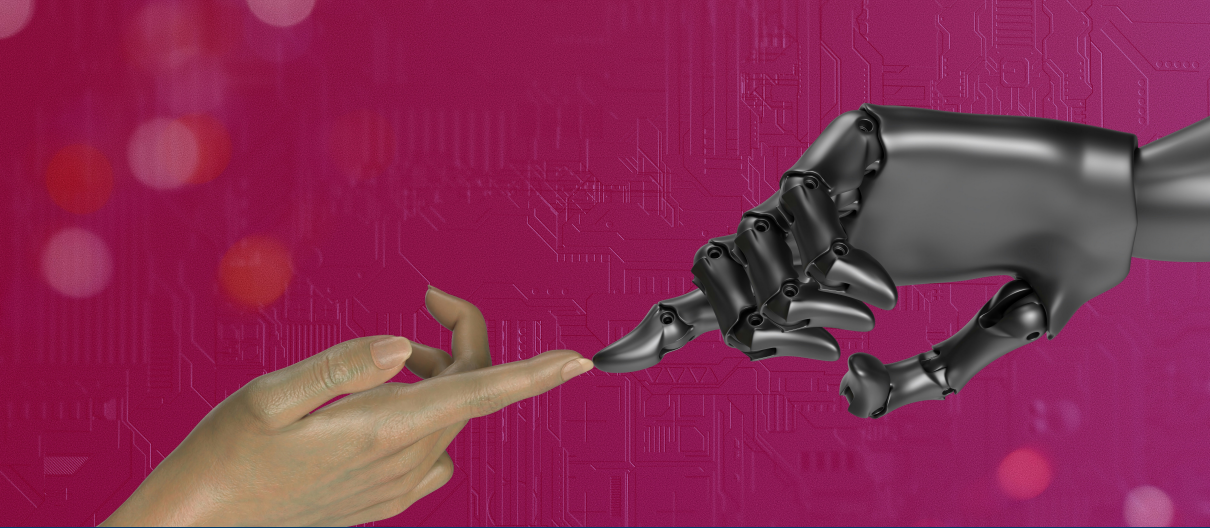




Hands-On Machine Learning

Dr. Derek Bridge | 2026/2027

1. Introduction

Dr. Derek Bridge

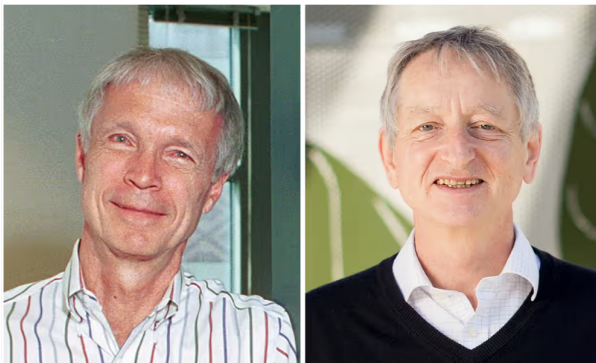


Position: Senior Lecturer
Location: Room 2.64, WGB
WWW: www.cs.ucc.ie/dbridge.html
Email: d.bridge@cs.ucc.ie

The Nobel Prize for Physics 2024

Machine learning pioneers win Nobel prize in physics

Geoffrey Hinton, 'godfather of AI', and John Hopfield
honoured for work on artificial neural networks



The Nobel Prize for Chemistry 2024

“David Baker has succeeded [in] building entirely new kinds of proteins. Demis Hassabis and John Jumper have developed an AI model to solve a 50-year-old problem: predicting proteins’ complex structures.”

David Baker

“for computational protein design”



Demis Hassabis

“for protein structure prediction”



John Jumper

“for protein structure prediction”

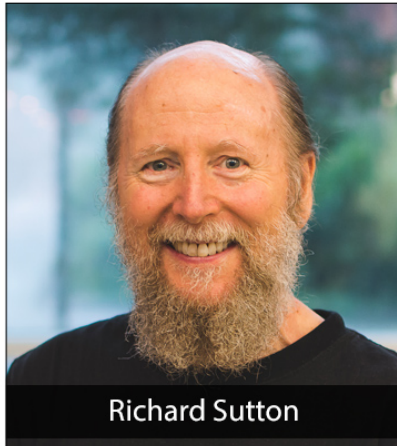


Turing Award 2018

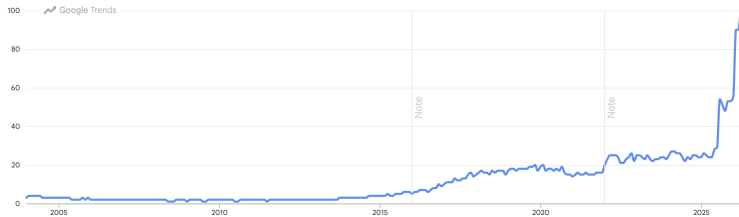


Yoshua Bengio, Geoffrey Hinton, and Yann LeCun

Turing Award 2024



Google Trends: "machine learning"



Jan 01 2004 – Jun 01 2026

Drivers of Machine Learning

Algorithmic advances

- Core ideas have been around a long time:
 - Mathematical model of neurons (1940s).
 - Perceptrons (1950s).
 - k -nearest neighbours (1950s).
 - “Self-learning” game playing (1950s).
 - Decision trees (1960s or earlier).
 - Backpropagation (1980s or earlier).
 - Convolutional networks (1980s).
 - LSTMs (1990s).
 - Deep Networks (2000s/2010s)
- But a burst of new ideas from 2020 onwards.

Data

- Sensor data.
- Web data (text, images, audio, video, clicks).

Hardware

- Faster CPUs, then GPUs, now TPUs.
- HDDs of up to 40TB, SSDs of up to 250TB.

Freeware

- Software such as toolkits, libraries and APIs.
- Educational resources.

Money!

Machine Learning

An early definition

the “field of study that gives computers the ability to learn without being explicitly programmed”

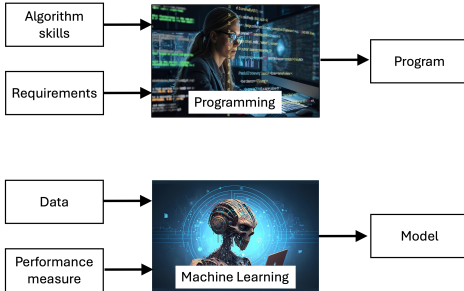
— Arthur Samuels, 1959

My definition

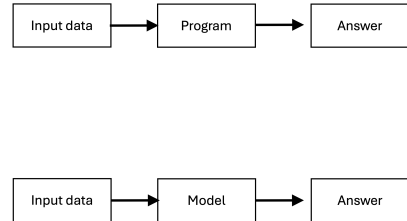
the development, analysis and deployment of algorithms that uncover patterns in training data which generalise to unseen data

Software Engineering vs. Machine Learning

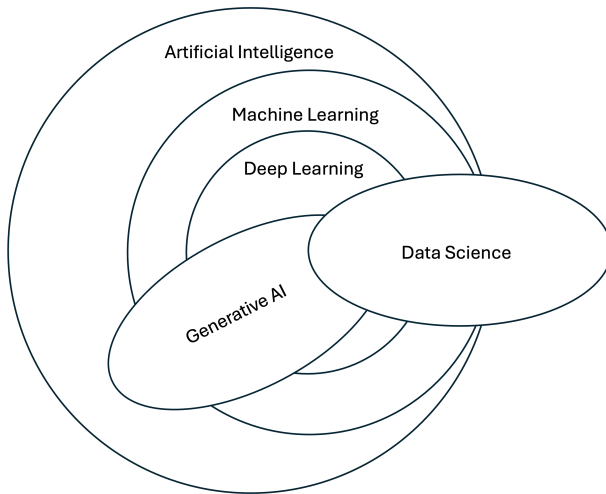
Development



Deployment



Relationships with Other Fields



Types of Machine Learning

Unsupervised learning

- Given an (unlabeled) dataset
- Finds structure within the data, e.g.:
 - Clustering
 - Dimensionality reduction
 - Anomaly detection
 - Association rule mining
- Does this without the guidance of labels or rewards

Supervised learning

- Given a labeled dataset
- Learns to make predictions
 - Regression: predicting numeric values
 - Classification: predicting class membership
- Guided by the labels

Reinforcement learning

- Given an agent situated in an environment
- Learns the agent's action policy, e.g.:
 - for game-playing agents
 - for robot control
- Guided by action rewards

Applications of Machine Learning: A Snapshot from CSIT @ UCC

Derek Bridge

Product recommendation for small-scale retailers

M Kaminskis, D Bridge, F Foping, D Roche
E-Commerce and Web Technologies: 16th International Conference on Electronic ...

Textual case-based reasoning for spam filtering: A comparison of feature-based and feature-free approaches

SJ Delany, D Bridge
Artificial Intelligence review 26, 75-87

Case-based support for forestry decisions: How to see the wood from the trees

C Nugent, D Bridge, G Murphy, BH Øyen
Case-Based Reasoning Research and Development: 8th International Conference ...

Cathal Hoare

Urban building energy performance prediction and retrofit analysis using data-driven machine learning approach

U Ali, S Bano, MH Shamsi, D Sood, C Hoare, W Zuo, N Hewitt, ...
Energy and Buildings 303, 113768

Building occupancy detection and localization using CCTV camera and deep learning

S Hu, P Wang, C Hoare, J O'Donnell
IEEE Internet of Things Journal 10 (1), 597-608

Multiclass sentiment classification of online health forums using both domain-independent and domain-specific features

R Alnashwan, H Sorensen, A O'Riordan, C Hoare
proceedings of the Fourth IEEE/ACM International Conference on Big Data ...

Ken Brown

Forecasting workload in cloud computing: towards uncertainty-aware predictions and transfer learning

A Rossi, A Visentin, D Carraro, S Prestwich, KN Brown
Cluster Computing '28

Rapid Quantification of NaDCC for Water Purification Tablets in Commercial Production Using ATR-FTIR Spectroscopy Based on Machine Learning Techniques

H Asadi, T O'Mahony, J Lambert, KN Brown
Irish Conference on Artificial Intelligence and Cognitive Science, 106-120

Motion Sensors-Based Machine Learning Approach for the Identification of Anterior Cruciate Ligament Gait Patterns in On-the-Field Activities in Rugby Players

S Tedesco, C Crowe, A Ryan, M Sica, S Scheurer, AM Clifford, KN Brown, ...
Sensors 20 (11), 3029

Luca Longo

Assessment of Mental Workload: A Comparison of Machine Learning Methods and Subjective Assessment Techniques

K Moustafa, S Luz, L Longo
Longo, L., & Leva, M. C. (Eds.). (2017). Human Mental Workload: Models and ...

A Review on Machine Learning Methods for Customer Churn Prediction and Recommendations for Business Practitioners

A Manzoor, MA Qureshi, E Kidney, L Longo
IEEE Access

Schizo-Net: A novel Schizophrenia Diagnosis Framework Using Late Fusion Multimodal Deep Learning on Electroencephalogram-Based Brain Connectivity Indices

N Grover, A Chharia, R Upadhyay, L Longo
IEEE Transactions on Neural Systems and Rehabilitation Engineering 31, 464-473

Applications of Machine Learning: A Snapshot from CSIT @ UCC

Hoang D. Nguyen

A Cough-based deep learning framework for detecting COVID-19

T Hoang, L Pham, D Ngo, HD Nguyen
2022 44th Annual International Conference of the IEEE Engineering in ...

Federated Artificial Intelligence for Unified Credit Assessment

MD Hoang, L Le, AT Nguyen, T Le, HD Nguyen
International Conference on Human-Computer Interaction, 44-56

Carbon stock estimation at scale from aerial and satellite imagery

A To, HQV Pham, QH Nguyen, JG Davis, B O'Sullivan, SL Pan, ...
IEEE Conference on Artificial Intelligence (IEEE CAI 2024)

Salvatore Tedesco

Predicting Three-Dimensional Ground Reaction Forces in Running by Using Artificial Neural Networks and Lower Body Kinematics

DS Komaris, E Pérez-Valero, L Jordan, J Barton, L Hennessy, B O'Flynn, ...
IEEE Access 7, 156779-156786

Comparison of Machine Learning Techniques for Mortality Prediction in a Prospective Cohort of Older Adults

S Tedesco, M Andrucci, MÅ Larsson, D Kelly, A Alamäki, S Timmons, ...
International Journal of Environmental Research and Public Health 18 (23), 12806

Machine learning based canine posture estimation using inertial data

M Marcato, S Tedesco, C O'Mahony, B O'Flynn, P Galvin
Plos one 18 (6), e0286311

Barry O'Sullivan

The potential for artificial intelligence to predict clinical outcomes in patients who have acquired acute kidney injury during the perioperative period

BJ Kelly, J Chevarria, B O'Sullivan, G Shorten
Perioperative Medicine 10, 1-7

Predicting judicial decisions: A statistically rigorous approach and a new ensemble classifier

A Visentin, A Nardotto, B O'Sullivan
2019 IEEE 31st International Conference on Tools with Artificial ...

Explainable machine learning for the multiclass classification of diffuse reflectance spectroscopy signals in orthopaedic applications

N Rossberg, CL Li, S Andersson-Engels, B O'Sullivan, K Komolibus, ...
Data Science for Photonics and Biophotonics 13011, 83-94

Andrea Visentin

A Review of Electricity Price Forecasting Models in the Day-Ahead, Intra-Day, and Balancing Markets

C O'Connor, M Bahloul, S Prestwich, A Visentin
Energies 18 (12), 3097

Road Pavement Health Monitoring System Using Smartphone Sensing with a Two-Stage Machine Learning Model

K Zhao, S Xu, J Loney, A Visentin, Z Li
Automation in Construction

Deep learning pipeline for blood cell segmentation, classification and counting

A Rao, KW Kho, V Mykityl, A Visentin
32nd Irish Conference on Artificial Intelligence and Cognitive Science

Machine Learning is not magic.

Machine Learning is just the detection of patterns in data.

Machine Learning is just algorithms, data structures and maths.

“Machine Learning is statistics minus any checking of models and assumptions.”
— Brian D. Ripley

Bias

Widely used algorithm for follow-up care in hospitals is racially biased, study finds



By [Shraddha Chakradhar](#) Oct. 24, 2019

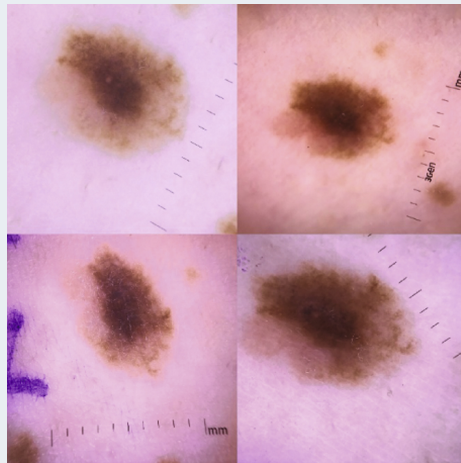
[Reprints](#)



An algorithm commonly used by hospitals and other health systems to predict which patients are most likely to need follow-up care classified white patients overall as being more ill than black patients — even when they were just as sick, a new [study](#) finds.

Overall, only 18% of the patients identified by the algorithm as needing more care were black, compared to about 82% of white patients. If the algorithm were to reflect the true proportion of the sickest black and white patients, those figures should have been about 46% and 53%,

Shortcuts



Surveillance

We're headed for big problems if gardaí get facial recognition technology

Ireland risks introducing a technology that scientific evidence has shown to be ineffective, inherently flawed and discriminatory. It's also a threat to fundamental rights

✕ Expand



An Garda Síochána say they do not have a reference database to match images against, but they want access facial recognition technology anyway. Photograph: iStock

Privacy Violations

Meta faces privacy lawsuit over AI smart glasses



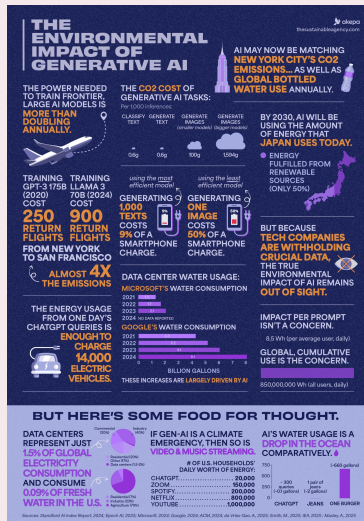
Copyright AP Photo/Nic Coury

By [Indrabati Lahiri](#)

Published on 06/03/2026 - 15:36 GMT+1

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Sensitive videos and pictures containing nudity and bank data information, among other things, captured by Meta's AI smart glasses, have allegedly been reviewed by human workers.



CS3515 HOML

Contact time

Lectures

2×1 hour per week

Labs

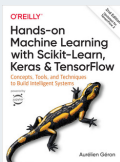
1×2 hours per week

Resources

Slides/Jupyter Notebooks

<https://www.cs.ucc.ie/~dgb/courses/homl.html>

Book



(if you are
skipping
lectures/labs)

Software

scikit-learn
keras

Assessment

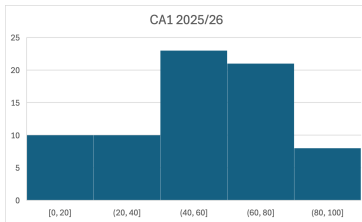
CA1, 50 marks

Classic ML
on a tabular dataset

CA2, 50 marks

Deep Learning
on an unstructured/
multimodal dataset

Warning



“The submission shows a lack of familiarity with the material covered in the module. . .”

Academic Integrity

Academic misconduct includes

- **Poor Academic Practice:** Actions that include, but are not limited to, poor academic writing skills (e.g., poor referencing or passing off someone else's idea as your own), or small errors made through carelessness or misunderstanding.
- **Cheating:** Actions that attempt to get advantage by means that undermine values of integrity.
- **Contract Cheating / Essay Mills:** A form of academic misconduct where a person uses an undeclared and/or unauthorised third party, online or directly, to assist them in dishonestly producing work for academic credit or progression, whether or not payment or other favour is involved.
- **Cumulation effect:** Where continued poor academic practice and repeated minor instances of academic misconduct are treated as a case of major academic misconduct.
- **Fabrication/Falsification:** Making up data, experiments, or other significant information in proposing, conducting, or reporting research. This includes the fabrication or falsification of official University documents regarding credit and/or academic achievement.
- **Impersonation:** Undertaking in whole or in part any work required as part of a programme in the place of an enrolled learner, without permission from the provider.
- **Any non-approved use of Generative Artificial Intelligence (GenAI) is not allowed:** Generative Artificial Intelligence (GenAI) refers to a subset of Artificial Intelligence (AI) that uses algorithms and models trained on massive datasets to generate new text, audio, video, code, and more. Academic integrity is breached if students submit the products of GenAI as their own without acknowledgement and without authorisation to use GenAI in fulfilling the task. **If in doubt, check with your lecturer.**
- **Plagiarism:** Presenting work or ideas taken from other sources without proper acknowledgement, whether done deliberately, carelessly, or inadvertently.
- Other acts that dishonestly use information to gain academic credit.

Plagiarism

Presenting work or ideas taken from other sources without proper acknowledgement, whether done deliberately, carelessly, or inadvertently.

It is a violation of UCC Policy and there are strict and severe penalties.

Types of Plagiarism include but are not limited to:

- **Collusion:** A joint effort of work is presented by an individual without due recognition of the input of others. Collusion also applies to both parties when an individual student provides their work to another student and allows them to present it as their own.
- **Self-plagiarism:** The use of one's own previous submitted/presented work in another context without appropriate citation.
- **Verbatim plagiarism:** Word-for-word copy of work from another source without providing acknowledgement.

You must read and comply with the [Academic Integrity for Examinations and Assessments Policy 2026-2027](#).

The Policy applies to all work submitted, including software.

You can expect that your work will be checked for evidence of plagiarism or collusion.

In some circumstances it may be acceptable to reuse a small amount of work by others, but only if you provide explicit acknowledgement and justification.

If in doubt, ask your module lecturer prior to submission. Better safe than sorry!

GenAI Declarations

- UCC now requires students to make a GenAI declaration as part of course work submissions such as lab report, CA work, etc.
- Lecturers will advise students whether GenAI use is permitted or not as part of course work.
- Where GenAI is NOT permitted, students will have to make a declaration that they did not use GenAI in the submitted course work.
- When GenAI is permitted, students must submit with their course work a declaration which GenAI tool(s) were used in the preparation of the assessment which tool (or tools) were used and what was done with them.
- Lecturers will provide template declarations with course work requirements.

Reasonable Accommodations for Students Registered with DSS

- The university has a policy to assist students with disabilities.
- A Reasonable Accommodation does not refer to living arrangements. It is a professional term used to explain the range of supports and services available in University College Cork ("UCC") to assist students with disabilities/learning differences/significant ongoing health conditions to fully participate in their studies. In the education sector, Reasonable Accommodations are described as any action that helps alleviate a substantial disadvantage due to a disability/learning difference/significant ongoing health condition. Examples of Reasonable Accommodations can be found in Appendix 3 of the [Reasonable Accommodations Policy](#).
- It is important to point out that the university does not oblige lecturers to record lectures and many do not regard it as the best option to enhance student learning.
- If you require reasonable accommodations, please register with DSS and discuss your situation with your lecturers.

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Published in the [Guardian](#)



The [Nobel Prize](#) web site



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Screenshot from www.euronews.com



Image taken from the blog of thesustainableagency.com



From the O'Reilly web site