Optimizing WiFi access points in an office building

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Problem Summary

- The code addresses the problem of optimizing WiFi coverage in a multi-floor office building.
- The goal is to minimize the number of WiFi access points (APs) installed, while ensuring that every desk in the building is within a specified distance threshold for good signal strength.

Problem Description

- Objective:
  - Minimize the number of WiFi access points while ensuring full coverage.
- Constraints:
  - Every desk must be within a certain distance (750 cm) of at least one access point.
  - Access points can only cover desks within this distance threshold.
- Building Specifications:
  - Floors: 7
  - Rows per floor: 20
  - Columns per floor: 7
  - Floor height: 3 meters
  - Row length: 1.5 meters
  - Column width: 2.5 meters

Problem formulation

$$Min \sum_{i \in I} y_i$$

$$s.t. \sum_{i \in I} a_{ij} y_i \geq 1 \forall j \in J$$

$$y_i \in \{0,1\} \forall i \in I$$

Problem formulation - Python

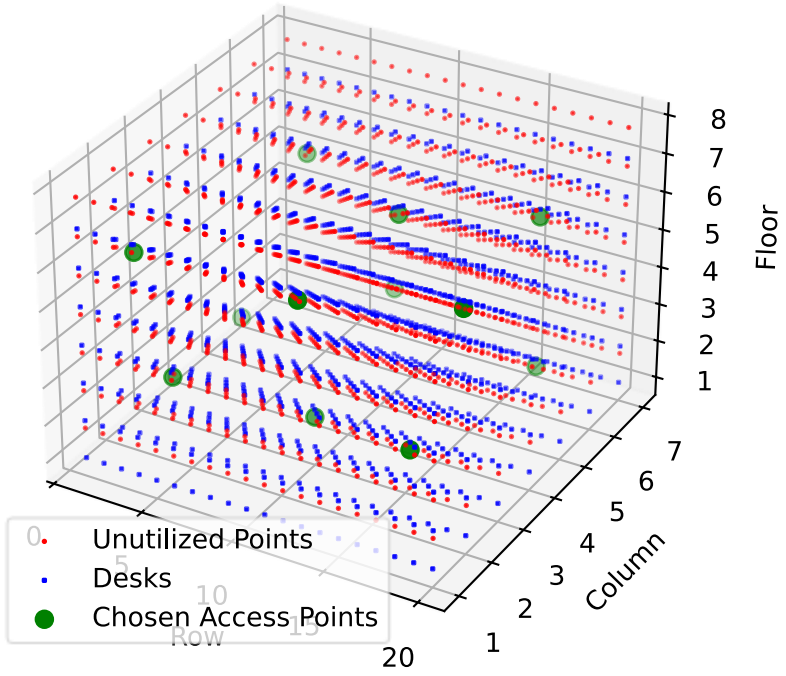
```
plp = pulp.LpProblem("AssignmentProblem", pulp.LpMinimize)

# Declaring variables
y = pulp.LpVariable.dicts("y", (access_points), 0, 1, pulp.LpBinary)
# a = pulp.LpVariable.dicts("a", (access_points, desks), 0, 1, pulp.LpBinary)

# Adding objective function
plp += pulp.lpSum(y[i] for i in access_points)

# Constraints
for j in desks:
plp += pulp.lpSum(a[i][j] * y[i] for i in access_points) >= 1
```

Approach

1. Modeling the Building Layout: Generating the locations of all desks and potential access point positions.
2. Calculating Distances: Computing the Euclidean distance between every desk and every access point.
3. Formulating the Optimization Problem: Defining variables, objective function, and constraints.
4. Solving the Problem: Using PuLP to find the optimal placement of access points.
5. Visualizing the Solution: Plotting the desks and chosen access points in a 3D space.

Result

- From 980 access points, the minimal value to supply the whole building with WiFi, we need to install 12 routers



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Thank you!