Data explains AI's Physics Nobel

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The Physics Nobel Prize was awarded to the groundbreaking research of John Hopfield and Geoffrey Hinton on artificial neural networks. This surprised many scientists and caused dissenting opinions, as this topic is commonly perceived as Computer Science - So why the prize in Physics?

Instead of relying on opinions, there are robust, data-driven methods from Science of Science to contextualize this award using citation data (Fortunato et al., *Science* **359**; 2018). This way, we have shown that indeed "Hopfield's 1982 paper on neural networks [is] indistinguishable from papers published in physics journals", similar to "six physics Nobel winning publications" in interdisciplinary physics (Sinatra et al., *Nature Physics* **11**, 791–796; 2015). Further, we assessed (Szell, Ma & Sinatra, *Nature Physics* **14**, 1075-1078; 2018) that interdisciplinary papers like Hopfield's and Hinton's are ripe for a Nobel Prize (see "AI's impact in multiple fields"): Until recently, the Physics Nobel Prize has been used to award traditional physics research impacting physics only; this year's award however shows that the prize has caught up with reality, recognizing interdisciplinary discoveries that impact both physics and other fields.

We are hopeful that this recognition will expedite the breakup of disciplinary silos which obstruct out-of-the-box thinking that combines ideas from different disciplines. This breakup is urgently needed to solve the world's big challenges like climate change. Physics itself is undergoing extensive changes and "spin-offs", influencing emerging fields like data science that embrace interdisciplinarity. In contrast, clinging to research fields as fixed territories is at best small-minded, at worst harmful. Although we should not discard useful domain knowledge, there is a clear need for better use of data and breaking up silo mentalities.

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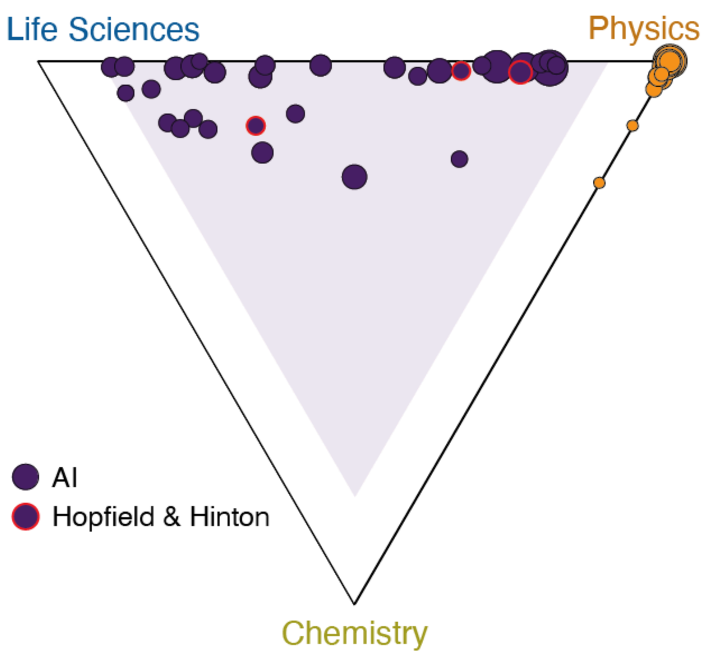

AI's impact in multiple fields
Highly cited AI papers (purple) have an impact in multiple fields, including both Physics and Life sciences, as opposed to traditional Nobel Prize papers in Physics (orange). Figure adapted from: Szell, Ma & Sinatra, *Nature Physics* **14**, 1075-1078; 2018

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Was the Nobel prize for physics? Yes — not that it matters

The award of the 2024 Nobel Prize in Physics to John Hopfield and Geoffrey Hinton for their groundbreaking research on artificial neural networks (*Nature* **634**, 523–524; 2024) has caused consternation in some quarters. Surely this is computer science, not physics?

Existing data can help to inform this debate. Almost a decade ago, two of us (M.S. and R.S.) co-authored an analysis of referencing and citation patterns that explicitly placed Hopfield's seminal 1982 paper on neural networks among 3.2 million interdisciplinary papers in non-physics journals that were "indistinguishable from papers published in physics journals". Six other physics Nobel-winning papers were also in this set (R. Sinatra *et al. Nature Phys.* **11**, 791–796; 2015).

The physics Nobel prize has until recently rewarded conventional 'core' physics research, even though Hopfield's and Hinton's papers were ripe for recognition (M. Szell *et al. Nature Phys.* **14**, 1075–1078; 2018). We hope that this year's prize will expedite the breakdown of silos that obstruct thinking across disciplines. Clinging to the idea of research fields as fixed territories is at best small-minded, and at worst harmful, when it comes to solving global challenges such as climate change.

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The world needs an AI 'telescope'

Artificial intelligence (AI) technologies have reached a crucial juncture. The vast computing clusters required to train the most advanced generative AI systems are available only to a few large corporations. Academic institutions, once at the forefront of scientific discovery, are falling behind. Proposals for collaborative efforts to close the gap, such as shared clusters, lack the required scale and organization.

With AI potentially soon surpassing human intelligence in some regards, it is dangerous to rely solely on corporations to explore and control the technology (C. L. Bockting *et al. Nature* **622**, 693–696; 2023). A large-scale project is needed to build and sustain an international AI 'telescope', in the form of the world's largest computing and data centre with thousands of affiliated academic laboratories and permanent staff, to peer into the universe of AI and its safety. Europe's particle-physics lab CERN, near Geneva, Switzerland — which last month celebrated its 70th anniversary — provides one model of the organization and scale of resourcing that might be required.

Now is the time for concerned scientists, governments and citizens to coalesce around such a large-scale international collaboration — to safeguard humanity and to ensure that AI's potential serves everyone.

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Faulty vision for US eye research

In June, a US House of Representatives committee released a plan to restructure the National Institutes of Health. This includes consolidating the National Eye Institute (NEI) into a broader neuroscience and brain-research institute (see go.nature.com/4f5373t). As leaders of professional organizations for vision research, we wish to voice our concern about this proposal.

Tens of millions of people in the United States self-report as visually impaired or blind. The US Centers for Disease Control and Prevention predicts substantial increases conditions such as cataracts, glaucoma, diabetic retinopathy (DR) and age-related macular degeneration (AMD) in the coming decades.

NEI-funded research has led to several scientific advances. These include drugs that inhibit blood-vessel formation (used to treat millions of people with AMD and DR), the first diagnostic, autonomous medical AI system (IDx-DR) and Luxturna, the first gene therapy to be approved by US regulators for an inherited disease.

Maintaining the NEI as an independent institute is crucial to achieving its mission of eliminating vision loss and improving quality of life through research. Consolidation with other programmes will dilute and diminish this effort.

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Share health data to boost space biomedicine

Last month, SpaceX's Polaris Dawn mission took humans beyond the orbit of the International Space Station (ISS) for the first time since the end of the Apollo Moon programme (*Nature* **633**, 504–505; 2024). Notably, crew members did not have to meet the stringent medical criteria applied to ISS career astronauts, or even the less-stringent ones applied to ISS 'space-flight participants'.

This greater medical diversity brings opportunities, as well as risks. There remain significant gaps in our knowledge of how physiological systems respond during and after space flight, in part because ISS crew members are carefully selected to minimize any risk of requiring medical evacuation. These gaps need filling for missions beyond the ISS, for which resource constraints will be more severe and communication delays unavoidable.

So far, however, commercial missions have been conducted largely without external medical scrutiny or data sharing — although data from SpaceX's 2021 Inspiration4 mission were included in the Space Omics and Medical Atlas (SOMA) initiative, results from which were released this year (see go.nature.com/4b8g1qd). Such sharing needs to become the norm. Measurement standardization, coupled with 'open innovation', must ensure that lessons learnt in one mission architecture can be applied in another. That would launch a golden era of iterative, evidence-based, mission-enabling space biomedicine.

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