Sustainable AI

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Initial thoughts

- Environmental concerns for creating AI models
- Power asymmetry for accessing the technology
- AI with societal bias embedded
- 'Sustainability', 'AI'

1 Strubell, E., Ganesh, A., & McCallum, A. (2019).
Energy and policy considerations for deep learning in NLP.
arXiv preprint arXiv:1906.02243.

2 van Wynsberghe, A. (2021).
Sustainable AI: AI for sustainability and the sustainability of AI.
AI and Ethics, 1-6.

3 Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., ... & Vayena, E. (2018).
AI4People—an ethical framework for a good AI society: opportunities, risks, principles, and recommendations.
Minds and Machines, *28*(4), 689-707.

4 Moore, J. (2019).
AI for not bad.
Frontiers in Big Data, *2*, 32.

Energy and Policy Considerations for Deep Learning in NLP

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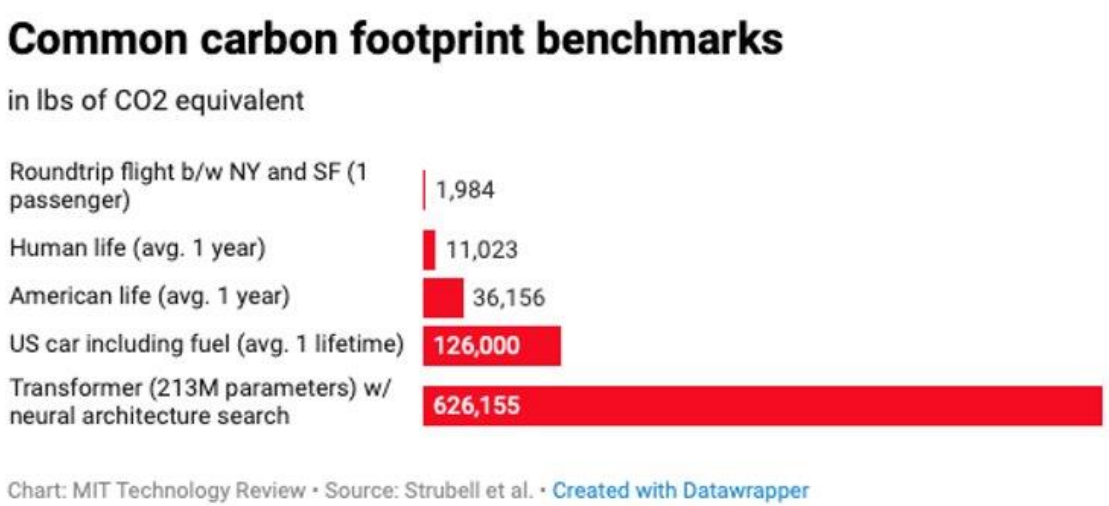

https://www.technologyreview.com/2019/06/06/239031/training-a-single-ai-model-can-emit-as-much-carbon-as-five-cars-in-their-lifetimes/

Consumption	CO_2e (lbs)
Air travel, 1 passenger, NY↔SF	1984
Human life, avg, 1 year	11,023
American life, avg, 1 year	36,156
Car, avg incl. fuel, 1 lifetime	126,000
Training one model (GPU)	
NLP pipeline (parsing, SRL)	39
w/ tuning & experimentation	78,468
Transformer (big)	192
w/ neural architecture search	626,155

Table 1: Estimated CO_2 emissions from training common NLP models, compared to familiar consumption.[1]

Problem of high energy demand models despite renewable/carbon credit-offset resources

1. Energy is not currently derived from carbon-neural sources in many locations
2. When renewable energy is available, it is still limited to the equipment we have to produce and store it, and **energy spent training a neural network might better be allocated to heating a family's home.**

Consumer	Renew.	Gas	Coal	Nuc.
China	22%	3%	65%	4%
Germany	40%	7%	38%	13%
United States	17%	35%	27%	19%
Amazon-AWS	17%	24%	30%	26%
Google	56%	14%	15%	10%
Microsoft	32%	23%	31%	10%

Table 2: Percent energy sourced from: Renewable (e.g. hydro, solar, wind), natural gas, coal and nuclear for the top 3 cloud compute providers (Cook et al., 2017), compared to the United States,[4] China[5] and Germany (Burger, 2019).

Recommendations

1. Time to retrain and sensitivity to hyperparameters should be reported for NLP machine learning models
2. Academic researchers need equitable access to computational resources
3. Researchers should prioritize developing efficient models and hardware.

AI and Ethics
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OPINION PAPER

Sustainable AI: AI *for* sustainability and the sustainability *of* AI

Aimee van Wynsberghe[1]

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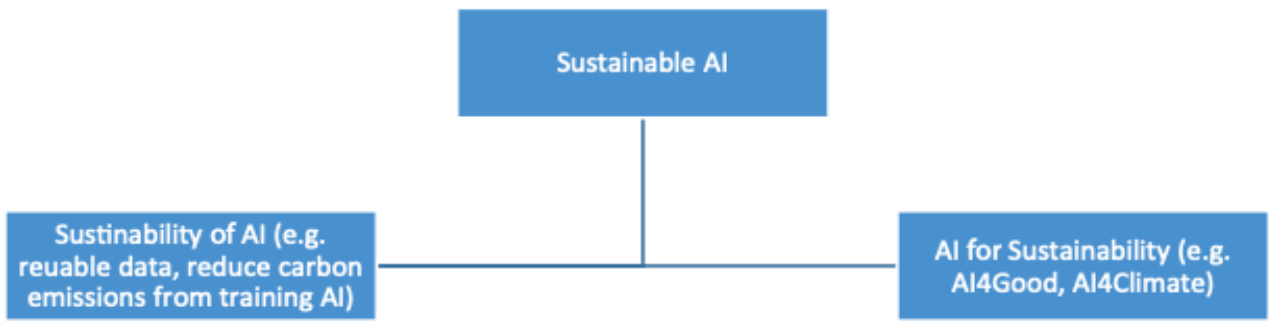

Three Waves of AI Ethics

- The first wave of AI ethics focused on **what AI might do (e.g. Superintelligence)** and amounted to the ethics of fanciful scenarios of robot uprisings
- The second wave of AI ethics addressed the **practical concerns of machine learning (ML) techniques**: the black-box algorithm and the problem of explainability, the lack of equal representation in training data and the resulting biases in AI models, and the increase in facial and emotion recognition systems infringing on citizen's rights (e.g. privacy)
- It is time to usher in the third wave of AI ethics, one that confronts the **environmental disaster of our time head-on** and actively seeks to engage academics, policy makers, AI developers and the general public with the environmental impact of AI.

Sustainable AI

"Sustainable AI is focused on more than AI applications; rather, it addresses the **whole sociotechnical system of AI**. I have suggested here that Sustainable AI is not about how to sustain the development of AI per say but it is about **how to develop AI that is compatible with sustaining environmental resources for current and future generations; economic models for societies; and societal values that are fundamental to a given society."**

Glorified marketing strategy?

"Google's AlphaGo Zero generated 96 tonnes of CO2 over 40 days of research training which amounts to 1000 h of air travel or a carbon footprint of 23 American homes'. In a time when the world must commit itself to reducing carbon emissions, one has to ask if the emissions from **algorithms that can play games (or do other menial tasks) is really worth the cost."**

- Framing AI as a pure intellectual/scientific achievement hides other externalities
- Should we treat AlphaGo differently from other marketing strategies (that are not sustainable)?

Towards Sustainable AI

1. AI must be conceptualized as a **social experiment** conducted on society
2. Sustainable AI taskforces to **seek out expert opinions of the environmental impact**
3. **'proportionality framework'** to assess whether training or tuning of an AI model for a particular task is **proportional to the carbon footprint, and general environmental impact, of that training and/or tuning**

Minds and Machines (2018) 28:689–707
https://doi.org/10.1007/s11023-018-9482-5

AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations

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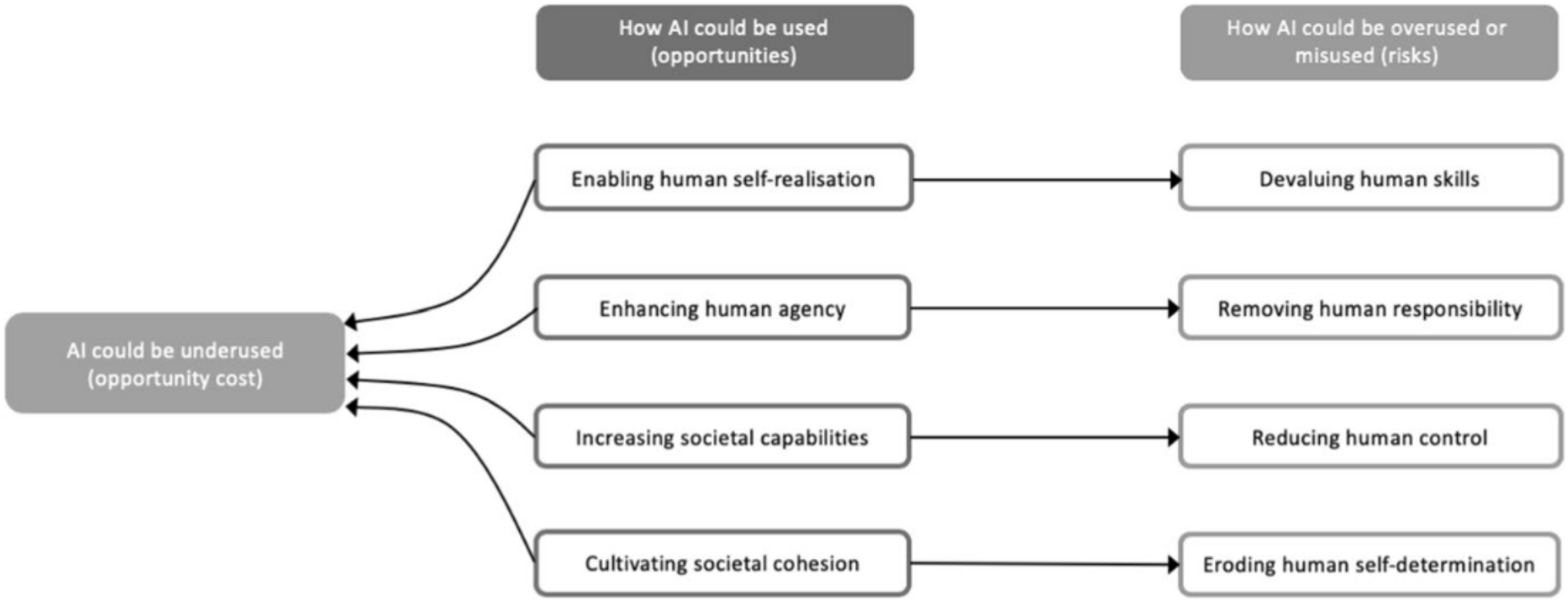

Fig. 1 Overview of the four core opportunities offered by AI, four corresponding risks, and the opportunity cost of underusing AI

A Unified Framework of Principles for AI in Society: comparison to bioethics

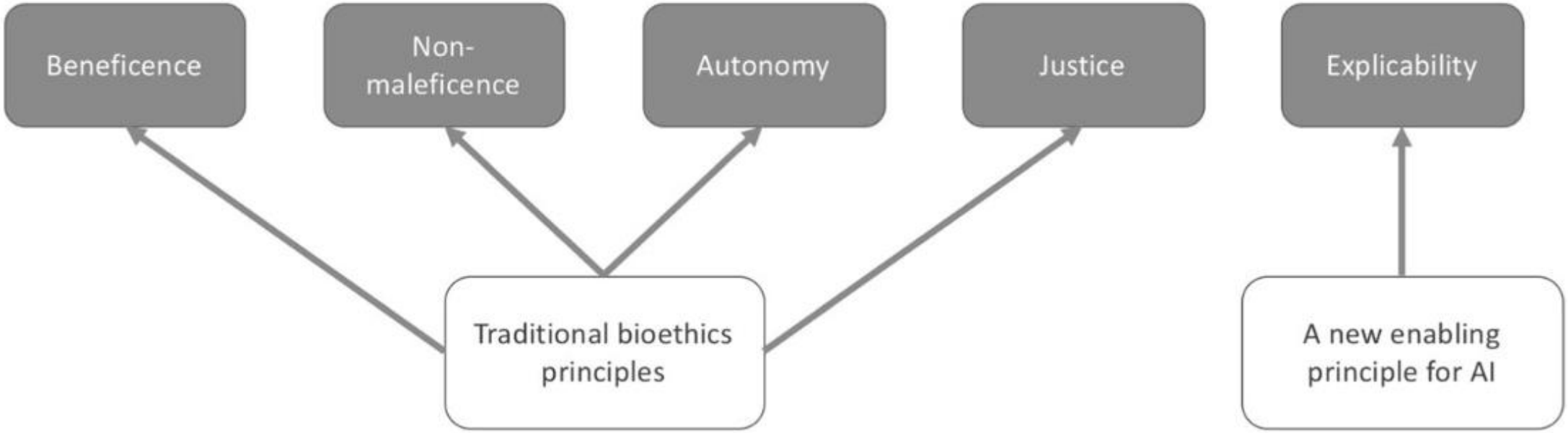

Fig. 2 An ethical framework for AI, formed of four traditional principles and a new one

Advantages of Ethical Approach to AI

1. **take advantage of the social value that AI enables:** identify and leverage new opportunities that are socially acceptable or preferable.
2. **anticipate and avoid or at least minimise costly mistakes:** prevention and mitigation of courses of action that turn out to be socially unacceptable and hence rejected, even when legally unquestionable.

"early warning system"

Did it?

"**Much as inventions, such as the washing machine, liberated people—particularly women—from the drudgery of domestic work, the "smart" automation of other mundane aspects of life may free up yet more time for cultural, intellectual and social pursuits**, and more interesting and rewarding work. More AI may easily mean more human life spent more intelligently. The risk in this case is not the obsolescence of some old skills and the"

Building up AI hype?

"Although there is no internationally agreed definition of AI, for this study we considered as AI any software technology **with at least one of the following capabilities: perception—including audio, visual, textual, and tactile (e.g., face recognition), decision-making (e.g., medical diagnosis systems), prediction (e.g., weather forecast), automatic knowledge extraction and pattern recognition from data (e.g., discovery of fake news circles in social media), interactive communication (e.g., social robots or chat bots), and logical reasoning (e.g., theory development from premises). This view encompasses a large variety of subfields, including machine learning**."

The role of artificial intelligence in achieving the Sustainable Development Goals (https://www.nature.com/articles/s41467-019-14108-y)

frontiers in Big Data

PERSPECTIVE
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Check for updates

AI for Not Bad

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Hype surrounds the promotions, aspirations, and notions of "artificial intelligence (AI) for social good" and its related permutations. These terms, as used in data science and particularly in public discourse, are vague. Far from being irrelevant to data scientists or practitioners of AI, the terms create the public notion of the systems built. Through a critical reflection, I explore how notions of AI for social good are vague, offer insufficient criteria for judgement, and elide the externalities and structural interdependence of AI systems. Instead, the field known as "AI for social good" is best understood and referred to as "AI for not bad."

Keywords: artificial intelligence, social good, not bad, ethics, data science, critical reflection

“AI for the good” is strategically vague

"Its proposals come in similar forms: calls for more data, better data, broader application, more diverse voices, reflexivity, transparency, changes to funding priorities, more education, more regulation—more."

"“AI for the good” de-politicizes the problems addressed. Many of these problems, like poverty, recidivism, and the distribution of resources, are ones of institutional failure. **Technology-based approaches, when not aimed at the root of problems, divert attention from the proper recourse: structural change**."

"Vague terms are the wagons of a modern gold rush into the promised riches of a mythic AI frontier. Like the California gold rush, this expansion may bring environmental degradation, concentrations rather than distributions of wealth, and the oppression of marginalized populations."