**COURSE SPECIFICATION DOCUMENT**

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| **Academic School / Department:** | Science, Innovation & Technology |
| **Programme:** | MSc Artificial Intelligence |
| ***FHEQ* Level:** | 7 |
| **Course Title:** | Advanced Computer Vision |
| **Course Code:** | COMP 7106 |
| **Total Hours:** | 200 (Lev 7) (4 US Credits) |
| Timetabled Hours: | 39 |
| Guided Learning Hours | 21 |
| Independent Learning Hours: | 140 |
| **Credit** | 20 UK CATS credits<br>10 ECTS credits<br>4 US credits |

**Course Description:**
This course provides an in-depth exploration of advanced computer vision theory and practice, focusing on modern deep learning-based methods for image and video processing. Students develop a thorough understanding of key architectures, including convolutional neural networks, transformers for vision, and diffusion-based generative models. The course also examines topics such as object detection, semantic segmentation, representation learning, and multimodal vision systems. Emphasis is placed on developing the ability to critically evaluate and implement state-of-the-art models using contemporary frameworks, and to apply vision systems to complex real world problems.

**Prerequisites:**
None

**Aims and Objectives:**
The aim of this course is to equip students with advanced theoretical and practical expertise in computer vision.

- Develop advanced knowledge of modern deep learning architectures for computer vision, including CNNs, Vision Transformers, and generative models.
- Equip students with the skills to implement, fine-tune, and optimise vision models using industry-standard tools and frameworks.
- Enable students to evaluate model performance using appropriate metrics, robustness tests, and experimental design principles.

- Foster the ability to interpret and communicate the behaviour, limitations, and ethical considerations of computer vision systems.
- Prepare students for research, innovation, and professional practice in AI domains involving automated perception, multimodal understanding, and real-world visual recognition challenges.

**Programme Outcomes:**
A2, A4, A5, B2, B3, C1, C2, C4, D4.

A detailed list of the programme outcomes are found in the Programme Specification. This is located at the archive maintained by Registry and found at:
https://www.richmond.ac.uk/programme-and-course-specifications/

**Learning Outcomes:**
By the end of this course, students will be able to:

1. Critically evaluate advanced computer vision models, including CNNs, transformers, and generative architectures (A2, B3);
2. Design and implement computer vision systems using contemporary deep learning frameworks (C1, B2);
3. Apply advanced methods for detection, segmentation, and representation learning to real-world tasks (A4, C2);
4. Critically assess the performance, limitations, and risks of different computer vision approaches (B3, C4, D4); and
5. Interpret and communicate the implications of computer vision technologies in applied and research contexts (A5, D4).

**Indicative Content:**

- Convolutional neural networks and modern architectural variants
- Vision transformers and attention-based architectures
- Object detection and tracking (e.g., Faster R-CNN, YOLO)
- Semantic and instance segmentation
- Representation learning and self-supervised learning
- Diffusion and generative models for vision
- Multimodal vision-language models
- Applied case studies in healthcare, autonomous systems, retail and creative industries

**Assessment:**
This course conforms to the University Assessment Norms approved at Academic Board and located at: https://www.richmond.ac.uk/university-policies/

**Teaching Methodology:**

Teaching includes lectures, deep learning coding labs, model evaluation workshops, and guided learning. Students will work with real-world datasets and implement advanced models using contemporary deep learning frameworks such as PyTorch or TensorFlow.

***Indicative Text(s):***

- Goodfellow, I., Bengio, Y. and Courville, A. (2022). *Deep Learning*. Cambridge, MA: MIT Press.
- Szeliski, R. (2022). *Computer Vision: Algorithms and Applications*. 2nd edn. Cham: Springer.
- Zhang, A., et al. (2023). *Dive into Deep Learning: Computer Vision Edition*. New York: Amazon Publishing.

***Journals***

- *International Journal of Computer Vision.*
- *Applied Artificial Intelligence.*

***Websites***

- Hugging Face AI community: https://huggingface.co
- PyTorch TorchVision: Datasets, Transforms and Models specific to Computer Vision: https://pytorch.org/vision

**Change Log for this CSD:**

| Nature of Change | Date Approved & Approval Body (School or AB) | Change Actioned by Registry Services |
|---|---|---|
| Guided Learning Hours menu updated | October 2025 | |
| Total Hours Updated | October 2025 | |
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