

Program 2

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Modules

Transitional Probability

Transitional Probability(Pos_i, Dir) =
($Pos_{from\ left} : Drift(Left), Pos_{from\ straight} : Drift(Straight), Pos_{from\ right} : Drift(Right)$) : (For smoothing)

Transitional Probability(Pos_i, Dir) =
($Pos_{from\ left} : Drift(Left), Pos_{from\ straight} : Drift(Straight), Pos_{from\ right} : Drift(Right), Pos_{from\ behind} : Drift(Straight)$) : (For prediction)

Left, *Right*, and *Straight* are all positions defined in relation to what *Dir* is: if *Dir* is EAST, then *Left* is SOUTH, *Right* is NORTH, and *Straight* is EAST.

Here, transitional probability has two forms: one which is all paths that converge to a point, and another where they diverge from a point. Prediction (as the name implies) wants all the possible paths to a point, which is why we include *Pos_{from behind}*. Smoothing however, does not require that, which is why it's not included.

Prediction

$$Prediction(Grid, Direction) = \left\{ pos_i \in Grid \mid \sum_{(Pos_j, DriftProb)}^{Transition\ Probability(pos_i, direction)} DriftProb \cdot P(Pos_j) \right\}$$

Prediction(*Grid*, *Direction*) (as the name implies) attempts to predict where the agent will be given previous information. It does this by transform-

ing the grid by the expression $\sum_{(Pos_j, DriftProb)}^{Transition\ Probability(pos_i, direction)} DriftProb \cdot P(Pos_j)$. This gets the probability of an agent drifting (or if direction is straight, accurately going to) a point, and what is the probability the agent would be at the point Pos_j .

Evidence Conditional Probability

$$Evidence\ Conditional\ Probability(Pos_i, Evidence) = \prod_{dir=W}^{Directions} Sense(evidence[pos_i dir], actual[pos_i + dir])$$

This is the equation we use to get the evidence conditional probability: it's the product of each the evidence's value at a direction times what's actually in the value of the direction. So if *Left* has opened, but evidence says it's closed, it's 0.2. Taking the product of all direction's sensed value and actual value, it will result in the Evidence Conditional Probability at Pos_i given *Evidence*

Filtering

$$Filtering(Grid, Evidence) = \{pos_i \in Grid \mid \frac{P(pos_i) \cdot Evidence\ Conditional\ Probability(pos_i, Evidence)}{\sum_{pos}^{all\ positions} P(pos_i) \cdot Evidence\ Conditional\ Probability(pos_i, evidence)}\}$$

Filtering is a transformation upon the grid: each value gets transformed by the expression $\frac{P(pos_i) \cdot Evidence\ Conditional\ Probability(pos_i, Evidence)}{\sum_{pos}^{all\ positions} P(pos_i) \cdot Evidence\ Conditional\ Probability(pos_i, evidence)}$, which for purposes of making it easier to talk about, will be expressed as $Filter\ Step(pos_i, Evidence)$. *Filter Step* is conditional probability of each point times what the point was previously, and then dividing it by the sum of all points on the grid. This operation is $O(n)$, although more accurately it's $O(2n)$ because there's a minimum of iterating through each value twice.

Results

The code outputs the following:

```
julia SUBMIT.jl
```

Initial Location Probabilities

```
4.17 4.17 4.17 4.17 4.17
4.17 ##### 4.17 4.17
4.17 ##### 4.17 4.17
4.17 ##### 4.17 4.17
4.17 ##### 4.17 4.17
```

4.17 4.17 4.17 4.17 4.17

Filtering after Evidence [0, 0, 0, 0]

1.62 1.62 1.62 5.2 1.62
1.62 ##### 5.2 5.2
1.62 ##### 0.51 16.63 5.2
1.62 ##### 5.2 5.2
1.62 ##### 1.62 16.63 5.2
1.62 1.62 5.2 5.2 1.62

Prediction after Action W

2.76 1.62 4.12 2.7 1.02
1.62 ##### 10.55 1.02
1.62 ##### 12.15 5.2 1.56
1.62 ##### 12.26 1.56
1.62 ##### 13.8 5.2 1.02
2.76 4.12 4.66 4.41 1.02

Filtering after Evidence [1, 1, 0, 1]

3.23 1.9 4.82 0.84 0.1
0.16 ##### 3.29 0.03
0.16 ##### 53.26 0.43 0.04
0.16 ##### 3.82 0.04
0.16 ##### 16.13 0.43 0.03
3.23 4.82 1.45 1.38 0.1

Prediction after Action N

3.14 2.54 3.79 3.63 0.23
0.16 ##### 0.8 0.53
0.16 ##### 45.33 10.67 0.1
0.16 ##### 0.88 0.6
2.31 ##### 14.8 3.39 0.14
1.21 4.08 0.93 0.23 0.22

Filtering after Evidence [1, 1, 0, 1]

1.55 1.25 1.87 0.48 0.01
0.01 ##### 0.11 0.01
0.01 ##### 83.92 0.37 0.0
0.01 ##### 0.12 0.01
0.09 ##### 7.3 0.12 0.0

0.6 2.01 0.12 0.03 0.01

Last position Smoothing with Evidence [1, 1, 0, 1] and north

1.59 0.94 2.12 0.14 0.01
0.06 ##### 0.37 0.0
0.01 ##### 84.08 0.16 0.0
0.01 ##### 0.18 0.0
0.01 ##### 6.85 0.07 0.0
0.57 2.12 0.64 0.07 0.0

Second Last position smoothing with Evidence [1, 1, 0, 1] And west

0.81 0.94 0.91 1.94 0.06
0.18 ##### 0.19 0.13
0.01 ##### 3.51 80.69 0.11
0.01 ##### 0.09 0.05
0.06 ##### 0.72 5.86 0.05
0.29 0.49 2.36 0.52 0.02

Screenshots

```
Initial Location Probabilities
4.17 4.17 4.17 4.17 4.17
4.17 ##### 4.17 4.17
4.17 ##### 4.17 4.17 4.17
4.17 ##### 4.17 4.17
4.17 ##### 4.17 4.17 4.17
4.17 4.17 4.17 4.17 4.17

Filtering after Evidence [0, 0, 0, 0]
1.62 1.62 1.62 5.2 1.62
1.62 ##### 5.2 5.2
1.62 ##### 0.51 16.63 5.2
1.62 ##### 5.2 5.2
1.62 ##### 1.62 16.63 5.2
1.62 ##### 5.2 5.2 1.62
1.62 1.62 5.2 5.2 1.62

Prediction after Action N
0.76 1.52 4.12 2.7 1.82
1.62 ##### 18.55 1.82
1.62 ##### 12.25 1.56
1.62 ##### 12.25 1.56
1.62 ##### 12.2 1.82
2.76 4.12 4.66 4.41 1.82

Filtering after Evidence [1, 1, 0, 1]
1.23 1.9 4.82 0.56 0.1
0.16 ##### 1.29 0.81
0.16 ##### 17.26 0.43 0.86
0.16 ##### 1.82 0.86
0.16 ##### 18.13 0.43 0.81
1.23 4.82 1.41 1.38 0.1

Prediction after Action N
1.14 2.56 3.79 2.63 0.23
0.16 ##### 0.8 0.33
0.16 ##### 45.23 18.67 0.1
0.16 ##### 0.86 0.5
2.31 ##### 14.2 3.29 0.14
1.12 4.06 0.93 0.23 0.22

Filtering after Evidence [1, 1, 0, 1]
1.55 1.25 1.87 0.48 0.61
0.01 ##### 0.11 0.82
0.01 ##### 81.52 0.17 0.8
0.01 ##### 0.12 0.82
0.99 ##### 7.1 0.12 0.8
0.6 2.01 0.12 0.03 0.01

Last position Smoothing with Evidence [1, 1, 0, 1] and north
1.59 0.94 2.12 0.14 0.01
0.06 ##### 0.37 0.0
0.01 ##### 84.08 0.16 0.0
0.01 ##### 0.18 0.0
0.01 ##### 6.85 0.07 0.0
0.57 2.12 0.64 0.07 0.0

[0] 0.0149686 1.241 The Road 2-Maze Atkaidor- "zab@kronos" 13:51 11-May-20
```

```

1.62 1.62 5.62 5.2 5.62
1.62 ##### 5.2 5.2
1.62 ##### 0.25 18.63 5.2
1.62 ##### 5.2 5.2
1.62 ##### 6.82 18.63 5.2
1.62 1.62 5.2 5.2 1.62

Prediction after Action W
2.76 1.62 4.12 2.7 1.82
1.62 ##### 18.35 1.82
1.62 ##### 12.15 5.2 1.56
1.62 ##### 12.26 1.56
1.62 ##### 13.8 5.2 1.82
2.76 4.12 4.66 4.43 1.82

Filtering after Evidence [1, 1, 0, 1]
3.23 1.9 4.82 0.84 0.1
0.16 ##### 0.25 0.83
0.16 ##### 53.26 0.43 0.84
0.16 ##### 0.82 0.84
0.16 ##### 16.33 0.43 0.83
3.23 4.82 1.45 1.38 0.1

Prediction after Action W
1.14 2.55 1.79 0.83 0.23
0.16 ##### 0.8 0.33
0.16 ##### 55.33 18.27 0.1
0.16 ##### 0.88 0.6
1.13 ##### 16.8 3.39 0.14
1.21 4.88 0.93 0.23 0.22

Filtering after Evidence [1, 1, 0, 1]
1.55 1.25 1.87 0.44 0.82
0.01 ##### 0.11 0.83
0.01 ##### 82.82 0.37 0.8
0.01 ##### 0.32 0.81
0.09 ##### 7.3 0.12 0.8
0.8 7.81 0.32 0.83 0.81

Last position Smoothing with Evidence [1, 1, 0, 1] and north
1.59 0.94 2.12 0.14 0.83
0.86 ##### 0.27 0.8
0.01 ##### 84.08 0.15 0.8
0.82 ##### 0.23 0.8
0.91 ##### 6.85 0.87 0.8
0.57 2.12 0.44 0.87 0.8

Second Last position smoothing with Evidence [1, 1, 0, 1] And west
0.81 0.94 0.95 1.94 0.86
0.16 ##### 0.19 0.13
0.01 ##### 1.55 88.99 0.13
0.01 ##### 0.89 0.83
0.86 ##### 8.72 3.86 0.83
0.78 0.49 2.36 0.52 0.82
[END]
[AI] @rakabanda 1:Zaki the Aband 2:Muaz Alhaidar-
"Zaki@Kasemo" 13:53 11-Nov-20

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Who did what

Zakariya

- Transitional probability/prediction

Muaz

- Conditional Evidence probability, filtering and smoothing.