SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

9 October – 10 December 2021

TOPICAL REPORT

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

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DATA SCIENCE

Data Quality: How to Show the ROI for Projects

"While you're pushing ahead with innumerable projects that rely on data in your organization, give attention to the quality of that data. Whether the data is collected in an analytic database for fraud detection or in a data lake for four to five different projects, that data needs to meet a quality standard that makes it fit for purpose.

Data quality is an elusive subject that can defy measurement and yet be critical enough to derail any project. It's easy to have overly optimistic assumptions about data's efficacy. Having data quality as a focus is a business philosophy that aligns strategy, business culture, company information, and technology in order to manage data to the benefit of the enterprise. Put simply, it is a component of competitive strategy.

Even so, many are asked to quantify the addition of data quality work and software to projects."

Source: Information Week

Data Analytics Can Fix the Supply Chain. Eventually

"Can data, analytics, and artificial intelligence save the supply chain? It's a question that corporate boards may be asking their CIOs. After all, technology came to the rescue helping many organizations address

DATA SCIENCE

Small Steps with Big Data: Using Machine Learning in Energy and Environmental Economics

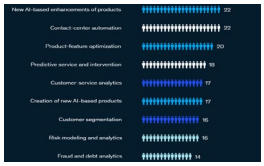
"This article reviews recent endeavors to incorporate big data and machine learning techniques into energy and environmental economics research. We find that novel datasets, from high frequency smart meter data to satellite images and social media data, are already used by researchers. At the same time most of the analyses rely on traditional econometric techniques. Nevertheless, we find applications of machine learning models that address the high dimensionality of the data and seek out new and better strategies for estimating heterogenous treatment effects. We provide an introduction to the main themes in machine learning, which are likely to be of use to economists in energy and environmental economics, and illustrate them using a real data example derived from an energy efficiency program evaluation. We provide the data and code in order to stimulate further research in this area."

Source: Annual Reviews

Big Data and Intelligent Decisions: Introduction to the Special Issue

"The World Robotics report shows that Europe is the region with the highest

ARTIFICIAL INTELLIGENCE



The state of AI in 2021

The results of our latest McKinsey Global Survey on AI indicate that AI adoption continues to grow and that the benefits remain significant—though in the COVID-19 pandemic's first year, they were felt more strongly on the cost-savings front than the top line. As AI's use in business becomes more common, the tools and best practices to make the most out of AI have also become more sophisticated.

We looked at the practices of the companies seeing the biggest earnings boost from AI and found that they are not only following more of both the core and advanced practices, including machine-learning operations (MLOps), that underpin success but also spending more efficiently on AI and taking more advantage of cloud technologies. Additionally, they are more likely than other organizations to engage in a range of activities to mitigate their AI-related risks—an area that continues to be a shortcoming for many companies' AI efforts."

Source: McKinsey & Company

'State of AI in the Enterprise' Fourth Edition: Becoming an AI-fueled Organization A Survey from the Deloitte AI Institute

"Key takeaways

the challenges brought by the COVID-19 pandemic such as remote work and online commerce.
But problems with the supply chain remain a lingering and painful reminder of how upside-down the world still is, even as office workers trickle back to their pre-COVID routines a few days a week. Ships continue to be stacked up off the coast of Los Angeles.
Restoring flow to the supply chain that has been clogged by unpredicted changes in supply, demand, production, and labor shortages will take time, according to experts. Investing in technology to gain visibility and transparency into the supply chain is one of a few steps that CIOs can recommend to the rest of the C-suite to gain ground against the current problems if they are impacting your enterprise, according to experts. On the flip side, companies that continue to fail to invest in supply chain technology may not survive. Technology investment is mandatory … but it's not enough to fix the current crisis."
Source: Information Week

Enabling Citizen Data Scientists to Reach Their Full Potential

"With data scientists regularly topping the charts as one of the most in-demand roles globally, many organizations are increasingly turning to non-traditional employees to help make sense of their most valuable asset: data.
These so-called citizen data scientists, typically self-taught specialists in any given field with a penchant for analysis, are likewise becoming champions for important projects with business-defining impact. They're often leading the charge when it comes to the global adoption of machine learning (ML) and artificial intelligence (AI), for example, and can arm senior leaders with the intelligence needed to navigate business disruption."
Source: Information Week

ARTIFICIAL INTELLIGENCE

How a complete AI architecture can transform business

"The use of Artificial Intelligence (AI) in modern enterprises now involves much more than gathering data to better program computers for various tasks. It is changing the playing field, making AI a crucial component to help businesses grow and innovate.

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 This special issue of Group Decision and Negotiation entitled "Big Data and Intelligent Decisions" focuses on theoretical and empirical investigations of big data and intelligent decision tools in group decision and negotiation processes. The aim is to present high-quality papers that report novel big data and intelligent group. decision and negotiation models in digital economies, innovation, business and management, social media and advertising, green low-carbon supply chain, tourism and transportation, and sustainable development. Following the peer-review process according to the aims and scope of Group Decision and Negotiation, nine papers are accepted for publication in this special issue. These papers address diferent topics of big data and intelligent decision methods involving large-scale group decision making (LGDM) and cooperative behavior."
Source: Springer Link

Special issue on the technologies and applications of big data

"Big data represents the collection of data characterized by volume, variety, velocity, value, veracity and variability. These characters make it difficult to apply traditional data processing techniques for insight extraction. Bid data serves as a source for confident decision making in industry and society at large. Thus, research in technologies relevant to big data receives increasing attention from not only academia and industry but also from practitioners and governments. The applications of big data technologies have far reaching implications in various industries such as agriculture, manufacturing, healthcare, transportation, education and so on. The aim of this special issue is to present high quality research articles from academia and industry on the recent advances in different aspects of big data technologies and applications. These articles have been selected after a rigorous review process. Weather forecasting finds its application."
Source: Springer Nature

Climate Change and big data analytics: Challenges and opportunities

"Scholars and practitioners have long acknowledged the impact of climate change on businesses, operations, and supply chains. Nevertheless,

- Survey respondents with an enterprise-wide AI strategy and leadership who communicate a bold vision are nearly 1.7 times more likely to achieve high outcomes.
- Organizations that document and enforce MLOps processes are twice as likely to achieve their AI goals. They're also nearly twice as likely to report being extremely prepared for risks associated with AI.
- Those that make significant investments in change management are 1.6 times more likely to report that AI initiatives exceed expectations and over 1.5 times more likely to achieve their desired goals.
- Organizations with more diverse ecosystems were 1.4 times more likely to use AI in a way that differentiates them from their competitors."

Source: Deloitte

Tech Trends 2022

"Engineer your tech-forward future
Deloitte's 13th annual Tech Trends report provides insights and inspiration to unlock innovation, build trust, and engineer advantage for your digital journey ahead. We invite you to explore the seven trends."
Source: Deloitte

Growth Opportunities In Electric Vehicles, Batteries, And Artificial Intelligence-Based Mobility Solutions

"The Mobility Technology Opportunity Engine (TOE) for November 2021 covers innovations related to electric vehicles, batteries, and artificial intelligence-based mobility solutions. Some of the innovations profiled include lithium battery manufacturing for electric vehicles, improved navigation systems using artificial intelligence (AI) and augmented reality (AR), deep learning cloud platform, sodium ion battery, and robotic trucks. The purpose of the Mobility Technology TOE is to raise awareness of global technology innovations in self-propelled ground-based mobile platforms that are not only technically significant, but potentially offering commercial value. Each monthly TOE provides subscribers valuable descriptions and analyses of 10 noteworthy innovations. The main focus is on highway-licensed motor vehicles (light, medium and heavy). Passenger cars, trucks, buses, motorcycles, scooters and railway locomotives are within the product scope, energized by any fuel. Many of the innovations

Incorporating an overarching AI architecture is crucial to take businesses to the next level. Having a robust AI architecture will continue to fuel massive digital transformation within companies and business sectors, especially when combined with other advanced technologies like natural language processing (NLP), automation, machine learning (ML) and more."
Source: World Economic Forum

What are the dangers of unregulated AI? An expert explains

"Artificial intelligence (AI) is often touted as the most exciting technology of our age, promising to transform our economies, lives, and capabilities. Some even see AI as making steady progress towards the development of 'intelligence machines' that will soon surpass human skills in most areas. AI has indeed made rapid advances over the last decade or so, especially owing to the application of modern statistical and machine learning techniques to huge unstructured data sets. It has already influenced almost all industries: AI algorithms are now used by all online platforms and in industries that range from manufacturing to health, finance, wholesale, and retail. Government agencies have also started relying on AI, particularly in the criminal justice system and in customs and immigration control."
Source: World Economic Forum

AI can see through you: CEOs' language under machine microscope

- "CEOs and other managers are increasingly under the microscope as some investors use artificial intelligence to learn and analyse their language patterns and tone, opening up a new frontier of opportunities to slip upNatural language processing (NLP) increasingly popular
- Investors seek edge in world of 'unstructured data'
- But CEOs are cottoning on, with more speech scripted."

Source: Reuters

AI, Automation Predictions for 2022: More Big Changes Ahead

"Just when you thought it was safe to go back to normal -- are you ready for round two?
"There are big changes ahead," says Forrester VP Brandon Purcell. "There are a lot of changes that have been brought about by what happened

there is still scant research on the role of Big Data and Analytics (BDA) in addressing these challenges but also opportunities created by Climate Change for operations and supply chains as they strive to become more sustainable. We address this gap in this opinion paper by identifying and discussing how these challenges and opportunities can be better pursued. We then propose thematic foci that future research on BDA and climate change could follow to facilitate the transition to a sustainable future."
Source: International Journal of Information Management

Toward a Reference Model for Artificial Intelligence Supporting Big Data Analysis

"This publication will introduce the reference model AI2VIS4BigData for the application domains Big Data analysis, AI, and visualization. Without a reference model, developing a software system and other scientific and industrial activities in this topic field lack a common specification and a common basis for discussion and thus pose a high risk of inefficiency, reinventing the wheel and solving problems that have already been solved elsewhere. To prevent these disadvantages, this publication systematically derives the reference model AI2VIS4BigData with special focus on use cases where Big Data analysis, artificial intelligence (AI), and visualization mutually support each other: AI-powered algorithms empower data scientists to analyze Big Data and thereby exploit its full potential. Big Data enables AI specialists to comfortably design, validate, and deploy AI models. In addition, AI's algorithms and methods offer the opportunity to make Big Data exploration more efficient for both, involved users and computing and storage resources."
Source: Springer Link

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI): Explaining, Querying, Demystifying

"Artificial intelligence (AI) is a buzzword today, reminding us of the concept of "globalization" and the relating debate two decades ago. As with globalization then, for the greater part of society, AI remains a concept poorly understood, vague, and approached with fear of the unknown. While AI is hailed as the

concern powertrains (internal combustion engines, turbines, battery electrics, fuel cell electrics, hybrid-electrics), as well as drivetrains (including transmissions), interiors--seating and displays, advanced materials--as for body/chassis, wireless connectivity, and self-driving technology that is currently receiving so much attention. The Mobility TOE outlines and evaluates each innovation, notes which organizations and developers are involved, projects the likely timing for commercialization, furnishes a patent analysis, and provides valuable strategic insights for industry stakeholders."
Source: Frost & Sullivan

over the last 2 years. The pace of change is very rapid. There are pretty big things happening."
Purcell spoke with InformationWeek about the predictions for AI in 2022 and beyond."
Source: Information Week

Explaining And Analyzing AI Decisions

""Artificial intelligence is helpful in making decisions, but because of the complexity of the process, it isn't quite transparent," he said. "This is a serious concern in domains where decisions have important consequences. We must provide good explanations for why decisions are made, pinpoint the root cause of any incorrect decisions and suggest changes to correct them to maintain public trust and ensure that the systems are working as intended."
Lei's work has great potential to increase the use and ability of AI technology for future applications, said Hong Jiang, chair of the Computer Science and Engineering Department."
Source: University of Texas Arlington

Researchers use AI to optimize several flow battery properties simultaneously

"For researchers working on flow batteries, their chief concern involves finding target molecules that offer the ability to both store a lot of energy and remain stable for long periods of time.
To find the right flow battery molecules, researchers at the U.S. Department of Energy's (DOE) Argonne National Laboratory have turned to the power of artificial intelligence (AI) to search through a vast chemical space of over a million molecules. Discovering the right molecules requires optimizing between several different characteristics. "In these batteries, we know that a majority of the molecules that we need will have to satisfy multiple properties," said Argonne chemist Rajeev Assary. "By optimizing several properties simultaneously, we have a better shot of finding the best possible chemistry for our battery."
Source: Argonne National Laboratory

KTU researchers proposed a novel approach to contactless machine failure detection – sustainable and cost efficient

"The world's largest manufacturers lose 1 trillion dollars per year to machine failure. Many problems lie in the noisy factory environment – working equipment and processes produce high sound, consequently, machinery faults are often unheard or for that reason detected too late. panacea to all the ills of the prevailing socio-economic model and a source of unimaginable opportunities, it is also seen as a source of substantial risks and threats to safety, security, and the operation of the markets. The objective of this chapter is to explain, query and demystify AI and by so doing to highlight the areas and domains that are crucial for AI to develop and serve society at large. To this end, the "dry", i.e., quite technical, facets of AI are discussed, and a case for an AI ecosystem is made. Technology-related limitations of AI, as well as possibilities, are outlined briefly. An overview of AI's implications for the (global) economy and selected policies follows. The ethical concerns are discussed in the concluding section."
Source: Springer Link

Artificial Intelligence-Based Decision-Making Algorithms, Internet of Things Sensing Networks, and Deep Learning-Assisted Smart Process Management in Cyber-Physical Production Systems

"With growing evidence of deep learning-assisted smart process planning, there is an essential demand for comprehending whether cyber-physical production systems (CPPSs) are adequate in managing complexity and flexibility, configuring the smart factory. In this research, prior findings were cumulated indicating that the interoperability between Internet of Things-based real-time production logistics and cyber-physical process monitoring systems can decide upon the progression of operations advancing a system to the intended state in CPPSs. We carried out a quantitative literature review of ProQuest, Scopus, and the Web of Science throughout March and August 2021, with search terms including "cyber-physical production systems", "cyber-physical manufacturing systems", "smart process manufacturing", "smart industrial manufacturing processes", "networked manufacturing systems", "industrial cyber-physical systems," "smart industrial production processes", and "sustainable Internet of Things-based manufacturing systems". As we analyzed research published between 2017 and 2021, only 489 papers met the eligibility criteria. By removing controversial or unclear findings (scanty/unimportant data), results unsupported by replication, undetailed content, or papers having quite similar titles, we decided on 164, chiefly empirical, sources. Subsequent analyses should develop on real-time sensor networks, so as to configure the importance of

Researchers from the Kaunas University of Technology (KTU), Lithuania have proposed an artificial intelligence-based method for different mechanical failures detection in a noisy environment. The new solution is not only sustainable – equipment can be easily digitalised, without remodelling it – but also relatively low cost."
Source: Kaunas University of Technology

Turbo boost for materials research: researchers train AI to predict new compounds

"A new algorithm has been designed to help discover previously unknown material compounds. It was developed by a team from Martin Luther University Halle-Wittenberg (MLU), Friedrich Schiller University Jena and Lund University in Sweden. The researchers designed a form of artificial intelligence (AI) based on machine learning that can perform complex calculations within a very short space of time. This has enabled the team to identify several thousand potential new compounds using a computer."
Source: Martin Luther University Halle-Wittenberg

Maths researchers hail breakthrough in applications of artificial intelligence

"For the first time, computer scientists and mathematicians have used artificial intelligence to help prove or suggest new mathematical theorems in the complex fields of knot theory and representation theory. The astonishing results have been published today in the pre-eminent scientific journal, Nature.
Professor Geordie Williamson is Director of the University of Sydney Mathematical Research Institute and one of the world's foremost mathematicians. As a co-author of the paper, he applied the power of Deep Mind's AI processes to explore conjectures in his field of speciality, representation theory."
Source: Phys Org

AI TECHNOLOGY

DeepMReye: an AI that reads your eyes

"You may think that they're random movements, but they're not: The way you use your eyes when perceiving the world around you reveals something significant about you and how you engage with the world. It can even be a diagnostic of brain disease. A new tool developed at the artificial intelligence-driven big data analytics by use of cyber-physical production networks."
Source: MDPI

Artificial Intelligence in Materials Modeling and Design

"In recent decades, the use of artificial intelligence (AI) techniques in the field of materials modeling has received significant attention owing to their excellent ability to analyze a vast amount of data and reveal correlations between several complex interrelated phenomena. In this review paper, we summarize recent advances in the applications of AI techniques for numerical modeling of different types of materials. AI techniques such as machine learning and deep learning show great advantages and potential for predicting important mechanical properties of materials and reveal how changes in certain principal parameters affect the overall behavior of engineering materials. Furthermore, in this review, we show that the application of AI techniques can significantly help to improve the design and optimize the properties of future advanced engineering materials. Finally, a perspective on the challenges and prospects of the applications of AI techniques for material modeling is presented."
Source: Springer Link

Modeling ultrasonic welding of polymers using an optimized artificial intelligence model using a gradient-based optimizer

"In this study, a new hybrid artificial intelligence approach is proposed to model the ultrasonic welding of a polymeric material blend. The proposed approach is composed of an ensemble random vector functional link model (ERVFL) integrated with a gradient-based optimizer (GBO). First, welding experiments were conducted on acrylonitrile butadiene styrene (ABS) and polycarbonate (PC) blends produced by the injection molding method. The experiments were designed according to the L27 orthogonal array considering three process factors (applied pressure, welding time, and vibration amplitude) and two responses (average temperature and joint strength). Then, the obtained experimental data were used to train the developed model. To verify the accuracy of the model, it was compared with standalone ERVFL in addition to two fine-tuned ERVFL models (ERVFL-SCA and ERVFL-MRFO) in which ERVFL is incorporated with

Kavli Institute for Systems Neuroscience, described in an article in Nature Neuroscience, predicts gaze direction and eye movement directly from magnetic resonance imaging (MRI) scans. The goal is to make eye tracking diagnostics a standard in brain imaging research and hospital clinics."
Source: Norwegian SciTech News

Artificial intelligence has helped scientists to create the 'ultimate' chickpea

"Using artificial intelligence, researchers have developed a genetic model for the "ultimate" chickpea, with the potential to lift crop yields by up to 12%.
Researchers genetically mapped thousands of chickpea varieties, and then used this information to identify the most valuable gene combinations using artificial intelligence (AI).
Researchers wanted to to develop a "haplotype" genomic prediction crop breeding strategy, for enhanced performance for seed weight.
"Most crop species only have a few varieties sequenced, so it was a massive undertaking by the international team to analyze more than 3,000 cultivated and wild varieties," says Ben Hayes, professor at the University of Queensland."
Source: World Economic Forum

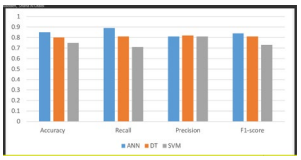
Development of an artificial intelligence model based on a novel concept with excellent performance for detecting and analyzing objects in various images

"The team of Prof. Jae Youn Hwang at the Department of Information & Communication Engineering, DGIST has developed an artificial intelligence neural network module for object segmentation in images within different domains, using deep learning technology. The findings of this research are expected to make a positive contribution to the development of remote sensing and medical imaging technologies
In line with the recent trend in remarkable advancement and performance improvement in deep learning, which is a subfield of artificial intelligence, there has been active research and applications in this field. In particular, there has been an increasing demand for industrial applications, and areal images of a wide range of areas have been acquired."
Source: Daegu Gyeongbuk Institute of Science and Technology

AI SYSTEMS

sine cosine algorithm (SCA) or Manta ray foraging optimization (MRFO)."
Source: Springer Link

MACHINE LEARNING

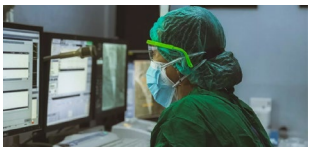


A new ML-based approach to enhance student engagement in online environment

"The educational research is increasingly emphasizing the potential of student engagement and its impact on performance, retention and persistence. This construct has emerged as an important paradigm in the higher education field for many decades. However, evaluating and predicting the student's engagement level in an online environment remains a challenge. The purpose of this study is to suggest an intelligent predictive system that predicts the student's engagement level and then provides the students with feedback to enhance their motivation and dedication. Three categories of students are defined depending on their engagement level (Not Engaged, Passively Engaged, and Actively Engaged). We applied three different machine-learning algorithms, namely Decision Tree, Support Vector Machine and Artificial Neural Network, to students' activities recorded in Learning Management System reports."
Source: Plos One

Advancing mathematics by guiding human intuition with AI

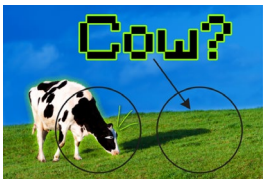
"The practice of mathematics involves discovering patterns and using these to formulate and prove conjectures, resulting in theorems. Since the 1960s, mathematicians have used computers to assist in the discovery of patterns and formulation of conjectures1, most famously in the Birch and Swinnerton-Dyer conjecture2, a Millennium Prize Problem3. Here we provide examples of new fundamental results in pure mathematics that have been discovered with the assistance of machine learning—demonstrating a method by which machine learning can aid mathematicians in discovering new conjectures and theorems. We propose a process of using machine learning to discover potential patterns and relations between mathematical objects, understanding them with attribution techniques and using these observations to guide intuition and propose conjectures. We outline this machine-learning-guided framework



Artificial intelligence - good or bad for public health?

"AI was used by researchers to detect breast cancer and it outperformed human specialists.
In research settings, AI systems tend to work well, however it is not uncommon for them to struggle in real-world settings.
Machine learning and deep learning are becoming a big part of healthcare systems, which shows the need for trust in science and evidence that it works."
Source: World Economic Forum

MACHINE LEARNING



Avoiding shortcut solutions in artificial intelligence

"In machine learning, a shortcut solution occurs when the model relies on a simple characteristic of a dataset to make a decision, rather than learning the true essence of the data, which can lead to inaccurate predictions. For example, a model might learn to identify images of cows by focusing on the green grass that appears in the photos, rather than the more complex shapes and patterns of the cows.
A new study by researchers at MIT explores the problem of shortcuts in a popular machine-learning method and proposes a solution that can prevent shortcuts by forcing the model to use more data in its decision-making."
Source: MIT

Machine learning a useful tool for quantum control, finds new study

"Researchers in Japan and Australia have shown, for the first time, that machine learning can produce accurate control of a particle within a complex quantum system.
Controlling quantum systems is essential for use in quantum technologies like powerful quantum computers and healthcare imaging."
Source: Okinawa Institute of Science and Technology

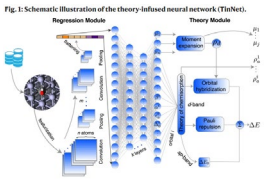
Artificial intelligence that understands object relationships

"A new machine-learning model could enable robots to understand and demonstrate its successful application to current research questions in distinct areas of pure mathematics, in each case showing how it led to meaningful mathematical contributions on important open problems: a new connection between the algebraic and geometric structure of knots, and a candidate algorithm predicted by the combinatorial invariance conjecture for symmetric groups."
Source: Nature

A survey of visual analytics techniques for machine learning

"Visual analytics for machine learning has recently evolved as one of the most exciting areas in the field of visualization. To better identify which research topics are promising and to learn how to apply relevant techniques in visual analytics, we systematically review 259 papers published in the last ten years together with representative works before 2010. We build a taxonomy, which includes three first-level categories: techniques before model building, techniques during modeling building, and techniques after model building. Each category is further characterized by representative analysis tasks, and each task is exemplified by a set of recent influential works. We also discuss and highlight research challenges and promising potential future research opportunities useful for visual analytics researchers."
Source: Springer Link

DEEP LEARNING



Infusing theory into deep learning for interpretable reactivity prediction

"Despite recent advances of data acquisition and algorithms development, machine learning (ML) faces tremendous challenges to being adopted in practical catalyst design, largely due to its limited generalizability and poor explainability. Herein, we develop a theory-infused neural network (TinNet) approach that integrates deep learning algorithms with the well-established d-band theory of chemisorption for reactivity prediction of transition-metal surfaces. With simple adsorbates (e.g., *OH, *O, and *N) at active site ensembles as representative descriptor species, we demonstrate that the TinNet is on par with purely

interactions in the world in the way humans do. In an effort to solve this problem, MIT researchers have developed a model that understands the underlying relationships between objects in a scene. Their model represents individual relationships one at a time, then combines these representations to describe the overall scene. This enables the model to generate more accurate images from text descriptions, even when the scene includes several objects that are arranged in different relationships with one another."
Source: MIT

DEEP LEARNING

Deep learning helps predict traffic crashes before they happen

"Today's world is one big maze, connected by layers of concrete asphalt that afford us the luxury of navigation by vehicle. For much of our road-related advancements - GPS lets us fire fewer neurons thanks to map apps, cameras alert us to potentially costly scrapes and scratches, and electric autonomous cars have lower fuel costs - our safety measures haven't quite caught up. We still rely on a steady diet of traffic signals, trust, and the steel surrounding us to safely get from point A to point B."
Source: MIT Computer Science & Artificial Intelligence Lab

FUTURE OF WORK

6 positive AI visions for the future of work

"Current trends in AI are nothing if not remarkable. Day after day, we hear stories about systems and machines taking on tasks that, until very recently, we saw as the exclusive and permanent preserve of humankind: making medical diagnoses, drafting legal documents, designing buildings, and even composing music.
Our concern here, though, is with something even more striking: the prospect of high-level machine intelligence systems that outperform human beings at essentially every task. This is not science fiction. In a recent survey the median estimate among leading computer scientists reported a 50% chance that this data-driven ML methods in prediction performance while being inherently interpretable."
Source: Nature

Securing Critical Infrastructures: Deep-Learning-Based Threat Detection in IIoT

"The Industrial Internet of Things (IIoT) is a physical information system developed based on traditional industrial control networks. As one of the most critical infrastructure systems, IIoT is also a preferred target for adversaries engaged in advanced persistent threats (APTs). To address this issue, we explore a deep-learning-based proactive APT detection scheme in IIoT. In this scheme, considering the characteristics of long attack sequences and long-term continuous APT attacks, our solution adopts a well-known deep learning model, bidirectional encoder representations from transformers (BERT), to detect APT attack sequences. The APT attack sequence is also optimized to ensure the model's long-term sequence judgment effectiveness. The experimental results not only show that the proposed deep learning method has feasibility and effectiveness for APT detection, but also certify that the BERT model has better accuracy and a lower false alarm rate when detecting APT attack sequences than other time series models."
Source: IEEE Xplore

Classification of Fermi-LAT sources with deep learning using energy and time spectra

"Despite the growing number of gamma-ray sources detected by the Fermi-Large Area Telescope (LAT), about one-third of the sources in each survey remains of uncertain type. We present a new deep neural network approach for the classification of unidentified or unassociated gamma-ray sources in the last release of the Fermi-LAT catalogue (4FGL-DR2) obtained with 10 yr of data. In contrast to previous work, our method directly uses the measurements of the photon energy spectrum and time series as input for the classification, instead of specific, human-crafted features. Dense neural networks, and for the first time in the context of gamma-ray source classification recurrent neural networks, are studied in depth. We focus on the separation between extragalactic sources, i.e. active galactic nuclei, and Galactic pulsars, and on the further classification of pulsars into young and millisecond pulsars. Our neural network architectures provide powerful classifiers, with a performance that is comparable to previous analyses

technology would arrive within 45 years."
Source: World Economic Forum

Can artificial intelligence help close gender gaps at work?

"Is it because she is a mother? Or perhaps she is perceived as lacking ambition, or leadership qualities?
Gender stereotypes continue to hold women back at work, but a handful of tech firms say they have developed artificial intelligence (AI) systems that can help break biases in hiring and promotion to give female candidates a fairer chance.
Employers and the wider economy could stand to gain, too."
Source: World Economic Forum

AI AND SOCIAL ISSUES

Racial bias in AI is a big problem. This activist explains why

"As concerns grow over racial bias in artificial intelligence, Black Lives Matter (BLM) co-founder Ayo Tometi urged the tech sector to act fast against perpetuating racism in systems such as facial recognition.
Artificial intelligence is transforming the world and can be applied in diverse sectors, from improving the early detection of diseases to sorting out data and solving complex problems, but there are also concerns around it.
"A lot of the algorithms, a lot of the data is racist," U.S. activist Tometi, who co-founded BLM in 2013, told Reuters on the sidelines of Lisbon's Web Summit.
"We need tech to truly understand every way it (racism) shows up in the technologies they are developing," she said."
Source: World Economic Forum

AI AND EDUCATION

Should universities be worried about the increasing capabilities of AI?

"The dramatic rise of online learning during the COVID-19 pandemic has spotlit concerns about the role of technology in exam surveillance — and also in student cheating.
Some universities have reported more cheating during the pandemic, and such concerns are unfolding in a

based on human-crafted features. Our benchmark neural network predicts that of the sources of uncertain type in the 4FGL-DR2 catalogue, 1050 are active galactic nuclei and 78 are Galactic pulsars, with both classes following the expected sky distribution and the clustering in the variability–curvature plane."
Source: Oxford Academic

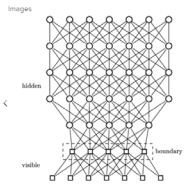
Development of microseismic monitoring system using deep learning P- and S-waves picker in geothermal fields

"Microseismic monitoring in geothermal fields is a fundamental tool to estimate the extent of geothermal reservoirs, geothermal activity, flow paths in real-time. However, precise hypocenter determinations, which are the first step of the subsequent microseismic analyses, are based on manual picking of P- and S-wave arrivals by human analysts. This manual process is time and cost consuming. In this study, we demonstrated an automatic picker that was specified to microseismic events in geothermal fields. We developed an automatic picker based on deep learning with Okuaizu Geothermal Field (Japan) data. This deep learning model could read P- and S-wave arrivals with similar accuracy as manual reading by human analysts. Further, we applied this deep learning model to another geothermal field, Basel Geothermal Field (Switzerland). The deep learning model trained by the Okuaizu Geothermal Field data could provide P- and S- arrival times that can lead to qualitatively satisfiable hypocenter distributions for the Basel Geothermal Field data."
Source: SEG Library

A Mutual Security Authentication Method for RFID-PUF Circuit Based on Deep Learning

"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: ACM Digital Library

NEURAL NETWORKS

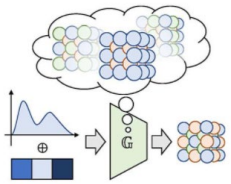


climate where technologies that allow for the automation of writing continue to improve.
Over the past two years, the ability of artificial intelligence to generate writing has leapt forward significantly, particularly with the development of what's known as the language generator GPT-3. With this, companies such as Google, Microsoft and NVIDIA can now produce "human-like" text.
AI-generated writing has raised the stakes of how universities and schools will gauge what constitutes academic misconduct, such as plagiarism."
Source: World Economic Forum

Computer scientist hailed for introducing AI concepts to K-12 students

"An accomplished group of K-12 teachers were recruited to the AI4K12 Initiative project to lead the development of progression charts that unpack and describe the big ideas in age-appropriate ways for students in kindergarten through second grade, third through fifth grade, sixth through eighth grade and for those in high school.
The team's most influential paper, Envisioning AI for K-12: What Should Every Child Know About AI?, has been cited more than 100 times since its publication in 2019, and the Five Big Ideas have guided the development of primary and secondary AI education initiatives around the world."
Source: EurekAlert!

DEEPFAKES



AI behind deepfakes may power materials design innovations, scientists say

"The scientists trained a generative adversarial network (GAN) to create novel refractory high-entropy alloys, materials that can withstand ultra-high temperatures while maintaining their strength and that are used in technology from turbine blades to rockets.
"There are a lot of rules about what makes an image of a human face or what makes an alloy, and it would be really difficult for you to know what all those rules are or to write them down by hand," Reinhart said. "The whole principle of this GAN is you have two neural networks that basically compete in order to learn what those rules are, and then generate examples that follow the rules."."

Entanglement-Induced Barren Plateaus

"We argue that an excess in entanglement between the visible and hidden units in a quantum neural network can hinder learning. In particular, we show that quantum neural networks that satisfy a volume law in the entanglement entropy will give rise to models that are not suitable for learning with high probability. Using arguments from quantum thermodynamics, we then show that this volume law is typical and that there exists a barren plateau in the optimization landscape due to entanglement. More precisely, we show that for any bounded objective function on the visible layers, the Lipshitz constants of the expectation value of that objective function will scale inversely with the dimension of the hidden subsystem with high probability. We show how this can cause both gradient-descent and gradient-free methods to fail."
Source: PRX Quantum

Hybrid artificial neural networks and analytical model for prediction of optical constants and bandgap energy of 3D nanonetwork silicon structures

"The aim of this study is to develop a reliable method to determine optical constants for 3D-nanonetwork Si thin films manufactured using a pulsed-laser ablation technique that can be applied to other materials synthesized by this technique. An analytical method was introduced to calculate optical constants from reflectance and transmittance spectra. Optical band gaps for this novel material and other important insights on the physical properties were derived from the optical constants. The existing optimization methods described in the literature were found to be complex and prone to errors while determining optical constants of opaque materials where only reflectance data is available. A supervised Deep Learning Algorithm was developed to accurately predict optical constants from the reflectance spectrum alone. The hybrid method introduced in this study was proved to be effective with an accuracy of 95%."
Source: Opto-Electro Advances

Designing an Aerofoil with a Fowler Flap Using Artificial Neural Networks

"The paper considers the problem of designing an aerofoil with a Fowler flap. The proposed approach is based on the use of artificial neural networks for rapid evaluation of aerodynamic characteristics. The

Source: Penn State University

SUSTAINABILITY

Artificial intelligence, the new frontier in climate change risks assessment

"Large amounts of data and new methods and technologies with which to analyze them. The new frontier of machine learning – a branch of artificial intelligence – at the service of climate studies, in research by the CMCC Foundation and Ca' Foscari University of Venice

Global warming is exacerbating weather and climate extreme events. The interaction between different forms of hazards triggered by climate change will cause future cross-sectoral impacts affecting a variety of natural and human systems.

Research can improve the understanding of these interactions and dynamics, in order to support decision makers in managing current and future climate change risks, also thanks to an improved ability to predict expected risks and quantify their impacts."

Source: Centro Euro-Mediterraneo sui Cambiamenti Climatici

BIOMEDICAL

AI-powered computer model predicts disease progression during aging

"Using artificial intelligence, a team of University at Buffalo researchers has developed a novel system that models the progression of chronic diseases as patients age.

Published in Oct. in the Journal of Pharmacokinetics and Pharmacodynamics, the model assesses metabolic and cardiovascular biomarkers – measurable biological processes such as cholesterol levels, body mass index, glucose and blood pressure – to calculate health status and disease risks across a patient's lifespan."

Source: University of Buffalo

Study shows how bias can creep into medical databanks that drive precision health and clinical AI

"Findings have already prompted improvements in how University of Michigan recruits new participants for its biobank. In the race to harness medical data for artificial intelligence

linear method of principal component analysis (PCA) is used to reduce the dimensionality of design parameter space and to generate ''random'' airfiols. The simulated annealing method is used to find the optimal shape of the airfoil and flap."

Source: Springer Link

Thin-film neural networks for optical inverse problem

"The thin-film optical inverse problem has attracted a great deal of attention in science and industry, and is widely applied to optical coatings. However, as the number of layers increases, the time it takes to extract the parameters of thin films drastically increases. Here, we introduce the idea of exploiting the structural similarity of all-optical neural networks and applied it to the optical inverse problem. We propose thin-film neural networks (TFNNs) to efficiently adjust all the parameters of multilayer thin films. To test the performance of TFNNs, we implemented a TFNN algorithm, and a reflectometer at normal incidence was built. Operating on multilayer thin films with 232 layers, it is shown that TFNNs can reduce the time consumed by parameter extraction, which barely increased with the number of layers compared with the conventional method."

Source: Light Advanced Manufacturing

A Method for Estimating the Entropy of Time Series Using Artificial Neural Networks

"Measuring the predictability and complexity of time series using entropy is essential tool designing and controlling a nonlinear system. However, the existing methods have some drawbacks related to the strong dependence of entropy on the parameters of the methods. To overcome these difficulties, this study proposes a new method for estimating the entropy of a time series using the LogNNet neural network model. The LogNNet reservoir matrix is filled with time series elements according to our algorithm. The accuracy of the classification of images from the MNIST-10 database is considered as the entropy measure and denoted by NNetEn. The novelty of entropy calculation is that the time series is involved in mixing the input information in the reservoir. Greater complexity in the time series leads to a higher classification accuracy and higher NNetEn values. We introduce a new time series characteristic called time series learning inertia that determines the learning rate of the neural network. The robustness and efficiency of the method is verified on chaotic, periodic, random, binary, and constant time series. The

tools and personalized health care, a new study shows how easily unintentional design bias can affect those effortsIt also points to specific ways to increase the chances that patients who are traditionally underrepresented in research can be included in the massive banks of genetic samples and data from digital medical records that underlie these efforts.

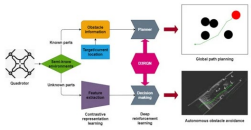
The study, in the December issue of Health Affairs, comes from a team at the University of Michigan and Michigan State University that studied U-M's efforts to build a large bank of data and samples for researchers to use."

Source: University of Michigan

comparison of NNetEn with other methods of entropy estimation demonstrates that our method is more robust and accurate and can be widely used in practice."

Source: MDPI

REINFORCEMENT LEARNING



Quadrotor Autonomous Navigation in Semi-Known Environments Based on Deep Reinforcement Learning

"In the application scenarios of quadrotors, it is expected that only part of the obstacles can be identified and located in advance. In order to make quadrotors fly safely in this situation, we present a deep reinforcement learning-based framework to realize autonomous navigation in semi-known environments. Specifically, the proposed framework utilizes the dueling double deep recurrent Q-learning, which can implement global path planning with the obstacle map as input. Moreover, the proposed framework combined with contrastive learning-based feature extraction can conduct real-time autonomous obstacle avoidance with monocular vision effectively. The experimental results demonstrate that our framework exhibits remarkable performance for both global path planning and autonomous obstacle avoidance."

Source: MDPI

Traffic engineering based on deep reinforcement learning in hybrid IP/SR network

"Segment Routing (SR) is a new routing paradigm based on source routing and provide traffic engineering (TE) capabilities in IP network. By extending interior gateway protocol(IGP), SR can be easily applied to IP network. However, upgrading current IP network to a full SR one can be costly and difficult. Hybrid IP/SR network will last for some time. Aiming at the low flexibility problem of static TE policies in the current SR networks, this paper proposes a Deep Reinforcement Learning (DRL) based TE scheme. The proposed scheme employs multi-path transmission and use DRL to dynamically adjust the traffic splitting ratio among different paths based on the network traffic distribution. As a result, the network congestion can be mitigated and the performance of the network is improved. Simulation results show that our proposed scheme can improve the throughput

of the network by up to 9% than existing schemes."
Source: IEEE Xplore

Optimizing Adaptive Notifications in Mobile Health Interventions Systems: Reinforcement Learning from a Data-driven Behavioral Simulator

"Mobile health (mHealth) intervention systems can employ adaptive strategies to interact with users. Instead of designing such complex strategies manually, reinforcement learning (RL) can be used to adaptively optimize intervention strategies concerning the user's context. In this paper, we focus on the issue of overwhelming interactions when learning a good adaptive strategy for the user in RL-based mHealth intervention agents. We present a data-driven approach integrating psychological insights and knowledge of historical data. It allows RL agents to optimize the strategy of delivering context-aware notifications from empirical data when counterfactual information (user responses when receiving notifications) is missing. Our approach also considers a constraint on the frequency of notifications, which reduces the interaction burden for users."
Source: Springer Link

Deep Reinforcement Learning for Trading—A Critical Survey

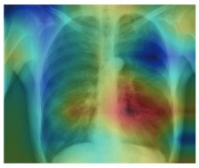
"Deep reinforcement learning (DRL) has achieved significant results in many machine learning (ML) benchmarks. In this short survey, we provide an overview of DRL applied to trading on financial markets with the purpose of unravelling common structures used in the trading community using DRL, as well as discovering common issues and limitations of such approaches. We include also a short corpus summarization using Google Scholar. Moreover, we discuss how one can use hierarchy for dividing the problem space, as well as using model-based RL to learn a world model of the trading environment which can be used for prediction. In addition, multiple risk measures are defined and discussed, which not only provide a way of quantifying the performance of various algorithms, but they can also act as (dense) reward-shaping mechanisms for the agent. We discuss in detail the various state representations used for financial markets, which we consider critical for the success and efficiency of such DRL agents. The market in focus for this survey is the cryptocurrency market; the results of

this survey are two-fold: firstly, to find the most promising directions for further research and secondly, to show how a lack of consistency in the community can significantly impede research and the development of DRL agents for trading."
Source: MDPI

Decentralized optimal large scale multi-player pursuit-evasion strategies: A mean field game approach with reinforcement learning

"In this paper, the intelligent design for the pursuit-evasion game with large scale multi-pursuer and multi-evader has been investigated. Due to the vast number of agents, the notorious "Curse of Dimensionality" can seriously challenge the traditional design in multi-player pursuit-evasion game, especially under harsh environment with limited communication resource to support information exchange among multi-players. To address this intractable challenge, the emerging Mean Field Games (MFG) theory has been utilized to solve the optimal pursuit-evasion strategies based on a new form of probability density function (PDF) instead of detailed information from all the other players/agents. As such, not only the information exchange is reduced, but also the computation dimension for the optimal strategy derivation is decreased. Specifically, the MFG has been integrated into the pursuit-evasion game to generate a hierarchical structure where the pursuers and the evaders form two mean field groups separately."
Source: Elsevier

HEALTHCARE



The false hope of current approaches to explainable artificial intelligence in health care

"The black-box nature of current artificial intelligence (AI) has caused some to question whether AI must be explainable to be used in high-stakes scenarios such as medicine. It has been argued that explainable AI will engender trust with the health-care workforce, provide transparency into the AI decision making process, and potentially mitigate various kinds of bias. In this Viewpoint, we argue that this argument represents a false hope for explainable AI and that current explainability methods are unlikely to

achieve these goals for patient-level decision support. We provide an overview of current explainability techniques and highlight how various failure cases can cause problems for decision making for individual patients. In the absence of suitable explainability methods, we advocate for rigorous internal and external validation of AI models as a more direct means of achieving the goals often associated with explainability, and we caution against having explainability be a requirement for clinically deployed models."
Source: Elsevier