# Case Study: Product Mix Optimization Problem

**Background**

The ABC Company specializes in custom-building and selling two types of computing workstations for AI and deep-learning projects: **DL1** and **DL2**. These workstations cater to individual researchers, for-profit businesses, and universities over the internet. DL1 is the more affordable, less capable, and less sophisticated workstation, while DL2 is the premium, high-performance model.

Both products require significant time for hardware and software installation, configuration, and quality control before shipping to customers. The company's goal is to determine the **optimal product mix** (number of DL1 and DL2 units to produce) to **maximize its total monthly profit**.

**Problem Details**

1. **Workstation Features:**
   * **DL1** sells for $1,400 per unit with a **profit margin of 25%**.
   * **DL2** sells for $2,375 per unit with a **profit margin of 20%**.
2. **Labor Resources:**
   * The production of both DL1 and DL2 involves three tasks:
     + **Hardware installation**
     + **Software configuration**
     + **Quality control**
   * The time required for each task is detailed in **Table 2.1** below.

|  |  |  |  |
| --- | --- | --- | --- |
| Task | DL1 (hours) | DL2 (hours) | Monthly Total Available Hours |
| Hardware | 5 | 8 | 1,200 |
| Software | 3 | 4 | 800 |
| Quality Control | 2 | 2 | 400 |

1. **Demand Constraints:**
   * To maintain relationships with loyal corporate customers, the company must produce at least:
     + **50 units of DL1**
     + **30 units of DL2**
2. **Objective:**
   * Maximize the company's **total monthly profit** while respecting the resource and demand constraints.

**Student Task**

Students are tasked with developing the **mathematical formulation** of the problem:

1. **Decision Variables:**
   * Number of DL1 workstations to produce.
   * Number of DL2 workstations to produce.
2. **Objective Function:**
   * Express the total profit as a function​, considering the profit margins.
3. **Constraints:**
   * Derive the constraints based on:
     + Labor availability for each task (hardware, software, quality control).
     + Minimum production requirements for DL1 and DL2.
     + Non-negativity constraints for the decision variables.