Introduction to Deep Learning

Assignment # 2

Due Date 2nd May 2025

Question: Compare the suitability of Sigmoid, Tanh, ReLU, and Leaky ReLU activation functions for real-world deep learning problems. For each function, identify three real-world applications where it has been effectively used, citing the relevant research papers or reliable sources. Submit a print.

Solution Template:

Introduction to Deep Learning

Assignment # 2 - Solution

Name: **Zain Ul Abideen**, ID: **L1F21BSCS0877**, Section: **H2**, Date: **2 8 - 0 4 - 2 0 2 5**

S.No	Sigmoid	Tanh	Relu	Leaky Relu
1.	Handwritten digit recognition **[1]**	Sentiment analysis in NLP **[4]**	ImageNet Classification with Deep Convolutional Neural Networks **[7]**	Image Synthesis using DCGANs **[10]**
2.	Heart disease prediction using Logistic Regression **[2]**	Speech emotion recognition **[5]**	Object Detection Based on CNN Family and YOLO Object Detection Based on CNN Family and YOLO **[8]**	Deep Reinforcement Learning (e.g., Atari Games) **[11]**
3.	Financial time-series prediction **[3]**	Energy-efficient image compression in wireless sensor networks using autoencoders with error-bound control **[6]**	CNNs in self-driving cars **[9]**	Human Pose Estimation **[12]**

References:

[1] F. Essam et al., "MLHandwrittenRecognition: Handwritten digit recognition using machine learning algorithms," *J. Comput. Commun.*, vol. 2, no. 1, pp. 9–19, 2023.
[2] C. M. Bhatt, P. Patel, T. Ghetia, and P. L. Mazzeo, "Effective heart disease prediction using machine learning techniques," *Algorithms*, vol. 16, no. 2, p. 88, Feb. 2023, doi:

10.3390/a16020088.
[3] M. Yang and J. Wang, "Adaptability of financial time series prediction based on BiLSTM," *Procedia Comput. Sci.*, vol. 199, pp. 18–25, 2022, doi: 10.1016/j.procs.2022.01.003.
[4] R. Socher et al., "Recursive deep models for semantic compositionality over a sentiment treebank," *Proc. Conf. Empir. Methods Nat. Lang. Process. (EMNLP)*, pp. 1631-1642, Oct. 2013.
[5] T. M. Wani et al., "A comprehensive review of speech emotion recognition systems," *IEEE Access*, vol. 9, pp. 47795-47814, 2021, doi: 10.1109/ACCESS.2021.3068045.
[6] B. A. Lungisani, A. M. Zungeru, C. Lebekwe, and A. Yahya, "Autoencoder-based image compression for wireless sensor networks," *Scientific African*, vol. 24, Art. no. e02159, Mar. 2024. [Online]. Available: https://doi.org/10.1016/j.sciaf.2024.e02159
[7] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," *Commun. ACM*, vol. 60, no. 6, pp. 84–90, Jun. 2017, doi: 10.1145/3065386.
[8] J. Du, "Understanding of Object Detection Based on CNN Family and YOLO," *J. Phys.: Conf. Ser.*, vol. 1004, no. 1, p. 012029, 2018, doi: 10.1088/1742-6596/1004/1/012029.
[9] V. Totakura, B. R. Vuribindi, and E. M. Reddy, "Improved Safety of Self-Driving Car using Voice Recognition through CNN," *IOP Conf. Ser.: Mater. Sci. Eng.*, vol. 1022, no. 1, p. 012079, 2021, doi: 10.1088/1757-899X/1022/1/012079.
[10] A. Radford, L. Metz, and S. Chintala, “Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks,” *arXiv*, 2015. [Online]. Available: https://arxiv.org/abs/1511.06434
[11] V. Mnih *et al.*, “Human-level control through deep reinforcement learning,” *Nature*, vol. 518, pp. 529–533, Feb. 2015. doi: 10.1038/nature14236
[12] A. Newell, K. Yang, and J. Deng, “Stacked Hourglass Networks for Human Pose Estimation,” in *Proc. ECCV*, 2016. [Online]. Available: https://arxiv.org/abs/1603.06937