Parallel Computing and Deep Learning Viva Preparation

1. Parallel BFS and DFS using OpenMP

Theory:

- BFS (Breadth First Search) explores neighbors level-wise using a queue.
- DFS (Depth First Search) explores as deep as possible using a stack or recursion.
- BFS is easier to parallelize since it processes nodes at the same level concurrently.
- DFS is harder to parallelize due to recursive backtracking.
- OpenMP allows parallel loops and tasks on shared-memory systems.

Viva Questions:

• Q: What is the difference between BFS and DFS?

A: BFS uses a queue and explores level-wise; DFS uses a stack or recursion and explores depth-first.

• Q: Why is BFS easier to parallelize than DFS?

A: Because all nodes at the same level can be processed independently.

• Q: What is OpenMP?

A: OpenMP is an API for parallel programming on shared-memory systems.

• Q: How is BFS parallelized using OpenMP?

A: By parallelizing the loop that processes all neighbors of nodes at the current frontier.

2. Parallel Bubble Sort and Merge Sort using OpenMP

Theory:

- Bubble Sort compares and swaps adjacent elements.
- Merge Sort splits and merges arrays recursively.

- Merge Sort is better suited for parallelism.
- Odd-even transposition helps parallelize Bubble Sort.

Viva Questions:

- Q: Which sorting is better for parallelism?
 - A: Merge Sort.
- Q: What is odd-even transposition sort?
 - A: A parallel variant of Bubble Sort.
- Q: Time complexity of Bubble and Merge Sort?
 - A: Bubble Sort: $O(n^2)$, Merge Sort: $O(n \log n)$.
- Q: Disadvantages of parallel Bubble Sort?
 - A: Inefficiency and high synchronization overhead.

3. Min, Max, Sum, and Average using Parallel Reduction

Theory:

- Reduction combines array values using associative operations.
- OpenMP's reduction clause enables efficient parallel reduction.

Viva Questions:

- Q: What is reduction?
 - A: Combining values using operations like +, min, or max.
- Q: Why use OpenMP reduction clause?
 - A: For efficient, automatic handling of shared data during reduction.

4. CUDA Program for Addition of Two Large Vectors

Theory:

- CUDA is NVIDIA's GPU computing API.
- Each thread adds one element pair from vectors.

Viva Questions:

- Q: What is a CUDA kernel?
 - A: A GPU function executed by many threads.
- Q: What are host and device in CUDA?
 - A: Host = CPU, Device = GPU.
- Q: Why is vector addition suitable for CUDA?
 - A: Each addition is independent and can be parallelized.

5. CUDA Matrix Multiplication

Theory:

• Each thread computes one cell of the output matrix.

Viva Questions:

- Q: Time complexity of matrix multiplication? A: $O(n^3)$.
- Q: How is CUDA used for matrix multiplication? A: Threads independently calculate result cells.

6. Linear Regression using Deep Neural Network (Boston Housing)

Theory:

- Predicts continuous output.
- Final layer uses linear activation.
- Uses Boston Housing dataset.

Viva Questions:

- Q: Difference between regression and classification?

 A: Regression outputs continuous values; classification predicts categories.
- Q: Activation function for regression? A: Linear or none.

7. DNN Classification

Option A: Multiclass (OCR Dataset)

Theory: Uses softmax in final layer to classify letters.

Dataset: https://archive.ics.uci.edu/ml/datasets/letter+recognition

Option B: Binary (IMDB Movie Reviews)
Theory: Uses sigmoid activation to classify sentiment.

Viva Questions:

• Q: What is softmax activation?

A: Converts logits to probability for multiclass classification.

• Q: Dataset used for sentiment classification?

A: IMDB.

• Q: Loss function for binary classification?

A: Binary cross-entropy.

8. Convolutional Neural Networks (CNN)

Option A: Plant Disease Detection Option B: Fashion MNIST Classification Theory:

- CNN uses convolution layers to extract spatial features.
- Pooling layers reduce size.
- ReLU is commonly used for activation.

Viva Questions:

- Q: What is a convolution layer?
 - A: Applies filters to extract features.
- Q: What is pooling?
 - A: Reduces spatial dimensions for efficiency.
- Q: Difference between CNN and DNN?
 - A: CNNs are for image data; DNNs are used for structured/text data.