In the Garden of Anthropos: Conservation after Artificial Intelligence

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Abstract

The term 'planetary garden' was coined by Gilles Clément to refer to the privileged site of the planetary mixing of species that is managed by humans. In the face of the ongoing environmental collapse, we envision the garden as a new locus for symbiotic attachment and original exchange between human and non-human ecologies. Drawing on the garden metaphor, we discuss the conceptual and ecological impacts of human stewardship of the environment. Recognising ecosystems as changing fields of social and technical interactions, we evaluate how conservation strategies shift in tandem with these changes. We explore the influence of emerging technologies on human understanding of natural ecosystems and on societal approaches to conservation. Envisioning the future, we are mapping out the need for human-centric technologies to foster new forms of agency between humans and their environments. While any technological promise does not come without ethical and technical challenges, we advocate for ecological intelligence (EI), a spatialised human-AI collaboration scheme, as a critical condition for reimagining and upscaling conservation practices in the Anthropocene.

Keywords

planetary garden, conservation, ecological intelligence, artificial intelligence, biodiversity

In the face of the ongoing environmental collapse, humanity's impact on the environment is at the forefront of global attention.[1] With policymakers stressing the need for ecosystem management, strategies that attempt to integrate non-human species conservation with urban economies and capitalist production are emerging.[2] At the same time, a new range of technological developments offers the promise of better comprehending and managing ecosystems. Satellites in orbit, and sensors in the sky, in the wild and in handheld devices are employed to monitor ecosystem processes in real time.[3] Software tools running artificial intelligence (AI) algorithms are employed to extract and analyse vast amounts of data to reveal ecological patterns previously undetected or unexplored.[4] As AI transforms scientific methodologies it gives rise to new conceptualisations and normative evaluations of the natural world. The influence of technology on the balance between humans and non-humans, and on the shaping of global policies for the preservation of critical environments demand thorough consideration.[5]

In this article, we examine the conceptual and ecological impacts of human stewardship over the environment, focusing on how conservation objectives intertwine with cultural views of the natural world and how these views change as new types of ecosystems emerge. We trace the transition from the idea of restoring an ecosystem to a pristine state before human influence, toward practices of stewardship that promote a symbiotic attachment between human and non-human habitats. Addressing conservation from a technological perspective, we examine the role of technology in the virtual and material specification of the planetary garden. We observe how the transformation of environmental science and practice evolves into an Earth-encompassing garden intelligence, redefining human entanglements with natural ecosystems. How could this intelligence contribute to the democratisation and upscaling of ecosystem conservation and point towards new approaches for addressing ecological challenges? We advocate for ecological intelligence (EI), a localised human-AI collaboration scheme that enforces human agency, methodological plurality, and knowledge sharing.

Dialogues on ecosystems and conservation

Making sense of the anthropogenic impacts on the environment is a longstanding challenge for researchers in environmental, sociocultural and design disciplines. With humans constantly reshaping ecological relationships, conventional models of the natural world as static vegetation units fall short in capturing dynamic human interactions with ecosystems or the climate. To provide a representation that captures the impacts of human determination of the environment, Erle Ellis and Navin Ramankutty introduce the idea of anthropogenic biomes, or 'anthromes', considering humans as integral components of ecosystem patterns.[6] Unlike biomes that are generally categorised by factors like vegetation, climate and wildlife, anthromes are defined by human activity such as urbanisation, food production and infrastructure.[7] The unforeseen exchanges between species and landscapes, a direct consequence of human presence, are altering ecosystems and transforming approaches to environmental conservation.

New types of ecosystems shaped under human influence and climate change disrupt the traditional understanding of what should be preserved.[8] To some, anthropogenic ecosystems like those in figures 1 to 4, changing and largely unclassified, represent the future of conservation. Abandoning the thought of restoring ecosystems to their 'pristine' state, some conservationists aim to understand and safeguard new forms of biodiversity in these evolving systems. To others, human-made and novel ecosystems are stark reminders of the irreparable harm inflicted upon nature.[9] Two distinct outlooks on conservation emerge: one advocating for substantial segments of the earth to be enclosed, isolated and copiously preserved; the other encouraging conservation within environments shaped by human activity. While the former upholds the ideal of ecosystem autonomy, the latter accepts the role of humans as caretakers of the planet perceiving ecological relations as designable under specific intentions and limitations.[10] Elements of both approaches resonate in environmental policies directing global conservation efforts, where the pursuit of 'restoring nature' coexists with the acceptance of universal human influence and the setting of moderate conservation goals.

To transcend the polarity of the outlined approaches, Bram Büscher and Robert Fletcher propose 'convivial conservation'.[11] Their pluralistic proposition of 'living with' incorporates indigenous practices and local community participation and positions conservation within a post-capitalist perspective. Creating ecological systems that transcend the distinction between nature and culture resonates with communities that espouse a philosophy of coexistence rather than dominance over non-human species. The bond between these communities and their environments has safeguarded ecosystems threatened directly or indirectly by human activity.[12] In Büscher and Fletcher's proposed scheme, conservation's reorientation towards such alternative paradigms becomes central, as 'taking responsibility for nature and taking responsibility for democracy come together' in 'making a world'.[13] Their political reformulation attempts to fuse some of the contradictions that are intrinsic to environmental management and conservation practices.

Sowing the garden metaphor

Conservation, culturally apprehended as human stewardship, entails the responsibility to safeguard and actively manage the natural world. The idea of a metaphorical garden encompassing the entire biosphere illuminates aspects of environmental stewardship moulded under societal, political and economic forces. For landscape designer Gilles Clément, the 'planetary garden' is the worldwide site where species and matter mix in ways that are induced and supervised by humans.[14] Clément's evocative descriptions resonate with evolutionary ecologist Daniel Janzen's observation on the human propensity to treat any landscape as their own garden.[15] For Janzen, the garden becomes the privileged locus of symbiosis, fostering an environment conducive to the continuation of non-human species. It can be likened to Noah's ark: the more species come aboard the greater their chances of survival. What transforms the planet into a garden is precisely this sort of management, which consists of coercive attachment and planned extinction. Janzen's garden scheme appears down-to-earth compared to experiments in climate engineering where the garden is reimagined as the metaphorical site of humanity's terraforming aspirations.[16] According to David Keith, an expert in atmospheric and climate sciences, global-scale modification of the planet's climate is inevitable. Humans are already 'in the gardening business with this planet' and should 'start making deliberate choices instead of altering the climate' indirectly.[17] Keith's gardening vision justifies an unconditional reliance on technology for radical environmental intervention on a global scale.

With the discussion of conservation unavoidably taking place within extended urbanisation, the direct and indirect impacts of technology on ecosystems reveal a complex ethical terrain where the sidelining of non-dominant cultures is a critical concern .[18] Driven by the desire to bend ecosystems to preordained designs, technological solutionism and its effect on human and non-human interactions deserves further investigation.

Fig. 1: The abandoned Lato-Kekrops mining site in the Tourkovounia hill range, less than five kilometres from the centre of Athens. Inactive for almost half a century due to the company's legal dispute with the Greek State and neighbouring municipality, the 200-hectare old quarry is being colonised by unidentified populations of ruderal species and urban flora. Photo: Christos Montsenigos.

Fig. 2: Watering of the Euphorbia Origanoides, endemic to Ascension Island, a British Overseas Territory in the South Atlantic. Registered as barren and uninhabitable in colonial reports and travel narratives until the early nineteenth century, the island today is a unique artificial forest and natural reserve. Its ecosystem has developed from over two centuries of reforestation, species introduction, and attempts in climate manipulation, and it presents the uncontrollable conditions that are characteristic of novel ecosystems. Photo: Lance Cheung (source: https://bit.ly/44ZSx8x, shared under CC BY 2.0 license).

Fig. 3: A botanical label and specimen distinguished from the surrounding flora in the McBryde Garden, located on the south shore of Kauai island, Hawaii. Established in 1970 in place of a nineteenth-century sugarcane plantation, McBryde and its neighbouring Allerton are two of five botanical gardens operated and managed by the non-profit NTBG (National Tropical Botanical Garden) institution dedicated to tropical plant research and conservation, and following a more traditional approach towards natural reserves and how they can be combined with scientific research. Photo: Katerina Labrou.

New machines in the garden

Historically, depictions of technology and nature have been in stark contrast. Contemplating the influence of technology in his 1969 book ‘The Machine in the Garden’, historian Leo Marx considered its integration into the pastoral landscape.[19] For the nineteenth-century imaginary, as depicted by Marx, machines were cast as a threat to traditional and idealised notions of nature. Today, technological omnipresence attests to the impossibility of distinguishing the natural from the anthropogenic, at the same time establishing the planet as a dynamic field under scrutiny.

Existing environmental technologies are inscribed in the garden-planet paradigm. The garden is mapped, monitored, and tended systematically to secure its growth. Satellite imagery and drone-based sensing; trap cameras, acoustic sensors and DNA sampling; citizen science platforms engaging the public in data reporting; scientific efforts are focused on identifying, documenting, and manipulating environmental and biodiversity patterns. [20] Technology introduces new ways to intervene and interact with the environment. Representing an array of operations that mimic human cognition, AI resets the boundaries of conservation. Sifting through vast amounts of climate and biodiversity data reveals patterns previously undetected or unexplored. Planetary monitoring is, by analogy, a necessary condition for establishing the garden on a global scale. In fact, the planetary garden would not be possible without the monitoring apparatus. Once established, this apparatus enables the garden metaphor to grow. It also lays the groundwork for control to flourish within the garden.

A radical thought experiment proposed by landscape architect Bradley Cantrell, biologist Laura J. Martin and earth scientist Erle C. Ellis, affirms the worldmaking potential of these technologies. The ‘wildness creator’ is a hypothetical AI control system designed to manage wild spaces through remote sensing and restorative acts based on surveillance data.[21] The authors envision AI as an alien mind that governs the conservation site, with autonomous agents performing operations such as controlled seeding or invasive species removal. Their provocative proposition suggests a new kind of autonomy for ecosystems – one that is initially constructed by humans but is ultimately self-sufficient. Building upon the concept of the wildness creator, Bradley Cantrell and Zihao Zhang suggest the need for a new intelligence that is specific to landscape architecture.[22] In their understanding, most implementations of AI systems overlook the complexities of human and non-human interactions. An AI that is tailored to the specific challenges of landscape architecture would need to actively engage with intelligent patterns that emerge in physical environments in order to ‘create places that serve the higher purpose of social and ecological justice for all peoples and all species’.[23]

In observing the wildness creator’s autonomous decision-making, questions about technology’s limitations and inherent biases emerge. Could AI contend with the dynamism of environments in the wild? Any act of tending or eradicating species is founded on culturally constructed ideas of value. What conservation objectives are engraved in the system? Does it inherently distinguish between native and invasive species? What ecological or ethical implications arise from a system autonomously developing its values through trial and error? Are the system’s values consistent with conservation? Who holds responsibility for making this judgment and halting its operation if it goes rogue? The wildness creator removes humans from the picture not only physically but also by operating as a black box. The lack of transparency leads to impenetrable technical and ethical conundrums that situate it within the realm of fiction.

Despite the increasing potential of advanced technologies to capture various aspects of the natural world, it is early to claim that natural complexity can be inscribed within and deciphered by the fixed frameworks of statistical models like machine learning and AI. Trained on data that represent quantifiable aspects of the physical world, statistical models identify patterns and correlations within these datasets. Physical and computational constraints like the sensor’s field of agency set the limits of what can be captured and represented. Satellite images of the earth constitute numerical matrices before any layer of interpretation. Biodiversity data are only available for places where sensor stations are installed. While the patterns learned by the models are used to predict future trends, the data come from past measurements. The more dissimilar the future from the past, the more inaccurate the data predictions. In a rapidly changing environment and climate where unforeseen phenomena occur, the predictive scope of data models is constrained to a short timeframe. Could overreliance on these predictive mechanisms result in myopic solutions, limited to parameter adjustments rather than radical changes? Data models lack awareness of qualities that are subjective (depend on human perception), that are ambiguous (their meaning is shifting and abstract in nature), that are conceptual rather than quantifiable. Capturing the ever-changing ecological dynamics within cultural settings in numerical terms is hard. Uncovering their inner workings and predicting the long-term effects of cultural or political attitudes on the environment appears unattainable.

‘Gardenification’, the enclosure and attachment of non-human species to human-designed environments for

Fig. 4: With a surface area of almost three hectares, the Javits centre's green rooftop in Manhattan's Hudson Yards provides a habitat for dozens of local and migratory birds, several bat species, and thousands of insects. Despite their limitations and possible disputes about their status in conservation science and research, similar projects have the capacity to function as prototype sites for original observation, studying biodiversity and conservation in complex metropolitan areas. Photo: Alexandra Kotis.

protection as Jansen describes it, takes a new form. In the gathering of environmental data, we observe the enclosure of the entire planet in its smallest dimensions to render the problems more familiar and manageable. This 'datafication' of ecosystems generates a new virtual ecology permeated by the epistemic shortcomings of fragmentation. The new ecology of the planetary garden remains a field of biopolitical tensions between human and non-human agents, in which humans are part of the enclosure. Scientific monitoring, seen as a surveillance mechanism, implies the exertion of power and biopolitical control. Datafication becomes an effort to secure new ecosystem services that involve human and non-human entities, be they living organisms or technological agents. Data as the 'new wild' becomes integral to green and data capitalism as a new commodity and an inexhaustible resource of institutional greenwashing and funding.

Two centuries after the machines were first introduced in the garden, technology retains its ideological weight. The promise that technology alone can fix the damage of industrialisation sustains the illusion that current lifestyles can be maintained without altering the root causes of the climate crisis. To reconcile environmental protection with relentless urban expansion, the tendency of mainstream conservation is towards restructuring the way ecosystems operate within capitalist economies.[24] Efforts to draw from indigenous knowledge to improve resource management often fail to move the established mechanisms, treating the members of these communities as mere instruments of the apparatus. The question of whether technology can foster new relationships that transcend dominant conservation paradigms remains open-ended.[25] In our view, technology finds its place in the garden within a symbiotic structure that can enhance interspecies relationships and give rise to new forms of agency.

Towards a convivial conservation technology

If there is no way to escape the apparatus, can we redirect it to embrace the diversity of worldviews? Conventional models of technological governance go hand in hand with an understanding of conservation as general strategies or regulatory frameworks that are part of international law or national policies. Questioning the designs of generic solutions implemented uniformly across different regions, we advocate for conservation technologies of local relevance. This overtly spatial argument regards technology as an integral part of a geographical or geophysical region. With socio-ecological and technological systems evolving and adapting in tandem, conservation could acquire traits akin to place-making.

While techno-centric solutions, like the wildness creator, delegate human agency to technology, adapting the apparatus to human communities and their environments can enhance ecological interactions, and create new forms of agency and collaboration between them. Technologies that enhance networking and communication exemplify this direction. The blockchain emerged as a promising medium for managing interactions aimed at shared objectives, such as those in conservation. The consensus mechanisms of blockchain technologies enable action traceability within the network and enforce accountability, ensuring the implementation of collective decisions. For instance, blockchain's application in monitoring a fishery's chain of activities – from feeding and farming to trading – or in overseeing eco-tourism practices in a national park, can assure the sustainable and fair use of natural resources. Blockchain's transparency allows multiple network participants to direct funding towards initiatives that are provably sustainable. By eliminating intermediaries, a broader range of initiatives is possible, promoting diversity in conservation efforts. [26] Nonetheless, blockchain's technological complexity has made it challenging for the inexperienced to adopt it.[27] In another technological niche, advancements in AI seen in models that can communicate through human language and respond to visual or other inputs, point towards a more human-centric technical sphere.[28] The adoption of natural language for interacting with computational systems holds the promise of more equitable access to scientific knowledge and tools.

The future of conservation calls for collaboration between humans and non-humans, encompassing biological, material, and computational systems – to construct new knowledge about changing ecosystems. Differentiated configurations of the apparatus will serve as local repositories of this new, shared resource. Scientific expertise from natural, social and applied sciences, experiential insights from conservationists in the field, and data flows running in and out of the ecosystems will come together to formulate a spatialised ecological intelligence. AI's increasing ability to translate between various languages, from spoken dialects to programming languages or other forms of technical and regulatory communication, points in the same direction. This EI will support conservation by conversing about the condition of ecosystems, giving environmental data insights, making recommendations, or implementing citizen-led policies. Integrating both bottom-up and top-down knowledge structures, it will provide a platform for information sharing and communication between communities, researchers and policymakers, deepening the ties of the participants with their immediate surroundings. Its existence can set forth new interactions between humans and non-humans, giving rise to new understandings of the diversity of social, biological, hydrological, agricultural, technological and other systems.

A new garden scheme that nurtures resilient ecologies on an environmentally fragile planet is now conceivable. Transcending the culture of continuous surveillance, the sociotechnical framing of the EI promotes a convivial approach to conservation. With more people participating in conservation, more pluralistic approaches can exist. Leveraging EI, the system that supports their decisions and actions can be equally diverse. Knowledge aggregation and sharing, inside and across various localities can drive new scientific findings and facilitate the creation of sustainable systems on the planetary scale. In this extended agglomerated garden, new ecosystem categories can grow, giving way to new notions of resilience in the face of the climate emergency.

The EI will inevitably encounter ethical and technical challenges. Like any data-collecting apparatus, it will be prone to reproduce the prejudices, the inequalities or the errors that are present in the data. Bias can manifest in attitudes towards people, just as it can in perceptions of different species. The dissemination of contested scientific knowledge or the deliberate insertion of false information into the system can complicate its use. To ensure the accuracy, reliability and integrity of information within the system, continuous refinements based on human feedback and ethical consensus among people will be essential. AI is not meant to impair human judgment or substitute human decision-making. Humans will have to be in command and bear responsibility for upholding the rights of all participants.

Diversifying the apparatus is beyond vital to integrate the human perspective in today's datafied landscape. Without collective involvement, data remain fragmentary representations akin to fleeting snapshots of a rapidly changing world. Lacking social grounding or holistic integration, data representations can obscure the dynamism and interconnectedness of social and ecological environments. The role of EI in the planetary garden extends beyond merely collecting and distributing information. By bringing together social, natural, and technological systems, it aims to weave the fragments into personal, cultural, historical, scientific or other narratives that describe the changing environments and the collective decisions to protect them. Incorporating a human perspective into the garden scheme can create new knowledge, establish new conservation cultures and prompt new inquiries: Whose knowledge yields the greatest influence on collaborative schemes? How are conservation ethics redefined? Can non-humans gain a voice within this paradigm? These and many more questions suggest future avenues of exploration as we attempt to re-envision environmental stewardship in the Anthropocene.

Notes

1. Details on the goals and targets to be reached by 2030 are listed in 'Kunming-Montreal Global Biodiversity Framework', 15th meeting of the Conference of Parties to the UN Convention on Biological Diversity; also, WWF, *Living Planet Report 2022: Building a nature-positive* society, ed. R.E.A. Almond et al. (Gland, Switzerland: WWF, 2022).
2. More on the use of scientific methods to increase landscape productivity can be found in The Royal Society, *Multifunctional Landscapes: Informing a long-term vision for managing the UK's land* (London: Royal Society, 2023), royalsociety.org/topics-policy/projects/living-landscapes/multifunctional-land-use/.
3. An example of real-time satellite data can be found on the website zoom.earth.
4. There are examples of satellite data and visualisation tools from NASA (https://www.nnvl.noaa.gov/view/globaldata.html), Copernicus's Climate Data Store (https://cds.climate.copernicus.eu/cdsapp#!/software/app-era5-explorer?tab=app), and the European Space Agency (https://climate.esa.int./en/).
5. Broader initiatives in the US towards AI integration are outlined in: 'NSF announces 7 new National Artificial Intelligence Research Institutes,' National Science Foundation, 4 May 2023, https://new.nsf.gov/news/nsf-announces-7-new-national-artificial.
6. Erle C. Ellis and Navin Ramankutty, 'Putting People in the Map: Anthropogenic Biomes of the World', *Frontiers in Ecology and the Environment* 6, no. 8 (2008): 439–47.
7. Ibid.; see also Erle C. Ellis, 'Anthropogenic transformation of the terrestrial biosphere', *Philosophical Transactions of the Royal Society A Mathematical Physical and Engineering Sciences* 369 (2011), 1010–35.
8. On the emergence of a new ecosystem world order, see Richard J. Hobbs, Eric Higgs, Carol M Hall et al., 'Novel ecosystems: theoretical and management aspects of the new ecological world order', *Global Ecology and Biogeography* 15 (2006): 1–7. For designer ecosystems, see Matthew R.V. Ross et al., 'Designer Ecosystems: Incorporating Design Approaches into Applied Ecology', *Annual Review of Environment and Resources* 40 (2015): 419–43.
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10. For a take on the first attitude, see Edward O. Wilson, *Half-Earth: Our Planet's Fight for Life* (New York: Liveright Publishing Corporation, 2016); also, Eileen Crist et al., *Protecting Half the Planet and Transforming Human Systems Are Complementary Goals*, *Frontiers in Conservation Science*,

Volume 2 (2021). For the second attitude, see Emma Marris, *Rambunctious Garden: Saving Nature in a Post-Wild World* (New York: Bloomsbury, 2011).

11. Bram Büscher and Robert Fletcher, *The Conservation Revolution: Radical Ideas for Saving Nature Beyond the Anthropocene* (London and New York: Verso, 2020); see Chapter 5, 'Towards Convivial Conservation', 158–98.
12. The contributions of indigenous communities in ecosystem protection, monitoring and restoration have been recognised by researchers and policymakers worldwide, for example in Alejandro Estrada et al., 'Global Importance of Indigenous Peoples, Their Lands, and Knowledge Systems for Saving the World's Primates from Extinction', *Science Advances* 8, no. 32 (2022): 1–19, also in Giulia C.S. Good Stefani, 'Indigenous Leaders at the Frontlines of Environmental Injustice and Solutions', NRDC website, 11 October 2021), https://www.nrdc.org/bio/giulia-cs-good-stefani/indigenous-leaders-frontlines-environmental-injustice-and-solutions; and Monique Broulliette, 'In Alaska, Tribal Governments Push for Larger Conservation Role' Undark website, 6 June 2023, undark.org/2023/06/06/in-alaska-tribal-governments-push-for-larger-conservation-role/ .
13. Jedediah Purdy, *After Nature: A Politics for the Anthropocene* (Cambridge, MA: Harvard University Press, 2015), 286.
14. Gilles Clément, '*The Planetary Garden' and Other Writings,* trans. Sandra Morris (Philadelphia: University of Pennsylvania Press, 2015).
15. Janzen explains the garden metaphor in: Daniel Janzen, 'Gardenification of Wildland Nature and the Human Footprint', *Science* 279, no. 5355 (1998): 1312–13.
16. See Benjamin H. Bratton, *Terraforming* (Moscow: Strelka, 2019).
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18. For a holistic consideration of the human impact on the ecosystem, see Eileen Crist, A*bundant Earth: Toward an Ecological Civilization* (Chicago: University of Chicago Press: 2019), specifically the chapter 'Human Supremacy and the Roots of the Ecological Crisis' .
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22. For a definition of landscape intelligence, see Bradley Cantrell and Zihao Zhang, 'A Third Intelligence', *Landscape Architecture Frontiers* 6, no. 2 (2018): 42–51.
23. Landscape Architecture Foundation, *The New Landscape Declaration*, June 2016, quoted in Cantrell and Zhang, 'A Third Intelligence'.
24. Aiming to create financial incentives for preserving rather than exploiting the environment, conservation policies are fraught with contradictions, even impossibilities. The Royal Society's Multifunctional Landscapes Policy Report is one example.
25. According to Büscher and Fletcher, 'the use of modern tools of conservation – including technologies, finance, 'smart' systems, governance and management – is of value only to the extent that they allow for more conviviality between humans and between humans and the rest of nature'. Büscher and Fletcher, *The Conservation Revolution*, 162. The role of technology is to strengthen existing relations and create new agencies.
26. terra0 (terra0.org), a conceptual prototype for managing specific land parcels that is based on the Ethereum blockchain, suggests the creation of technologically augmented ecosystems capable of autonomous action within predetermined financial constraints.
27. Read more on conservation technologies in general, and blockchain, in particular, in Catherine Corson, and Lisa M. Campbell, 'Conservation at a Crossroads: Governing by Global Targets, Innovative Financing, and Techno-Optimism or Radical Reform?', *Ecology and Society* 28, no. 2 (2023), https://doi.org/10.5751/ES-13795-280203.
28. OpenAI's GPT-4V(ision) model was an initial step towards multimodal AI. For a comprehensive analysis of language and image AI models, see Rishi Bommasani et al., 'On the Opportunities and Risks of Foundation Models' (Stanford: Center for Research on Foundation Models, 2021), arXiv:2108.07258.

Biography

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