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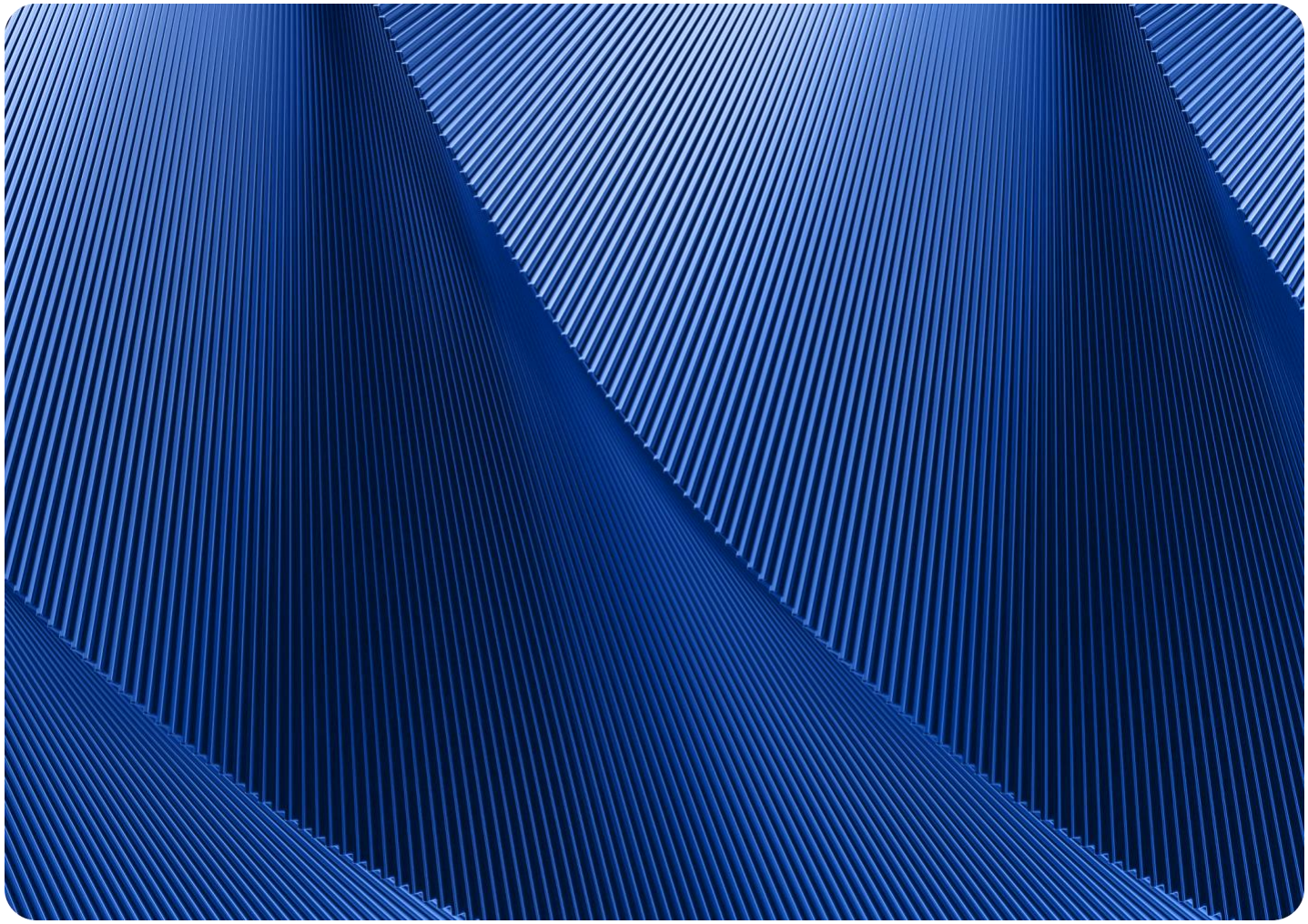
Course Syllabus

Computer Vision for Artificial Intelligence

This course explores fundamental principles of computer vision as a core component of artificial intelligence systems.



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Course Description

This introductory course provides hands-on experience with machine learning concepts, techniques, and real-world applications. Students will explore fundamental topics including classification, training processes, inference, and linear regression through practical lab exercises and projects. The course emphasizes conceptual understanding and applied skills using industry-standard tools and environments. Students will progress from basic machine learning concepts to implementing solutions for automated decision-making tasks, building the foundational knowledge essential for careers in Applied Artificial Intelligence and pursue higher learning.

Prerequisites:
Python programming language
Machine Learning course

Course Competencies

Competency 1
Analyze visual data characteristics and processing challenges unique to computer vision systems
Competency 2
Apply computer vision algorithms for image processing, object detection, and scene understanding tasks
Competency 3
Evaluate different computer vision architectures and their suitability for specific visual analysis problems
Competency 4
Design computer vision pipelines that integrate visual data acquisition, processing, and interpretation components
Competency 5
Create real-time computer vision applications for robotics, autonomous systems, and visual AI implementations
Competency 6
Assess ethical implications specific to visual surveillance, biometric systems, and automated visual decision-making

Instructional Resources

No prescribed textbook is required due to the rapidly evolving nature of artificial intelligence and NLP. Instructors will curate up-to-date articles, papers, videos, and other resources, available via Canvas, to provide the latest advancements and diverse perspectives. This approach ensures flexibility to tailor content to class needs and incorporate emerging topics.

Platforms and Tools:
Kaggle, GitHub, Google Colab, Amazon SageMaker, VS Code, Hugging Face

Recommended Reading:
See Supplemental Books (Optional) and Supplemental Papers (Optional) sections.

Grading Schema

Assignment Type	Percentage of Grade
General Assignments	20%
Labs/Hands-On Activities	25%
Midterm Project	20%
Capstone Project	25%
Course Portfolio	10%

Supplemental Information

General Assignments (20%)

Objective: To reinforce theoretical concepts and develop analytical skills through weekly assignments including case studies, research discussions, problem sets, and design tasks directly related to module content.

Labs/Hands-On Activities (25%)

Objective: To provide students with practical understanding of computer vision through guided implementation exercises, coding workshops, and interactive demonstrations using industry-standard tools and frameworks.

Midterm Project (20%)

Objective: Individual or group project demonstrating integration and application of knowledge from the first half of the course. Students will design and implement a focused computer vision solutions addressing a specific problem or use case.

Capstone Project (25%)

Objective: To provide students with comprehensive hands-on experience in creating a practical, real-world application. Students will integrate multiple computer Vision techniques learned throughout the course to develop an end-to-end solution with documentation and presentation.

Course Portfolio (10%)

Objective: Individual dynamic document continuously updated and maintained on GitHub, serving as a comprehensive record of learning progress, code repositories, reflections, and achievements throughout the course. This portfolio demonstrates professional development and technical growth**.**

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Course Outline

Week starting on / Module	Module Topic
Week 1	Mod 01: Introduction to Computer Vision
Week 2	Mod 02: Digital Image Fundamentals and Processing
Week 3	Mod 03: Machine Learning Integration in Computer Vision
Week 4	Mod 04: Neural Network Foundations for Visual Processing
Week 5	Mod 05: Convolutional Neural Networks for Image Analysis
Week 6	Mod 06: Advanced Neural Architectures for Computer Vision
Week 7	Mod 07: Object Detection and Recognition Systems
Week 8	Mod 08: Advanced Detection and Real-Time Processing
Week 9	Mod 09: Video Analysis and Temporal Processing
Week 10	Mod 10: Generative Models and Advanced Visual AI
Week 11	Mod 11: Visual Data Acquisition and Sensor Integration
Week 12	Mod 12: Autonomous Systems (Agents) and Computer Vision
Week 13	Mod 13: Computer Vision in Production Systems
Week 14	Mod 14: Ethical Implications and Responsible Development
Week 15	Mod 15: Course Review & Future Trends
Week 16	Mod 16: Final Project Presentations

Supplemental Books (Optional)

Elgendy, M. (2020). *Deep Learning for Vision Systems*. Manning Publications.
Recommended for Modules 4, 5, 6, 7, 8, and 10 for neural network foundations, CNNs, advanced architectures, object detection, real-time processing, and generative models.

Rosebrock, A. (2024). *Computer Vision and Image Processing with OpenCV 5*. No Starch Press.
Recommended for Modules 1, 2, 3, and 11 for development environment setup, image fundamentals, ML integration, and sensor data processing.

Subramanian, V. (2023). *Modern Computer Vision with PyTorch*. Packt Publishing.
Recommended for Modules 5, 6, 7, 8, and 9 for CNNs, advanced architectures, object detection, real-time processing, and video analysis.

Géron, A. (2024). *Hands-On Computer Vision with TensorFlow 2 and Keras (2nd ed.)*. Packt Publishing.
Recommended for Modules 4, 5, 7, 10, and 13 for neural networks, CNNs, object detection, generative models, and production deployment.

Liu, L., & Wang, S. (2023). *Edge AI for Computer Vision*. Manning Publications.
Recommended for Modules 11, 12, 13, and 14 for sensor integration, autonomous systems, production deployment, and ethical considerations

Supplemental Papers (Optional)

Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). ImageNet classification with deep convolutional neural networks. *Communications of the ACM*, 60(6), 84–90. https://doi.org/10.1145/3065386
Recommended for Modules 5, 6, and 7 for foundational CNN architectures, deep learning breakthroughs in computer vision, and object classification techniques.

He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 770–778. https://doi.org/10.1109/CVPR.2016.90
Recommended for Modules 6, 7, and 8 for advanced neural architectures, residual connections, and state-of-the-art object detection foundations.

Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You only look once: Unified, real-time object detection. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 779–788. https://doi.org/10.1109/CVPR.2016.91
Recommended for Modules 8, 9, and 12 for real-time object detection, unified detection frameworks, and autonomous system applications.

Instructors may consider adopting these books and papers to complement curated resources, aligning with course objectives, SLOs, and teaching style.