DEEP LEARNING DEMYSTIFIED

Marc Hamilton
VP, Solutions Architecture & Engineering
NEURAL NETWORKS ARE NOT NEW

Historically we never had large datasets or compute

The MNIST (1999) database contains 60,000 training images and 10,000 testing images.
NEURAL NETWORKS ARE NOT NEW

Data and model size are the key to accuracy

Algorithm performance in big data regime

![Graph showing algorithm performance in big data regime with different models like Small NN, ML1, ML2, ML3, and Big NN.](image-url)
DEEP LEARNING

TRAINING
Learning a new capability from existing data

INFEERENCE
Applying this capability to new data

Untrained Neural Network Model
EXPLODING DATASETS

Logarithmic relationship between the dataset size and accuracy

- Translation
- Language Models
- Character Language Models
- Image Classification
- Attention Speech Models

EXPLODING DATASETS
Logarithmic relationship between the dataset size and accuracy
EXPLODING DATASETS
The good news - you can calculate how much data you need

Step 1: Establish how much accuracy you need

EXPLODING DATASETS

The good news - you can calculate how much data you need

Step 2: Conduct a number of experiments with dataset of the varying size (in the Power-law region)
EXPLoding Datasets
The good news - you can calculate how much data you need

Step 3: Interpolate

EXPLODING DATASETS

The bad news - log-scale

NEURAL NETWORK COMPLEXITY IS EXPLODING
To Tackle Increasingly Complex Challenges

2015 - Microsoft ResNet
Superhuman Image Recognition

2016 - Baidu Deep Speech 2
Superhuman Voice Recognition

2017 - Google Neural Machine Translation
Near Human Language Translation
FUNDAMENTAL CHANGE TO THE ECONOMY

Microsoft just officially listed AI as one of its top priorities, replacing mobile

- Satya Nadella's "mobile-first and cloud-first world" line is out.
- The change comes after Microsoft formed the Artificial Intelligence and Research group.

Jordan Novet | @jordannovet
Published 5:48 PM ET Wed, 2 Aug 2017 | Updated 7:00 PM ET Fri, 4 Aug 2017

Bloomberg News
July 21, 2017, 4:04 AM GMT+1  Updated on July 21, 2017, 8:12 AM GMT+1

China’s Got a Huge Artificial Intelligence Plan

Priorities are intelligent robotics, vehicles, virtual reality
AI seen contributing up to $15.7 trillion worldwide by 2030

UAE: First minister of artificial intelligence don land

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WHAT MAKES AI PROJECTS SUCCESSFUL?
# WHAT TYPE OF A PROBLEM IS IT?

Supervised Learning: the mapping from the data to the labels

<table>
<thead>
<tr>
<th>Data</th>
<th>Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image</td>
<td>Name of objects in the image</td>
</tr>
<tr>
<td>Speech</td>
<td>Text</td>
</tr>
<tr>
<td>Video (e.g. football game)</td>
<td>Event statistics (number of football passes)</td>
</tr>
<tr>
<td>Mortgage application</td>
<td>Mortgage risk</td>
</tr>
<tr>
<td>Text</td>
<td>Speech</td>
</tr>
<tr>
<td>English</td>
<td>French</td>
</tr>
<tr>
<td>Click through data</td>
<td>Content recommendations</td>
</tr>
</tbody>
</table>
WHAT TYPE OF A PROBLEM IS IT?

Noise vs Structure

Lots of noise, little structure - most probably not (changing with self normalising NN)

Little noise, complex structure - most probably yes

WHAT TYPE OF A PROBLEM IS IT?

What is possible today?

“If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future.”

Andrew Ng, Founder of Google Brain
DO YOU HAVE ENOUGH LABELED DATA?
The Achilles heel of deep learning: You need a lot of labeled data.

Without a large dataset, deep learning isn’t likely to succeed.

Labels:
- Getting someone to decide the “right” answer can be hard (think about medical imaging)
- If a dataset requires skilled labor to produce labels, this limits scale / affects the cost
DO YOU HAVE ENOUGH LABELED DATA?

How much data is enough?

“As of 2016, a rough rule of thumb is that a supervised deep learning algorithm will generally achieve acceptable performance with around 5,000 labeled examples per category, and will match or exceed human performance when trained with a dataset containing at least 10 million labeled examples.”

“Working successfully with datasets smaller than this is an important research area, focusing in particular on how we can take advantage of large quantities of unlabeled examples, with unsupervised or semi-supervised learning.”

Ian Goodfellow, Yoshua Bengio, Aaron Courville

WHAT LEVEL OF ACCURACY DO YOU NEED?

Defining and measuring accuracy

How much accuracy you need? (mortgage risk calculation - high, celebrity portal - low)

Aim for lowest acceptable for the product

What is the measure:

- Accuracy (% correct)
- Coverage (% of examples processed)
- Precision (% of detections that are right)
- Recall (% of objects that are detected)
- Amount of error (for regression problems)

- What protective mechanisms to you need to safeguard the system from unavoidable prediction error?

CALL TO ACTION
TALK TO US ABOUT YOUR USE CASE
We can help (POC, partner network, training and more)
NVIDIA GPU DEEP LEARNING EVERYWHERE, EVERY PLATFORM

TESLA
Servers in every shape and size

DGX Systems — The essential deep learning systems for instant productivity

CLOUD
Everywhere
INNOVATE IN MINUTES, NOT WEEKS WITH DEEP LEARNING CONTAINERS

Benefits of Containers:

- Simplify deployment of GPU-accelerated applications, eliminating time-consuming software integration work
- Isolate individual frameworks or applications
- Share, collaborate, and test applications across different environments
DEEP LEARNING INSTITUTE

DLI Mission: Help the world to solve the most challenging problems using AI and deep learning

We help developers, data scientists and engineers to get started in architecting, optimizing, and deploying neural networks to solve real-world problems in diverse industries such as autonomous vehicles, healthcare, robotics, media & entertainment and game development.