Autumn/Winter 2023 | Issue 28

澳大新語 UMagazine

解讀數據 編織創新藍圖

WEAVING INNOVATION ROADMAPS WITH DATA

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編者的話
EDITOR'S WORDS

在大數據技術為全球各行各業帶來變革之際，澳門大學培養數據專才，深化跨學科研究，並且推動數據科學應用於日常生活和工作。我們引領讀者進入本期精彩內容，將封面專題放在澳大協同創新研究院數據科學中心與各學院的合作上，揭示它們如何推進數據科學在人工智能應用、市場營銷分析、金融科技、數據戰略與合規管理、精準醫學、計算語言學、教學分析及智慧政務等八大領域的應用與創新。

在「專題探討」欄目，我們介紹澳大的澳門先進材料研發中心，探討其如何推進澳門新材料產業邁向綠色、低碳、精細及節約的未來，同時向讀者介紹四項環保科研項目，展示澳大在可持續發展領域的努力。

本期也專訪了兩位教授，分別是藝術與設計系主任李軍和英文系教授Nick Groom。李軍教授分享他對藝術史及文藝復興時期藝術作品的獨特見解，Nick Groom教授則暢談他的文學研究心路歷程。

在「學術研究」投稿欄目，澳大學者探討中國投資者在歐盟面臨的挑戰、機器人能否激勵人類，以及電子皮膚技術的潛在應用，這些研究突出了澳大學者在探索當今社會重要問題方面的努力。最後，我們帶領讀者了解何鴻燊東亞書院和霍英東珍禧書院學生的社會服務成果。

我們期待本期《澳大新語》為讀者帶來新的視野和啟發，一起探索知識的無限可能。

In an era where big data technologies transform global industries, the University of Macau (UM) has made strides in cultivating data professionals, fostering interdisciplinary research, and integrating data science into both personal and professional spheres. In this issue of *UMagazine*, we spotlight the collaboration between UM's Centre for Data Science and various faculties within the university, delving into their endeavours in artificial intelligence applications, marketing analytics, financial technology, data strategy and compliance, precision medicine, computational linguistics, analytics in teaching and learning, and smart governance.

In this issue's Topic Insight, our focus shifts to the Macao Centre for Research and Development in Advanced Materials at UM. We examine the centre's role in shaping a more environmentally conscious and efficient new materials industry in Macao. In addition, we highlight four research projects that illustrate the university's commitment to sustainable development.

We have also interviewed two professors, Prof Li Jun in the Department of Arts and Design, and Prof Nick Groom in the Department of English. Prof Li talks about the captivating realm of art history and the Renaissance, while Prof Groom shares his experience in literary research.

Within the pages of Academic Research, UM scholars unravel the challenges faced by Chinese investors in the EU, examine whether robots can inspire humans to do good deeds, and shed light on the potential applications of electronic skin technology. These studies not only showcase UM's commitment to scholarly pursuits but also underscore its efforts to address some of the most pressing issues of our time. Lastly, we introduce the social services provided by the students of Stanley Ho East Asia College and Henry Fok Pearl Jubilee College.

We believe this issue of *UMagazine* will provide fresh perspectives about timely social issues. Together, let us embark on a journey to explore UM's contribution to the pursuit of knowledge.

張惠琴 Katrina Cheong

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數據科學推動社會進步

Improving Society Through Data Science

文 / 葉浩男 · 圖 / 何杰平、編輯部
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在每次點讚、每筆買賣甚至每次心跳都可化為數據記錄下來的今天，澳門大學的專家和學生正在將數據化為實用見解，涵蓋人文、工商管理、教育、健康科學、法學、科技和社會科學等領域，觸及全校所有學院，不僅引發學術創新，也對澳門和其它地區的進步有所貢獻。

以數據規劃未來

「現在的時間與過去的時間，或許皆是未來的時間。」從詩人T·S·艾略特這句話，我們或可領略到數據的關鍵之處。它們不只是歷史的殘跡，也是解讀當下和規劃未來的要素。澳大協同創新研究院數據科學研究中心主任余亮豪教授指出：「科技進步使數據能不僅能反映事物和環境，也成為推動創新的重要力量。無論是數字、文字、圖像、聲音或影像，各類數據都促使我們取得了十年前難以想像的科技突破。」

余亮豪是電腦及資訊科學系副教授，研究專長包括大數據處理與強化學習。他表示，數據科學家不斷開發新方法來更有效地解讀數據，獲得新的洞見。「這個領域融合統計、數據分析、機器學習與計算機科學，可在我們日常生活與工作中廣泛應用。此外，機器學習與數據科學密不可分。機器學習主要是指電腦算法通過數據來學習，提升執行任務的效能，其進展也能反過來提高收集和分析數據的效率。」

新一代數據科學家

數據科學研究中心與澳大七所學院合辦理學碩士學位（數據科學）課程，是澳門首個跨學科大數據課程，自2019年8月推出起報讀人數逐年攀升。學生須從八個專業範疇中選擇其一，分別是人工智能應用、市場營銷分析、金融科技、數據戰略與合規管理、精準醫學、計算語言學、教學分析和智慧政務。

學生須修讀由澳大科技學院開設的四門基礎科目，學習數據科學編程、數據可視化、數據庫技術、機器學習工具的知識與技能，並且選修四門屬於其專業範疇、由相應學院開設的科目。他們亦會探討從數據使用與收集而衍生的私隱、安全和倫理問題，研究數據科學技術對社會各方面的影響。

余教授說：「每名學生畢業前要完成一個研究項目，融會數據科學技巧與專業範疇知識。畢業生可望在各行各業擔任數據工程師、分析師或科學家等。」

跨學科數據研究

除了促進教育，數據科學研究中心也是一個跨學科研究平台，有16名來自各學院的成員參與研究。其中，該中心聯合法律與資訊技術領域的專家，探究科技在私隱保護上的角色、發展相應的科技和提出政策建議。中心的學者還結合健康科學、科技和藥物方面的研究，開發針對罕見疾病和常見癌症的精準療法。

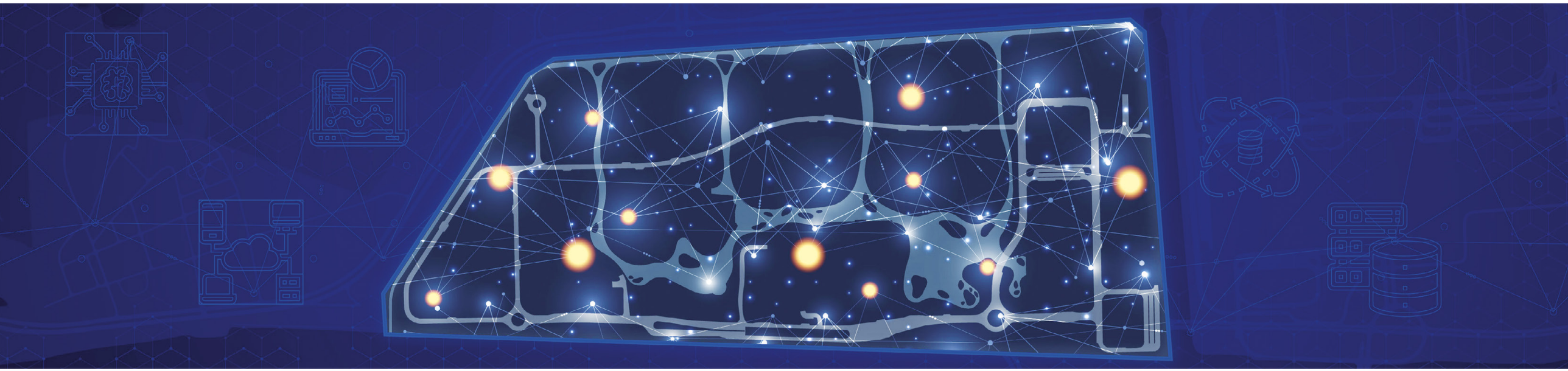
在澳門積極發展現代金融業之際，數據科學研究中心也扮演支持角色，透過數據分析和研究促進金融業發展，包括以大數據技術開創嶄新的應用、流程、產品和商業模式。該中心也協助澳大各學院在語言學、公共行政和數據合規等領域應用數據科學。余教授指出：「新冠疫情期間，我們中心的研究人員設計了澳門新冠疫情數據可視化系統，協助市民了解和應對疫情變化。」

在教育與研究以外，中心也促進跨學科對話與合作，例如曾舉辦關於跨境數據使用的圓桌會議和學生治理數據分析比賽。2023年9月，中心還主辦「第一屆澳門數據科學研討會」，匯聚大數據處理、市場營銷分析、精準醫學、智慧政務等多領域的專家。

解讀和改善社會

社會現象複雜多變，過去缺乏全面和系統的預測方法，但數據科學的進步正帶來轉變。社會科學學院副院長、社會學系主任蔡天驥教授是數據科學研究中心的成員，不斷開展計算社會科學研究：「我有兩個主要研究方向，首先是運用數據科學來解決社會問題，其次是將預測性分析融入社會科學研究。在數據能實時更新的今日，我們也可實時驗證社會現象預測的準確性。」

蔡教授說，數據與機器學習模型在提供及研究公共



服務上已不可或缺。例如，他在近年一項關於預測澳門固體廢物量增長的研究中，開發了多種機器學習模型，發現「廣義加性模型」的預測最為精確。「澳門固體廢物來源眾多，受家庭結構、遊客流量和建築業發展的影響，人均固體廢物量在世界前列，遠超香港、上海和新加坡等地。」

蔡教授進一步指出，澳門家庭結構的變化與少子化不僅會影響未來的廢物總量，亦會改變廢物種類的比例：「一些小家庭，特別是沒有子女的家庭，可能常常點外賣，而非在家裡煮飯，塑膠餐具用量因此增加。」他期望開發更全面的模型，預測廢物總量及各類廢物的數量，協助規劃廢物分類與處理設施。

探究傳播過程

數據科學也深化了我們對個人和群體溝通的認識。傳播系講座教授、數據科學研究中心成員趙心樹致力運用大數據分析方法探索傳播學議題。他說：「在網絡發達的今日，人們可獲得豐富和即時的資訊，但也更容易只接收到與自己觀點相符的資訊，這可能使大眾意見愈趨分歧。研究這些問題時必須借助大數據作精確分析。」

趙教授進一步說，在社交媒體環境中，資訊的發佈、接收和轉發都會形成「選擇螺旋」：「在我們研究的內地社交媒體平台，帖文發佈者在初期的『選擇螺旋』中較能主導螺旋的走向，但後來的螺旋會愈來受點讚、轉發及讀者的偏好影響，形成網絡輿論的『同音效應』。」

在近年一項研究中，趙教授等學者透過大數據技術收集和分析社交媒體帖文，了解標題長度對點讀率和點轉率的影響。研究發現，點讀群體偏好中等長度的標題，約28字為最佳；但點轉群體傾向更短的標題，最好不過20字。「這些發現有助我們理解內地網絡輿論，也為市場推廣提供參考。」

各行各業應用數據科學

數據科學不僅串聯過去、現在和未來，也能連接不同的人物和事物。余亮豪教授指出：「透過充分的跨學科合作，數據科學研究中心正在培養新一代數據科學家，並且廣泛開展跨學科研究，推動深度知識探索和建立預測機制與模型，引導數據科學在生活各層面的應用，提升新興科技產業發展，貢獻社會。」

澳大舉辦第一屆澳門數據科學研討會
UM hosts the 1st Macau Symposium on Data Science

In an era where every swipe, purchase, and heartbeat can be catalogued as data, the University of Macau (UM) is seizing this opportunity to transform data into actionable insights. Such efforts are evident across UM faculties, encompassing disciplines from the humanities to business, education, health sciences, law, social sciences and technology. By doing so, the university is not merely fuelling academic innovation but also contributing to social progress in Macao and beyond.

Planning the Future Through Data

'Time present and time past. Are both perhaps present in time future.' These words from poet T.S. Eliot encapsulate the essence of data. Far more than a historical artefact, data can serve as a lens through which we interpret the present and shape the future. Prof U Leong Hou Ryan, head of the Centre for Data Science (CDS) at UM's Institute of Collaborative Innovation (ICI), explains, 'Technological advancements allow data not only to represent our world, but also to act as a catalyst for innovation. Whether it is numerical, textual, visual, auditory, or video-based, data has enabled technological leaps that were not imaginable at all just a decade ago.'

Prof U, associate professor in the Department of Computer and Information Science who specialises in big data processing and reinforcement learning, says that data scientists are developing new techniques to extract insights from data. 'The field of data science is an amalgamation of statistics, data analytics, machine learning and computer science. It is widely used in our daily life and work,' he says. 'Moreover, data science and machine learning are closely related. The latter refers to the process in which algorithms learn primarily from data to enhance task performance. Therefore, advancements in machine learning have in turn improved our efficiency in data collection and analysis.'

The Next Generation of Data Scientists

In collaboration with seven UM faculties, CDS offers a Master of Science in Data Science programme—the first interdisciplinary programme in big data in Macao. The programme has attracted increasing numbers of applications since its launch in August 2019. Students in this programme are required to specialise in one of these eight areas: artificial intelligence applications, marketing analytics, financial technology, data strategy and

余亮豪教授
Prof U Leong Hou Ryan

compliance, precision medicine, computational linguistics, analytics in teaching and learning, and smart governance.

The programme has four fundamental courses. They are delivered by UM's Faculty of Science and Technology and equip students with skills in data science programming, data visualisation, database technology, and machine learning tools. In addition, students take four courses under their chosen specialisation offered by the related faculties. Throughout their studies, students may also explore the privacy, ethical, and safety issues arising from the collection and use of data, thereby delving into the broader impact of data science technologies on society.

Each student must complete a research project that integrates data science with their area of specialisation before they can graduate. Prof U says, 'Graduates are well-positioned to work as data engineers, analysts, and scientists in a variety of sectors.'

Interdisciplinary Data Research

Beyond educational initiatives, CDS also serves as a platform for interdisciplinary research. Currently, the centre has 16 members from various UM faculties who engage in a wide range of research activities. For example, CDS collaborates with experts in law and information technology to study the role of technology in privacy protection, thus developing related technologies and offering

policy recommendations. As an interdisciplinary platform, members also integrate research in health sciences, technology, and pharmacology to develop precision medicine solutions for rare diseases and common cancers.

As Macao develops a modern finance industry, CDS plays a supporting role by leveraging data analysis for the benefit of the industry. This includes using big data technologies to pioneer new applications, processes, products, and business models. Moreover, the centre has helped different UM faculties apply data science in fields such as linguistics, public administration, and data compliance. Prof U adds, 'During the COVID-19 pandemic, our research team developed a data visualisation system which helped the Macao public better understand and adapt to the changing situation.'

Aside from its contributions to education and research, CDS also fosters interdisciplinary discussion and collaboration. For example, it has hosted roundtable discussions on cross-border data usage and organised data analysis competitions. Additionally, in September 2023, the centre hosted the 1st Macau Symposium on Data Science, which gathered experts from diverse fields including big data processing, market analytics, precision medicine, and smart governance. These initiatives have reinforced its role as a platform for interdisciplinary innovation and scholarly exchange.

Deciphering and Improving Society

Given the complexity of social phenomena, it is difficult to make comprehensive and systematic predictions about the future development of society. However, the rise of data science is changing this landscape. Prof Cai Tianji, associate dean in the Faculty of Social Sciences and head of the Department of Sociology, is a member of CDS. He is dedicated to research in computational social science. Prof Cai explains, 'My research is twofold. First, I use data science to tackle social issues. Second, I integrate predictive analytics into social science research. With the availability of real-time data updates, we can now also verify the accuracy of predictions about social phenomena in real time.'

Prof Cai elaborates that data and machine learning models have become crucial in both the provision and study of public services. For example, in a recent research project focused on predicting the growth of solid waste in Macao, Prof Cai developed multiple machine learning models and found that 'Generalised Additive Models' made the most accurate predictions. He says, 'Macao ranks among the top in the world in terms of per capita solid waste generation, outpacing Hong Kong, Shanghai, and Singapore. The sources of solid waste in Macao are varied and influenced by factors such as family structure, tourist influx, and construction activity.'

Prof Cai further explains how changes in family

數據科學研究中心於2019/2020學年起開設理學碩士學位(數據科學)課程
The Centre for Data Science introduced a Master of Science in Data Science programme in the 2019/2020 academic year

蔡天驥教授
Prof Cai Tianji

趙心樹教授
Prof Zhao Xinshu

structure and the declining birth rate in Macao will affect the proportion of waste types, in addition to affecting the overall amount of waste. 'For instance, smaller households, especially those without children, are more likely to order takeaway food than cooking at home, thereby increasing the use of plastic utensils,' he notes. In view of this, Prof Cai hopes to develop more robust models to predict the overall amount of waste and the amount of each type of waste, which can help with the planning of waste sorting and processing facilities in Macao.

Exploring Communication Processes

Data science enhances our understanding of communication, whether between individuals or groups. Zhao Xinshu, chair professor in the Department of Communication and a member of CDS, employs big data analytics in communication studies. He says, 'In today's digital age, people have ready access to abundant real-time information. However, there's a significant caveat: we are increasingly likely to only receive information that aligns with our viewpoints, which may lead to wider division among the public. Rigorous big data analytics is therefore essential for exploring these issues.'

Prof Zhao expands on the concept of 'selective spiral', which is formed as information is disseminated, received, and reposted on social media. 'In our examinations of social media platforms in mainland China, post creators can mostly lead the selective spiral in the initial stage. However, as the spiral continues, it will be more heavily influenced by the preferences of people who like, share, and read the post, leading to the formation of an "echo chamber" in online public opinion,' he explains.

In a recent study, Prof Zhao and his team used big data technologies to collect and analyse Chinese-language social media posts, so as to understand the impact of headline length on click-through and share rates. The study shows that readers generally prefer medium-length headlines, with a length of around 28 characters as optimal. On the other hand, sharers favour shorter headlines, with an ideal length of no more than 20 characters. 'Such findings not only shed light on online public opinion in mainland China but also provide guidance for marketing strategies,' he concludes.

Applying Data Science Across Industries

Data science serves not just as a conduit between the past, present, and future, but also as a nexus among different communities and phenomena. It fosters innovation and new methodologies in different sectors. Prof U states, 'Through rigorous interdisciplinary collaboration, CDS is cultivating a new generation of data scientists. The centre engages in extensive interdisciplinary research to promote in-depth knowledge exploration and create predictive models. Such endeavours facilitate the application of data science in all aspects of life, thereby supporting the development of emerging technologies and making contributions to society.'

拓展人工智能應用

Applying AI in Novel Ways

文 / 葉浩男 · 圖 / 何杰平

Chinese & English Text / Davis Ip · Photo / Jack Ho

人工智能技術湧現，滲透各行各業，背後多以大量數據為推手，而拓展人工智能的應用和培養數據科學人才，正是澳門大學科技學院電腦及資訊科學系副教授楊丁奇等專家的目標。

無盡創新前景

楊教授說：「人工智能近年突破不斷，包括自動駕駛車輛進一步發展和蛋白質折疊預測系統出現，但最受公眾關注的，莫過於ChatGPT等大型語言模型。」

楊教授是大數據專家，其中一項課題是研究構建知識圖譜，使之更精確地儲存複雜的知識，從而準確地預測和推理。他也致力開發圖神經網絡模型，用來分析複雜的圖數據。

過去數年，不少人士修讀澳大的理學碩士學位（數據科學）課程中的「人工智能應用」專業範疇。該專業範疇由協同創新研究院與科技學院合辦，涵蓋計算機視覺、自然語言處理、網絡挖掘、大數據分析及深度學習等。

楊教授是該專業範疇的課程統籌人。他說，很多學生都運用人工智能作有趣而實用的嘗試，2022年就有學生用深度學習模型分析星雲圖像，識別星雲的生命週期。目前他有兩名學生運用大型語言模型，驗證知識圖譜中資訊的可信度。

此外，在楊教授指導下，一名數據科學碩士課程學生和一名計算機科學碩士課程學生開發了一個系統，通過分析一個有多座公共設施的區域內連接無線網絡的移動裝置的時間和位置，預測該區域的每日人流動態。該系統近來更增添新功能，能推導突發情境（如部分入口封鎖或火災）時的人流，成果獲知名學術期刊刊登。

培育數據科學思維

楊教授說，一些學生畢業後擔任數據科學家、數據工程師或人工智能課程導師，也有不少修讀博士課程，他們不僅精通程式語言和人工智能技術，而且具備出色的分析思維能力。「我們的畢業生面對不同領域的問題時，都能識別所需的數據，確立想取得的結果，然後選用合適的機器學習模型將兩者連接起來。這就是數據科學家的思考方式。」

楊丁奇教授

Prof Yang Dingqi

A new wave of artificial intelligence (AI) technology driven primarily by vast data repositories is permeating almost every industry. Yang Dingqi, associate professor in the Department of Computer and Information Science in the Faculty of Science and Technology (FST) at the University of Macau (UM), is among experts committed to cultivating talent in data science and expanding the applications of AI.

Boundless Prospects for Innovation

'Recent years have seen many breakthroughs in AI, ranging from advances in autonomous vehicles to the development of systems that predict protein folding, not to mention large language models [LLMs] like ChatGPT, which has captured the most public attention,' says Prof Yang.

Prof Yang is an expert in big data, and one of his research interests is developing new schemas for knowledge graphs. This allows for accurate storage of complex knowledge, thereby supporting more accurate predictions and inferences based on such graphs. He is also devoted to the development of graph neural network models for analysing complex graph data.

Over recent years, many people have enrolled in the Artificial Intelligence Applications specialisation under UM's Master of Science in Data Science programme. This specialisation, jointly offered by the university's Institute of Collaborative Innovation and FST, covers topics such as computer vision, natural language processing, web mining, big data analysis, and deep learning.

As the coordinator of the specialisation, Prof Yang says that many students have conducted intriguing and practical experiments in AI. In 2022, one student used deep learning models to analyse images of nebulae and identify various stages of nebula formation. Two other students are using LLMs to verify the credibility of information stored in knowledge graphs.

Furthermore, under Prof Yang's guidance, a master's student in data science and a master's student in computer science developed an innovative data system. The system predicts crowd movements within an area that encompasses multiple large public facilities by analysing the spatiotemporal data from mobile devices connected to wireless networks. The system has been further upgraded to predict crowd movements in emergencies such as blocked entrances or fires. A paper detailing this project has been published in a reputable academic journal.

Nurturing the Data Science Mindset

'Some graduates have moved on to become data scientists, data engineers, or AI instructors, while others are pursuing doctoral degrees,' says Prof Yang. 'When faced with challenges across various sectors, they excel at identifying the relevant data, determining the desired outcomes, and linking the two through machine learning models. In essence, they think like data scientists.'

數據引領精準營銷

Marketing to Minds With Data

文 / 葉浩男 · 圖 / 何杰平

Chinese & English Text / Davis Ip · Photo / Jack Ho

消費者一舉一動早已成為企業營銷的重要數據來源。澳門大學工商管理學院管理及市場學系副教授周詠芝表示，營銷成功除了取決於服務和產品質素，分析市場數據的能力同樣不可或缺。

預測消費者行為

企業營銷過去大多借助大眾媒體廣告和推銷員的技巧與人脈，前者缺乏針對性，後者難以規模化。在社交媒體和電子支付盛行的今天，企業很容易收集大量數據，包括客戶的購買記錄、上網習慣、付款方式和個人資料，從而精確、大規模地分析和預測市場，向客戶精準推廣。周教授說：「在瀏覽器尋找一個地名，你的社交媒體程式可能立刻推送機票廣告。」

研究消費者和服務業前線員工行為的周教授說，澳門大型的休閒旅遊企業均廣泛運用大數據模型作營銷，沿用舊有營銷模式難免流失客戶，花費雖大卻成效不彰。「澳門以旅遊等服務業為主，必須運用科技了解旅客不斷變化的需要，才能保持競爭力。」

數據分析工具能讓我們了解市場現象，甚至建立模型預測動向，但探究背後原因時仍需傳統的市場學調查與實驗。由澳大協同創新研究院與工商管理學院合辦的理學碩士學位（數據科學）課程中的「市場分析」專業範疇正正兼重兩者。周教授是該專業範疇的課程統籌人。她說：「先了解市場現況，再探索背後原因，才能制訂高效營銷策略。」

周教授說，「市場分析」專業範疇的畢業生能將數據科學活用於商業，最近一名學生與一個大型本地電子商貿平台合作，分析數以十萬計客戶的數據，識別新的競爭平台出現時可能流失的客戶群，針對他們的消費模式開展營銷。

善用數據開拓客源

對一些業界人士來說，運用大數據營銷需時學習和適應，但這無疑已成業界的基本要求。周教授說：「因應趨勢，我們不斷通過教學和研究，推動業界更有效地收集和分析數據，協助他們鞏固和開拓客源。」

周詠芝教授

Prof Cheris Chow

Every consumer swipe and click is a valuable source of data for businesses eager to sharpen their marketing strategies. According to Cheris Chow, associate professor in the Department of Management and Marketing of the Faculty of Business Administration (FBA) at the University of Macau (UM), while quality products and services matter, the effective use of data is just as crucial for marketing success.

Predicting Consumer Behaviour

Before the big data era, companies relied on untargeted mass-media advertisements and skilled salespeople, an approach that is not easily scalable. Today, the popularity of social media and the widespread use of e-payments enable companies to collect a varied array of data, including purchase history, browsing patterns, payment methods, and customer demographics. This rich dataset allows companies to accurately analyse consumer behaviour and create customised marketing campaigns. ‘Search for a city online through a search engine, and your next social media interaction could very well show you an advertisement for flights to that destination,’ says Prof Chow.

Big data models are vital to the marketing efforts of top leisure and hospitality businesses in Macao, according to Prof Chow, a researcher specialising in consumer behaviour and frontline service staff. In contrast, companies clinging to traditional marketing methods not only risk losing customers but also face inefficiencies in their advertising expenditure. ‘In a service-based economy like Macao’s, which is focused on tourism, using technology to keep up with the ever-changing needs of visitors is essential for staying competitive,’ she notes.

While data analytics tools can reveal ‘what’ is happening in the marketplace and assist in creating predictive models, traditional marketing research methods such as experiments and surveys remain indispensable for understanding the reasons ‘why’ consumers make particular choices. The Marketing Analytics specialisation under the Master of Science in Data Science, jointly offered by UM’s Institute of Collaborative Innovation and FBA, is unique in that it encompasses both approaches. ‘The first step is to learn about the current market situation, followed by analysing the underlying dynamics. This enables us to formulate effective marketing strategies,’ says Prof Chow, who also serves as the coordinator of this specialisation.

Prof Chow says that graduates of the Marketing Analytics specialisation can apply their data skills to solve real-world business challenges. For instance, a recent graduate partnered with a leading local e-commerce platform to create a system that identifies the buying habits of customers at risk of switching to a new competitor. This analysis, encompassing hundreds of thousands of customer data points, paves the way for targeted marketing initiatives.

Harnessing Data for Customer Growth

‘Big data tools are fast becoming the standard in marketing, even if there’s a learning curve for some,’ Prof Chow says. ‘Recognising these industry shifts, our focus remains on advancing both education and research in the field. Our goal is to equip industries with the data skills essential for customer retention and growth.’

釋放大數據的金融價值

Extracting Financial Value From Big Data

文 / 葉浩男 · 圖 / 何杰平

Chinese & English Text / Davis Ip · Photo / Jack Ho

金融世界每分每秒產生大量數據。澳門大學工商管理學院金融及商業經濟學系副主任李振國副教授指出，這些數據經機器學習模型分析後能成為改善投資策略、減低投資風險和開發嶄新金融產品的基石。

培育現代金融業人才

金融市場向來起伏不定，但疫情、戰爭和人工智能等因素近年令市場更趨波動。面對這些挑戰，單靠傳統的計量經濟學模型未必能精準地分析與預測金融市場。李教授說：「憑藉基於大數據的機器學習模型，金融機構不僅可制訂更佳的投資方案，也能洞察客戶所需，提供合適產品。」

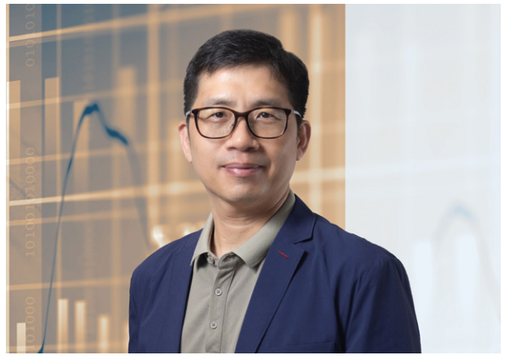
與此同時，經濟和金融學者也愈來愈多利用大數據開展研究，如李教授曾收集和分析居民在社交媒體上表達對金融和資產市場的情緒，研究金融和資產市場不景和消費下滑之間的關聯。

因應金融業變革，澳大協同創新研究院和工商管理學院共同開設理學碩士學位（數據科學）課程的「金融科技」專業範疇。李教授是該專業範疇的課程統籌人。他表示：「發展現代金融業是澳門走向經濟適度多元發展的關鍵一環，預期未來數年澳門對數據分析、業務分析和金融分析等方面專業人才的需求日益增多。」

李教授續說，該專業範疇涉及人工智能、區塊鏈、雲計算和大數據在金融業的應用。在大數據方面，學生不僅學習收集和清洗金融大數據，亦能掌握使用決策樹和神經網絡等機器學習模型來分析數據。「一位畢業生今年開發了一個系統，結合多種機器學習模型，能相當精確地預測在點對點[P2P]借貸中，哪些借款人的違約風險較高。該模型在評估信用卡申請者的債務違約風險上也表現突出，商業價值顯著。」

大數據引領金融業

正如航海者參考精確的氣象數據來決定航向，今日的金融機構和投資者同樣需要先進的數據科學技術來推測市場走向和擬定投資策略。李教授指出：「運用大數據是金融業人士維持競爭力的關鍵，也是澳門現代金融業發展的重要方向。」



李振國教授

Prof Henry Lei

An immense volume of data flows through the financial sector every second. Henry Lei, associate head of the Department of Finance and Business Economics in the Faculty of Business Administration (FBA) at the University of Macau (UM), emphasises that machine learning models, by harnessing this data, can enhance investment strategies, reduce investment risks, and contribute to the development of new financial products.

Nurturing Modern Financial Professionals

The recent pandemic, wars, and the rise of artificial intelligence have amplified the fluctuations in financial markets. Using traditional econometric models alone may fall short in providing accurate analyses and forecasts for today's dynamic markets. 'By leveraging machine learning models trained on big data, financial institutions can devise superior investment strategies,' says Prof Lei. 'More importantly, they can gain a deep understanding of client needs, allowing them to provide tailored products.'

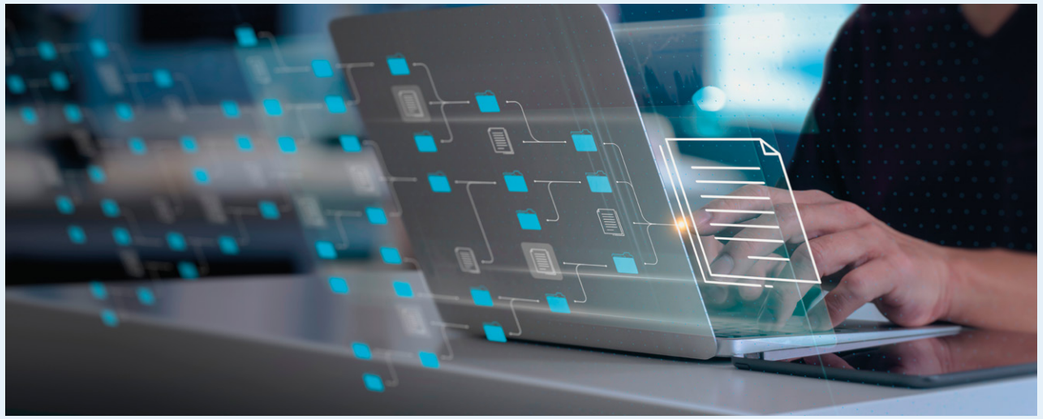
Experts in economics and finance also increasingly rely on big data for their research. Prof Lei, for example, has explored sentiments on social media regarding financial and asset markets. This approach provides insight into the correlation between poor financial or asset market performance and declining consumption.

Recognising the evolving needs of the financial sector, UM's Institute of Collaborative Innovation, in collaboration with FBA, has introduced the Financial Technology specialisation under the university's Master of Science in Data Science programme. Prof Lei, who also serves as the coordinator of the specialisation, says, 'Developing the modern financial services industry is crucial for Macao as the city moves towards economic diversification. We foresee a growing demand for specialists in areas like data analytics, business analytics, and financial analytics in the coming years.'

According to Prof Lei, the specialisation encompasses the application of artificial intelligence, blockchain technology, cloud computing, and big data in the financial domain. 'In addition to data collection and cleaning, students learn to use machine learning models ranging from decision trees to neural networks,' Prof Lei adds. 'This year, a graduate developed a system that integrates various machine learning models to predict default risks among peer-to-peer [P2P] lenders. The model also has the advantage of evaluating the default risk of credit card applicants, which underlines its considerable commercial value.'

Big Data at the Forefront of Modern Finance

Just as navigators rely on accurate weather data to determine their course, financial institutions and investors need advanced data technologies to decode market trends and formulate investment strategies. Prof Lei concludes, 'Tapping into the vast potential of big data is important for finance professionals to stay competitive. It is also a promising direction for Macao's modern financial services industry.'



從數據合規建立信任

Building Trust Through Data Compliance

文 / 葉浩男、資深校園記者古詠軒 · 圖 / 校園記者梁鎮鴻

Chinese & English Text / Davis Ip, Senior UM Reporter Ku Weng Hin · Photo / UM Reporter John Leung

在大數據科技盛行的今日，我們對數據擁有權和相關權利的保護足夠嗎？澳門大學法學院環球法律學系副教授Muruga Perumal Ramaswamy認為，社會亟待在科技創新與法律考慮之間求取平衡。

數據使用的法律挑戰

大數據科技在商業活動和公共服務中早已不可或缺，但也引發不少合規管理問題，涉及知識產權保護、私隱、數據安全和爭議解決途徑等。Ramaswamy教授表示：「良好的數據戰略不僅要符合法規要求，亦應遵守自願制定的行業標準等其它基準，從而降低法律風險，贏得數據使用者和提供者的信任。」因此，他和法學院其他學者正開展相關研究，涵蓋歐洲和澳門的數據保護、粵港澳大灣區網絡安全、生成性人工智能規管、基因數據保護和智能合同使用等。

培養融會法律與科技的人才

Ramaswamy教授說，對法律界人士而言，理解大數據的收集、存儲和使用有助他們提供更適切的法律意見和數據戰略；對科技業人士而言，理解相關法律框架亦有助他們管理和使用數據。因此，澳大協同創新研究院與法學院合辦了理學碩士學位（數據科學）課程中的「數據戰略與合規管理」專業範疇。

身為該專業範疇的課程統籌人，Ramaswamy教授表示，這個課程的教學團隊匯集不同法系的多語言國際法律專家。「除了教授數據科學技術，該課程亦探討在醫療保健、生物醫學研究和公共管理等領域運用和保護數據，以及比較各地關於數據使用和人工智能程式開發的法律和規定。」

過去數年，該專業範疇的學生開展了眾多研究項目，涉及歐盟《一般資料保護規範》、澳門的個人數據保護標準，以及粵港澳大灣區內不同司法管轄區的合規要求，學生可提升其設計預防性合規策略的能力，將來能協助機構降低處理數據時的法律風險，尤其是跨境數據傳輸和使用不合規時可能面對的巨額罰款。

Ramaswamy教授指出，畢業生能在法律或爭議調解領域發揮所長，也能在公私營機構找到許多其它職業機會，亦有愈來愈多人有意攻讀博士課程，進一步研究數據戰略與合規管理方面日新月異的跨學科前沿課題。

In an era dominated by big data technologies, are we adequately safeguarding data ownership and other related rights? Muruga Perumal Ramaswamy, associate professor in the Department of Global Legal Studies in the Faculty of Law (FLL) at the University of Macau (UM), argues that there is a pressing need to strike a balance between technological innovation and legal considerations.

Legal Complexities of Data Use

Big data technologies are indispensable in both commercial activities and public services, yet they also present a myriad of compliance challenges, ranging from intellectual property protection and privacy to data security and recourse to dispute resolution. Prof Ramaswamy contends that an effective data strategy should extend beyond merely satisfying regulatory requirements; it should also align with voluntary industry standards. 'Adhering to such standards not only mitigates legal risks but can also gain trust from data users and providers,' he explains. In FLL, Prof Ramaswamy and his colleagues are engaged in research on data protection in Macao and Europe, cybersecurity in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), regulation of generative artificial intelligence, genetic data protection, and application of smart contracts.

Cultivating Talent at the Intersection of Law and Technology

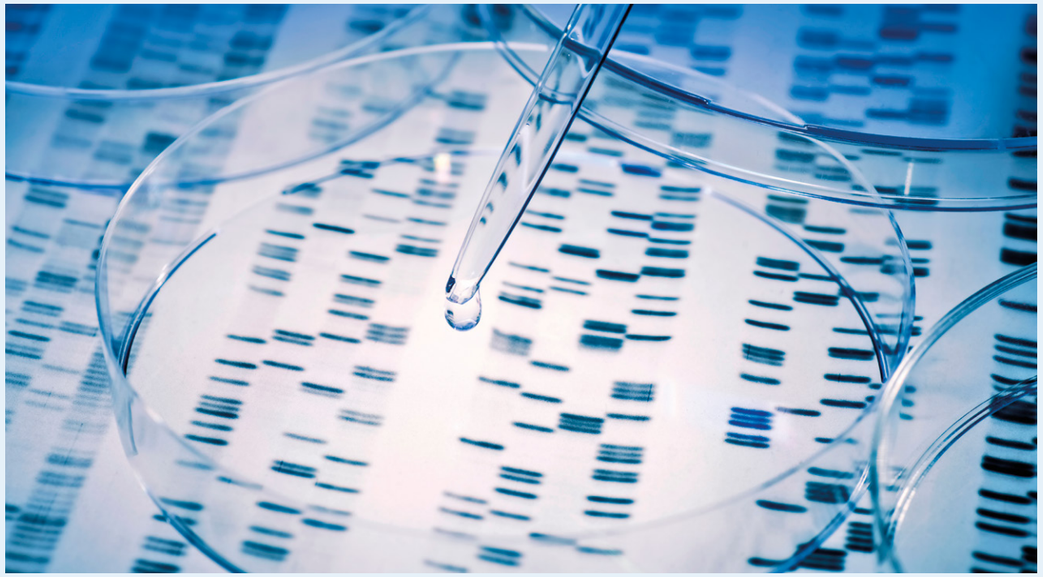
'Understanding the collection, storage, and use of data is invaluable for legal professionals, equipping them to provide more tailored legal advice and data strategies. For tech professionals, a grasp of pertinent legal frameworks is equally beneficial when it comes to data management and use,' says Prof Ramaswamy. Against this backdrop, UM's Institute of Collaborative Innovation, in collaboration with FLL, has launched a Data Strategy and Compliance specialisation under the university's Master of Science in Data Science programme.

According to Prof Ramaswamy, the coordinator of this specialisation, the teaching team comprises multilingual international legal experts with extensive knowledge of various jurisdictions and legal systems. Students in this specialisation not only learn about data technologies but also explore how to apply and protect data in fields such as healthcare, biomedical research, and public administration. Moreover, students compare legal frameworks on data use and the development of artificial intelligence applications between jurisdictions.

Muruga Perumal Ramaswamy教授
Prof Muruga Perumal Ramaswamy

Over the past few years, students in this specialisation have undertaken various research projects, covering topics such as the General Data Protection Regulation in the European Union, personal data protection standards in Macao, and compliance requirements in various jurisdictions within the GBA. These projects have enhanced their ability to design preventive compliance strategies, which can help reduce legal risks associated with data processing faced by organisations. This is particularly important given the substantial penalties that may result from non-compliance in cross-border data transfer and use.

Prof Ramaswamy adds that graduates of this specialisation are not only well-positioned to excel in the fields of law and dispute resolution but are also capable of securing a wide range of career opportunities in both public and private sectors. 'A growing number of our graduates express interest in pursuing doctoral studies to delve further into advanced interdisciplinary topics in the rapidly evolving field of data strategy and compliance.'



數據指引精準醫療

Crafting Tailored Cures Through Data

文 / 葉浩男 · 圖 / 編輯部
Chinese & English Text / Davis Ip · Photo / Editorial Board

當癌症患者經多次化療仍然效果有限，失望之情難以言喻。澳門大學健康科學學院副教授潘全威表示，常規治療無法滿足個人需求時，借助機器學習與大數據分析的精準醫學能提供新的治療方向。

分析多元健康數據

「精準醫學」是較為新興的臨床和研究領域。潘教授說，開展精準醫學診療時，醫生除了進行常規檢查，也會分析患者的基因，了解基因多態性／變異如何影響疾病的形成，也可能進一步分析患者體內如蛋白質分子、代謝物等各類能反映病情的「生物標誌物」。透過整合這些數據，醫生能更準確地識別病症的亞型，選擇合適療程。

潘教授指出：「機器學習與大數據分析在精準醫學中扮演重要角色，尤其能相當精確地協助識別生物標誌物，有助我們更深入地了解癌症、糖尿病等複雜疾病。」他的研究包括利用人工智能發現疾病標記物、區分患者亞型和監測疾病狀況，以及開發多種高通化驗技術，從而大規模和快速地分析血液和身體組織樣本。

精準醫學需求日增

隨著大眾對個人化醫療的需求日增，加上澳門近年積極發展健康產業，學術界、醫療機構、藥廠及生物技術開發行業需要愈來愈多精準醫學人才，不少學生修讀澳大的理學碩士學位（數據科學）課程中的「精準醫學」專業範疇。該專業範疇由澳大協同創新研究院與健康科學學院合辦。

身為該專業範疇的課程統籌人，潘教授說：「該專業範疇涵蓋從數據分析、機器學習到生物醫學等方面的廣泛知識，包括以不同疾病為例，探討基礎生物學和人工智能在醫療環境中的應用，以備學生應對各種醫療保健挑戰，達致精準醫療。」該專業範疇的學生畢業前須完成一個研究項目，將數據科學與生物醫學相結合，探討生物醫學、醫學或醫療方面的實際問題。

潘教授指出，該專業範疇的學生以來自學界、醫院和業界的大型數據集開展研究。近年的研究項目涉及眾多主題，從解決與生命相關的基本生物學問題、建立疾病模型、對發病機制的理解、藥物開發，以至人工智能在醫學中的應用等均有涉獵。「憑藉數據科學與生物醫學方面的專長，我們的畢業生能為社會帶來更個人化的醫療服務。」

潘全威教授
Prof Terence Chuen Wai Poon

When a cancer patient still only has limited response after multiple chemotherapy treatments, the sense of despair can be crushing. Terence Chuen Wai Poon, associate professor in the Faculty of Health Sciences (FHS) at the University of Macau (UM), suggests that in such circumstances, precision medicine—enabled by machine learning and big data analytics—can serve as a compelling alternative to conventional therapies.

Harnessing Multifaceted Health Data

According to Prof Poon, precision medicine is an emerging clinical and research field that is gaining prominence in diagnosis and treatment of disease. Beyond routine check-ups, clinicians may examine patients' genetic profiles to discern how polymorphism/mutations affect disease formation. They may also delve into other 'biomarkers'—such as proteins and metabolites—to get a clearer picture of the patient's health. By integrating these data, clinicians are better placed to identify disease subtypes, thus enabling more tailored treatment plans.

'Machine learning and big data analytics play important roles in precision medicine. They are particularly adept at pinpointing biomarkers with remarkable accuracy. This enables us to have a deeper understanding of complex diseases like cancer and diabetes,' explains Prof Poon. His research applies artificial intelligence for tasks like biomarker discovery, patient classification and disease monitoring. He has also been developing various high-throughput analytical technologies that allow swift and large-scale analyses of biological specimens such as blood and tissue.

Growing Demand for Precision Medicine

With the increasing demand for personalised healthcare and the active development of the health industry in Macao in recent years, there is a growing demand for precision medicine professionals in many fields, from academia and clinical settings to the pharmaceutical and biotechnology industries. Against this backdrop, many students have chosen the Precision Medicine specialisation under the university's Master of Science in Data Science programme, jointly offered by UM's Institute of Collaborative Innovation and FHS.

'This specialisation equips students with a diverse skill set, from data analytics to biomedical sciences, preparing them to tackle a variety of healthcare challenges towards achieving precision medicine,' says Prof Poon, who also serves as the coordinator of the specialisation. Before graduation, students are required to pursue a research project to solve a practical data science problem in the field of biomedical sciences, medicine, or healthcare.

According to Prof Poon, students of the precision medicine specialisation conduct research using large datasets from academia, hospitals, and industries. Recent projects have ranged from solving fundamental biological questions related to life, disease modelling, understanding of disease pathogenesis, drug development and applications of AI in medicine. 'With expertise in data science and biomedical sciences, our graduates have the ability to contribute to society with more personalised healthcare solutions,' Prof Poon concludes.

構築人與機器的共同語言

Developing a Common Language for Humans and Machines

文 / 葉浩男、實習校園記者李少傑 · 圖 / 何杰平

Chinese & English Text / Davis Ip, Trainee UM Reporter Ason Lei · Photo / Jack Ho

研究語言為我們不斷注入對溝通、文化與歷史的寶貴見解，但過去大眾不怎麼將語言學與電腦科學聯繫起來。澳門大學人文學院中國語言文學系主任、計算語言學家袁毓林講座教授指出，這種現象在ChatGPT等生成式人工智能誕生後發生變化。

大型語言模型革新語言學研究

袁教授說，人工智能過去十年的發展帶來了機器翻譯、文本分析和語音轉換文字等多方面的突破，包括運用「大型語言模型」的對話型人工智能系統，例如OpenAI的GPT-4和Google的Bard。

有語言學家認為，人類的語言能力和「心智理論」（即理解和推測他人心理狀態的能力）都是後天通過使用語言不斷發展的。值得關注的是，大型語言模型也在理解和產生文本方面有飛躍進展。袁教授表示，有研究指出，通過人類用自然語言提供的反饋，一些模型似乎呈現出「心智理論」能力。因此，許多研究者開始將傳統語言學研究、反映神經行為的腦影像和大型語言模型研究結合起來。袁教授認為，這方面的進展有望提升人工智能的語言能力，也能令我們更深入地理解人類的語言運用和思考過程。

培育理論與實踐並重的語言人才

在語言學和計算機科學日漸交織的當下，許多學生報讀澳大的理學碩士學位（數據科學）課程中的「計算語言學」專業範疇。該專業範疇由澳大協同創新研究院與人文學院合辦，不但教授語言和語言學研究的關鍵概念和方法、語言數據收集和分析，也會講授在語言和應用語言學研究中運用大數據分析工具和方法，包括機器翻譯、自動評分和基於語料庫的分析等。

過去一年，袁教授指導了四名碩士生，每人負責一個關於大型語言模型的項目。第一個項目嘗試構建更為精細的檢驗大型語言模型的語義理解與常識推理能力的測試集。第二個項目則涉及開發一套文本檢測系統，從而區分人工智能與人類所產生的文本。第三個項目進行了文本分析，旨在探究創作者的人格特質。最後一個項目則涉及應用層面，研究如何編寫更精確的指令，使大型語言模型更有效地調整寫作風格、製作表格，以及編寫電腦程式。

袁教授強調，語言專業人士越來越需要以數據科學技術來處理和分析語言。「無論在出版、教育、媒體、企業溝通、翻譯，乃至是人文學科、社會科學和信息技術等領域的研究，計算語言學的畢業生都能走在前沿。」

The study of languages has long offered profound insights into communication, culture, and history. However, in the past, people seldom associated linguistics with computer science. 'This landscape has changed with the emergence of generative AI models such as ChatGPT,' says Yuan Yulin, chair professor and head of the Department of Chinese Language and Literature at the University of Macau (UM), who is also a computational linguist.

Revolutionising Linguistics Research with Large Language Models

'The extraordinary advances in AI over the past decade have brought ground-breaking developments in areas such as machine translation, text analysis, and speech-to-text technology,' says Prof Yuan. More recently, these advances have culminated in the advent of conversational AI systems underpinned by large language models (LLMs), such as OpenAI's GPT-4 and Google's Bard.

Some linguists believe that humans develop their language abilities and 'Theory of Mind'—the ability to comprehend and infer the mental states of others—through language use and continuous interaction. It is worth noting that LLMs have made significant progress in text comprehension and generation in a similar trajectory. 'Research suggests that after receiving feedback provided by humans using natural language, some of these models begin to exhibit an ability similar to the "Theory of Mind",' says Prof Yuan. As a result, there is a growing effort to integrate traditional linguistics research, neuroimaging studies on neural behaviour, and LLM research. Prof Yuan is optimistic about the progress of this interdisciplinary field, which promises to amplify the language capabilities of AI while deepening our understanding of human language use and cognition.

Cultivating Language Professionals with Emphasis on Both Theory and Practice

As linguistics and computer science are increasingly intertwined, many students see the advantages offered by the Computational Linguistics Specialisation under UM's Master of Science in Data Science programme. This specialisation, jointly offered by the Institute of Collaborative Innovation and the Faculty of Arts and Humanities, combines theoretical research with practical applications. It equips students with foundational concepts and methodologies in language and linguistics research, as well as skills in collecting and analysing linguistic data. It also covers the application of big data techniques to areas such as machine translation, automated grading, and corpus-based analysis.

袁毓林教授

Prof Yuan Yulin

Over the past year, Prof Yuan has supervised four master's students, each focusing on a project related to LLMs. The first project aims to develop a more refined test set for evaluating the semantic understanding and common-sense reasoning capabilities of large language models. The second project involves the creation of a text detection system that can distinguish between AI-generated and human-authored content. The third project focuses on text analysis to investigate personality traits through an individual's written text. Lastly, the fourth project delves into practical applications, such as crafting more precise prompts to enable LLMs to adapt writing styles, create tables, and write computer programmes more effectively.

'An increasing number of professionals across various linguistic disciplines are employing data science technologies for language analysis,' Prof Yuan remarks. 'The career prospects for graduates specialising in computational linguistics are broad. They may find opportunities in sectors such as publishing, education, media, corporate communication, translation, or even research in the humanities, social sciences, and information technology.'

數據科學推動個性化教育

Data Science Driving Personalised Education

文 / 葉浩男、資深校園記者顧文晴．圖 / 由受訪者提供

Chinese & English Text / Davis Ip, Senior UM Reporter Amber Gu · Photo / Provided by the interviewee

在理想的世界，人人都應該享有高度個性化的教育，數據科學正促使我們邁向這個目標。澳門大學教育學院助理教授陳孚指出，教育數據挖掘和學習分析是兩項正在革新教育的科技。

預測和改善學生表現

大數據工具使教師和學校得以深入分析、預測以至改善學生的學習表現。陳教授舉例：「運用由往年數據訓練出來的機器學習模型，學校可分析新生的資料，預測哪些同學比較可能在學業遇上困難。」

陳教授說，數據帶來的革新也包括設定個人化學習計劃、自動評分和基於遊戲的學習，而以大型語言模型為基礎的聊天機器人教學助理也日益盛行。

身為教育數據挖掘專家，陳教授曾通過分析學習過程和結果的數據，探索14個國家和地區逾七萬名學生的數字閱讀素養，提出改善策略。他也致力以深度學習模型開發一套系統，預測和推斷學生學習時的認知狀態（如技能水平、正面或負面情感、參與水平）和學習成果（如正確或錯誤的作答）。

陳教授說，對從事教學分析的人來說，數據清洗、統計分析、數據可視化和數據驅動決策等都是必備技能，這些也是澳大協同創新研究院和教育學院合辦的理學碩士學位（數據科學）課程的「教學分析」專業範疇的科目。

參與該專業範疇教學的陳教授說：「有學生基於認知診斷模型，通過數據分析理解成人在廣泛運用科技的學習環境中解難的能力，也有學生開發了同時供教師、學生和學校管理層使用的教學質素評估系統。」

人工智能增強人類智能

掌握數據技能不僅能使畢業生從事數據分析、教育設計、學習分析、教育數據科學等工作，也能提升教師的教學成效。一些畢業生也在攻讀博士課程，拓展數據科學在教育的應用。陳教授說：「即使傳統的教學角色，今日亦可能需要一定的教學數據分析能力，才能協助每位學生走最合適的學習道路。」

陳孚教授

Prof Chen Fu

In an ideal world, personalised education would be accessible to everyone, and data science is gradually making this dream a reality. According to Chen Fu, assistant professor in the Faculty of Education (FED) at the University of Macau (UM), technologies such as educational data mining and learning analytics are revolutionising teaching and learning.

Predicting and Enhancing Student Performance

Big data tools enable educators and schools to analyse, predict, and enhance student academic performance. 'For example, machine learning models trained on historical data can identify incoming students who are likely to struggle in their studies,' says Prof Chen.

Moreover, data science-driven innovations are contributing to learning path recommendations, automated grading, game-based learning, and the use of virtual learning assistants powered by large language models, adds Prof Chen.

As an expert in educational data mining, Prof Chen has studied the digital reading literacy of over 70,000 students across 14 countries and regions. Analysing data about their learning process and outcomes, he has proposed strategies for improvement. Through deep-learning models, he is also developing a system to assess and interpret students' cognitive states during learning, such as skill levels, emotions, and engagement levels, as well as learning outcomes such as correct or incorrect responses.

Prof Chen emphasises that data cleaning, statistical analysis, data visualisation, and data-driven decision-making are essential skills for those engaged in teaching and learning analytics. These skills form the backbone of the Analytics in Teaching and Learning specialisation under UM's Master of Science in Data Science programme, a collaborative offering between the university's Institute of Collaborative Innovation and FED.

Prof Chen, a faculty member in the programme, says that some graduates have applied their skills to analyse the problem-solving abilities of adults in technology-rich environments, based on cognitive diagnosis models. Others have created a comprehensive teaching quality evaluation platform for a variety of stakeholders, including teachers, students, and school administrators.

Enhancing Human Intelligence With AI

Mastering data skills not only prepares graduates for careers in data analysis, educational design, learning analytics, and educational data science but also enables teachers to enhance their teaching effectiveness. Furthermore, some of the graduates are pursuing doctoral degrees to further explore the applications of data science in education. 'Even those in traditional teaching roles may find themselves in need of a certain level of proficiency in data analysis, which will improve their ability to tailor learning paths for their students,' says Prof Chen.

運用數據提升公共服務

Leveraging Data to Enhance Public Services

文 / 葉浩男、資深校園記者古詠軒 · 圖 / 何杰平
Chinese & English Text / Davis Ip, Senior UM Reporter Ku Weng Hin • Photo / Jack Ho

公共部門每日運作均收集和產生大量數據。澳門大學社會科學學院副院長、社會學系主任蔡天驥教授說，這些公共部門所掌握的數據以往大多僅供存檔，如今則可通過科技轉化為透視社會的洞見，有助提升公共服務和推動更深更廣的學術研究。

展現社會科學預測能力

澳門特區政府近年提升其綜合服務應用程式的功能，並且推出數據開放平台，反映不同政府部門的數據加緊整合、數據科學在公共服務日益重要。蔡教授說，利用大數據技術，政府可從龐大的數據中提取有價值的資訊，更有效地了解社會需求，提供更佳的公共服務，例如透過分析人流和車流數據，發佈更詳盡的交通資訊和規劃長遠的交通基建。利用自然語言處理技術，政府亦能更精準地分析市民對政策和法案的意見。

身為計算社會科學學者，蔡教授也指愈來愈多學者借助文本挖掘、圖像分析和網絡分析等技術深入探究社會問題。「社會科學的敘事傳統結合數據科學的預測能力，正為學術研究開闢新視野。」

培養智慧政務人才

2021/2022學年起，澳大協同創新研究院與社會科學學院開辦理學碩士學位（數據科學）課程中的「智慧政務」專業範疇。身為該專業範疇的課程統籌人，蔡教授說：「學生能獲取多項實用技能，包括數據收集、文本分析和數據可視化，能處理政策文件、媒體報導、輿論和公共部門活動記錄等數據。」

過去兩年，蔡教授和學院其他教授指導學生開展了一系列量化社會科學研究，例如透過分析政府如何回應網上訴求來評估服務質素，以及利用機器學習模型預測澳門固體廢物量的增長。「澳門的人均固體廢物量較高。隨著今年旅客量回升，澳門在廢物管理方面的挑戰日益加劇，制訂長期政策和規劃基礎設施時需要準確預測廢物量。」

蔡教授續說，澳門要有更智能化的公共服務，就需要更多了解社會動態的數據科學專才，「智慧政務」專業範疇正能滿足需求。「我們的畢業生能在政府部門、研究機構和社會服務機構工作時應用大數據技術，也能開展與社會息息相關的前沿學術研究。」

Public departments accumulate huge amounts of data every day. Cai Tianji, associate dean of the Faculty of Social Sciences (FSS) and head of the Department of Sociology at the University of Macau (UM), says this data, most of which was formerly archived, can now be transformed into valuable social insights. These insights not only enhance public services, but may also facilitate in-depth and far-reaching academic research.

蔡天驥教授
Prof Cai Tianji

Demonstrating the Predictive Power of Social Sciences

In recent years, the Macao SAR Government has been improving its integrated service applications, and has launched an open data platform. Such initiatives show the government's effort to consolidate data from different departments and an emphasis on the rising importance of data science in public service delivery. According to Prof Cai, the government can extract valuable information from the vast amounts of data by leveraging big data technologies, thus gaining a clearer understanding of societal needs and enabling more efficient public services. For instance, by analysing pedestrian and vehicular traffic data, the government can provide more accurate and detailed traffic information, in addition to enhancing the planning of transport infrastructure. Furthermore, the adoption of natural language processing technology enables accurate analysis of public opinion concerning policies and legislation.

As a computational social science scholar, Prof Cai notes that a growing number of scholars are exploring social issues through technologies such as text mining, image analysis, and network analysis. 'The integration of the traditional narrative approach in social sciences with the predictive capabilities of data science is pushing the frontiers of academic research,' he says.

Nurturing Talent for Government Innovations

From the 2021/2022 academic year, UM's Institute of Collaborative Innovation, in collaboration with FSS, has introduced a Smart Governance specialisation under its Master of Science in Data Science programme. As the coordinator of this specialisation, Prof Cai says, 'Students will acquire a comprehensive skill set about data collection, text analysis and data visualisation, enabling them to handle different data types such as policy documents, media reports, public opinion, and records of public sector activities.'

Over the past two years, Prof Cai and his colleagues have mentored students in a series of quantitative social science research projects, topics of which include analysing the government's response to citizens' online appeals to evaluate service quality, and using machine learning models to predict the growth of solid waste in Macao. 'Macao has one of the world's highest per capita solid waste generation rates,' says Prof Cai. 'Along with a rebound in tourist numbers this year, the challenges of waste management are intensifying. Accurate prediction of waste volumes is indispensable for long-term policy formulation and infrastructure planning.'

Prof Cai says that if Macao wants to have more intelligent public services, it is necessary to have data science professionals who have a deep understanding of social dynamics. The Smart Governance specialisation is tailored to meet this need. 'Our graduates are proficient in big data technologies, which they can apply in different work settings including government departments, research institutes, and social service organisations. Moreover, they are capable of conducting frontier academic research to address social issues,' he says.

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新一代資訊技術、新能源、智慧製造等新興產業迅速發展，社會對材料的需求和標準亦隨之提高。澳門大學因此成立澳門先進材料研發中心，推進新材料科技創新和轉化，助力澳門新材料產業邁向綠色化、低碳化、精細化和節約化。

研發佈局厚積薄發

新一輪科技和產業變革促使全球科技創新空前活躍。國家和澳門不論是打造高新科技產業、構建智慧城市，還是拓展城市基建時，性能超群的新材料都是不可或缺的物質支撐。利用先進科技開發的新材料大多高性能、高耐用、低缺陷、低成本、多功能，是百業轉型升級的基礎，更是城市可持續發展的先決條件，相關研發工作任重道遠、刻不容緩。

澳大的科研佈局早以先進材料為重要方向之一。2014年，澳大成立應用物理及材料工程研究院（下簡稱：研究院），匯聚來自美國、歐洲、日本、新加坡、香港等地大學及世界知名研究機構、創新意識強烈的菁英，組成實力雄厚的跨學科團隊，從量子力學、原子理論、晶體結構的固態理論出發，攻關新材料的關鍵技術。經過近十年努力，研究院的科研環境日益成熟，累積卓越成果。因此，澳大在澳門科學技術發展基金的支持下成立了澳門先進材料研發中心（下簡稱：研發中心），促進新型特徵半導體、量子生物醫學，以及新一代傳感器等與新材料相關的交叉研究。這是澳大繼澳門中藥研發中心後的又一個澳門產學研轉化平台。

研發中心位於澳大科研基地N23科研大樓，毗鄰澳大的國家重點實驗室。科研基地與橫琴澳門青年創業谷僅一牆之隔。研發中心與珠海澳大科技研究院緊密聯動，借助科技研發和高端製造業在橫琴發展的契機，加快把研究院既有成果轉化落地，助力澳門特區探索以市場需求為導向、產學研結合的發展模式。

優先開發的新材料

能源危機、環境污染、人類健康等問題均為研究院一直鑽研的課題。2020年澳大榮譽理學博士、2014年諾貝爾物理學獎得主中村修二教授是可持續能源技術的先驅，其發明不僅為照明行業帶來革命性改變，也為人類福祉作出重大貢獻。中村教授對澳大的新材料研發方向深表認同。他進一步指出，新材料研發有助企業提升競爭力和開拓市場，但更重要的是能有效改善生產和生活環境，提升大眾幸福感，造福社會。

對此，研發中心正加強結合新材料的基礎研究與技術應用，針對市場需求推進新材料開發，並直接對接企業，加速成果轉化。研究院院長、研發中心主任湯子康教授是國際知名的納米光電子材料領域領軍人物，多年來引領團隊走在先進材料研究前沿，以創新思維為「卡脖子」技術研發別闢蹊徑。

湯子康教授指出：「研製劃時代意義的材料一直是我們的目標。新材料是粵港澳大灣區當前最活躍、最具潛力的科研版塊之一，而集應用研究、成果轉化、產業服務於一體的研發中心，則象徵澳大在新材料領域能為澳門產學研結合提供創新動力、可以提升與大灣區產業界創新合作和協同發展的水平。」

綠色建材用於澳門基建

製造水泥通常耗費大量熱能，其化學過程亦會產生大量二氧化碳。僅2021年，全球來自建築、道路及基建工程使用的水泥的碳排量達29億噸，佔碳排放總量的7%。澳大研發的「納米泡沫混凝土」與市面常規產品相比，泡孔大幅減小，施工時能節約10%至40%水泥原料，顯著降低碳排放和生產成本，隔熱保溫能力更提升兩至三倍，能用於輕質牆板、門芯板乃至大規模建築現澆回填工程。該技術已用於澳門、珠海等地多項重大工程，如澳氹第四條跨海大橋口岸人工島連接線和珠澳橫琴口岸綜合交通樞紐。這款混凝土在上述兩項工程的用量已達六萬立方米，相較市面同類技術方案節約水泥一萬噸，降低相應碳排放九千噸（按生產一噸水泥排放0.9噸二氧化碳計算），使施工更符合綠色理念。

生態環保材料助農田保水

全球暖化持續，乾旱和沙漠化不斷擴大，對生態體系、水土資源、生命安全均構成威脅。澳大研發的「新型超級水凝膠」吸水能力出眾，高達自身重量18,000倍以上，刷新世界紀錄。該產品能固定植物根系附近40%水分，有助防止水土流失，可埋在土壤，用於農田保水和沙漠綠化治理。該產品已進入用戶試用階段。同樣由澳大研發的「植物防曬霜」則能透過噴灑保護植物葉片，防止農作物出現高溫日灼現象，隔阻有害紫外線和促進光合作用，對在高海拔、乾旱或熱帶等環境的植物尤其有用。它的成本較市面進口產品低70%，而且效果更佳，正在企業進行中試生產。

新材料促進能源轉型

潔淨能源開發是實現全球能源轉型和構建「綠色澳門」的關鍵一環。澳大研發的「水變氫」催化劑能在大電流下保持穩定和高效，滿足工業綠色製氫對水電解電極的要求，成本低、壽命長、生產過程無污染。該催化劑已投入批量生產，並於內地進行大規模、大面積製氫的試行測試，有望推動傳統化石燃料的能源替代進程。

中村修二教授
Prof Shuji Nakamura

另一方面，市面的光伏電池通常以多晶矽為原材料，提煉時高污染、高耗能、高成本，而澳大基於鈣鈦礦材料開發的光伏器件則能用低溫印刷方式大面積製備，成本低廉。其中，最新開發的「純相準二維鈣鈦礦薄膜」使用柔軟輕便的鈣鈦礦材料，可透過噴霧列印在背包或衣服上，進行穩定、高效的太陽能儲電。這種鈣鈦礦光伏器件在光電轉換率的關鍵指標上在市場有領先地位，正對接資本作大規模生產。

腫瘤免疫治療新技術

治療癌症的難處之一在於癌細胞能通過免疫逃逸機制，逃脫免疫系統追殺。澳大研發的新型碳納米點材料能快捷、準確地對癌細胞的蛋白「整容」，使其與正常蛋白有所區別，引發人體免疫系統的免疫反應，清除癌細胞。研究團隊已初步完成碳量子點材料的標準化生產工藝，並與國藥集團合作，於粵澳合作中醫藥科技產業園完成碳量子點材料標準化生產的GMP（藥品生產質量管理規範）實驗室規劃。

支撐高新技術產業

澳大已透過研發中心將多個先進材料項目與本地、外地的企業和社會資本談判對接，以提高科技成果轉化落地的效率，並支撐未來重大工程和高新技術產業的發展。研發中心將把握橫琴粵澳深度合作區的政策優勢，加快科研成果產業化，助力澳門發展新材料產業，並促使更多澳大科技用於灣區高新產業，為提升國家和澳門的科技實力貢獻澳大的力量。

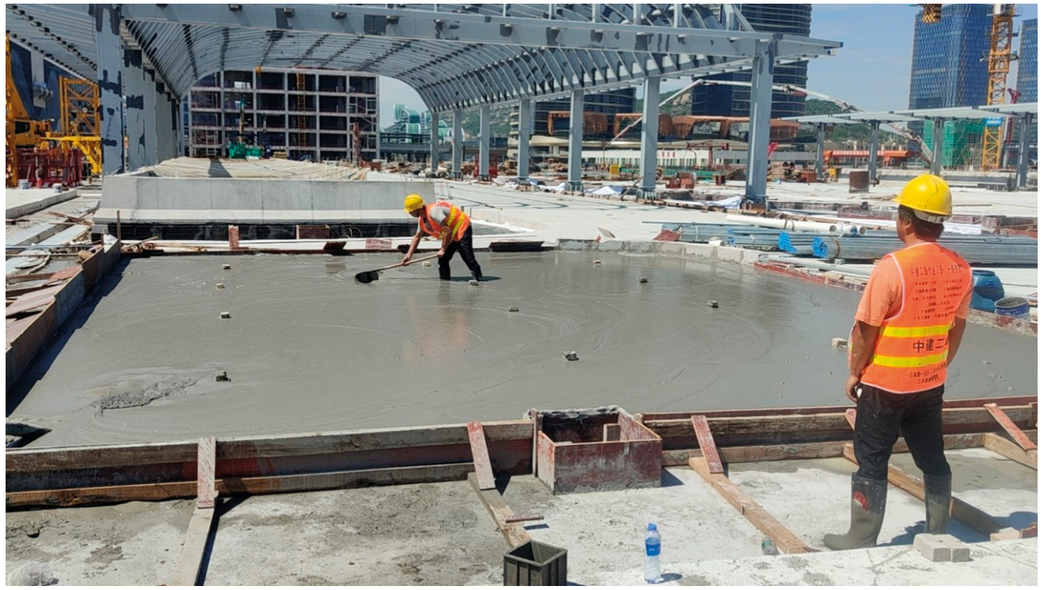
With the rapid development of emerging industries such as next-generation information technology, new energy sources, and smart manufacturing, society's demand for quality materials has also increased. For this reason, the University of Macau (UM) has established the Macao Centre for Research and Development in Advanced Materials, whose mission is to foster technological innovation and the commercialisation of advanced materials, and to emphasise green practices, low carbon, refinement, and efficiency in Macao's advanced materials industry.

Laying the Foundation for R&D Advancement

The new wave of technological and industrial revolution has led to unprecedented innovation in science and technology worldwide. Meanwhile, advanced materials with superior performance have become essential to the development of high-tech industries, smart cities, and urban infrastructure in Macao and mainland China. Advanced materials are developed using cutting-edge technologies and most exhibit characteristics such as high performance, high durability, low defect rates, low cost, and multi-functionality. They not only lay the groundwork for the transformation and upgrading of all industries but also serve as a cornerstone of sustainable urban development. Therefore, related research and development (R&D) work holds immense significance.

Advanced materials have long been at the heart of UM's research layout. In 2014, the university established the Institute of Applied Physics and Materials Engineering (IAPME). The institute brings together innovative scholars from world-renowned universities and research institutes in the United States, Europe, Japan, Singapore, and Hong Kong to form a strong interdisciplinary team. Building on quantum mechanics, atomic theory, and solid-state physics, the team is committed to developing key technologies for advanced materials. After nearly

湯子康教授
Prof Tang Zikang



珠澳橫琴口岸綜合交通樞紐運用澳大研發的納米泡沫混凝土技術
The nano-foam concrete technology developed by UM was used in the construction of the Integrated Transport Hub at the Hengqin Port between Zhuhai and Macao

a decade of concerted efforts, IAPME has fostered a thriving research environment and achieved a wealth of remarkable results. Furthermore, with the support of the Science and Technology Development Fund of Macao, UM has established the Macao Centre for Research and Development in Advanced Materials (the centre), which is the second platform for the commercialisation of industry-academia research results in Macao, after the university's Macao Centre for Research and Development in Chinese Medicine. The centre aims to provide a conducive environment for interdisciplinary research on advanced materials, such as the next generation of semiconductors and quantum biomedical technology.

The centre is located in Research Building N23 of UM's Research Base, adjacent to the university's state key laboratories. Across a wall behind the Research Base is the Hengqin-Macao Youth Entrepreneurship Valley. The centre is working closely with the Zhuhai UM Science & Technology Research Institute, leveraging the opportunities presented by technological R&D and the development of the high-end manufacturing industry in Hengqin. They aim to accelerate the commercialisation of IAPME's research results, thereby supporting the Macao Special Administrative Region to explore a market-oriented development model that organically integrates industry and academia.

Prioritising the Development of Advanced Materials

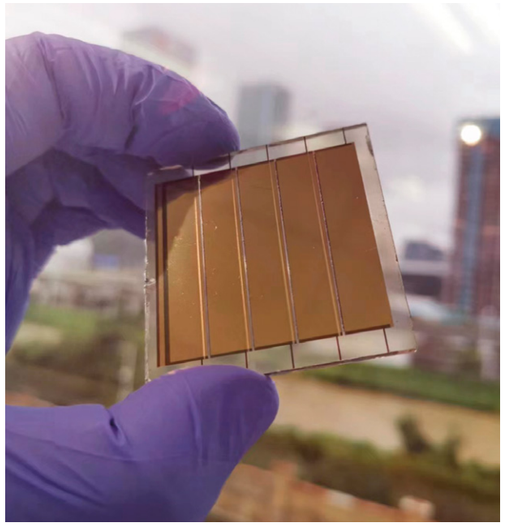
The energy crisis, environmental pollution, and global health are pressing concerns, and the IAPME research team is working on these issues. Prof Shuji Nakamura, who received the Doctor of Science *honoris causa* degree from UM in 2020 and the 2014 Nobel Prize in Physics, is a pioneer of sustainable energy technology. His inventions have not only revolutionised the lighting industry, but have also made significant contributions to human well-being. He recognises UM's research direction in advanced materials. He also noted that apart from helping companies enhance their competitiveness and explore new markets, the development of advanced materials may improve productivity and the everyday living environment, ultimately benefiting society by enhancing people's sense of well-being.

To this end, the centre integrates fundamental research with advanced materials, fosters the development of advanced materials to meet market demands, and connects with businesses to accelerate the commercialisation of research results. Prof Tang Zikang, director of IAPME and director of the centre, is an internationally renowned scholar and pioneer in the field of nano-optoelectronic materials. Over the years, he has led his team to conduct cutting-edge research on advanced materials and develop innovative techniques to tackle technological bottlenecks in the field.

According to Prof Tang, 'Our goal is to develop materials of epoch-making significance. Advanced materials are among the most dynamic and promising areas of scientific research in the Guangdong-Hong Kong-Macao Greater Bay Area [GBA]. The centre, which integrates applied research, commercialisation of research results, and industrial services, is a great demonstration of UM's capability to foster innovative industry-academia collaboration in the field of advanced materials, as well as cooperation and coordinated development among industries in the GBA.'

Green Building Materials for Macao's Infrastructure

Cement production is an energy-intensive process that requires high temperatures, and the chemical reaction involved also produces a substantial amount of carbon dioxide. In 2021 alone, carbon emissions from the production of cement used in constructing buildings, roads, and infrastructure reached 2.9 billion tons, accounting for 7 per cent of the world's total carbon emissions. Compared with conventional products on the market, the nano-foam concrete developed by UM has smaller air voids. This advanced material can reduce cement consumption by 10 to 40 per cent, significantly reduce carbon emissions and production costs, and improve the insulating capacity of the structure by two to three times. It can be used in lightweight wall panels, door panels, and even in large-scale cast-in-place (backfill) projects. The cast-in-place concrete solution has also been applied in several major projects in Macao and Zhuhai, such as the road connecting the fourth Macao-Taipa bridge and the Zhuhai-Macao Port Artificial Island of the Hong Kong-Zhuhai-Macao Bridge, as well as the Integrated Transport Hub at the Hengqin Port between Zhuhai and Macao. These two construction projects alone have used 60,000 cubic metres of nano-foam concrete. Compared with similar solutions available on the market, this advanced material has saved 10,000 tons of cement and reduced the corresponding carbon emissions by 9,000 tons (calculated on the basis of 0.9 tons of carbon dioxide emitted during the production of one ton of cement), thus making the construction more eco-friendly.



澳大開發的鈣鈦礦光伏器件
The perovskite solar cells developed by UM

Eco-Friendly Materials That Help Farmland Retain Water

As global warming continues to take its toll, drought and desertification become increasingly prevalent. UM has developed an innovative super hydrogel that exhibits an exceptional water absorption capacity of more than 18,000 times its weight, setting a new world record. The super hydrogel can retain up to 40 per cent of water near plant roots, which helps prevent soil erosion. It can also be buried in the ground to retain water in farmland and deserts. The product has already entered the pilot phase. Sunscreen for plants, another product developed by UM, can be sprayed on leaves to protect crops from scorching heat and harmful ultraviolet rays, and promote photosynthesis. It is particularly useful for plants grown in high-altitude, arid, or tropical environments. The production cost of the sunscreen is 70 per cent less than that of imported products available on the market, and notably, it is more effective. With a good value proposition, the sunscreen is in pilot production.

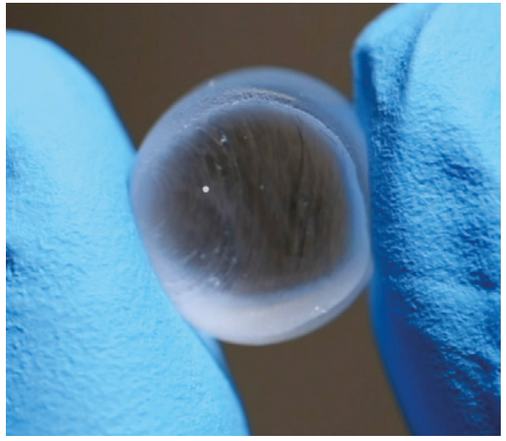
Facilitating Energy Transition With Advanced Materials

The development of clean energy is a crucial step in the global energy transition and in the building of a 'green Macao'. In light of this, UM has developed a catalyst that can split hydrogen from photo-/electro-catalytic water. The catalyst can maintain its stability and efficiency under high electric current, which meets the requirements of water electrolysis for the industrial production of 'green hydrogen'. In addition, it has the advantages of low preparation cost, long service life, and an environmentally friendly production process. The catalyst has been put into mass production and is being pilot tested for large-scale hydrogen production in the mainland, promoting energy transition from fossil fuels.

On the other hand, photovoltaic cells generally use polysilicon as a raw material, which is highly polluting, energy intensive, and costly to refine. In contrast, UM's photovoltaic solar cells are developed using perovskite materials and can be mass-produced through low-temperature printing at low cost. It is worth noting that the university's newly developed phase-pure quasi two-dimensional (2D) metal-halide perovskites are also made of perovskite materials, which are flexible and light in weight. The perovskites can be printed onto backpacks or clothes by aerosol spraying, providing stable and efficient solar energy storage. UM's perovskite solar cells occupy a market-leading position in terms of photovoltaic conversion rate, and the research team is in the process of securing funding for mass production.

Pioneering Technologies for Tumour Immunotherapy

Cancer is difficult to treat because cancer cells can evade immune system attacks through immune escape. The new carbon quantum dot developed by UM can 'facelift' the proteins of cancer cells so that they no longer resemble normal proteins, thereby triggering the patient's immune response against the cancer cells and eliminating them. The research team has completed the standardised production process of the carbon quantum dot material. The team has also completed planning for a GMP (Good Manufacturing Practice of Medical Products) laboratory for the production of the material. The laboratory will be located in the Traditional Chinese Medicine Science and Technology Industrial Park of Cooperation between Guangdong and Macao in collaboration with Sinopharm, a Chinese state-owned enterprise.



澳大開發的新型超級水凝膠
The innovative super hydrogel developed by UM

Supporting the High-Tech Industries

Through the centre, UM's advanced materials projects have established connections with local and foreign businesses and social capital. This facilitates the commercialisation of research results and supports future major construction projects and the development of high-tech industries. The centre will leverage the policy advantages of the Guangdong-Macao In-depth Cooperation Zone in Hengqin, accelerate the industrialisation of research results, and help Macao develop its advanced materials industry. This will enable more UM technologies to serve the high-tech industry in the GBA and contribute to the technological strength of Macao and the country.

嶄新科技推動綠色創新

Fuelling Green Innovation With Pioneering Technology

文 / 余偉業 · 圖 / 由受訪者提供 · 英文翻譯 / 關詠琪
Text / Kelvin U · Photo / Provided by the interviewee · English Translation / Winky Kuan

澳門大學的科研團隊通過研發嶄新技術，在環境工程、生物技術、潔淨能源、智慧城市等領域推動綠色創新，協助實現可持續發展，同時支持學生參與環保創業。多項研究成果已進入轉化落地階段並與企業對接，助力打造循環經濟、建設綠色澳門。

有機廢物轉為商品

澳大團隊開發的「揮發性有機酸（VFA）及鹼度在線監測系統」能為發酵工業即時監測VFA含量和鹼度，確保發酵系統投入大規模生產時高效運行和提前預警。海洋科學及技術系助理教授郝天偉、研究助理教授錢光升為該研究項目的負責人，他們指出，城市每日產生數以噸計的污水、污泥、餐廚垃圾等有機廢棄物，「厭氧發酵」技術能減低各類有機廢棄物引致的環境污染，還可「轉廢為寶」，生產高價值商品。

「厭氧發酵」系統以VFA含量和鹼度為關鍵指標，其監測技術成熟度達TRL6級別，能用於「發酵」產業，包括環保、食品藥品加工、清潔能源等以有機廢棄物為原材料的行業，也可用於生產多類產品，如抗生素、維生素和藥用氨基酸等藥物；酒、麵包和乳酪等食品；以及甲烷和生物塑膠等，蘊含巨大經濟效益。郝教授說，即時監測「厭氧發酵」可及早檢測問題，有助採取措施提高產品質量和系統可控性。

傳統VFA檢測依賴昂貴儀器，需時15至30分鐘，需要專業人員操作和維護，而且樣品測定需要預處理，無法即時監測及預警。郝教授表示，「我們的系統操作簡單，檢測只需三分鐘內，而且精確度高、裝置成本低廉，能穩定地即時在線監測，保證發酵系統高效運行和提前預警。」

研發團隊已利用該系統完成和跟進多項專案，包括香港小蠔灣污水廠硫化氫檢測項目、香港東涌污水廠鹼度及硫化氫檢測，以及澳門廚餘垃圾與城市生活污水綜合管理專案。該系統的原型組件已通過實驗室相關環境的測試和驗證，並於真實環境使用。團隊正透過澳大與多家環境工程及創業投資公司商討合作。

支持學生環保創業

澳大學生組成的BioPeTech團隊借助書院的創業模式、學院的開發技術指導和「國家級眾創空間」創新創業中心的支持，在學期間利用啤酒行業日常產生的大量麥芽渣作為植物纖維基底，研發出環保、健康、優質的貓砂。BioPeTech正與澳門首家專門生產手工啤酒的「趣眼釀酒廠」（由澳大另一支創業團隊創立）和香港麥氏啤酒廠就回收麥芽渣的工序、所需機械、人力資源調配開展深度合作，擴展啤酒行業下游渠道，打造循環經濟。

從大學生變老闆，一切源於愛貓心切、創意思維，以及善用大學的創新創業環境。BioPeTech核心成員譚佩詩、唐敏、付昊明和王正浩相識於鄭裕彤書院，由書院院長黃承發和導師鄧宇明擔任顧問。他們專業不同但志趣相投，對釀製啤酒時產生的麥芽渣突發奇想，開發麥芽貓砂。經過書院非駐院導師、健康科學學院副教授譚建業指導，團隊在2021年研發出「噬糖真菌」技術，把廢棄麥芽渣的殘糖噬走，製成獨特的麥芽貓砂配方。

透過書院支持，環保麥芽貓砂項目於半年內接連在原料配比實驗、產品原型測試、小規模化生產等階段取得突破，也進駐了澳大創新創業中心優化改造。經過多方循循善誘，BioPeTech逐步實踐創業概念。在書院牽綫下，BioPeTech在2021年與香港科技大學合作，將項目進駐香港科技園，研發更成熟和穩定的「噬糖真菌」技術，為進一步創新創業奠下穩固基石。

今年4月，BioPeTech經澳門科學技術發展基金配對，以校友企業角色與黃承發教授進行產學研合作，完成麥芽貓砂的技術驗證，確保幼貓不會因誤食貓砂而影響健康。BioPeTech更已走進粵港澳大灣區其它城市，進駐廣州南沙的孵化中心OVO PLUS澳創家孵化器，從而接觸當地的資源，尋找銷售的戰略合作伙伴，將產品引入內地。

提升氫燃料電池效能

氫能源使用時無污染，被視為未來發電和運輸的綠色燃料，而氫燃料電池的穩定性是氫能源發展的關鍵。澳大團隊開發的線上演算法系統能快速、準確地檢測氫燃料電池的氧氣計量，確保電池正常運行，延長壽命。海洋科學及技術系助理教授張平、博士研究生李哲君是該研究項目負責人。他們表示，人離不開氧氣，氫燃料電池也是類似，一旦供氧不足就會影響氧化還原反應，令電池容易「窒息」，出現反極現象，危害電池壽命。

張教授進一步解釋，氫燃料電池多以質子交換膜為高分子電解材料，當處於低氧狀態的電池突然負載增加，會導致膜受熱不均和出現膜針孔，對膜造成不可逆轉的損壞。他們開發的系統通過「高斯過程分類」、「拉丁超立方抽樣」及「核密度估計」等機器學習方法，準確得出氫燃料電池在能量轉換的過程中（即氫能發電）氧氣化學計量比，並透過「電化學阻抗頻譜」減少在線診斷測量出錯的問題。

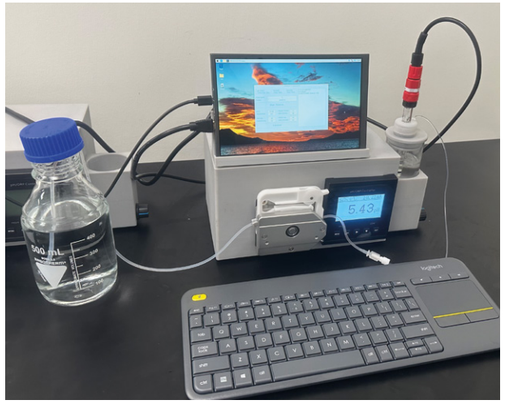
該系統已進入測試，預計用於監測電動車、備用電池和發電站等。張教授表示：「氫能電動車將成為可持續發展的趨勢，需要高效而穩定的氫燃料電池系統。氧氣供應過多或過少都會降低電池效能，我們研發的技術能準確計量供氧狀態，確保電池發揮最佳性能。」

開發智慧能源管理系統

澳大團隊依託智慧城市物聯網國家重點實驗室（SKL-IoTSC）的科研成果，開發出室內能源智慧管理系統，通過智能決策演算法考量舒適度、減少碳排放、降低費用等因素，自動調節室內能源使用。該系統的感測器和智能轉接終端即插即用，方便用戶室內自行安裝，而且配備資源聚合與大數據後台，從用戶側有效分析和監測室內能源的使用狀況，實現智能的能源分配與調整。

為推動科研成果轉化，團隊在SKL-IoTSC和珠海澳大科技研究院支持下成立創業實體「希畝SEM」，SKL-IoTSC助理教授惠紅勳為導師，碩士研究生陳倫澍為負責人，碩士研究生王可欣、程欣欣、朱江舸、劉釗西等為核心成員。惠教授表示，該系統是師生共同努力的見證，以物聯網負荷控制、智慧能源管理、優化演算法的研究突破作為關鍵的理論和技術支撐。

「希畝SEM」成員已開發原型機，並在實驗環境下深



澳大團隊開發的「厭氧發酵」監測系統

The automatic analyser for volatile fatty acid (VFA) and alkalinity developed by UM researchers

化智能決策演算法。他們還積極參與創新創業競賽、學術會議、成果轉化展會，並到企業實習，深入了解行業最新動態和相關的技術發展和工程應用。惠教授相信，系統進一步的開發和驗證有望為環保領域帶來革命性貢獻，這種教學、科研和創新創業的模式也有利學生在提升科研實力的同時，把成果結合實際應用、服務社會。

Research teams at the University of Macau (UM) are driving green innovation in fields such as environmental engineering, biotechnology, clean energy, and smart cities through the development of innovative technologies. Their efforts aim to achieve sustainable development goals while also supporting student involvement in starting businesses focused on environmental protection. Currently, several UM research teams are establishing partnerships with businesses to assist Macao in developing a circular economy and helping the city achieve environmental sustainability.

Turning Organic Waste Into Valuable Products

One UM research team has developed a novel real-time automatic volatile fatty acid (VFA) and alkalinity analyser. The system enables real-time monitoring of VFA content and alkalinity in fermentation industries, ensures efficient operation and provides early warning signals when scaling up production in fermentation systems. Assistant Professor Hao Tianwei and Research Assistant Professor Qian Guangsheng in the Department of Ocean Science and Technology are the project leaders. According to them, from an environmental improvement perspective, cities generate tons of wastewater, sludge, and organic waste such as kitchen waste every day. Anaerobic fermentation technology can reduce environmental pollution caused by various organic waste, and can also turn waste into valuable products.

The system utilises VFA content and alkalinity as key indicators in anaerobic fermentation, and has reached technology readiness level 6 (TRL6) in terms of monitoring technology. It has the potential to be implemented in various sectors that depend on fermentation, such as clean energy, food and pharmaceutical processing, and environmental protection. For instance, it can be applied to the fermentation process involved in the production of medical products such as antibiotics, vitamins, and medicinal amino acids; the fermentation of wine, bakery products, and yoghurt; as well as the production of methane and bioplastics. In other words, the system has tremendous economic benefits. ‘By monitoring the anaerobic fermentation process in real time, issues can be detected at an early stage, and corresponding measures can be taken to improve product quality and system controllability,’ says Prof Hao.

Traditional VFA monitoring relies on expensive laboratory equipment that requires skilled operators and maintenance. The detection process takes 15 to 30 minutes, and sample preparation is necessary, making it impossible to perform real-time monitoring and provide early warning signals. Prof Hao says, ‘This system is simple to use and it takes less than three minutes for each testing. With high accuracy and low installation cost, the system enables online real-time and consistent monitoring to ensure that the fermentation system operates efficiently and provides early warning signals.’

The research team has deployed the system in multiple projects, including hydrogen sulphide monitoring at Siu Ho Wan Sewage Treatment Works in Hong Kong, alkalinity and hydrogen sulphide monitoring at Tung Chung Sewage Pumping Station in Hong Kong, Macao Household Food Wastes-Sewage Sludge Co-digestion towards Energy Recovery, and Characterization and Energy Recovery Potential Evaluation of Macau Commercial Food Waste (Phase I and II). The prototype components of the system have undergone laboratory tests and validation and have been used in real-world settings. Currently, the team is negotiating with several environmental engineering companies and venture capital firms regarding potential partnerships.

Supporting Student Entrepreneurs in Environmental Protection

BioPeTech is a company founded by a group of UM students that specialises in producing a natural, eco-friendly, and high-quality malt cat litter from brewer’s spent grain (BSG), a by-product of the beer brewing process. During their studies at UM, the students received technical guidance from their residential college and support from the Centre for Innovation and Entrepreneurship, a national co-working space at the university. The company has entered partnerships with Funny Eye Brewery, the first craft brewery in Macao (established by another entrepreneurial team from UM) and Mak’s Brewery in Hong Kong, and established close cooperation with these companies to recycle malt residue, machinery, and staff management. The goal is building a circular economy in the beer brewing industry.

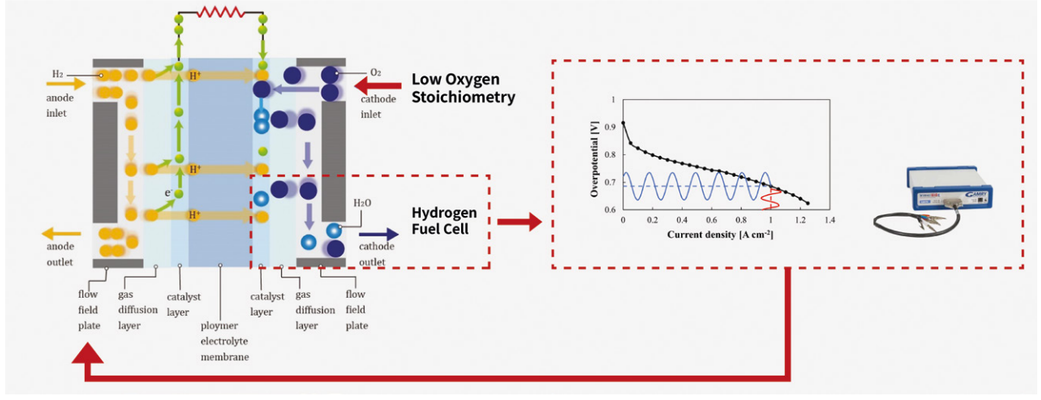
It all started with a deep love for cats and a creative idea. The core members of BioPeTech, Tam Pui Si, Tong Man, Fu Haoming, and Wang Cheng-hao, first met at Cheng Yu Tung College (CYTC) of UM and found that they shared a common interest in entrepreneurship even though they majored in different disciplines. They came up with the idea of using malt residue from beer brewing to create BSG cat litter. With College Master Wong Seng Fat and Resident Fellow Tang Yu Ming of CYTC serving as advisors, and under the guidance of Associate Professor Tam Kin Yip in the Faculty of Science and Technology, the team developed a technology called sugar phagocytic fungus. This technology helps eliminate sugar from malt residue to prevent kittens from consuming sugar by accident, creating a unique formula for the BSG cat litter.

澳大學生開發的環保麥芽貓砂

The eco-friendly malted cat litter developed by UM students

BioPeTech團隊與黃承發、鄧宇明合影

The BioPeTech team, along with Wong Seng Fat and Tang Yu Ming



澳大開發能提升氫燃料電池穩定性的技術

UM develops technologies to enhance the stability of hydrogen fuel cells

With the support of CYTC, the BSG cat litter project achieved rapid progress within six months in formulation experiments, product prototype testing, and small-scale production. The team also carried out further optimisation and improvement of the product at UM's Centre for Innovation and Entrepreneurship. Thanks to guidance from multiple parties, BioPeTech gradually transformed its initial idea into a tangible product. In 2021, the team collaborated with the Hong Kong University of Science and Technology with the help of CYTC, establishing a presence in the Hong Kong Science and Technology Parks for further research and development. This move helps navigate the sugar phagocytic fungus technology towards a more mature and stable stage, laying a solid foundation for BioPeTech's future development.

In April this year, BioPeTech, through matching funding from the Science and Technology Development Fund of Macao, engaged in industry-academia collaboration with Prof Wong Seng Fat as an alumni company. They have completed the technical validation of the BSG cat litter, ensuring the product is safe for kittens in case of accidental ingestion of the litter. Currently, BioPeTech has expanded into the Guangdong-Hong Kong-Macao Greater Bay Area and established a footing at OVO PLUS, an incubator located in the Nansha district of Guangzhou. This allows the company to tap into local resources and seek strategic partners for sales, with the aim of introducing their product to the mainland market.

Enhancing Hydrogen Fuel Cell Efficiency

Hydrogen energy, known for its pollution-free properties, is considered a green fuel for future power generation and transportation. The stability of fuel cells plays a crucial role in the development of hydrogen energy. A research team at UM has developed an online algorithm system that can rapidly and accurately measure the oxygen content in proton exchange membrane fuel cells (PEMFCs), to ensure the normal operation of the cells and prolong their lifespan. Zhang Ping, assistant professor in the Department of Ocean Science and Technology, and doctoral student Li Zhejun are the project leaders. Just as humans cannot live without oxygen, PEMFCs also require an adequate supply of oxygen. Insufficient oxygen can hinder the oxygen reduction reaction, leading to a 'suffocating' effect and causing detrimental effects on the cell's lifespan.

Prof Zhang further explains that PEMFCs often use proton exchange membranes as the electrolyte. When the cell is in a low oxygen state and experiences a sudden increase in load, it can result in uneven heating and the formation of pinholes in the membrane, causing irreversible damage. The algorithm system utilises machine learning techniques such as Gaussian Process Classification, Latin Hypercube Sampling, and kernel density estimation to accurately determine the oxygen stoichiometry in the process of hydrogen energy conversion, that is, electricity generation from hydrogen in PEMFCs. It addresses issues of inaccuracy with online diagnostic measurement using electrochemical impedance spectroscopy.

Currently, the system is undergoing testing and is expected to be used in monitoring devices for fuel cell power systems, such as electric vehicles, backup batteries, and power stations. Prof Zhang says, 'Hydrogen-powered electric vehicles are set to become a market trend for sustainable development, which requires efficient and stable fuel cell power systems. Excessive or insufficient oxygen supply can diminish cell performance. The technology we developed can accurately measure the oxygen supply status to ensure that fuel cell power systems achieve optimal performance.'

Developing an Intelligent Energy Management System

One UM research team has developed an indoor energy management system based on the research achievements of the State Key Laboratory of Internet of Things for Smart City. Through intelligent decision-making algorithms, the system can automatically adjust the use of indoor energy for users, taking into account key factors such as comfort, carbon emission reduction, and cost reduction. The system's sensors and intelligent interface terminals are plug-and-play, making it easy for users to install it indoors. In addition, it is equipped with resource aggregation and a big data backend, which allows users to analyse and monitor their indoor energy usage, thereby achieving intelligent energy distribution and adjustment.

To promote the commercialisation of research results, and with the support of the laboratory and the Zhuhai UM Science & Technology Research Institute, a UM research team has established a startup called Smart Energy in Macao (SEM). Hui Hongxun, assistant professor in the laboratory, serves as the mentor; master's student Chen Lunshu is the team leader; and master's students Wang Kexin, Cheng Xinxin, Zhu Jiangge, and Liu Zhaoxi are the core members. According to Prof Hui, the system, which leverages research breakthroughs in internet of things load control, intelligent energy management, and optimisation algorithms as key theoretical and technical support, stands as a testament to the joint efforts of the students and faculty.

SEM members have completed the development of the prototype and further refined the intelligent decision-making algorithms in experimental environments. In addition, they actively participate in innovation and entrepreneurship competitions, academic conferences, exhibitions, and internships in companies to gain more knowledge of the latest developments in the industry, as well as relevant technological advancements and engineering applications. Prof Hui believes that with further development and validation, the system holds the potential to make revolutionary contributions in the field of environmental protection. Moreover, the integration of teaching, research, innovation, and entrepreneurship is beneficial for students to enhance their research capabilities and transform their research results into practical applications for public interest.

澳大開發室內能源智慧管理系統

UM has developed an intelligent indoor energy management system

希畝團隊成員參與創業比賽

The SEM team members participate in an entrepreneurship competition

李軍：藝術是心與手構築的理想世界

Li Jun: Art Is an Ideal World Crafted by Heart and Hands

文 / 盛惠怡、校園記者李昌洲 · 圖 / 何杰平，部分由受訪者提供
Chinese & English Text / Debby Seng, UM Reporter Li Changzhou · Photo / Jack Ho, with some provided by the interviewee

達文西的《蒙羅麗莎》裡那微微上揚的唇角，早已引起無數評論家的好奇與探索。對澳門大學藝術與設計系主任、講座教授李軍而言，文藝復興時期藝術家的作品深入人心，不僅在於其精湛的技藝，更在於其作品流露出當時的社會和文化背景，以及對人性情感和內心矛盾的細緻描繪。在李軍教授眼中，這是藝術真正價值的所在，也是他不懈鑽研藝術史的動力。

半途出家藝術人

李軍從北京大學畢業後於中央美術學院任教37年，曾任該院人文學院院長，研究涵蓋達文西、文藝復興、跨文化藝術、文化遺產、策展，以及視覺藝術與藝術史方法論，著有《可視的藝術史：從教堂到博物館》和《跨文化的藝術史：圖像及其重影》等書。2023年6月，他加入澳大藝術與設計系，與其他教授組建一支集合頂尖藝術家和藝術史學家的教學團隊，培育藝術創作精英。

在李教授看來，藝術是我們用心與手構築的理想世界。「不少孩童學習書寫前已愛上繪畫，這是人的天性，象徵我們對於理解世界的渴望。初學繪畫的小孩畫一個圓形，與外界分割開來，是在表達心中認知的世界。我深信藝術不僅是一個專業領域，而且是與人的成長息息相關的探索。」

生於浙江杭州的李軍自小熱愛繪畫、詩歌和文學，可謂典型文藝青年。1980年，他懷著文學寫作夢入讀北京廣播學院（現中國傳媒大學）新聞系，時值內地改革開放之初。他將美學研究視為思想解放運動的一環，廣泛閱讀美學和哲學著作，並於1984年到北京大學哲學系深造，攻讀美學專業研究生課程。

在北大的葛路教授指導下，李軍專研中國美學。當時西方思潮蜂擁而入，引發內地許多知識分子反思中華文化與精神，這對李軍的畫論和中國藝術理論研究影響甚深：「先深入了解西方，再基於此重新審視我們的傳統文化，正是我的藝術追求。」

探秘文藝復興時期作品

李軍畢業後於中央美術學院任教。期間，他在2002年到法國國家遺產學院、2011年到法國巴黎第一大學、並在2013年到美國哈佛大學進修，深入認識歐洲藝術。「歐洲藝術研究存在於生活之中。藝術品散佈在教堂和博物館等地，人們有很多機會親身感受偉大藝術家的內心世界。在各個城市的大街小巷，我都可以隨時進入藝術現場。」

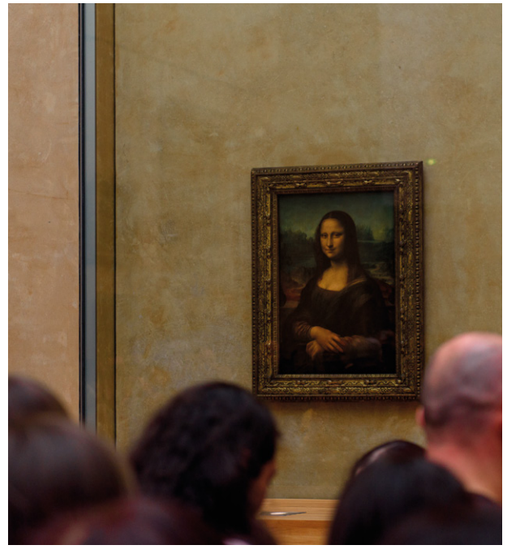
通曉中、英、法、意多語的李教授認為，掌握多門語言有助深入研究藝術史。「我們必須進入原作、原文、原語境之中。原文是創作者的文化語言，如果不懂原文，很難深入理解他們的作品。」

李教授也認為，流傳千古的畫作必有深沉的意涵，要了解其時代背景才能窺探真正的創作意念。著重以原文研究文藝復興時期藝術史的他舉例說：「15世紀畫家弗朗切斯科 · 德爾 · 科薩在《天使報喜》中，在天使與聖母瑪利亞之間畫上一條不符透視原理的柱子；從整體來看，這種不協調上是一種在世俗世界表達神聖的方式，那條柱子寓意基督，而基督本身就是奇跡。」

李教授進一步指出，在很多文藝復興時期的藝術創作中，藝術家要在神聖世界觀和世俗世界觀之間尋求某種妥協。「從現代人看來，那個時代是人文與信仰兼容並蓄，因此藝術作品時有矛盾的呈現。我們唯有回到那個時代，代入充滿宗教情緒的藝術家的想法，才能解讀這些矛盾。」

對達文西作品情有獨鍾

在文藝復興時期的作品中，最負盛名者莫過於藏在巴黎羅浮宮、出自達文西之手的《蒙羅麗莎》。李教授對達文西的作品情有獨鍾，其辦公室有一整列書架放著關於這位天才巨匠的著述。「達文西的藝術作品魅力非凡，潛藏很多秘密，其解密過程十分有趣。」



展於羅浮宮的《蒙羅麗莎》
The *Mona Lisa* on display at the Louvre Museum

在達文西之前，西方女性肖像多為側面像，如同錢幣上的形像，著重人物輪廓，但《蒙羅麗莎》是四分之三側面像。李教授說，達文西繪畫此作時採用其開創的暈塗法，以半透明顏料一層層薄塗，一層乾了再上一層，營造漸層效果，使觀眾不論站在何處，畫中人都仿佛注視著他們。

對李教授來說，《蒙羅麗莎》的偉大不止於技法的革新，更在於它與觀眾之間建立的情感聯繫。「達文西一系列畫作都在呈現人際關係，早年作品展現畫中人物之間的聯繫，晚期作品側重畫面與觀眾的交流。我們欣賞《蒙羅麗莎》時都成為了達文西，不僅看到蒙羅麗莎及其背後山水所代表的宇宙，更可看到蒙羅麗莎所象徵的母親與觀眾（象徵孩子）的情感關係。這些偉大作品的涵義往往超脫作品本身，變成觀眾參與的故事。」

藝術再現與生活的關聯

李教授認為，藝術是一門講求多元調和的學問，絕非一種精神獨大或二元對立：「藝術作品是一種『Representation』，這個詞意義深長，中文通常譯為『再現』，意指藝術家以作品重新建構他們認知的世界。我認為藝術對於世人正是對生活的再次呈現（Re-presentation）。每個人都想再活一次。在理想生活與現實生活之間存在的藝術，正是我們描繪理想生活的媒介。」

日常生活矛盾紛擾不斷，例如我們的自我意識和潛意識時有衝突。李教授說：「在此背景下，藝術的真正價值並非是抹去生活中的不正常之處，而是讓多種力量在同一件作品中達到一種妥協。因此，藝術更多是一個想像的結局，不會用來直接解決各種衝突，但通過表現這些衝突，藝術能使人們各種不同的情感和想法在相互妥協中融為一爐。」

多元文化激發藝術創作

2020年首次踏足澳門的李教授對這座城市有獨特感情，一大原因是澳門與他熟悉的歐洲城市相似，新舊建築之間沒有明確界限，如大三巴牌坊旁有哪吒廟，哪吒廟旁有民居，這種風貌在內地殊為罕見。「我們常在一程車跨越澳門半島、氹仔和路環，從人煙稠密的現代住宅區，到充滿歷史的舊城區、金碧輝煌的路氹填海區、再到富有小島風韻的路環，最終到達宛如世外桃源的澳大校園，窗外景物變化萬千。」

2021年，「從庫爾貝、柯羅到印象派——來自法國諾曼第光影世界·真跡展」在北京舉行，李教授擔任其學術顧問。他正籌備在2024年將該展覽以新面貌帶到澳大，精選多幅莫內和布丹等法國印象派大師、法國現實主義代表藝術家庫爾貝和法國巴比松畫派畫家柯羅等名家的作品，主題環繞法國諾曼第的海景。他計劃於該展覽增添以澳門為主題、名為「在海的那一面」的單元，展出澳門藝術家的作品。

展望將來，李教授期望把澳門獨有的歷史文脈融於澳大的藝術創作課程，拓寬學子的藝術創作資源。「憑藉澳大藝術與設計系這個平台，我們將在多媒介、多學科交織的藝術學習和研究環境下，孕育能融合中西與古今文化、利用多種媒介創作的現代藝術人才，將澳門的藝術與世界連結起來。」

李軍教授
Prof Li Jun

《可視的藝術史：從教堂到博物館》《跨文化的藝術史：圖像及其重影》《在最遙遠的地方尋找故鄉：13-16世紀中國與意大利的跨文化交流》
A Visible History of Art: From Church to Museum, A Transcultural History of Art: On Images and Its Doubles, and *Finding A Homeland at the End of the World – The Trans-cultural Exchanges and Interactions Between China and Italy From the 13th Century to the 16th Century*

The enigmatic smile of Leonardo da Vinci's *Mona Lisa* has long captivated audiences. To Prof Li Jun, head of the Department of Arts and Design at the University of Macau (UM), Renaissance artists' genius goes beyond their technical skills. Their works capture the socio-cultural currents of their times, offering deep insights into human emotions and inner conflicts. This, Prof Li believes, is the true value of art, and is what fuels his passion for the study of art history.

Unveiling the Artist Within

After graduating from Peking University, Prof Li taught at the Central Academy of Fine Arts for 37 years. He also served as dean of the School of Humanities. His research interests encompass Leonardo da Vinci, the Renaissance, transcultural arts, cultural heritage, exhibition planning, as well as visual culture and art history methodology. Among his notable publications are *A Visible History of Art: From Church to Museum*, and *A Transcultural History of Art: On Images and Its Doubles*. In June 2023, he joined UM's Department of Arts and Design. He is currently working with other professors in the department to nurture the next generation of artists and art historians.

Prof Li believes that art is an ideal world crafted by our heart and hands. 'Children are naturally drawn to scribbling, even before they develop their writing skills,' he explains. 'This innate connection underlines human's instinct to understand the surrounding world. For example, a child who just starts learning to draw may draw a circle, which can be seen as creating a separation from the outside world. In other words, drawing is a way to express one's worldview. I am convinced that art is not merely an expertise; it is intrinsically linked to personal growth,' he says.

Born in Hangzhou, Zhejiang, Prof Li has had a passion for painting, poetry, and literature since a young age. In 1980, as mainland China began its reform and opening-up, he enrolled in the Department of Journalism of the Beijing Broadcasting Institute (now known as the Communication University of China), hoping to pursue a literary career. He regarded the study of aesthetics as integral to the intellectual renaissance of the time and immersed himself in reading publications on aesthetics and philosophy. In 1984, he furthered his studies by enrolling in a postgraduate programme in aesthetics at Peking University's Department of Philosophy.

Under the guidance of Prof Ge Lu at Peking University, Li focused on Chinese aesthetics in his studies. During that time, there was an influx of Western ideas into China, prompting intellectuals to reassess the core of Chinese culture. This setting had a profound influence on Prof Li's art criticism and his research on Chinese art theory. He explains, 'My approach to art is to fully understand Western art concepts and then revisit our own traditional culture based on that.'

Exploring the Mysteries of Renaissance Art

During his professorship at the Central Academy of Fine Arts, Prof Li gained a profound understanding of European art through several academic visits. He visited the National Heritage Institute in France in 2002, the University of Paris 1 Panthéon-Sorbonne in 2011, and Harvard University in the US in 2013. 'Art is woven into the fabric of everyday life in Europe,' he remarks. 'Art pieces are omnipresent in churches, museums, and beyond, presenting abundant opportunities for individuals to step into the minds of great artists. I could immerse myself in the realm of art at any given moment, wherever I went.'

Proficient in Chinese, English, French, and Italian, Prof Li believes that mastering multiple languages is essential for in-depth study of art history. 'It is necessary to immerse oneself in the original works, the source texts, and the authentic language environment,' he says. 'The source language serves as the cultural language of the creators. Without understanding the creator's cultural language, we can hardly get a grasp on their works and truly appreciate them.'

Prof Li believes that some artworks can stand the test of time because they carry profound meanings. To understand what message the artists sought to convey through the masterpieces, one must understand their historical backdrop. Prof Li, who advocates studying the history of Renaissance art through source texts, notes, 'In his painting *Annunciation*, the 15th-century artist Francesco del Cossa painted a column between an angel and the Virgin Mary. The column was surprisingly arranged, which leads to a question: do the angel and Mary really see each other? However, from a macroscopic perspective, the presence of the column underscores the interplay of the divine in the secular world. The column symbolises Christ, and Christ himself is a miracle.'

Prof Li points out that Renaissance artists often had to seek a compromise between the sacred and the secular in their works. 'From a modern perspective, that era embraced both humanism and faith, sometimes resulting in seemingly paradoxical artistic representations. To decode these, we have to immerse ourselves in the artists' religious mindset.'

Enchanted by Leonardo da Vinci's Works

Among the renowned works of the Renaissance, none is more celebrated than Leonardo da Vinci's *Mona Lisa*, which is housed at the Louvre Museum in Paris. Prof Li is fond of Leonardo da Vinci and dedicates a significant portion of his office bookshelf to the Renaissance master. 'The fascination of his artworks lies in their myriad hidden layers, which always captivate those who seek to decipher them.'

Prior to Leonardo da Vinci, Western female portraits were often depicted in profile, similar to the portrait on a coin, with the silhouette of the figure highlighted. However, the *Mona Lisa* presents a three-quarter profile. Prof Li explains that when Leonardo da Vinci painted this masterpiece, he employed his signature *sfumato* technique. The artist created a gradient effect on the painting by applying successive thin layers of semi-transparent paint and letting each layer dry before adding the next. This technique gives the impression that the figure in the painting is gazing at the viewer, regardless of their position.

According to Prof Li, the brilliance of the *Mona Lisa* extends beyond the groundbreaking technique; it lies in the emotional connection the painting establishes with the viewer. 'Leonardo da Vinci's body of work depicts interpersonal relationships. His early pieces demonstrate the relationships between the figures within the painting, while his later works focus more on the interaction between the painting and the viewer. When we look at the *Mona Lisa*, we all become, in a sense, Leonardo da Vinci. We not only observe the smiling lady and the landscape behind her, but may also sense an emotional connection with the lady, who symbolises a mother figure. The underlying meanings of these masterpieces often transcend the artworks themselves and become a narrative that involves the viewer.'

The Representation of Life in Art

For Prof Li, art is a harmonising force amid diverse perspectives, going beyond any kind of dominance or binary opposition. 'In the field of art, each piece of work is a "representation" that signifies the artist's endeavour to reconstruct and reconceptualise the world they perceive,' he explains. 'For me, art is a re-presentation of life. It is a common desire for humans to experience life anew. Art bridges the gap between reality and ideals, and is the very medium through which we depict our ideal world.'

Prof Li believes that everyday life is entangled with contradictions, such as the tug-of-war between self-consciousness and the unconscious mind. 'Against this backdrop, the true value of art lies not in eradicating the abnormalities in life but in orchestrating a delicate balance of the contrasting forces within a single artwork,' he says. 'Therefore, art is more of an imagined resolution rather than a direct solution to various conflicts. Through the representation of the conflicts, art allows people to perceive one another's emotions and thoughts in an inclusive and compromising manner.'

Multiculturalism Inspiring Artistic Creation

Prof Li, who first set foot in Macao in 2020, has a unique affection for the city. One of the reasons is that Macao resembles the European cities with which he is familiar, where there are no clear boundaries between old and modern buildings. For instance, the Na Tcha Temple sits right next to the Ruins of St Paul's, which is neighboured by residential buildings. This kind of urban landscape is rare in mainland China. 'Driving around the Macao Peninsula, Taipa, and Coloane, one can see how the scenery changes from bustling modern neighbourhoods to the historic district, from the glittering Cotai Strip to the serene allure of Coloane. And, as you reach the UM campus, it feels like stepping into a peaceful paradise. It is genuinely mesmerising how every turn reveals a different scenery,' he says.

Prof Li served as academic advisor to the exhibition 'From Courbet, Corot to Impressionism—The World of Light and Shadow from Normandy, France' held in Beijing in 2021. He is now planning to bring this exhibition to UM in 2024. The exhibition will feature a selection of works by renowned French Impressionists such as Monet and Boudin, alongside celebrated artists from the realms of French Realism and the Barbizon school such as Courbet and Corot. The selected pieces will mainly include seascape paintings of Normandy in France. In addition, Prof Li wants to introduce a Macao-themed session titled 'Beyond the Sea', showcasing works by artists from Macao.

Looking ahead, Prof Li hopes to incorporate Macao's unique history into UM's art programmes and seek more resources for student creative endeavours. He says, 'In UM's Department of Arts and Design, an environment that fosters multimedia and interdisciplinary art learning and research, our goal is to nurture contemporary artists who excel in integrating Chinese and Western, ancient and contemporary cultures, and possess the ability to work across diverse mediums. In doing so, we strive to connect Macao's arts with the global community.'

2021年，「從庫爾貝、柯羅到印象派——來自法國諾曼第光影世界·真跡展」在北京舉行，李軍教授擔任其學術顧問。(圖片來源：中央美術學院網站)

Prof Li Jun was academic advisor to the exhibition 'From Courbet, Corot to Impressionism—The World of Light and Shadow from Normandy, France' held in Beijing in 2021. (Credit: Website of the Central Academy of Fine Arts)

Nick Groom: 引領學生尋找經典文學的價值

Nick Groom: Leading Students to Discover the Value of Classic Literature

文 / 余偉業、校園記者董樂萱 · 圖 / 何杰平、資深校園記者廖榮志 · 英文翻譯 / 謝菀菁
Text / Kelvin U, UM Reporter Dong Lexuan · Photo / Jack Ho, Senior UM Reporter Matt Lio · English Translation / Bess Che

在澳門大學的英語兒童文學課堂，英文系教授Nick Groom身穿歐洲哥德式復古服飾，化身格林童話人物授課，引領學生探索童話背後的文化和價值。他曾於英美多間大學任教，擁有逾30年教學經驗，對英國作家J. R. R. Tolkien及其成名之作《魔戒》鑽研多年，並將研究結果輯錄成書，獲國際媒體盛譽，成為《魔戒》迷不容錯過的讀物之一。Groom教授相信，經典文學呈現的情感共鳴，總會讓我們在困難時刻找到力量和希望。

全情投入文學世界

為使學生全情投入兒童文學的世界，Groom教授從皮革公事包裡掏出一個米奇玩偶，鄭重其事地介紹這是他的「寵物」，並把米奇置於肩膀上。往後每一節課，他的愛寵從不缺席。從《三隻小熊》和《小紅帽》，到《愛麗絲夢遊仙境》和《小熊維尼》，Groom教授都讓學生在歡聲笑語中感受童話的魅力。學生當下都能卸下成年人的拘束，朗讀富有韻律的童謠，配以誇張逗趣的肢體語言，以兒童視角品讀文本，75分鐘課堂轉眼結束。

Groom教授於2020年加入澳大，擔任英語文學教授。他曾在牛津大學、布里斯托大學、艾賽司特大學執教，並於史丹福大學、芝加哥大學擔任客座教授，如今將其在文學領域的專長帶到澳大，豐富英文系的教學特色，包括增設「英語文學專題：Tolkien－從五世紀至今」、「十九世紀哥德文學」等科目，吸引鍾情世界文學的學生爭相修讀。「我相信自己能以獨特的英語研究視角為英文系注入新元素，同時為學生的文學視野帶來新的思考，使他們從經典著作中認識文學的價值。」

從文學樹立人生觀

Groom教授生於英格蘭東米德蘭城鎮北安普頓，從小性格文靜，閒時常獨自到鎮內圖書館，透過書籍窺探外面的世界。1985年，他獲牛津大學取錄，修讀英語語言與文學，三年後以雙一等（Double First-Class）榮譽成績取得學士學位，並繼續於牛津深造，取得碩士和博士學位。Groom教授博覽群書，兒時對傳記尤感興趣，特別是牽涉20世紀重大衝突的人物的著作。「傳記是文學體裁之一，可視為史實的側寫，我小時候讀過紅男爵（一戰時德軍飛行員）的傳記，他駕駛的三翼戰鬥機實在型格。」

Nick Groom七歲起寫故事，同學交一兩頁作文時，他的寫作已超過10頁。他還會思考讀本與自己的關係，並寫下當中感悟，久而久之意識到這就是文學評論。經過年月洗禮，從莎翁的曠世巨作，到狄更斯的經典名著，他都逐一拜讀，試圖透過大文豪的筆墨領悟人生，但令他印象最深的是牛津大學教授、語言學家J. R. R. Tolkien創作的史詩式奇幻文學作品《魔戒》。

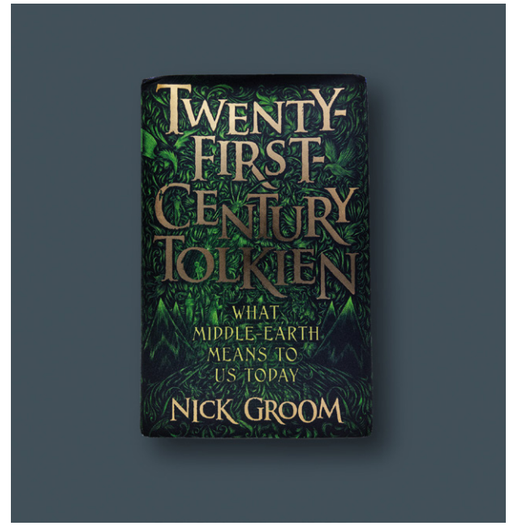
Groom教授解釋，Tolkien絕大部分出版作品執筆於1936年至1949年，即多為二戰期間，情節涉及不同族群的戰爭，令人不期然將自身處境聯想到現實世界。「面對看似毫無勝算的殘局，我們該如何自處？如何在成功與失敗之間找到平衡？這也許是人性的探討。」

大膽的創意寫作

時至今天，《魔戒》的魅力從未減退，就如《西遊記》、金庸小說等以不同方式改編，從廣播節目、Peter Jackson執導的電影，到亞馬遜Prime電視劇集，不斷推陳出新。Groom教授指出，Tolkien的小說最令人佩服之處在於他憑充沛的想像力描繪出廣袤無垠的中土大陸（Middle-earth）。這個充滿奇幻魔法的異世界有語言、文字和風土習俗各異的不同族群居住，描繪精細程度令人咋舌。「如今，21世紀的新生代也對中土大陸有自己的想像和理解，重新演繹Tolkien作品。」

作家普遍借用現成的人文地理說故事，結局早就安排穩當，Tolkien卻是例外。Groom教授解釋，中土大陸並非一開始就鉅細無遺，作者也是見步行步，一邊設計角色，一邊推演大陸的歷史，因此劇情充斥大量故意的矛盾和含糊其詞。「現實世界就是這樣，永不可能有一種完整、全面的方式來觀察，總有些東西是砸你眼睛，不符你的理解，所以你在了解中土大陸時，也會看到Tolkien如何帶領讀者一起探索。這是很大膽的創意寫作。」

Groom教授鑽研Tolkien和《魔戒》多年，其文學評論專著《21世紀Tolkien：中土大陸對我們的意義》在2022年9月發行，由英國出版社Atlantic Books出版，面世幾天便獲瑞士《Le Temps》、美國《華盛頓郵報》報導，獲英國《星期日郵報》譽為「一本令人振奮的精彩書籍」，是《魔戒》迷不可錯過的讀物。該書再版時更擴充內容，並特設美國版，而且正轉譯成多種語言版本。



Nick Groom教授的著作《21世紀Tolkien：中土大陸對我們的意義》
Twenty-First-Century Tolkien: What Middle-Earth Means To Us Today by Prof Nick Groom

Nick Groom教授
Prof Nick Groom

研究格局的塑造

從英國越洋移居澳門，伴隨Groom教授而來的除了他的文學造詣和紳士涵養，還有辦公室書架上他珍愛的經典古籍。Groom教授也是歷史文物、文學真跡鑑賞家，常常流連藝墟和市集，以發掘和鑑別古物真偽為人生一大樂趣。他這份熱愛緣起於1993年攻讀博士時對18世紀英國詩人Thomas Percy的研究，奠定了他往後的研究方向。

Groom教授某次在牛津大學回家探望父母路上，偶然經過Percy住過的老房子，只距離他家約五英里。當時他激動萬分，就是這份「咱倆是老鄉」的情意結，令他覺得自己的論文題目冥冥中自有眉目。於是Groom教授翻查史館古籍，對Percy的書信、手稿和著作逐一勘察，窺探古詩的歷史背景、呈現方式，以及剖析當時民眾對這些詩作的看法。最終他將研究發現輯錄成《The Making of Percy's Reliques》一書，由牛津大學出版社出版。

完成博士研究後，Groom教授的研究格局大致形成，主要劃分為：文化構成與真偽，包括歸因及真跡研究；國家及地區身分認同（以英國、愛爾蘭和英語世界為例）；文化環保主義及非物質文化遺產研究；最早期到現代的哥德式歷史主義解讀。Groom教授至今發表八部學術專著、12部經他編輯的書籍，以及逾百篇學術文章。

他說：「我的研究足跡或多或少都與Percy收集的古詩有關，並以此延伸至眾多主題和學術領域。我透過對不同時空和地域的文本作比較研究，從而對不同的社會文化議題有更深刻的討論和詮釋，並反思這些文本對話對此時此刻的我們有何影響和意義。」

COVID-19的文學反思

經典文學之所以經典，是因為它們觸及人類情感深處，使讀者與主角共鳴、共情。Groom教授的《21世紀Tolkien》在全民防疫中完稿，期間他一直思考COVID-19疫情為他帶來的人生課題，並與學生分享感悟。「Tolkien經歷過第一次世界大戰剛結束就出現的西班牙流感大流行，與一個世紀後的我們一樣都要學習面對被孤立、被異化、被限制和對生活喪失信心的處境，有如《魔戒》裡不朽美人Arwen愛上凡人，為愛情放棄永生，最終在餘生中承受孤寂。」

Groom教授說：「人生在世，坎坷在所難免。Tolkien也曾深受戰火所累，飽受疾病煎熬，但熬過去就是一種勝利。《魔戒》告訴我們，勝利一天未到，你一天都不會意識到敵人（心魔）多麼邪惡。我希望學生能夠從美麗的文學世界裡，學會於低谷的日子中找回平衡和勇氣，懂得如何安身立命。」

If you have the chance to attend a class on Children's Literature at the University of Macau (UM), you may be amazed by this scene: a character from a fairy tale dressed in a vintage Gothic costume is lecturing students, leading them on a journey about the culture and value of children's stories. The name of this 'character' is Prof Nick Groom in the Department of English. With more than 30 years of teaching experience, Prof Groom has held positions in universities in the UK and the US. He has studied the English writer J.R.R. Tolkien and his most famous work, *The Lord of the Rings*, for many years. He recently published the book *Twenty-First Century Tolkien: What Middle-Earth Means To Us Today*, which has been praised highly by international media and is regarded as a must-read for fans of *The Lord of the Rings*. To Prof Groom, the emotional resonance evoked by classic literature provides hope that can help us in difficult times.

Engaging Students in the World of Literature

Back in the Children's Literature classroom, Prof Groom takes from his leather briefcase a Mickey Mouse plush toy, which he introduces as his 'pet', and sits it on his shoulder. From *Goldilocks and the Three Bears* to *Little Red Riding Hood*, from *Alice's Adventures in Wonderland* to *Winnie-the-Pooh*, Prof Groom, together with his pet, never fails to captivate students with the enchantment of fairy tales; his classroom abounds with laughter. Moreover, by leading students to appreciate children's literature from a child's perspective, he enables them to travel back to their own childhoods: they feel free to read nursery rhymes aloud with exaggerated and humorous body language. Their immersion in the discussion means that a 75-minutes class is over in the blink of an eye.

Prof Groom joined UM as a professor of English literature in 2020. He has previously taught at the University of Exeter, the University of Bristol, and the University of Oxford. He has also held visiting professorships at the University of Chicago and Stanford University. With his expertise in literature, Prof Groom has enriched the curriculum of UM's Department of English. For example, he has added two courses to the department curriculum: 'Special Topics in English: Tolkien – From the Fifth Century to the Present Day' and 'Nineteenth-Century Gothic Literature'. 'With my special research perspective, I believe I can bring something new to the Department of English, as well as enable students to rethink literature so that they can learn about the value of literature through classic works,' he says.

Building an Outlook on Life Through Literature

Born in the town of Northampton in East Midlands of England, Prof Groom was a quiet child who liked spending his time reading alone in the town library. It was through books that he learned about the outside world. In 1985, he was admitted to the University of Oxford, where he studied English Language and Literature. Three years later, he received his bachelor's degree with double first-class honours. He continued his studies at Oxford and received his master's and

Nick Groom教授講授《科學怪人》等哥德文學作品時穿的皮外套
The jacket Prof Nick Groom wears when he teaches Gothic literature such as *Frankenstein*

doctorate degrees. Well-read as he is, Prof Groom has a keen interest in biography. In particular, as a child he was fascinated by the biographies of those who were involved in the major conflicts in the 20th century. 'As a literary genre, biography can be seen as an additional source of history. I read *The Red Fighter Pilot: The Autobiography of the Red Baron* when I was very young: The Fokker triplane he piloted was amazing,' says Prof Groom.

Prof Groom has been writing stories since he was seven. While his schoolmates' compositions were generally one to two pages in length, Groom could easily write ten pages. Moreover, as he read, he thought about his relationship with the particular story or book. He would also write down inspirations he derived from reading. The more he wrote, the more he realised he was writing literary criticism. The literary works read by Prof Groom span many genres, from Shakespeare's plays to the classic stories of Charles Dickens, from which Groom hopes to understand more about life. However, he is still enamoured of the epic fantasy novel *The Lord of the Rings*.

According to Prof Groom, most of Tolkien's published stories were written during World War II between 1936 and 1949. The plots of many of his works depict wars between different ethnic groups, which would easily encourage people to associate the fictional stories with the real world. 'What should we do in the face of a seemingly hopeless endgame? How do we find a balance between success and failure? I guess we are also exploring human nature when we try to answer these questions,' says Prof Groom.

Boldness in Creative Writing

The Lord of the Rings has stood the test of time. There have been many adaptations of this classic work, from radio shows to the movie series directed by Peter Jackson, to the TV series on Amazon Prime. As Prof Groom points out, the most admirable thing about Tolkien's novels lies in his fertile imagination. This imagination was able to conjure the boundless Middle-earth, which is a fantastical world inhabited by different species, each with their own languages, scripts, and customs, all crafted in astonishing detail. He adds, 'The younger generation in the 21st century nowadays also have their own imagination and understanding of Middle-earth; they are breathing new life into Tolkien's works through reinterpretation.'

More often than not, writers use existing places and peoples to tell their stories, with an ending already planned carefully in their minds. However, Tolkien did not follow this rule. As explained by Prof Groom, Middle-earth was originally not as detailed as it appeared later. Tolkien was constantly designing the characters and planning the history of Middle-earth as he was writing—he was thinking on his feet. It also explains why the stories are full of deliberate contradictions and ambiguities. 'This reflects the reality,' explains Prof Groom. 'It is never possible to look at the world holistically. There is always something that goes against your understanding or aesthetics. Therefore, as you read about Middle-earth, you can also see how Tolkien explores this legendarium together with his readers. This is very bold creative writing,' he adds.

Having studied Tolkien and *The Lord of the Rings* for many years, Prof Groom's book of literary criticism *Twenty-First-Century Tolkien: What Middle-Earth Means To Us Today*, published by the British publishing house Atlantic Books, was released in September 2022. Within a few days of its publication, the book was reviewed in the Swiss press *Le Temps*, the US press *Washington Post*, and the UK press *Mail on Sunday*—where it was described as 'Fascinating… Wonderfully exhilarating' and regarded as a must-read for fans of *The Lord of the Rings*. It has since been republished in an expanded edition and a US edition, and several translations are in preparation.

Shaping Research Interests

In addition to his extensive literary knowledge and gentlemanly demeanour, Prof Groom also brought with him from England to Macao his classic books, which can be found on the bookshelves in his office. This reveals another identity of Prof Groom: he is also a connoisseur of literary manuscripts and historical relics. He can often be seen visiting art markets, where he enjoys discovering antiques and judging their authenticity. This passion can be traced back to his research on the 18th-century English poet Thomas Percy during his doctoral studies in the early 1990s—it was a defining project that provided some direction toward his future academic research.

Prof Groom remembers a serendipitous discovery during his journey from the University of Oxford to his parents' house. While he was walking, he unexpectedly encountered Percy's old house, which was located a mere five miles from his parents' house. The overwhelmed Groom felt an instant connection with the English poet—they shared the same hometown. This connection also dropped hints about his dissertation topic: Thomas Percy. As a result, Groom embarked on his extensive research about the poet. He made trips to history museums to study Percy's correspondence, manuscripts, and writings, delving into the historical background and styles of his works. Groom also analysed how the public at that time viewed Percy's works. He eventually compiled his research into a book titled *The Making of Percy's Reliques*, which was published by Oxford University Press.

The completion of Groom's doctoral studies also helped shape his research interests. His research areas primarily include cultural formation and authenticity, including attribution studies and literary forgery; national and regional identities (primarily UK, Irish, and Anglophone); cultural environmentalism and intangible cultural heritage; and historicist readings of the Gothic from earliest times to the present day. To date, Prof Groom has published 8 academic monographs, edited 12 books, and authored more than 100 academic papers.

Prof Groom says, 'My research endeavours began with the study of the ancient poetry collected by Percy, which I have since extended to many other themes and academic fields. For example, by comparing texts from different time periods and regions, I can delve deeper into various social and cultural issues, thus having more profound discussions and interpretations. I also reflect on the impact on and significance for us in the present moment as I compare the texts.'

Reflecting on Life Through Literature During COVID-19

Classic literature is considered classic because it touches the depths of human emotions, creating resonance and empathy between readers and the stories' protagonists. Prof Groom completed *Twenty-First-Century Tolkien* during pandemic restrictions. During this time, he contemplated the life lessons drawn from COVID-19. He shared with his students his reflections. 'Tolkien also went through the devastating Spanish flu pandemic that started after the end of World War I. Like us, who were born a century later, Tolkien also had to learn to deal with isolation, alienation, restriction, and loss of confidence in life. These situations can be compared to that of Arwen, the immortal beauty in *The Lord of the Rings*. Falling in love with a mortal man, she had to give up her immortality and endure years of solitude before her eventual death.'

Drawing these connections between life and literature, Prof Groom continues: 'Life is full of ups and downs. Tolkien himself also suffered the ravages of war and the pain of illness. With that said, overcoming these challenges is a victory in itself. *The Lord of the Rings* teaches us that we will never know how evil our enemy (or inner demon) is until victory is achieved. I hope that students can learn from the beautiful literary world how to regain balance and courage during challenging times and understand how to establish their own purpose and meaning in life.'

在歐盟戰略自主下，中國投資者將會面臨甚麼？

The European Union's Strategic Autonomy: What Does It Mean for Chinese Investors?

文、圖 / Alexandr Svetlicinii · 中文翻譯 / 葉浩男
Text & Photo / Alexandr Svetlicinii · Chinese Translation / Davis Ip

在地緣政治局勢持續升溫的當下，全球經濟一體化使各國日益依賴外部供應的商品、服務和科技。但過度的外部依賴自然帶來不少風險和危機。在2019冠狀病毒病大流行期間供應鏈斷裂時，這種供應的脆弱顯露無遺。這種危機更愈來愈常被用來謀求政治、經濟乃至軍事方面的目標。因此，歐盟把「戰略自主」的概念融入《2019—2024年戰略議程》之中。

促進內產 減少依賴

在「戰略自主」概念引領下，歐盟正致力提升其經濟競爭力，規避經濟安全風險，同時與更多國家結為伙伴，追求經濟互利。歐盟為此實施了一系列新的工業政策，旨在促進內部生產能力和降低對外部供應的依賴。其中，透過《歐洲晶片法案》，歐盟計劃在2030年前將其半導體產能的全球份額提升至20%。《關鍵原材料法案》則著眼於推動關鍵原材料供應的多元化，並致力通過廢物回收和再利用，改進這些材料的可持續性和循環利用性。此外，《淨零工業法案》旨在支持歐盟的綠色協議工業計劃，鼓勵投資「綠色科技」，並推動在歐盟本土開發這些科技。

經濟安全和對外投資審查

歐盟在這方面並非獨行其道。全球各國都致力將經濟利益和安全利益互相結合，即所謂將經濟關係「安全化」，從而增強抵禦風險的能力和減少對關鍵資源的依賴。在此過程中，歐盟試圖在推行去風險化和維護歐盟內部市場開放經濟的四項基本自由之間找到平衡。這四項基本自由包括商品的自由流通、人員的自由流動、資本的自由流動和設立場所的自由選擇。其中，資本的自由流動不僅適用於歐洲的公民和企業，還適用於來自第三國的投資者。然而，追求戰略自主和推動去風險化的政策必然會對海外投資者行使資本自由帶來影響，特別是影響在歐洲經商的中國企業。

安全和公共秩序是歐盟成員國的專屬職權。因此，歐盟在協調對外投資審查時，運用的是它在與其它國家的外部經濟關係方面的共同商業政策權力。例如，歐洲委員會負責監管可能影響歐盟內部市場競爭的大規模企業合併和收購。如果出現競爭問題，委員會可能要求企業調整，甚至禁止交易計劃。雖然歐盟的合併監控是所有權中立，即不會區分私營企業和國有企業，但大型中國國有企業的收購已對合併監控的過程帶來挑戰。在判定國有所有權和控制權如何及何時影響國有企業的商業決策，以及它們是否可能協調市場行為時，委員會不時遇到困難。

由於中國企業在歐洲市場的份額較小，至今未有中國企業在歐盟合併監管下被禁止開展合併或收購。唯一相關案例在2017年發生，當時中國化工集團公司正在收購瑞士Syngenta公司，被歐洲委員會要求作出特定承諾，以保持歐盟的農藥和植物生長調節劑市場的競爭。同時，代表歐洲各產業的持份者團體呼籲實施更嚴格的合併監管，以應對在工業政策、補貼和保障歐洲企業在全球市場的競爭力等方面的問題。這些討論在2019年委員會禁止西門子與阿爾斯通合併後加劇。該合併當時被認為可在高速列車製造業創造一個領先的歐洲巨頭。

直接投資審查和外國補貼規定

為免讓歐盟的合併控制「政治化」，歐洲委員會提交了《歐盟外來直接投資審查框架條例》，旨在讓歐盟及其成員國能在這個替代的監管框架下保障戰略利益。該《條例》為成員國和委員會設立了一個協調機制，專門用於審查外來直接投資項目有否潛在安全風險。審查時考慮的因素包括：關鍵基礎設施、關鍵科技、關鍵物品（例如能源，原材料和食品）的供應、敏感資訊（包括個人數據）的獲取，以及媒體的自由和多元化。成員國施行該條例後已加快實施和擴展其國內審查機制，為外來投資者帶來額外監管負擔，並降低審查結果的可預測性。在當今的地緣政治局勢下，可能遭受嚴格審查的中國投資者對此尤其擔憂。

此外，為確保在歐盟內部市場活躍的公司在獲取政府補貼方面享有「公平競爭的環境」，歐盟實施了《外國補貼條例》。該條例於2023年初生效，規定任何活躍於歐盟市場的公司在開展合併、收購或參與公共採購時，必須通報它們從非歐盟國家獲得的補貼，由歐洲委員會評估這些外國補貼是否可能對歐盟的內部市場產生扭曲影響。

中國投資將面臨挑戰

歐盟競爭專員瑪格麗特．維斯塔格在2015年於紐約大學演講時引述鄧小平的名言「不管黑貓白貓，能捉到老鼠就是好貓」後表示：「反壟斷法執法者也應該說：不管來自何處，企業能按規則競爭就好。」雖然上述的監管框架在法理上不具歧視性，但它明顯可能為在歐洲的中國投資者帶來重大挑戰。

Svetlicinii教授在中國環球電視網節目《欣視點》討論中國《對外關係法》
Prof Svetlicinii discusses China's Law on Foreign Relations on the TV programme 'The Point with Liu Xin' broadcast on China Global Television Network

Svetlicinii教授在克羅地亞南部城市杜布羅夫尼克的2023年競爭法與政策會議上作學術報告
Prof Svetlicinii presents his research at the 2023 Competition Law and Policy Conference in Dubrovnik, Croatia.

With rising geopolitical tensions, global economic integration poses a multitude of risks. Countries are increasingly dependent on each other for the supply of important goods, services, and technologies. Supply chain disruptions during the coronavirus pandemic have brought to light these vulnerabilities that are now increasingly exploited to attain various political, economic, and even military objectives. For the European Union (EU), the concept of 'strategic autonomy' embedded in the EU's New Strategic Agenda 2019-2024 signifies its capacity to act independently in strategically important policy areas ranging from defence to healthcare.

Promoting Domestic Production and Reducing Dependencies

Under its 'strategic autonomy' agenda, the EU aims to promote its economic competitiveness, protect itself from economic security risks, and partner with a wider range of countries for mutually beneficial economic relations. In pursuit of these objectives, it has adopted a number of industrial policies stimulating domestic production capabilities and reducing external supply dependencies. For example, the EU Chips Act aims to bolster the EU's production capacity in semiconductors, targeting up to 20 per cent of the global market share by 2030. In addition, the proposed EU Critical Raw Materials Act promotes the diversification of supplies of critical raw materials and aims to improve sustainability and circularity through waste collection and recycling. The proposed EU Net-Zero Industry Act would support the EU's Green Deal Industrial Plan by encouraging investments in 'green technologies' and promoting their manufacturing in the EU.

Economic Security and Foreign Investment Scrutiny

The EU is not alone in intertwining economic and security interests. Countries all over the world are continuously 'securitising' their economic relations to ensure resilience and reduce critical dependencies. At the same time, the EU attempts to balance its de-risking policies and its commitment to maintaining its open economy grounded on the four freedoms of the EU internal market: free movement of goods, free movement of people, freedom of capital, and freedom of establishment. Among the four freedoms, the freedom of capital is guaranteed not only to European citizens and businesses but also to investors from third countries. However, the pursuit of strategic autonomy and the implementation of de-risking policies will inevitably affect the exercise of the freedom of capital by foreign investors, particularly Chinese firms operating in Europe.

As the domains of security and public order fall under the exclusive competence of its member states, the EU coordinates the scrutiny of foreign investment using its common commercial policy powers related to external economic relations with other countries. For example, the European Commission carries out control over corporate mergers and acquisitions of a certain size that could potentially affect competition in the EU internal market. If such competition concerns exist, the Commission may require companies to modify their planned transaction or even prohibit it. While the EU merger control is ownership-neutral, not distinguishing between private and state-owned companies, acquisitions by large Chinese state-owned enterprises (SOEs) have raised several challenges in the merger assessment process. For instance, the Commission encountered difficulties in ascertaining whether and how state ownership and control affect the commercial decisions by the SOEs and whether they are likely to coordinate their market conduct.

Given the relatively modest presence of Chinese companies on European markets, no merger or acquisition involving Chinese firms has been prohibited under EU merger control thus far. The only notable case was the acquisition of the Swiss company Syngenta by ChemChina in 2017, where the Commission requested certain commitments to preserve competition in the pesticides and plant growth regulators market. Meanwhile, various stakeholder groups representing European industries have called for more stringent merger control that would consider industrial policies, subsidies, and the need to protect the competitiveness of European firms in global markets. These discussions accelerated in 2019, after the Commission prohibited the *Siemens/Alstom* merger, which was expected to create a 'European champion' in high-speed train manufacturing.

FDI Screening and Foreign Subsidies Regulation

Unwilling to 'politicise' the EU merger control, the Commission proposed an alternative regulatory framework—the EU Foreign Direct Investment (FDI) Screening Regulation—to protect the strategic interests of the EU and its member states. It established a coordination mechanism for the member states and the Commission to evaluate planned FDI projects for potential security risks. The following factors are considered during such screening: 1) critical infrastructure; 2) critical technologies; 3) supply of critical inputs such as energy, raw materials, and food; 4) access to sensitive information including personal data; and 5) freedom and pluralism of media. Following the adoption of the EU FDI Screening Regulation, member states have accelerated the adoption and expansion of their national screening mechanisms, which creates additional regulatory burdens for foreign investors and reduces predictability concerning the screening outcomes. The application of FDI screening in the EU is of particular concern for Chinese investors who may face more stringent scrutiny in the current geopolitical climate.

Furthermore, to 'level the playing field' in terms of subsidies that companies active on the EU internal market may receive from governments, the EU adopted the Foreign Subsidies Regulation, which entered into force in early 2023. As a result, any company active on the EU markets must disclose subsidies received from non-EU countries when it engages in mergers and acquisitions or participates in public procurement. The Commission would then determine whether such foreign subsidies could have distorting effects on the EU internal market.

Chinese Investments Likely to Face Challenges

The EU Competition Commissioner Margrethe Vestager noted in her speech at New York University in 2015: 'Deng Xiaoping was famous for his saying that it doesn't matter whether a cat is black or white as long as it catches mice. The antitrust enforcer version of this saying should be that: it doesn't matter where the company comes from, as long as it competes—by the rules.' Although the regulatory frameworks mentioned above are not discriminatory *de jure*, it is not hard to see that they may present substantial challenges to Chinese investments in Europe.

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「學術研究」為投稿欄目，內容僅代表作者個人意見。
Academic Research is a contribution column. The views expressed are solely those of the author(s).

WALL-E與現實：為何災難應對機器人不能激勵我們

WALL-E vs. Reality: Why Disaster Response Robots Don't Inspire Us

文 / 陳方圓、黃思綺 · 中文翻譯 / 葉浩男
Text / Chen Fangyuan & Huang Szu-chi · Chinese Translation / Davis Ip

你看過「英雄」機器人執行危險任務，例如撲滅熊熊野火或新冠疫情期間在醫院消毒的片段或相片嗎？機器人幾年前還僅在工業自動化領域使用，現在已愈來愈常用於服務領域，例如災難應對工作，提升人類安全和福祉。2008年彼思動畫製作室電影《太空奇兵 · 威E》（WALL-E）中討人喜愛的清潔機器人WALL-E，在現實世界已有相似的機器人了。

機器人出乎意料的影響

不過，科技進步引發了一個問題：有機器人幫忙，人類會表現出更多親社會行為嗎？抑或相反？我們最近一項在《消費者心理學雜誌》發展的研究對此提供重要啓示。我們的研究顯示，執行危險任務的機器人雖然是高效的助手，卻無法激勵人們挺身而出幫助他人。當人們看到機器人（而非人類）在災難現場參與救援時，他們自己參與親社會行為的意願會大大降低。換言之，「英雄」機器人不知不覺間削弱了我們的人性特質。

我們在一項實驗中向參加者展示有關人類或服務機器人於新冠疫情時在醫院消毒的報導，一些聚焦於人類工作者，另一些聚焦於機器人。我們隨後測量參加者對幫助弱勢群體的意願，發現他們讀到關於機器人助手的報導後，助人意願有所降低。

效能高 激勵少

這些發現有深刻意義：「英雄」機器人雖然能提高效率，卻無法像「人類英雄」般激勵人們產生同等的同理心和親社會行為。這些機器人的出現為何會影響我們在危急關頭助人的天性？經過深入研究後，我們發現：首先，機器人缺乏自主性，無法為其工作成果邀功；其次，在救援行動中，機器人面對的風險和危險遠遠少於人類。人類的英勇行為會激勵他人，但機器人由於其低脆弱性和低自主性，無法激勵人類。

肯定人在救援時的角色

我們構思了一些改善這個困境的方法，包括聚焦人的身上、凸出機器人的效率優勢，以及增強機器人的自主性和脆弱性，使它們看起來更人性化。

基於這些發現，我們提出幾點建議。首先，即使機器人效率高，我們也應緊記，大眾在災難發生時仍然假設救援者是人類。為保持人們的親社會意圖，媒體在報導時應聚焦在人類救援者身上，同時強調機器人的效率優勢，降低個人在災難時的無助感。

為機器人增添人性元素

機器人按程序執行任務，無法鼓舞人心。因此，為機器人賦予人類特徵，例如與人類相似的自主性和脆弱性，可以使它們看起來更「勇敢」，增強激勵人類的能力。我們的研究還發現，組建一個機器人和人類工作者協作的「團隊」也是可取的方法，令機器人更人性化。

> 「機器人難以激勵我們，而當我們缺乏激勵時，就不太可能主動幫助他人。」

重塑人機協作

在社會各領域日益依賴服務機器人之際，我們的研究提出需要重新思考對科技的看法。人類設計的技術不僅應能優化效率，而且要激發人們的親社會行為。隨著人類和機器人有愈來愈多機會在災難應對等困難任務時協作，這些見解將有助我們以科技改善社會。

Have you ever come across videos or photos of 'hero' robots tackling hazardous tasks such as fighting a wildfire or sanitising hospitals during the COVID-19 pandemic? Whereas robots were once limited to industrial automation, we now see them increasingly deployed in service domains like disaster response to improve human safety and well-being. It seems that WALL-E, the endearing cleaning robot from the 2008 Pixar movie, has found its real-world counterparts.

The Unexpected Effect of Robotic Progress

This robot progress prompts an important question: If robots now help humans with such tasks, does that make humans more prosocial or less prosocial? Our recent research sheds important light on this issue. The research, published in the *Journal of Consumer Psychology*, reveals that while robots doing dangerous jobs are seen as efficient helpers, they do not inspire people to step up and help others. In other words, our research indicates that people's willingness to engage in prosocial behaviours decreased significantly when they watched robots (as opposed to human workers) assist in disaster scenarios. In short, 'hero' robots inadvertently diminish our human qualities.

For instance, in one experiment, we presented participants with narratives derived from actual news reports depicting the efforts of people or robots to disinfect hospitals during the COVID-19 pandemic. Some narratives highlighted human workers, while others highlighted robots. We measured how likely participants would be to help other vulnerable people in a subsequent task. The study revealed that participants displayed a reduced inclination to extend a lending hand to others after reading about robots helping rather than humans helping.

High Efficiency With Diminished Inspiration

The implications of these findings are profound. It appears that the presence of 'heroic' robots, while significantly enhancing efficiency, fails to inspire empathy and prosociality among observers. This raises questions about the impact of robot involvement on our innate desire to help others in times of crisis. Our further exploration into this matter revealed two primary reasons why 'heroic' robots fail to inspire. Firstly, robots lack agency and autonomy, which prevents them from taking credit for their virtuous actions. Additionally, robots face fewer risks and dangers than people. Therefore, while courageous humans inspire others, robots, by contrast, fail to generate such motivation due to their low vulnerability and low autonomy.

Reaffirming Humans in Disaster Response

Some solutions to this dilemma: 1) put people front and centre; 2) highlight the efficiency of robots; 3) humanise robots to increase their autonomy and vulnerability.

> 'We don't feel as encouraged by the disaster response robots. And when we are not encouraged and inspired, we are less likely to help others.'

Based on these findings, we offer a few suggestions to address this dilemma. Firstly, while robots are highly efficient, organisations should bear in mind that when disasters occur, human help may remain the default assumption among the general population. Therefore, to avoid disrupting people's prosocial intentions, journalists should put human workers front and centre in these news stories. At the same time, emphasising robots' efficiency may help counteract individual feelings of powerlessness during catastrophic events.

Adding Human Elements to Robots

Moreover, humans are not inspired when confronted with robots that are simply programmed to perform tasks. Therefore, imbuing robots with human-like characteristics, such as autonomy and vulnerability, could increase their perceived bravery and, consequently, their ability to inspire us. In addition, our study suggestes that creating hybrid human-robot teams is another viable option to elevate robots' humanness and thus achieve the same objective.

Reshaping Human-Robot Collaboration

In light of society's increasing reliance on service robots in various domains, our research highlights the need to rethink our perspective on technology. We need to focus on designing technology that not only optimises efficiency but also inspires people to act prosocially. In the future, people and robots will increasingly collaborate in disaster response and other difficult tasks. These insights have significant implications for leveraging technology for the betterment of society as a whole.

陳方圓是澳門大學工商管理學院市場學副教授、亞太經濟與管理研究所成員，研究重點為利用擬人化和社會感知理論來理解消費者與市場中的非人類實體的互動。

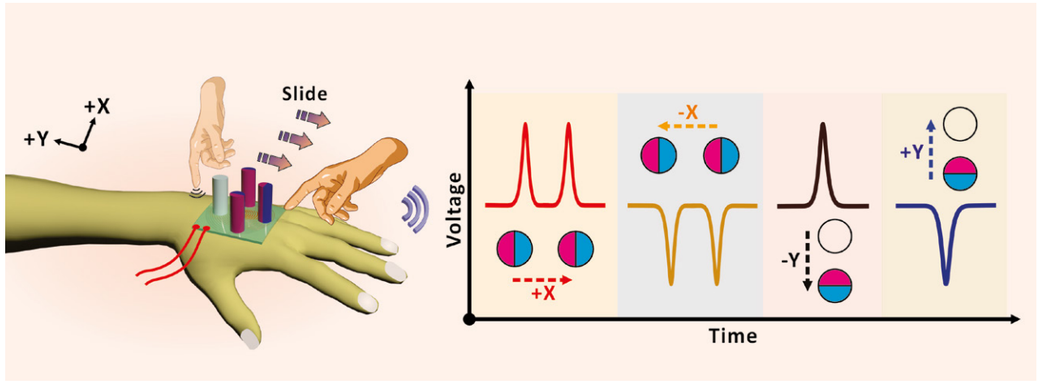
Chen Fangyuan is an associate professor of marketing in the Faculty of Business Administration and a member of the Asia-Pacific Academy of Economics and Management at the University of Macau. Her research focuses on using anthropomorphism and social perception theories to understand consumers' interaction with non-human entities in the marketplace.

黃思綺是史丹福大學市場行銷學系副教授、R.Michael Shanahan學者，研究重點是消費者動機，包括如何促使人們向非營利組織捐款或參與志願服務。

Huang Szu-chi is an associate professor of marketing and R. Michael Shanahan Faculty Scholar at Stanford University. Her research focuses on consumer motivation, including what drives people to donate to non-profits or volunteer to help others.

「學術研究」為投稿欄目，內容僅代表作者個人意見。

Academic Research is a contribution column. The views expressed are solely those of the author(s).



可穿戴界面的設計：該界面由四支微柱和一個線圈基板組成，專為感知力的方向而設計。不同的軸向力能產生不重疊且可識別的誘導電壓。

The design of the wearable interface consists of four micropillars and one coil substrate for force direction perception. Different axial forces can induce identifiable patterns of voltage profiles in non-overlapping behaviour.

電子皮膚——未來的可穿戴人機交互界面

Electronic Skin: Wearable Interactive Interface for the Future

文、圖 / 方丹、周冰樸 · 中文翻譯 / 葉浩男

Text & Photo / Fang Dan & Zhou Bingpu · Chinese Translation / Davis Ip

電子皮膚是一種柔韌、輕盈而靈活的新型可穿戴裝置，能夠模擬人類皮膚的感測特性。它可捕捉機械性的刺激，將其轉化為電信號讀出，是人體與電子終端之間的連接紐帶。電子皮膚的潛在應用領域可從健康監測擴展到智慧感知，所以愈來愈受關注。我們的團隊基於「電磁感應」原理和「彈性體的固有振動」原理研發出一種自供電、輕便的可穿戴貼片。這種創新的貼片為未來可穿戴的人機互動界面的設計提供更簡便的新視角。

經典的物理學定律：電磁感應定律

「法拉第電磁感應定律」（簡稱：「法拉第定律」）是物理學基本定律之一，也是眾多電感器和發電器的核心運作原理。根據這個定律，只要導電體的線圈層中發生局部磁通量變化，便能產生感應電動勢（EMF）。受此經典定律啟發，我們推斷出只要改變磁通量的空間分佈，便能將機械能化為電能。基於這個原理，由柔性磁化元件和導體組成的電子皮膚可用自供電方式來運行，減少對外部功耗的依賴。

來自自然界的啟發：彈性微結構的固有振盪特性

法拉第定律也詳述了時間變量對感應電動勢幅值的影響。磁通量的變化愈快，期間產生的電動勢信號就愈明顯。這在實際應用中對提升信號的精確度和減少噪音干擾有重要作用。

受自然現象的啟發，許多彈性系統都具有特徵頻率，主要由其結構特性所決定。例如，「物體和彈簧系統」的頻率由彈簧的常數和物體的質量所決定；簡單擺錘的擺動週期則受擺長所控制。

我們的團隊發現，人造的彈性微結構（微柱）依然遵循相似的自然行為規律。彈性膠體和釹磁鐵（NdFeB）微粒子組成的微柱經磁化後能產生永久磁矩。在進一步研究中，我們證實通過調整微柱的尺寸參數或物理特性，可以改變其固有頻率。這項發現使我們得以大幅縮短磁化彈性微柱的振盪時間，產生更強烈的電信號，確保通信準確。

磁偶極子用於方向感知

自然界的磁體均有兩個磁極（南極和北極），構成磁偶極子。如果將一塊永久磁體一分為二，兩塊新的磁體亦各有一個南極和一個北極。這個規律適用於更小的磁體，包括微米尺度的微柱；這些微柱一旦磁化，必然也有一對相反的磁極。

基於這個觀察，我們的團隊認為，磁體的南極和北極提供了一個感知方向的機制。當磁化後的微柱朝北極或南極方向變形時，導電體線圈中的磁通量會隨之產生正向或負向變化。這些變化能轉成明確可辨的「+/-」或「-/+」電動勢信號，能被電子終端準確識別。

設計可感知平面內力向的可穿戴貼片

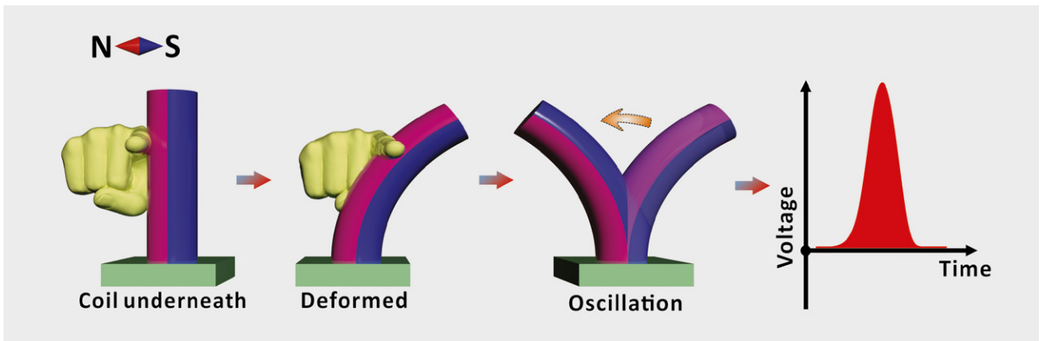
基於感應電動勢的正負信號，單個磁化微柱只能回應兩個在一維上相反方向的力。我們觀察到，只要調節電壓峰值的數量，便可感知出一個平面中源於不同軸向（例如+X、-X、+Y和-Y方向）的力。

通過精確設計一些磁化微柱的方向和排列，我們開發了一種測量定向面內力的界面。基於電壓峰值的數量和極性，這個界面可通過完全互不重疊的信號，識別來自+X、-X、+Y和-Y方向的平面力。因此，這個可穿戴界面只需一個通信通道和兩個電極，便能區分來自四個方向的機械力。

可穿戴貼片：從智慧控制到娛樂

一個易於使用的可穿戴式人機互動系統應該輕便和低功耗，我們的設計正能滿足要求。評估這類系統有多實用時，電子連接和通信的方法是重要的考慮因素。一些研究人員曾用可穿戴感測器陣列作為人機互動界面，由於涉及多條電子連接和通信通道，難免增加其功耗和佔用的空間。相反，我們設計的界面可根據力的不同方向輸出互不重疊的信號，只需一個通信通道便可完成信號交互。

為評估這個可穿戴貼片的各項功能，我們還開發了一些用於軌跡映射、機器人控制、數字密碼輸入和摩斯密碼通信的應用界面。在整個應用過程中，我們的可穿戴貼片在耐用性、抗濕度、準確性和通用適用性方面均有優勢。我們期望這種可穿戴貼片能提供新的解決方案，滿足柔性和可穿戴電子產品對高效人機互動界面日益增長的需求，研究成果已於學術期刊《Chemical Engineering Journal》發表。



感應電信號可通過磁化微柱變形引起導電線圈層中的磁通量變化而產生

Signals are generated via deforming a magnetised micropillar to induce magnetic flux change in the conductive coil layer

Electronic skin (E-skin) is a novel, lightweight, and flexible wearable device that mimics the sensory function of human skin. By collecting mechanical stimuli and converting them into electrical readouts, E-skin acts as an important link connecting human and electronic terminals. It has attracted increased attention due to its potential applications in various fields, ranging from healthcare monitoring to intelligent perceptions. Therefore, our research group has developed a lightweight, self-powered, and wearable patch by incorporating the principles of 'electromagnetic induction' and 'intrinsic oscillation of elastomer'. This innovative patch offers a fresh perspective on designing future wearable human-machine interaction (HMI) interfaces in a more concise and convenient approach.

A Law of Classical Physics: Electromagnetic Induction

Faraday's law of electromagnetic induction is a fundamental law in physics that serves as the basic operating principle of various inductors and generators. According to this law, a change in magnetic flux can induce an electromotive force (EMF) when a conductive coil layer is present. This classical law inspired us to explore the conversion of mechanical energy into electrical energy by altering the spatial distribution of magnetic flux. By leveraging this principle, flexible E-skin can operate in a self-powered manner, reducing reliance on external power consumption, provided that it is comprised of flexible magnetised components and conductors.

Nature-Inspired Intrinsic Oscillation of Elastic Microstructures

According to Faraday's law, the time scale also plays a role in determining the magnitude of the EMF. A more significant EMF signal can be obtained if the magnetic flux variation is completed within a shorter duration. This is essential to improving accuracy and avoiding noise interference in real-world applications.

Inspired by natural phenomena, many elastic systems exhibit eigenfrequency, which is primarily determined by the properties of their structure. For example, the frequency of a block-spring system is determined by the spring constant and block mass, while the period of a simple pendulum depends on the length of the string.

Our research group found that artificial elastic micro-structures (micropillars) also follow rules similar to those of natural behaviour. The micropillars are mainly composed of elastomer gel and microparticles (NdFeB) that can produce a permanent magnetic moment after magnetisation. In subsequent studies, we demonstrated that the eigenfrequency of the elastic micropillars can be tuned by simply adjusting their dimensional parameters or physical properties. These findings enable us to significantly shorten the oscillation period of the magnetised elastic micropillars, thereby generating more pronounced electrical signals and ensuring accurate communication.

Magnetic Dipole for Direction-Aware Sensing

In nature, magnets have two poles, the north pole and the south pole, which form a magnetic dipole. If you break a permanent magnet, the two daughter magnets will each have a north pole and a south pole. The same rule applies to even smaller magnets such as the micron-sized micropillars, which, once magnetised, also have a pair of north and south poles.

Based on this observation, our research group believes that the magnet's north and south poles could serve as a mechanism to perceive the force direction. When a magnetised micropillar is deformed towards the north or south side, a negative or positive variation of the magnetic flux in the conductive coil will be generated. These ultimately become EMF signals of '+/-' or '-/+' that can be clearly distinguished and accurately identified by the electrical terminal.

Designing a Wearable Patch for In-Plane Force Perception

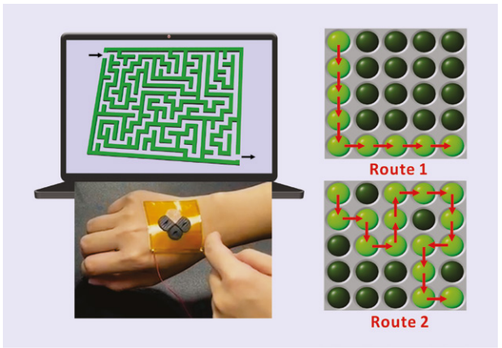
A single magnetised micropillar can only respond to two opposite directions of force in one dimension based on the positive and negative signals of the induced EMF. To address this limitation, our research group discovered that the number of voltage peaks can identify the in-plane force from different axial directions (+X, -X, +Y, and -Y).

We developed an interface for measuring directional in-plane force by precisely designing the orientation and arrangement of magnetised micropillars. Based on the number and polarity of voltage peaks, the interface can perceive the in-plane forces in the +X, -X, +Y, and -Y directions with non-overlapping readouts. As a result, the wearable interface requires only one communication channel and two electrodes to distinguish mechanical input from four different directions.

Wearable Patch: From Intelligent Control to Entertainment

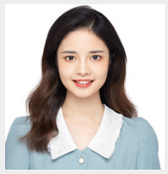
A wearable HMI system should be lightweight and low-power in order to be user-friendly, and our design satisfies these requirements. Additionally, the electric connection and communication method are important considerations in assessing the practicability of HMI systems. While some researchers use wearable sensor arrays as the HMI interface, this approach inevitably brings concerns about power consumption and space occupied due to the multiple electric connections and communication channels involved. In contrast, as our design can produce non-overlapping signals according to different force directions, only one communication channel is required to complete the signal interaction process.

To evaluate the multiple functions of the wearable patch, we developed the application interfaces for trajectory mapping, robot control, digital password input, and Morse code communication, among others. Throughout the application process, the wearable patch demonstrated robustness, humidity resistance, accuracy, and universal applicability. We expect that this wearable patch can provide a new solution to meet the ever-growing demand for effective HMI in flexible and wearable electronics. The related research results were recently published in the *Chemical Engineering Journal*.



迷宮遊戲演示：使用貼在皮膚上的可穿戴界面展示一個迷宮遊戲。以不同方式掃動微柱組件可產生兩條不同的遊戲路線。

Demonstration of maze game using an on-skin wearable interface: two routes can be easily produced by sweeping the micropillar assembly in different directions



方丹是澳門大學應用物理及材料工程研究院博士研究生，本研究的論文第一作者，研究集中於柔性感測器和智能材料。

Fang Dan is a PhD candidate in the Institute of Applied Physics and Materials Engineering at the University of Macau. She is the first author of the related publication. Her research interests include flexible sensors and smart materials.

周冰樸是澳門大學應用物理及材料工程研究院副教授，擁有香港科技大學納米科學與技術博士學位，其研究領域包括柔性電子學、可穿戴設備和智能界面。

Zhou Bingpu is an associate professor in the Institute of Applied Physics and Materials Engineering at the University of Macau. He holds a PhD in Nano Science and Technology from the Hong Kong University of Science and Technology. His research interests include flexible electronics, wearable devices, and smart interfaces.

「學術研究」為投稿欄目，內容僅代表作者個人意見。
Academic Research is a contribution column. The views expressed are solely those of the author(s).

何鴻燊東亞書院
多元與持續性並重的社會服務

Diversity and Sustainability of Social Services at Stanley Ho East Asia College

文 / 陳宇威．圖 / 資深校園記者廖榮志，部分由何鴻燊東亞書院提供．英文翻譯 / 盛惠怡

Text / Saul Chan．Photo / Senior UM Reporter Matt Lio, with some provided by Stanley Ho East Asia College
English Translation / Debby Seng

「同學們第一次合作在街上收集紙皮並拿去回收，這個體驗很有趣，但我們知道收集紙皮對拾荒者來說毫不有趣，因為他們以此維生……回收紙皮工作量大，而且回報很低，載滿一輛貨車的紙皮只能賣約50澳門元。」

這是澳門大學何鴻燊東亞書院學生參與回收紙皮體驗後的反思。該體驗是書院在2023年舉辦的一系列了解弱勢社群的活動之一。透過到街頭回收紙皮，學生得以設身處地了解拾荒者的工作和面對的困難。

組織學生服務社區

何鴻燊東亞書院一直致力推動多元和可持續的社會服務。我們相信，書院的價值之一是連繫社區，組織學生服務社區。透過服務學習，同學有機會參與各類社會服務，從中發掘感興趣、配合其個人特質及專長又願意投身的範疇。有同學參與書院自2022起舉辦、旨在關懷本地獨居長者的「愛心湯」活動後，今年繼續協助書院舉辦該活動。

參與社會服務能讓同學走近少數族群等他們平時鮮少接觸的階層。今年，我們帶領同學參與印尼外傭的開齋節慶祝會（開齋節是全球穆斯林慶祝齋戒月結束的節日）。活動期間，同學認識到外傭在澳門生活的苦與樂，例如發現曾在香港、台灣和澳門工作的外傭最喜歡在澳門打工，因為澳門在制度上容許他們不與僱主同住，而且不少人認為澳門僱主普遍較和善，容易相處。

若非參與這類活動，同學可能只知道外傭在澳門工作的辛酸——例如部分外傭需忍受僱主的無理要求、難以在澳門購買家鄉食品等。但同學聆聽少數族群的想法後，打破了不少對他們的刻板印象和迷思，從而建立更多元、包容的價值觀。

服務涵蓋多個社會議題

上述這些較具體的例子能讓讀者容易理解服務學習（書院教育十分重要的一環）及其意義。書院舉辦的社會服務還包括到街市回收剩菜、淨灘、支持扶貧組織募捐、為動物保護團體做義工和為有特殊教育需要的兒童舉辦親子活動。這些活動涵蓋各類社會議題，包括全球經濟不平等、氣候變化、貧窮、弱勢群體和動物權益。

然而，單單強調活動的多元性，很容易使服務對象淪為滿足學生個人成長需要的「消費品」。假如我們每年只探訪獨居長者一次，這些探訪其實只是開眼界的體驗。我們深信只有持續服務學習，同學才能了解服務對象的真正需要，這樣才算真正的社會服務。試想，如果獨居長者每次面對新一批同學來訪，傾談的內容都是自我介紹，無法深入詳談，何來真正的關懷？

正如文章開首同學的反思：一次體驗或許有趣，但無法令人深刻體會拾荒者的困苦。因此，我們持續與同學一起服務和關懷本地弱勢群體，包括每月一次探訪基層長者和定期與少數族群交流。

在《你在大學，學些甚麼？》一書中，日本知名社會學者加藤諦三建議大學生在四年大學生涯努力尋找「不以為苦、能持續做下去的興趣」。同學在澳大學院裡學習的專業知識，或許是他們報讀大學時想研習的「興趣」。我們期望書院為他們提供另一種可能，就是透過多元化的服務學習拓展視野，從中發掘願意投身而不以為苦的「興趣」，並且使這個興趣融入他們的習慣和態度，持續服務社會。

書院學生在澳門新口岸區回收紙皮，體驗拾荒，同時了解回收品價格下降的趨勢。

SHEAC students participate in a cardboard recycling activity in Macao's ZAPE district to experience the life of scavengers while learning about the downward trend in recycling prices

書院導師在2022/2023學年帶領同學參與兩個由印尼外傭組織的活動，分別是開齋節慶祝會和印尼傳統服飾派對。

In the 2022/2023 academic year, SHEAC fellows led students to participate in two events organised by Indonesian domestic workers in Macao, namely a celebration of Eid al-Fitr and a traditional Indonesian costume party.

學生參加「社區引導人」導賞員培訓計劃
Students participate in SHEAC's community docent training programme

'For us, students, picking up discarded cardboard from the streets for recycling was a fresh experience. However, we're aware that for those scavengers who depend on this task for a living, it's far from a walk in the park... Recycling cardboard is hard work. Yet, the financial gain is depressingly low, and a truckload of cardboard only pulls in around MOP 50.'

These are the reflections of students at the University of Macau (UM) Stanley Ho East Asia College (SHEAC) on their participation in a cardboard recycling activity. The activity was part of a series organised by the college in 2023, which aimed to let students understand the plight of the underprivileged. By collecting and recycling cardboard on the streets, the students experienced first-hand the laborious work undertaken by waste pickers and the obstacles they encounter.

Mobilising Students for Social Services

SHEAC has spared no effort in promoting diverse and sustainable social services. We believe that one of the key values of the college lies in its capacity to foster community connections and encourage students to serve the community. Service learning offers students the opportunity to engage in various social services, which, in turn, helps them discover their interests and strengths and identify areas they wish to explore further. Following their involvement in the 'Soup for Love' campaign launched by the college in 2022 to support local elderly citizens living alone, several students assisted in coordinating the campaign this year.

Social services often bring students into contact with minority groups that they seldom interact with in their daily lives. This year, we led our students to join the Eid al-Fitr (a global Muslim festival marking the end of Ramadan) celebrations organised by Indonesian domestic helpers in Macao. During the event, the students gained a deeper understanding of the challenges and joys experienced by domestic workers living in Macao. For example, they learned that those who have work experience in Hong Kong, Taiwan, and Macao generally prefer to work in Macao as local regulations do not require them to live with their employers, which they greatly appreciate. Many also find employers in Macao are generally friendlier and more approachable.

Had they not participated in such activities, students may only be aware of the challenges these domestic helpers face in Macao, such as dealing with demanding employers and the difficulty finding food products made in their homelands. By listening to the views of ethnic minorities and learning about their working conditions in Macao, the students managed to debunk various stereotypes and misconceptions about them. This experience fostered a more diverse and inclusive perspective among the students.

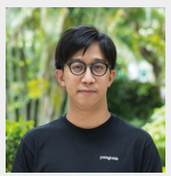
Addressing a Broad Spectrum of Social Issues

The concrete examples mentioned above illustrate the concept of service learning, a significant aspect of SHEAC's educational ethos. The college provides a range of social services, including collecting leftovers from markets, beach clean-ups, supporting fundraising efforts for poverty alleviation organisations, volunteering with animal welfare groups, and organising activities for children with special educational needs. These initiatives address a broad spectrum of social issues, including global economic disparity, climate change, poverty, vulnerable groups, and animal rights.

However, overemphasising diversity in service-learning activities may run the risk of reducing recipients of student services to mere 'consumer commodities' that cater only to our students' personal growth. If our interactions with the elderly living alone are limited to annual visits, then these encounters will be nothing more than eye-opening experiences. We strongly believe that the essence of social services lies in this continuous commitment. Only through ongoing service learning can students truly understand the needs of those they serve. Imagine how those elderly living alone would feel if every time they were visited by a new group of students who only engaged in introductory small talk rather than in-depth conversations.

As exemplified by the students mentioned at the beginning of this article, a one-time service-learning experience can be eye-opening but it fails to provide participants with a deep understanding of the scavengers' situation. Recognising this, we continue to partner with our students to provide sustained support and care to underprivileged groups in Macao, including monthly visits to grassroots elderly people and regular interaction with ethnic minorities.

In *What to Study at University* (original Japanese title: 大学で何を学ぶか), renowned Japanese sociologist Taizo Kato encourages university students to find interests that they are passionate about and that they can continue to develop throughout their four-year academic journey. The professional knowledge students acquire in faculties at UM may be the 'interest' they wanted to pursue when they enrolled at the university. However, we aspire to offer another possibility. Through diverse service-learning activities, we aim to broaden students' horizons and help them identify 'interests' to which they are prepared to devote themselves without feeling constrained. They may ultimately incorporate these interests into their habits and attitudes, thereby nurturing a lifelong commitment to serving society.



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澳大於2010年引入住宿式書院系統。書院作為多元文化與多元學科融會貫通的知識整合學習平台，致力培養學生具有公民責任心、全球競爭力、知識整合能力、團隊協作、服務與領導、文化參與和健康生活的七項勝任力。
UM launched its residential college (RC) system in 2010 to create a multicultural and multidisciplinary learning platform for knowledge integration. RC education aims to cultivate seven competencies of students, namely responsible citizenship, global competitiveness, knowledge integration, teamwork and collaboration, service and leadership, cultural engagement, and healthy lifestyle.

住宿式書院系統網站
Website of the Residential College System

學生於2014年在貴州省畢節市與當地兒童一起學習苗族蠟染工藝
Students learned about the art of the Miao ethnic group's wax dyeing technique alongside local children in Bijie municipality, Guizhou province in 2014.

愛的果實是服務，服務的果實是成長
——霍英東珍禧書院服務學習項目

The Fruit of Love Is Service; The Fruit of Service Is Growth: Henry Fok Pearl Jubilee College's Service-Learning Programmes

文 / 蔣怡 · 圖 / 霍英東珍禧書院提供 · 英文翻譯 / 葉浩男
Text / Vivian Jiang · Photo / Henry Fok Pearl Jubilee College · English Translation / Davis Ip

2023年5月28日，在廣州往貴州的動車上，一群穿著橙色T恤的年輕人時而交頭接耳、時而奮筆疾書。他們都是奔赴從江的澳門大學霍英東珍禧書院的服務領袖，正在熱烈討論和完善翌日開始的義教課程。受疫情阻隔，書院學生已有數年沒與從江的兒童相聚。此次重啟實地教學，大家都懷著激動的心情奔赴深山。

「統合式」教育模式與服務學習項目

霍英東珍禧書院2010年成立以來一直致力發展「統合式」教育模式，將學習、實踐、服務融入書院活動，使每個具有獨立教育目標的活動互補，同時為修讀不同學科、擁有不同興趣和愛好的院生提供更廣闊、無縫銜接的體驗式學習網絡。服務學習作為「統合式」教育模式的重要部分，鼓勵院生服務社會，讓他們以專業知識服務社區，從中培養反思和終身學習的能力。

從2014年起，書院每年到內地展開服務學習項目，為偏遠地區的貧困兒童義教，近200位珍禧服務領袖先後踏足了海南、貴州、江西、雲南、湖南、廣西等省區，在13所學校共400多個班級為20,000多名中小學生提供各種課程。

服務學習項目的活動網絡

無論在澳門還是內地的偏遠山區，書院每年都有各種服務學習項目。院生既向社區對象傳遞服務，也從中有所習得和反思。服務和學習不僅發生在「傳遞」這一環節，而是同時見於活動策劃等環節組成的活動網絡。

其中，書院每年舉辦義賣，為內地山區義教項目籌款。有些院生參加工作坊學習基本的生產工藝，然後按客戶偏好設計和製作產品；有些院生則收集同學的捐贈物資，將之分類、標記、展示和出售；有些同學參加宣傳推廣小組，設計海報、拍攝廣告和編輯產品目錄；也有同學參與銷售團隊，輪崗銷售。除了義賣，書院還舉辦分享會、主題講座、與義教相關的工作坊、到合作機構訪問，也會出版服務學習書籍、創作主題曲和宣傳視頻，以及舉辦成果展等。

服務學習項目旨在服務他人、回報社會，使學生透過多元化的活動網絡培養七大勝任力，包括良好的公民責任心（家國情懷和社會責任感）、全球競爭力（全球視野和跨文化溝通）、知識整合能力（學以致用、解決實際問題）、團隊協作（溝通協調與合作）、服務與領導（領導力的培育與發展）、文化參與（體驗和欣賞多元文化）和健康生活（推廣健康生活和環保理念），這是「統合式」教育模式在服務學習項目成功應用的例證。

與校外機構廣泛合作

書院的內地服務學習項目始於與香港言愛基金在內地的思源學校體系的合作。在基金會協調下，學生曾赴各地的思源學校為留守兒童義教，為他們提供安全而健康的學習環境。這些活動讓學生踏足內地偏遠山區，見證扶貧攻堅政策的成效，激發社會責任感和家國情懷。

珍禧書院先後與香港社會企業潔世亞洲（Clean the World Aisa）和國際公益活動「小小發明家」（Little Inventors）合作，為內地義教活動增添元素。通過與潔世亞洲合作，院生有機會參與酒店肥皂回收和再生項目，學習衛生和環保知識，然後將知識傳授給山區兒童。此外，小小發明家項目不僅使服務學習項目的內容更豐富，同時啟發學生的創新思維，使他們為之後的義教活動設計了廣受當地兒童歡迎的「小小攝影師」和「小小程序員」項目。

發展學生的領導力

回顧多年經驗，書院發現，雖然服務學習項目的直接目標不是培養領袖，但它無疑提升了學生多項領袖需具備的能力，包括自信、溝通技巧、人際協調能力、團隊精神和解難能力。它將社區服務和公民教育結合，提升學生的社會責任感。此外，服務學習時的反思和探討是有效的再學習過程，讓他們將「愛心」轉變為「行動力」，進而發展「領導力」。不少參與了內地義教項目的同學後來積極投身書院院生會和其它學生組織，成為出色的學生領袖。

珍禧書院學生喜歡自稱橘子或其葡語Laranja，不僅是因為書院以一顆可愛的橘子為吉祥物，更是因為他們喜歡橘子散發的溫暖、活力和愛，並且希望以此感染和幫助別人。珍禧服務學習之旅一路走來，一路將陽光和愛心帶給偏遠地區的貧困兒童，而大家也從中收獲了學習和成長的喜悅。如果說愛的果實是服務，那麼服務的果實就是院生們的全人成長。

學生於2019年在貴州省從江縣往兒童家中訪問
Students visited local children's homes in Congjiang county, Guizhou province in 2019.

學生於2019年在貴州省從江縣為當地兒童寫下臨別贈言
Students wrote farewell messages to local children in Congjiang county, Guizhou province in 2019.

On 28 May 2023, a train made its way from Guangzhou to Guizhou. On the train, a group of young people in bright orange T-shirts were talking to each other and taking notes. They were all service leaders from Henry Fok Pearl Jubilee College (HFPJC) of the University of Macau (UM), and were preparing for the volunteer teaching programme that would begin the following day in Congjiang county in Guizhou. Due to the COVID-19 pandemic, the programme had been suspended for a few years. Now the service leaders were eagerly anticipating a trip to the mountains to re-launch the programme.

'Integrated' Education Model and Service-Learning Programmes

Since its establishment in 2010, HFPJC has been committed to developing an 'integrated' education model that incorporates academic learning, hands-on practice, and community service into college activities. In this model, the college ensures that activities with different educational objectives can complement each other, and at the same time, provide a broad and seamless experiential learning network for students of different disciplines, interests, and hobbies. At the core of the 'integrated' education model lies service learning, which encourages students to serve the community by applying their academic knowledge in a practical context, and thus developing the ability of self-reflection and the concept of lifelong learning.

The college has launched service-learning programmes every year since 2014 to offer free education to underprivileged children in remote areas of mainland China. To date, nearly 200 HFPJC service leaders have travelled to Hainan, Guizhou, Jiangxi, Yunnan, Hunan, Guangxi and other provinces and regions to provide a variety of courses for more than 20,000 primary and secondary students in over 400 classes at 13 schools.

2019年，貴州省從江縣的兒童在衛生課上展示潔世亞洲捐贈的環保肥皂。
Children in Congjiang county, Guizhou province, demonstrated the use of eco-friendly soap donated by Clean the World Asia during a personal hygiene lesson in 2019.

An Activity Network for Service-Learning Programmes

Each year, HFPJC organises a multitude of service-learning programmes in Macao and in remote, mountainous regions of mainland China. These initiatives allow students to contribute to the community while learning from and reflecting on their experiences. It is worth noting that such experiential learning opportunities not only occur when they are serving others, but also in programme planning and coordination.

In particular, the college organises an annual bazaar to raise funds for volunteer teaching programmes to be carried out in the mountainous regions in the mainland, and the students all take up different roles in the preparation process. Some attend workshops to learn basic techniques to design and develop products according to customer preferences. Some handle the donations by sorting, labelling, and displaying the products for sale. Some form a publicity and promotion team for designing posters, taking photos for advertisements, and creating product catalogues. And some join the sales team and take turns manning the booth and selling the products. In addition to charity bazaars, the college organises sharing sessions, talks, workshops related to volunteer teaching, and visits to partner organisations. It also publishes books on service learning, composes theme songs, makes promotional videos, and holds exhibitions to showcase student accomplishments.

The service-learning programmes aim to serve others and contribute to the community. They also empower students to develop seven competencies through a variety of activities. These include responsible citizenship (affection for home country and social responsibility), global competitiveness (global perspective and intercultural communication), knowledge integration (integration of academic knowledge and problem-solving skills), teamwork and collaboration (communication, coordination, and cooperation), service and leadership (cultivation and development of leadership skills), cultural engagement (multicultural experience and appreciation), and healthy lifestyle (healthy living and environmental protection). These competencies are integral to the 'integrated' education model and are incorporated into the service-learning programmes.

Extensive Collaboration Beyond UM

HFPJC's first service-learning programme in mainland China was launched with Yanai Foundation, a non-profit organisation based in Hong Kong. Coordinated by the foundation, service leaders of the college visited Siyuan Schools in different parts of the country to help create a safe and healthy learning environment for left-behind children—children who remain in rural regions while their parents seek work in urban areas. The programme allowed students to visit mountainous regions in mainland China to witness the effectiveness of poverty alleviation policies, thereby fostering a sense of social responsibility and national identity.

To enrich the content of the volunteer teaching programmes, the college also teamed up with Clean the World Asia, a Hong Kong-based social enterprise, and Little Inventors, an international charity initiative. The collaboration with Clean the World Asia enabled HFPJC students to take part in a hotel soap recycling programme. The students then imparted the knowledge of hygiene and environmental protection that they learned from the programme to the children in the mountainous regions. Furthermore, the Little Inventors project, which brought new elements to the service-learning programmes, encouraged the students to be creative. Such experiences ultimately led them to design the well-received 'Little Photographers' and 'Little Programmers' projects for the volunteer teaching activities that followed.

Cultivating Leadership Among Students

Looking back, HFPJC has found that although nurturing leaders is not the primary objective of the service-learning programmes, they indeed foster a range of leadership qualities among students. These include confidence, communication skills, interpersonal and coordination skills, team spirit, and problem-solving skills. By integrating community service with civic education, the programmes strengthen students' sense of social responsibility. In addition, the reflections and discussions during service-learning activities can prompt the process of relearning, enabling students to translate compassion into action and thereby develop leadership. Many students who took part in the volunteer teaching programmes in the mainland have later gone on to become active in the college's House Association and other student organisations and have thus turned themselves into exemplary student leaders.

HFPJC students affectionately call themselves 'juzi' ('orange' in Chinese) or 'laranja' ('orange' in Portuguese). This is not only because the college has an adorable orange as its mascot, but also because they embrace the warmth, vitality, and love that the colour orange symbolises. The students aspire to share these attributes and lend others a helping hand. On their service-learning journey, students have brought rays of sunshine and love to underprivileged children in remote areas, and in turn, they have also experienced joy from their own learning and personal growth. If the fruit of love is service, then the fruit of service is holistic student development.

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澳大於2010年引入住宿式書院系統。書院作為多元文化與多元學科融會貫通的知識整合學習平台，致力培養學生具有公民責任心、全球競爭力、知識整合能力、團隊協作、服務與領導、文化參與和健康生活的七項勝任力。
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