



# DEEP LEARNING IN FINANCE

Adam Grzywaczewski

# ABOUT ME

Adam Grzywaczewski - [adamg@nvidia.com](mailto:adamg@nvidia.com)



- Deep Learning Solution Architect @ NVIDIA - Supporting delivery of AI / Deep Learning solutions
- 10 years experience delivering Machine Learning of all scale (from embedded, mobile to Big Data)
- My past experience:
  - Capgemini: <https://goo.gl/MzgGbq>
  - Jaguar Land Rover Research: <https://goo.gl/ar7LuU>



## NVIDIA A LEARNING MACHINE

GPU sparked the growth of PC gaming, redefined modern computer graphics, and revolutionized parallel computing

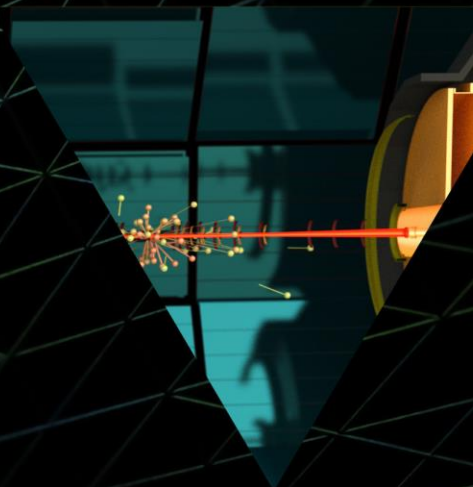
GPU deep learning ignited modern AI – the next era of computing

PC GRAPHICS



1996

GPU COMPUTING



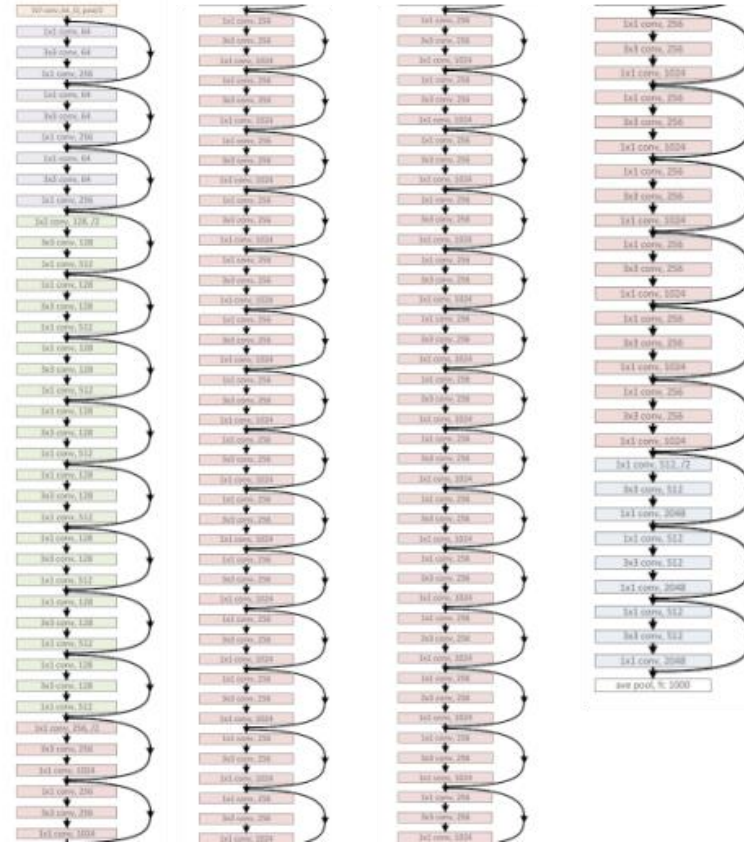
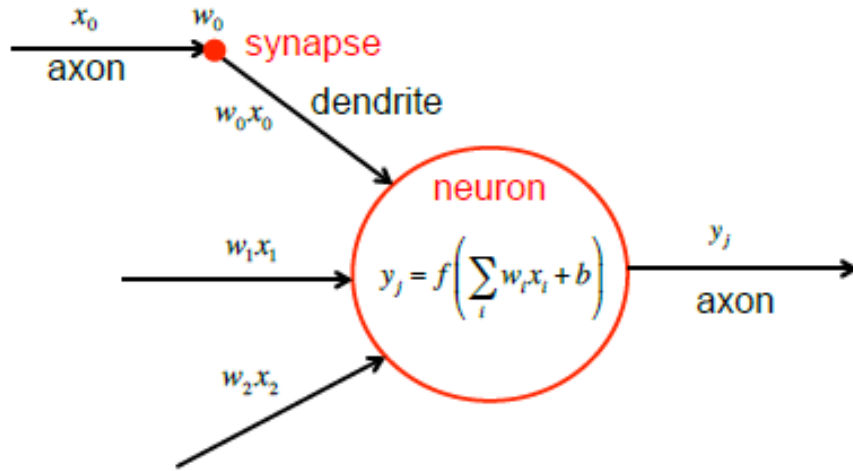
2006



2016

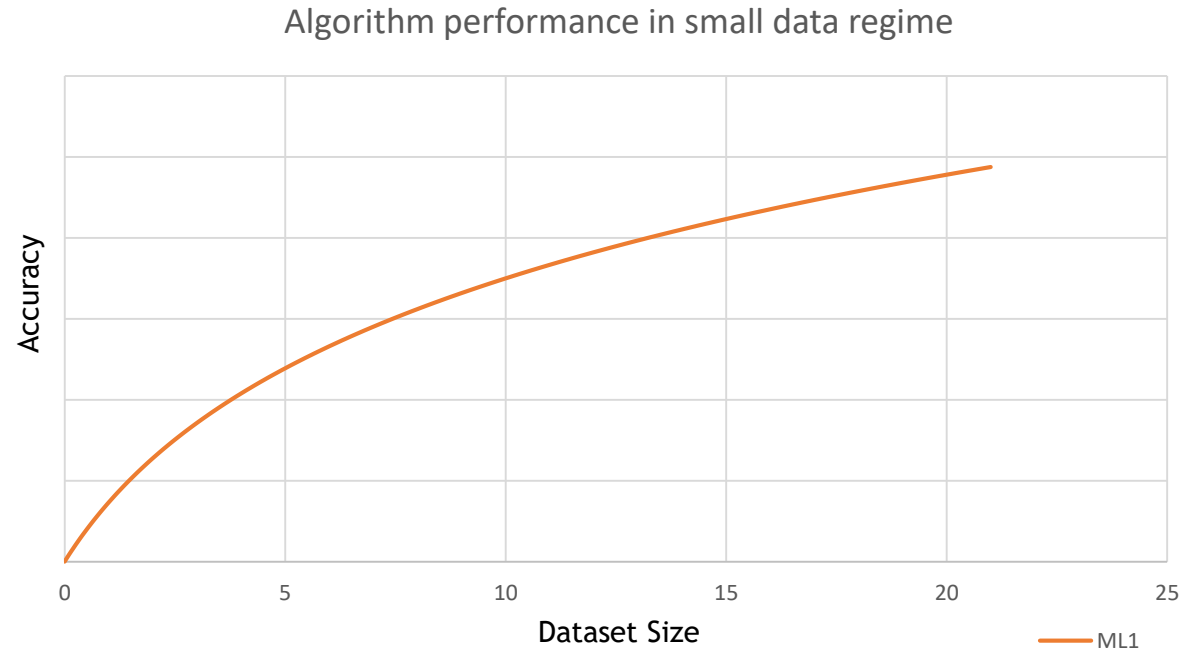
# NEURAL NETWORKS ARE NOT NEW

And are disappointingly simple as an algorithm



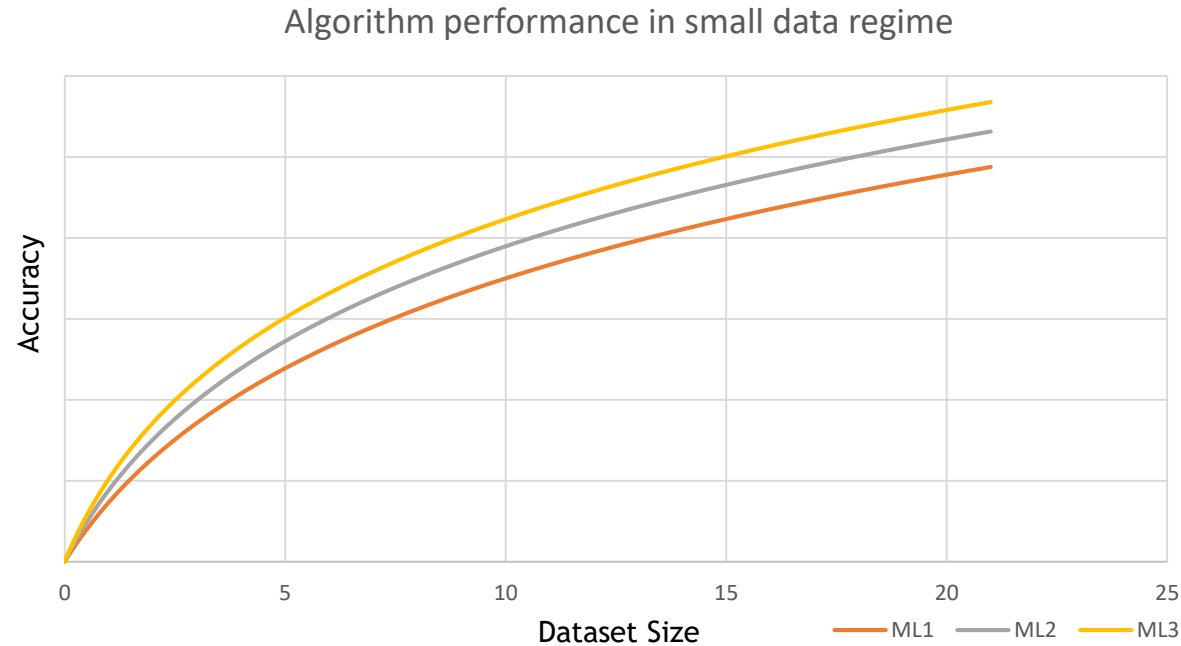
# NEURAL NETWORKS ARE NOT NEW

They just historically never worked well



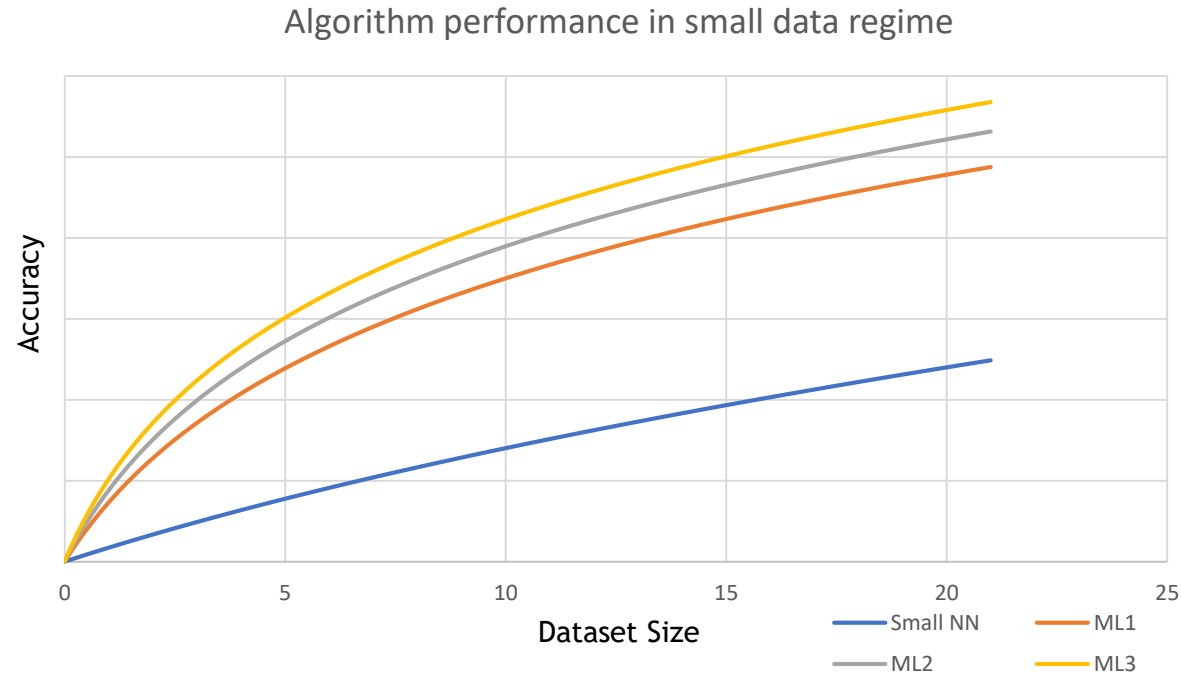
# NEURAL NETWORKS ARE NOT NEW

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**WHY?**



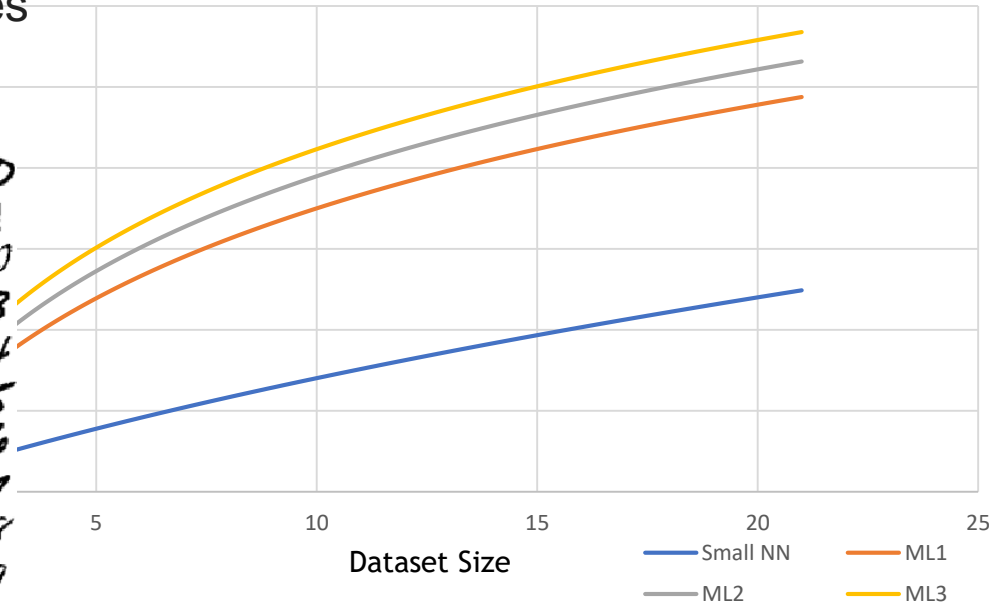
# DATA

Historically we never had large datasets

The MNIST (1999) database contains 60,000 training images and 10,000 testing images.



Algorithm performance in small data regime



**PERSPECTIVE**

# PERSPECTIVE

1.759 petaFLOPs in November 2009



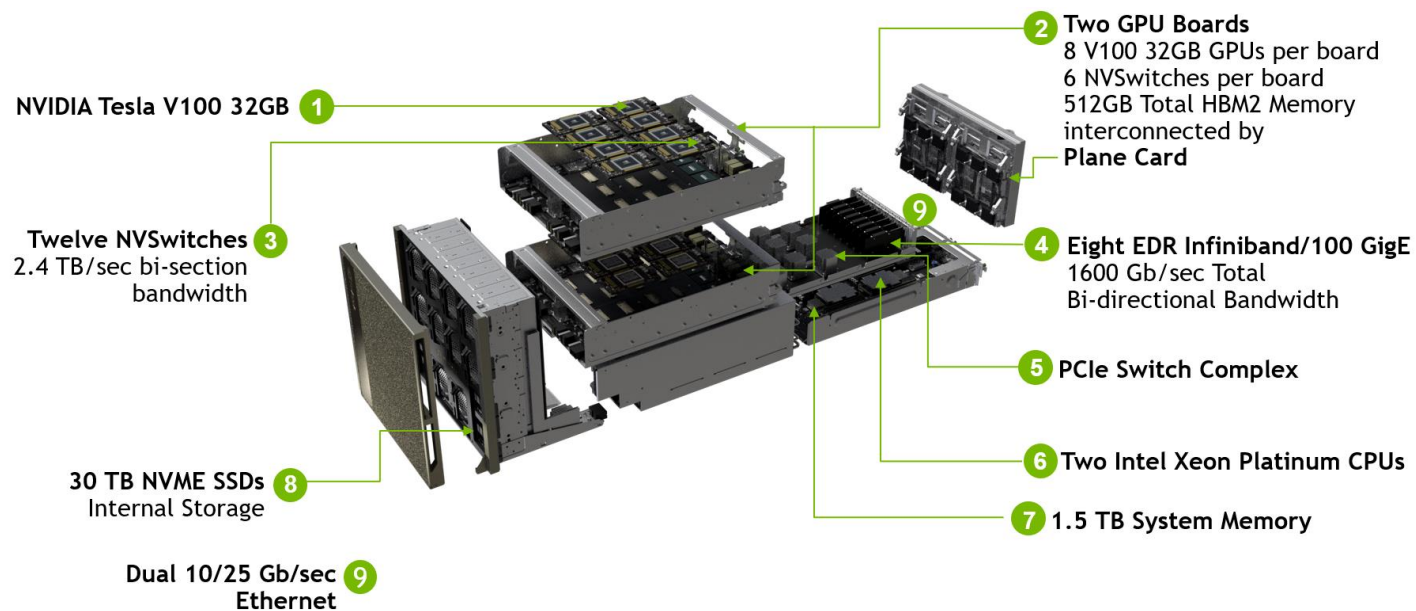
# THE GPU COMPUTING

## From Gaming to High Performance Computing



# PERSPECTIVE

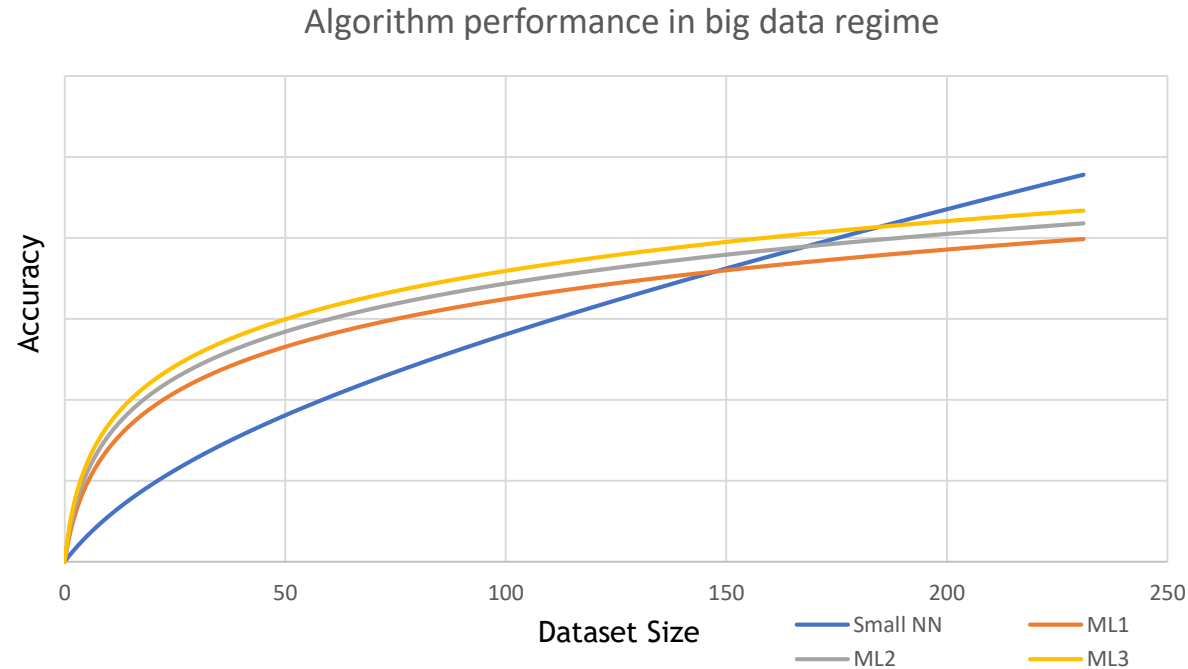
2 petaFLOPs - today





# NEURAL NETWORKS ARE NOT NEW

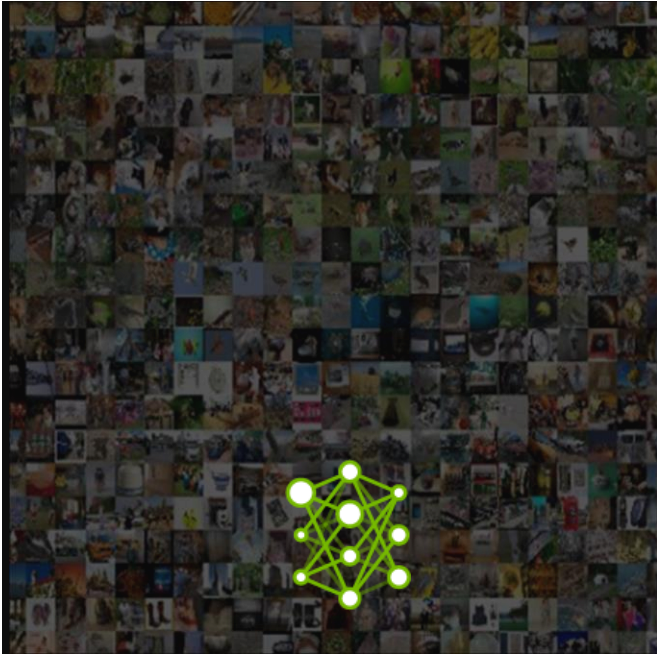
Availability of data and compute



# NEURAL NETWORK COMPLEXITY IS EXPLODING

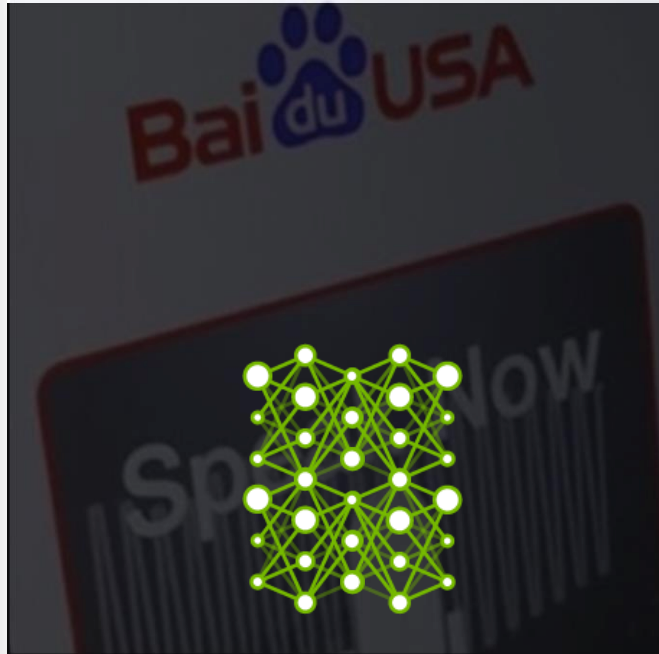
To Tackle Increasingly Complex Challenges

7 ExaFLOPS  
60 Million Parameters



2015 - Microsoft ResNet  
Superhuman Image Recognition

20 ExaFLOPS  
300 Million Parameters



2016 - Baidu Deep Speech 2  
Superhuman Voice Recognition

100 ExaFLOPS  
8700 Million Parameters

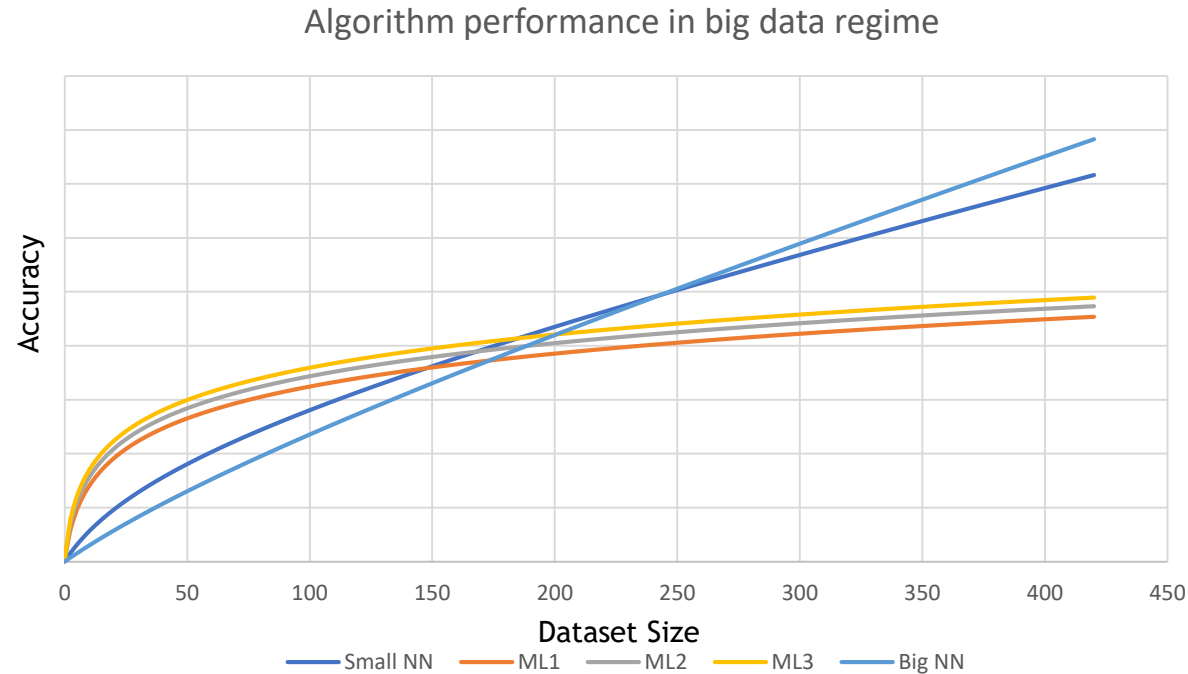


2017 - Google Neural Machine Translation  
Near Human Language Translation

100 EXAFLOPS  
=  
2 YEARS ON A DUAL CPU SERVER

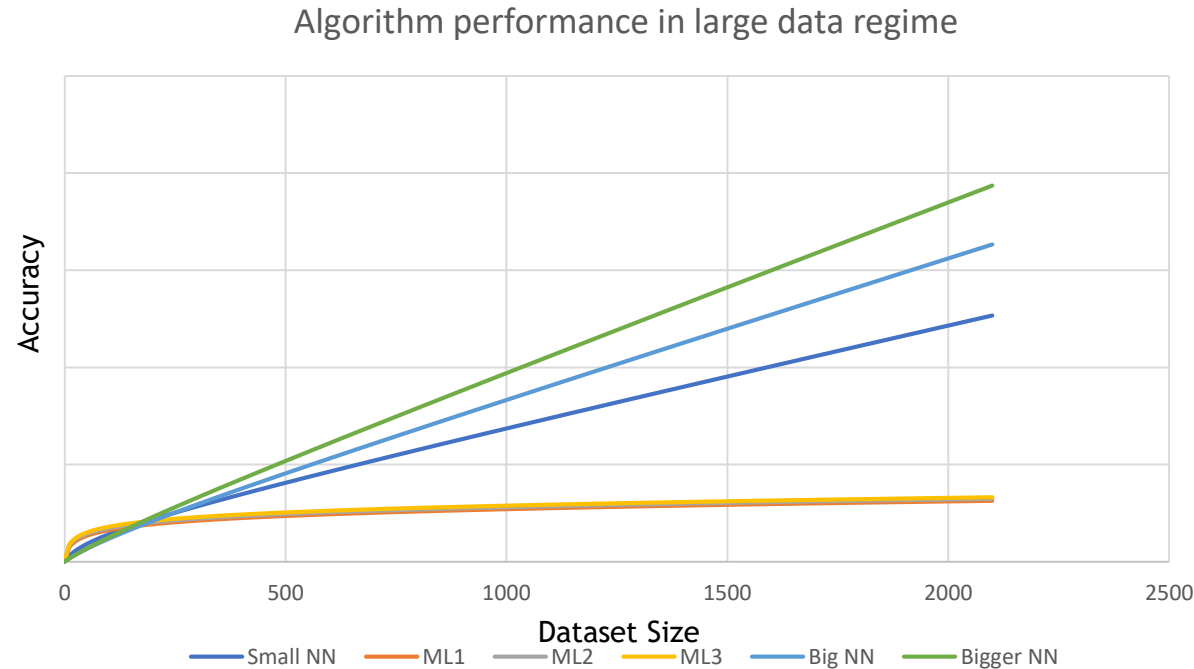
# NEURAL NETWORKS ARE NOT NEW

Data and model size are the key to accuracy



# NEURAL NETWORKS ARE NOT NEW

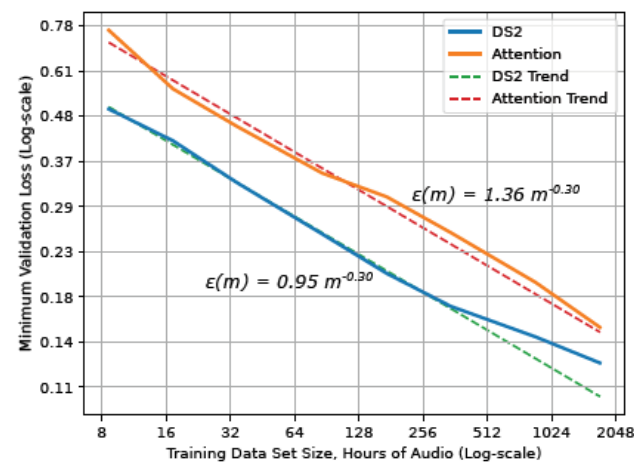
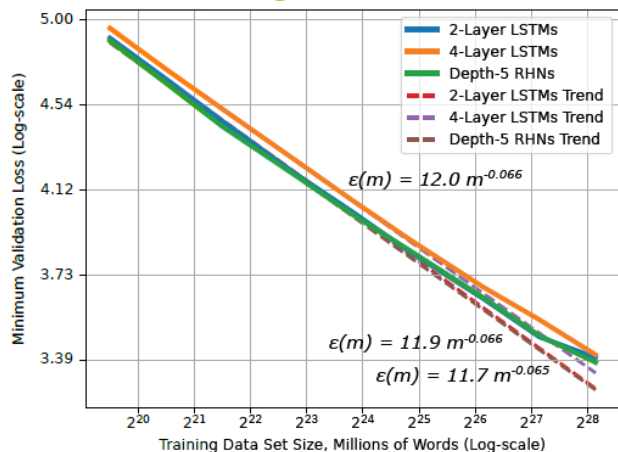
Surpassing human-level performance



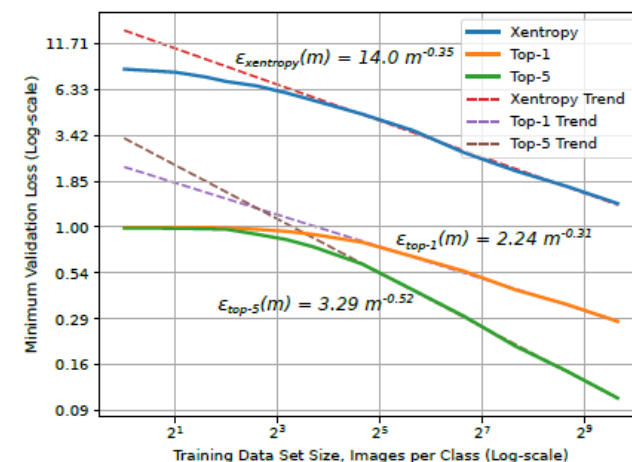
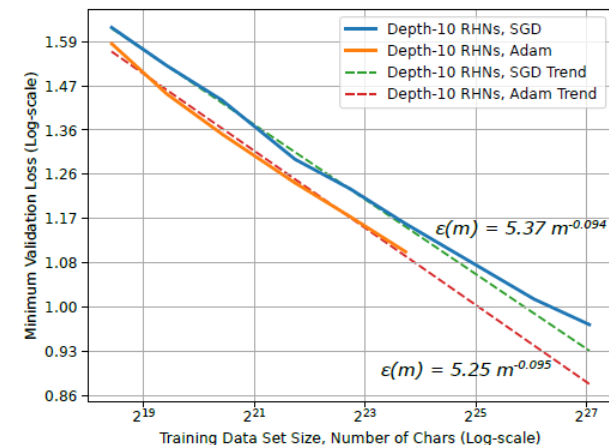
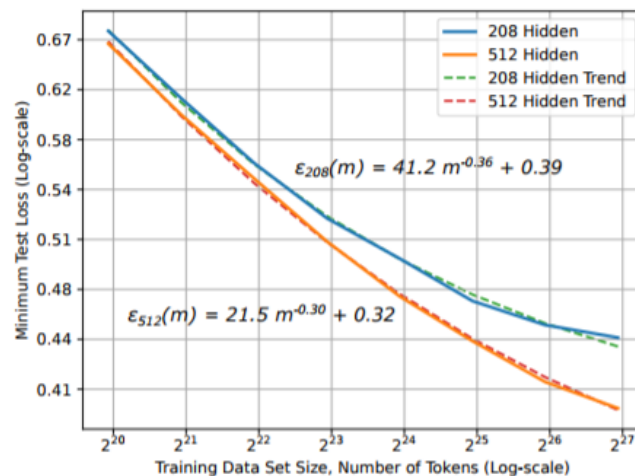


# EXPLODING DATASETS

Logarithmic relationship between the dataset size and accuracy

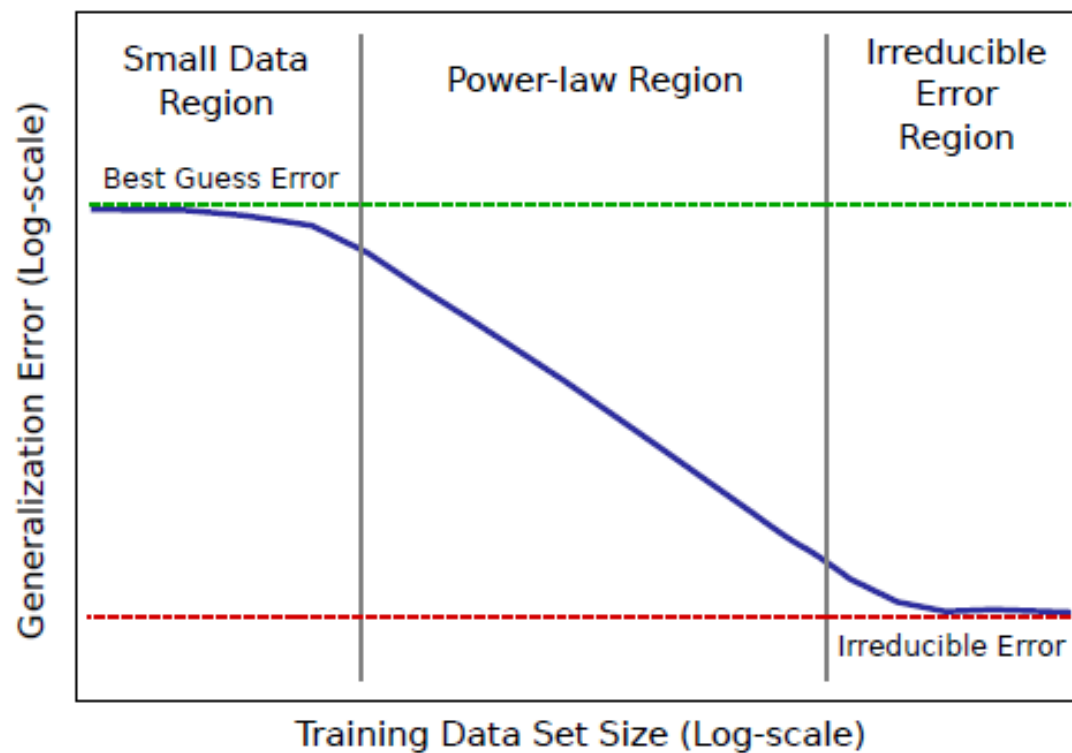


- Translation
- Language Models
- Character Language Models
- Image Classification
- Attention Speech Models



# EXPLODING DATASETS

Logarithmic relationship between the dataset size and accuracy



**MAKING COMPLEX PROBLEMS EASY**

**TRANSFORMING IMPOSSIBLE INTO EXPENSIVE**





# FUNDAMENTAL CHANGE TO THE ECONOMY



REUTERS

World

Business

Markets

Politics

TV

TechRepublic.



## INNOVATION

### The 10 tech companies that have invested the most money in AI

Of the tech giants, Google is the biggest investor in AI by billions.

By Olivia Krauth | January 12, 2018, 1:12 PM PST

- |                              |                                 |
|------------------------------|---------------------------------|
| 1. Google - \$3.9 billion    | 6. Uber - \$680 million         |
| 2. Amazon - \$871 million    | 7. Twitter - \$629 million      |
| 3. Apple - \$786 million     | 8. AOL - \$191.7 million        |
| 4. Intel - \$776 million     | 9. Facebook - \$60 million      |
| 5. Microsoft - \$690 million | 10. Salesforce - \$32.8 million |

## China's Got a Huge Artificial Intelligence Plan

Bloomberg News

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

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

SCIENCE NEWS

MARCH 29, 2018 / 2:36 PM / 10 DAYS AGO

## France to spend \$1.8 billion on AI to compete with U.S., China

Mathieu Rosemain, Michel Rose

BBC

Menu

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## UAE: First minister of artificial intelligence don land

19 October 2017



## 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



# AI IS THE NEW ELECTRICITY

Affecting every aspect of our lives

*“Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don’t think AI will transform in the next several years, ...”*

Andrew Ng , Founder of Google Brain

**CALL TO ACTION**

# TALK TO US ABOUT YOUR USE CASE

We can help (POC, partner network, training and more)



# 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.



# GPU TECHNOLOGY CONFERENCE

October 9-11, 2018 | Munich | #GTC18  
[www.gputechconf.eu](http://www.gputechconf.eu)



## CONNECT

Connect with technology experts from NVIDIA and other leading organizations



## LEARN

Gain insight and valuable hands-on training through hundreds of sessions and research posters



## DISCOVER

See how GPU technologies are creating amazing breakthroughs in important fields such as deep learning



## INNOVATE

Hear about disruptive innovations as early-stage companies and startups present their work

**REGISTRATION IS OPEN AT [WWW.GPUTECHCONF.EU](http://WWW.GPUTECHCONF.EU)**

Don't miss the world's most important event for GPU developers  
October 9–11, 2018 in Munich

**Use discount code: NVADAMG for 25% discount**