Viva Questions - Laboratory Practice V (LPV)

1. What is the difference between BFS and DFS in terms of traversal and application?
BFS explores level by level using a queue (good for shortest path), while DFS goes deep using a stack (good for path finding).

2. How does OpenMP help in parallelizing BFS and DFS?
OpenMP allows multiple threads to process nodes or neighbors in parallel using directives.

3. What are the advantages of using Parallel Bubble Sort over Sequential Bubble Sort?
Parallel Bubble Sort reduces sorting time by handling multiple comparisons simultaneously.

4. How do you implement performance measurement in parallel algorithms?
By measuring execution time using functions like omp_get_wtime() before and after execution.

5. Explain the concept of Parallel Reduction and how it's applied in finding Min, Max, Sum, and Average.
Parallel reduction splits data among threads to compute parts of result (like sum) and combines them.

6. What is CUDA and how is it different from OpenMP?
CUDA is for GPU-based parallelism; OpenMP is for CPU-based parallelism.

7. Explain the architecture of GPU in context with CUDA programming.
GPU has many cores organized into blocks and threads, optimized for data-parallel tasks.

8. How is matrix multiplication implemented using CUDA?
Each thread computes one element of the output matrix using input rows and columns.

9. What is the use of shared memory in CUDA programming?
Shared memory allows threads in the same block to share data quickly, reducing global memory access.

10. What is the difference between Convolutional Neural Networks and Recurrent Neural Networks?
CNNs process spatial data (images), RNNs process sequential data (text/time series).

11. Describe the process of Linear Regression using a Deep Neural Network.
A DNN predicts a continuous output using layers and a linear activation at the end.

12. How would you train a deep neural network on the Boston Housing Dataset?
Normalize data, define layers, compile with MSE loss, and train using backpropagation.

13. What are the common activation functions used in deep learning?
ReLU, Sigmoid, Tanh, Softmax.

14. What is the purpose of using the ReLU activation function in deep learning?
ReLU adds non-linearity and helps avoid vanishing gradients.

15. How does a Convolution layer work in CNN?
It applies filters to extract features from input images.

16. What is the vanishing gradient problem in deep networks?
It occurs when gradients become too small for deep layers to learn effectively.

17. Describe the role of backpropagation in neural network training.
It updates weights by computing gradients of loss with respect to each weight.

18. Explain time series forecasting using RNN and LSTM.
RNN/LSTM models learn patterns in past data to predict future values.

19. How do you handle overfitting in deep learning models?
Use dropout, early stopping, regularization, or more data.

20. What performance metrics would you use to evaluate classification and regression models?
Accuracy/F1-score for classification; MSE/MAE for regression.

Topic-wise Viva Questions

Parallel BFS and DFS using OpenMP

What is BFS and how is it implemented using OpenMP?
BFS is level-order traversal and OpenMP can parallelize processing of nodes at each level.

What are the key differences between sequential and parallel BFS?
Sequential BFS processes one node at a time, while parallel BFS processes many nodes simultaneously.

What is DFS and how is it parallelized using OpenMP?
DFS is depth-first traversal; parallel DFS explores child branches concurrently using OpenMP tasks.

What are the advantages of using OpenMP in graph traversal algorithms?
It reduces execution time and handles large graphs more efficiently.

How do you avoid race conditions in parallel BFS/DFS using OpenMP?
Use critical sections or atomic operations to safely update shared data.

Parallel Sorting Algorithms

How does Bubble Sort work and what is its time complexity?
It compares and swaps adjacent elements; time complexity is O(n^2).

What changes are required to parallelize Bubble Sort using OpenMP?
Use OpenMP to parallelize even-odd phases of the algorithm.

Explain Merge Sort and how it benefits from parallelization.
Merge Sort divides and merges arrays; parallelization speeds up recursive calls.

What are the performance metrics used to compare parallel vs sequential sorting?
Execution time, speedup, and efficiency.

Parallel Reduction Operations

What is parallel reduction and what are its applications?
It's a method to combine results (like sum) using parallel threads; used in statistics, ML, etc.

Explain how to implement Min, Max, Sum, and Average using OpenMP reduction clause.
Use #pragma omp parallel for reduction(min:max:sum) to aggregate values.

How does the reduction clause in OpenMP help in performance improvement?
It avoids race conditions and uses multiple threads efficiently.

CUDA Programming

What is the role of CUDA in high performance computing?
CUDA enables programs to run massively parallel computations on NVIDIA GPUs.

How is memory allocated and managed in CUDA?
Use cudaMalloc(), cudaMemcpy(), and cudaFree() for device memory management.

How do you launch CUDA kernels for vector addition and matrix multiplication?
Define grid/block dimensions and call kernel <<<blocks, threads>>> with input data.

What are the optimization techniques in CUDA programming?
Use shared memory, minimize memory access, and coalesce memory accesses.

Deep Learning with Neural Networks

Explain the concept of linear regression using a deep neural network.
Use a neural network with linear activation to predict continuous output.

What is the architecture of a deep neural network used for classification?
It has input, multiple hidden layers with activation, and output layer with softmax.

Describe the use of CNN in image recognition tasks.
CNN extracts spatial features to classify or recognize patterns in images.

What is an RNN and how is it used in time-series prediction?
RNN uses memory of past inputs to predict future values in sequences.

General Viva Questions

What are the advantages of parallel computing over sequential computing?
Faster execution, better resource utilization, handles larger problems.

How do you measure the performance of a parallel algorithm?
By speedup, efficiency, and execution time.

What are the common tools to monitor CPU and memory usage in Ubuntu?
Use 'top', 'htop', or 'system monitor'.

Assignment 1: Linear Regression using Deep Neural Network (Boston Housing Dataset)

1. What is linear regression, and how is it implemented using neural networks?
Linear regression predicts a continuous value and in neural networks, it's implemented using layers with linear activation and loss like MSE.

2. Explain the architecture of a deep neural network used for regression tasks.
It consists of an input layer, hidden layers with ReLU, and an output layer with no activation (linear) for continuous prediction.

3. What is the loss function used in regression models?
Mean Squared Error (MSE) is commonly used for regression tasks.

4. Why is the Boston Housing dataset commonly used for regression examples?
It’s simple, small, and has real-world continuous targets for house prices.

5. How do you evaluate the performance of a regression model?
Using metrics like MSE, MAE (Mean Absolute Error), and R^2 (coefficient of determination).

Assignment 2: Classification using Deep Neural Network

6. What is the difference between binary and multiclass classification?
Binary classifies into two categories, while multiclass involves more than two labels.

7. What is one-hot encoding and why is it important?
It converts categorical labels into binary vectors, useful for neural network outputs.

8. How is a deep neural network structured for classification?
It has input, hidden layers with ReLU, and an output layer with softmax (multiclass) or sigmoid (binary).

9. What activation function is commonly used in the output layer for binary classification? What about for multiclass classification?
Sigmoid is used for binary, Softmax for multiclass classification.

10. How do you deal with overfitting in classification problems?
Use dropout, early stopping, regularization, and data augmentation.

Assignment 3: Convolutional Neural Network (CNN)

11. What is the function of convolutional layers in CNN?
They extract spatial features from input images using filters.

12. Explain pooling and its types (max pooling vs average pooling).
Pooling reduces feature map size; max pooling takes max value, average pooling takes average.

13. What are the advantages of using CNNs for image-related tasks?
CNNs learn spatial features and reduce parameters, making them ideal for images.

14. Describe the role of filters/kernels in CNNs.
Filters slide over input and extract features like edges, patterns, or textures.

15. What dataset did you use for training CNN (e.g., Fashion MNIST or Plant Disease dataset)?
Common datasets are Fashion MNIST, CIFAR-10, or specific ones like Plant Disease dataset.

Assignment 4: Recurrent Neural Network (RNN)

16. What are RNNs, and how do they differ from feedforward neural networks?
RNNs have loops to process sequential data, unlike feedforward which only flows one way.

17. What is the vanishing gradient problem in RNNs?
It's when gradients shrink during backpropagation, making learning long dependencies hard.

18. How do RNNs handle sequential data?
They use hidden states that carry past information to next time steps.

19. Explain the application of RNNs in time series analysis.
RNNs predict future values based on past sequences, useful for forecasting.

20. How did you implement prediction using RNN for Google stock prices?
We used past price sequences as input to the RNN and trained it to predict next-day prices.

Mini Project

21. Describe the problem statement and dataset used in your Deep Learning mini project.
We solved a prediction/classification problem using a real-world dataset relevant to the task.

22. What model architecture did you choose and why?
We chose CNN/RNN/DNN based on data type (images, sequences, or tabular).

23. How did you train and evaluate your deep learning model?
We split data into training/testing, used loss/accuracy metrics and plotted learning curves.

24. What challenges did you face during the project?
We faced issues like overfitting, data imbalance, or slow training.

25. What would you improve if you had more time?
We would optimize hyperparameters, try more architectures, or use more data.

General Deep Learning Concepts

26. What is backpropagation?
It's the algorithm to update weights by propagating the error backward.

27. What is the purpose of using dropout in deep learning?
It randomly disables neurons to prevent overfitting during training.

28. Explain the difference between epoch, batch size, and iteration.
Epoch: full dataset pass, Batch size: samples per update, Iteration: one batch update.

29. What optimizer did you use and why (e.g., SGD, Adam)?
Adam is commonly used for faster and adaptive learning.

30. What is the importance of normalization in neural networks?
Normalization speeds up learning and makes training more stable by scaling input data.