ADAPT

Engaging Content
Engaging People

A World Leading SFI Research Centre

Science Foundation Ireland SFI For what's next

Leading the way in Artificial Intelligence research and innovation

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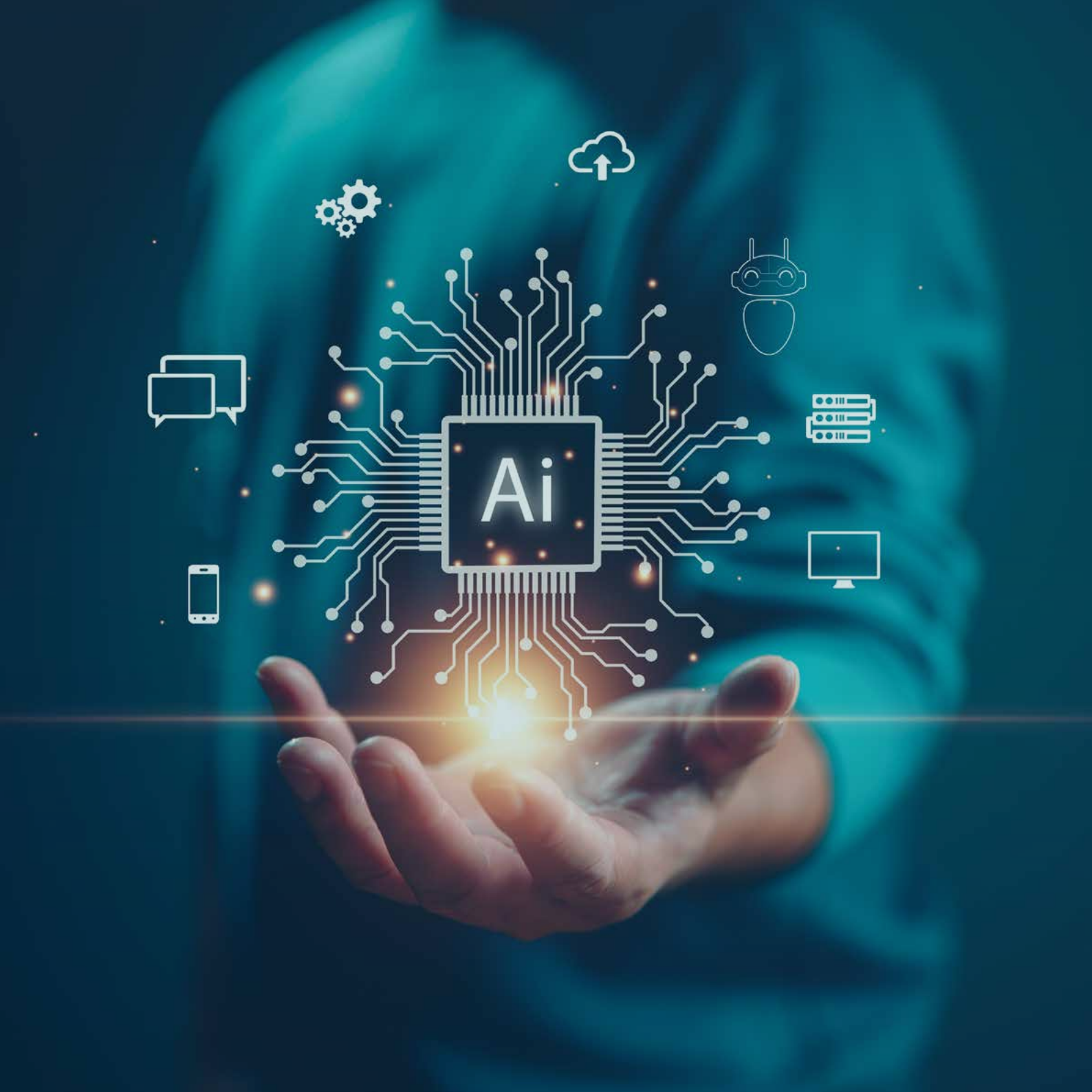

Ai

Foreword

At ADAPT, the SFI Research Centre for AI-Driven Digital Content Technology, our mission is to foster human empowerment through AI-enabled digital technologies. By integrating cutting-edge research with active stakeholder participation, we ensure that our AI solutions are intelligent, culturally and socially appropriate, trustworthy, and impactful.

Generative AI represents the next frontier in technological innovation, yet harnessing its potential effectively is not guaranteed. While some powerful foundation models are freely available, they alone do not provide a competitive edge. To truly unlock AI's potential, organisations must enhance these models with their own data, creating unique business insights and opportunities.

ADAPT has been a pioneering force in artificial intelligence research in Ireland. For over 20 years, many of our Principal Investigators have been at the forefront of AI and machine learning advancements. ADAPT is uniquely positioned to tackle the modern challenges of AI and all it encompasses, leading the ethical and sustainable development and refinement of human-centric AI. With a presence in eight Irish universities, we are leveraging our broad interdisciplinary collaborations along with our existing strengths to advance AI technology.

Our mission is to build a community around AI, as we believe strong collaborations across research and industry will be invaluable over the next decade of development in this space. We look forward to continued success with our partners and welcome new opportunities in this rapidly evolving space.

Professor John D. Kelleher
Director of SFI ADAPT Centre for AI-Driven Digital Content Technology

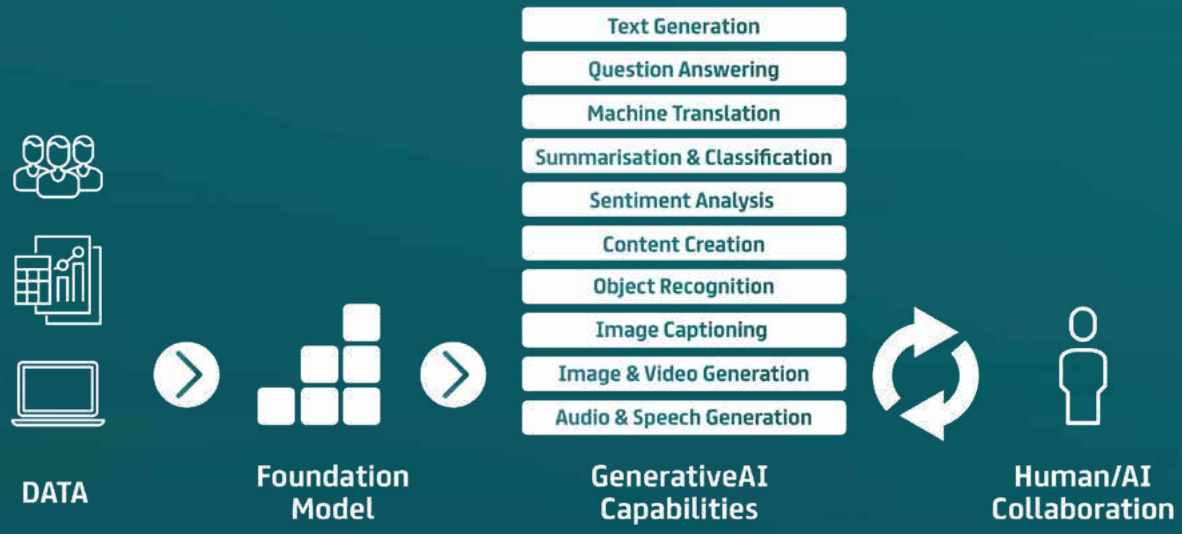
Transforming Industries with Generative AI: Insights from ADAPT's Research

Introduction to Generative AI

Generative AI is revolutionising industries with its ability to generate diverse and dynamic outputs, from detailed textual content to intricate visual media. Central to this innovation are the large-scale neural networks known as Foundation Models, which excel in their adaptability and can tackle a broad range of tasks that were not specified during their initial training.

How Does Generative AI Work?

The effectiveness of Generative AI largely stems from a neural network architecture called Transformers. These are designed to convert input sequences (like speech or text) into corresponding outputs using a mechanism known as 'attention'. This enables the AI to focus on different parts of the input data, understanding contextual relationships crucial for tasks like natural language processing. It allows tasks such as language translation, content generation, and even complex decision-making processes to be more accurate and context-aware.



For instance, OpenAI's Generative Pre-trained Transformers (GPT models), including GPT-3.5 and GPT-4, are prime examples of how these large language models use transformers to mimic human-like text interactions. They are trained on expansive datasets to grasp and replicate complex language patterns.

Addressing Challenges and Expanding Applications

Generative AI offers extensive benefits across numerous domains, from automating customer service to advancing healthcare diagnostics, significantly enhancing operational efficiency. However, its widespread adoption by organisations is hampered by several substantial challenges. These include the high costs associated with training complex models, the need for substantial control over diverse training data, and the extensive computing power and time required for training. Additionally, concerns about sustainability and the need for stringent AI regulation further complicate the deployment of these technologies.

ADAPT's research is at the forefront of addressing these issues, helping organisations utilise the transformative power of AI in a responsible and ethical way. Across the ADAPT research programme, our experts are committed to increasing digital inclusion, fostering human empowerment with AI enabled digital technologies, achieving greater sustainability of AI and use of AI for sustainability, and improving systems for societies' governance of digital technology.

How our Generative AI Experts Can Help

As Generative AI continues to evolve, its capabilities to adapt and generate novel solutions promise to accelerate progress and drive efficiency in unprecedented ways. ADAPT's research expertise is helping organisations harness the power of generative AI to innovate and succeed in an increasingly digital future. ADAPT's regulatory and risk expertise is internationally renown and can help ensure effective governance, building trust and transparency in the process from the outset.

Transform Your Business with High-Impact Research

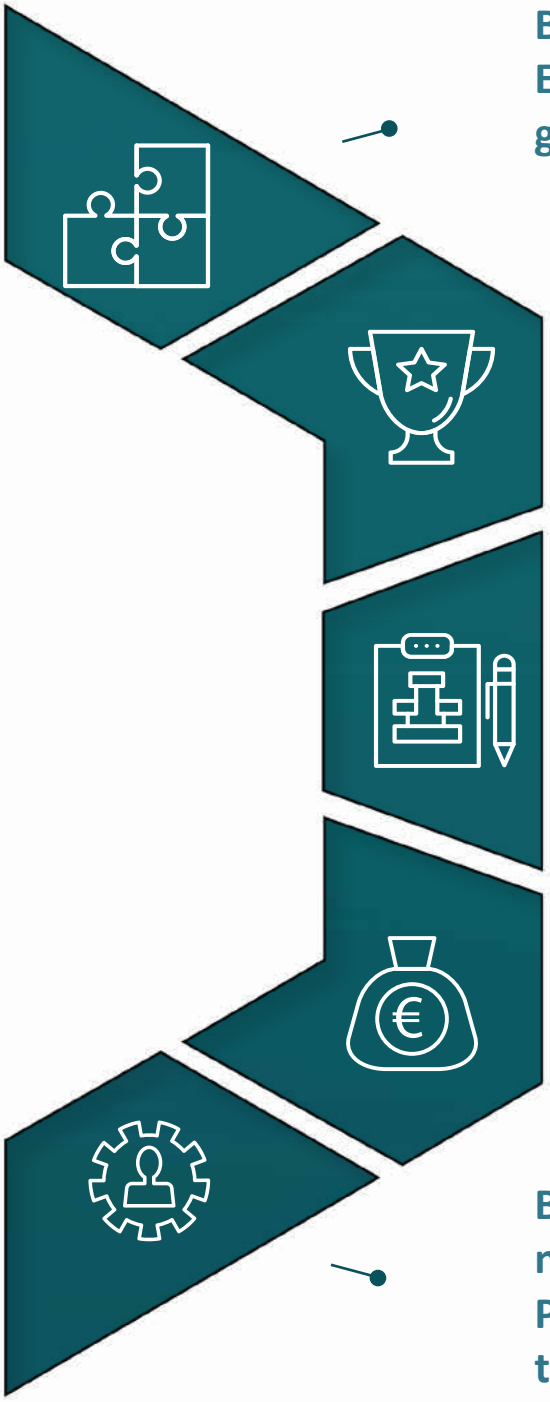
ADAPT's AI research is at the forefront of empowering businesses to harness new economic value, unlock opportunities within digital media, and redefine ways to connect people, processes, and data. As we push the boundaries of what's possible with AI, we remain committed to exploring both the challenges and potential of using AI to foster novel business outcomes. Our internationally recognised expertise is continually developing innovative solutions tailored to meet the diverse challenges faced by businesses.

Recent Advancements in Generative AI

In the past year, generative AI has seen remarkable advances, particularly in areas like natural language understanding, automated content generation, and real-time decision-making systems. ADAPT's interdisciplinary research team co-create solutions with stakeholders ensuring sustainable, robust and socially appropriate solutions that deliver real impact for organisations in a rapidly evolving digital landscape.

Collaborate to Innovate

Through strategic partnerships and collaboration, we work alongside you to navigate your most complex challenges, create substantial value, and deliver significant impact. Our approach includes:



Bringing Innovations from Idea to Reality: Engage with us in research partnerships that turn groundbreaking ideas into practical solutions.

Accessing World-Class Expertise: Tap into our pool of top-tier researchers through bespoke research projects tailored to your specific needs.

Transforming Your Organisation: Leverage AI-driven processes and system developments to revolutionise your operations.

Connecting to Funding Support: Utilise our extensive network to access research funding through various government initiatives.

Building Your Future Workforce: Invest in the next generation of talent through co-funded PhD programs that prepare your team for future technological advancements.

Industry Case Studies

The ADAPT Centre serves as a crucial link between world-leading academics and industry, transforming how research is conducted and tackling the world's most significant challenges. Our multi-disciplinary team collaborates on research and innovation projects to harness the power of AI and digital content technologies. These efforts aim to push forward the state-of-the-art to enhance analysis, boost efficiency, and accelerate groundbreaking discoveries. As a result, ADAPT has spearheaded numerous collaborative research initiatives. Here is a glimpse of some of our impactful projects.

Enhancing Disease Surveillance with ADAPT's Social Media Analytics

Challenge

Conventional disease surveillance systems often lag behind the rapid spread of diseases, causing delays in response and resource allocation. The COVID-19 pandemic highlighted the urgent need for more timely and accurate disease monitoring.

ADAPT's Innovative Solution

To address this challenge, the ADAPT Centre developed an advanced framework utilising state-of-the-art deep learning and large pre-trained language models to harness social media data for disease surveillance. This solution extracts relevant data from diverse social media platforms, such as Twitter and Reddit, and news media, operating effectively across multiple languages.

Key Features of the Solution

- **Data Acquisition:** Automated scraping of social media and news content to expand the range of data sources.
- **Language Translation:** Conversion of non-English text into English to standardise data analysis.
- **Feature Extraction:** Application of sophisticated natural language processing (NLP) techniques to identify key information.
- **Caseload Forecasting:** Utilisation of extracted features to enhance the accuracy of COVID-19 caseload predictions, aiding public health decision-making.

Results and Impact

ADAPT's innovative system markedly improves early detection capabilities, enabling the healthcare industry to allocate resources more effectively and allowing public health authorities to respond swiftly to disease developments. The framework's success in improving caseload forecasting exemplifies how digital innovation can significantly benefit public health strategies.

Conclusion

Through this initiative, ADAPT demonstrates its commitment to leveraging digital innovations to address critical challenges in public health surveillance, setting new standards for responsiveness in health crisis management.

Advancing Database Interactivity with ADAPT's Natural Language to SQL Translation

Challenge

Converting natural language queries into SQL commands requires a nuanced understanding of language semantics and precise query execution, presenting significant technical hurdles.

ADAPT's Innovative Solution

To address these challenges, ADAPT developed a groundbreaking final beam re-ranker model that enhances the natural language to SQL translation process. This model was the first to integrate optimisation techniques within existing NL2SQL frameworks, setting new performance benchmarks.

Key Features of the Solution

- **Data Representation and Pre-processing:** Uses advanced NatSQL techniques and GAZP for effective data preparation.
- **Model Training and Optimisation:** Employs SmBoP and RASAT, augmented with a novel re-ranker that identifies the most effective model configurations.
- **Modular Integration:** Facilitates easy adaptation into existing systems, allowing for scalable improvements in database querying.

Results and Impact

The new model has achieved a 4.5% accuracy improvement over previous state-of-the-art benchmarks, becoming the top-performing non-LLM system on the Spider leaderboard.

Potential Impact and Industry Benefits

- **Enhanced Accessibility:** Simplifies interactions with relational databases, making data management more user-friendly and reducing the need for specialised SQL training.
- **Cost Efficiency:** Lowers reliance on large datasets and intensive model training.
- **Broad Applicability:** Can be integrated into any existing NL2SQL system, enhancing both business-facing and customer-facing database interactions.

Conclusion

ADAPT's NL2SQL translation advancements offer transformative benefits for database management, improving both the efficiency and accessibility of database systems in various industrial settings.

Strengthening AI Governance with the Fundamental Rights Impact Assessment (FRIA)

Challenge

The forthcoming EU AI Act mandates a Fundamental Rights Impact Assessment (FRIA) for high-risk AI systems under Article 27. This assessment aims to ensure comprehensive review and protection of fundamental rights potentially affected by AI technologies across various contexts.

ADAPT's Innovative Solution

ADAPT's research reveals critical insights into the FRIA's framework, identifying that AI technologies could impact all 50 rights enshrined in the EU Charter of Fundamental Rights—not just the 23 initially outlined by the AI Act. The study criticises the current FRIA approach for its individualistic and siloed nature, which may fail to address the complex interplay between AI and fundamental rights, including the broader political and institutional frameworks.

Key Features of the Solution

- **Comprehensive Legal and Ethical Analysis:** Examines the relationship between the AI Act and the EU Charter of Fundamental Rights.
- **Integration of Intersectionality and Vulnerability Theory:** Proposes these frameworks to address fundamental weaknesses in the current FRIA approach.
- **Practical Recommendations:** Suggests enhancements for implementing the FRIA model to better safeguard fundamental rights.

Results and Impact

By broadening the scope of rights considered and incorporating more nuanced theoretical perspectives, ADAPT's research proposes a more robust FRIA model. This revised approach promises to enhance the trustworthiness and effectiveness of the EU AI Act in managing high-risk AI applications.

Potential Impact and Industry Benefits

- **Enhanced Trust and Compliance:** Ensures that AI systems are ethically deployed, building public trust.
- **Clarification of Regulatory Expectations:** Provides clearer guidelines for AI developers and deployers on how to conduct thorough FRIAs.
- **Educational Value:** Increases understanding of how AI impacts fundamental rights, linking legal obligations to ethical considerations.

Conclusion

ADAPT's research into FRIA under the EU AI Act provides vital recommendations for improving AI governance frameworks, ensuring that high-risk AI systems are deployed in a manner that respects and protects fundamental human rights, thereby fostering a safer and more ethical AI ecosystem in the EU.

Simplifying High-Risk AI Classification Under the EU AI Act with ADAPT's Novel Tool

Challenge

The EU AI Act mandates strict controls on AI systems to protect health, safety, and rights, necessitating precise identification and classification of high-risk AI applications. This complex task challenges AI developers and deployers due to the intricate nature of AI system development and usage.

ADAPT's Innovative Solution

ADAPT has developed a streamlined framework and accompanying tool that simplify the determination of high-risk AI applications according to Annex III of the AI Act. This solution categorises the criteria into five key concepts: the domain, purpose, capability, deployer, and subject of the AI system.

Key Features of the Solution

- **Simplified Criteria**: Condenses the AI Act's conditions into five clear questions, easing the classification process.
- **Automated Risk Assessment Tool:** Assists stakeholders in consistently identifying and evaluating high-risk AI systems, integrating effortlessly with existing risk management frameworks.
- **Enhanced Compliance:** Ensures adherence to the AI Act's standards, aiding AI providers and deployers in meeting their regulatory obligations.

Results and Impact

By reducing complexity and enhancing the accuracy of risk assessments, this approach streamlines compliance and improves understanding among AI stakeholders regarding their responsibilities under the AI Act.

Potential Impact and Industry Benefits

- **Efficiency in Compliance:** Streamlines processes for AI providers, deployers, and risk officers.
- **Integration with Established Practices:** Bolsters current risk assessment activities, including Data Protection Impact Assessments (DPIA).
- **Educational Advantages:** Clarifies the requirements of the EU AI Act for all involved parties, promoting safer AI implementation.

Conclusion

ADAPT's tool and framework simplifies the regulatory challenges posed by the EU AI Act, facilitating more effective management and compliance for high-risk AI applications across the EU.

Your ADAPT Customer Journey

Commercial Focused Team

Meet our Commercial Team who will act as your innovation champion and strive to understand your business and technology challenges.

Ideation

Once business priorities are identified, we summarise and prioritise the opportunities in a research roadmap in terms of the business problem, highlight the relevant technology and research that can solve it, along with the likely impact that can be achieved.

Workshop

The cornerstone of our approach is to ask the right questions during a discovery workshop - capture and map out how things are working and areas where innovation improvements can be made.

Project Review Meetings

Simplicity is essential needing a clear line of sight to impact outcomes. ADAPT works in accordance with Agile principles - testing assumptions, timelines, and regular buy-in from stakeholders to ensure projects are delivered on time to meet customer expectations.

Prototype Development

Our Design and Innovation Lab project management team work closely with our industry partners to develop impactful prototype solutions to solve your challenges.

Collaborative Outcome

We deliver solutions to your current challenge and a digital technology roadmap for future collaboration.

Education and Public Engagement

Join the National Conversation on Artificial Intelligence

#DiscussAI

ADAPT's research on human-centric AI means advancing research with societal stakeholders rather than for them.

ADAPT's '#DiscussAI' campaign has engaged more than 64,000 people in communities across Ireland in learning and dialogue about AI and its role in our lives.

#DiscussAI conversations aim to raise and answer questions about AI, generate new ideas for research, and give voice to the people of Ireland on how we can ensure the 'Age of AI' reflects the needs and interests of all of society.

#DiscussAI initiatives include:

Citizens' Think-In forums on AI for adults

AI in My Life workshops on AI literacy for Transition Year students

Technology in My Life workshops on technology and ethics for primary schools

Art or AI? Interactive pop-up museum for people of all ages

In addition, ADAPT's All Ireland Linguistics Olympiad is fostering the next generation of talented linguistic problem solvers for Ireland.

Support the Conversation

We offer opportunities for organisations to partner with us to sponsor or support initiatives that can strengthen AI literacy and participation among the communities in which they operate.

Discover more at www.adaptcentre.ie/public-engagement
or email education@adaptcentre.ie

Directory of Experts

ADAPT leverages the strengths of eight universities across Ireland, bringing together AI scientists and scholars from other key disciplines to develop and translate AI powered solutions motivated by human, societal, and business needs. Here is a glimpse of some of our experts.

Prof. John D. Kelleher
Director of ADAPT and Chair of AI at TCD, Prof Kelleher brings over two decades of AI research with expertise in the areas of machine/ deep learning and natural language processing.

Prof. Cathal Gurrin
Head of ADAPT at DCU and the Deputy Head of the School of Computing at DCU, Prof Gurrin's research focuses on deep user profiles to develop assistive technologies using wearable sensors and data analytics.

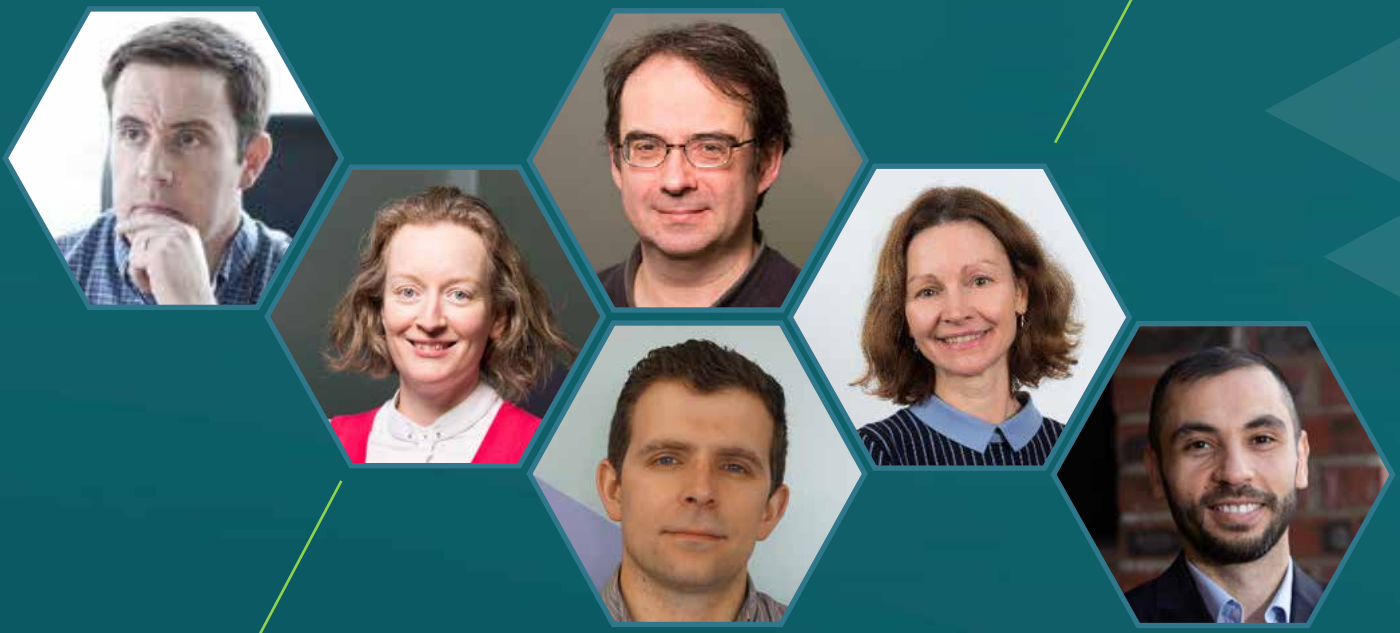
Prof. Anya Belz
Professor of Computer Science at DCU and expert in Natural Language Processing systems. Her projects and publications span automatic language generation, text analysis, evaluation and image description.

Prof. Vinny Wade
Professor of Computer Science and AI at TCD, Prof Wade has made significant contributions to research in web-based personalisation and AI-driven adaptive technologies with interests in knowledge and data-driven AI models and generative AI.

Prof. Owen Conlan
Based at TCD, his research focuses on empowering users in understanding and interacting with complex information and media.

Prof. Dave Lewis
Head of Artificial Intelligence at TCD, his research focuses on the use of open semantic models to manage the Data Protection and Data Ethics issues associated with digital content processing.

Prof. Aphra Kerr
Professor at the Department of Sociology at MU, her research focuses on the ethics and values underpinning data governance, AI related public policy and social expectations of AI.



Prof. Naomi Harte
Professor in Speech Technology in the School of Engineering at TCD, her research centres around Human Speech Communication.

Prof. Ben Cowan
Assistant Professor at UCD's School of Information & Communication Studies, his research lies at the juncture between psychology, human-computer interaction and communication systems.

Dr. Haithem Afli
Faculty member of MTU with expertise in Machine Learning and Deep Learning Research.

Dr. Malika Bendechache
Based at the UoG with a focus on the development and validation of new analytics, metrics, and tools to support automated Data Governance and AI Governance.

Dr. Niall Murray
Based at TUS his research interests include immersive (AR & VR), human-centric AI, multisensory multimedia communication and applications, multimedia signal processing and quality of experience.

Dr. Rob Brennan
Assistant Professor at UCD with research interests in data governance, cybersecurity risk, data protection, data value, data quality, knowledge graphs, and AI governance.

Dr. Brendan Spillane
Professor at UCD, his work focuses on Human Judgement of Information which is at the intersection of Human Computer Interaction, Behavioural Science and Information Science.

Prof. Mark Little
A clinician scientist with an interest in translational immunology as applied to autoimmune disease, he leads the Health Working Group at ADAPT with the goal of creating trusted research environments for deep phenotyping and predictive analytic tools to improve patient care.

Prof. Marus Helfert
Professor at Maynooth University, his research is centred on Digital Service Innovation, Smart Cities and IoT based Smart Environments.

Prof. Claire Gillan
Associate Professor of Psychology at TCD, she runs a lab that focuses on using data science to understand, predict and treat mental health conditions.

Dr. Robert Ross
Based at TU Dublin, his research focuses on the application of ML methods to Human Robot Interaction, with specific projects across NLP, dialogue management, behavioural analysis, and user state estimation.

Prof. Cal Muckley
Professor of Operational Risk in Banking and Finance at UCD, his research is in areas of financial misconduct, mitigating financial fraud and the information content of corporate dividends.

Prof. Giovanni Di Liberto
Assistant Professor in Intelligent Systems at TCD, his scientific interests centre on understanding the brain mechanisms underlying speech communication.

Prof. Orla Hardiman
Professor of Neurology at TCD and Consultant Neurologist at Beaumont Hospital, she leads a research group of over 50 individuals in neurodegeneration, with particular focus on ALS and frontotemporal dementia, and the €10m+ PrecisionALS Research Programme.

Prof. Gareth Jones
Professor of Computing at DCU, his research focuses on topics related to information retrieval and search technologies.

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