國立台灣科技大學 114學年 第2學期　課程大綱

Spring 2026 NTUST Course Outline

授課教師：鍾昕燁

Instructor:Jhong, Sin-Ye

課程名稱：智慧視覺檢測

Course Title：AI-Based Visual Inspection

2026/11/3

課程代號： SI5102701 Course Code 學分數： 3 Credits	必選修：選修/半學年 Required/Electve:Elective/Half Yr. 先修課程： Prerequisites
節次教室： Time/Location	T6(華夏恆毅樓D205) T7(華夏恆毅樓D205) T8(華夏恆毅樓D205)
專業核心能力： Core Professional Competencies	■ 專業知識及技能 ■ 整合跨領域專業知識之能力 ■ 解決工程與管理問題之能力 ■ 研讀及撰寫專業論文之能力 ■ 設計規劃與執行專題及系統整合之能力
課程網址： Course Website	
課程宗旨： Course Objectives	This course adopts a problem-based learning (PBL) approach to explore the application of artificial intelligence in visual inspection. Students will read, implement, and present the latest AI techniques published between 2024 and 2026. Instead of using standard academic datasets, the curriculum focuses on applying these models to real-world data from the industry. The primary domains covered in this course include industrial visual inspection, such as defect detection, and medical image analysis for diagnostics. Throughout the semester, students will adapt, refine, and optimize existing AI methodologies to address the challenges presented by these practical datasets. As an advanced-level course, it builds upon foundational concepts rather than introducing them. Enrolled students must already possess a solid understanding of deep learning theory and digital image processing algorithms. Practical programming skills in Python and hands-on experience with the PyTorch framework are essential prerequisites for completing the technical assignments. The ultimate goal is to bridge the gap between recent academic research and actual industry needs. By actively engaging with current literature and real datasets, students will develop the capability to design, evaluate, and improve AI-based visual inspection systems. This comprehensive practical experience will directly prepare them for specialized engineering roles in both advanced academic research and complex industrial applications.
課程大綱： Outline of Lectures	

Week 1: Course Introduction & Logistics
Week 2: Datasets & Guidelines: Exploring 2D/3D industrial/medical data challenges and explaining strict project scopes.
Week 3: 2D Industrial Inspection I: Applying deep learning to visible light imaging for anomaly detection tasks.
Week 4: 2D Industrial Inspection II: Utilizing thermal imaging to detect internal flaws and structure anomalies.
Week 5: 3D Industrial Metrology: Processing 3D point cloud data for precise spatial and component measurement.
Week 6: Medical Image Analysis I: Adapting AI methodologies for 2D X-ray diagnostics and abnormality detection.
Week 7: Medical Image Analysis II: Implementing real-time AI processing techniques for ultrasound segmentation.
Week 8: Midterm Project Presentations & Demo (I)
Week 9: Midterm Project Presentations & Demo (II)
Week 10: Medical Image Analysis III: Analyzing 3D CT volumetric data for precise clinical organ reconstruction.
Week 11: SOTA Implementation I: Coding 2024-2026 advanced vision models based on individual paper selections.
Week 12: SOTA Implementation II: Exploring optimization strategies to enhance AI efficiency for edge deployment.
Week 13: SOTA Implementation III: Developing cross-domain adaptation algorithms to overcome data scarcity issues.
Week 14: SOTA Implementation IV: Improving model robustness to tackle variability in complex testing conditions.
Week 15: Final Project Presentations & Demo (I)
Week 16: Final Project Presentations & Demo (II)

授課方式：
Method of Instruction

講授 Lecture：50%

分組討論 Group discussion：0%

案例研討 Case study：25%

操做練習 Practical exercises：25%

講授 Lecture：This course uses a Problem-Based Learning (PBL) model centered on project work. The format includes lectures, regular student presentations on paper research, and major midterm/final projects. You must independently train AI models; grades are based on model accuracy. CRITICAL: Training is highly demanding. A high-spec PC (e.g., GPU w/ 16GB+ VRAM) is mandatory and essential for your success and final grade.%

教科書：
Textbooks

Please be explicitly aware that this is an advanced, research-oriented course. There is no single textbook that covers the cutting-edge curriculum of this class. The primary pedagogical materials will consist exclusively of state-of-the-art (SOTA) academic papers published between 2024 and 2026 in top-tier conferences and journals (e.g., CVPR, ICCV, ECCV, MICCAI, NeurIPS, and IEEE Transactions). Students are expected to read, analyze, and present these recent publications extensively.

參考書目：
References

[1] G. Pang, C. Shen, L. Cao, and A. v. d. Hengel, "Deep learning for anomaly detection: A review," ACM Comput. Surv., vol. 54, no. 2, pp. 1–38, Mar. 2021.
[2] X. Liu et al., "Diffusion models for medical image computing: A survey," IEEE Trans. Med. Imag., vol. 43, no. 1, pp. 120–138, Jan. 2024.

修課須知：
Notice

Note for Week 1 (February 24th): Attendance is strictly mandatory for all enrolled students. HW0 will be officially assigned during this session, directly accounting for 15% of your overall course grade. This preliminary assignment is specifically designed to rigorously verify your practical engineering skills in Python, ROS, Git, Docker, OpenCV, and the PyTorch framework. Furthermore, it will conclusively confirm that you possess the required hardware resources to succeed in this course.

評量方式：
Grading

	Participation & Paper Reports (35%): Includes active class engagement and four rigorous paper implementation reports. HW0 accounts for 15% of the overall course grade. Midterm Project (30%): Rigorously evaluated on a Live Demo (20%), Performance Metrics (20%), a 20-min Oral Presentation (30%), and a Written Report (30%). Final Project (35%): Rigorously evaluated on a Live Demo (20%), Performance Metrics (20%), a 20-min Oral Presentation (30%), and a detailed Written Report (30%).
備註說明： Notes	This course requires prior knowledge in deep learning and digital image processing. Proficiency in Python, Git, Docker, and PyTorch is expected. A high-end GPU with at least 16GB of VRAM is required to run the models. Students will present and implement four top-tier conference or journal papers. Grading heavily weighs model performance, efficiency, and optimization contributions. Given the workload, students are advised to allocate a minimum of 20 hours per week to fulfill course requirements.