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FAKULTÄT FÜR
INFORMATIK

Performance Factors for Deep Learning and Shallow Neural Network Applications: A Beginners Guide

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Agenda

Motivation

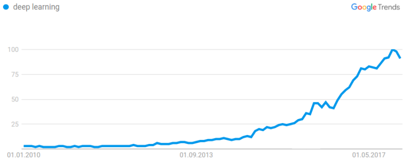
Overview

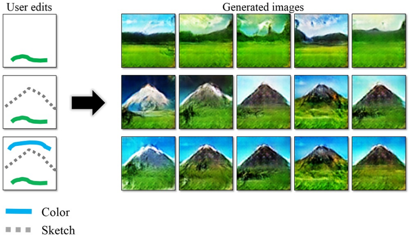
Choice of Neural Network

Choice of Processing Unit

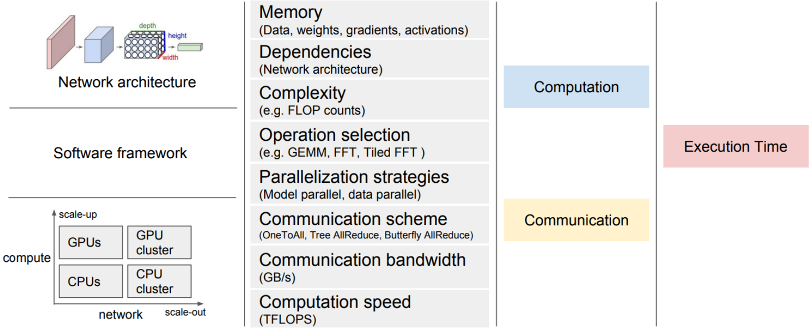
Challenges

Motivation


deep learning
Google Trends
100
75
50
25
01.01.2010
01.09.2013
01.05.2017


User edits
Generated images
Color
Sketch

Overview



Network architecture

Software framework

GPUs	GPU cluster
CPUs	CPU cluster

Memory
(Data, weights, gradients, activations)

Dependencies
(Network architecture)

Complexity
(e.g. FLOP counts)

Operation selection
(e.g. GEMM, FFT, Tiled FFT)

Parallelization strategies
(Model parallel, data parallel)

Communication scheme
(OneToAll, Tree AllReduce, Butterfly AllReduce)

Communication bandwidth
(GB/s)

Computation speed
(TFLOPS)

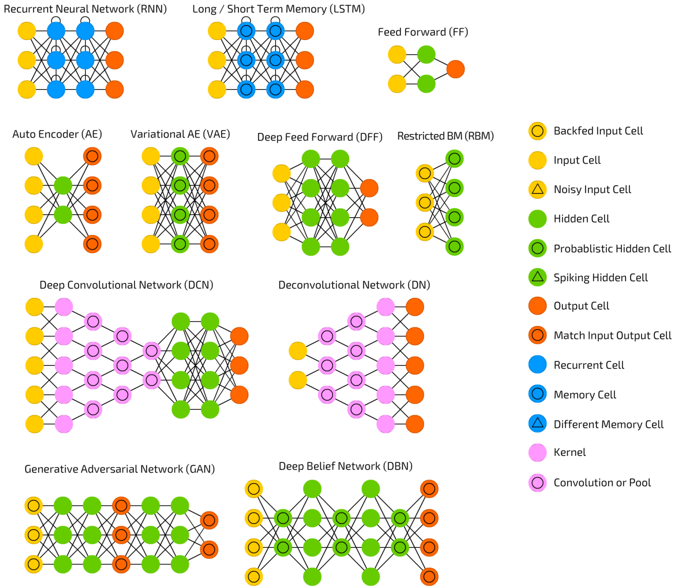
Computation

Communication

Execution Time

Choice of Neural Network

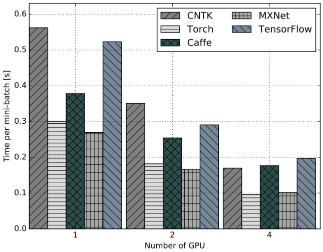
- Shallow Networks
  - FFN, AE, RBM
- Deep Networks
  - VAE, DBN, GAN, RNN e.g. LSTM, DCN, DN, RN
- Hyperparameters
- Usage of specific networks

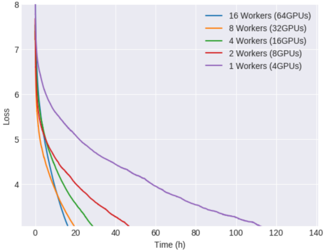

Recurrent Neural Network (RNN)
Long / Short Term Memory (LSTM)
Feed Forward (FF)
Auto Encoder (AE)
Variational AE (VAE)
Deep Feed Forward (DFF)
Restricted BM (RBM)
Deep Convolutional Network (DCN)
Deconvolutional Network (DN)
Generative Adversarial Network (GAN)
Deep Belief Network (DBN)
Backfed Input Cell
Input Cell
Noisy Input Cell
Hidden Cell
Probablistic Hidden Cell
Spiking Hidden Cell
Output Cell
Match Input Output Cell
Recurrent Cell
Memory Cell
Different Memory Cell
Kernel
Convolution or Pool

Choice of Processing Unit

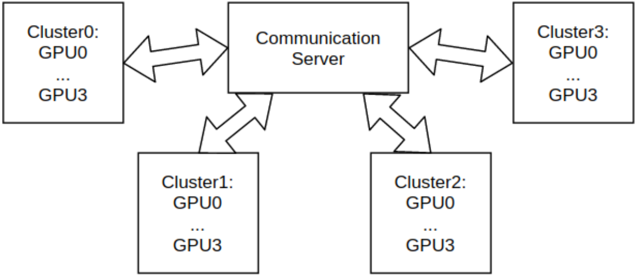
- CPU
  - Single-thread
  - Multi-thread
  - Advantage
  - Disadvantage
- GPU
  - Single unit
  - Multi-GPU
  - Advantage
  - Disadvantage
- GPU-Cluster
  - Advantage
  - Disadvantage

Framework	1 Thread	2 Threads	4 Threads	8 Threads
Caffe	1.324	0.790	0.578	15.444
Tensorflow	7.062	4.789	2.648	1.938
Torch	1.329	0.710	0.423	na





Challenges



Cluster0:
GPU0
...
GPU3

Communication
Server

Cluster3:
GPU0
...
GPU3

Cluster1:
GPU0
...
GPU3

Cluster2:
GPU0
...
GPU3

Thank you for your attention!

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