Minor in AI and Data Science for Materials

This minor provides NUS students with a structured pathway to integrate artificial intelligence, data science, and materials science. It responds to the growing convergence of AI-driven methods with materials discovery, advanced manufacturing, and digital engineering, preparing students to work at the interface of physical sciences and digital technologies.

The programme equips students with foundational knowledge in programming, machine learning, and materials science, and develops their ability to apply data-driven approaches to materials challenges. Students will learn how machine learning and optimisation algorithms are used for materials property prediction, structure–property analysis, process optimisation, and AI-assisted experimentation. The minor also introduces emerging areas such as high-throughput experimentation, autonomous laboratories, and digital twins in manufacturing.

Graduates will develop computational thinking, data literacy, and interdisciplinary problem-solving skills relevant to AI-enabled scientific and industrial innovation. The minor prepares students for roles such as materials data analyst, AI-assisted process engineer, digital manufacturing engineer, computational materials researcher, semiconductor process integration engineer, and R&D engineer in advanced materials and sustainability technologies. It also supports pathways in technology consulting, technical procurement, and innovation management, where knowledge of AI-driven materials development is increasingly valuable.

The programme aligns with the NUS Educational Philosophy and Singapore's National AI Strategy by cultivating "bilingual" graduates with competency in both materials science and AI methodologies. It supports national priorities in advanced manufacturing, AI for Science, and scientific innovation.

The objectives of this minor programme are as follows:

1. Provision of the strategic impetus and objectives that were considered in proposing the programme.
The increasing flexibility of the NUS curriculum allows students to pursue minors that complement their majors and career aspirations. It is therefore important for departments to offer open minors that are accessible across the University. This minor aims to equip students with the ability to apply AI, machine learning, and data-driven methods to accelerate materials innovation.

2. Indication of the needs unmet by the present programme(s) that will be addressed by the proposed programme/revision
There is currently no structured interdisciplinary pathway for students outside Engineering or Computing to learn how AI can be applied specifically to materials science problems. While AI and materials courses exist separately, this minor integrates them into a focused programme on data-driven materials analysis, simulation, optimisation, and experimentation. Recent hires in this area will further strengthen future course offerings.

3. Educational value of the proposed programme
AI for materials is an emerging field central to modern science and industry. This minor enables students to understand how machine learning, optimisation, and data analytics can enhance experimental workflows, materials discovery, and manufacturing processes. These skills are important for developing sustainable materials and improving real-time process optimisation.

4. Industry Relevance
As AI and big data reshape advanced manufacturing, competency in Materials AI is increasingly important for technical roles in autonomous experimentation, digital manufacturing, semiconductor processing, and AI-driven materials discovery. For students pursuing management, procurement, consulting, or innovation roles, the minor provides essential literacy for evaluating technologies, supply chains, and investment decisions in data-driven manufacturing environments.

The minor supports Singapore's National AI Strategy and AI for Science initiative by developing graduates who can bridge materials science and AI. This interdisciplinary capability is important for strengthening Singapore's competitiveness in advanced manufacturing and innovation under the RIE framework.

5. Achieve the goals set out in the NUS' Educational Philosophy
As an open minor, the programme provides students from diverse majors with a bridge between materials science and AI. It fosters digital literacy, interdisciplinary thinking, and responsible innovation. Students will learn how AI can accelerate the discovery of sustainable materials while also appreciating the broader implications of these technologies.

Within the NUS Education Framework, the minor contributes to “Information Literacy and Computational Thinking” and “Multi-disciplinary and Inter-disciplinary” learning.

6. Teaching resource consideration

The minor is primarily formed by integrating existing courses across Materials Science, Computing, and Engineering. It therefore does not require significant additional teaching resources or staffing. New courses in Materials AI and related areas may be progressively introduced to enrich the curriculum and maintain relevance, within existing departmental capacity.

Eligibility

Open to all NUS undergraduate students enrolled in a full-time undergraduate degree, except for B.Eng (Materials Science & Engineering) (Hons) programme and Minor in Engineering Materials.

Requirements

To satisfy the Minor in AI and Data Science for Materials, a student is required to complete a minimum of 20 Units, including a mix of core courses and elective courses as shown below:

Core Courses (8 Units)

MLE2301 Introduction to Materials Science & Engineering and

One from the following list of courses:
EE2213 Introduction to Artificial Intelligence
EE2211 Introduction to Machine Learning
CS2109S Introduction to AI and Machine Learning
CS3243 Introduction to Artificial Intelligence
CS3244 Machine Learning

List of Elective Courses (minimum of 12 units)

From the following list of courses:
MLE4112 Foundational Advanced AI for Materials Science
MLE4214 Advanced Methods in AI for Materials Science
MLE4217 Application of Big Data in Materials Science
MLE4230 Current Topics in Materials AI
MLE5215 Atomistic Modelling of Molecules and Materials **(Students must be in Year 4 standing with a minimum GPA of 3.5)**

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