DAIHC-2-03T: Deep Learning for Medical Imaging and Signal Analysis

Total Marks: 100
External Marks: 70
Internal Marks: 30
Credits: 4

Detailed Contents

Module	Module Name	Module Contents	Lectures /Tutorials Hours
Module-1	Fundamentals of Deep Learning Architectures for Healthcare	• Introduction to deep learning in healthcare • Neural networks recap: Perceptron, multi-layer perceptron (MLP) • Convolutional Neural Networks (CNNs): Filters, pooling, architectures (LeNet, VGG, ResNet – basic overview), Applications in medical image classification and detection • Recurrent Neural Networks (RNNs): Sequence modeling, LSTM basics, Applications in ECG, EEG signal processing • Autoencoders: Dimensionality reduction, denoising, feature learning • Overview of U-Net and SegNet architectures for segmentation	15
Module	**Module Name**	**Module Contents**	**Lectures /Tutorials Hours**
Module-II	Preprocessing Techniques for Medical Image and Signal Data	• Medical image preprocessing: Normalization, resizing, contrast adjustment, Image augmentation: Rotation, flipping, noise injection, Intensity standardization for CT/MRI • Biomedical signal preprocessing: Denoising with filters (Butterworth, Savitzky-Golay), Baseline correction, segmentation, Feature extraction: Time and frequency domain features • Data preparation for deep learning: train-test split, batch generation, label encoding	15
Module-III	Deep Learning Model Development with TensorFlow/PyTorch	• Introduction to TensorFlow/Keras and PyTorch frameworks • Building and training CNN models for medical image classification • Deep learning for image segmentation: U-Net implementation • RNN-based models for biosignal sequence classification • Transfer learning for small healthcare datasets (e.g., pretrained ResNet, VGG) • Real-world datasets: Chest X-ray (NIH), ISIC (skin cancer), MIT-BIH (ECG), TUH EEG	15

		corpus	
Module-IV	Evaluation, Interpretation, and Clinical Relevance	• Evaluation metrics: Accuracy, Precision, Recall, F1-score, AUC-ROC • Medical-specific metrics: Sensitivity, Specificity, Dice coefficient, IoU • Confusion matrix analysis • Model validation: Cross-validation, early stopping, learning curves • Interpreting results in clinical context: false positives/negatives implications • Explainability and interpretability: Grad-CAM, saliency maps • Ethical and regulatory concerns in clinical AI applications	15

Books

- Shen, D., Wu, G., & Suk, H.-I. (2017). Deep learning in medical image analysis. Annual Review of Biomedical Engineering, 19, 221–248.
- Litjens, G., Kooi, T., Bejnordi, B. E., Setio, A. A. A., Ciompi, F., Ghafoorian, M., ... & Sánchez, C. I. (2017). A survey on deep learning in medical image analysis. Medical Image Analysis, 42, 60–88.
- Acharya, U. R., Fujita, H., Sudarshan, V. K., Oh, S. L., & Adam, M. (2019). Deep learning for biomedical signal processing: State-of-the-art, challenges and future directions. Computers in Biology and Medicine, 113, 103387.
- Min, E., Guo, X., Liu, Q., Zhang, C., Cui, J., & Long, J. (2021). A survey of clustering with deep learning: From the perspective of network architecture. IEEE Access, 6, 39501–39514.