|  |  |  |
| --- | --- | --- |
| IQRA University (IU) | | |
| Faculty of Engineering Sciences and Technology (FEST) | | |
| Computer Science Department (CS) | | |
| Course Code | Course Name | Credit Hr |
| AIE 423- L | Computer Vision (Lab) | 2+1 |

|  |  |  |  |
| --- | --- | --- | --- |
| 1. Basic Information | | | |
| Instructor | Hafiza Maliha Iqbal | Designation | Lab Instructor |
| Prerequisite(s) | AIC 221/AIC211 | Semester | Fall 2024 |
| Email | hafiza.iqbal@iqra.edu.pk | Phone | NA |
| Consulting Hours | 8:30 - 6:00 Friday | Office Location | 8th Floor |

|  |
| --- |
| 1. **Course Objective(s)** |
| This course aims to equip students with the practical skills to implement computer vision techniques. Students will gain hands-on experience in designing and implementing image processing algorithms, training deep learning models, and applying advanced techniques like object detection, segmentation, and 3D vision. By the end of the course, students will be able to build and deploy computer vision applications using industry-standard tools and frameworks. |

|  |
| --- |
| 1. **Course Contents** |
| Introduction and history of neural networks, Basic architecture of neural networks, Perceptron and Adaline (Minimum Error Learning) for classification. Basics of deep learning, learning networks, Shallow vs. Deep learning etc.; Machine learning theory – training and test sets, evaluation, etc. Selected topics from: Gradient descent (Delta) rule, Hebbian, Neo-Hebbian and Differential Hebbian Learning, Drive Reinforcement Theory, Kohonen Self Organizing Maps, Associative memory, Bi-directional associative memory (BAM), Energy surfaces, The Boltzmann machines, Backpropagation Networks, Feedforward Networks; Theory of Generalization; Multi-layer perceptrons, error backpropagation; Deep convolutional networks, Computational complexity of feed forward and deep convolutional neural networks; Unsupervised deep learning including auto-encoders; Deep belief networks; Restricted Boltzman Machines; Deep Recurrent Neural Networks (BPTT, LSTM, etc.); GPU programming for deep learning CuDNN; Generative adversarial networks (GANs); Sparse coding and auto-encoders; Data augmentation, elastic distortions, data normalization; Mitigating overfitting with dropout, batch normalization, dropconnect; Novel architectures, ResNet, GoogleNet, etc |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1. **Course Learning Outcomes** | | | | | | |
| **CLOs** | **CLO Statement** | **BT Level** | **Mapping** | | | **% Weight** |
| **GAs** | **ACM KA** | **SGDs** |
| CLO1 | **Apply appropriate deep learning models for Computer Vision Tasks to solve real work problems**. | C3 | GA2 | #9  IS | 9 | 65% |
| CLO2 | **Participate** in implementing advanced Computer Vision tasks. | A2 | GA6 | 35% |
| ***Note: On successful completion of course GA 1 (Academic Education) will automatically attain.*** | | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| 1. **Course Textbook / Reference Books and Supplementary Reading Material** | | | |
| **S No** | **Book Title** | **Author(s)** | **Edition/ publication year/publisher** |
|  | Computer Vision: Algorithms and Applications | Richard Szeliski | 2nd Edition (latest edition- 2010) |
|  | Multiple View Geometry in Computer Vision. | Richard Hartley and Andrew Zisserman | 2nd Edition |
|  | Computer Vision: A Modern Approach. | David Forsyth and Jean Ponce. | 2nd Edition |
|  | Digital Image Processing, | Rafael Gonzalez and Richard Woods. | 3rd Edition |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1. **CLO Outcome Based Assessment (OBA) Tentative** | | | | | | |
| **Assessment Tool** | | **CLO Mapped** | **CLO Marks** | **% Weight** | **Total Marks** | **Assessment Date** |
| **Lab Manual**  **15** |  | ***CLO 1*** | 15 | 20% |  | **TBD** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| **Total %** | | | **100%** | 15 |  |
|  | | | | | | |
| **OEL**  **20** |  | *CLO 1* | 10 | 65% | 13 | **TBD** |
|  | *CLO 2* | 10 | 35% | 7 |  |
|  |  |  |  |  |  |
|  | **Total %** | | | **100%** | 20 |  |
|  | | | | | | |
| **Midterm**  **25** | Midterm Q1(a),Q2(a) | *CLO1* | 20 | **(80%)** | **20** | **27-11-24** |
| Midterm Q1(b),Q2(b) | *CLO 2* | **5** | **(20%)** | **5** |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Total Midterm %** | | | **46.667%** | **25** |  |
|  |  | | |  |  |  |
| **Final Exam**  **40** | Final Exam Q# | *CLO1* | **30** | **75%** | **30** | **TBD** |
| Final Exam Q# | *CLO2* | 10 | **25%** | **10** |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Total Final Exam %** | | | **100%** | **40** |  |
| **100** | **Total Marls** | | | | **100** |  |
| ***Note: Please make sure every CLO must be assessed at least 3 time.*** | | | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. **Weekly Plan** | | | | |
| **Week**  **No** | **Lab No** | **Lab Description** | **Contact**  **Hr** | **CLO** |
| 1 | 1 | Explore image manipulation in OpenCV: reading, displaying, writing, color space conversions, arithmetic, and bitwise operations on images. | 3 | **1** |
| 2 | 2 | Implement and evaluate KNN on the CIFAR-10 dataset, exploring performance variations with different k values. | 3 | **1** |
| 3 | 3 | Implement linear classifiers with Softmax and SVM loss functions, exploring regularization techniques for model complexity. | 3 | **1** |
| 4 | 4 | Understand the core concepts of neural networks: linear models, feature transformations, activation functions, and multi-layer architectures. | 3 | **1** |
| 5 | 5 | Gain practical knowledge of gradient-based optimization algorithms, including Gradient Descent, SGD, SGD with Momentum, and adaptive techniques. | 3 | **1** |
| 6 | 6 | Understand the concept of backpropagation and its role in neural network training, and learn how to compute gradients using the chain rule and computational graphs.. | 3 | **1** |
| 7 |  | **Open Ended Lab Assigned /Revision** |  |  |
| 8 | **Midterm Exam** | | | |
| 9 | 7 | Understand the structure and components of CNNs and how they process image data, including convolution layers, fully connected layers, and backpropagation. | 3 | **1** |
| 10 | 8 | Explore various CNN architectures, particularly ImageNet and AlexNet, and understand the key aspects of training CNN models and the impact of recent advancements. | 3 | **1** |
| 11 | 9 | Learn key techniques for effective neural network training, including optimization and evaluation, and understand the structure and functioning of RNNs for sequential data tasks. | 3 | **1** |
| 12 | 10 | Explore advanced neural network topics, including attention mechanisms, and their application in sequence-to-sequence models and other architectures. | 3 | **1** |
| 13 | 11 | Understand the principles of visualization, object detection, segmentation, and 3D vision, and apply these techniques to real-world applications. | 3 | **1** |
| 14 | 12 | Grasp the fundamentals of Generative Models and Reinforcement Learning, exploring techniques like GANs, VAEs, and Q-learning. Understand their applications and challenges in data generation and decision-making tasks. | 3 | **1** |
| 15 |  | **Revision / Open Ended Lab/Project Assessment** |  |  |
| 16 |  | **Open Ended Lab/Project Assessment** |  |  |
| 17 | **Final Exam** | | | |

|  |  |  |
| --- | --- | --- |
| 1. **IU Assessment/grading Policy** |  | **Instructor grading for course \*** |
| Lab Manual+ Lab Tasks  OEL  Mid Semester Examination/  Final Semester Examination | 15%  15%-20%  25%  40% | 15  20  25  40 |