1 Exercise Objects 1

An enterprise of logistics has contacted us. In order to get good information for buying robots for pick and place, they want to simulate two kind robots for being able to understand which kind is the best for specific deliveries .

Our robots will be working on a matrix based map of variable dimensions (As shown in the example Matrix). In this matrix we can find three values:

- free space (0)
- occupied (100)
- unknown (-1).

$$\begin{bmatrix}
100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 & -1 & -1 & -1 & -1 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 & -1 & -1 & -1 & -1 \\
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100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 & 100 & 100 & 0 & 0 & 0 & 100 & 0 & 0 & 100 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 & 0 & 0 & 0 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \\
100 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 100 \\
100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100 & 100
\end{bmatrix}$$

There are two main attributes that the company is wanting to compare:

- Speed
- Energy consumption

The enterprise is comparing now the following two kinds of robots:

- Holonomic drive
- Differential drive

Holonomic drive robot

1. Can move in any direction without changing it orientation.
2. It always favors diagonal movement if it is possible.
3. It must face the item before pick it
4. it takes 2 seconds in giving a complete turn (0,5 second on giving a quarter turn).
5. It moves two speeds
   - (5 / (weight of the item)) meters/second on straight movement
   - (2 / (weight of the item)) meters/second on diagonal movement
6. It has a consumption of
   - 0.1 * (weight of the item) of battery on straight movement
   - 0.25 * (weight of the item) of battery on diagonal movement
   - 0.5 * (weight of the item) of battery when it turns

Differential drive robot

1. It can move only forward. It is pushed to turn to change direction.
2. It always favors non diagonal movements.
3. It must face the item before pick it
4. it takes 1 seconds in giving a complete turn (0,25 second on giving a quarter turn).
5. It moves two speeds
   - 3 meters/second on straight movement
6. It has a consumption of
   - 0.2 * (weight of the item) of battery on straight movement
   - 0.1 * (weight of the item) of battery when it turns

The exercise is about implementing for classes #HolonomicRobot and #DifferentialRobot the following methods

```
>>doOneStepTowards: aPoint.
 does one step towards the item position (knowing that we cannot pass by any point with the value 100), accord
>>hasArrivedTo: aPoint
returns true if the robot is at on point of distance of the item. If not returns false.
>>faceTo: aPoint.
 it turns to the item if it must, accounting the described energy and time consumption.
>>pick: anItem
it updates the load of the robot.
>>place: anItem
it updates the load of the robot.
```

For simplifying the model, we propose to model the pose of a robot as { x, y, { #North — #South — #West — #East } }

We want as well to know, for the given map grid, Considering the first element to be the center of coordinates (1@1) and that each point represents a squared meter.

1. How much energy and time spends a HolonomicRobot that is originally at (2@17) to pick an item at (14@14) and place it at (2@2) .
2. How much energy and time spends a DifferentialRobot that is originally at (2@17) to pick an item at (14@14) and place it at (2@2) .