**The Hong Kong University of Science and Technology (Guangzhou)**

**UG Course Syllabus**

[Course Title] Introduction to Embodied AI

[Course Code] *AIAA 4220*

[No. of Credits] 3 credits

[Any pre-/co-requisites] UFUG1103 Calculus II, UFUG2104 Applied Statistics

**Name:** [Instructor(s) Name] Changhao Chen

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**Office Hours:** [Specify Office Hours and Location] Wednesday 16:30-17:30pm, E1 613

**Course Description**

[Briefly describe the course content, key topics or themes, objectives, methods of instruction, e.g., lectures, discussions, projects].

This course emphasizes the integration of AI with physical embodiment, which is essential for tasks that involve direct interaction with the environment. Embodied AI represents a paradigm shift where AI systems are not just virtual entities but are housed within a physical structure, enabling them to perceive and act within the world. This course provides students with a timely introduction to this trending research direction.

**Intended Learning Outcomes (ILOs)**

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

1. Demonstrate a fundamental understanding of embodied autonomous AI research and applications.

2. Understand the status of current embodied AI research and applications, including their limitations and future potential.

3. Understand several common designs of embodied AI systems.

4. Develop algorithms for robot perception and navigation

5. Demonstrate comprehension of key algorithms and models in embodied AI

6. Design and develop small AI projects using the learned techniques on real physical robots or in 3D simulation.

**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 |
|---|---|---|
| In-class Quizzes & Attendance | 30% | 03/12/2025 * |
| Paper Reading & Presentation | 20% | 15/10/2025 * |
| Machine Perception Project | 20% | 03/12/2025 * |
| Embodied Navigation Project | 30% | 03/12/2025* |

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

**Mapping of Course ILOs to Assessment Tasks**

[add to/delete table as appropriate]

| Assessed Task | Mapped ILOs | Explanation |
|---|---|---|
| In-class Quizzes & Attendance | ILO 1, 2, 3 | This task assesses students' ability to recall and explain core embodied AI concepts and frameworks (ILO 1), evaluate current trends and research limitations (ILO 2), and understand common embodied AI system designs and architectures (ILO 3). Active participation ensures ongoing engagement with foundational theories and emerging developments. |
| Paper Reading & Presentation | ILO 2, 5 | This task evaluates students' ability to critically analyze cutting-edge embodied AI research (ILO 2) and interpret key algorithms, models, and experimental methodologies (ILO 5). Students are expected to synthesize insights, critique strengths and weaknesses, and clearly articulate technical content through scholarly presentation. |
| Machine Perception Project | ILO 3, 4, 6 | This project assesses students' ability to understand and design components of embodied perception systems (ILO 3), develop and implement perception algorithms, i.e. egocentric object detection (ILO 4), and deploy their solutions in real settings while demonstrating systematic experimentation and validation (ILO 6). |
| Embodied Navigation Project | ILO 3, 4, 5, 6 | This project measures students' ability to design embodied AI architectures for navigation and interaction (ILO 3), |

| | | |
|---|---|---|
| | | implement motion planning, control, and learning-based navigation algorithms (ILO 4), interpret and evaluate embodied behavior and model performance (ILO 5), and integrate perception-navigation modules into a working robot or simulated agent with clear documentation and performance analysis (ILO 6). |

**Grading Rubrics**

[Detailed rubrics for each assignment will be provided. These rubrics clearly outline the criteria used for evaluation. Students can refer to these rubrics to understand how their work will be assessed.]

**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 a comprehensive grasp of embodied AI concepts and methods, with exceptional problem-solving ability and creativity in applying algorithms to perception and navigation tasks. Produces innovative, well-engineered solutions with rigorous evaluation and clear technical communication. Shows strong initiative, research curiosity, and collaboration skills, consistently going beyond core requirements to deepen understanding and achieve outstanding project outcomes. |
| B | Good Performance | Shows solid understanding of key embodied AI principles and competence in applying algorithms to solve practical tasks. Demonstrates sound reasoning, appropriate experimentation, and clear interpretation of results. Exhibits motivation to learn and an ability to work effectively both independently and with peers, meeting course requirements with well-structured and complete deliverables. |
| C | Satisfactory Performance | Possesses adequate but basic understanding of core topics in embodied AI. Can apply learned methods to familiar problems with reasonable success and shows some analytical and critical-thinking capacity. Completes essential coursework and projects with sufficient accuracy and effort, though solutions may lack depth, originality, or advanced reflection. |
| D | Marginal Pass | Demonstrates minimal understanding of key concepts and limited ability to apply methods to solve embodied AI problems. Provides partially correct or incomplete solutions with significant conceptual or implementation gaps. Shows basic engagement and some potential to improve, but overall performance only meets threshold requirements for passing. |
| F | Fail | |

| | | |
|---|---|---|
| | | Shows insufficient understanding of embodied AI concepts and inability to apply problem-solving or analytical skills. Produces incomplete, incorrect, or non-functional work and lacks meaningful engagement in coursework. Does not meet the minimum academic standard for professional or research development in the field. |

**Course AI Policy**

[State the course policy on the use of generative artificial intelligence tools to complete assessment tasks.]

The use of generative AI tools (e.g., ChatGPT, GitHub Copilot) is encouraged for homework assignments, as such tools are becoming essential in modern AI and robotics workflows; however, students must clearly disclose any use of AI in their homework README, including the specific tools used and the prompts provided. While AI can assist with brainstorming, debugging, and code suggestions, students are fully responsible for understanding all concepts and being able to reproduce work independently. Use of AI tools is strictly prohibited during in-class tests, quizzes, and examinations, and any unauthorized use will be treated as an academic integrity violation.

**Communication and Feedback**

Assessment marks for individual tasks will be communicated via Canvas within two weeks of submission. Feedback will highlight strengths, identify areas for improvement, and offer suggestions for further development in both technical understanding and practical implementation. Students who have questions regarding their feedback or marks are encouraged to contact the instructor within five working days after receiving the results to schedule a clarification discussion.

**Resubmission Policy**

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

Resubmission of coursework is generally not permitted in this course. Exceptions may be made only under approved special academic consideration (e.g., documented medical or personal emergencies) and must be formally requested within five working days of receiving the original grade. If a resubmission is granted, revised work must be submitted within the deadline specified by the instructor, and the maximum attainable grade may be capped depending on the circumstances. No resubmission opportunities will be offered for in-class assessments, quizzes, or examinations.

**Required Texts and Materials**

[List required textbooks, readings, and any other materials]

Textbooks:

1) IanGoodfellow,YoshuaBengioandAaronCourville. Deep Learning. MITPress. 2016.

2) Sebastian Thrun, Wolfram Burgard, and Dieter Fox, Probabilistic Robotics, MIT Press, 2005.

3) Illah Reza Nourbakhsh and Roland Siegwart. Introduction to Autonomous Mobile Robots. MIT Press. 2004

4) Liang Lin, Ruimao Zhang, Hefeng Wu. Principles and Practice of Embodied Intelligence. Publishing House of Electronics Industry. 2025

**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.

**[Optional] Additional Resources**

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