To: Santiago Garces (Chief Information Officer, City of Boston)
Cc: Aleja Jimenez Jaramillo (Director of Governance + Policy, Department of Innovation and Technology, City of Boston); Michael Evans (Director of Emerging Technology, Department of Innovation and Technology, City of Boston)
From: Diana Garcia De La Cruz (3rd year Environmental and Sustainability Sciences Major); Giannis Kastanos (3rd year Biochemistry Major); Hazel Lim (4th year Criminal Justice and Psychology Major); Sinead Qiu (4th year Nursing Major) - Northeastern University Students
Date: 4/4/24
Re: Final Memo

Background

Our community is made up of the STEM disciplines. We are all students in one of the fields of STEM. Technology is integral to our community, as it enables all sorts of predictions, calculations, and machinery necessary to perform tasks. This larger community is of interest to our team because all of us actively engage and interact with this community in our day-to-day lives. Given our vast experiences with this community, we have noticed the effects AI systems have been diffusing into our community.

Our Sub-Communities:

Giannis: I represent the sub-community of biochemical research and biotechnology, which focuses on understanding and treating disease. This field uses an incredible amount of plastic every day, due to everything needing to be one-use to maintain sterility. This poses significant economic and environmental concerns.

Diana: My sub-community is the environmental/sustainability sciences community. An important thing to know about us is that with advancing technologies, they require lots of materials and locations to run their operations which can often have a negative impact on the environment overtime.

Hazel: I am part of the cognitive psychology sub-community. Something important to know about this community is its general focus on the individual and its efforts to understand the individual using broader, more generalized concepts.

Sinead: My sub-community is the nursing/healthcare community, whose common goal is to improve the safety and wellbeing of patients. Something important to know about this community and many other STEM communities is the importance of interdisciplinary collaboration.

AI Technologies in Our Sub-Communities:

Giannis: AI has been playing a big role in biomedical research and even more so in biotechnology. Biotech companies are in fierce competition and must perfect their products to succeed. AI is an invaluable tool in optimizing procedures, predicting productivity, and automating the analysis of huge swaths of data. Hopefully in the near future, AI can replace a lot of trial and error in research, minimizing tedious labor as well as costly and unsustainable usage of materials.

Diana: For environmental/sustainability, I think AI has made a big impact with the research that scientists have been putting out as it has been used as an aid for data analysis and assisting with the formatting or grammar of their writing.

Hazel: In terms of cognitive psychology, I believe that AI has a strong bidirectional relationship with cognitive psychology/ neuropsychology. For example, during the psychological revolution in the 1960s, the advent of the computer helped provide workings of the mind. Likewise, neural networks often seen in more advanced AI systems have been inspired by the architecture of the brain.

Sinead: I think AI plays an increasingly prevalent role in the nursing community, especially with the growth of the nursing informatics field. The use of this technology is apparent in electronic medical records and databases that nurses can use to learn more about hospital policies and medications.

Potential & Concerns

After conducting interviews with other members of our STEM subcommunities, it's notable that artificial intelligence is having a significant and ever-growing impact on STEM fields. There are undeniable benefits to the use of AI in these disciplines. Aside from automating and streamlining a lot of tedious or long tasks, such as processing huge swaths of data and trial-and-error experiments, AI models can make crucial predictions and judgments. In some cases it can serve as inspiration for ideas that scientists haven't thought about yet or fill in gaps in knowledge we haven't considered yet. In the biomedical field, AI is being used to predict protein structure and interactions, the potential of cell lines for production of cancer-targeting molecules, and the efficiency of potential drugs. In healthcare, AI is most apparently being used in electronic medical records through databases on hospital policies, procedures, medications, and surgery through robots and devices to perform complex tasks. In the psychology field, computers have had a bidirectional relationship with understanding the human mind—a notable event involves the cognitive revolution in the 1960s. Various organizations, such as Columbia's ARNI institution, have been using AI to further understand the brain and, in turn, use the understanding of the brain to advance AI models. The environmental field's use of AI can be helpful and applicable to data and scientific writing. Not many environmental scientists enjoy coding for data visualization and it can be difficult to learn so AI is used as guidance for this.

However, AI presents real dangers in the STEM community. Most prevalent perhaps is over-reliance on predictive models. AI, as of now, can not serve as a replacement for the diagnosis of patients, or the accurate selection of drug targets. Not only is the way a model makes decisions often incompletely understood, but they also often lack the sufficient training to be reliable. AI can be used to narrow down some options in this regard, but final results must always be confirmed by trained professionals that have the background and experience of understanding the community being studied or even rocks found at a field site. Given that AI systems are always learning, this means they can often have inconsistencies and mistakes in the outputs they provide to those using the system which makes it difficult to rely on.

Another common theme across various STEM subcommunities is the ethical concerns surrounding AI. This can include the falsification of data, data privacy and HIPAA violations in clinical settings, algorithmic bias, the lack of transparency in how AI makes decisions, and taking credit for AI-generated text. After one interview, we came across a peer-reviewed, published medical paper that copied directly from an AI model, forgetting to remove the "as an AI model part," and failing to cite it.[1] Lastly, a concern especially prevalent in the clinical side of our community is the lack of humanistic properties of AI models. Despite the gradual infusion of AI technology in healthcare facilities, they will never replace clinical workers due to their lack of emotions and human-inherent features. Similarly, for

the field work aspect in applied earth sciences AI can't replicate the knowledge of a mineralogist when identifying minerals in the field.

Recommendations

One of the foundational values that our community believes should be involved in AI-focused policies is the explainability/transparency of the AI system. Decisions made by intelligent systems that have real-world applications should be explainable (i.e., what data was utilized to make such decisions, where was the data sourced from, and the logic behind the network of the AI model). Also important in the transparency of AI is clearly communicating whether some sort of AI system has been utilized to produce certain outcomes. If some sort of LLM was used to produce a body of text in an academic paper, it is imperative to clearly reference what type of LLM was used with what sort of prompts. Moreover, given the disjunction between the lack of knowledge surrounding AI models and the prevalence of AI systems in the status quo, we believe that ethics (e.g., privacy, accountability) should be central to AI innovation.

The principles that our group wants implemented are validated data by professionals, transparency, full disclosure, and ethics for future improvement to protect user safety. As AI models and tools become more integrated with research and data processes, their resourcefulness and ability to assist professionals should be noted and credited by professionals. This transparency communicates clearly to readers that AI tools were used in their writing/data process and that they can be held accountable should an error or mistake be found. With transparency of AI usage comes full disclosure and crediting AI used which ensures proper acknowledgments are given and so that whoever would like to verify the credits could track the steps taken with the AI usage. Another important principle is that AI is understood by communities, so that they can make informed decisions about if they should and how to use AI in safe and efficient ways. Users should also know how much and what kind of information the AI model was trained on.

A crucial aspect of AI regulation must be the validation of important medical decisions that AI makes. For example, an AI model may screen through a great number of images from a patient to identify evidence of a neurodegenerative disease, like Alzeheimer's. It's too dangerous, however, to rely on AI to make the diagnosis alone. A medical professional must review the identified evidence and validate the diagnosis. While AI may be a helpful tool for such procedures, it cannot have the final word on something so crucial to a patient's life, especially given the limited and often biased data that AI models are sometimes trained on. Lastly, it's important to address accountability for such AI actions. Should AI misdiagnose a patient, resulting in negative health consequences, or a self-driving car hurt a pedestrian, blame ought to be placed on both the user and the AI creator. The technology failed, and it must be held responsible, just as if a car's brakes suddenly failed, the manufacturer would hold some responsibility. As previously mentioned, however, it's up to the user to validate the decision of AI, and therefore the user is even more responsible and should face greater consequences.

What the Tech – *Oh mAI gosh: Best Match in PubMed*
This video explores how AI, namely PubMed's use of machine learning in Best Match, is used by and benefits the STEM community.

References:

1. Bader, R., Imam, A., Alnees, M., Adler, N., Ilia, J., Zugayar, D., Dan, A., & Khalaileh, A. (2024, March 8). *Successful management of an iatrogenic portal vein and hepatic artery injury in a 4-month-old female patient: A case report and literature review*. Radiology Case Reports. https://www.sciencedirect.com/science/article/pii/S1930043324001298#abs0001