Introduction to Artificial Intelligence

AIAA2205

3 Credits

Prerequisites: UFUG 2601 (C ++ Programming) OR UFUG 2602 (Data Structure and Algorithm Design)

Prerequisite Connection:

- ⑩ Students are expected to have basic programming proficiency and familiarity with algorithmic concepts from the prerequisite courses.
- ⑩ This course does not revisit programming syntax or data structure design in detail; instead, it emphasizes high-level AI concepts, model intuition, and application-driven reasoning.
- ⑩ The prerequisite knowledge enables students to focus on understanding AI methodologies rather than implementation mechanics.

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Course Description

This course introduces the fundamental concepts, methods, and applications of Artificial Intelligence (AI). It covers core topics including data, models, and tasks in AI, as well as essential machine learning techniques such as regression, classification, and optimization. Students will learn key neural network architectures, including CNNs, RNNs, Transformers, and large language models. The course also introduces modern AI topics such as generative models (VAE, GAN, diffusion models), few-shot learning, and multimodal learning. Selected lectures highlight real-world AI applications in areas such as speech processing, healthcare, and AI security. The course emphasizes conceptual understanding and critical thinking, providing students with a solid foundation to understand, evaluate, and apply AI technologies.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Demonstrate a comprehension of advanced knowledge of Artificial Intelligence.

2. Demonstrate a comprehension of applications of Artificial Intelligence.

3. Recognize the limitations of current methods of Artificial Intelligence.

4. Apply programming and Artificial Intelligence skills.

5. Develop a broad interest in the Artificial Intelligence and connect the knowledge to their major study.

6. Communicate effectively in written format to convey scientific knowledge and the application of modern technologies.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Final Exam	60%	TBD
Written assignment	15%	dd/mm/yyyy *
Project	25%	dd/mm/yyyy *

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Final Exam	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5, ILO-6	The Final Examination is designed to assess students' achievement of **ILOs 1–6**. It evaluates students' understanding of core Artificial Intelligence concepts (**ILO-1**), their comprehension of AI applications in practical contexts (**ILO-2**), and their ability to recognize the limitations of current AI methods (**ILO-3**). The exam also assesses students' ability to apply programming and AI-related reasoning in problem-solving tasks (**ILO-4**), connect AI knowledge to broader domains or their major field of study (**ILO-5**), and communicate technical ideas clearly and effectively in written form (**ILO-6**).
Written assignment	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5, ILO-6	A structured report where students investigate an AI topic or mini-project: demonstrate understanding of key concepts and applications (ILO-1, ILO-2), analyze limitations and ethical/technical constraints (ILO-3), implement or prototype a method and interpret results (ILO-4), relate the topic to their own major/discipline and broader impacts (ILO-5), and communicate clearly with well-

		organized, evidence-based writing (ILO-6).
Project	ILO-1, ILO-2, ILO-3, ILO-4, ILO-5, ILO-6	The Project is an integrative assessment that allows students to explore an Artificial Intelligence topic in greater depth. It evaluates students' understanding of core AI concepts and applications (ILO-1, ILO-2), their ability to recognize limitations and broader implications of AI methods (ILO-3), and their application of basic programming or AI tools (ILO-4). By encouraging topic selection related to students' academic interests, the project promotes interdisciplinary connections and engagement with AI (ILO-5). Students present their work in a structured written format, assessing their ability to communicate technical ideas clearly and effectively (ILO-6).

Grading Rubrics

1. Final Exam (60%)

Total: 100 points

A. Conceptual Understanding & Knowledge Application – 60 pts

1. Core AI Concepts & Terminology (ILO-1) – 15 pts
   Demonstrates accurate understanding of fundamental Artificial Intelligence concepts, definitions, and principles under closed-book conditions.
2. Method Selection & Application (ILO-1/2) – 15 pts
   Correctly selects and applies appropriate AI methods or techniques to given problems or scenarios, with clear justification.
3. Algorithmic Reasoning & Problem Solving (ILO-4) – 15 pts
   Shows logical reasoning in solving AI-related problems; correctly outlines algorithmic steps, pseudocode, or computational logic.
4. Recognition of Limitations & Assumptions (ILO-3) – 15 pts
   Identifies assumptions, limitations, or potential weaknesses of AI methods and discusses their implications.

B. Written Explanation & Analytical Thinking – 40 pts

1. Structured Reasoning & Clarity of Explanation (ILO-6) – 15 pts
   Presents answers in a clear, logical, and well-organized written format; reasoning is easy to follow.
2. Analytical Depth & Critical Thinking (ILO-3) – 15 pts
   Demonstrates analytical thinking by interpreting results, comparing approaches, or explaining why certain methods succeed or fail.

3. Application Context & Concept Integration (ILO-2/5) – 10 pts
   Connects AI concepts to practical scenarios or broader disciplinary contexts, demonstrating integrative understanding.

2. Written Assignment (15%)

Total: 100 points

1. Technical Understanding of AI Concepts (ILO-1) – 20 pts
   Demonstrates accurate understanding of relevant AI concepts, models, or methods related to the chosen topic.
2. Applications & Use-Cases (ILO-2) – 20 pts
   Effectively explains how AI techniques are applied in real-world or practical scenarios.
3. Limitations, Ethics & Responsible AI (ILO-3) – 10 pts
   Identifies limitations, risks, or ethical considerations associated with the AI approach or application.
4. Implementation / Experimentation & Interpretation (ILO-4) – 25 pts
   Demonstrates basic implementation, experimentation, or tool-based exploration, with appropriate interpretation of results.
5. Connection to Major / Broader Impact (ILO-5) – 10 pts
   Relates the AI topic to the student's major discipline or broader societal and technological impacts.
6. Writing & Presentation Quality (ILO-6) – 10 pts
   Presents ideas clearly in a well-structured, coherent, and academically appropriate written format.
7. Citations & Academic Integrity – 5 pts
   Uses appropriate references and follows academic integrity and citation standards.

3. Project (25%)

Total: 100 points

A. Project Design & Technical Content – 60 pts

1. Understanding of AI Concepts & Methods (ILO-1) – 15 pts
   Demonstrates sound understanding of core AI concepts and techniques relevant to the project topic.
2. Application to Practical Problem or Scenario (ILO-2) – 15 pts
   Applies AI methods to a meaningful problem, use case, or scenario with clear motivation.
3. Implementation, Experimentation or Tool Use (ILO-4) – 20 pts
   Implements, experiments with, or effectively utilizes AI tools or models at an appropriate introductory level.
4. Recognition of Limitations & Assumptions (ILO-3) – 10 pts
   Identifies limitations, assumptions, or challenges of the chosen approach, including ethical or societal considerations.

B. Integration, Communication & Impact – 40 pts

5. Interdisciplinary Connection & Engagement (ILO-5) – 15 pts
   Connects the project topic to the student's academic background, interests, or broader disciplinary context.
6. Analysis, Reflection & Insight (ILO-3) – 15 pts
   Demonstrates reflective thinking by analyzing results, discussing trade-offs, or proposing improvements.

7. Written Report Quality & Communication (ILO-6) – 10 pts
   Communicates project objectives, methods, and findings clearly and effectively in a structured written report.

Final Grade Descriptors:

[As appropriate to the course and aligned with university standards]

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates comprehensive and accurate understanding of core Artificial Intelligence concepts and principles (ILO-1), and applies them appropriately across theoretical questions, written analysis, and project work (ILO-2). Shows strong ability to analyze assumptions, limitations, and ethical considerations of AI methods with depth and insight (ILO-3). Effectively applies programming or AI-related skills in problem-solving, assignments, or project-based exploration at a high standard (ILO-4). Clearly connects AI knowledge to broader application contexts or the student's academic discipline (ILO-5). Communicates ideas clearly and professionally in written form, with logical structure, clear reasoning, and proper academic referencing (ILO-6).
B	Good Performance	Demonstrates solid understanding of fundamental AI concepts and methods (ILO-1) and generally applies them correctly in exams, assignments, and project work (ILO-2). Identifies key limitations or assumptions of AI approaches, though analysis may lack depth or completeness (ILO-3). Shows adequate application of programming or AI tools with minor errors or omissions (ILO-4). Makes reasonable connections between AI topics and practical or disciplinary contexts (ILO-5). Written communication is clear and organized, with only minor issues in clarity, structure, or citation (ILO-6).
C	Satisfactory Performance	Meets basic expectations for understanding core AI concepts and routine applications (ILO-1, ILO-2). Discussion of limitations, assumptions, or ethical issues is superficial or partially incomplete (ILO-3). Demonstrates basic use of programming or AI-related methods, but with limited depth or accuracy (ILO-4). Connections to broader applications or the student's major are present but generic (ILO-5). Written work is generally understandable but may show noticeable issues in organization, clarity, or referencing (ILO-6).
D	Marginal Pass	Shows limited or uneven understanding of AI concepts, with notable misconceptions or difficulties applying methods beyond straightforward cases (ILO-1, ILO-2). Demonstrates minimal awareness of limitations or ethical considerations (ILO-3). Application of programming or AI techniques is incomplete, poorly justified, or weakly executed (ILO-4). Connections to broader contexts or the student's discipline are unclear or missing (ILO-5). Written communication lacks clarity and structure, with frequent errors or citation problems (ILO-6).
F	Fail	Demonstrates insufficient understanding of fundamental AI concepts and inability to apply them correctly (ILO-1, ILO-2). Fails

		to recognize limitations, assumptions, or ethical issues related to AI methods (ILO-3). Shows little or no evidence of effective application of programming or AI-related skills (ILO-4). Does not meaningfully connect AI knowledge to broader contexts or disciplinary relevance (ILO-5). Written work is unclear, disorganized, ineffective, or violates academic integrity standards (ILO-6).

Course AI Policy

Students are encouraged to use generative AI tools, such as ChatGPT, to assist in solving homework assignments, as proficiency in these tools is likely to become an essential professional skill in the future. However, any use of ChatGPT or other large language models (LLMs) must be explicitly declared in the homework submission. Students should include a brief statement describing how the tool was used, along with the specific prompts employed during the process.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include [specific details, e.g., strengths, areas for improvement]. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

[If applicable, explain the policy for resubmitting work or reassessment opportunities, including conditions and deadlines.]

Required Texts and Materials

"Deep Learning", Ian Goodfellow, Yoshua Bengio, Aaron Courville

"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd ed.)", Aurélien Géron

Google Colab

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Student Feedback (SFQ)

Students are encouraged to complete the Student Feedback Questionnaire (SFQ). Feedback from students will help improve the course and enhance the overall learning experience.

[Optional] Additional Resources

[List any additional resources, such as online platforms, library resources, etc.]

Weekly Plan

#Weeks	Topic	Learning Focus & Activities
1	Introduction to AI: Concept, Data, Model and Task	Course overview; understanding AI as a mapping from data to tasks; discussion of real-world AI systems and limitations
2	Regression and Classification	Supervised learning tasks; comparison between regression and classification; examples of evaluation metrics
3	Optimization	Intuition of optimization in model training; gradient-based learning; convergence and overfitting discussion
4	CNN and Object Detection	Visual perception in AI; convolutional neural networks; object detection pipeline with illustrative examples
5	RNN, Transformer and LLM 1	Sequential modeling motivation; RNN and attention mechanisms; evolution toward Transformer models
6	RNN, Transformer and LLM 2	Large Language Models (LLMs); pretraining and fine-tuning; capabilities and known limitations of LLMs
7	VAE + GAN	Generative modeling motivation; latent representations; comparison between VAE and GAN frameworks
8	Diffusion Model	Noise-based generative modeling; intuition of diffusion and denoising processes; comparison with GAN-based methods
9	Introduction to Few-shot Learning	Learning with limited data; transfer learning concepts; practical challenges in few-shot scenarios
10	Introduction to Multi-modal Learning	Multi-modal data (text, vision, speech); fusion strategies; benefits and challenges of multi-modal AI
11	AI+X Research & Applications: Speech Recognition / Synthesis	AI for human–computer interaction; speech recognition and speech synthesis pipelines; application demonstrations
12	AI+X Research & Applications: AI for Healthcare	AI-assisted diagnosis, decision support, and biomedical knowledge discovery; how to conduct AI for Healthcare research.
13	Introduction to AI Security	Adversarial attacks; robustness and trustworthiness of AI systems; security risks in real-world deployments