SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

7 August – 8 October 2021

TOPICAL REPORT

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

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news

DATA SCIENCE

Surge in students choosing data science degrees amid calls to tackle workforce shortage

"Students are rushing towards data science degrees as demand for qualified graduates surges, with enrolments increasing by up to 400 per cent at one institution, according to new Queensland figures. However, despite the surging enrolments in the field, workforce demand still outstrips the number of graduates and qualified workers.

Griffith University introduced data science into two double undergraduate degrees in 2019. Enrolments have since increased by 400 per cent, a spokesperson said.

"Enrolment growth in these degrees has been strong, and we have since introduced two more double degrees, as well as numerous data analytics and data science offerings at the postgraduate level," a Griffith University spokesperson said."

Source: ABC News

Streamlit, which helps data scientists build apps, hits version 1.0

"Streamlit, a popular app framework for data science and machine learning, has reached its version 1.0 milestone. The open source project is curated by a company of the same

academic

DATA SCIENCE

Mobile Data Science and Intelligent Apps: Concepts, AI-Based Modeling and Research Directions

"Artificial intelligence (AI) techniques have grown rapidly in recent years in the context of computing with smart mobile phones that typically allows the devices to function in an intelligent manner. Popular AI techniques include machine learning and deep learning methods, natural language processing, as well as knowledge representation and expert systems, can be used to make the target mobile applications intelligent and more effective. In this paper, we present a comprehensive view on "mobile data science and intelligent apps" in terms of concepts and AI-based modeling that can be used to design and develop intelligent mobile applications for the betterment of human life in their diverse day-to-day situation. This study also includes the concepts and insights of various AI-powered intelligent apps in several application domains, ranging from personalized recommendation to healthcare services, including COVID-19 pandemic management in recent days."

Source: Springer Link

ARTIFICIAL INTELLIGENCE

reports

DATA SCIENCE

Data Science Impacting the Pharmaceutical Industry

"Data science and AI have the potential to transform drug discovery in terms of costs, speed and efficiency. With explosion in biomedical data, data sharing and analysis platforms have surged. AI technologies are moving to the next phase of advancements, and when combined with other emerging tech areas, AI is expected to witness a full fledged adoption by pharma and biotech companies in the next 4-5 years"

Source: Frost & Sullivan

ARTIFICIAL INTELLIGENCE

Gathering Strength, Gathering Storms: The One Hundred Year Study on Artificial Intelligence (AI100)

2021 Study Panel Report

"This report, the second in that planned series of studies, is being released five years after the first report. Published on September 1, 2016, the first report was covered widely in the popular press and is known to have influenced discussions

name that offers a commercial service built on the platform. So far, the project has had more than 4.5 million GitHub downloads and is used by more than 10,000 organizations.
The framework fills a vital void between data scientists who want to develop a new analytics widget or app and the data engineering typically required to deploy these at scale. Data scientists can build web apps to access and explore machine-learning models, advanced algorithms, and complex data types without having to master back-end data engineering tasks."
Source: Venture Beat

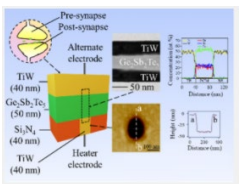
The Evolution Of Data Science And AI At The New York Times

"Data science and machine learning are evolving in just about every single industry. The adoption of AI at companies continues to grow and evolve and AI developers are trying to prove that there is value that can be added to different parts of the company through machine learning. Not surprisingly, journalism, an industry whose primary focus is the communication of ideas in both text and visual format, has come to adopt the tools and techniques of data science to put power behind analysis and visualization of data.
The New York Times (NYT) has had a data science group since 2012, but only recently has this group moved out of the experimental phase and taken a major role in the company, adding value through machine learning."
Source: Forbes

The Top 3 Tools Every Data Scientist Needs

"As a field, data science moves at a different speed than other areas. Machine learning constantly evolves and libraries like PyTorch and TensorFlow keep improving. Research companies like Open AI and Deep Mind keep pushing the boundaries of what machine learning can do (i.e. DALL.E and CLIP). Foundationally, the skills required to be a data scientist remain the same: statistics, Python/R programming, SQL or NoSQL knowledge, PyTorch/TensorFlow and data visualization. However, the tools data scientists use constantly change."
Source: Built In

ARTIFICIAL INTELLIGENCE



What makes an AI device human-like? The role of interaction quality, empathy and perceived psychological anthropomorphic characteristics in the acceptance of artificial intelligence in the service industry

"Intelligent AI devices have become a common presence in the business landscape, offering a wide range of services, from the medical sector to the hospitality industry. From an organizational perspective, AI devices have several advantages, by performing certain tasks quicker and more accurately in comparison to humans while at the same time being more cost-efficient. However, in order to maintain the high standards of a brand, they have to be accepted by consumers and deliver socially adequate performance. Therefore, it is important to determine the characteristics of AI devices which make them accepted and trusted by consumers. Based on the Computers as Social Actors (CASA) Theory, we have researched on the role of psychological anthropomorphic characteristics, perceived empathy, and interaction quality in the acceptance of AI devices in the service industry. The results show that anthropomorphic characteristics alone do not influence acceptance and trust towards AI devices. However, both perceived empathy and interaction quality mediate the relation between anthropomorphic characteristics and acceptance."
Source: Elsevier

Space-Based Global Maritime Surveillance. Part II: Artificial Intelligence and Data Fusion Techniques

"Maritime surveillance (MS) is of paramount importance for search and rescue operations, fishery monitoring, pollution control, law enforcement, migration monitoring, and national security policies. Since ground-based radars and automatic identification system (AIS) do not always provide a comprehensive and seamless coverage of the entire maritime domain, the use of space-based sensors is crucial to complement them. We reviewed space-based technologies for MS in the first part of this work, titled "Space-based Global Maritime Surveillance. Part I: Satellite Technologies." However, MS systems combining multiple terrestrial and space-based on governmental advisory boards and workshops in multiple countries. It has also been used in a variety of artificial intelligence curricula. In preparation for the second Study Panel, the Standing Committee commissioned two study-workshops held in 2019. These workshops were a response to feedback on the first AI100 report. Through them, the Standing Committee aimed to engage a broader, multidisciplinary community of scholars and stakeholder in its next study. The goal of the workshops was to draw on the expertise of computer scientists and engineers, scholars in the social sciences and humanities (including anthropologists, economists, historians, media scholars, philosophers, psychologists, and sociologists), law and public policy experts, and representatives from business management as well as the private and public sectors."
Source: Stanford University

The use of artificial intelligence and machine learning by market intermediaries and asset managers Final Report

"Artificial Intelligence (AI) and Machine Learning (ML) are increasingly used in financial services, due to a combination of increased data availability and computing power. The use of AI and ML by market intermediaries and asset managers may be altering firms' business models. For example, firms may use AI and ML to support their advisory and support services, risk management, client identification and monitoring, selection of trading algorithms and portfolio management, which may also alter their risk profiles. The use of this technology by market intermediaries and asset managers may create significant efficiencies and benefits for firms and investors, including increasing execution speed and reducing the cost of investment services. However, this use may also create or amplify certain risks, which could potentially have an impact on the efficiency of financial markets and could result in consumer harm. The use of, and the controls surrounding, AI and ML within financial markets is, therefore, a current focus for regulators across the globe. IOSCO identified its work on the use of AI and ML by market intermediaries and asset managers as a key priority. The IOSCO Board approved a mandate in April 2019 for Committee 3 on Regulation of Market Intermediaries (C3) and Committee 5 on Investment Management (C5) to examine best practices arising from the supervision of AI and ML.1 The committees were asked to propose

SUTD researchers designed an ultralow power artificial synapse for next-generation AI systems

"Brain-inspired computing is a promising candidate for next-generation computing technologies. Developing next-generation advanced artificial intelligence (AI) systems that can be as energy-efficient, lightweight, and adaptable as the human brain has attracted significant interest.

"However, mimicking the brain's neuroplasticity, which is the ability to change a neural network connection, in traditional artificial synapses using ultralow energy is extremely challenging." said Desmond Loke, assistant professor at the Singapore University of Technology and Design (SUTD)."

Source: EurekAlert!

Simulations, systems and applications of artificial intelligence

"Artificial Intelligence: Models, Algorithms and Applications presents focused information about applications of artificial intelligence (AI) in different areas to solve complex problems. The book presents 8 chapters that demonstrate AI based systems for vessel tracking, mental health assessment, radiology, instrumentation, business intelligence, education and criminology. The book concludes with a chapter on mathematical models of neural networks.

The book is primarily intended for students as it serves as an introductory book about AI applications at undergraduate and graduate levels and as a reference for industry professionals working with AI based systems, Researchers and engineers that are interested in AI and how it may be used to solve concrete problems. The structure of the book is organized as several different topics. We hope that technology developers and companies also find it interesting to be used in industry."

Source: EurekAlert!

Scientists develop AI to predict the success of startup companies

"A study in which machine-learning models were trained to assess over 1 million companies has shown that artificial intelligence (AI) can accurately determine whether a startup firm will fail or become successful. The outcome is a tool (www.venhound.com) that has the potential to help investors identify the next unicorn.

It is well known that around 90% of startups are unsuccessful: between sensors with additional information sources require dedicated artificial intelligence and data fusion techniques for processing raw satellite images and fusing heterogeneous information. The second part of our work focuses on some recent promising artificial intelligence and data fusion techniques for MS using space-based sensors."

Source: IEEE Xplore

Functionalization of remote sensing and on-site data for simulating surface water dissolved oxygen: Development of hybrid tree-based artificial intelligence models

"Dissolved oxygen (DO) is an important indicator of river health for environmental engineers and ecological scientists to understand the state of river health. This study aims to evaluate the reliability of four feature selector algorithms i.e., Boruta, genetic algorithm (GA), multivariate adaptive regression splines (MARS), and extreme gradient boosting (XGBoost) to select the best suited predictor of the applied water quality (WQ) parameters; and compare four tree-based predictive models, namely, random forest (RF), conditional random forests (cForest), RANdom forest GEneRator (Ranger), and XGBoost to predict the changes of dissolved oxygen (DO) in the Klang River, Malaysia. The total features including 15 WQ parameters from monitoring site data and 7 hydrological components from remote sensing data. All predictive models performed well as per the features selected by the algorithms XGBoost and MARS in terms applied statistical evaluators."

Source: Elsevier

MACHINE LEARNING

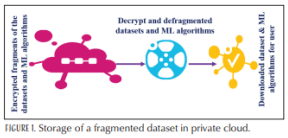


FIGURE 1. Storage of a fragmented dataset in private cloud.

Blockchain-Based Attack Detection on Machine Learning Algorithms for IoT-Based e-Health Applications

"The application of machine learning (ML) algorithms are massively scaling up due to rapid digitization and emergence of new tecnologies like the Internet of Things (IoT). In today's digital era, we can find ML algorithms being applied in the areas of healthcare, IoT, engineering, finance, and more. However, all these algorithms need to be trained in order to predict/solve a particular problem. There is high possibility of tampering guidance that member jurisdictions may consider adopting to address the conduct risks associated with the development, testing and deployment of AI and ML."

Source: IOSCO

REALIZE THE FULL POTENTIAL OF ARTIFICIAL INTELLIGENCE

"Artificial intelligence (AI) has and will continue to transform business strategies, solutions, and operations. AI-related risks need to be top of mind and a key priority for organizations to adopt and scale AI applications and to fully realize the potential of AI. Applying enterprise risk management (ERM) principles to AI initiatives can help organizations provide integrated governance of AI, manage risks, and drive performance to maximize achievement of strategic goals. The COSO ERM Framework, with its five components and twenty principles, provides an overarching and comprehensive framework, can align risk management with AI strategy and performance to help realize AI's potential."

Source: Cosco and Deloitte

Growth Opportunities In Artificial Intelligence, Supercomputers, And Quantum Computing

"This edition of IT, Computing and Communications (ITCC) Technology Opportunity Engine (TOE) provides a snapshot of the emerging ICT led innovations in Machine Learning, Supercomputers, Quantum Computing. This issue focuses on the application of information and communication technologies in alleviating the challenges faced across industry sectors in areas such as retail, healthcare, BFSI, and manufacturing.

ITCC TOE's mission is to investigate emerging wireless communication and computing technology areas including 3G, 4G, Wi-Fi, Bluetooth, Big Data, cloud computing, augmented reality, virtual reality, artificial intelligence, virtualization and the Internet of Things and their new applications; unearth new products and service offerings; highlight trends in the wireless networking, data management and computing spaces; provide updates on technology funding; evaluate intellectual property; follow technology transfer and solution deployment/integration; track development of standards and software; and report on legislative and policy issues and many more."

Source: Frost & Sullivan

The geography of AI: WHICH CITIES WILL DRIVE THE

10% and 22% fail within their first year, and this presents a significant risk to Venture Capitalists and other investors in early-stage companies. In a bid to identify which companies are more likely to succeed, researchers have developed machine-learning models trained on the historical performance of over 1 million companies."
Source: EurekAlert!

Opportunities and limits of AI in climate modelling

"Earth system models are the most important tools for quantitatively describing the physical state of the Earth and - for example in the context of climate models - predicting how it might change in the future under the influence of human activities. How the increasingly used methods of artificial intelligence (AI) can help to improve these forecasts and where the limits of the two approaches lie has now been investigated by an international team led by Christopher Irrgang from the German Research Centre for Geosciences Potsdam (GFZ) in a Perspectives article for the journal Nature Machine Intelligence. One key proposal: to merge both approaches into a self-learning "Neural Earth System Modelling"."
Source: EurekAlert!

AI-driven dynamic face mask adapts to exercise, pollution levels

"The researchers developed a dynamic air filter with micropores that expand when the filter is stretched, allowing more air to pass through. A large increase in the breathability of the filter, which was made of electrospun nanofibers, was achieved with only about a 6% loss in filtration efficiency. The team then placed a stretcher around the filter that was connected to a lightweight, portable device containing a sensor, air pump and microcontroller chip. The device communicates wirelessly with an external computer running artificial intelligence (AI) software that reacts to particulate matter in the air, as well as changes in the wearer's respiratory patterns during exercise."
Source: ACS Chemistry

Artificial intelligence makes it faster, easier to analyze hockey video

"Researchers have made a key advancement in the development of technology to automatically analyze video of hockey games using artificial intelligence.
Engineers at the University of Waterloo combined two existing deep-learning AI techniques to identify players by with the training datasets and producing biased results. Hence, in this article, we propose a blockchain-based solution to secure the datasets generated from IoT devices for e-health applications. The proposed blockchain-based solution uses private cloud to tackle the aforementioned issue. For evaluation, we have developed a system that can be used by dataset owners to secure their data."
Source: IEEE Xplore

mlr3proba: an R package for machine learning in survival analysis

"As machine learning has become increasingly popular over the last few decades, so too has the number of machine-learning interfaces for implementing these models. Whilst many R libraries exist for machine learning, very few offer extended support for survival analysis. This is problematic considering its importance in fields like medicine, bioinformatics, economics, engineering and more. mlr3proba provides a comprehensive machine-learning interface for survival analysis and connects with mlr3's general model tuning and benchmarking facilities to provide a systematic infrastructure for survival modelling and evaluation."
Source: Oxford Academic

Review: Theory-guided machine learning applied to hydrogeology—state of the art, opportunities and future challenges

"Thanks to recent technological advances, hydrogeologists now have access to large amounts of data acquired in real time. Processing these data using traditional modelling tools is difficult and poses a number of challenges especially for tasks such as extracting useful features, uncertainty quantification or identifying links between variables. Artificial intelligence, and more specifically its subset 'machine learning (ML)', may represent a way of the future in hydrogeological research and applications. Unfortunately, several aspects of machine-learning methods hamper its adoption as a complementary tool for hydrogeologists, namely the black-box nature of most models, an often-limited generalization ability, a hypothetical convergence, and uncertain transferability. Recently, an entirely novel paradigm in the field of machine learning has been identified—theory-guided machine learning–in which the models integrate some specific theoretical knowledge, laws or principles of the

ARTIFICIAL INTELLIGENCE REVOLUTION?

"As the post-pandemic economic era nears, much of the U.S. artificial intelligence (AI) discussion revolves around futuristic dreams of both utopia and dystopia, with promises ranging from solutions to global climate change on the positive side to a "robot apocalypse" on the negative. However, it bears remembering that AI is also becoming a real-world economic fact, with major implications for national and regional economic development. Based on advanced uses of statistics, algorithms, and fast computer processing, AI has become a focal point of U.S. innovation debates. Even more, AI is increasingly viewed as one of the next great "general purpose technologies"—one that has the power to transform sector after sector of the entire economy. All of which is why state and city leaders are increasingly assessing AI for its potential to spur economic growth. Such leaders are analyzing where their regions stand and what they need to do to ensure their locations are not left behind."
Source: Brookings

WHITE PAPER

Harnessing Artificial Intelligence to Accelerate the Energy Transition

"The efforts to decarbonize the global energy system are leading to an increasingly integrated and electrified energy system, with much more interaction between the power, transport, industry and building sectors. The move to decarbonize the energy supply is also leading to high levels of decentralization in the power sector. This will require much higher levels of coordination and flexibility from all sector players – including consumers – in order to manage this increasingly complex system and optimize it for minimal greenhouse gas emissions. AI has tremendous potential to support and accelerate a reliable and lowest-cost energy transition, with potential applications ranging from optimizing and efficiently integrating variable renewable energy resources into the power grid, to supporting a proactive and autonomous electricity distribution system, to opening up new revenue streams for demand-side flexibility. AI could also be a crucial accelerator in the search for performance materials that support

their sweater numbers with 90-percent accuracy.
"That is significant because the only major cue you have to identify a particular player in a hockey video is jersey number," said Kanav Vats, a PhD student in systems design engineering who led the project. "Players on a team otherwise appear very similar because of their helmets and uniforms."."
Source: EurekAlert!

AI may predict the next virus to jump from animals to humans

"To develop machine learning models using viral genome sequences, the researchers first compiled a dataset of 861 virus species from 36 families. They then built machine learning models, which assigned a probability of human infection based on patterns in virus genomes. The authors then applied the best-performing model to analyze patterns in the predicted zoonotic potential of additional virus genomes sampled from a range of species."
Source: EurekAlert!

New AI tool developed by University of Liverpool researchers accelerates discovery of truly new materials

"Reported in the journal Nature Communications, the new tool has already led to the discovery of four new materials including a new family of solid state materials that conduct lithium. Such solid electrolytes will be key to the development of solid state batteries offering longer range and increased safety for electric vehicles. Further promising materials are in development.
The tool brings together artificial intelligence with human knowledge to prioritise those parts of unexplored chemical space where new functional materials are most likely to be found."
Source: University of Liverpool

New report assesses progress and risks of artificial intelligence

"Artificial intelligence has reached a critical turning point in its evolution, according to a new report by an international panel of experts assessing the state of the field.
Substantial advances in language processing, computer vision and pattern recognition mean that AI is touching people's lives on a daily basis — from helping people to choose a movie to aiding in medical diagnoses. With that success, however, comes a renewed urgency to understand and mitigate the risks and downsides of AI-driven systems,

field of study. This review article sets out to examine three theory-guided methods in their ability to overcome the limitations of machine learning for hydrogeological research and applications."
Source: Springer Link

Comparison of Different Machine Learning Classifiers for Glaucoma Diagnosis Based on Spectralis OCT

"Early detection is important in glaucoma management. By using optical coherence tomography (OCT), the subtle structural changes caused by glaucoma can be detected. Though OCT provided abundant parameters for comprehensive information, clinicians may be confused once the results conflict. Machine learning classifiers (MLCs) are good tools for considering numerous parameters and generating reliable diagnoses in glaucoma practice. Here we aim to compare different MLCs based on Spectralis OCT parameters, including circumpapillary retinal nerve fiber layer (cRNFL) thickness, Bruch's membrane opening-minimum rim width (BMO-MRW), Early Treatment Diabetes Retinopathy Study (ETDRS) macular thickness, and posterior pole asymmetry analysis (PPAA), in discriminating normal from glaucomatous eyes. Five MLCs were proposed, namely conditional inference trees (CIT), logistic model tree (LMT), C5.0 decision tree, random forest (RF), and extreme gradient boosting (XGBoost)."
Source: MDPI

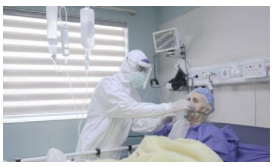
Understanding the Correlation between Lithium Dendrite Growth and Local Material Properties by Machine Learning

"Lithium metal batteries are attractive for next-generation energy storage because of their high energy density. A major obstacle to their commercialization is the uncontrollable growth of lithium dendrites, which arises from complicated but poorly understood interactions at the electrolyte/electrode interface. In this work, we use a machine learning-based artificial neural network (ANN) model to explore how the lithium growth rate is affected by local material properties, such as surface curvature, ion concentration in the electrolyte, and the lithium growth rates at previous moments. The ion concentration in the electrolyte was acquired by Stimulated Raman Scattering Microscopy, which is often missing in past experimental data-based modeling. The ANN network

the next generation of clean energy and storage technologies. However, despite its promise, AI's use in the energy sector is limited, with it primarily deployed in pilot projects for predictive asset maintenance. While it is useful there, a much greater opportunity exists for AI to help accelerate the global energy transition than is currently realized. The nine "AI for the energy transition" principles (see below) aim at creating a common understanding of what is needed to unlock the potential of AI across the energy sector and how to safely and responsibly adopt AI to accelerate the energy transition. The principles are split into three areas: those that govern AI use, those that will help design AI to be fit for purpose, and those that enable AI's deployment and are aimed at helping to create collaborative industry and policy practices."
Source: World Economic Forum

such as algorithmic discrimination or use of AI for deliberate deception. Computer scientists must work with experts in the social sciences and law to assure that the pitfalls of AI are minimized."
Source: Brown University

MACHINE LEARNING



World first for AI and machine learning to treat COVID-19 patients worldwide

"The research was sparked by the pandemic and set out to build an AI tool to predict how much extra oxygen a COVID-19 patient may need in the first days of hospital care, using data from across four continents.
The technique, known as federated learning, used an algorithm to analyse chest x-rays and electronic health data from hospital patients with COVID-19 symptoms.
To maintain strict patient confidentiality, the patient data was fully anonymised and an algorithm was sent to each hospital so no data was shared or left its location.
Once the algorithm had 'learned' from the data, the analysis was brought together to build an AI tool which could predict the oxygen needs of hospital COVID-19 patients anywhere in the world."
Source: University of Cambridge

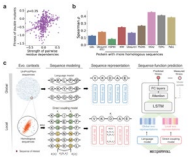
Is your ML training set biased? How to develop new drugs based on merged datasets

"Polymorphs are molecules that have different molecular packing arrangements despite identical chemical compositions. In a recent paper, researchers at GlaxoSmithKline (GSK) and the Cambridge Crystallographic Data Centre (CCDC) combined their proprietary (GSK) and published (CCDC) datasets to better train machine learning (ML) models to predict stable polymorphs to use in new drug candidates."
Source: EurekAlert!

New machine learning method to analyze complex scientific data of proteins

"Scientists have developed a method using machine learning to better analyze data from a powerful scientific tool: nuclear magnetic resonance (NMR). One way NMR data can be used is to understand reached a high correlation coefficient of 0.8 between predicted and experimental values."
Source: IOP Science

DEEP LEARNING



ECNet is an evolutionary context-integrated deep learning framework for protein engineering

"Machine learning has been increasingly used for protein engineering. However, because the general sequence contexts they capture are not specific to the protein being engineered, the accuracy of existing machine learning algorithms is rather limited. Here, we report ECNet (evolutionary context-integrated neural network), a deep-learning algorithm that exploits evolutionary contexts to predict functional fitness for protein engineering. This algorithm integrates local evolutionary context from homologous sequences that explicitly model residue-residue epistasis for the protein of interest with the global evolutionary context that encodes rich semantic and structural features from the enormous protein sequence universe. As such, it enables accurate mapping from sequence to function and provides generalization from low-order mutants to higher-order mutants. We show that ECNet predicts the sequence-function relationship more accurately as compared to existing machine learning algorithms by using ~50 deep mutational scanning and random mutagenesis datasets."
Source: Nature

Automatic segmentation tool for 3D digital rocks by deep learning

"Obtaining an accurate segmentation of images obtained by computed microtomography (micro-CT) techniques is a non-trivial process due to the wide range of noise types and artifacts present in these images. Current methodologies are often time-consuming, sensitive to noise and artifacts, and require skilled people to give accurate results. Motivated by the rapid advancement of deep learning-based segmentation techniques in recent years, we have developed a tool that aims to fully automate the segmentation process in one step, without the need for any extra image processing steps such as noise filtering or artifact removal. To get a general

proteins and chemical reactions in the human body. NMR is closely related to magnetic resonance imaging (MRI) for medical diagnosis.
NMR spectrometers allow scientists to characterize the structure of molecules, such as proteins, but it can take highly skilled human experts a significant amount of time to analyze that data. This new machine learning method can analyze the data much more quickly and just as accurately."
Source: Ohio State University

Argonne and Parallel Works Inc. win FLC recognition for commercializing lab's machine learning-based design optimization software technology

"Argonne National Laboratory and Parallel Works, Inc., a Chicago-based HPC software platform company, have won the Federal Laboratory Consortium's (FLC) Midwest Regional Award for Excellence in Technology Transfer for bringing Argonne's Machine Learning–Genetic Algorithm (ML-GA) design optimization software to commercialization.
The recognition marks the second major success for the pair. Argonne won an award of $750,000 three years ago from the DOE's Vehicle Technologies Office, within the Office of Energy Efficiency and Renewable Energy, through the Technology Commercialization Fund (TCF) program to integrate novel features into ML-GA and make it more efficient and portable. It streamlines the process of integrating the software with Parallel Works' commercial platform."
Source: Argonne National Laboratory

Working Smarter: Leveraging Machine Learning to Optimize CO2 Adsorption

"If we are to mitigate climate change, we must find cost-effective and sustainable ways to reduce industrial carbon dioxide (CO2) emissions. Unfortunately, most well-established methods for carbon capture and storage (CCS) in industrial post-combustion sources bear significant downsides, such as a high cost, environmental toxicity, or durability issues. Against this backdrop, many researchers have focused on what may be our best bet for next-generation CCS systems: CO2 adsorption using solid porous carbon materials.
One notorious advantage of using porous carbons for CO2 sequestration is that they can be produced from biomass waste, such as agricultural waste, food waste, animal waste, and forest debris."
Source: EurekAlert!

model, we train our network using a dataset made of high-quality three-dimensional micro-CT images from different scanners, rock types, and resolutions. In addition, we use a domain-specific augmented training pipeline with various types of noise, synthetic artifacts, and image transformation/distortion. For validation, we use a synthetic dataset to measure accuracy and analyze noise/artifact sensitivity. The results show a robust and accurate segmentation performance for the most common types of noises present in real micro-CT images."
Source: Nature Scientific Reports

Wide-Area Land Cover Mapping with Sentinel-1 Imagery using Deep Learning Semantic Segmentation Models

"Land cover (LC) mapping is essential for monitoring the environment and understanding the effects of human activities on it. Recent studies demonstrated successful applications of specific deep learning (DL) models to small-scale LC mapping tasks (e.g., wetland mapping). However, it is not readily clear which of the existing state-of-the-art models for natural images are the best candidates to be taken for the particular remote sensing task and data. In this study, we answer that question for mapping the fundamental LC classes using the satellite imaging radar data. We took ESA Sentinel-1 C-band SAR images acquired during the whole summer season of 2018 in Finland, which are representative of the land cover in the country. CORINE LC map was used as a reference, and the models were trained to distinguish between the 5 major CORINE based classes. We selected seven among the state-of-the-art semantic segmentation models so that they cover a diverse set of approaches: U-Net, DeepLabV3+, PSPNet, BiSeNet, SegNet, FC-DenseNet, and FRRN-B, and further fine-tuned them."
Source: IEEE Xplore

Deep learning for early warning signals of tipping points

"Many natural systems exhibit tipping points where slowly changing environmental conditions spark a sudden shift to a new and sometimes very different state. As the tipping point is approached, the dynamics of complex and varied systems simplify down to a limited number of possible "normal forms" that determine qualitative aspects of the new state that lies beyond the tipping point, such as whether it will oscillate or be stable. In several of those forms,

NEURAL NETWORK

Road Work Ahead: Using Deep Neural Networks to Estimate the Impacts of Work Zones

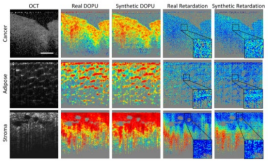
"The World Robotics report shows that Europe is the region with the highest robot density globally, with an average value of 114 units per 10,000 employees in the manufacturing industry. For more facts about robots watch IFR´s video news about Europe in one minute."
Source: National Institute for Transportation and Communities

SUSTAINABILITY

Artificial intelligence may be set to reveal climate-change tipping points

"Researchers are developing artificial intelligence that could assess climate change tipping points. The deep learning algorithm could act as an early warning system against runaway climate change.
Chris Bauch, a professor of applied mathematics at the University of Waterloo, is co-author of a recent research paper reporting results on the new deep-learning algorithm. The research looks at thresholds beyond which rapid or irreversible change happens in a system, Bauch said."
Source: University of Waterloo

BIOMEDICAL

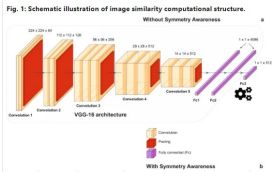


Deep learning enhances cancer diagnostic tools

"Yi "Edwin" Sun, a Ph.D. candidate in electrical and computer engineering at the University of Illinois Urbana-Champaign and member of the Beckman Institute's Biophotonics Imaging Laboratory headed by Stephen Boppart, explored how deep learning methods can make polarization-sensitive optical coherence tomography, or PS-OCT, more cost-effective and better equipped to diagnose cancer in biological tissues.

indicators like increasing lag-1 autocorrelation and variance provide generic early warning signals (EWS) of the tipping point by detecting how dynamics slow down near the transition. But they do not predict the nature of the new state. Here we develop a deep learning algorithm that provides EWS in systems it was not explicitly trained on, by exploiting information about normal forms and scaling behavior of dynamics near tipping points that are common to many dynamical systems. The algorithm provides EWS in 268 empirical and model time series from ecology, thermoacoustics, climatology, and epidemiology with much greater sensitivity and specificity than generic EWS."
Source: PNAS

NEURAL NETWORKS



Symmetry-aware recursive image similarity exploration for materials microscopy

"In pursuit of scientific discovery, vast collections of unstructured structural and functional images are acquired; however, only an infinitesimally small fraction of this data is rigorously analyzed, with an even smaller fraction ever being published. One method to accelerate scientific discovery is to extract more insight from costly scientific experiments already conducted. Unfortunately, data from scientific experiments tend only to be accessible by the originator who knows the experiments and directives. Moreover, there are no robust methods to search unstructured databases of images to deduce correlations and insight. Here, we develop a machine learning approach to create image similarity projections to search unstructured image databases. To improve these projections, we develop and train a model to include symmetry-aware features. As an exemplar, we use a set of 25,133 piezoresponse force microscopy images collected on diverse materials systems over five years. We demonstrate how this tool can be used for interactive recursive image searching and exploration, highlighting structural similarities at various length scales."
Source: Nature

Prediction of storage time in different seafood based on color values with artificial neural network modeling

The paper, titled "Synthetic polarization-sensitive optical coherence tomography by deep learning," was published in npj Digital Medicine."
Source: University Of Illinois Urbana-Champaign

Owkin and Cleveland Clinic develop artificial intelligence model that predicts liver cancer prognosis

"The findings showed the deep learning model trained on histopathology data predicted recurrence among transplant patients both in the whole cohort and in subgroups of patients treated with or without loco-regional therapy prior to transplantation. These results were comparable to a separate model that incorporated clinical, biological, and pathological data. Most significantly, combinations of both histological and clinical models outperformed scoring systems currently used in the literature. Taken together, this study demonstrates the prognostic power of deep learning applied to histology slides to predict recurrence of HCC patients following liver transplantation."
Source: EurekAlert!

Pioneering software can grow and treat virtual tumors using AI designed nanoparticles

"The EVONANO platform allows scientists to grow virtual tumors and use artificial intelligence to automatically optimize the design of nanoparticles to treat them. The ability to grow and treat virtual tumors is an important step towards developing new therapies for cancer. Importantly, scientists can use virtual tumors to optimize design of nanoparticle-based drugs before they are tested in the laboratory or patients."
Source: Science Daily

AI standards in biomedical research

"An international group of scientists, including the **ELIXIR Machine Learning Focus Group**, developed a set of guidelines for better reporting standards for AI methods aiming to classify biomedical data. Examples of such methods are machine learning predictors that try to identify, based on genetic and other data, whether someone suffers from a particular rare disease or predictive methods that aim to identify the drug to which a cancer patient would respond best. The recommendations were published in the renowned journal **Nature Methods**.."
Source: VRIJE UNIVERSITEIT BRUSSEL

"The determination of storage time in seafood could be performed by microbiological, chemical and sensory analysis. Among these mentioned methods color changes are one part of sensory analysis and are prior acceptance criteria from the point of consumers' view. In this study, a feedforward artificial neural network (ANN) model was developed to predict the storage time of seafood based on L*, a* and b* values. A total of 205 data set were compiled from the literature that represents the color changes of different seafood products to train and test the ANN model. Another set of data (n = 45) were used for the validation of developed ANN model. A multi-layer perceptron (MLP) was applied for the determination of agreements between input and output data. The most accurate topology were determined in accordance with the changes in the values of correlation coefficients (R2) and mean square errors (MSE) and found to be 30 neurons in the layer (R2 = 0.81 and MSE = 0.2)."
Source: Springer Link

Study on Aberration Correction of Adaptive Optics Based on Convolutional Neural Network

"The existence of aberrations has always been an important limiting factor in the imaging field. Especially in optical microscopy imaging, the accumulated aberration of the optical system and the biological samples distorts the wavefront on the focal plane, thereby reducing the imaging resolution. Here, we propose an adaptive optical aberration correction method based on convolutional neural network. By establishing the relationship between the Zernike polynomial and the distorted wavefront, with the help of the fast calculation advantage of an artificial intelligence neural network, the distorted wavefront information can be output in a short time for the reconstruction of the wavefront to achieve the purpose of improving imaging resolution. Experimental results show that this method can effectively compensate the aberrations introduced by the system, agarose and HeLa cells. After correcting, the point spread function restored the doughnut-shape, and the resolution of the HeLa cell image increased about 20%."
Source: MDPI

Phase retrieval based on difference map and deep neural networks

"Phase retrieval occurs in many research areas. There are some classical phase retrieval methods such as hybrid input-output (HIO) and

Training enormous AI models in health care while protecting data privacy

"Researchers at Duke University and the University of Pittsburgh have developed a platform that allows multiple hospitals and research centers to share private patient data securely to better train machine learning models. The technology could provide single institutions access to advanced predictive tools they could never develop on their own to both advance research and improve patient outcomes.

Called "LEARNER," researchers summarized the platform's development at the National Science Foundation's Convergence Accelerator Expo 2021, an event that shares the program's research portfolio in an exhibition format, like a big science fair."

Source: Duke University

BIOMIMICRY

Taking lessons from a sea slug, study points to better hardware for artificial intelligence

"For artificial intelligence to get any smarter, it needs first to be as intelligent as one of the simplest creatures in the animal kingdom: the sea slug.

A new study has found that a material can mimic the sea slug's most essential intelligence features. The discovery is a step toward building hardware that could help make AI more efficient and reliable for technology ranging from self-driving cars and surgical robots to social media algorithms.

The study, publishing this week in the Proceedings of the National Academy of Sciences, was conducted by a team of researchers from Purdue University, Rutgers University, the University of Georgia and Argonne National Laboratory."

Source: Purdue University

Scientists create artificial cells that mimic living cells' ability to capture, process, and expel material

"Researchers have developed artificial cell-like structures using inorganic matter that autonomously ingest, process, and push out material—recreating an essential function of living cells.

Their article, published in Nature, provides a blueprint for creating "cell mimics," with potential applications

difference map (DM). However, phase retrieval results are sensitive to noise, and the reconstructed images always include artefacts. In this paper, we use the DM algorithm together with DNN to get better phase retrieval results. We train one deep neural network using amplitude images and phase images, respectively. First, using DM, we get initial reconstructed amplitude and phase results. Then, using DNN improves both amplitude and phase results. Finally, using the DM algorithm again improves the DNN results further. The numerical experimental results show that using DM gives better results than HIO and using DNN improves phase information better than just using DNN to train for amplitude information alone. Compared with only using DNN improves amplitude methods, our method using DM plus DNN plus DM yields a better reconstruction performance for both amplitude and phase."

Source: Taylor & Francis

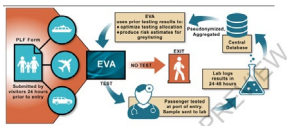
Active Learning for Efficient Segmentation of Liver with Convolutional Neural Network–Corrected Labeling in Magnetic Resonance Imaging–Derived Proton Density Fat Fraction

"This study aimed to propose an efficient method for self-automated segmentation of the liver using magnetic resonance imaging–derived proton density fat fraction (MRI-PDFF) through deep active learning. We developed an active learning framework for liver segmentation using labeled and unlabeled data in MRI-PDFF. A total of 77 liver samples on MRI-PDFF were obtained from patients with nonalcoholic fatty liver disease. For the training, tuning, and testing of the liver segmentation, the ground truth of 71 (internal) and 6 (external) MRI-PDFF scans for training and testing were verified by an expert reviewer. For 100 randomly selected slices, manual and deep learning (DL) segmentations for visual assessments were classified, ranging from very accurate to mostly accurate. The dice similarity coefficients for each step were 0.69 ± 0.21, 0.85 ± 0.12, and 0.94 ± 0.01, respectively (p-value = 0.1389 between the first step and the second step or p-value = 0.0144 between the first step and the third step for paired t-test), indicating that active learning provides superior performance compared with non-active learning. The biases in the Bland-Altman plots for each step were − 24.22% (from − 82.76 to − 2.70),

ranging from drug delivery to environmental science.
A fundamental function of living cells is their ability to harvest energy from the environment to pump molecules in and out of their systems. When energy is used to move these molecules from areas of lower concentration to areas of higher concentration, the process is called active transport. Active transport allows cells to take in necessary molecules like glucose or amino acids, store energy, and extract waste."
Source: New York University

− 21.29% (from − 59.52 to 3.06), and − 0.67% (from − 10.43 to 4.06)."
Source: Springer Link

REINFORCEMENT LEARNING



Efficient and targeted COVID-19 border testing via reinforcement learning

"Throughout the COVID-19 pandemic, countries relied on a variety of ad-hoc border control protocols to allow for non-essential travel while safeguarding public health: from quarantining all travellers to restricting entry from select nations based on population-level epidemiological metrics such as cases, deaths or testing positivity rates1,2. Here we report the design and performance of a reinforcement learning system, nicknamed 'Eva'. In the summer of 2020, Eva was deployed across all Greek borders to limit the influx of asymptomatic travellers infected with SARS-CoV-2, and to inform border policies through real-time estimates of COVID-19 prevalence. In contrast to country-wide protocols, Eva allocated Greece's limited testing resources based upon incoming travellers' demographic information and testing results from previous travellers. By comparing Eva's performance against modelled counterfactual scenarios, we show that Eva identified 1.85 times as many asymptomatic, infected travellers as random surveillance testing, with up to 2-4 times as many during peak travel, and 1.25-1.45 times as many asymptomatic, infected travellers as testing policies that only utilize epidemiological metrics."
Source: Nature

Framework for Mitigation of Welding Induced Distortion Through Response Surface Method and Reinforcement Learning

"Welding induced distortion causes dimensional inaccuracies in parts being produced and assembly fit-up problems during manufacturing. In this study, a framework is proposed to mitigate weld distortion at the design stage. A sequential approach is adopted to optimize the welding process. In the first phase, welding process parameters are optimized through the response surface method. The effect of these parameters on the overall distortion of the welded part is observed by a simulation of the welding process. In the second phase, the weld

sequence is optimized using the optimum weld parameters. A reinforcement learning-based Q-learning technique is used to select the optimum welding path by sequential observation of weld distortion at each segment being welded. The optimum process parameters and weld path sequence have been selected for 3 mm steel plates having a lap joint configuration and a 2 mm vent panel with a butt joint configuration. It is concluded that the combination of the optimum welding parameters and welding sequence yields minimum distortion. By applying this framework, a reduction of 19% is observed in overall welding induced distortion."
Source: MDPI

How Helpful is Inverse Reinforcement Learning for Table-to-Text Generation?

"Existing approaches for the Table-to-Text task suffer from issues such as missing information, hallucination and repetition. Many approaches to this problem use Reinforcement Learning (RL), which maximizes a single manually defined reward, such as BLEU. In this work, we instead pose the Table-to-Text task as Inverse Reinforcement Learning (IRL) problem. We explore using multiple interpretable unsupervised reward components that are combined linearly to form a composite reward function. The composite reward function and the description generator are learned jointly. We find that IRL outperforms strong RL baselines marginally. We further study the generalization of learned IRL rewards in scenarios involving domain adaptation. Our experiments reveal significant challenges in using IRL for this task."
Source: ACL Anthology

A Reinforcement Learning Framework for Multi-source Adaptive Streaming

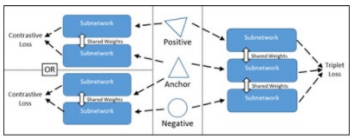
"Dynamic adaptive streaming over HTTP (DASH) is widely used in video streaming recently. With DASH, a video is stored in multiple equal-playing-time chunks with different quality levels. Video chunks are in-order delivered from a single source over a path in traditional DASH. The adaptation function in video player chooses a suitable quality level to request depending on current network status for each video chunk. In modern networks such as content delivery networks, edge caching, content-centric networks, etc., popular video contents are replicated at multiple cache nodes. Utilizing multiple sources for video streaming is investigated in this paper. We propose a reinforcement learning

based algorithm, called RAMS, for rate adaptation in multi-source video streaming. The proposed algorithm outperforms the other notable adaptation methods."
Source: Springer Link

Reinforcement Learning for Optimizing Wi-Fi Access Channel Selection

"Wi-Fi's success is largely a testament to its cost-effectiveness, convenience, and ease of integration with other networks. Wi-Fi allows a suddenly increased number of users to access network services within their networking environment from any convenient location. However, wireless networks have a frequent issue of losing packets caused by poor Wi-Fi signal, network interference, and long-distance connection. This study primarily analyses the mentioned Wi-Fi issues and demonstrates the solution to maintain a reliable network connection within an area including multiple access points and devices by using Reinforcement Learning (RL). The RL algorithm is developed to recommend appropriate channels for the access points in a wireless network environment. The case study of Wi-Fi access data at a university is examined to evaluate the proposed method. Experimental results have shown that the RL-based Wi-Fi access channel selection can achieve higher performance than manual channel selection."
Source: Springer Link

BIOMEDICAL



Machine learning techniques demonstrating individual movement patterns of the vertebral column: the fingerprint of spinal motion

"Surface topography systems enable the capture of spinal dynamic movement; however, it is unclear whether vertebral dynamics are unique enough to identify individuals. Therefore, in this study, we investigated whether the identification of individuals is possible based on dynamic spinal data. Three different data representations were compared (automated extracted features using contrastive loss and triplet loss functions, as well as simple descriptive statistics). High accuracies indicated the possible existence of a personal spinal 'fingerprint', therefore enabling subject recognition. The present work forms the basis for an

objective comparison of subjects and the transfer of the method to clinical use cases."
Source: Taylor & Francis

Artificial Intelligence in Mental Healthcare During COVID-19 Pandemic

"There is an emergence of several mental health issues in the community during this COVID-19 pandemic. Rising mental health concerns put mental health professionals under tremendous pressure. As mental health services are scarce worldwide and more so in the low- and middle-income countries, the mental health resources available will soon be depleted. During this mental health crisis, the use of technologies like artificial intelligence holds some promise. This chapter addresses the problems of mental health during this COVID-19 pandemic and the potential role of artificial intelligence in addressing mental health issues."
Source: Springer Link
