
THE UNIVERSITY
of ADELAIDE
Annual Report
2020
AUSTRALIAN
INSTITUTE FOR
MACHINE LEARNING
adelaide.edu.au/aiml

RANKED IN THE TOP 3 OF GLOBAL RESEARCH ORGANISATIONS FOR COMPUTER VISION

CREATING AI SOLUTIONS FOR AUSTRALIAN BUSINESSES

THE LARGEST UNIVERSITY MACHINE LEARNING GROUP IN THE COUNTRY

OUR VISION

To be global leaders in machine learning research, and high-impact research translation.

OUR MISSION

Research excellence in machine learning, artificial intelligence and computer vision.

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ABOUT THE INSTITUTE

The Australian Institute for Machine Learning (AIML) is a global leader in fundamental and applied research, and Australia's first university-based research institute dedicated to machine learning.

A joint initiative of the South Australian Government and the University of Adelaide, AIML was launched early in 2018.

With more than 140 members, AIML is the largest University-based research group in machine learning in Australia and one of the best in the world.

Built on the success of its predecessor the Australian Centre for Visual Technologies, AIML has taken high-impact applied research to very high levels of achievement. Over the last decade, the Institute has consistently ranked third in the world for publications in the top computer vision sites globally.

AIML makes an important national and international contribution to pushing the boundaries of what machine learning can do, and how that can be applied to almost every aspect of our lives.

Machine learning underpins the business models of the largest corporations and has the potential to deliver great social, economic and environmental benefits.

At AIML we collaborate with world-leading companies to develop high-tech products and solutions to everyday problems. Our impact partners include experts in many fields including agriculture, space, medicine, transport, defence, cybersecurity and advanced manufacturing.

AIML CAPABILITIES

Artificial intelligence (AI) is changing every aspect of our lives. The core capability of AI is to learn the patterns that exist in large datasets – hence the term machine learning. AI has been used to create computers that can see, and those that understand human language.

AI can create, mimic, detect fraud, target advertising to the right audience, and more. Those jurisdictions that have their own capabilities will be most able to harness the best from this powerful technology.

AIML consistently wins international competitions for excellence in tailoring AI to address specific tasks, often in completely new areas of application and with short lead times for team building and technology development.

AIML expertise lies across many areas of applied AI, including:

1. **Computer Vision** for object counting; extracting information from images and videos, tracking and detecting anomalies; or identifying objects.
2. **Robotic Vision** has a focus on the camera as a sensor for a robot, so is usually interested in real-time, creating "situation awareness" so that a robot can suitably respond. We have particular capability in visual SLAM, visual geometry and real-time semantic scene understanding.
3. **Natural Language Processing/ Understanding Language** to extract useful information from documents and datasets, to sort, order and analyse information for patterns, or for chat bots.
4. **Visual Question Answering**, where computers are queried with open-ended questions about images. These questions require an understanding of vision, language and common-sense knowledge to answer.
5. **Advanced Learning and Reasoning** to extract meaningful insights from big data, to make AI systems explainable and to push machine learning beyond today's capabilities.
6. **Signal Processing** to interpret complex signals such as audio and radar, and to review medical images and more.
7. **Reinforcement Learning**, where a machine learning model is trained to make a sequence of decisions. The AI faces a game-like situation and learns through trial and error to find a solution to the problem. This is the type of software that was applied for a computer to beat a human at games such as checkers, Go and more recently Fortnite.
8. **Deep Learning** imitates the working of the human brain in processing data and creating patterns for use in decision making. It is applied in virtual assistants, vision for driverless cars and in face recognition.
9. **Generative Adversarial Networks** involves using machine learning to create a new instance of a particular input (e.g. image, audio, video). For example, based on a series of text the machine will generate an image or a piece of art.
10. **Causation and Probabilistic Graphical Models** is a rich framework for learning the relationships in a system or asking causal and interventional questions. For instance, we can ask what are the best times of the year for irrigation or intervening with fertilisers to maximise yield in a farm.

WELCOME

Despite many challenges presented by the year 2020, exciting developments in artificial intelligence and machine learning capability offered a view to the future.

The University of Adelaide's Australian Institute for Machine Learning (AIML) is a prominent member of the world's machine learning research and development landscape. In 2020, the University ranked in the global top three research organisations for computer vision research, and AIML cemented its capability in machine learning for space, agriculture, geology, medical health, business innovation and more.

In the third year of its establishment, AIML members again displayed remarkable resilience and high attainment in both academic and applied capabilities. Researchers and students delivered numerous publications and virtual presentations in leading journals and professional conferences.

AIML staff continued to work closely with government and private sector partners and collaborators, cementing the Institute's reputation as a founding and vital member of the Lot Fourteen innovation precinct in South Australia.

Professor Simon Lucey joined Professor Anton van den Hengel as Co-Director of AIML in 2020, strengthening the Institute's standing as an agile participant working effectively across fundamental research and applied capabilities in machine learning and robotic vision. Also in 2020, the Federal Government allocated $20 million to establish a new Centre for Augmented Reasoning (CAR) at AIML, aimed at developing the high-calibre expertise the nation needs in order to be an active participant in the machine-learning-enabled global economy.

AIML's achievements in just a few short years have been remarkable, and I encourage you to continue to watch this space as the pace of development in machine learning continues to build and deliver remarkable capabilities for South Australia and our nation into the future.

Please enjoy AIML's 2020 Annual Report.

Professor Anton Middelberg
Deputy Vice-Chancellor and Vice-President (Research)

Professor Anton Middleberg

AT AIML WE CONTINUE TO BUILD OUR REPUTATION AS A GLOBALLY COMPETITIVE RESEARCH INSTITUTE PLAYING A VITAL ROLE AT THE CENTRE OF AN AUSTRALIA-WIDE MACHINE LEARNING NETWORK.

PURSUING OUR VISION TO BE GLOBAL LEADERS IN MACHINE LEARNING RESEARCH AND HIGH IMPACT RESEARCH TRANSLATION REMAINS PARAMOUNT.

2020 OVERVIEW

As an exemplar model of deep partnership between the University of Adelaide, South Australian Government and Lockheed Martin, AIML demonstrates the power of universities, governments and industry for unlocking the potential of collective know-how and vision.

Being based at Adelaide's Lot Fourteen puts AIML in a prime position to attract the smartest minds through its doors – not just those originating in South Australia, but also those from across Australia and the world. The Institute is a key, active component of the State Government's strategy for increasing innovation and high tech employment in South Australia. AIML is a key attractor of innovative, high tech companies and organisations onto the Lot Fourteen site.

Our researchers and staff secure new funding from traditional grant agencies and industry collaborators, and deliver project outcomes for diverse, innovative and future-focussed clients.

Helping South Australian companies thrive

After three years of operation, numerous benefits that stem from AIML's capabilities are now emerging. Through our partnership program, AIML has been working with State Government agencies to improve the efficiency and quality of public services in South Australia. This program is also designed to stimulate investment by SA companies in machine learning to create world-class products. Many companies are now making the leap into adopting machine learning for commercial benefit, including in the banking sector, for renewable energy and in creating PR opportunities for sports stars and celebrities.

AIML is attracting international companies and organisations into SA. We partner with Lockheed Martin, we have signed MoUs to develop joint opportunities with MIT and with Carnegie Mellon University and we are working with the University of South Australia and the South Australian Government to develop a Living Labs program in SA.

Fresh collaborations and projects

The Institute has driven and contributed resources to some major national funding programs, including:

- The Smarter Regions CRC, which aims to ensure that regional Australia benefits from the power of artificial intelligence. Professor Javen Shi from our team is doing a fantastic job in attracting industry interest and recruiting other university partners.
- The NHMRC Centre of Research Excellence in Healthy Housing, which aims to reduce the risk to human health from poorly designed housing. AIML is a core partner.
- The NHMRC Centre of Research Excellence Program and the Medical Research Future Fund, thanks to Dr Johan Verjans and Professor Gustavo Carneiro facilitating connections and identifying opportunities for collaboration.

Our leaders and high achievers

Professor Simon Lucey joined Professor Anton Van Den Hengel as Co-Director in October 2020. Attracted from Pittsburgh, USA where he was Associate Professor at Carnegie Mellon University's Robotics Institute and Principal Scientist at Argo AI, a company that builds technology for self-driving cars, Professor Lucey embodies the new model for academics in AI where they hold positions in industry and academia at the same time. This model has become standard in the US and Europe, because both industry and academia benefit.

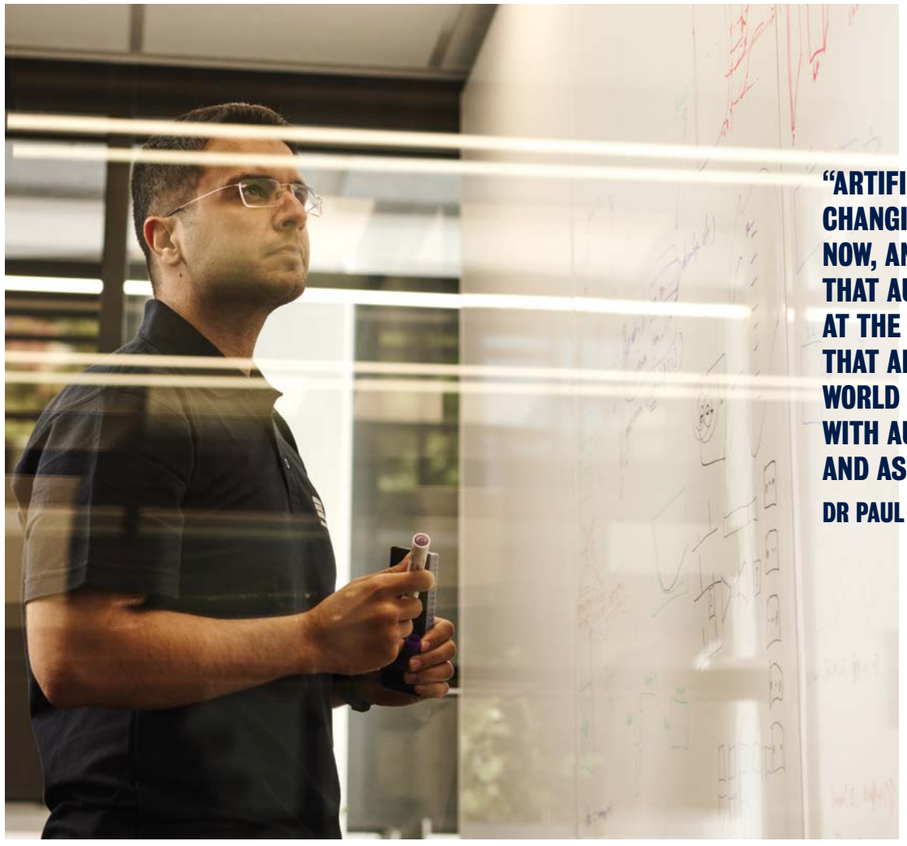
Professor Anton van den Hengel was named as a 2020 Fellow of the Academy of Technology and Engineering (ATSE) in an online ceremony. ATSE appoints fellows each year, selected from a competitive application process to recognise Australia's leaders in science, technology and engineering.

Professor van den Hengel also commenced in the role of Director of Applied Science at Amazon in 2020. He leads a Machine Learning research group based in Adelaide, working on Visual Question Answering, Conversational Agents, and general Computer Vision.

Professor Anton Middelberg, Deputy Vice-Chancellor and Vice-President (Research) stepped down as Chair of the AIML Advisory Board, a position he held since his appointment into the position in October 2019. AIML welcomed his nominee Professor Richard Hillis, Pro Vice-Chancellor (Research Performance) into this important role.

AIML marked the retirement of AIML Professor Wojciech Chojnacki in 2020. Wojciech started his association with Computer Science in 1991, joining the University of Adelaide as a grant funded researcher working with Professor Michael Brooks. Professor Wojciech Chojnacki has been awarded an Adjunct Professorship at the University of Adelaide and we know that Wojciech will not be a stranger at AIML.

L to R: Professor Richard Hillis, Professor Anton van den Hengel, Professor Simon Lucey



"ARTIFICIAL INTELLIGENCE IS CHANGING THE WORLD RIGHT NOW, AND IT IS IMPORTANT THAT AUSTRALIA HAS A VOICE AT THE TABLE TO ENSURE THAT AI IS USED TO CREATE A WORLD THAT IS CONSISTENT WITH AUSTRALIAN VALUES AND ASPIRATIONS."

DR PAUL DALBY

Academic excellence

Our world-class researchers continued to excel academically in 2020. AIML's members produced approximately 140 publications over the year, with many noteworthy advances and other career recognition worth noting.

Professor Chunhua Shen was listed in the top 5 researchers for Engineering and Computer Sciences as part of The Australian's Lifetime Achievers Leaderboard. This is an exceptional achievement and shows the consistent high quality of Professor Shen's research.

South Australian team DeepSightX led by Professor Javen Shi developed new interpretive maps revealing undiscovered mineral deposits deep underground in remote South Australia. The team combined newly released government magnetic and gravity data with deep neural network AI analysis to generate the approach, receiving a merit award in the ExploreSA: The Gawler Challenge. With tough competition against more than 2,200 data scientists and geologists from over 100 countries, this is a global award targeting innovation to identify valuable new mineral deposits in South Australia's Gawler region.

AIML had 23 publications accepted in the Conference on Computer Vision and Pattern Recognition (CVPR) 2020 conference, an increase of more than 50% from previous years. These numbers are comparable to those of institutions orders of magnitude larger, and are an incredible result when considering the relative age of AIML. With Apple, Google and Amazon being among the sponsors, the annual conference is touted as the most revered event for computer vision research. It's said that getting just one paper accepted here is a career highlight, a claim backed up by the submission and acceptance statistics. To have had 23 papers accepted to CVPR is an incredible result, and again puts AIML amongst the world's best research groups in this very competitive field. CVPR is the highest ranked venue in Computer Vision, and the second highest in all of Engineering and Computer Science. AIML member Dr Qi Wu, an ARC DECRA fellow at the University of Adelaide School of Computer Science, had six publications accepted this year.

Professor Mark Jenkinson, Professor of Neuroimaging was named a Chief Investigator on the $1.9 million grant from the Federal Government's Medical Research Future Fund (MRFF) for research into the links between Traumatic Brain Injury (TBI) and the development of neurodegenerative diseases, such as Parkinson's and Alzheimer's.

Professor Tat-Jun Chin, AIML's Director for Machine Learning for Space, is one of the first appointments to oversee a $20 million investment to develop next generation space technologies through the SmartSat Collaborative Research Centre. Professor Chin joined fellow world-leading researchers Professor Christopher Fluke and Professor Jill Slay from Swinburne University and University of South Australia respectively, with another six professorial chairs yet to be announced.

New Centre for Augmented Reasoning

Australia's position as a world leader in artificial intelligence (AI) and machine learning will be further boosted thanks to $20 million announced in the 2020-21 Federal Budget towards a new national centre, based at the University of Adelaide. The Centre for Augmented Reasoning is an investment by the Department of Education, Skills and Employment in people and research to make computers better at interacting with humans, so that all technology is easier and safer to use.

AI and machine learning is one of the fastest moving research sectors in academia, and this investment will strengthen AIML's reputation as one of the world's best institutions in this field. Starting in 2021, the Centre will support Advanced Reasoning research through grants and PhD scholarships, facilitate innovation and rapid commercialisation, and increase AI literacy and engagement in Australia.

High-level collaboration and engagement

2020 was both a challenging and rewarding year for collaboration and engagement, and AIML's researchers presented at many public events.

In March the inaugural Art Intelligence Hackathon was held at AIML, part of a new initiative with the University's Sia Furler Institute. Award-winning NYC avant-garde artist and creative pioneer, Laurie Anderson, was the inaugural artist-in-residence at Art Intelligence. Following her week-long visit to Adelaide in March 2020, Laurie Anderson collaborated with AIML scientists on a lyric and prose generator fine-tuned on the work of Laurie Anderson and Lou Reed, and on an app for Norse myth and Bible mixing.

After an energetic start many activities were curtailed due to restrictions after the outbreak of the COVID-19 pandemic. AIML staff quickly adapted to working and collaborating online, and events resumed once restrictions lifted.

Dr Paul Dalby, Business Development Manager at AIML, was one of five Australians selected to represent the nation in the new multilateral Global Partnership on Artificial Intelligence (GPAI). In June, The Hon Karen Andrews MP announced that Australia would be a founding member of the GPAI, formed to guide the development of AI such that privacy and human rights are preserved while also capitalising on the economic potential of the technology. Two centres have been created, one focusing on data governance and the future of work, and the other focusing on responsible AI, innovation and commercialisation. Dr Dalby is one of 30 experts from 17 countries on the data governance working group.

2021 and beyond

Looking forwards, the Institute will continue to build its research capabilities, and ensure that SA is able to capture the benefits of a world-class research group in AI and machine learning.

AIML has commenced development of the strategy for AIML2.0 to guide evolution of our future direction and focus. To that end, we welcome developing new relationships with international technology companies.

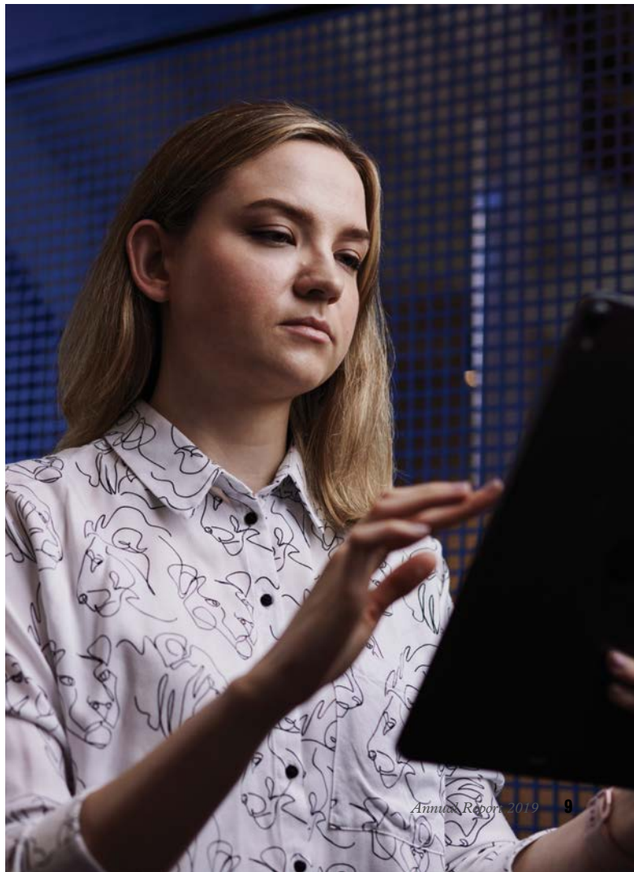
We acknowledge the Department for Premier and Cabinet, Department for Innovation and Skills, and Department for Trade and Investment for their enthusiastic support and promotion and our State Government agency project partners Department for Infrastructure and Transport, Department for Energy and Mining, and Department for Primary Industries and Regions (PIRSA). We also acknowledge the fantastic support of the Vice-Chancellor and senior management of the University of Adelaide.

We are continually thankful to the AIML's Advisory Board, Project Review Committee, Early and Mid-Career Researchers' Committee, professional services team, and our highly-valued members for their hard work and perseverance.

Professor Richard Hillis
Pro Vice-Chancellor (Research Performance)
Chair of the Advisory Board

Professor Anton van den Hengel
Co-Director, Australian Institute of Machine Learning

Professor Simon Lucey
Co-Director, Australian Institute of Machine Learning



PARTNERSHIP WITH THE GOVERNMENT OF SOUTH AUSTRALIA

The Australian Institute for Machine Learning (AIML) is a partnership between the University of Adelaide and the Government of South Australia.

AIML is a collaborative partnership between government and academia, established with the purpose of driving our state's economic growth and delivering more jobs across a range of sectors.

With the support of the South Australian Government, AIML has grown into a state-of-the-art research institute with over 140 members. AIML is recognised as one of the best Machine Learning research groups in the world and is currently ranked number 3 globally in Computer Vision research output across leading Computer Science publications over the last ten years (CSRankings).

From left: The Honourable Steven Marshall MP Premier of South Australia, Professor Anton van den Hengel, Professor Mike Brooks

THE PARTNERSHIP COMPRISES FOUR PROGRAMS

1. ARTIFICIAL INTELLIGENCE SKILLS DEVELOPMENT

Developing a workforce with the appropriate skills is critical if South Australia is to grow an AI industry sector. This program supports undergraduate students making the transition to post-graduate programs, and the attraction and maintenance of high-quality PhD students.

2. DEFENCE INDUSTRY ENGAGEMENT

Supports AIML's collaborative research partnerships with defence industry partners by allocating 27,000 research hours to address the priority needs of the defence industry and contribute to necessary industrial capabilities.

3. GOVERNMENT EFFICIENCY ENGAGEMENT

AIML is liaising with relevant Government Agencies to identify priority projects for adoption of AI into Government processes. Research hours are being used to deliver projects that provide solutions to government, improving productivity and efficiency and service delivery to South Australian citizens.

4. SME ENGAGEMENT AND GLOBAL R&D

AIML is actively engaging and working with South Australian SME's that wish to integrate and adopt machine learning and AI to drive transformational productivity growth in their business to improve their local and global competitiveness.

AIML was an experiment in forming a partnership between state government and a university to support the transition of South Australia to a more modern economy, deliver skills and education in a strategically important area of technological advancement and grow a brand presence in a particular capability in South Australia that was previously not readily apparent.

The experiment has worked in attracting jobs to SA, in supporting SA companies and government agencies to innovate, and by establishing some landmark new training and education options for South Australians. In addition, South Australia has developed a brand for being a centre for machine learning know-how and innovation, attracting both Federal Government and other funding for research (over $38M) and global businesses to base themselves here.

KEY ACHIEVEMENTS AGAINST THE PARTNERSHIP OBJECTIVES

Establishment of a new Major in AI within the Bachelor of Computer Science program, or a new Master of Data Science program (or equivalent)

02 AI
MASTERS COURSES IN DATA SCIENCE AND MACHINE LEARNING
MAJOR FOR BSC(COMP)

Leverage investment of at least $10m from Commonwealth and industry sources

>$38M
IN COMMONWEALTH AND INDUSTRY FUNDING, 2018-2020

An additional 20 FTE in staff and students within AIML, over the term of the agreement

+60
MEMBERS - 80 IN 2017 TO 140 IN 2021

Collaborate with South Australian SME's to develop at least five new products or services

09
NEW PRODUCTS AND SERVICES IN DEVELOPMENT

Attraction of at least two international organisations' research and development projects to AIML

04
INTERNATIONAL R&D PROJECTS IN PROGRESS

Delivery of at least three South Australian Government AI related projects that result in demonstatble benefits in productivity, efficiency and/or service delivery

04
PROJECTS WITH DIT, PIRSA AND DEM

Adoption of AIML technology, intellectual property or know-how into at least five defence industry projects, products or services

10
DEFENCE PROJECTS, COMPLETED AND IN PROGRESS

Adoption of AIML technology, intellectual property or know-how into at least five other industry projects, products or services

11
SME PROJECTS, COMPLETED AND IN PROGRESS

GOVERNANCE

ADVISORY BOARD

Professor Anton Middelberg
Deputy Vice-Chancellor and Vice-President (Research), Board Chair (Jan-Jul)

Professor Richard Hillis
Pro Vice-Chancellor (Research Performance), Board Chair (Aug-Dec)

Professor Anton van den Hengel
Co-Director AIML

Professor Simon Lucey
Co-Director AIML

Ms Lusia Guthrie
Independent Business Consultant; Chair, BioMelbourne Network; Chair, Medicines Manufacturing Innovation Centre

Mr Adam Reid
Chief Executive, Department for Innovation and Skills

Dr Tony Lindsay
Director, STELaRLab, Lockheed Martin Australia (Science, Technology, Engineering Leadership and Research Laboratory)

Professor Katrina Falkner
Executive Dean, Faculty of Engineering, Computer and Mathematical Sciences

PROJECT REVIEW COMMITTEE

Dr Paul Dalby (Chair)
Business Development Manager, AIML

Dr Andrew Dunbar
Executive Director, Innovation and Science, Department for Innovation and Skills.

Mr Kim Scott
Managing Director, TAO Consulting
Chair, Australian Cyber Collaboration Centre

EARLY CAREER RESEARCH COMMITTEE

Mr Anthony Manchin (Chair)
Mr Adrian Orenstein
Mr Dung Ahn Doan
Dr Huangying Zhan
Mr James Paul Bockman
Mr Mahdi Kazemi Moghaddam
Dr Rafael Felix Alves
Dr Tong He
Mr Thomas Martin Walker
Ms Violetta Shevchenko
Mr Yang Zao

RESEARCH THEMES

The core of machine learning is the development of systems that are able to learn by example. This is important for a range of tasks, and particularly for those that humans have difficulty in specifying algorithmically.

Our focus at AIML is to develop fundamental new methods and technologies in machine learning. Research at AIML can be broken down into six major themes.

RESEARCH PROGRAM & THEME LEADERS

Machine Learning Theory
Advancing the mathematical fundamentals of the field.

Professor Chunhua Shen

Trusted Autonomous Systems
Developing machines that cooperate actively with humans.

Professor Anton van den Hengel

Robotic Vision
Enabling machines that see.

Professor Ian Reid

Medical Machine Learning
Applying machine learning methods to problems in Health and Medicine.

Professor Gustavo Carneiro

Vision and Language Methods
Enabling natural language interactions with systems that exploit visual information.

Dr Qi Wu

Advanced Reasoning and Learning
Enabling higher-level analysis and ongoing learning in machine learning methods.

Professor Javen Shi

MACHINE LEARNING THEORY

How machine learning actually happens

Machine learning is a form of artificial intelligence that enables computers and machines to learn autonomously complex tasks without being overtly programmed. Machine learning theory focuses in particular on the relevant mathematical and computation processes, helping computer scientists tease apart and gain in-depth understanding of how learning takes place. In turn, this facilitates the design of new, more efficient and reliable approaches for machine learning, and leads to applications that are useful in the real world. For example, theoretical research into computer vision helps researchers create new algorithms for digital photography and driverless car cameras.

Research strengths at AIML

A particular strength of researchers at AIML is our ability to teach computers through machine learning using multi-modality, weakly labelled, and/or imperfect data. Our scientists are making major contributions in:

- **Computer vision**, including tasks such as object detection, semantic segmentation, instance segmentation and monocular depth estimation
- **Deep learning**, by advancing the mathematical tools that underpin the training of computers to perform human-like tasks
- **Systems optimisation**, through development of the theory, algorithms and tools
- **Robust statistics**, by developing procedures to analyse data to make sure that information from machines remains informative and efficient
- **Learning with multi-modality data** such as images, video, text, 3D point clouds.

THEME LEADER
Professor Chunhua Shen

CASE STUDY
MACHINE LEARNING THEORY

A NEW INDUSTRY STANDARD

Professor Chunhua Shen
Director, Machine Learning Theory

Whether on our phones or in different types of vehicles, devices we use are getting better at identifying objects in images – for example: a dog versus a cat versus a person.

The preferred approach for achieving this capability is known as instance segmentation.

In 2020 the Machine Learning Theory group at AIML made significant advances in instance segmentation capability. Their new method is more accurate and faster than the previous industry standard and is now being used by many organisations in academia and industry.

Instance segmentation is a challenging computer vision task that requires prediction of the existence of things (object detection) plus grouping of pixels in an image according to which object they belong (semantic segmentation).

“Instance segmentation is a fundamental vision task that has a wide range of downstream applications,” says Professor Chunhua Shen.

“In 2020, we developed a series of instance segmentation methods that achieve state-of-the-art performance in terms of accuracy and speed.”

“Our newly developed method largely simplifies previous best methods, which are complex in design, making it significantly more flexible and friendlier to end users,” Shen says.

Shen said his group’s new approach simplified the pipeline of the instance segmentation algorithm and also achieved greater accuracy.

“These methods are open sourced in the toolbox AdelaiDet hosted at GitHub, and are now used by many organisations both in academia and industry,” says Shen.

The previous industry standard for instance segmentation was published by Facebook in 2017.

CASE STUDY
ROBOTIC VISION

A FRESH TAKE ON ROBOTIC VISION

PhD candidate Huangying Zhan
with Professor Ian Reid

Human vision allows us to move through the world and gather constant feedback about our location. For example, we watch the trees whizz by as we leave home and cycle down the street, and experience our workplace grow larger and larger as we approach it.

New AIML research published in 2020 is helping robots take one step closer to having similar capacity. The paper focuses in particular on a capability know as visual odometry, which uses images captured by a robot to determine where in an environment that robot is located.

"Vastly improving existing approaches, AIML PhD student Huangying Zhan produced state-of-the-art visual odometry using just one camera," says Professor Ian Reid.

"He achieved this by taking a fresh look at visual odometry, and pulling in deep learning and engineering to work alongside the geometric algorithms that had typically been used for basic capability."

"There are also elements of self-supervision and self-improvement in the new approach, where imagery is fed back into system so that it gets better over time," Reid explains.

Zhan's solution for visual odometry has been integrated with other capability for state-of-the-art large scale place recognition developed by AIML staff Dzung Doan, Dr Yasir Latif and Professor Tat-Jun Chin. The combined system is now published as open-source code, available for anyone to use.

For robots and autonomous vehicles, the real value of accurate and efficient capability in visual odometry is realised when it's combined with place recognition technology.

"When you move, odometry tells you about your location relative to where you started," Reid says.

"When we combine this with images that pinpoint a robot to a recognised location, then it's really getting closer to human vision."

As visual odometry capability continues to improve, robots will get better and better at operating in hostile and remote environments – for example, in places where GPS does not work, such as on Mars, underground or in contested spaces.

ROBOTIC VISION

Machines that can see

Robotic vision refers to a range of technologies that work together to give machines the ability to understand the physical world through "seeing". The capability comes from applying camera hardware with computer algorithms to enable a robot or vehicle to process visual information. As technologies improve, robots, drones and autonomous vehicles gain greater operating capabilities without direct supervision by humans and without reliance on satellite information.

Research strengths at AIML

Researchers in the Robotic Vision theme work independently on a range of capabilities and also collaborate with other national institutions. AIML was a founding partner of the recently completed Australian Centre for Robotic Vision, which ran until April 2021.

Visual simultaneous localisation and mapping (SLAM) research is a core strength at AIML. This approach relies on 3D vision cameras to determine the position and orientation of the vehicle, and to map the unknown surrounding environment. We apply geometry, robust statistics and deep learning techniques to improve the reliability of SLAM.

Semantics focuses on extracting meaning from data. In semantic vision research we aim to understand not only what objects are present in an image, but also the relationship between those objects. Applications for semantic vision include autonomous driving, medical imaging analysis, industrial inspection, classification of terrain from satellite imagery and data management.

Humans and robots can only collaborate if they can reach mutually understood objectives, so a flexible means of communication must be established. **Vision and language** research focuses on the link between imagery and language, enabling automatic generation of language descriptions of scenes, and allowing a robot to respond to natural language queries about what it sees, or to understand and conduct a complex task conveyed by language. Vision-language navigation and so-called "embodied question answering" – in which a robot must make an action plan such as moving to a particular location to answer a question – are closely related to vision and language, and build on the semantic and geometric understanding the robot can acquire.

THEME LEADER
Professor Ian Reid

Text Visual Question Answering. To answer questions in these images, the model needs to understand the texts that appeared in the image and the given questions.

CASE STUDY
VISION AND LANGUAGE

FIRST PRIZE IN GLOBAL COMPUTER VISION CHALLENGE

Dr Qi Wu Director of Vision and Language Methods

"Siri, play Queen's Bohemian Rhapsody!"

Right now, we can use voice commands to instruct our digital device to play a particular song, or dial the phone number of our best friend.

But computer scientists want to be able to ask technology more complex questions – ones that involve some degree of reasoning. Queries like: "what is the brand of that computer?" or "according to this street sign, how many kilometres is Adelaide from Melbourne?"

It's an approach called Visual Question Answering, often shortened to VQA.

AIML's Dr Qi Wu and his local and international colleagues made significant inroads on VQA capability in 2020.

Wu's work was awarded first prize in the global 2020 CVPR TextVQA Challenge. CVPR is an acronym for Computer Vision Pattern Recognition, one of the leading conferences in the field.

"The CVPR TextVQA Challenge requires computer models to look at images, to read and to reason," explains Dr Qi Wu.

"The challenge provided a series of images and questions, and we applied our trained system to provide the answers."

In 2020, 19 international teams competed in the TextVQA Challenge, with Wu's team taking first prize with a test accuracy of 45.5%.

Wu says there are a number of reasons he chooses to compete in computer science competitions.

"Challenges help us test our work and benchmark our capabilities against other research groups," Wu says.

"It's like the Olympic Games for our area of expertise."

Wu also sees value in the fact that challenges take place with a limited time frame.

"Compared to publishing research papers, competitions feel more like a test in the real world – this provides good practice for students, and is a good way to help others see the quality of our work," he says.

Better VQA capability is expected to lead to improvements in robot and other vehicular vision systems. It may also provide technology to aid humans; for example, for people who are visually impaired.

VISION AND LANGUAGE METHODS

Putting vision and language together

Vision and language methods research brings together technologies that understand human spoken and written languages (also referred to as natural language) and vision (in the form of images or video). The goal is to be able to use words and pictures to interact with and direct digital devices. In visual question and answering, for example, an algorithm is designed to respond to queries.

- Q: What colour is the T-shirt in this picture?
  A: The T-shirt is red.
- Q: How many grey books are on my shelf?
  A: There are 7 grey books.

AIML works with many partners to develop vision and language capability, and collaborates with Australian and international colleagues.

Research strengths at AIML

Vision and Language Navigation (VLN) is a key focus for researchers at AIML. The challenge here is to give natural language directions that are followed accurately by a device. For example, directing a robot: "go down the corridor, open the second door on the left, pick up the yellow document on the desk, and bring it back to me." The algorithm operating the robot must be able to comprehend the instructions, "see" and understand the environment, and then act.

Sophisticated **Visual Question Answering** (VQA) research at AIML involves taking existing capability (simple question, one answer) and creating new functionality. For example, visual dialogue, where algorithms can conduct back-and-forth dialogue about the content in an image.

Image captioning research involves increasing the accuracy and efficiency of algorithms that use natural language to describe visual information. AIML researchers achieve significant developments in this field through treating the problem not just as a machine learning task, but as a challenge that involves high level reasoning.


THEME LEADER
Dr Qi Wu

TRUSTED AUTONOMOUS SYSTEMS

Machines that work cooperatively with humans

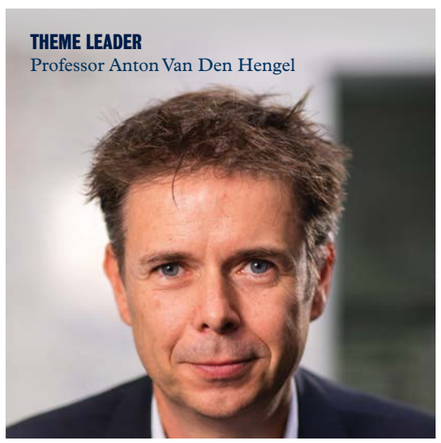
The goal of the trusted autonomous systems program is to develop machine learning methods able to collaborate with humans at a high level; such systems would work alongside humans, helping us achieve our goals without explicit instruction on how to do so. They may communicate, cooperate and negotiate with us or other autonomous systems to achieve complex goals that change rapidly. Trusted autonomous systems might thus enable robots to operate our homes, allow cars to understand natural language, and respond to rain by telling your garden irrigation system to stop.

As the application of autonomous systems becomes more widespread across industries including health, education and finance, it's important we create systems that are useful, reliable, transparent and accepted by our communities.

Research strengths at AIML

At AIML, our theoretical and practical research focuses on developing autonomous systems that are capable of:

- providing transparent and explainable decisions
- intelligently controlling vehicles
- asking questions when uncertain about decisions or the surrounding environment
- understanding their interactions with the world
- applying reasoning to their surrounds.



THEME LEADER
Professor Anton Van Den Hengel

GLOBAL PUSH FOR SCREENING TOOL TO PREVENT BLINDNESS

Professor Anton van den Hengel

AIML's Professor Anton van den Hengel and colleagues are part of a global drive to apply deep learning to tackle the problem of glaucoma – one of the leading causes of irreversible but preventable blindness in working age populations.

In 2020 they published a research paper detailing the development of diagnostics stemming from the Retinal Fundus Glaucoma Challenge (REFUGE). Teams competing in the challenge worked with a data set of 1200 images of the fundus, which is the interior surface of the back of the eye.

"Glaucoma results from gradual damage to the optic nerve, which is visible in images of the fundus," says van den Hengel.

"In this challenge, we used the images of the fundus to train a deep learning system to pick up physical changes associated with that damage."

Many people who have early-stage glaucoma remain undiagnosed due to the lack of an effective screening tool. Unfortunately, their vision may be permanently diminished by the time they do show up in a doctor's clinic.

"Automated diagnostics that can pick up glaucoma early and with high cost-effectiveness are urgently needed," van den Hengel says.

"We hope this sort of technology will soon offer a glaucoma screening tool that can be used in GP clinics and in remote field settings to ensure that nobody with early-stage glaucoma is missed."

Early-stage glaucoma can be treated to prevent permanent damage to the optic nerve.

Images of the retina can also be used to detect a wide range of diseases that affect the rest of the body, such as diabetes and heart disease. Using machine learning to diagnose these diseases cheaply, and without complex equipment, has the potential to dramatically improve the health of remote and third-world communities.

HELPING SURGEONS NAVIGATE KNEES

Professor Gustavo Carneiro

At least 70,000 knee arthroscopies are performed every year in Australia. It's a delicate surgery, in which orthopaedic surgeons insert instruments through button-sized holes to visualise, diagnose and treat problems inside the joint.

Along with colleagues, Professor Carneiro has developed a new system to help surgeons find their way around inside knees.

In 2020 they published their latest findings as part of the 23rd International Conference on Medical Image Computing and Computer Assisted Intervention.

"Even though it's a small space, sometimes surgeons find themselves lost inside the knee joint when they're doing arthroscopic surgery," says Professor Carneiro.

"They're constantly having to work out where their instruments are located in relation to key structures such as bones and ligaments, plus trying to avoid doing any damage."

"Our research aims to provide feedback to the surgeon through live labelling and depth estimation of the knee structure using a stereo arthroscopic camera," says Professor Carneiro.

The machine learning approaches being used are semantic segmentation and depth estimation. An algorithm is trained to estimate the depth and recognise key structures in the knee such as the femur and tibia bones, the anterior cruciate ligament (ACL) and the meniscus (a rubbery structure that acts like a shock absorber in the knee).

"We used more than 8000 images to train our system, with information provided regarding the names of key structures and also depth measurements," says Professor Carneiro.

"We found this method was much more accurate than a previous, simpler approach to the problem."

THEME LEADER
Professor Gustavo Carneiro

MEDICAL MACHINE LEARNING

Improving patient diagnosis, prognosis and care

Medical machine learning is a specialty field that sits at the intersection of statistics, computer science and medicine. The field uses thousands to millions of data points to develop new algorithms and statistical models that can interpret medical information to improve patient diagnosis, prognosis and care. In the near future, some medical machine learning algorithms are likely to be able to analyse an image or a complex medical dataset as well as humans. Performance even better than a human may occur when multiple sources of information or specific patterns in health information can be incorporated into the system. Also, artificial intelligence may soon be involved in patient follow-up care, providing meaningful and bespoke information to improve wellbeing.

Research strengths at AIML

AIML conducts fundamental and applied research in medical machine learning, and partners with world-leading medical researchers and institutions to create solutions for patients, medical specialists and healthcare systems.

Our work focuses on the following speciality areas:

- applying machine learning to cardiology, cancer (colorectal and breast cancer), obstetrics and gynaecology, orthopaedics (arthroscopy, hip replacement), neurology (transient ischaemic attack, stroke, vascular dementia), and public health
- improving clinician certainty through machine learning methods to provide a 'second opinion'
- increasing patient awareness and experience through improving accessibility to approachable and bespoke information.

ADVANCED REASONING AND LEARNING

Reasoning and decision-making with super-human performance

Machine learning is an applied form of artificial intelligence that can recognise patterns in complex datasets – a capability that offers huge potential for many industries. Fields as diverse as computer vision, mining, sport, social networks, healthcare, bushfire management, smart agriculture, smart manufacturing (Industry 4.0) and automated trades can all be transformed by advanced machine learning capability. Developments are moving at pace, creating increasingly efficient algorithms and systems that can evolve and learn from massive amounts of data. Related work focuses on probabilistic graphical models, causality, structured learning, optimisation and deep learning.

Research strengths at AIML

With artificially intelligent systems being used to inform decisions in the public and private sectors, it is crucial that the solution provided can be understood and justified by humans. Researchers at AIML are designing AIs that make decisions using logic and reason, and that are explainable.

At AIML we focus on advancing machine learning through research into core theory in causality, optimisation and deep learning, and developing algorithms that advance analysis beyond today's capability and that solve real world challenges.

PREDICTING BUSHFIRE SPREAD

PhD candidate Mahdi Kazemi and Dr Ehsan Abbasnejad with Professor Javen Shi

Part of the Fuel and Fire Risk collaborative team with CSIRO and the University of the Sunshine Coast (USC), AIML scientists Mr Mahdi Kazemi and Dr Ehsan Abbasnejad developed a fast, lightweight and accurate tool to predict bushfire burn areas.

AIML's Professor Javen Shi and forestry expert Professor Mark Brown from USC were advisors for the team.

The work was selected as an exemplar case study in the Data Quest 2020 showcase exploring how bushfire, machine learning and Earth-observation researchers can help solve the bushfire crisis.

"Our model provides a unique insight into the devastating impact a fire can have, but before it even happens," says Dr Abbasnejad.

"To develop this tool, we used deep neural networks, which are a special type of machine learning that can capture complex patterns in data."

"Once a neural network is trained, it's able to work with new scenarios and make predictions based on what it has learned from its previous observations," Dr Abbasnejad says.

For bushfire management, the researchers hope their tool can help identify communities at risk ahead of the fire season, and inform forest management strategies to prevent fires from happening. The tool may also be used to provide directions for fire response teams after a fire has started.

"Our tool can be applied in different ways before and during a bushfire," says PhD student Mr Kazemi.

"It offers a viable alternative to complex physics-based modelling currently being used during bushfire seasons."

The data used to train the tool consisted of satellite imagery, plus maximum temperature, relative humidity, evapotranspiration (evaporation of water from plants to the atmosphere) and land elevation.

For Data Quest 2020, submissions were received from 36 teams from Australia and New Zealand who participated in an intensive research sprint, applying modern data-science and artificial intelligence techniques to mitigate the effect of bushfires.

"Bushfires come back to Australia every year and we wish to do something about it," says AIML's Professor Javen Shi.

"Young talents like Mr Mahdi and Dr Abbasnejad are at the forefront of using cutting-edge technology to make a change and renew people's belief in what's possible with new approaches."

CASE STUDY
ADVANCED REASONING AND LEARNING

FASTER DIAGNOSIS OF ENDOMETRIOSIS WITHOUT NEEDING A SPECIALIST

Professor Gustavo Carneiro

AIML is working with the Robinson Research Institute at the University of Adelaide to harness artificial intelligence to help improve diagnosis and care of patients with endometriosis.

Endometriosis – a condition where cells similar to the lining of the uterus grow outside of the uterus – affects an estimated 1 in 10 women world-wide, often causing pain and fertility problems.

Diagnosis can be particularly tricky, especially when doctors aren't specifically trained in how to identify endometriosis in scans of the uterus and surrounding tissues. Often surgery is required as the only reliable diagnostic approach.

Professor Gustavo Carneiro, AIML Director of Medical Machine Learning, supervised the design and implementation of a program that can read specialist scans and recognise certain imaging markers seen in endometriosis, helping doctors provide surgery-free diagnosis.

Initial tests show the software is capable of diagnostic accuracy approaching that of a specialist doctor, and that's only set to improve as the research develops.

"Machine learning is an iterative process – as you give more and more training samples, the accuracy of the system improves," says Professor Carneiro.

The project is ongoing, and will build as more data becomes available.

Professor Carneiro and his collaborators hope their approach will soon mean patients from all over Australia will have access to high-quality, non-invasive screening for endometriosis.

"This is a system that works together with doctors to improve their ability to diagnose endometriosis," says Professor Carneiro.

Endometriosis scanning and interpretation is a specialist skill, and not all gynaecologists have the opportunity to receive the required training.

A machine learning algorithm could hasten identification of endometriosis when a specialist isn't available, easing the burden on women and fast-tracking delivery of surgical, medical and fertility care as appropriate.

Thanks to Ashleigh Geiger for the source material for this story.

CASE STUDY
ENDOMETRIOSIS

CASE STUDY
NASA
CHALLENGE

NAVIGATING A ROBOT ON THE MOON

Professor Tat-Jun Chin Director, Machine Learning for Space

NASA's Space Robotics Challenge is designed to identify and develop capability to advance autonomous robotic operations for space exploration missions on the surface of other worlds, such as the Moon and Mars.

AIML researchers Professor Tat-Jun Chin, Mr Thomas Rowntree, Mr Andrew Du, Mr Sam Bahrami, Mr Kiet To and Professor Ian Reid were part of the University of Adelaide team that qualified for Stage 2 of the competition in 2020. The next phase will continue into 2021.

"The competition is a great way for us to apply our machine learning and artificial intelligence capability to solve space problems, in particular autonomy for lunar exploration," says Professor Chin, who is Professorial Chair of Sentient Satellites at AIML.

"It's the sort of work that is really exciting, and maybe it will inspire new generations of researchers to study and become involved in machine learning, or the space industry."

Out of 114 registered teams, only 22 successfully addressed the NASA criteria in their entries, allowing them to move on to the final competition round.

"It was not a simple problem," says Professor Chin.

"We were provided with a simulated moon environment, and we had to design algorithms to control a robot to move around on that surface."

But it wasn't enough to just move around on the moon – the robot should also be able to find and identify valuable resources, and then collect and return them to a lunar processing plant.

It's the sort of activity that NASA and other space agencies and entities envisage for a future where space mining and remote operations on moons and planets is likely. Valuable resources might one day include water, fuel ingredients, or high value minerals.

So why get involved? Professor Chin says competitions provide important opportunities for AIML scientists.

"They give us a platform to show others what we're capable of – it's like a skills demonstration to share with other academics, collaborators, potential investors in technology and even the general public who may be interested in our work," he says.

Curiosity at 'Glen Etive'

NASA's Curiosity rover took this selfie on Oct. 11, 2019, the 2,553rd Martian day, or sol, of its mission.

ART INTELLIGENCE

A collaboration between AIML and the Sia Furler Institute Pairing world-class AI and machine learning scientists with leading artists

The Art Intelligence Agency creates and curates collaborations between artists and AIML scientists with the aim of developing new art and new technologies that will lead to the establishment of global companies in Adelaide. By bringing together artists, scientists and entrepreneurs, the Art Intelligence Agency draws upon South Australia's unique combination of talents to create high-value economic opportunities for South Australia.

Artist-in-Residence

The purpose of the Artist-in-Residence program is to bring globally-recognised artists to collaborate with AI scientists on art works as well as creative entrepreneurship projects.

Award-winning NYC avant-garde artist and creative pioneer, Laurie Anderson, was the inaugural artist-in-residence at Art Intelligence. Following her week-long visit to Adelaide in March 2020, Laurie Anderson collaborated with AIML scientists on a lyric and prose generator fine-tuned on the work of Laurie Anderson and Lou Reed and an app for Norse myth and Bible mixing.

In a first for Australia, Ms Anderson will feature her work with AIML in her third lecture 'The Rocks' in the 2021 Norton Lecture Series, Harvard University's preeminent lecture series, in the arts and humanities. The Charles Eliot Norton Professorship in Poetry recognises individuals of extraordinary talent who, in addition to their particular expertise, have the gift of wide dissemination and wise expression. The term 'poetry' is interpreted in the broadest sense to encompass all poetic expression in language, music, or the fine arts.

"When people say the purpose of art is to make the world a better place I always think: better for who? Art is not medicine or science. It's not about creative problem solving. If I had to use one word to describe art it would be freedom. I'm curious about whether this freedom can be translated or facilitated by AI in a meaningful way."

Laurie Anderson

Podcast Series

AI Agents is a podcast series that explores the intersections of contemporary art and artificial intelligence. https://omny.fm/shows/ai-agents

Hosted by Tim Whiffen of Whimsy Productions, AI Agents represents the work of many respected contributors to the art and AI fields, including significant work by Carolyn Strauss, director of Slow Research Lab, in the early episodes titled "AI Murmurings". To date, 20 podcasts have been created.

AI Art Gallery

The AI Gallery features some of the projects from the Art Intelligence Agency as well as work from artists around the world.

ANTON VAN DEN HENGEL

Director of the Centre for Augmented Reasoning

"AI is the technology that is defining our times. It is essential that artists have access to, and are involved in this technology if we are to reach an outcome that benefits us all."

Hackathon 2020

The purpose of the Hackathon is to create a process to produce start up ideas that can be incubated in South Australia to create new businesses and high value jobs.

Art Intelligence's annual hackathon is about collaboration, innovation and problem solving – art driving engineering, engineering driving art – at speed to get results. The first Art Intelligence Hackathon took place in March 2020, with Laurie Anderson and Art Intelligence directors - Anton van den Hengel and Tom Hajdu - guiding engineers, artists, scientists, sociologists, architects, students, and more along a broad new path of renewal and early construction.

"This project will help shape the future of AI and of art. There is a lot of art about AI, but very little that is AI. We're aiming to change that. We want to give the people the freedom to take a risk."

Professor Anton van den Hengel, Director of the Centre for Augmented Reasoning

TOM HAJDU

Director of Sia Furler Institute

"The duty of the artist is to respond to and reflect upon the human experience. The edges of that experience are now clearly being challenged by AI and the machines that we are rapidly welcoming into our lives."

AIML IN THE COMMUNITY

Off and racing in 2020

AIML started 2020 in community engagement with a bang, with public events featuring our researchers booking out fast. These included The University of Adelaide's first Research Tuesday event of the year, where AIML's Professor Anton van den Hengel, Professor Emma Baker and Dr Johan Verjans discussed the potential for Machine Learning and AI in health.

Professor Anton van den Hengel presented an at-capacity Future Briefing event for the Financial Review, titled: Will AI make or break your business?

AIML's Ali Anderson participated in a debate with other colleagues on Ethics in AI at Stone and Chalk, Lot Fourteen.

Professor Tat-Jun Chin was a presenter at a popular Science in The Pub event – The Science of Robotics: More than Roboco and Roombas.

AIML was a co-sponsor of the App for Good workshop for women on International Women's Day 2020. Around 40 women from social purpose organisations attended, and received coding and other technical training from Microsoft Australia.

Dabbling in the arts

Collaboration and brainstorming across computer science and the arts can produce surprising outcomes.

In 2020, the inaugural Art Intelligence Hackathon was held at AIML, part of a new initiative with the Sia Furler Institute, the University of Adelaide.

Dr Jamie Sherrah displayed great additional creativity in 2020, creating a range of AI tools designed to engage the general public with new technologies. These included:

- AI Art Snob app, that uses machine learning algorithms to provide descriptions of artwork (or indeed any sort of image you choose)
- @froydAI – an AI self-help guru
- Working with Dr Paul Dalby, released an endless cowboy song with AI-generated lyrics
- Voog, the singing keyboard, that uses AI to write its own lyrics.

A 2020 online competition invited members of the general public to submit names for AIML's newest high-performance computer. After 200 submissions, the winning title was DEEP PURPLE.

Pivot to virtual

When many in-person events shifted to digital and virtual formats, AIML researchers remained busy with outreach.

AIML collaborated with AiLab on a number of networking and collaborative opportunities, including Adelaide AI meetups online. AIML also participated in an Amazon Web Services User Group meetup, with Dr Ehsan Abbasnejad sharing some background on AIML, and discussing recent projects.

Dr Johan Verjans presented a webinar on AI applications in medicine for Adelaide BioMed City, and another for The Data Lab for SAHMRI.

Professor Tat-Jun Chin was a plenary lecturer for the 2020 BLiSS*Adelaide online event, discussing interdisciplinary collaborations, partnership formation and harnessing academic diversity to generate meaningful outcomes.

Professor Javen Shi presented at the SA Department for Trade and Investment Minerals and Mining series - Data science: The Frontier in mineral exploration. Professor Shi and colleagues discussed how the principles of data science offer new ways to accelerate discovery and creation of the mines of tomorrow.

For Adept Adelaide, Professor Anton van den Hengel's short video offered current and potential students of AI some career-related tips and how to get through working from home.

Dr Zygmunt Szpak presented a free webinar: AI at work, how to design ethical AI in the workplace.

Taking AI to parliament and the regions

Once we were free to move about more freely again, AIML was delighted to host a discussion between Senator Rex Patrick and Adept students from the University of Adelaide studying computer science about the benefits AI can bring to our economy and our country more broadly.

Senator Patrick tweeted after the event:

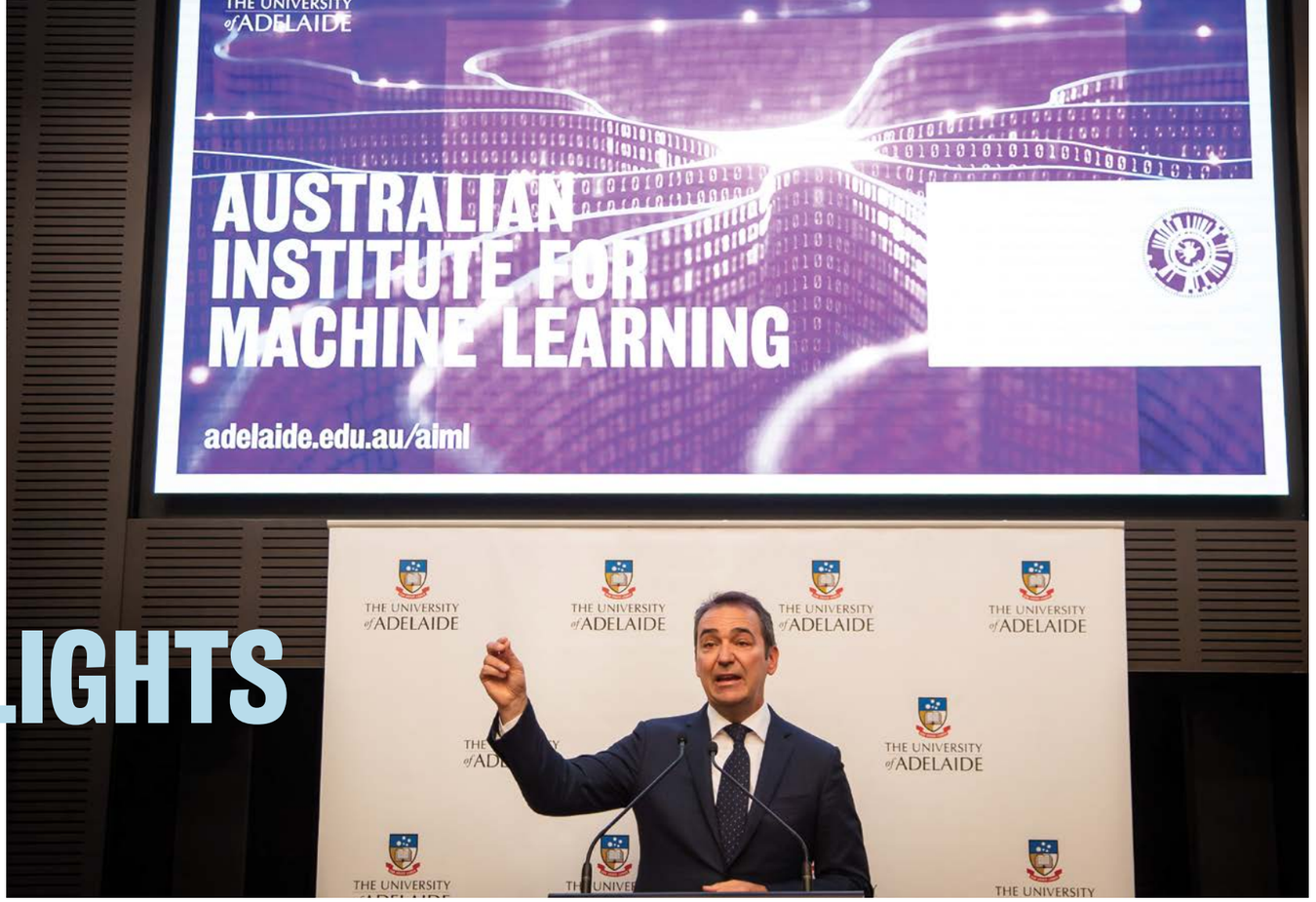
It was great to sit down and talk with some of SA's best and brightest students. We shared thoughts and ideas, some of which I will take back to the Federal Parliament. #AI will be part of our future, although exactly how much depends on decisions that are being made now.

Professor Anton van den Hengel presented a seminar for the Department for Trade and Investment, 'Why now and why AI? SA's opportunities in the global economy'.

AIML's Dr Paul Dalby and Professor Javen Shi delivered a series of workshops targeting the agricultural sector. These were linked to developing a bid for the Smarter Regions CRC.

Is there a difference between machine learning and artificial intelligence? Professor Anton van den Hengel spoke to Amanda Vanstone on Counterpoint about the difference between the two and the industries that AIML is working with not only to improve our lives but also to protect and enhance our working lives.

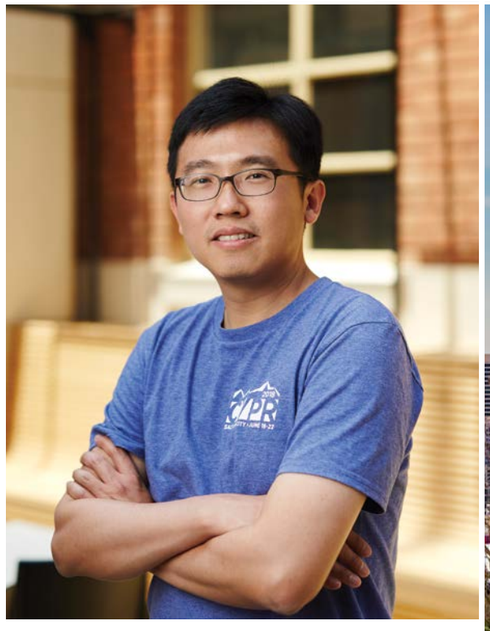
HIGHLIGHTS



On 17 March 2020, AIML was officially launched by Premier Steven Marshall. The event was a great success and we were extremely fortunate to celebrate AIML just before the Nation went into lockdown due to Covid19.

Distinguished guests included Senator Simon Birmingham, Senator Rex Patrick, Chief Scientist-Professor Caroline McMillen, Executive Director SAHMRI-Professor Steve Wesselingh, Executive Director, Defence and Space-Reg Carruthers, The Lord Mayor of Adelaide, Sandy Verschoor and the State Chief Entrepreneur-Jim Whalley. Other guests included members of AIML and the University Executive, and the media.

AWARDS AND PRIZES



PROFESSOR CHUNHUA SHEN IN TOP 5 RESEARCHERS FOR ENGINEERING AND COMPUTER SCIENCES

Sep 29 2020

AIML Academic, Professor Chunhua Shen was listed in the top 5 researchers for Engineering and Computer Sciences as part of The Australian's Lifetime Achievers Leaderboard. This was an exceptional achievement and showed the consistent high quality of Professor Shen's research.

AIML DIRECTOR PROFESSOR ANTON VAN DEN HENGEL AWARDED PRESTIGIOUS FELLOWSHIP

Dec 6 2020

Congratulations to AIML's Director Professor Anton van den Hengel who was named as a 2020 Fellow of the Academy of Technology and Engineering.

PROFESSOR TAT-JUN CHIN AMONG THE FIRST APPOINTMENTS CHAIRING $20M SMARTSAT CRC INVESTMENT

Feb 26 2020

Professor Tat-Jun Chin, AIML's Director, Machine Learning for Space, was one the of the first appointments to oversee the $20 million investment to develop next generation space technologies through the SmartSat Collaborative Research Centre.

Professor Chin joined fellow world-leading researchers Professor Christopher Fluke and Professor Jill Slay from Swinburne University and University of South Australia respectively, along with another six professorial chairs.

PROFESSOR CHIN FINALIST IN AUSTRALIAN SPACE AWARDS

Feb 11 2020

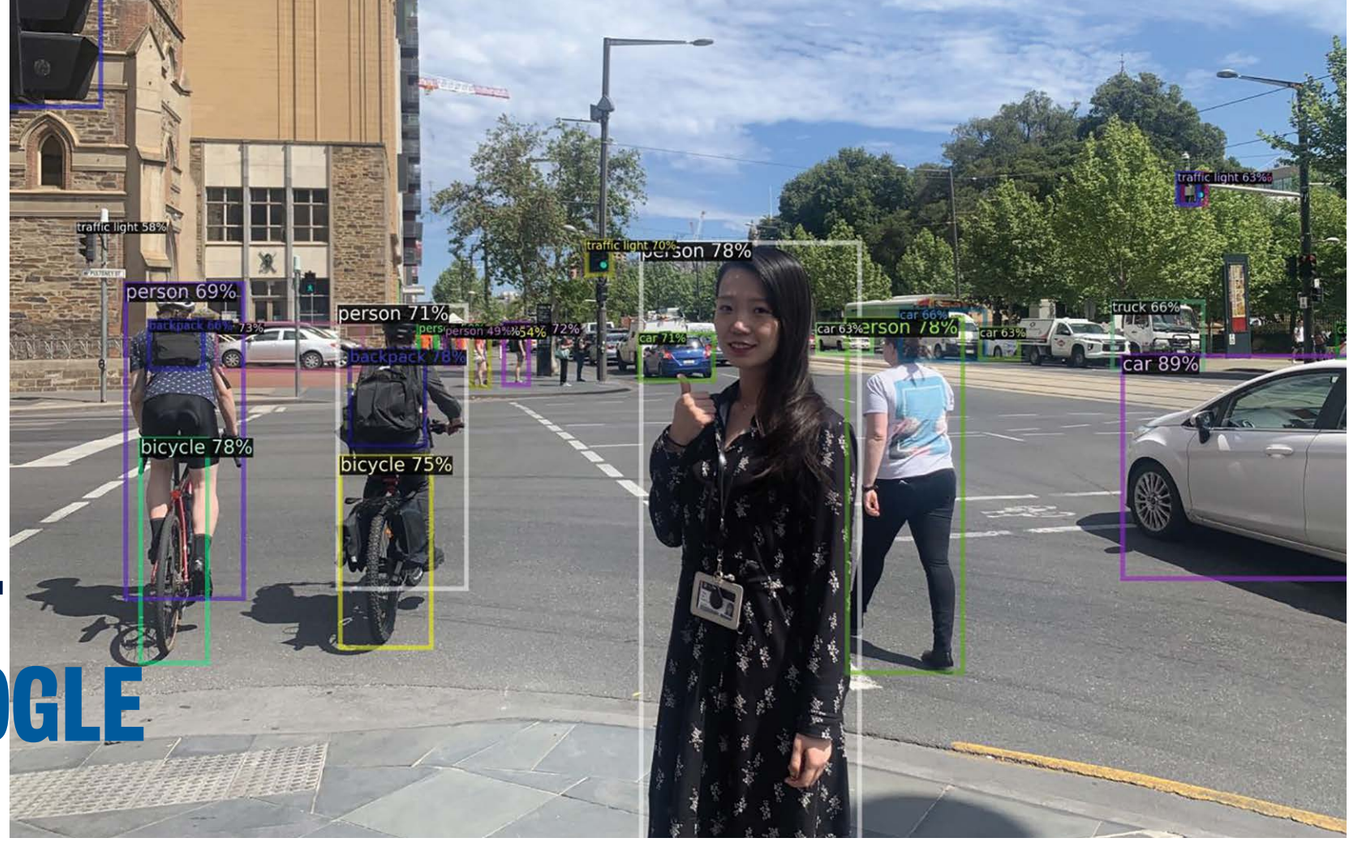
Professor Tat-Jun Chin (Director, Machine Learning for Space) was announced as a finalist for the inaugural Australian Space Awards, in the Academic of the Year category. The award recognises outstanding achievements of those participating in the Australian space industry.

THE UNPARALLELED PRESENCE OF AIML AT CVPR 2020

Jun 25 2020

AIML had an unprecedented 23 publications accepted in the CVPR conference in June, an increase of more than 50% from previous years. These numbers are comparable to those of institutions orders of magnitude larger, and are an incredible result when considering the relative age of AIML. With Apple, Google and Amazon being among the sponsors, the annual conference is touted as the most revered event for computer vision research. It's said that getting just one paper accepted here is a career highlight, a claim backed up by the submission and acceptance statistics.

OUTSTANDING PHD STUDENT AWARDED GOOGLE FELLOWSHIP



Professor Chunhua Shen with **Yifan Liu**

AIML PhD student Yifan Liu was awarded a prestigious 2020 Google Fellowship in recognition of her exceptional research in computer vision. The scholarship provides Liu AU$15,000 as well as access to a research mentor at Google.

Across all 2020 Google Fellowships, Liu is one of only six recipients in Australia, with an additional 47 students from top academic institutions winning the awards globally.

"Recipients of the Google PhD Fellowships represent the best young researchers in their fields across the world," said Professor Chunhua Shen, Lui's PhD supervisor and head of AIML's Machine Learning Theory research theme.

"Liu is full of passion for her work and has a strong capacity to conduct independent research."

Liu's research addresses machine learning for understanding images and video in mobile devices. It's the sort of technology that would be useful for many applications such as smart robotic vacuums and AI driven smartphone photography.

"I am particularly interested in a process called semantic segmentation, which involves creating very fine-grained labelling of all the items a camera has in its field of vision – what a camera can 'see'", says Liu.

Semantic segmentation is much more challenging than classifying a photo into a simple 'cat' versus 'dog', for example. It involves labelling every single pixel in an image into a category.

"Making the task even more difficult, I want to develop such software to run on mobile devices like phones, which need the software to be extremely light and fast," says Liu.

"To be usable in the real world, for example in smart phones, the system must be very accurate as well as very fast. That's what I'm focusing on, bringing together different aspects of the technology to make that happen."

Lui's achievement was covered by The Advertiser in October 2020.

FACEBOOK INTERNSHIP BEARS FRUIT

In 2019 PhD student Kejie Li enjoyed a 6-month internship with mentors at Facebook Reality Lab in Seattle, USA.

In 2020, Li returned to AIML and built on that formative experience: he became co-author on two new high-impact publications describing a new object-based mapping system known as FroDO.

"FroDO is a method that takes information from a video stream, and allows you to create a high fidelity map of the world and objects in it," explains Professor Ian Reid, who is Li's PhD supervisor in the Robotic Vision theme at AIML.

"It's the sort of approach that will be vital as we move towards self-driving cars and other devices having some kind of situational awareness."

Traditional mapping and localisation techniques such as SLAM operate at the level of geometry. They create maps comprised of "clouds" of points, which are collections of measurements that indicate where the surface of an object is in space. Point clouds don't necessarily have any context or meaning.

"Building on the findings of previous students in AIML, Li's work is exciting because it allows a camera to look at the world as more than just point clouds," Reid says.

"Instead, his approach elevates the map to become something that is meaningful – a characteristic we describe as semantics."

Semantics are vital if we want a vehicle or robot to interpret what it sees in its environment and to be able to interact with it.

"If the goal of the robot is to manipulate objects on a desk for example, it needs a representation of the world that distinguishes a mug from a fork, say, and distinguishes these objects from the table they sit on," says Reid.

"Li's system builds a semantic map that can do this – so the robot knows that the mug and fork are different objects that can be picked up and moved, relative to each other and to the table."

Keiji Li is a joint student with the Australian Centre for Robotic Vision.

AIML STAFF AND STUDENTS

AIML Co-Directors

Professor Anton van den Hengel
Deep Learning and Vision & Language Problems

Professor Simon Lucey
Computer Vision, Deep Geometry, Machine Learning and AI

AIML Academics

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Housing and Healthy Cities

Professor Gustavo Carneiro
Director, Medical Machine Learning
Medical image analysis

Professor Tat-Jun Chin
Director, Machine Learning for Space
3D mapping, augmented reality and autonomous robots

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Visual tracking analysis

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Professor Andrew Lowe
Plant ecological and evolutionary genetics

Professor Ian Reid
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Computer vision for robotics and autonomous vehicles

Professor Chunhua Shen
Director, Machine Learning Theory
Object detection, semantic pixel labelling, and generic image understanding

Professor Javen Qinfeng Shi
Director, Advanced Reasoning and Logic
Probabilistic graphical models, optimisation, and deep learning

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Machine learning in Cardiovascular Disease

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Qiaoyang Luo
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Anthony Manchin
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2020 PUBLICATIONS

Abbasnejad ME, Shi J, van den Hengel A, Liu L. GADE: A Generative Adversarial Approach to Density Estimation and its Applications. International Journal of Computer Vision. 2020;128(10-11):2731-43.

Abedin A, Motlagh F, Shi Q, Rezatofighi H, Ranasinghe D. Towards deep clustering of human activities from wearables. Proceedings - International Symposium on Wearable Computers, ISWC. 2020:1-6.

Adeli V, Adeli E, Reid I, Niebles J, Rezatofighi H. Socially and Contextually Aware Human Motion and Pose Forecasting. IEEE Robotics and Automation Letters. 2020;5(4):6033-40.

Angelova A, Carneiro G, Sünderhauf N, Leitner J. Special Issue on Deep Learning for Robotic Vision. International Journal of Computer Vision. 2020;128(5).

Antico M, Fontanarosa D, Carneiro G, Vukovic D, Camps SM, Sasazawa F, et al. Deep learning for US image quality assessment based on femoral cartilage boundaries detection in autonomous knee arthroscopy. IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control. 2020;67(12):2543-52.

Antico M, Sasazawa F, Dunnhofer M, Camps S, Jaiprakash A, Pandey A, Crawford R, Carneiro G, et al. Deep learning-based femoral cartilage automatic segmentation in ultrasound imaging for guidance in robotic knee arthroscopy. Ultrasound in Medicine and Biology. 2020;46(2):422-35.

Antico M, Sasazawa F, Takeda Y, Jaiprakash AT, Wille ML, Pandey AK, Crawford R, Carneiro G et al. Bayesian CNN for Segmentation Uncertainty Inference on 4D Ultrasound Images of the Femoral Cartilage for Guidance in Robotic Knee Arthroscopy. IEEE Access. 2020;8:223961-75.

Armstrong NJ, Mather KA, Sargurupremraj M, Knol MJ, Malik R, Satizabal CL, et al. Common Genetic Variation Indicates Separate Causes for Periventricular and Deep White Matter Hyperintensities. Stroke. 2020;51(7):2111-21.

Banach A, Strydom M, Jaiprakash A, Carneiro G, Brown C, Crawford R, et al. Saliency improvement in feature-poor surgical environments using Local Laplacian of Specified Histograms. IEEE Access. 2020;8:213378-88.

Camps S, Houben T, Carneiro G, Edwards C, Antico M, Dunnhofer M, et al. Automatic quality assessment of transperineal ultrasound images of the male pelvic region, using deep learning. Ultrasound in Medicine and Biology. 2020;46(2):445-54.

Cao Y, Zhao T, Xian K, Shen C, Cao Z, Xu S. Monocular Depth Estimation with Augmented Ordinal Depth Relationships. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(8):2674-82.

Carneiro G, Tavares JMRS, Bradley AP, Papa JP, Belagiannis V, Nascimento JC, et al. Special issue: 4th MICCAI workshop on deep learning in medical image analysis. Computer Methods in Biomechanics and Biomedical Engineering: Imaging and Visualization. 2020;8(5):501.

Carneiro G, Zorron Cheng Tao Pu L, Singh R, Burt A. Deep learning uncertainty and confidence calibration for the five-class polyp classification from colonoscopy. Medical Image Analysis. 2020;62(ARTN 101653):1-13.

Chen B, Parra Á, Cao J, Li N, Chin TJ. End-to-end learnable geometric vision by backpropagating PNP optimization. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2020:8097-106.

Chen Q, Wu Q, Chen J, Wu Q, Van Den Hengel A, Tan M. Scripted Video Generation with a Bottom-Up Generative Adversarial Network. IEEE Transactions on Image Processing. 2020;29:7454-67.

Chen X, Zhu Y, Liu W, Sun J, Zhang Y. Blur kernel estimation of noisy-blurred image via dynamic structure prior. Neurocomputing. 2020;403:268-81.

Chen Y, Shen C, Chen H, Wei X, Liu L, Yang J. Adversarial learning of structure-aware fully convolutional networks for landmark localization. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020;42(7):1654-69.

Cheng Tao Pu LZ, Maicas G, Tian Y, Yamamura T, Nakamura M, Suzuki H, et al. Computer-aided diagnosis for characterisation of colorectal lesions: a comprehensive software including serrated lesions. Gastrointestinal Endoscopy. 2020;92(4):891-9.

Chin TJ, Cai Z, Neumann F. Robust fitting in computer vision: Easy or hard? International Journal of Computer Vision. 2020;128(3):575-87.

Chng CK, Parra A, Chin TJ, Latif Y. Monocular Rotational Odometry with Incremental Rotation Averaging and Loop Closure. 2020 Digital Image Computing: Techniques and Applications, DICTA 2020. 2020;abs/2010.01872.

Chojnacki W, Szpak Z, Wadenbäck M. The equivalence of two definitions of compatible homography matrices. Pattern Recognition Letters. 2020;135:38-43.

Dendorfer P, Rezatofighi H, Milan A, Shi J, Cremers D, Reid ID, et al. MOT20: A benchmark for multi object tracking in crowded scenes. CoRR. 2020;abs/2003.09003.

Dorraki M, Allison A, Abbott D. Publisher Correction: Truels and strategies for survival (Scientific Reports, (2019), 9, 1, (8996), 10.1038/s41598-019-45253-5). Scientific Reports. 2020;10(1).

Dorraki M, Fouladzadeh A, Allison A, Bonder C, Abbott D. Angiogenic Networks in Tumors—Insights via Mathematical Modeling. IEEE Access. 2020;8:43215-28.

Dunnhofer M, Antico M, Sasazawa F, Takeda Y, Camps S, Martinel N, Micheloni C, Carneiro, G, Fontanarosa D. Siam-U-Net: encoder-decoder siamese network for knee cartilage tracking in ultrasound images. Medical Image Analysis. 2020;60(101631):101631-1-17.

Eichert N, Robinson EC, Bryant KL, Jbabdi S, Jenkinson M, Li L, et al. Cross-species cortical alignment identifies different types of anatomical reorganization in the primate temporal lobe. Elife. 2020;9(ARTN e53232):1-30.

Fitzgibbon SP, Harrison SJ, Jenkinson M, Baxter L, Robinson EC, Bastiani M, et al. The developing Human Connectome Project (dHCP) automated resting-state functional processing framework for newborn infants. NeuroImage. 2020;223(117303):117303.

Gong D, Zhang Z, Shi Q, van den Hengel A, Shen C, Zhang Y. Learning deep gradient descent optimization for image deconvolution. IEEE Transactions on Neural Networks and Learning Systems. 2020;31(12):5468-82.

Gou Y, Lei Y, Liu L, Zhang P, Peng X. A Dynamic Parameter Enhanced Network for distant supervised relation extraction. Knowledge-Based Systems. 2020;197(105912):1-12.

Guo Y, Chen J, Du Q, Van Den Hengel A, Shi Q, Tan M. Multi-way backpropagation for training compact deep neural networks. Neural Netw. 2020;126:250-61.

Hajdu T, Van Den Hengel A, Anderson L. Art Intelligence Annual Artificial Artist in Residence: Laurie Anderson. World Wide. 2020.

Huang Y, Wu Q, Wang W, Wang L. Image and Sentence Matching via Semantic Concepts and Order Learning. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020;42(3):636-50.

Jiang S, Lu X, Lei Y, Liu L. Mask-Aware Networks for Crowd Counting. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(9):3119-29.

Jin H, Gu Q, Chen B, Tang C, Zheng Y, Zhang H, et al. Molten salt-directed catalytic synthesis of 2D layered transition-metal nitrides for efficient hydrogen evolution. Chem. 2020;6(9):2382-94.

Jonmohamadi Y, Takeda Y, Liu F, Sasazawa F, Maicas G, Crawford R, et al. Automatic segmentation of multiple structures in knee arthroscopy using deep learning. IEEE Access. 2020;8:51853-61.

Lai T, Wang H, Yan Y, Chin TJ, Zheng J, Li B. Accelerated guided sampling for multistructure model fitting. IEEE Transactions on Cybernetics. 2020;50(10):4530-43.

Le HS, Akmeliawati R, Carneiro G. Domain Generalisation with Domain Augmented Supervised Contrastive Learning (Student Abstract). CoRR. 2020;abs/2012.13973.

Lei Z, ul Haq A, Dorraki M, Zhang D, Abbott D. Composing recipes based on nutrients in food in a machine learning context. Neurocomputing. 2020;415:382-96.

Li J, Liu Y, Yuan X, Zhao C, Siegwart R, Reid I, et al. Depth based semantic scene completion with position importance aware loss. IEEE Robotics and Automation Letters. 2020;5(1):219-26.

Li J, Thiele S, Quirk BC, Kirk RW, Verjans JW, Akers E, et al. Ultrathin monolithic 3D printed optical coherence tomography endoscopy for preclinical and clinical use. Light: Science and Applications. 2020;9(1):124-1--10.

Liao Z, Drummond T, Reid I, Carneiro G. Approximate Fisher information matrix to characterise the training of deep neural networks. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020;42(1):15-26.

Liao Z, Girgis H, Abdi A, Vaseli H, Hetherington J, Rohling R, et al. On Modelling Label Uncertainty in Deep Neural Networks: Automatic Estimation of Intra- Observer Variability in 2D Echocardiography Quality Assessment. IEEE Transactions on Medical Imaging. 2020;39(6):1868-83.

Lin G, Liu F, Milan A, Shen C, Reid I. RefineNet: multi-path refinement networks for dense prediction. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020;42(5):1228-42.

Liu C, Yao R, Rezatofighi SH, Reid I, Shi Q. Model-Free Tracker for Multiple Objects Using Joint Appearance and Motion Inference. IEEE Transactions on Image Processing. 2020;29:277-88.

Liu D, Chen B, Chin TJ, Rutten MG. Topological Sweep for Multi-Target Detection of Geostationary Space Objects. IEEE Transactions on Signal Processing. 2020;68:5166-77.

Liu L, Cao Z, Lu H, Xiong H, Shen C. NSSNet: Scale-Aware Object Counting With Non-Scale Suppression. IEEE Transactions on Intelligent Transportation Systems. 2020:1-12.

Liu L, Lu H, Xiong H, Xian K, Cao Z, Shen C. Counting objects by blockwise classification. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(10):3513-27.

Liu L, Lu H, Zou H, Xiong H, Cao Z, Shen C. Weighing Counts: Sequential Crowd Counting by Reinforcement Learning. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 2020;12355 LNCS:164-81.

Liu W, Zhang P, Chen X, Shen C, Huang X, Yang J. Embedding Bilateral Filter in Least Squares for Efficient Edge-preserving Image Smoothing. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(1):23-35.

Liu W, Zhang P, Huang X, Yang J, Shen C, Reid I. Real-time image smoothing via iterative least squares. ACM Transactions on Graphics. 2020;39(3):28-1-4.

Liu Y, Liu L, Zhang H, Rezatofighi H, Yan Q, Reid I. Meta learning with differentiable closed-form solver for fast video object segmentation. IEEE International Conference on Intelligent Robots and Systems. 2020:8439-46.

Lu X, Ma C, Shen J, Yang X, Reid I, Yang MH. Deep Object Tracking with Shrinkage Loss. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020:1.

MacDonald L. Equivariant KK-theory for non-Hausdorff groupoids. Journal of Geometry and Physics. 2020;154(ARTN 103709).

MacDonald LE, Rennie A. The Godbillon-Vey invariant and equivariant KK-theory. Annals of K-Theory. 2020;5(2):249-94.

Messina S, Mariano R, Roca-Fernandez A, Cavey A, Jurynczyk M, Leite MI, Calabrese M, Jenkinson Met al. Contrasting the brain imaging features of MOG-Antibody disease, with AQP4- Antibody NMOSD and Multiple Sclerosis. 2020.

Milton AG, Kremer KL, Rao SR, Mas E, Snel MF, Trim PJ, Edwards S, Lau S, Jenkinson M, Noscha E et al. A Prospective Cohort Study to Develop and Validate a Multivariable Prediction Model for Transient Ischaemic Attack (TIA) Diagnosis Using Proteomic Discoveryand Candidate Lipid Mass Spectrometry, Neuroimaging and Machine Learning: Study Protocol. KARGER; 2020:72

Montarello NJ, Nelson AJ, Verjans J, Nicholls SJ, Psaltis PJ. The role of intracoronary imaging in translational research. Cardiovascular Diagnosis and Therapy. 2020;10(5):1480-507.

Nascimento JC, Carneiro G. One shot segmentation: unifying rigid detection and non-rigid segmentation using elastic regularization. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2020;42(12):3054-70.

Naskovska K, Lau S, Korobkov AA, Haueisen J, Haardt M. Coupled CP decomposition of simultaneous MEG-EEG signals for differentiating oscillators during photic driving. Frontiers in Neuroscience. 2020;14(261):261-1--18.

Nekrasov V, Chen H, Shen C, Reid ID. Architecture search of dynamic cells for semantic video segmentation. CoRR. 2020;abs/1904.02371:1959-68.

Oakden-Rayner L, Dunnmon J, Carneiro G, Re C. Hidden stratification causes clinically meaningful failures in machine learning for medical imaging. ACM CHIL 2020 - Proceedings of the 2020 ACM Conference on Health, Inference, and Learning. 2020;2020:151-9.

Orlando JI, Fu H, Barbossa Breda J, van Keer K, Bathula DR, Diaz-Pinto A, et al. REFUGE Challenge: A unified framework for evaluating automated methods for glaucoma assessment from fundus photographs. Medical Image Analysis. 2020;59(101570).

Osborn HP, Ansdell M, Ioannou Y, Sasdelli M, Angerhausen D, Caldwell D, et al. Rapid classification of TESS planet candidates with convolutional neural networks. Astronomy and Astrophysics. 2020;633(ARTN A53):A53-1-A-11.

Pang G, Cao L. Heterogeneous univariate outlier ensembles in multidimensional data. ACM Transactions on Knowledge Discovery from Data. 2020;14(6):68-1-27.

Pedersen M, Verspoor K, Jenkinson M, Law M, Abbott DF, Jackson GD. Artificial intelligence for clinical decision support in neurology. Brain Commun. 2020;2(2):fcaa096-fcaa.

Pena G, Kuang B, Szpak Z, Cowled P, Dawson J, Fitridge R. Evaluation of a Novel Three-Dimensional Wound Measurement Device for Assessment of Diabetic Foot Ulcers. Advances in Wound Care. 2020;9(11).

Pflanz CP, Charquero-Ballester M, Majid DSA, Winkler AM, Vallée E, Aron AR, et al. One-year changes in brain microstructure differentiate preclinical Huntington's disease stages. NeuroImage: Clinical. 2020;25(102099):1-11.

Qiao Y, Deng C, Wu Q. Referring Expression Comprehension: A Survey of Methods and Datasets. IEEE Transactions on Multimedia. 2020:1.

Rana K, Nicholls SJ, Verjans JW. Mechanisms of the Vulnerable Atherosclerotic Plaque and Imaging. Mechanisms of Vascular Disease: Springer International Publishing; 2020. p. 47-70.

Ranasinghe I, Hossain S, Ali A, Horton D, Adams RJ, Aliprandi-Costa B, Bertilone, Carneiro G, et al. SAFety, Effectiveness of care and Resource use among Australian Hospitals (SAFER Hospitals): a protocol for a population-wide cohort study of outcomes of hospital care. BMJ. 2020;10(8):e035446-1-e-9.

Rezatofighi H, Kaskman R, Motlagh FT, Shi Q, Milan A, Cremers D, et al. Learn to Predict Sets Using Feed-Forward Neural Networks. CoRR. 2020;abs/2001.11845.

Sengupta PP, Shrestha S, Berthon B, Messas E, Donal E, Tison GH, et al. Proposed Requirements for Cardiovascular Imaging-Related Machine Learning Evaluation (PRIME): A Checklist: Reviewed by the American College of Cardiology Healthcare Innovation Council. JACC: Cardiovascular Imaging. 2020;13(9):2017-35.

Shevchenko V, Teney D, Dick AR, Hengel AVD. Visual Question Answering with Prior Class Semantics. CoRR. 2020;abs/2005.01239.

Sundaresan V, Zamboni G, Rothwell P, Jenkinson M, Griffanti L. Triplanar ensemble U-Net model for white matter hyperintensities segmentation on MR images. 2020.

Teney D, Abbasnedjad E, van den Hengel A. Learning What Makes a Difference from Counterfactual Examples and Gradient Supervision. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 2020;12355 LNCS:580-99.

Teney D, Abbasnejad E, Hengel AVD. Unshuffling Data for Improved Generalization. CoRR. 2020;abs/2002.11894.

Teney D, Kafle K, Shrestha R, Abbasnejad E, Kanan C, van den Hengel A. On the value of out-of-distribution testing: An example of Goodhart's law. Advances in Neural Information Processing Systems. 2020;2020-December.

Tian Y, Maicas G, Pu LZCT, Singh R, Verjans JW, Carneiro G. Few-Shot Anomaly Detection for Polyp Frames from Colonoscopy. CoRR. 2020;abs/2006.14811.

Tian Z, Shen C, Chen H, He T. FCOS: A Simple and Strong Anchor-free Object Detector. IEEE Trans Pattern Anal Mach Intell. 2020;PP.

Torso M, Bozzali M, Cercignani M, Jenkinson M, Chance SA. Using diffusion tensor imaging to detect cortical changes in fronto-temporal dementia subtypes. Scientific Reports. 2020;10(1).

Wang C, Zhang Y, Du J, Huszár IN, Liu S, Chen Y, Buch S, Wu F, Lui Y, Jenkinson M, et al. Quantitative Susceptibility Mapping for Characterization of Intraplaque Hemorrhage and Calcification in Carotid Atherosclerotic Disease. Journal of Magnetic Resonance Imaging. 2020;52(2):534-41.

Wang X, Kong T, Shen C, Jiang Y, Li L. SOLO: Segmenting Objects by Locations. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 2020;12363 LNCS:649-65.

Wang X, Shen C, Li H, Xu S. Human Detection Aided by Deeply Learned Semantic Masks. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(8):2663-73.

Wang X, Yin W, Kong T, Jiang Y, Li L, Shen C. Task-aware monocular depth estimation for 3D object detection. AAAI 2020 - 34th AAAI Conference on Artificial Intelligence. 2020:12257-64.

Wang X, Zhang R, Kong T, Li L, Shen C. SOLOv2: Dynamic and fast instance segmentation. Advances in Neural Information Processing Systems. 2020;2020-December.

Wen S, Deng L, Liu Y. Distributed optimization via primal and dual decompositions for delay-constrained FANETs. Ad Hoc Networks. 2020;109(102288):1-14.

Xie F, Zhang L, Jiao Y, Vasileff A, Chao D, Qiao SZ. Hydrogenated dual-shell sodium titanate cubes for sodium-ion batteries with optimized ion transportation. Journal of Materials Chemistry A. 2020;8(31):15829-33.

Xie Y, Zhang J, Xia Y, Shen C. A Mutual Bootstrapping Model for Automated Skin Lesion Segmentation and Classification. IEEE Transactions on Medical Imaging. 2020;39(7):2482-93.

Yan Q, Wang B, Li P, Li X, Zhang A, Shi Q, et al. Ghost Removal via Channel Attention in Exposure Fusion. Computer Vision and Image Understanding. 2020;201(103079):1-8.

Yan Q, Wang B, Zhang W, Luo C, Xu W, Xu Z, et al. An Attention-guided Deep Neural Network with Multi-scale Feature Fusion for Liver Vessel Segmentation. IEEE Journal of Biomedical and Health Informatics. 2020;PP(7):2629-42.

Yan Q, Zhang L, Liu Y, Zhu Y, Sun J, Shi Q, et al. Deep HDR imaging via A non-local network. IEEE Transactions on Image Processing. 2020;29:4308-22.

Yan Y, Tan M, Tsang I, Yang Y, Shi Q, Zhang C. Fast and Low Memory Cost Matrix Factorization: Algorithm, Analysis and Case Study. IEEE Transactions on Knowledge and Data Engineering. 2020;32(2):288-301.

Yu J, Zhang W, Lu Y, Qin Z, Hu Y, Tan J, et al. Reasoning on the Relation: Enhancing Visual Representation for Visual Question Answering and Cross-Modal Retrieval. IEEE Transactions on Multimedia. 2020;22(12):3196-209.

Zhang H, Li Y, Chen H, Shen C. Memory-efficient hierarchical neural architecture search for image denoising. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2020:3654-63.

Zhang L, Wang P, Li H, Li Z, Shen C, Zhang Y. A Robust Attentional Framework for License Plate Recognition in the Wild. IEEE Transactions on Intelligent Transportation Systems. 2020:1-10.

Zhang L, Wang P, Liu L, Shen C, Wei W, Zhang Y, et al. Towards Effective Deep Embedding for Zero-Shot Learning. IEEE Transactions on Circuits and Systems for Video Technology. 2020;30(9):2843-52.

Zhang L, Wang P, Shen C, Liu L, Wei W, Zhang Y, et al. Adaptive importance learning for improving lightweight image super-resolution network. International Journal of Computer Vision. 2020;128(2):479-99.

Zhang L, Wei W, Shi Q, Shen C, van den Hengel A, Zhang Y. Accurate tensor completion via adaptive low-rank representation. IEEE Transactions on Neural Networks and Learning Systems. 2020;31(1):4170-84.

Zhang P, Liu W, Lei Y, Lu H. Semantic Scene Labeling via Deep Nested Level Set. IEEE Transactions on Intelligent Transportation Systems. 2020:1-13.

Zhang P, Liu W, Lei Y, Wang H, Lu H. Deep Multiphase Level Set for Scene Parsing. IEEE Transactions on Image Processing. 2020;29:4556-67.

Zhang P, Liu W, Lei Y, Wang H, Lu H. RAPNet: Residual Atrous Pyramid Network for Importance-Aware Street Scene Parsing. IEEE transactions on image processing : a publication of the IEEE Signal Processing Society. 2020;29:5010-21.

Zhang P, Liu W, Wang D, Lei Y, Wang H, Shen C, et al. Non-rigid object tracking via deep multi-scale spatial-temporal discriminative saliency maps. Pattern Recognition. 2020;100(ARTN 107130).

Zhang W, Ma C, Wu Q, Yang X. Language-guided Navigation via Cross-Modal Grounding and Alternate Adversarial Learning. IEEE Transactions on Circuits and Systems for Video Technology. 2020:1-13.

Zhang X, Zhang R, Cao J, Gong D, You M, Shen C. Part-Guided Attention Learning for Vehicle Instance Retrieval. IEEE Transactions on Intelligent Transportation Systems. 2020:1-13.

Zhao Y, Liu Y, Shen C, Gao Y, Xiong S. MobileFAN: transferring deep hidden representation for face alignment. Pattern Recognition. 2020;100(ARTN 107114).

Zhao Y, Shen C, Wang H, Chen S. Structural Analysis of Attributes for Vehicle Re-Identification and Retrieval. IEEE Transactions on Intelligent Transportation Systems. 2020;21(2):723-34.

Zheng D, Pang G, Liu B, Chen L, Yang J. Learning transferable deep convolutional neural networks for the classification of bacterial virulence factors. Bioinformatics. 2020;36(12):3693-702.

Zhuang B, Liu L, Tan M, Shen C, Reid I. Training quantized neural networks with a full-precision auxiliary module. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2020:1485-94.

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