Review:

LIDAR: LIght Detection And Ranging, LIDAR produces a list of directions, relative bearings with accompanying distances to the obstacle(s) that the light bounced off of

ϕ : Greek letter, refers to the relative bearings from the LIDAR

Polar Coordinates: consist of an angle and a range

Robots keep track of position of obstacles on a map

Each cell on the map is either free, an obstacle, or unknown. Some cells we haven't seen yet, others we have a reflection from, and yet others had the sensor beam travel through them without detecting anything.

Since the sensors have some error, we track the probability that each cell is occupied instead of just the binary option of free or occupied.

We use **conditional probability** to keep track of this. We want the probability of their being an obstacle given that there was or was not a return from that cell.

$$p(obstacle|return)$$

However, what we typically have from our sensor specifications is the probability of getting a return if the cell has an obstacle (true positive rate) and the probability of getting a return when the cell is clear (false positive rate).

$$p(return|obstacle) \text{ or } p(return|clear)$$

Since we either get a return or we don't, we know that the probability of not getting a return is one minus the probability of getting a return for each case.

$$p(return|obstacle) = 1 - p(no\ return|obstacle)$$

We can also calculate the probability of getting a return from both cases by taking the probability of each event multiplied by the probability of that event happening.

$$p(return) = p(obstacle) \cdot p(return|obstacle) + p(clear) \cdot p(return|clear)$$

This leads us to **Bayes' Theorem**:

$$p(cell_{new}) = \frac{p(obstacle) \cdot p(cell_{old})}{p(return)}$$

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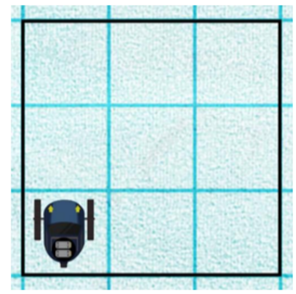
Challenge Questions:

Start with a 3m by 3m grid with 1m cells as shown. The robot is in the center of the bottom left cell. Initially the map has a value of 50% for all cells. Use:

$p(return|obstacle)$ = 80% and $p(return|clear)$ = 10%



The robot gets a lidar return from the bottom right cell – Which cells will have a change in value?

What are the updated values for each cell?

If the robot gets a second return from the bottom right cell, what are the updated values?

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