INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
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AY 2023-24
SCHOOL OF COMPUTING
CURRICULUM: IIITUGCSE22

END SEMESTER EXAMINATION
07-DECEMBER-2023
09:00 AM-12:00 PM

Degree	B. Tech.	**Branch**	CSE/IT/ECE
Semester	VII		
Subject Code & Name	CSSE12: Deep Learning		
Time: 180 Minutes	**Answer All Questions**		**Maximum: 100 Marks**

Sl. No.	Question	Mark
1.a	Explain the key differences between a biological neuron and a McCulloch–Pitts unit in terms of structure, function, and information processing. Highlight the strengths and limitations of each model in simulating neural behaviour.	[5]
1.b	Define the concept of linear separability in the context of a linear perceptron. How does the linear perceptron model contribute to solving linearly separable problems, and what are its limitations when faced with non-linearly separable data? Provide examples to illustrate the points.	[5]
1.c	Perform two iterations of the Perceptron Learning Algorithm and show the updated weights after each iteration on the following data: • Training examples: ($x^{(1)} = [1,2]$, $y^{(1)}=1$), ($x^{(2)} = [2,-1]$, $y^{(2)}=-1$) • Initial weights: $W_0=0.2$, $W_1=0.3$, $W_2=0.4$ • Learning rate (η): 0.1	[5]
1.d	If a McCulloch–Pitts unit has two inputs X_1 and X_2 with weights $W_1 = 0.6$ and $W_2 = -0.8$ and a threshold $\theta = 0.5$, compute the weighted sum $\sum_i w_i x_i$ and determine whether the unit will be activated for the input $X_1 = 0.7$ and $X_2 = -0.3$.	[5]

2.a	Define the vanishing gradient problem in the context of deep neural networks. How does this issue affect the training of deep networks, and what are some strategies to mitigate it?	[5]
2.b	Discuss the relationship between empirical risk minimization and overfitting in deep learning models. How does ERM help in finding a balance between fitting the training data and generalizing to new data?	[5]
2.c	Given a simple Multilayer Perceptron with two hidden layers, perform one iteration of gradient descent to update the weights. Use a suitable activation function and a defined loss function.	[5]
2.d	Describe the role of gradient descent in training neural networks. How does backpropagation work, and what is its significance in optimizing the weights of a neural network?	[5]
3.a	Define the saddle point problem in the context of neural networks. How does it affect the training process, and what are the challenges associated with overcoming saddle points? Discuss the role of optimization algorithms in addressing the issues related to saddle points during training.	[5]
3.b	Compare and contrast three regularization methods used in neural networks: dropout, drop connect, and batch normalization. Explain the underlying principles of each technique and how they contribute to improving the generalization performance of a neural network. Provide examples of scenarios where each regularization method might be most beneficial.	[5]
3.c	Compare the architectures of Long Short-Term Memory networks and Gated Recurrent Units. Explain how these architectures address the vanishing gradient problem and facilitate learning long-range dependencies in sequential data.	[5]
3.d	Consider the function: $$f(x) = x^2 - 4x + 4$$ Apply gradient descent with a fixed learning rate to find the minimum of $f(x)$. After three iterations, adjust the learning rate to half of its current value and continue for three more iterations. What is the impact on the convergence?	[5]
4.a	Compare and contrast Deep Boltzmann Machines with RBMs and Variational Autoencoders. Discuss the advantages and challenges of training deep generative models. Explain how the layer-wise unsupervised pre-training approach is utilized in training DBMs.	[5]

4.b	Explain the concept of receptive fields in Convolutional Neural Networks. How do they contribute to feature learning and hierarchical representation in image data? Provide an example to illustrate the concept.	[5]
4.c	The college already has some security measures in place, including access control systems and security personnel. Explain how CNN-based surveillance can be seamlessly integrated with existing security infrastructure. Discuss potential synergies and areas where collaboration can enhance overall security effectiveness.	[5]
4.d	Discuss the feasibility and ethical implications of using GANs to detect deepfake content on a large-scale social media platform. Discuss potential limitations and ways to balance content moderation with user privacy.	[5]
5.a	In what ways can Variational Autoencoders be considered both generative models and tools for unsupervised representation learning? Discuss specific applications in computer vision and natural language processing where VAEs excel and the challenges they may face.	[5]
5.b	Compare and contrast the benefits and challenges of multi-task deep learning in the context of computer vision and natural language processing. How can shared representations across multiple tasks enhance model efficiency, and what considerations should be made when choosing tasks for multi-task learning in diverse applications?	[5]
5.c	In the multi-view deep learning, consider scenarios where data is collected from different modalities. Discuss the potential advantages of leveraging multi-view information in speech recognition applications and the challenges that may arise when integrating data from various sources.	[5]
5.d	Discuss recent trends in deep learning research and their practical applications across vision, NLP, and speech processing. Reflect on the role of transfer learning in these trends and how advancements in one domain may influence developments in others?	[5]