DEEP LEARNING WITH NVIDIA
GPUS

JONATHAN COHEN, DIRECTOR OF ENGINEERING
DEEP LEARNING SOFTWARE, NVIDIA
What is Deep Learning?

Machine Learning Software

Forward Propagation

Backward Propagation

Compute weight update to nudge from “turtle” towards “dog”

Repeat

Training

Classification

Trained Model

Cat

Dog

“turtle”

“cat”
Why is Deep Learning Hot Now?

- **Big Data Availability**
  - Facebook: 350 millions images uploaded per day
  - Walmart: 2.5 Petabytes of customer data hourly
  - YouTube: 100 hours of video uploaded every minute

- **New ML Techniques**

- **GPU Acceleration**
GPUs and Deep Learning

<table>
<thead>
<tr>
<th></th>
<th>NEURAL NETWORKS</th>
<th>GPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherently Parallel</td>
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<td>✔</td>
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<tr>
<td>Matrix Operations</td>
<td>✔</td>
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<tr>
<td>FLOPS</td>
<td>✔</td>
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<tr>
<td>Bandwidth</td>
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**GPUs deliver** --
- same or better prediction accuracy
- faster results
- smaller footprint
- lower power
DAVE

Deep Learning approach to robot navigation
Deep Neural Network “watches” human drivers, learns how to react
The Theory of DAVE

Learn: Visual Input => Action
DAVE in Action
An advanced computing platform based on NVIDIA Tegra processors for autonomous driving cars

FEATURES

The ability to capture and process multiple HD camera and sensor inputs

A rich middleware for computer graphics, computer vision and deep learning

A powerful and easy to develop platform for algorithm research and rapid prototyping

Preliminary information — Subject to change
Running on Drive PX and developed in just 3 weeks!
Drive PX Development Platform
Practical Examples of Deep Learning

Image Classification, Object Detection, Localization, Action Recognition

Speech Recognition, Speech Translation, Natural Language Processing

Pedestrian Detection, Lane Detection, Traffic Sign Recognition

Breast Cancer Cell Mitosis Detection, Volumetric Brain Image Segmentation

Todo: better version of this slide
The Deep Learning Community: Detecting Diabetic Retinopathy
Founded in 2010

Sponsor contests to spur collaborative problem solving

354K data scientists in Kaggle community

92K machine learning models submitted to Kaggle competitions each month
Strength of Community-based Data Science - “Mapping Dark Matter” results

Accuracy (lower is better)

Week 1 | Week 3 | Week 5 | Week 7 | End

- Martin O’Leary
  PhD student in Glaciology, Cambridge U
- Ali Haissaine & Eu Jin Loc
  Signature Verification, Qatar U & Grad Student @ Deloitte
- Marius Cobzarenco
  Grad student in computer vision, UC London
- Other
- deepZot (David Kirkby & Daniel Margala)
  Particle Physicist & Cosmologist
Diabetic Retinopathy

Affects 347 million people worldwide

Leading cause of blindness among working age population in developed world

Changes to blood vessels in the retina lead to aneurisms and fluid leaks

If no treated early, can cause blindness

Requires regular screenings

Fundus photography with interpretation by trained physician

Kaggle Diabetic Retinopathy Contest

$100,000 award sponsored by the California Healthcare Foundation

Contestants provided 17,000 left/right images with score: 0 (healthy) to 4 (diseased)

Typical clinician scores 0.83 (1.0 = perfect agreement with another clinician)

661 teams entered

Winning score 0.84958

4 teams above 0.83
Benjamin Graham - Finished #1!
Assistant Professor in Stats and Complexity, University of Warwick

SparseConvNet (written in CUDA)

NVIDIA CUDA

NVIDIA GPU

SparseConvNet
Deep Network with fractional pooling

Random Forest (scikits-learn)
Antreas Antoniou - Finished in top 3rd
Master’s Data Science student, University of Lancaster

NVIDIA DIGITS
NVIDIA cuDNN
NVIDIA CUDA
NVIDIA GPU
Deep Learning Platform
NVIDIA DEEP LEARNING PLATFORM
NVIDIA cuDNN
GPU Acceleration for Deep Learning Frameworks

High performance neural network training

GPU acceleration for Caffe, Theano, Torch and other deep learning frameworks

Support for widely-used layer types, including pooling, ReLU, sigmoid, softmax and TANH

Performance optimized for the latest NVIDIA GPU architectures

Linux, Windows, OSX and Linux for Tegra (ARM)

http://developer.nvidia.com/cuDNN
NVIDIA DIGITS
Interactive Deep Learning GPU Training System

Process Data
Configure DNN
Monitor Progress
Visualize Layers

http://developer.nvidia.com/digits
Automatic Multi-GPU Training
DIGITS 2 interactive deep learning training system

Automatic multi-GPU scaling
Up to 4 GPUs

DIGITS 2 trains models up to 2x faster
with Multi-GPU Scaling

DIGITS 2 performance vs. previous version on an NVIDIA DIGITS DevBox system

developer.nvidia.com/digits
Learn More: Introduction to Deep Learning

Free 10-week Online Course

Get Started with Deep Learning

DIGITS, Caffe, Theano, Torch

5 units - available worldwide

Live classes (recordings available)

Hands-on labs (no GPU required)

Office hours with NVIDIA experts

Wednesdays, 9-10am Pacific Time

developer.nvidia.com/deep-learning-courses
THANK YOU

JOIN THE CONVERSATION

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