# Warehouse storage optimization problems

1. You are given a warehouse to store goods. There are 'n' storage racks which are placed in a cartesian coordinate system. Rack $i$ has a particular item which has a frequency of order $f_i$ and the rack is placed at $X_i = [x_i, y_i]$ where $x_i, y_i \in Z$ (Set of integers). Any two racks should not overlap i.e. $X_i \neq X_j$. Furthermore, the racks are brought to a packaging station with the coordinate $C = [c_x, c_y]$ before sending them out. This station would be somewhere on the boundary of the warehouse. The warehouses are constrained areas bound by walls, this imposes constraints on the minimum and maximum values that $x_i and y_i$ can take. For a general scenario, take $x_{min} \leq x_i \leq x_{max}$ and $y_{min} \leq y_i \leq y_{max}$ for all $i \in [1, n]$. There are robots which move throughout the warehouse (on the cartesian grid only) to pick these racks and bring it to the packing station. How would you find the optimal $X_i$ for each rack s.t the robots take the least time to deliver. General analytical solutions are welcome, however if you can form an optimization problem it would be even better.

**Solution:**

2. Consider the previous question. Apart from all the previous information, you now know that there are patterns when people buy certain products. For example, If a person buys beer, then the person is likely to buy chips. Assume that you have 'Z' unique products and a correlation matrix where this data is captured. How would you solve the same problem? Is the solution same as the previous or different?

**Solution:**

3. For the final part, there might be 'm' packaging stations at different locations given by $C_1, C_2, ...C_m$. How would you formulate the problem?

**Solution:**