The Wicked Problem Map of Quantum Technology

Quantum technology presents a dual-edged sword with profound benefits and intricate challenges. On one hand, it promises revolutionary advances in computing power, cryptography, and materials science, holding the potential to reshape various technological landscapes and drive societal innovation.

However, the deployment of quantum technology also introduces a complex web of concerns. Socially, it raises questions about job displacement, altered work dynamics, and ethical considerations tied to privacy (all summarized in the term **"Social impact"** in the wicked problem map). Environmentally, the technology demands meticulous attention to its energy-intensive processes, potential manufacturing impacts, and responsible disposal practices (see "**Environmental impact**" in the map). Additionally, the absence of established international regulations and ethical frameworks poses challenges in ensuring the responsible development and use of quantum technology.

In this wicked problem map we present the interconnected nature of these factors emphasizing the need for a holistic approach to navigate the intricate landscape of quantum technology, considering both its transformative potential and the intricate socio-environmental-technological challenges that may arise.

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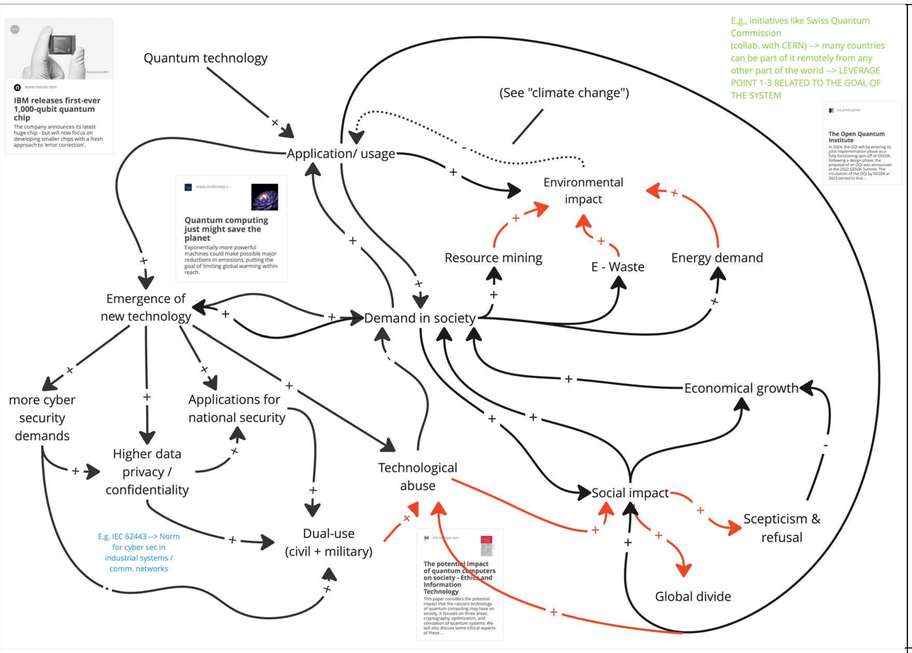
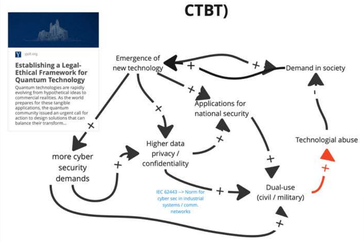
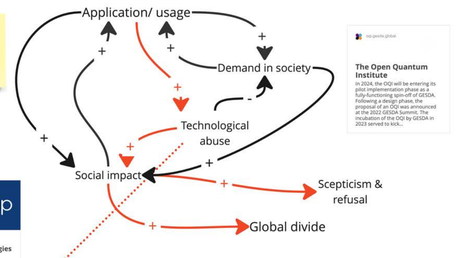


International Treaty on friendly usage of QT (comparable to the Nuclear Test-Ban Treaty, CTBT)

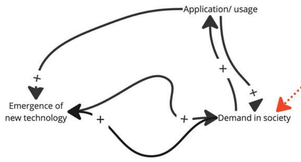


1. **Making policies to educate people and spread awareness about the benifits of quantum technology**
2. **International collaborations to reduce global divide**

Policies for increased & targeted education on QT

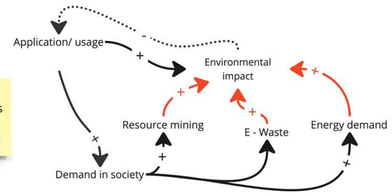


Government subsidies to encourage the usage of new technology



International regulations on the usage of the technology

Obviously regulations are necessary!



Leverage points:

- **International Treaty on friendly usage of QT** should be driven by the motive to not use the technology in a violent way; conviction by the international court, if the treaty is violated

- **(International) Policies** for increased focus on education in QT serves for nations'/peoples' knowhow on the right usage of the technology.
  - This decreases the impact of negative aspects (red arrows) in the wicked problem map
  - The **international collaborations** should serve the purpose to minimize global and social divide

- **Governmental subsidies** to encourage the **development of new technologies** driven by QT and linked with the policies and regulations the positive impact on the (demand) in society will be enhanced.

- Need to setup **international regulations** to define the usage of the technology. At the national level screening committees should be formed. Each user of the QT should submit a **project proposal** to the screening committe. The objective of the **screening committee** will be to evaluate the proposal based on the international regulations and provide the **clearance to use the technology** for the proposed application; thereby, the judicial/regulated usage of the technology is enforced.

What is the purpose of academic research and how does the current system support this purpose ?

Academia, as opposed to industry, is generally seen as being the perfect ground for unconstrained research. Among other motifs, people choose this path because it gives them complete freedom on their research topic. However, research is highly dependent on funding and the latter, in most cases, come from interested parts.

This leads to the natural question of **what the actual goals of academia are and who sets them**? The most obvious answer would be that it aims at increasing the general knowledge that we have of our environment and its application to increase our quality of life (technological developments, addressing global issues). Nevertheless, in our current economy, an important part of the funding also originates from the private sector with its own agenda.

For early-career researchers, securing funding requires acquiring prestige and peer recognition. The current evaluation system relies heavily on metrics such as the number of publications, impact and h-index. This method, while intended to assess scientific merit, creates a competitive environment **favouring those who are already established in the field**. Consequently, this system may inadvertently compromise the fundamental purpose of academia by fostering an atmosphere where personal and public interests intertwine, and financial considerations play a pivotal role.

The race for the highest number of publication and recognition appears to be fertile soil for scientific misconduct and loss of scientific integrity.

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NEWS | 07 November 2023

***Nature* retracts controversial superconductivity paper by embattled physicist**

The immediate, obvious damage is wasted NIH funding and wasted thinking in the field because people are using these results as a starting point for their own experiments.

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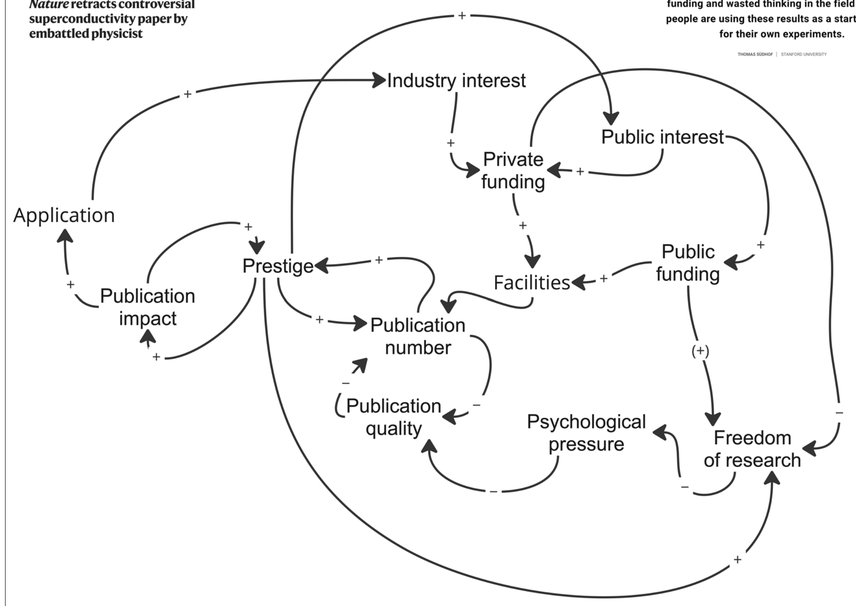


This wicked problem map illustrates the intricate relationship between academic freedom, public interest (as reflected in resource allocation), and power struggles within the academic sphere.

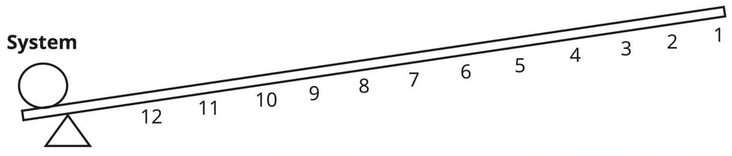
In theory, researchers in academia are supposed to enjoy the freedom to explore any topic of interest. However, in reality, the constant need to secure funding and win grants imposes limitations on this freedom, as funding is often directed toward specific fields. For instance, **there is currently ample funding for research in green technologies, but significantly less for basic science**. The more funding available, the better the facilities at disposal, and more work can be done and published allowing the securing of more funding...

Moreover, the system tends to favour those who are already established within it. Recognised researchers in their respective fields often find it easier to secure grants and face fewer constraints regarding their research topics, allowing them to keep publishing and gain more prestige and influence.

On the other hand, the unfair competition for both funding and recognition compels researchers to prioritise quantity over quality in their scientific output (e.g., publications), sometimes compromising the integrity of their work.

Proposed leverage points:

- Science ethics education (2)
- Reforming evaluation metrics (qualitative assessment, anonymity) (5)
- Public science communication (6)
- Alternative publication models (preprints, online platforms) (6)
- Long-term funding support (7)
- Promoting collaboration (reward) (7)
- Open access publishing (11)
- Policy advocacy (11)



A neuroscience image sleuth finds signs of fabrication in scores of Alzheimer's articles, threatening a reigning theory of the disease *By* **Charles Piller**

to Print on Monday if possible

The Wicked Problem Map of Data Collection for AI

The increasing public concern about massive data collection for AI has become a prominent issue. People are worried about the extent and nature of the **data being collected**, particularly sensitive information, and **how it might be used or misused**. This concern is not just about privacy but also about the **security risks** posed by malicious actors who could potentially access and exploit this data.

Despite these worries, there is a recognition of the **benefits that come from data collection**, such as the improvement in the quality of AI models. **Better AI applications can lead to more user-friendly and efficient services, ultimately benefiting the consumers.**

However, the landscape of data collection is dominated by a few large companies, leading to concerns about the concentration of power and the lack of competition. This **monopoly on data restricts innovation and limits the potential benefits that could be derived from a more diverse data landscape**. In response, there have been calls for regulations to curb excessive data collection, and public pressure is mounting for these big players to open up their data reserves for broader use.

Meanwhile, the use of **Privacy Enhancing Technologies** (PETs) presents a solution to **balance data utility and privacy,** but implementing these technologies remains a **challenge due to their complexity** and potential impact on the **profitability** of companies.

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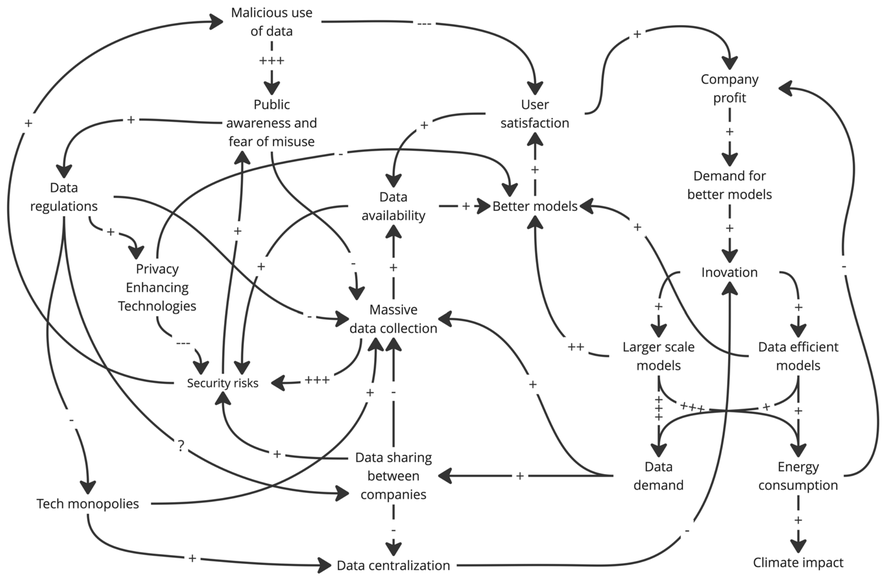
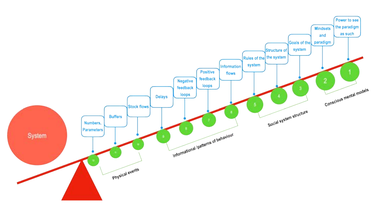


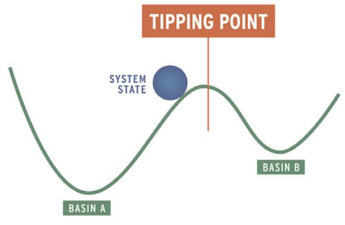
This causal map outlines the **multifaceted challenges** and **opportunities** surrounding the growing public concern regarding **massive data collection for AI**. The issue encompasses various dimensions, from **privacy and security** to monopolistic concerns and the need for innovation. Additionally, it addresses the pressing matter of **climate concerns, as AI systems often demand substantial energy resources**. Balancing the quest for technological advancement with environmental sustainability is a critical consideration in the ongoing discourse on AI.

In an era dominated by the relentless pursuit of data-driven advancements, **striking a balance between technological progress, safeguarding individual rights, and mitigating environmental impact becomes paramount**. As society grapples with the implications of extensive data harvesting, including the substantial energy footprint of AI, this visual representation delves into the intricate web of challenges and potential avenues for navigating the evolving landscape of AI and data ethics.

Leverage points:

1-Energy regulations
2-Data collection regulations
3-Data sharing/openness 4-regulations
5-Data protection/security
6-Models quality
7-Specialized data collection
8-Users/Public awareness/ education





Massive Data Collection Problem

Under the motto of "Data is the new oil, massive data collection practices are taking place at scale, continuously, and on every smart device [1]. It is hard -if not impossible- to find a smart device that doesn't gather amounts of data that fairly exceed the minimum required for the intended function [2]. Moreover, the collected data used for processing is saved for further use and re-purposing [1].

This massive data amounts about everyone is used not only for behavior analysis for the sake of advertising, but for **shaping beliefs/opinions, nudging towards certain behaviors, which increase the polarization, isolation and threatens democracy** [2,3]. Moreover, this consequences of such massive data related practices contributes today roughly to around **20% of energy consumption** and the figure is increasing [4]. Besides these side effects, the major concern which arises from today's massive data collection forms is **how it threatens privacy**, at the very deep notion of the private space of the self, which is the basis of freedom 13].

The current practices are hard to stop or even interrupt because from one side, of the huge amounts of profits made by various involved parties makes lobbying stands on the way of meaningful regulations that can protect people [1,2]. From the other hand, massive data collection is the status quo, and realizing that there is a problem involves pain and uncertainty that human nature try to avoid.

[1] Shoshana Zuboff, "The Age of Surveillance Capitalism", 2019, Profile Books
[2] Elizabeth M. Renieris, "Beyond Data: Reclaiming Human Rights at the Dawn of the Metaverse", The MIT Press, 2023
[31 Nick Couldry and Ulises A. Mejias, "The costs of connection", 2019. Stanford University Press
[4] Andrae, Anders SG, and Tomas Edler. "On global olectricity usage of comunication technology: tronds to 2030." Challengos 6.1 (2015): 117-167

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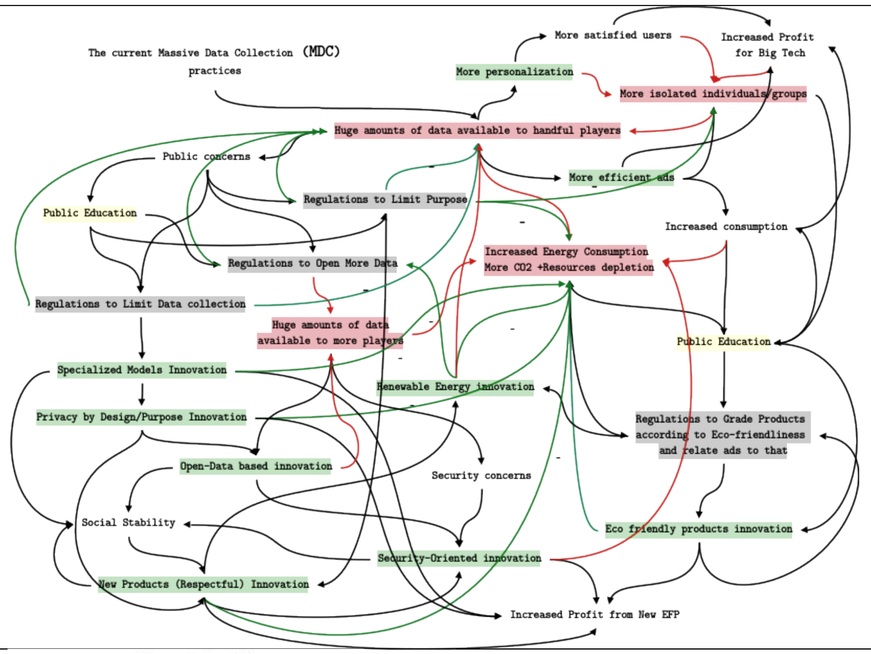

Regulations
Innovation
Warning

Red arrows increase warning level
Green arrows decrease warning level

Specialized Models Innovation
Means gathering data explicitly from the users/plant with their cooperation and involvement

References
1. Shoshana Zuboff, "The Age of Surveillance Capitalism", 2019, Profile Books
2. Elizabeth M. Renieris, "Beyond Data: Reclaiming Human Rights at the Dawn of the Metaverse", The MIT Press, 2023
3. Nick Couldry and Ulises A. Mojias, "The costs of connection", 2019, Stanford University Press
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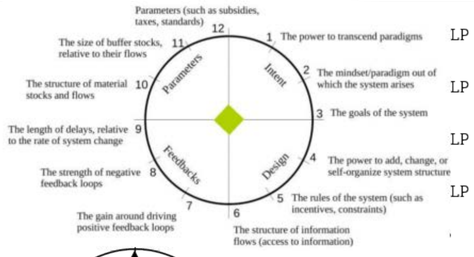
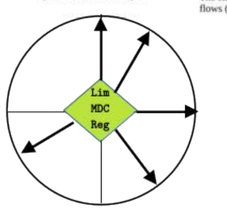


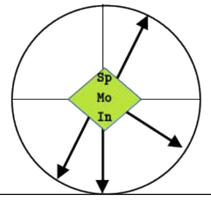
LP 1 Public Education (**PubEdu**)

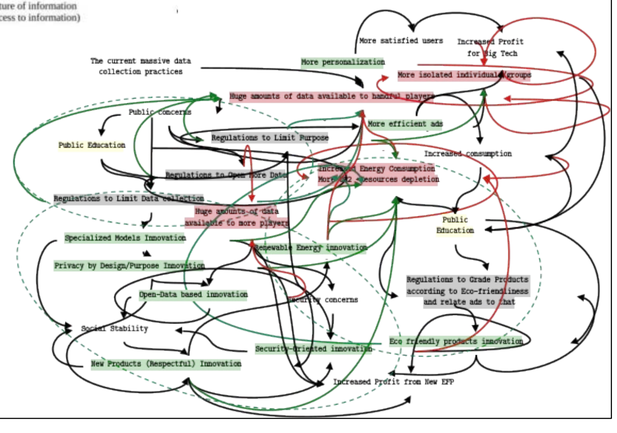
LP 2 Limiting MDC by Regulation (**LimMDCReg**)

LP 3 Products Echo Friendliness Regulation (**EchoFReg**)

LP 4 Specialized Models (**SpMoInno**)







Ethical Guidance of AI Systems

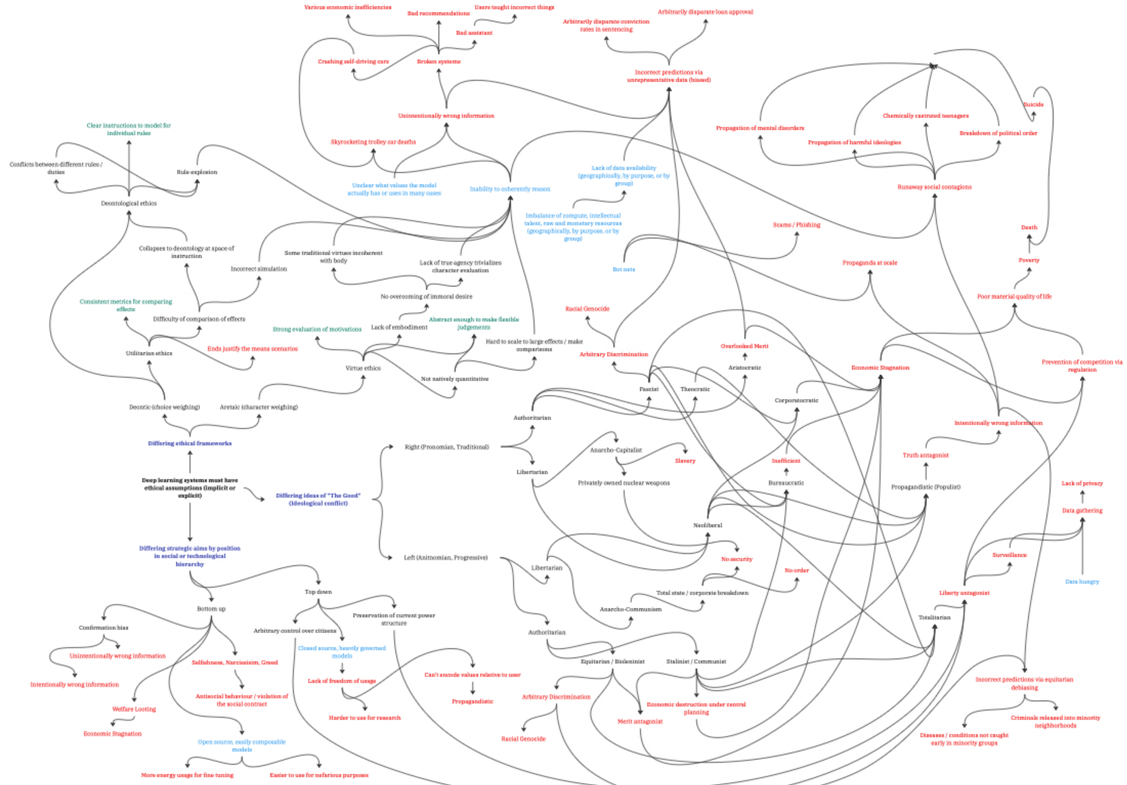
With recent advances in the capabilities of deep learning based systems and the proliferation of their use, it has become increasingly important to articulate clearly the ethical values encoded into these systems in a more explicit way. In the case of the language models that underpin virtual assistants like ChatGPT or Bard, there is already substantial research into how to encode particular values or priorities into the model, and to some degree ethical guidance is functionally related to general control and guidance of model behavior. Models, like humans, cannot be value neutral; they always hold some values, assumptions, and foundational beliefs even if they learn them implicitly.

The landscape of AI ethics is marred by key conflicts in the assumed ethical systems, differing definitions of "the good" which is weighed by the ethical system, as well as adversarial motivations between the users of deep learning systems and the funders / developers of deep learning systems.

Adjudicating and articulating the risks of these conflicts presents a wicked problem; one where there is no clear answer and many interlocking sets of challenges.

"There are no solutions. There are only trade-offs."
-- Thomas Sowell, *A Conflict of Visions: Ideological Origins of Political Struggles*

Alexander Rusnak



Wicked Problem Map

This graph represents the flow of different assumptions, constraints choices, or perspectives and the various problems that arise relative to each path. The bold phrase in the bottom left is a summary of the initial problem and is the start of the graph. Otherwise, there are five types of information present in the graph:

Purple: Key initial conflicts at the highest level of abstraction.

Black: Various perspectives, facts, or other information which is assumed to be value neutral.

Light Blue: Technical information about the usage, capabilities, or needs of deep learning systems.

Green: Positives of each particular ethical system (Positives are not presented for other parts of the map).

Red: Negative results or externalities produced by a particular path.

Leverage Points

Leverage points are targets for manipulating a problem set and changing outcomes in societal structures. They are formalized into the structure of a fulcrum; points farther from the pivot point are the most effective at changing the world at large but also often the most difficult to achieve.

For this particular problem, we identify the following leverage points:

(1) Promoting public discussion in open forums (i.e. X) between various stakeholders.

(1) Education in comparative ethics for engineering and computer scientists.

(4) Funding for more ethical guidance research at a technical level.

(4) Proliferation of more open source models.

(5) Regulation for model usage / training which is not competition stifling.