

Introduction to Deep Learning

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Notes

Foreword

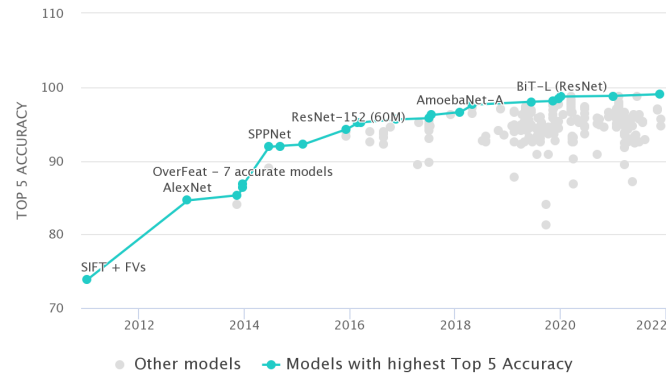
- There is an increasing concern on the environmental impact of deep learning
- Hardware concerns will not be addressed here
 - ▶ <https://bouveres.pages.ensimag.fr/jied/ressources/2021-2022/20211109-ImpactNumerique.pdf> (in french)
- We will focus on energy consumption



Notes

A focus on accuracy

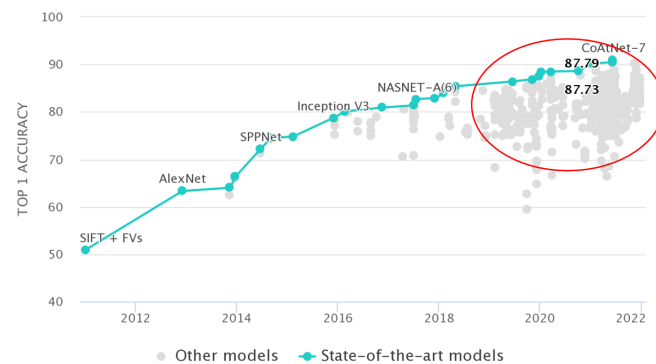
- Image recognition: improve top N error
 - ▶ Principle: the correct category should be among the N guesses with the highest priority
- Results in December 2021
(<https://paperswithcode.com/sota/image-classification-on-imagenet>):



Notes

A focus on accuracy (2)

- Still a lot of ongoing research

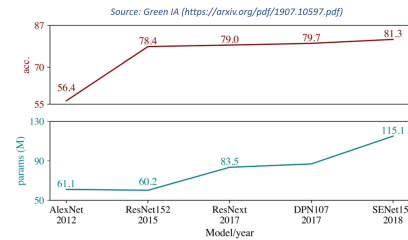


Notes

The requirements of an improved accuracy

A better accuracy is obtained using more complex models

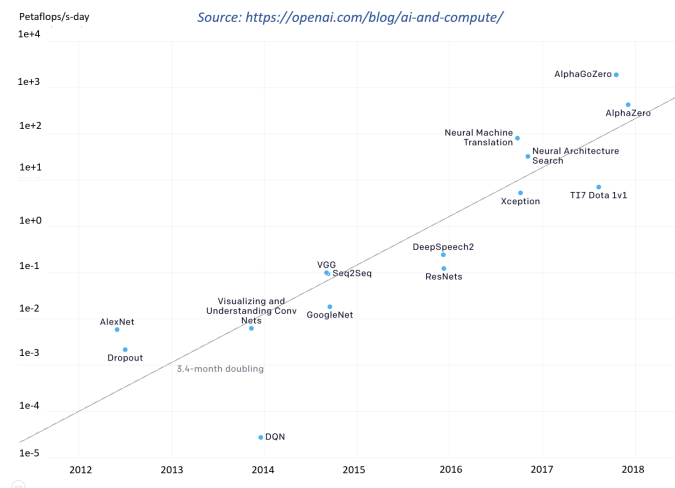
- Models with billions of parameters...
 - ▶ Up to 40 billion in NLP models
- ... that require larger training sets
 - ▶ 3.5 billion images from Instagram for a model trained by Facebook
- Models require hyperparameter tuning
 - ▶ Sometimes thousands of hyperparameters are tested
- This has to be done for each tested network architecture
 - ▶ Google trained 12800 networks to improve object detection and language modeling



Notes

The computational cost of an improved accuracy

The search for more accurate models has entailed an **exponential growth** in **computational costs**



Notes

Towards efficiency

Suggestion (<https://arxiv.org/pdf/1907.10597.pdf>): we should distinguish **Red AI** and **Green AI**

- Goal of **Red AI**: improve the state of the art
 - ▶ Most common research domain
 - ▶ Little to no consideration for environmental impact
- Goal of **Green AI**: obtain new results without increasing computational costs
 - ▶ Ideally reducing computational costs
 - ▶ Improve global efficiency (model size, training effort, necessary amount of training data...)

How can we evolve towards more **Green AI**?

- By fully reporting efforts to obtain a model
 - ▶ Number of epochs
 - ▶ Number of hyperparameters to tune...
- By making the trained models publicly available

Notes

Transfer learning

- Some data sets have features that are reusable on other data sources
 - ▶ Text words
 - ▶ Images
- Principle: use a pretrained model on another data set as a starting point
 - ▶ No longer necessary to train a model from scratch
 - ▶ *Zoo of pretrained PyTorch models*:
https://pytorch.org/serve/model_zoo.html

Notes

Conclusion

- This is a new topic, with questions that don't have a clear answer yet
 - ▶ What is the best measure of efficiency to use?
 - ▶ Is there even a single best measure of efficiency?
- It is a topic to be aware of
 - ▶ Especially during internships on applications of Deep Learning
- Additional resources
 - ▶ Lecture notes by Anne-Laure Ligozat (in french):
https://ecoinfo.cnrs.fr/wp-content/uploads/2021/04/Cours_CentraleSupelec_IA_responsable-1.pdf

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