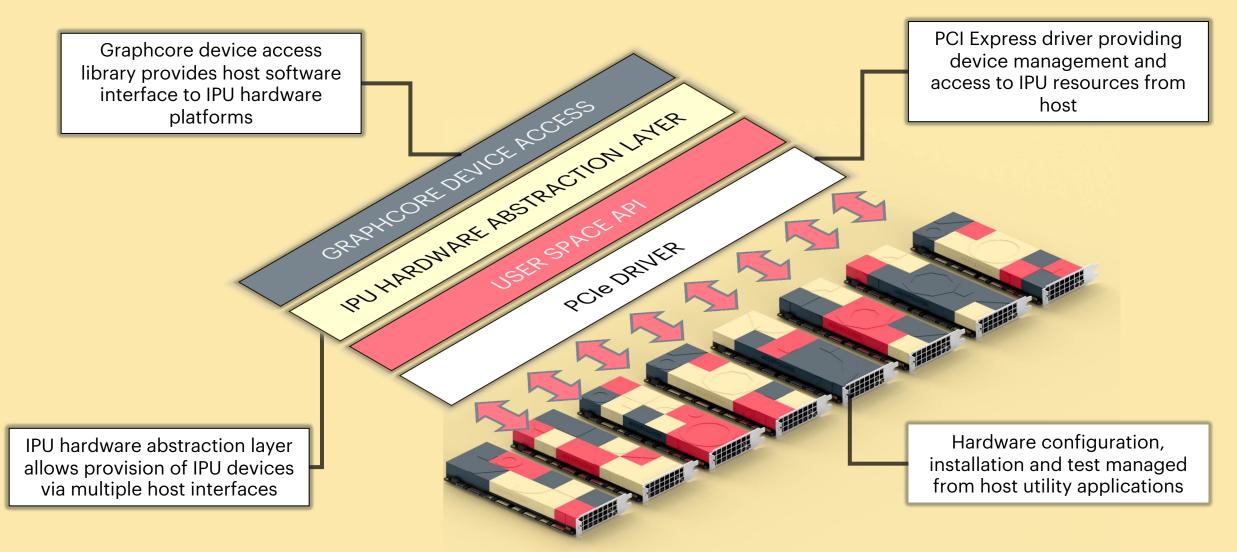
WAITING FOR SYNC

SYNC

COMPUTE

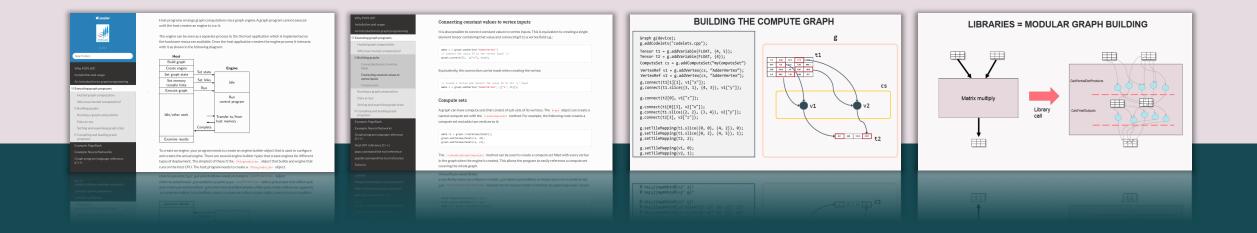


DRIVERS AND UTILITIES





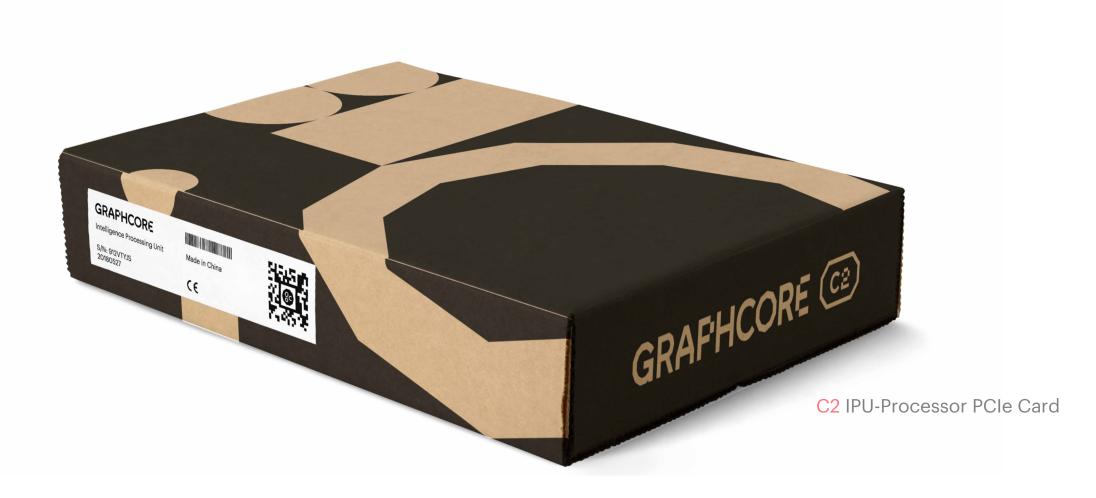
COMPREHENSIVE DOCUMENTATION



DOCUMENTATION, CODELET EXAMPLES, APPLICATION NOTES, AND TUTORIALS including VIDEOS



PRODUCTS



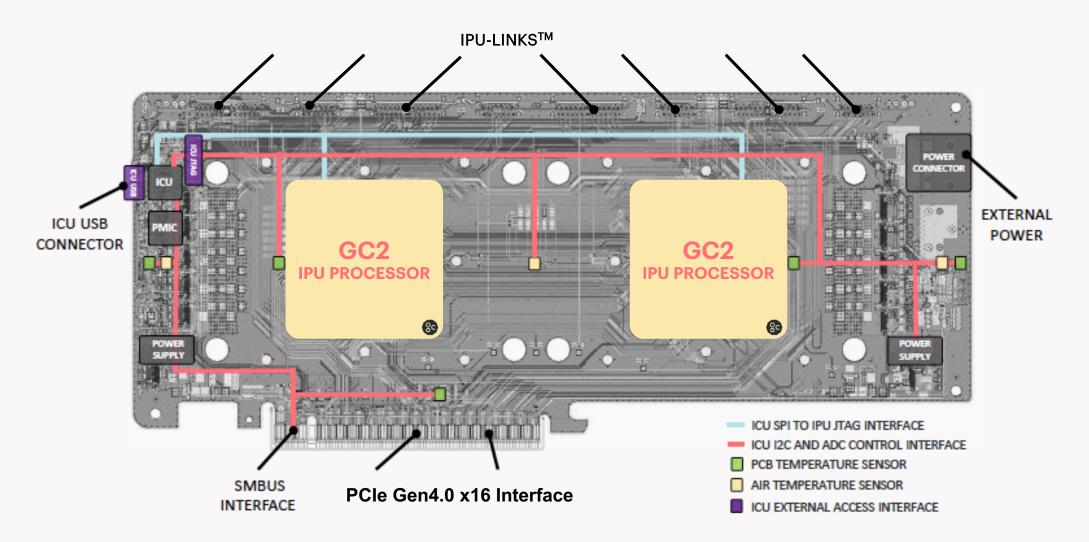
C2 IPU-PROCESSOR PCIe CARD



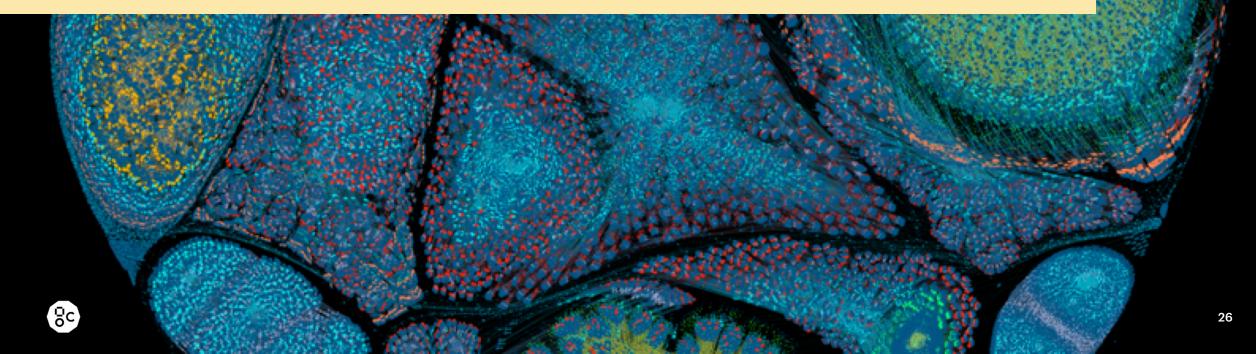
DOUBLE WIDTH PCIE CARD WITH 2 – COLOSSUS GC2 IPU PROCESSORS CARD-TO-CARD IPU-LINKS[™] (320GB/s) 250 TERA-FLOP MIXED PRECISION IPU COMPUTE @ 300W

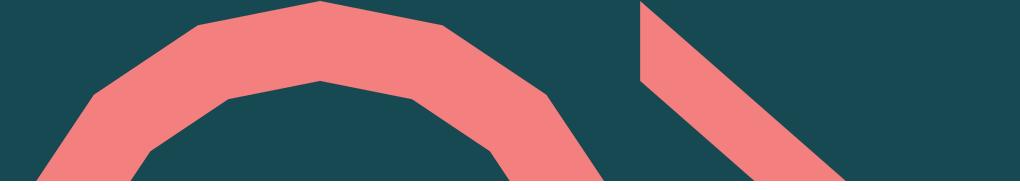


C2 IPU-PROCESSOR PCIe CARD



WE HAVE DEVELOPED A NEW KIND OF HARDWARE THAT WILL LET INNOVATORS CREATE THE NEXT GENERATION OF MACHINE INTELLIGENCE





THANK YOU



