IMPERIAL

Data Science and AI Winter School

3rd to 14th February 2025 at Imperial College London

IMPERIAL COLLEGE LONDON AND THE DATA SCIENCE INSTITUTE

Consistently rated amongst the world's best universities (1st in Europe and 2nd in World according to the QS World University Rankings 2025), Imperial College London is a science-based institution with an international reputation for excellence in teaching and research. Imperial attracts over 22,000 students and 8,000 staff of the highest international quality from more than 126 different countries.

Since its foundation in 1907, Imperial's contributions to society have included the discovery of penicillin, the development of holography and the foundations of fibre optics. This commitment to the application of research for the benefit of all continues today, with current areas of focus including interdisciplinary collaborations to improve global health, tackle climate change, develop sustainable sources of energy, address security challenges, advance data management and analysis technologies for supporting data driven research, and tackle problems at the molecular scale.

Imperial's Continuing Professional Development Unit within the Institute of Extended Learning has extensive experience in developing and running a range of winter and summer schools for international undergraduate students. We draw on Imperial's education pedagogy to design and deliver programmes that provide an engaging learning experience for students, incorporating group projects that are designed to assess students' learning outcomes.

The **Data Science Institute** (DSI) is a major initiative at Imperial College London that brings together the College's existing data science activities and expertise while providing a focus and catalyst for new partnerships.

The DSI supports multidisciplinary collaborations between the College's academic experts in various disciplines, including healthcare, financial services, climate science, and city infrastructure, to create solutions for complex problems. Alongside its research initiatives, the Institute fosters the next generation of data scientists and engineers by developing a range of postgraduate and executive courses.

The DSI includes seven academic labs, has attracted over £50 million in funding for data science research, technology, and infrastructure, and has published over 300 papers.

The Institute's Data Observatory (DO) is one of the first and largest visualization suites in Europe. It provides a multi-dimensional and immersive environment for analyzing large and complex datasets and for collaborative work.

Thanks to its extensive research collaborations both within the College and with a variety of external academic and industrial partners, the DSI is establishing itself as an international hub for data science.

WINTER SCHOOL OVERVIEW

Data Science is revolutionising business models across industries by leveraging statistics and deep learning tools to drive better decision-making. With an increasing number of companies hiring data scientists to analyse data and predict potential risks, the demand for skilled professionals in this field is growing rapidly.

This winter school is specifically designed for undergraduate students in the final two years of their studies, particularly those studying IT, computing, or any engineering degrees with an interest in data science. Students will be introduced to key concepts, develop a solid understanding of data science, learn from experts in data science and AI applications, and collaborate on a technical project.

Team-based learning through group project:

Students will engage in team-based learning by working on a group project focused on a real-world challenge:

Gliomas, the most common malignant brain tumours, pose significant clinical challenges due to their high mortality and morbidity rates worldwide. Accurate detection of these brain tumours is crucial but remains difficult. MRI scans are commonly used to identify potential gliomas, but analysing these scans is a time-consuming and tedious task for clinicians. In this project, students will develop an AI framework capable of accurately detecting and segmenting brain tumours in MRI scans. This automated framework has the potential to enhance efficiency in healthcare systems and aid in extracting imaging biomarkers for assessing disease progression and evaluating treatment outcomes. Supervised by Imperial academics throughout the programme, students will present their project to a panel of experts on the final day.

Learning objectives:

Upon completion of this winter school, students will:

- Grasp the basic concepts of data science.
- Develop an understanding of natural language processing, data science for computer vision, and machine learning for data science.
- Learn about data visualisation and experience it firsthand at the state-of-the-art Data Observatory.
- Understand the real-world applications of data science and its transformative potential in healthcare.
- Gain insight into data entrepreneurship and the mathematical aspects of AI.
- Appreciate the importance of data privacy and ethics.
- Acquire unique insights into advances in data science from Imperial's leading researchers in data science and AI.
- Develop essential professional skills in teamwork, communication, and presentation through practical workshops.
- Experience team-based learning by working on a technical data science project.
- Improve their English language skills through practice.

Additional Opportunities:

Beyond academics, students will have the chance to form new friendships through social activities, engage with Imperial student ambassadors, explore opportunities for further study, and experience what it's like to study at a world-class university.

Data Science Career Planning Workshop:

For the first time in this winter school, students will have the opportunity to attend a new half-day career planning workshop, delivered by Imperial's Careers Service team. This workshop is designed to help students unlock their potential in data science. Through a series of guided activities and strategic discussions, students will explore various roles in this dynamic field, gain clarity on their career paths, and acquire actionable insights to propel their data science journey forward.

Visit to the Data Science Institute

As part of this winter school, students will have a unique opportunity to visit the state-of-the-art Data Observatory at the Data Science Institute, one of the seven Global Institutes at Imperial College London, and witness demonstrations of cutting-edge data science research.

PROGRAMME STRUCTURE AND FORMAT

The programme consists of 60 contact hours spread over two weeks, covering lectures, workshops, tutorials, project work, and visits. Classes will be held on weekdays.

Students will be allocated to small groups for project work, which will be conducted through team-based learning with supervision. The final project will be presented in groups to a panel of experts on the last day of the programme. A prize will be awarded to the team with the best project.

The entire programme will be taught in English.

CERTIFICATION

Students will receive a verified certificate from Imperial College London upon successful completion of the winter school, and a prize will be awarded to the best project team. Each student will also receive a transcript of their project marks.

ENTRY REQUIREMENTS

All students are expected to be studying an undergraduate degree, preferably in the final two years of their undergraduate studies, in any engineering discipline, IT or computing degree.

English requirements:

All students are required to have a good command of English, and if it is not their first language, they will need to satisfy the College requirement as follows:
- a minimum score of IELTS (Academic Test) 6.5 overall (with no less than 6.0 in any element) or equivalent.
- TOEFL (iBT) 92 overall (minimum 20 in all elements)

Technical requirements:

As the project has a strong technical element, students are expected to have the following knowledge and interests:

- An interest in computer visualization and natural language processing.
- At least an intermediate level of proficiency in one of the common programming languages (Python, Java, C++, etc.)
- A mathematical foundation (probability theory, linear algebra, etc.)
- An understanding of the Linux environment.
- Knowledge of machine learning, with experience using PyTorch, TensorFlow, or Keras.

Students will be asked to bring their own computers, pre-installed with Python, for project work.

PROVISIONAL SCHEDULE

Data Science and AI Winter School
3-14 February 2025 at Imperial College London, UK

Week 1:	
Day 1	**Monday 3 February**
09:30	Programme Registration
09:45	**Welcome, Housekeeping and Introduction to Imperial**
10:00	**Programme Overview and Icebreaker**
10:30	Break
10:45	**Introduction to Data Science**
12:15	**Group Photo**
	Welcome lunch with Imperial Ambassadors
13:30	**Group Project Introduction and Briefing**
15:30	**Data Preparation**
16:30	End of day
Day 2	**Tuesday 4 February**
09:15	**Data Science Entrepreneurship**
10:45	Break
11:00	**Introduction to Natural Language Processing**
12:30	Lunch
13:30	**Social activity - Visit to The Royal Albert Hall**
15:30	**Project Tutorials Q & A**
16:30	End of day
Day 3	**Wednesday 5 February**
09:15	**Computer Vision and Applications (I)**
10:45	Break
11:00	**Team Building Theory and Effective Communication for Presentation**
12:30	Lunch
13:30	**Building Effective Team Workshop in Chemical Kitchen (Group 1-5)**
	Teams work on group project (Groups 6-10)
17:00	End of day
Day 4	**Thursday 6 February**
09:15	**Computer Vision and Applications (II)**
10:45	Break
11:00	**Data Privacy and Ethics**

12:30	Lunch	
13:30	**Building Effective Team Workshop in Chemical Kitchen (Group 6-10)**	
	Teams work on group project (Groups 1-5)	
17:00	End of day	

Day 5	Friday 7 February

09:15	**Mathematical Aspects of AI**
10:45	Break
11:00	**Data Visualization**
12:30	Lunch

13:30	**Visit to DSI data observatory for Groups 1, 2, 3**
	Visit to DSI data observatory for Groups 4, 5, 6
	Visit to DSI data observatory for Groups 7, 8, 9, 10
	Teams work on group project during non-visit period
16:30	End of day

Saturday& Sunday

	Free time to explore London

Week 2:

Day 6	Monday 10 February

09:15	**Machine Learning for Data Science**
10:45	Break
09:15	**Transforming the future of healthcare with data science**
12:30	Lunch
13:30	**Social activity - British Cultural Quiz**
14:30	**Project Tutorials Q & A**
15:30	Teams work on group project
16:30	End of day

Day 7	Tuesday 11 February

09:15	**Research Showcase - Generative AI and Image Analysis**
10:00	Break
10:10	**Research Showcase - Diffusion generative models**
10:55	Break
11:05	**Research Showcase – Understanding LLM Memorization**
11:50	Break
12:00	**Opportunities for International Students**
12:30	Lunch
13:30	**Project Tutorials Q & A**

14:30	Teams work on group project
16:30	End of day

Day 8	**Wednesday 12 February**

09:15	**Career Workshop**
12:30	Lunch
13:30	**Project tutorials Q & A**
14:30	Teams work on group project
16:30	End of day

Day 9	**Thursday 13 February**

09:15	**Project tutorials Q & A**
10:15	Teams work on group project
12:15	Lunch
13:15	**Project tutorials Q & A**
14:45	Teams work on group project
16:45	End of day

Day 10	**Friday 14 February**

08:45	**Students arrive to upload project presentations**
09:00	**Group 1**
09:20	**Group 2**
09:40	**Group 3**
10:00	**Group 4**
10:20	**Group 5**
10:40	**Break**
10:50	**Group 6**
11:10	**Group 7**
11:30	**Group 8**
11:50	**Group 9**
12:10	**Group 10**
12:30	**End of Presentation**
	Students to complete feedback form
12:45	**Announcement of Winning Teams & Certificate Ceremony**
13:00	Celebration Lunch
14:00	End of Winter School

TEACHING FACULTY

The winter school is co-directed by [Dr Kai Sun](#) and Ping Huang and taught by a multi-disciplinary teaching faculty from the Data Science Institute and other departments of Imperial College London.

LOCATION

The winter school will take place at Imperial College London's South Kensington Campus, located amongst many famous [attractions](#) in London.

The cultural triangle is home to three of London's most prestigious (and free) museums. Right next door is the Science Museum; across the road is the Victoria and Albert Museum; and around the corner is the Natural History Museum. From Neolithic artifacts to the latest scientific breakthroughs, experience it all just minutes from Imperial's doorstep.

The campus is also adjacent to the famous Royal Albert Hall, one of London's most iconic music venues, established in 1871 and host to the BBC Proms and countless world-renowned international artists.

In addition, the beautiful Hyde Park and the renowned Harrods Department Store are just a short walk from the campus.

FEEDBACK FROM PAST COHORT

- *"I really have learned a lot through the programme. Thanks to all professors and supervisors"* - student from Shanghai Jiaotong University

- *"High quality teaching, useful knowledge and full support"* - student from Shanghai Jiaotong University

- *"Wonderful. It enhanced my understanding of data science. It was also wonderful to listen and discuss opinions with the professors"* – student from Zhejiang University

- *"It's indeed a wonderful experience, learning knowledge and coming across with so many excellent teachers and classmates"* -student from Zhejiang University

- *"This programme opens a door to the world of data science for me! Brilliant!"* - student from Zhejiang University

- *"The project gave me the opportunity to meet many great students and professors. I learned how to use artificial intelligence to improve everyday tasks, including but not limited to the computer vision and natural language projects in the program. This has greatly broadened my horizons and expanded my knowledge beyond my undergraduate studies."* – student from Xi'an Jiaotong-Liverpool University

- *"Many thanks for this valuable experience. I have benefited greatly from being exposed to cutting-edge data science knowledge and trying to work on a project with students from different schools and disciplines. I will always cherish this memory."* -student from Nanjing Audit University

- *"It's a fantastic opportunity to experience the research atmosphere at Imperial College London. It is exhilarating to meet so many outstanding staff and professors talking like friends to us. It was also a valuable experience working with my teammates, who doesn't actually know each other before, but come together tighter after this programme. And my passion towards IC has never become so high like now."* – student from University of Nottingham Ningbo China.