

## Objective:

Explore and implement vertical and horizontal partitioning of AI models, applying them to a wireless network optimization problem.

---

## Assignment Questions

### Part 1: Theory and Concepts (10 Points)

1. Define **vertical partitioning** and **horizontal partitioning** in the context of AI models.
  2. Compare the advantages and disadvantages of these partitioning methods, focusing on computational efficiency, scalability, and real-world application in wireless networks (you can take any dataset).
- 

### Part 2: Practical Implementation (60 Points)

You are given a pre-trained model for predicting network latency and a dataset with the following attributes:

- **Tower ID**
- **Signal Strength (dBm)**
- **Network Traffic (MB)**
- **Latency (ms)**
- **User Count**
- **Device Type**

#### Tasks:

1. **Vertical Partitioning (30 Points)**
  - o Split the original model into two sub-models:
    - **Model A:** Processes features related to the network (e.g., Signal Strength, Network Traffic).
    - **Model B:** Processes features related to user behavior (e.g., User Count, Device Type).
  - o Combine the outputs of **Model A** and **Model B** to predict network latency.
  - o Compare the performance of the partitioned model to the original monolithic model using metrics like accuracy and latency prediction error.
2. **Horizontal Partitioning (30 Points)**
  - o Divide the dataset into two subsets based on geographic categories:
    - **Subset 1:** Urban cell towers.
    - **Subset 2:** Rural cell towers.
  - o Train separate models for each subset and compare their performance to a single model trained on the entire dataset.
  - o Provide insights into the benefits of horizontal partitioning in this scenario.

---

### Part 3: Industry-Oriented Analysis (30 Points)

1. Based on your partitioning experiments:
    - o Recommend scenarios where vertical partitioning is more effective.
    - o Suggest situations better suited for horizontal partitioning.
  2. Prepare a concise report or presentation for a potential Qualcomm use case:
    - o How can these techniques improve scalability and performance in 5G network optimization?
    - o What challenges might arise in deployment, and how would you address them?
- 

### Submission Guidelines

- Submit your answers as follows:
    - o **Part 1:** A written document with your theoretical answers.
    - o **Part 2:** Python scripts/notebooks for the partitioning experiments in ipnyb format with output cells.
    - o **Part 3:** A detailed report (**in pdf format**) or a slide deck summarizing your analysis and recommendations.
- 

### Evaluation Criteria

- **Conceptual Clarity (20%)**
- **Implementation Accuracy and Code Quality (40%)**
- **Analysis and Insights (30%)**
- **Presentation of Recommendations (10%)**