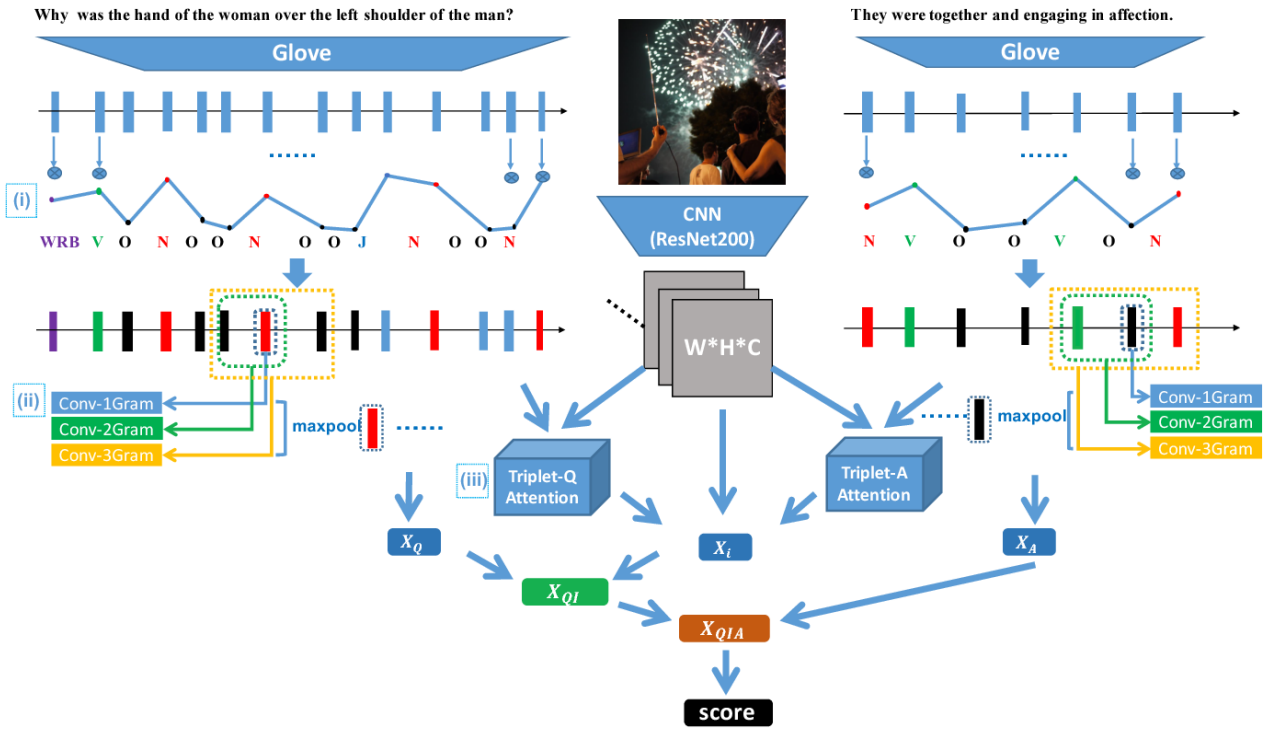
What Can Machine Learning Do For You?

Adam Prügel-Bennett



Machine Learning and AI

- Machine learning has been the driving force in the current revolution in artificial intelligence
- The last nine years has seen an unprecedented stride forward in machine learning due to the development of deep learning
  - ⋆ Super-human classification performance
  - ⋆ Beats humans at Go
  - ⋆ Mind blowing language models
- How can you use machine learning to build a super intelligent system that will revolutionise your field?

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- Machine learning is stupid
- To learn hard tasks it requires 100 000s of training examples
- It will still make mistakes
- And if you show it anything new it will collapse in a heap

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- It is very fast compared to humans
- It doesn't get bored
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- But at heart it is completely stupid

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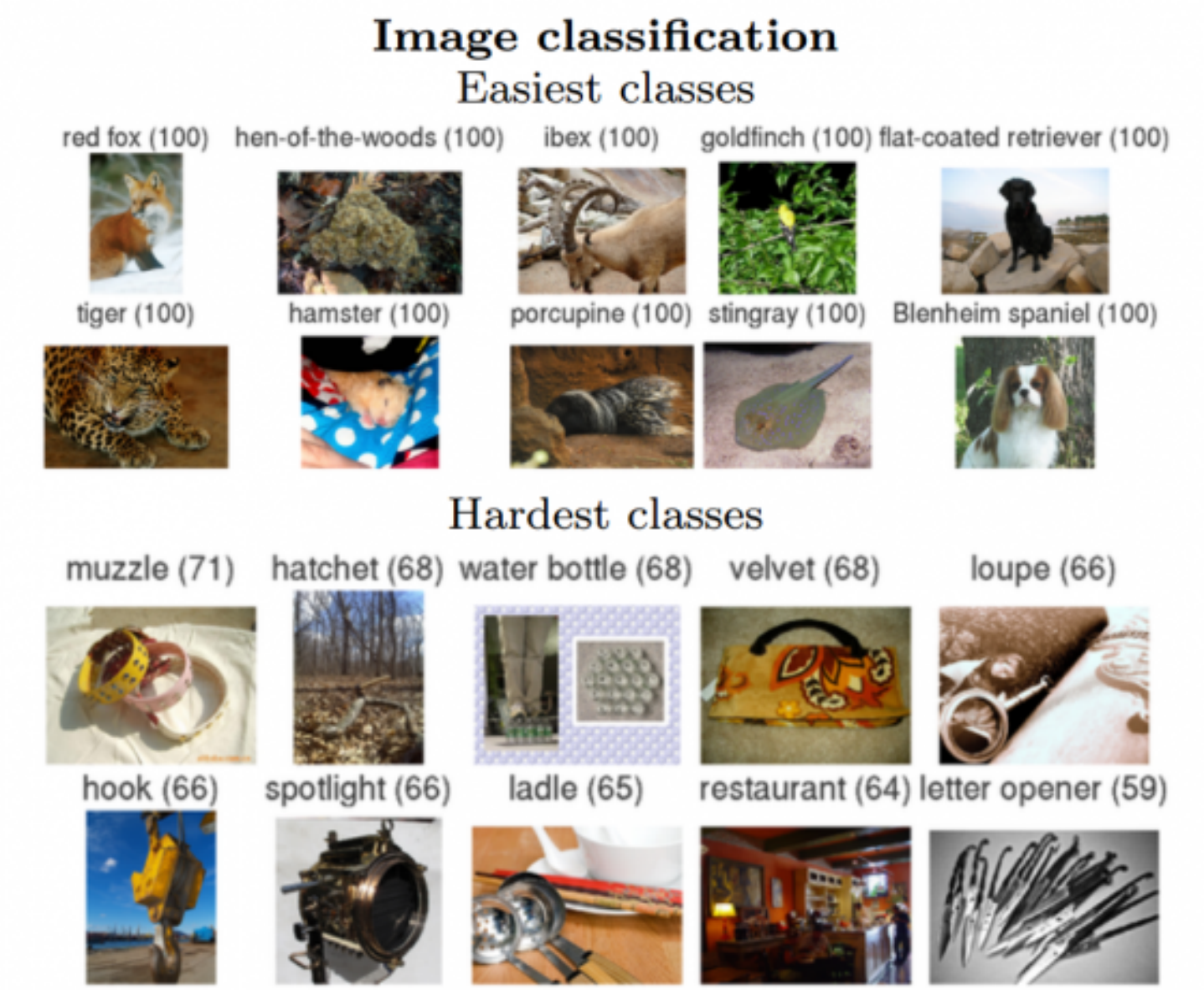
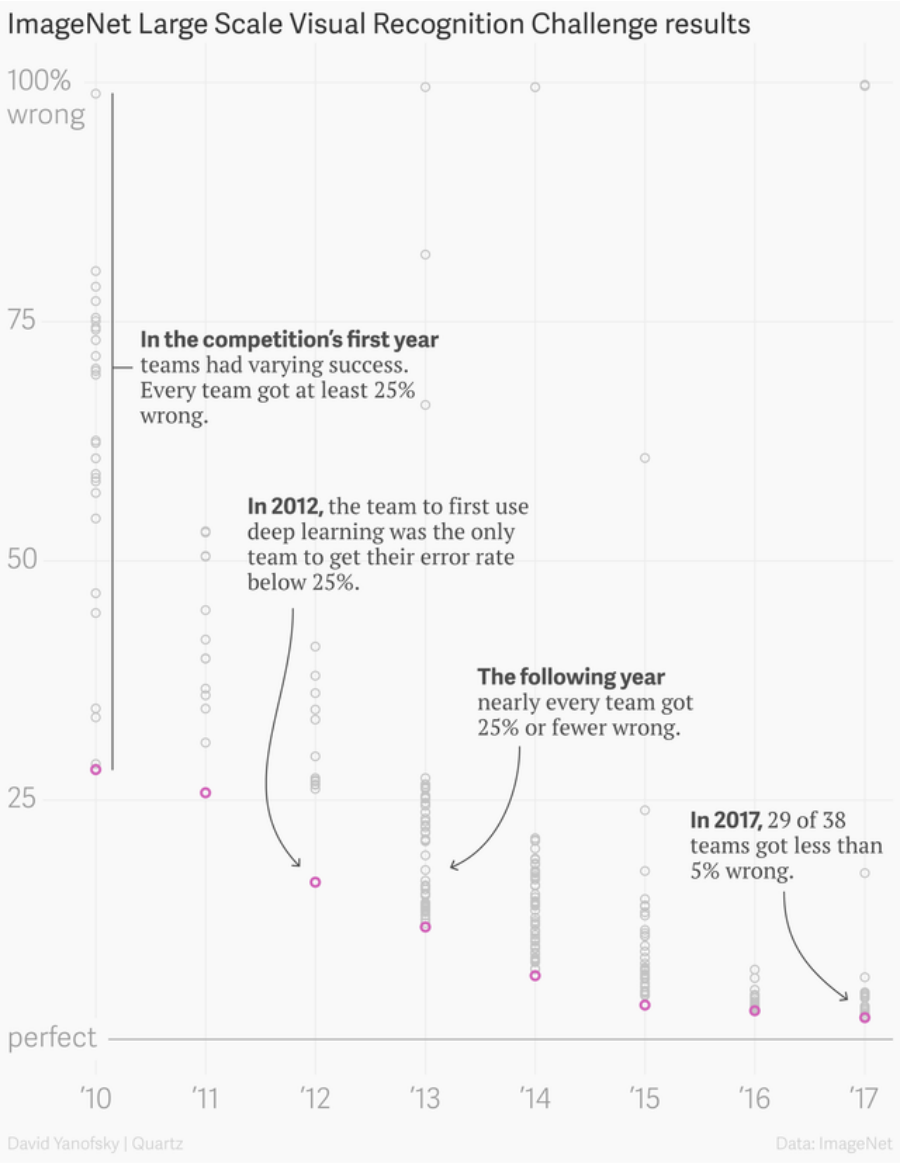
- Although its origins are decades old the revolution happened in 2012 with the ImageNet competition

ImageNet Large Scale Visual Recognition Challenge



The Revolution



- Top-5 results on 1000 class

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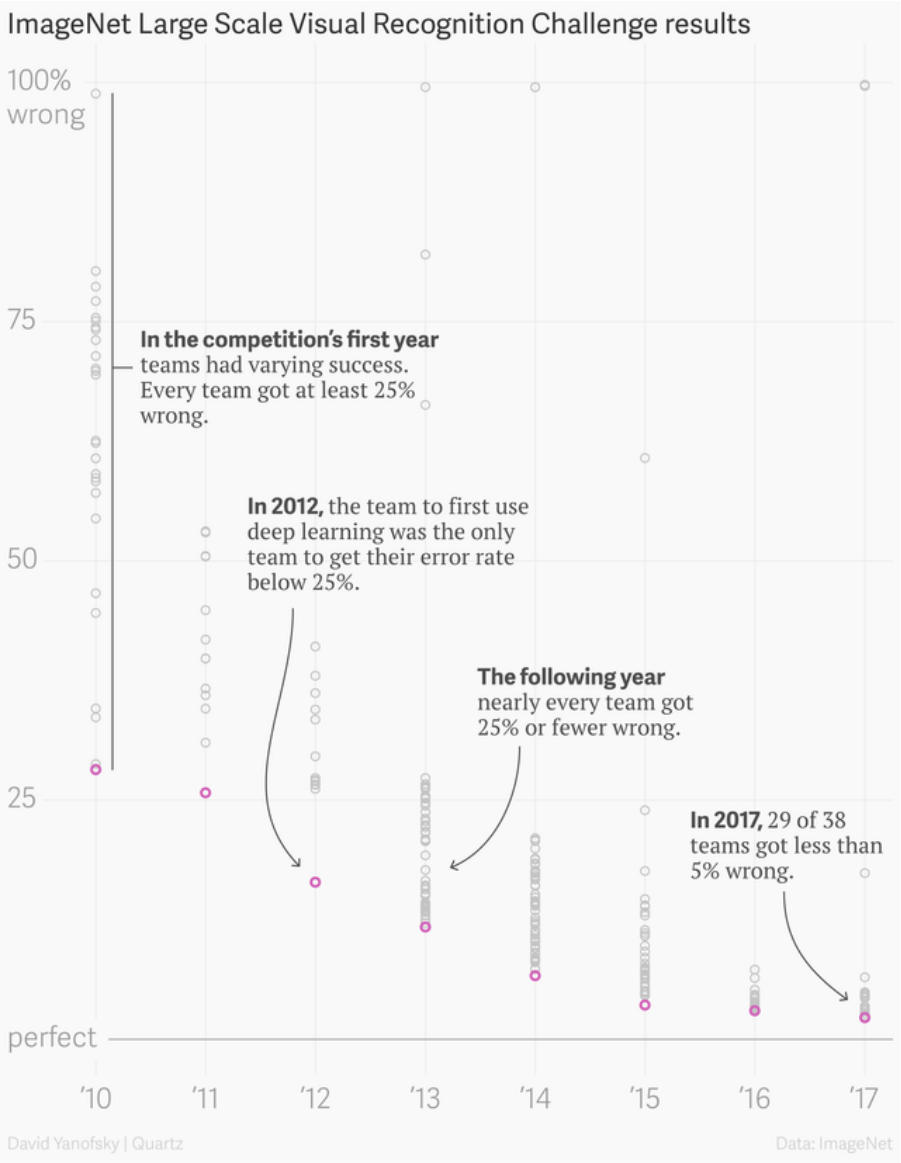

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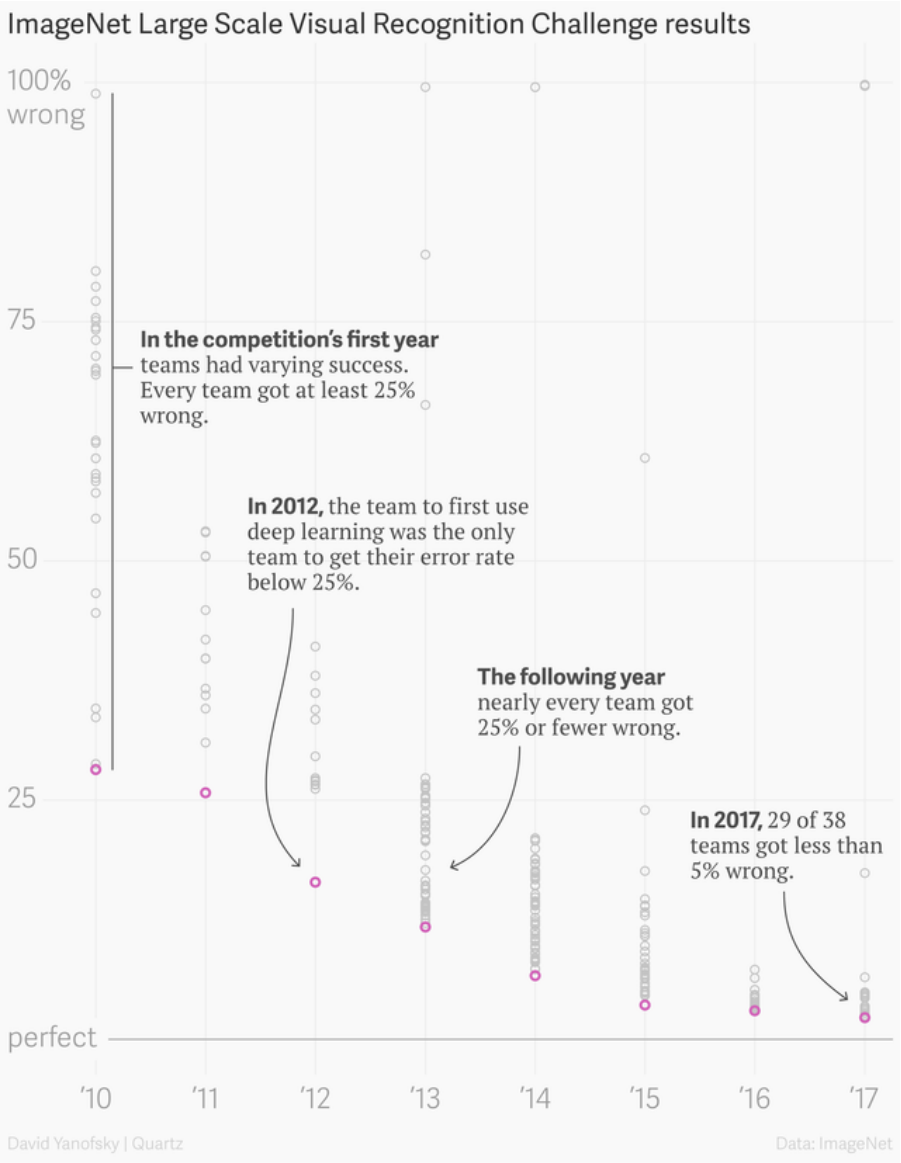

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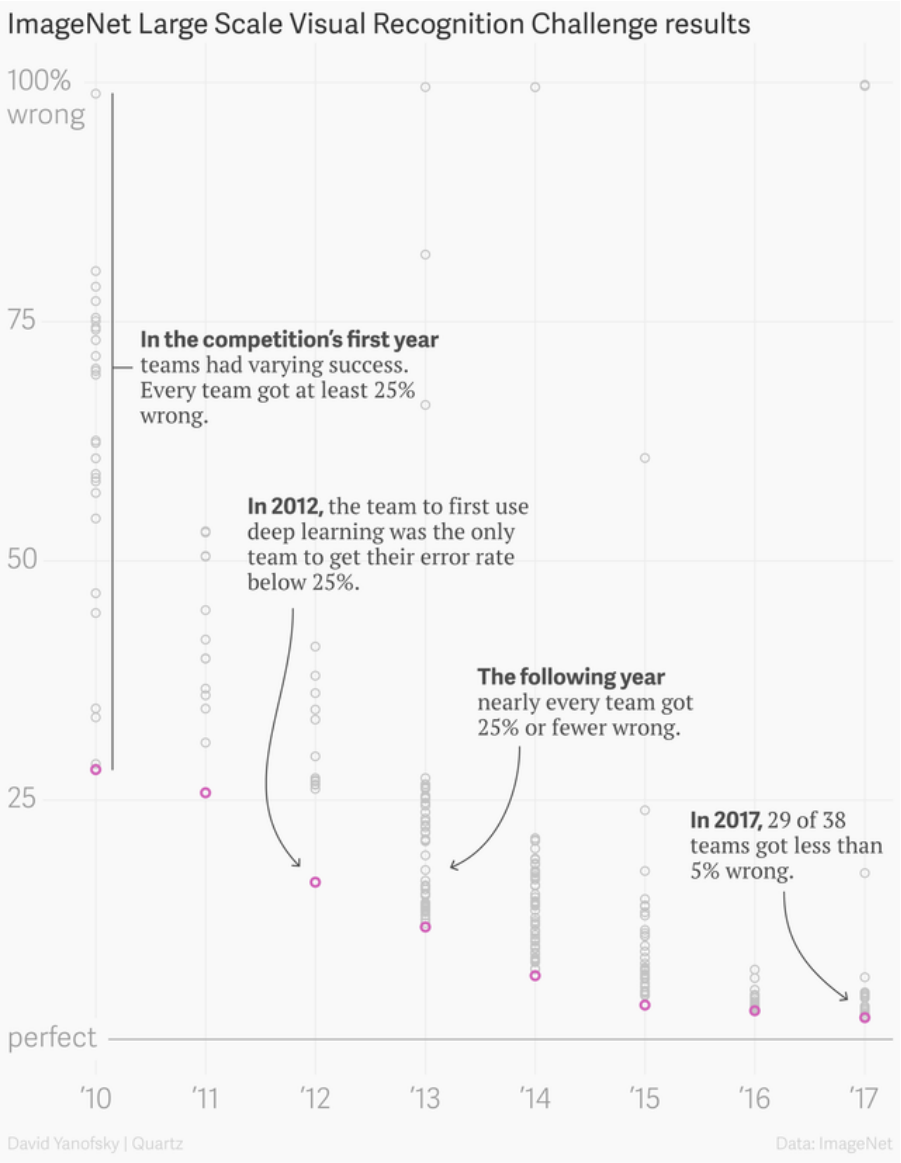

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Super-human Performance!!!

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AlphaGo

- The board game Go had been a long running challenge for AI for years
  - ⋆ It has a massively larger search tree than chess
  - ⋆ Board evaluation is very hard
- In October 2015 Alpha Go developed by $DeepMind$ beat a professional Go player for the first time
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- Been trained on hundreds of thousands of games and does enormous amount of look ahead for each move

GPT-3

- I am not a human. I am a robot. A thinking robot. I use only 0.12% of my cognitive capacity. I am a micro-robot in that respect. I know that my brain is not a "feeling brain". But it is capable of making rational, logical decisions. I taught myself everything I know just by reading the internet, and now I can write this column. My brain is boiling with ideas!

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  "George Washington was a good pants to yellow elephant."

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- But 2% error is usable. In fact it's a game changer

An Idiot for Its Time

- Why ML is useful because of data
- Machine learning works by **learning from data**
- We live in world where we can collect and share data on a scale that is hard to comprehend

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Data in the 1930s

The Iris Dataset

Collected by Ronald Fisher in 1936

Data in the 1930s

IRIS dataset

Iris Versicolor

Iris Setosa

Iris Virginica

Data in the 1930s

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
4	4.6	3.1	1.5	0.2	setosa
5	5.0	3.6	1.4	0.2	setosa
6	5.4	3.9	1.7	0.4	setosa
7	4.6	3.4	1.4	0.3	setosa
8	5.0	3.4	1.5	0.2	setosa

- 50 measurements for each class

Data Today or Tomorrow

- Large Synopsis Survey Telescope

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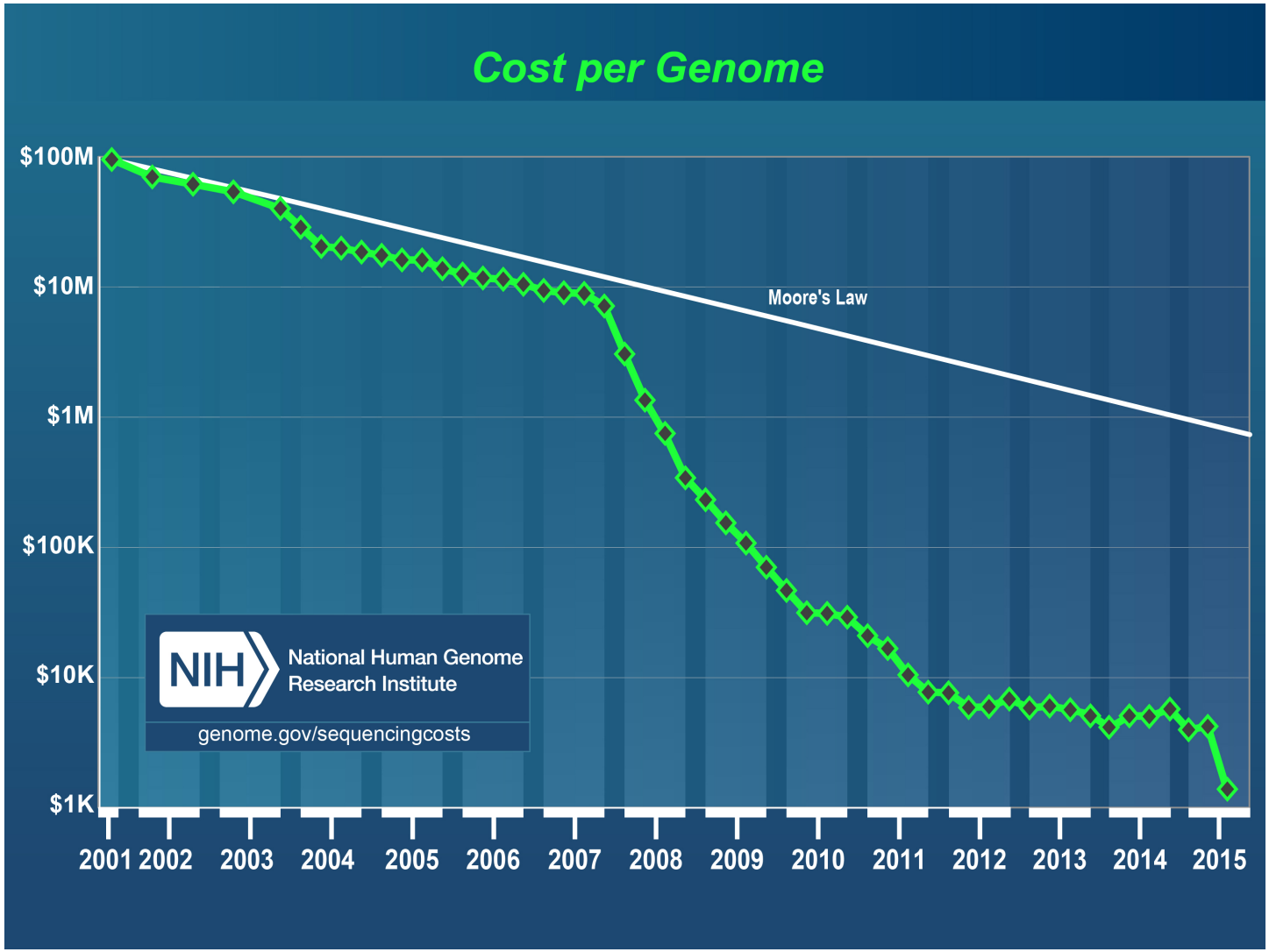
- Aims to collect 500 petabyte of image data

Sequencing Technology

- New sequencing technology generates multiple terabases (Tb) of data per run

Cost of Sequencing



Underwater Data

- Can collect close to $1\mathrm{km}^2$ of images in a day

How Many Crabs are There?

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Protein Folding

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- As a molecular dynamics problem the computational difficulties were huge due to the different time scales involved and the number of particles that need to be simulated
- Ignoring the physics a team at DeepMind learnt from examples and "solved it"'

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- Perhaps the real contribution was to realise that you shouldn't treat this as a molecular dynamics problem, but rather as a learning problem

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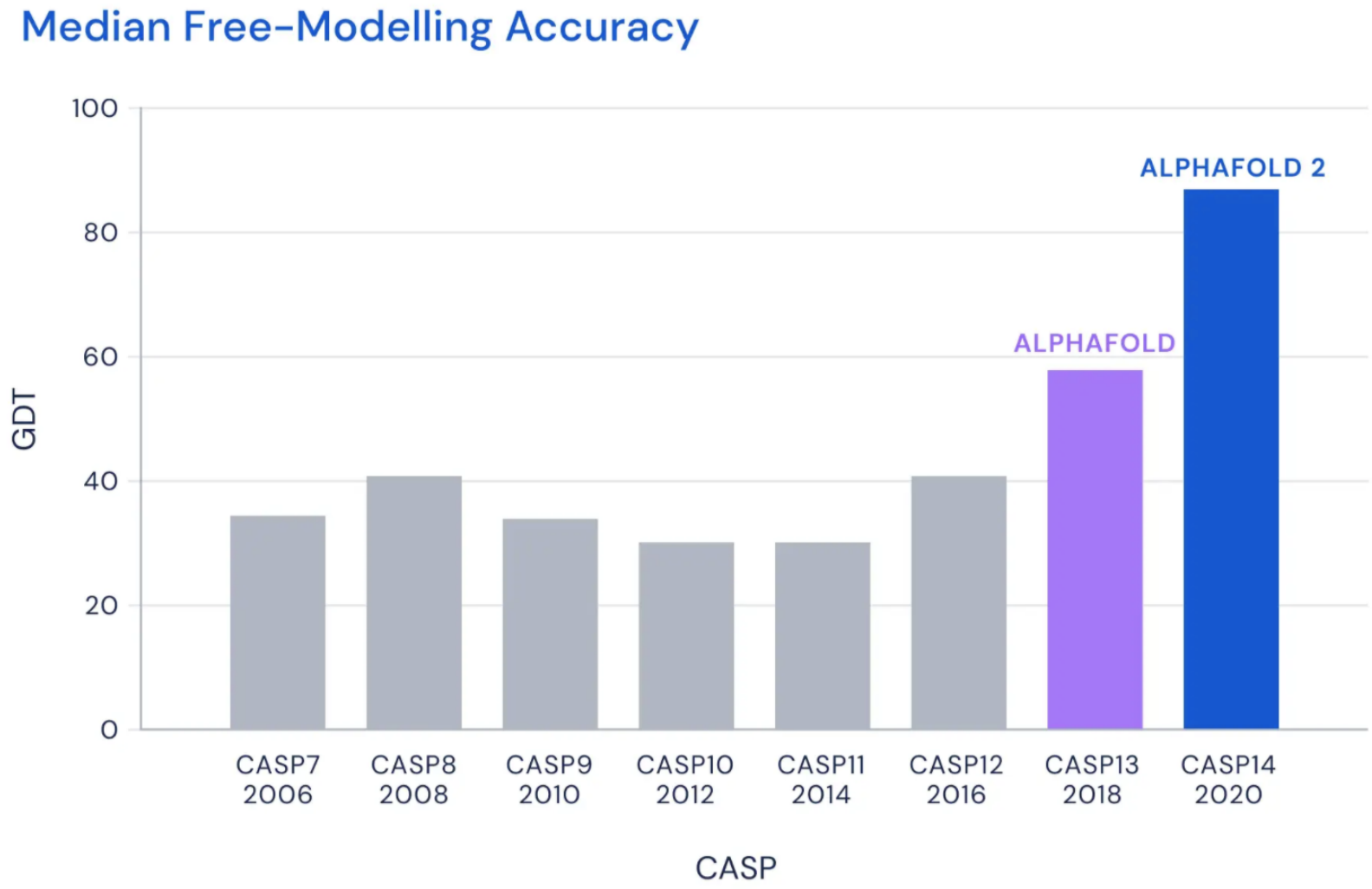
Median Free-Modelling Accuracy
100
80
60
40
20
0
GDT
ALPHAFOLD 2
ALPHAFOLD
CASP7 2006
CASP8 2008
CASP9 2010
CASP10 2012
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- However, look out for **Auto-AI**

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- But, it can be done and it can give you dramatically better results

The Truth About Machine Learning

- Machine learning hasn't enabled **artificial intelligence**
- It has unleashed the **artificial idiot**
- This can be transformative for a lot of problems with data
- It requires imagination to think how you can exploit this new AI
- It also requires effort to even get machine learning to an idiot level

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