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General Comment

Nine Proposals for Human-Centered Artificial Intelligence

Labor: The Future of Work at the Human-Technology Frontier was one of the 10 Big Idea initiatives of the National Science Foundation, built on convergence of many fields of engineering and also some social and cognitive science that served primarily a minor rather than critical role. The supported research seemed limited to abilities that enhance national economic and military competitiveness in an unstable world, rather than improving worker prosperity and social well-being. A new initiative could support research on the immediate impact of AI on workers, including the transformation of education required to get a good job, and the potential increase of human unemployment.

Idea Machine: The 2018 "2026 Idea Machine" was framed as a Big Idea contest in which winners would gain publicity and thus honor, plus small dollar prizes, but not full research grants. Just seven gained full NSF encouragement. Subsequently, a few exploratory grants were funded, but the significance of this experiment for future policies seems to have been ignored. Consideration should be given to reviving the wider Idea Machine, but especially urgent is deeper analysis of the original inputs and of related critiques about AI research that have been expressed subsequently.

Consciousness: One of the challenging outcomes of NSF's Idea Machine exploration in 2020 was encouragement of research on conscious experience, a phenomenon that may exist in advanced machines as well as human minds. Future NSF research on consciousness must support cognitive, social and cultural sciences, as well as computer science. While each individual person experiences existence subjectively, and engineers are concerned about how well smart machines perform the tasks assigned to them, research must draw upon many distinct meanings for "consciousness," often defined in terms of a conceptual framework, set of human values, or subculture.

Rules of Life: The Big Idea managed by NSF's Biology directorate sought to reconceptualize research principles, because the earlier breakthrough development of gene sequencing has failed to achieve some of its anticipated benefits. Frankly, this problem may reflect the future of all sciences that study complex phenomena, progress slowing to a halt after the simple discoveries had already been achieved. Advanced artificial intelligence promises to be capable of analyzing complex systems, thus helping to continue scientific progress, at least for a few more years.

Misinformation: Artificial intelligence can be used as a tool to spread or to combat "misinformation," yet that term is often applied ideologically to statements with which some critics disagree. AI already influences human minds covertly within recommender systems, serving the selfish interests of multiple political and business organizations. A five-year initiative should be considered, supporting research in economics, sociology and political science about the motivations and consequences of misinformation.

Convergence: Given that the exact structure of an AI application depends upon the type of information it will process, and that such powerful tools will have broad applications, their design must often prioritize interdisciplinary convergence. NSF developed a long-lasting initiative called NBIC, a convergence of Nanotechnology, Biotechnology, Information technology and technologies based on Cognitive science, and future convergence research will need to give emphasis to the social and cultural sciences.

Digital Libraries: It is time to revive the Digital Library Initiative that began in 1993 and was fundamental in the development of the World Wide Web, to focus artificial intelligence on memory, equally with thinking. Fully 243 of the grant abstracts on the NSF website contain

the word "Wikipedia," and many others concerned different social media through which people shared information. Given that search engines use algorithms that can be called "artificial intelligence," these popular online archives must be created through partnerships between people and AIs.

Avatars: Digital libraries and social media serve individuals, but they are shaped by the needs of user communities. Many existing and future applications need to be personalized, adapted to the needs of a single user and under his or her control. Self-driving cars and humanoid robots may deserve the "avatar" label, and it seems that far more extensive research is needed to fully develop this personal mode of human-centered artificial intelligence.

Memorials: Already, AI chatbots can simulate with moderate authenticity the thoughts and communication styles of famous deceased individuals. Intelligent memorials for more "ordinary" people will require extensive collection of their words and actions during life, thus raising ethical as well as technical questions, which require answers from both social and computer sciences.