Knowledge-transfer techniques toward sustainable learning

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First ALMA-AI workshop on Foundations of AI

Outline

The lack of modern AI (Deep Learning) sustainability

Addressing environmental impact with knowledge-transfer techniques

Addressing social impact with effective decision-making integration

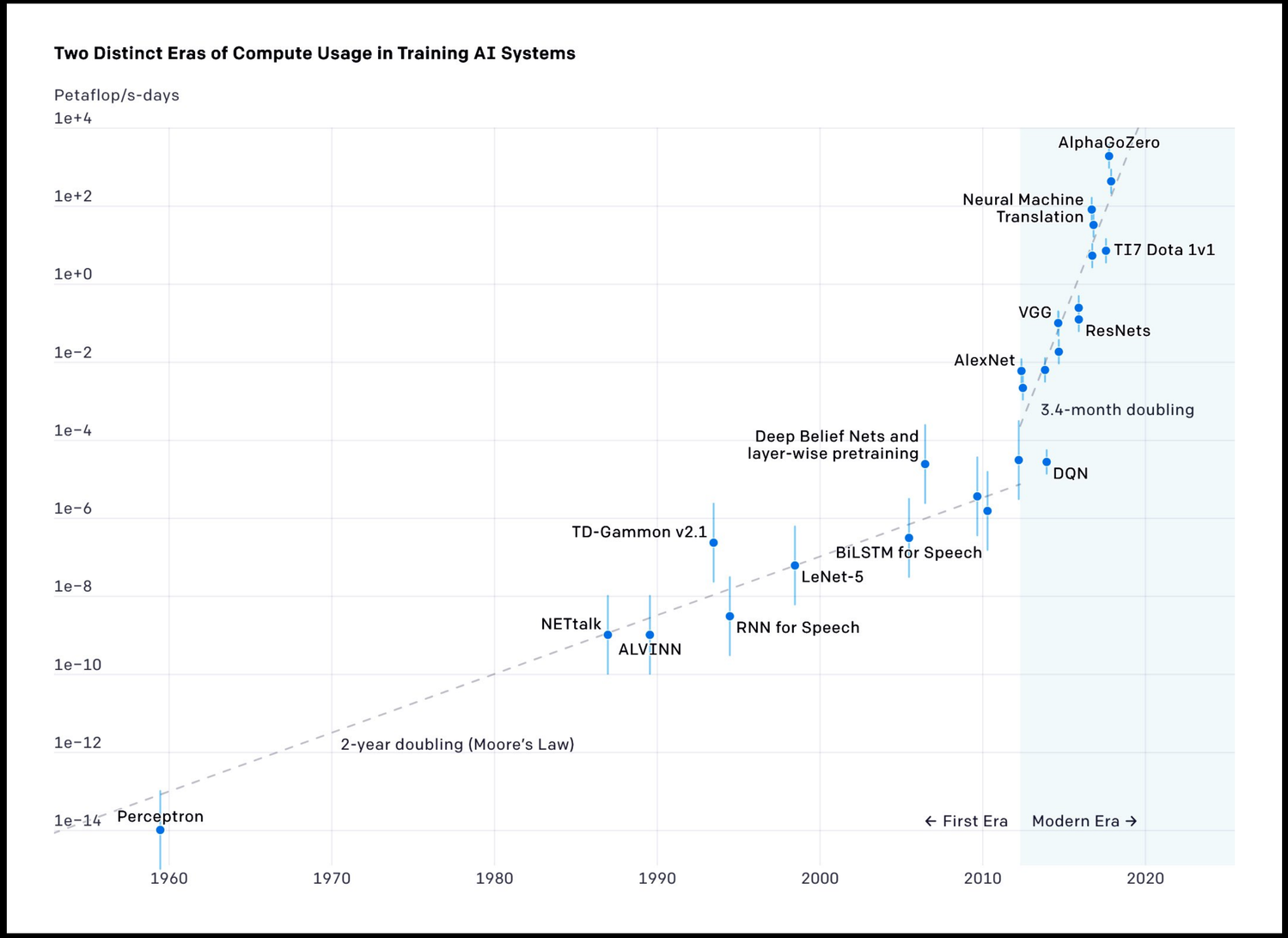
Some final thoughts on AI research and teaching in the University

"[...] accuracy improvements depend on the availability of exceptionally large computational resources that necessitate similarly substantial energy consumption. As a result these models are costly to train and develop, both financially, due to the cost of hardware and electricity or cloud compute time, and environmentally, due to the carbon footprint required to fuel modern tensor processing hardware."

Strubell et al. (2019). *Energy and Policy Considerations for Deep Learning in NLP*. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 3645-3650).

AI training runs increase exponentially with a 3.4-month doubling time

(Moore's Law had a 2-year doubling period) [AI and Compute 2020]



“This trend toward training huge models on tons of data is not feasible for academics, because we don’t have the computational resources. So there’s an issue of equitable access between researchers in academia versus researchers in industry.”

Strubell et al. (2019). *Energy and Policy Considerations for Deep Learning in NLP*. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (pp. 3645-3650).

University of Bologna Missions

From the strategic plan 2019—2021

- [0.5] Enhance the service available to students and *support policies* addressing the right to higher education.
- [0.7] Promote transversal scientific and *cultural dissemination* to all stakeholders and social context.
- [0.8] Promote initiatives that enhance *social* and *environmental sustainability*.

Open challenges of XAI (not exhaustive)

Long story shot: no agreed (formal?) definition of explainable

- High-Stakes scenarios deserve transparent models (Netflix VS Healthcare) [Rudin 2018]
- **Interpretability is always scenario-dependent!** [Lipton 2016]

  “Is the system interpretable?” **=>** “To whom is the system interpretable?”

Student University Dropout

Presented at Artificial Intelligence in Education (AIED 2020)

Motivation of Student Dropout prediction

- Provide classification rules for active dropout prevention to institutional decision-maker

- Framework to define model updates strategies to practically reason on the AI system

Objectives of Sustainable Machine Learning

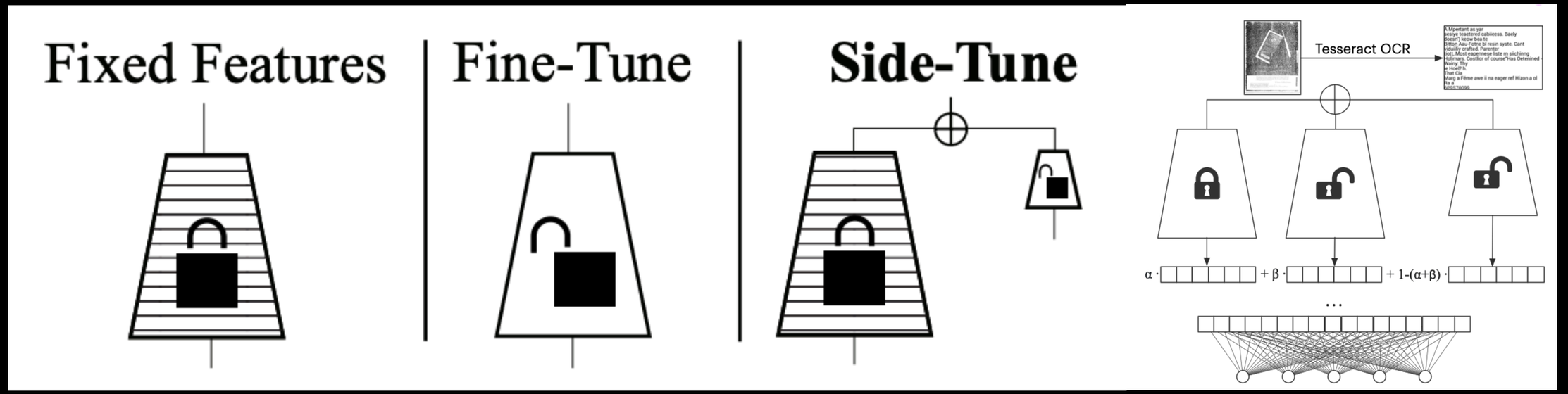
Reduce environmental impact and social inequalities

- Minimize carbon footprint of training/inference procedure reducing computational demand (Green AI) with Knowledge-transfer
- Prefer transparent design or post-hoc explanation of AI models (XAI) [Mittelstadt et al. 2018]

Multimodal Side-Tuning

Presented at Int. Conf. on Pattern Recognition (ICPR 2020)

- ST is effective in combining embeddings from heterogeneous sources (i.e., Image + Text) aligning feature spaces with complementary information
- Comparable SOTA performance with lightweight architectures (low FLOPS train/inference)



Motivation for Network Adaptation

[Zhang et al., 2019]

- Scarse training data
- Lifelong learning
  - to learn new task while previously trained for other task

Grazie!

In case you are interested in our methods and materials, mail me at stefanopio.zingaro@unibo.it