Why is deep learning so cool?

Lamberto Ballan

University of Padova, Italy
Lamberto Ballan: “Why is deep learning so cool?”

Visual recognition results

- ImageNet-ILSVRC (classification) over the years

<table>
<thead>
<tr>
<th>Year</th>
<th>NEC</th>
<th>Xerox</th>
<th>AlexNet</th>
<th>Clarifi</th>
<th>VGG</th>
<th>GoogleNet</th>
<th>ResNet</th>
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<tbody>
<tr>
<td>2010</td>
<td>28.2</td>
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<td>2011</td>
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<td>2012</td>
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<td>2015</td>
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<td>3.6</td>
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</table>

Human error (5.1)
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Scale drive deep learning progress

Adapted from slide by Andrew Ng

- Large neural networks
- Medium neural networks
- Small neural networks
- ML: logistic reg, SVM, etc.

Performance vs. Amount of data
Scale drive deep learning progress

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Performance vs. Amount of data

- Caltech101 (2005)
- Pascal-VOC (2007)

Adapted from slide by Andrew Ng
This is super cool but...

- **The long tail**: a small number of objects / entities appear very often while most others appear rarely

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**Q1**: How to scale up to very large vocabularies (infrequent labels) and a scenario where it is hard to collect ground truth data?
How children learn to see

by observing lots (tons) of data

Fox

(Linda loves foxes)
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How children learn to see

by observing lots (tons) of data
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Again, CNNs are cool but…

- Even two year old kids are good at abstraction, and are able to generalize and transfer their knowledge

Q2: Our algorithms are very good at memorising categories, but are we really going toward full image understanding?

Breakthroughs in object recognition

Cat | Dog

… and fine-grained image recognition

Cardigan Welsh Corgi | Pembroke Welsh Corgi
Sharing knowledge

• One example (*i.e.* an attempt to address Q1) in the context of social media such as Flickr images

Tags: flower, petal, closeup, water, GPS, groups, ...

[Johnson*, Ballan*, Fei-Fei, ICCV’15 (*equal contrib)]
Sharing knowledge

• One example (i.e. an attempt to address Q1) in the context of social media such as Flickr images

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[Johnson*, Ballan*, Fei-Fei, ICCV’15 (*equal contrib)]