Objective:
The objective of this project is to make a pathfinding algorithm for the spot robot from Boston dynamics on any given building - given some preconditions of the building are met. The program should be able to get as input CAD data for a one level floor-plan of a building and should from that, output the path that the robot should traverse. The path should take into consideration the dimensions of the robot, such that it does not walk into walls or such that the planned path is not too narrow for the robot.

The path should be in the form of a loop, such that the start and end destinations of the path are the same - such that the robot can be put into the charger the following morning.

The path should furthermore try to optimise for photo area coverage using a heuristic approach.

How will this be done?
It makes sense to split this objective into 3 distinct problem definitions:

1. **Making a graph - which we will denote “grid”- graph - from the input data.**

From the CAD input we will sample nodes with a given resolution resulting in a discretized floor plan, denoted “grid”-graph. The walls of the floor plan will also be included for visual purposes. The graph is processed in such a way that the robot will always be able to traverse between two nodes in the floor plan if the nodes are connected; either directly or through intermediary nodes.

2. **Making a subgraph - which we will denote “photo-location”-graph - from the “grid”-graph.**

The essential nodes that the robot must visit - such as to cover as much photo area as possible - will be generated, denoted as “photo location” nodes. Guaranteeing that the nodes generated will lead to optimal photo area coverage for the robot is a difficult problem to solve. In this project one heuristic will be used, but it is possible to use another heuristic if a better one is found.

A subgraph of the “grid”-graph will be generated where only the “photo-location” nodes are included, denoted “photo-location”- graph.

An optimal graph traversal algorithm (e.g A*) will be used to find the shortest distance between each node in this subgraph. An important property of this subgraph will be that it is fully connected; this means that all room nodes are connected to each other.

3. **Making a path that traverses through all “photo-location” nodes in the “grid” graph.** We will find an approximate solution to the traveling salesman problem on the “photo-location” graph. This solution will be used to generate a path on the “grid”-graph where each “photo-location” node is visited at least once.