DSA 8430
Parallel Computing for Data Analytics

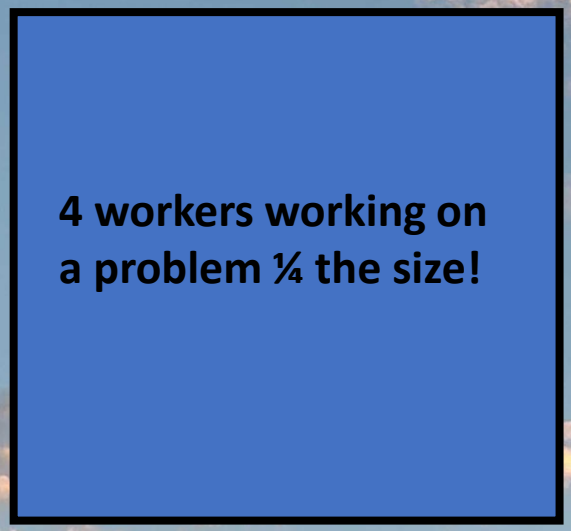
Divide and Conquer

Module Topics

- Divide and Conquer Concepts
- Parallel Computing at the machine level, GPU
- Parallel Patterns
- GPU Acceleration of Neural Networks
- Notes on Module Infrastructure

Divide and Conquer

4 hours of Compute



1 hour of compute

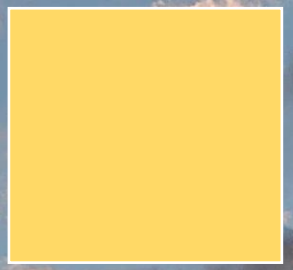
1 hour of compute

1 hour of compute

1 hour of compute

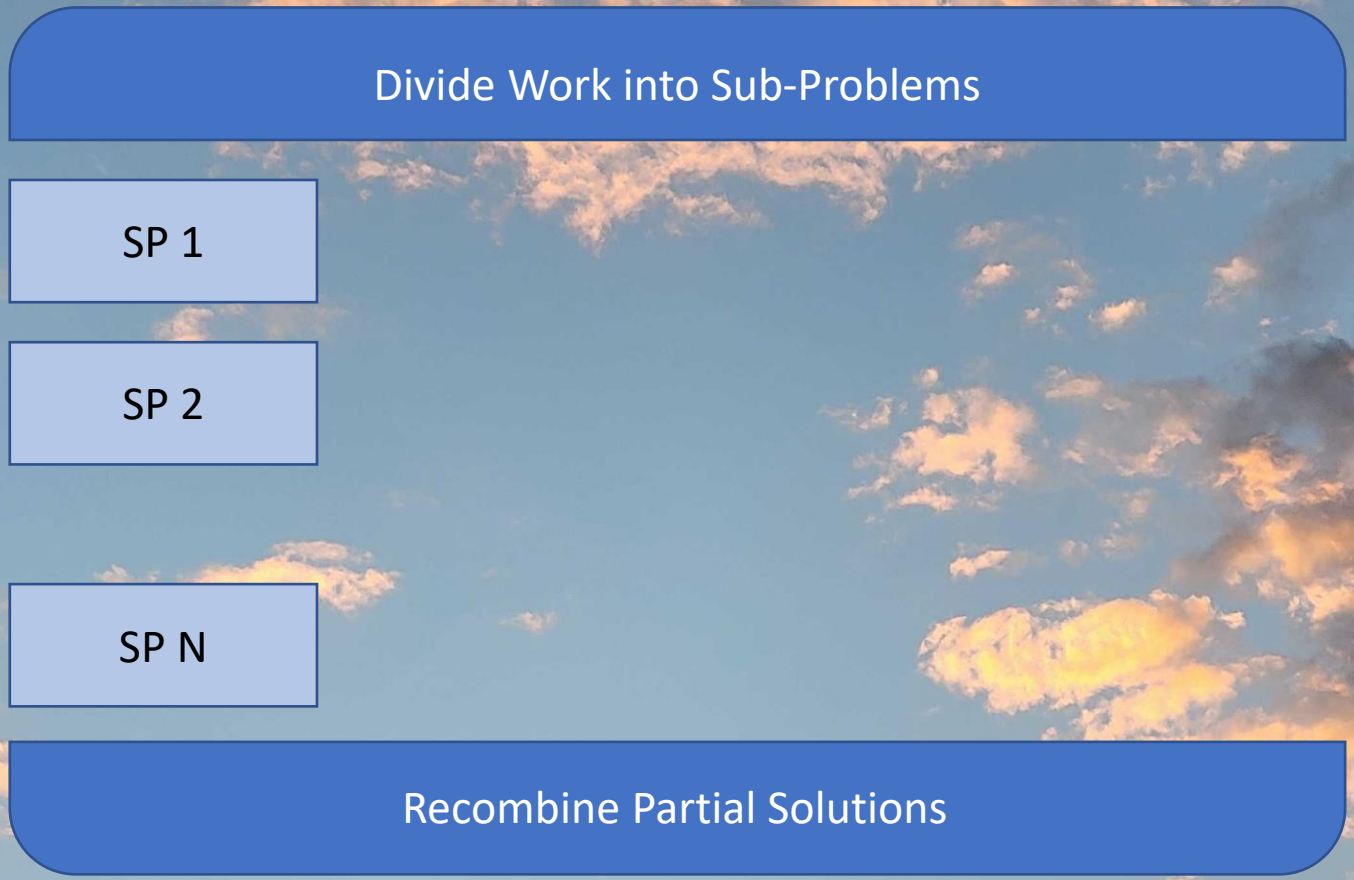
Divide and Conquer

1 hour to get a 4-hour solution



Divide and Conquer

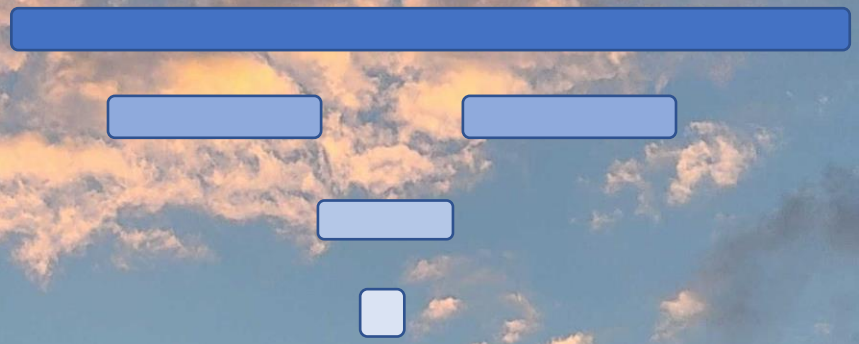
Goal
Minimize
Computing
Latency

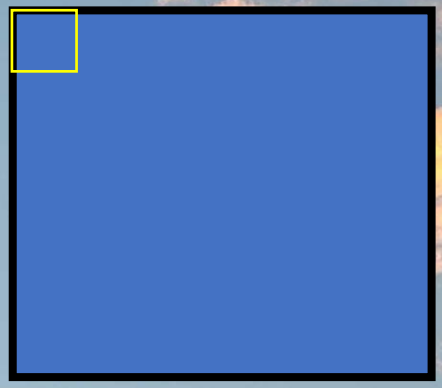


Divide and Conquer - Variants

Numerous Patterns

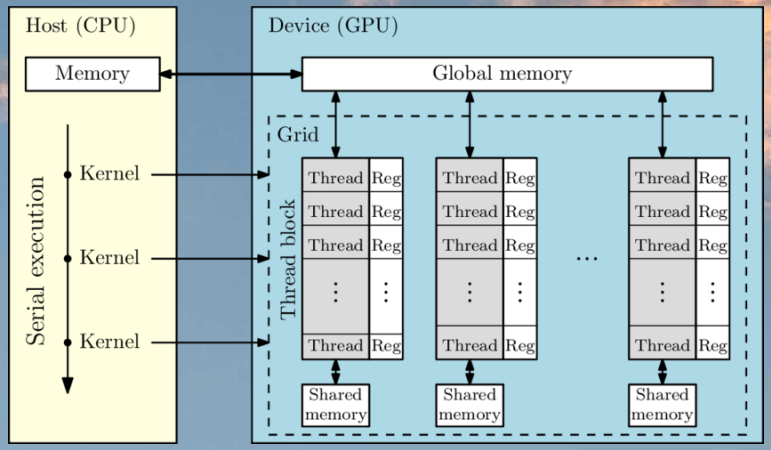
- Fork-Join
  - Map-Reduce
  - Hadoop/Spark
- Reduction
- Stencil
- Geometric Decomposition

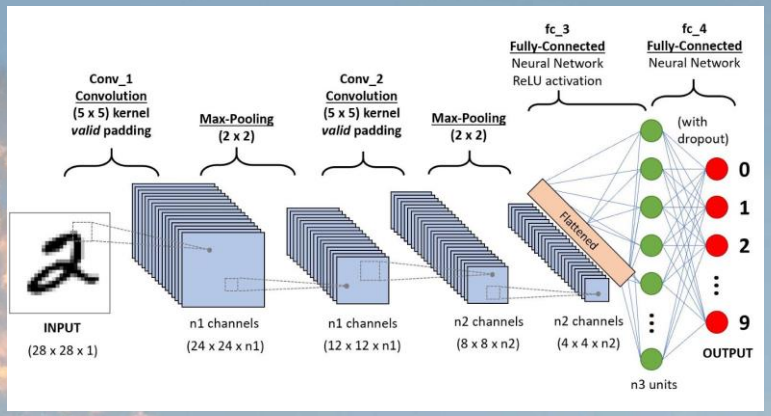




Divide and Conquer - Variants

Image Source: https://www.researchgate.net/figure/Schematic-of-GPU-computing_fig2_304612009





Platforms

- Typical Cluster & Grid Computing

Hardware

- Multi-Core CPU
- Field-Programmable Gate Arrays (FPGA)
- Graphics Processing Units (GPU)

Image Source: https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53

Neural Network Training

Training Convolutional Neural Network

- Reduction Pattern
  - Neural Network Dot-Products
- Stencil Pattern
  - Convolution
  - Pooling

DSA Europa (TensorFlow)

- CPU based training

NSF Nautilus (TensorFlow)

- GPU based training