Fuzzy Controller Report

Inputs: We are given 2 inputs.
- Starting position of the robot.
- Position of the goal.

Outputs: We give the system 2 outputs.
- An angle: which rotates the direction of the robot's movement by that angle.
- A speed: which changes the robot's current speed by the speed given.

Constraints:
- The robot's angle of movement and speed can only be updated every 100ms.
- The robot's angle of movement and speed when updated is changed instantaneously.
- For the robot to succeed its speed must be 0 when at the destination.
- The robot starts facing 0 degrees (due east), and its velocity starts at 0.

My defined specifications:
- Since we are controlling a robot, it can't be infinitely small like a point is so I will give it size and the shape of a circle (just like a Roomba chasing a speck of dust). Its exact size is 5 meters in radius.
- Robot's mass: 1 kg.
- The goal is just a point (maybe a speck of dust).
- The angle the robot is currently facing (in radians).

Physics equations for the robot's movement:
- The project states that "change in θ and speed happen instantaneously", which is impossible to be described by physics. If we assume the robot accelerates over the course of the 100ms interval we can calculate the force applied to the robot:

Force applied onto robot =

Mass * Acceleration =

1 * The change in velocity =

sqrt(x change in velocity^2 + y change in velocity^2) =

   Let's denote previous speed by: v1

   Let's denote the new speed by: v2
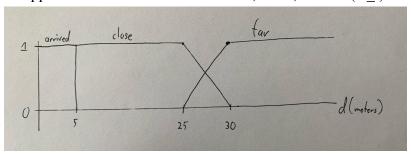
   Let's denote difference in angle by: θ

sqrt((v1 - v2*cos(θ))^2 + (v2*sin(θ))^2) = | simplified too

sqrt(v1^2 + 2*v1*v2*cos(θ) + v2^2) | equation used to find force applied to robot
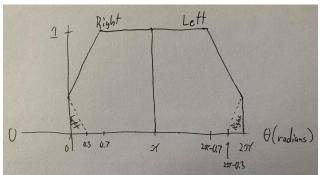
Fuzzifier design:

With my inputs, I convert the current position and end location into a vector of distance to the goal, and an angle from the direction the robot is facing to the direction of the goal. I call these distance, and theta respectively.

I mapped distance to 3 choices: arrived, close, and far (D_i):
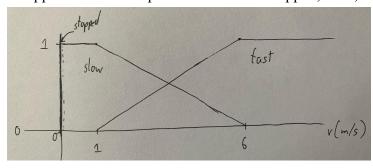

Arrived is set up in this manner because when we have arrived at the goal when we are within 5 meters of it.

I mapped the theta to 2 choices: left and right(R_i):

I mapped the current speed to 3 choices: stopped, slow, fast (V_i):

The polts above model the fuzzification of the data, converting the speed, theta, and distance to goal into fuzzy values.

Design of my fuzzy inference engine

FIE Matrix for updating speed (D_i by V_i):

$$V\_i$$

D_i		stopped	slow	fast
	arrived	Stop | W1	Stop | W4	Stop | W7
	close	Increase | W2	Maintain | W5	Decrease | W8
	far	Increase | W3	Increase | W6	Maintain | W9

Rule Set of updating speed FIE:

$W1 = \min[\mu\_arrived(d), \mu\_stopped(v)]$
$W2 = \min[\mu\_close(d), \mu\_stopped(v)]$
$W3 = \min[\mu\_far(d), \mu\_stopped(v)]$
$W4 = \min[\mu\_arrived(d), \mu\_slow(v)]$
$W5 = \min[\mu\_close(d), \mu\_slow(v)]$
$W6 = \min[\mu\_far(d), \mu\_slow(v)]$
$W7 = \min[\mu\_arrived(d), \mu\_fast(v)]$
$W8 = \min[\mu\_close(d), \mu\_fast(v)]$
$W9 = \min[\mu\_far(d), \mu\_fast(v)]$

Explanation of the rules for updating speed:
- When we have arrived at the goal, we stop, because the robot has successfully reached the goal.
- When we are not at the goal we want to have the robot speed up (Increase) when the robot is not moving, because if we are not moving we won't ever reach the goal.
- When the robot is going slow and is far from the goal, we want the robot to reach the goal sooner so we tell it to (Increase).
- When the robot is going fast, and the goal is close, we want the robot to slow down (Decrease), so it can accurately rotate to find the goal.
- When the robot is slow when the goal is close, or fast when the goal is far, it is going at the appropriate speed so we tell it to (Maintain).

FIE Array for updating facing angle:

$$R\_i$$

Left		Right	
Left		W1	Right		W2

Rule Set for setting up angle FIE:

If the goal is to the left of the direction the robot is facing, then turn left.
If the goal is to the right of the direction the robot is facing, then turn right.

Creation of the defuzzifier:

Speed Control Options:
- Increase = 2
- Maintain = 0
- Decrease = -1
- Stop = negative of current speed

Speed Control Element:

The acceleration of the robot is equal to the sum of each weight * it's corresponding Speed Control Option, divided by the sum of the weights:

$$Accel =$$
$$\frac{W1*Stop+W2*Inc+W3*Inc+W4*Stop+W5*Maint+W6*Inc+W7*Stop+W8*Dec+W9*Maint}{W1+W2+W3+W4+W5+W6+W7+W8+W9}$$

New speed = speed + Accel

Rotation Control Options:
- Left = 0.1
- Right = -0.1

Rotation Control Element:

The rotation of the robot is equal to the sum of each weight * its corresponding Rotation Control Option, divided by the sum of the weights.

$$Rotation = (W1*left + W2*right)/(W1 + W2)$$

New facing angle of the robot = Current facing angle of the robot + Rotation

Results of the system:

At each timestamp of 100ms, the following is outputted:
- Weights of each of the membership functions at that given time
- New angular velocity
- New forward force

Example #1. The robot starts at (0, 0) and its goal is (4, 5):

The purpose of this example is to show that in a simple case the robot can reach its goal.

```
At 000 ms: (0.0000, 0.0000) Speed = 0.0000 m/s, Angle = 0.0000 radians and forward force: 0 N
At 100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=1.00, Slow=0.00, Fast=0.00, Left:0.60, Right:0.00
(0.1990, 0.0200) New Speed = 2.0000 m/s, Angle = 0.1000 radians and New Forward Force = 20.0000 N
At 200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.80, Fast=0.20, Left:0.52, Right:0.00
(0.3754, 0.0557) New Speed = 1.8000 m/s, Angle = 0.2000 radians and New Forward Force = 2.7563 N
At 300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.84, Fast=0.16, Left:0.44, Right:0.00
(0.5321, 0.1042) New Speed = 1.6400 m/s, Angle = 0.3000 radians and New Forward Force = 2.3472 N
At 400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.87, Fast=0.13, Left:0.35, Right:0.00
(0.6714, 0.1631) New Speed = 1.5120 m/s, Angle = 0.4000 radians and New Forward Force = 2.0288 N
At 500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.90, Fast=0.10, Left:0.27, Right:0.00
(0.7951, 0.2307) New Speed = 1.4096 m/s, Angle = 0.5000 radians and New Forward Force = 1.7827 N
At 600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.92, Fast=0.08, Left:0.18, Right:0.00
(0.9046, 0.3056) New Speed = 1.3277 m/s, Angle = 0.6000 radians and New Forward Force = 1.5941 N
At 700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.93, Fast=0.07, Left:0.09, Right:0.00
(1.0012, 0.3869) New Speed = 1.2621 m/s, Angle = 0.7000 radians and New Forward Force = 1.4505 N
At 800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.95, Fast=0.05, Left:0.00, Right:0.01
(1.1010, 0.4552) New Speed = 1.2097 m/s, Angle = 0.6000 radians and New Forward Force = 1.3418 N
At 900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.96, Fast=0.04, Left:0.10, Right:0.00
(1.1903, 0.5305) New Speed = 1.1678 m/s, Angle = 0.7000 radians and New Forward Force = 1.2599 N
At 1000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.97, Fast=0.03, Left:0.01, Right:0.00
(1.2693, 0.6118) New Speed = 1.1342 m/s, Angle = 0.8000 radians and New Forward Force = 1.1983 N
At 1100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.97, Fast=0.03, Left:0.00, Right:0.09
(1.3540, 0.6832) New Speed = 1.1074 m/s, Angle = 0.7000 radians and New Forward Force = 1.1520 N
At 1200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:0.02, Right:0.00
(1.4297, 0.7611) New Speed = 1.0859 m/s, Angle = 0.8000 radians and New Forward Force = 1.1170 N
At 1300 ms: Weight of membership functions: Arrived=1.00, Close=0.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:0.00, Right:0.07
(1.4297, 0.7611) New Speed = -0.0000 m/s, Angle = 0.7000 radians and New Forward Force: 10.8590 N
Within 5ft of the goal (4, 5)
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Example #2. The robot starts at (6, 0) and its goal is (0, 0):

The Purpose behind this example is to show that the robot can successfully turn around to reach its goal if need be.

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At 000 ms: (6.0000, 0.0000) Speed = 0.0000 m/s, Angle = 0.0000 radians and forward force: 0 N
At 100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=1.00, Slow=0.00, Fast=0.00, Left:1.00, Right:0.00
(6.1990, 0.0200) New Speed = 2.0000 m/s, Angle = 0.1000 radians and New Forward Force = 20.0000 N
At 200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.80, Fast=0.20, Left:1.00, Right:0.00
(6.3754, 0.0557) New Speed = 1.8000 m/s, Angle = 0.2000 radians and New Forward Force = 2.7563 N
At 300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.84, Fast=0.16, Left:1.00, Right:0.00
(6.5321, 0.1042) New Speed = 1.6400 m/s, Angle = 0.3000 radians and New Forward Force = 2.3472 N
At 400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.87, Fast=0.13, Left:1.00, Right:0.00
(6.6714, 0.1631) New Speed = 1.5120 m/s, Angle = 0.4000 radians and New Forward Force = 2.0288 N
At 500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.90, Fast=0.10, Left:1.00, Right:0.00
(6.7951, 0.2307) New Speed = 1.4096 m/s, Angle = 0.5000 radians and New Forward Force = 1.7827 N
At 600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.92, Fast=0.08, Left:1.00, Right:0.00
(6.9046, 0.3056) New Speed = 1.3277 m/s, Angle = 0.6000 radians and New Forward Force = 1.5941 N
At 700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.93, Fast=0.07, Left:1.00, Right:0.00
(7.0012, 0.3869) New Speed = 1.2621 m/s, Angle = 0.7000 radians and New Forward Force = 1.4505 N
At 800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.95, Fast=0.05, Left:1.00, Right:0.00
(7.0855, 0.4737) New Speed = 1.2097 m/s, Angle = 0.8000 radians and New Forward Force = 1.3418 N
At 900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.96, Fast=0.04, Left:1.00, Right:0.00
(7.1580, 0.5652) New Speed = 1.1678 m/s, Angle = 0.9000 radians and New Forward Force = 1.2599 N
At 1000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.97, Fast=0.03, Left:1.00, Right:0.00
(7.2193, 0.6606) New Speed = 1.1342 m/s, Angle = 1.0000 radians and New Forward Force = 1.1983 N
At 1100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.97, Fast=0.03, Left:1.00, Right:0.00
(7.2696, 0.7593) New Speed = 1.1074 m/s, Angle = 1.1000 radians and New Forward Force = 1.1520 N
At 1200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:1.00, Right:0.00
(7.3089, 0.8605) New Speed = 1.0859 m/s, Angle = 1.2000 radians and New Forward Force = 1.1170 N
At 1300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:1.00, Right:0.00
(7.3375, 0.9635) New Speed = 1.0687 m/s, Angle = 1.3000 radians and New Forward Force = 1.0904 N
At 1400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:1.00, Right:0.00
(7.3554, 1.0675) New Speed = 1.0550 m/s, Angle = 1.4000 radians and New Forward Force = 1.0702 N
At 1500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:1.00, Right:0.00
(7.3628, 1.1716) New Speed = 1.0440 m/s, Angle = 1.5000 radians and New Forward Force = 1.0548 N
At 1600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:1.00, Right:0.00
(7.3598, 1.2751) New Speed = 1.0352 m/s, Angle = 1.6000 radians and New Forward Force = 1.0429 N
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At 1700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:1.00, Right:0.00
(7.3465, 1.3770) New Speed = 1.0281 m/s, Angle = 1.7000 radians and New Forward Force: 1.0336 N
At 1800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:1.00, Right:0.00
(7.3233, 1.4766) New Speed = 1.0225 m/s, Angle = 1.8000 radians and New Forward Force: 1.0264 N
At 1900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:1.00, Right:0.00
(7.2904, 1.5729) New Speed = 1.0180 m/s, Angle = 1.9000 radians and New Forward Force: 1.0208 N
At 2000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:1.00, Right:0.00
(7.2482, 1.6652) New Speed = 1.0144 m/s, Angle = 2.0000 radians and New Forward Force: 1.0164 N
At 2100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:1.00, Right:0.00
(7.1971, 1.7525) New Speed = 1.0115 m/s, Angle = 2.1000 radians and New Forward Force: 1.0130 N
At 2200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.98, Right:0.00
(7.1377, 1.8341) New Speed = 1.0092 m/s, Angle = 2.2000 radians and New Forward Force: 1.0102 N
At 2300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.89, Right:0.00
(7.0706, 1.9092) New Speed = 1.0074 m/s, Angle = 2.3000 radians and New Forward Force: 1.0080 N
At 2400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.81, Right:0.00
(6.9964, 1.9772) New Speed = 1.0059 m/s, Angle = 2.4000 radians and New Forward Force: 1.0063 N
At 2500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.72, Right:0.00
(6.9159, 2.0373) New Speed = 1.0047 m/s, Angle = 2.5000 radians and New Forward Force: 1.0050 N
At 2600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.63, Right:0.00
(6.8299, 2.0890) New Speed = 1.0038 m/s, Angle = 2.6000 radians and New Forward Force: 1.0039 N
At 2700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.54, Right:0.00
(6.7392, 2.1319) New Speed = 1.0030 m/s, Angle = 2.7000 radians and New Forward Force: 1.0030 N
At 2800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.45, Right:0.00
(6.6448, 2.1655) New Speed = 1.0024 m/s, Angle = 2.8000 radians and New Forward Force: 1.0023 N
At 2900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.36, Right:0.00
(6.5475, 2.1895) New Speed = 1.0019 m/s, Angle = 2.9000 radians and New Forward Force: 1.0018 N
At 3000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.26, Right:0.00
(6.4484, 2.2036) New Speed = 1.0015 m/s, Angle = 3.0000 radians and New Forward Force: 1.0013 N
At 3100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.17, Right:0.00
(6.3483, 2.2078) New Speed = 1.0012 m/s, Angle = 3.1000 radians and New Forward Force: 1.0010 N
At 3200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.08, Right:0.00
(6.2484, 2.2019) New Speed = 1.0010 m/s, Angle = 3.2000 radians and New Forward Force: 1.0007 N
At 3300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.02
(6.1484, 2.2061) New Speed = 1.0008 m/s, Angle = 3.1000 radians and New Forward Force: 1.0005 N
At 3400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.09, Right:0.00
(6.0485, 2.2002) New Speed = 1.0006 m/s, Angle = 3.2000 radians and New Forward Force: 1.0003 N
At 3500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.01
(5.9485, 2.2044) New Speed = 1.0005 m/s, Angle = 3.1000 radians and New Forward Force: 1.0002 N
At 3600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.10, Right:0.00
(5.8487, 2.1985) New Speed = 1.0004 m/s, Angle = 3.2000 radians and New Forward Force: 1.0000 N
At 3700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.00
(5.7499, 2.1828) New Speed = 1.0003 m/s, Angle = 3.3000 radians and New Forward Force: 0.9999 N
At 3800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.10
(5.6500, 2.1769) New Speed = 1.0003 m/s, Angle = 3.2000 radians and New Forward Force: 0.9999 N
At 3900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.01, Right:0.00
(5.5513, 2.1612) New Speed = 1.0002 m/s, Angle = 3.3000 radians and New Forward Force: 0.9998 N
At 4000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.09
(5.4514, 2.1553) New Speed = 1.0002 m/s, Angle = 3.2000 radians and New Forward Force: 0.9998 N
At 4100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.02, Right:0.00
(5.3527, 2.1395) New Speed = 1.0001 m/s, Angle = 3.3000 radians and New Forward Force: 0.9997 N
At 4200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.08
(5.2528, 2.1337) New Speed = 1.0001 m/s, Angle = 3.2000 radians and New Forward Force: 0.9997 N
At 4300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.03, Right:0.00
(5.1541, 2.1179) New Speed = 1.0001 m/s, Angle = 3.3000 radians and New Forward Force: 0.9997 N
At 4400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.07
(5.0542, 2.1121) New Speed = 1.0001 m/s, Angle = 3.2000 radians and New Forward Force: 0.9997 N
At 4500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.04, Right:0.00
(4.9555, 2.0963) New Speed = 1.0001 m/s, Angle = 3.3000 radians and New Forward Force: 0.9996 N
At 4600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.06
(4.8556, 2.0905) New Speed = 1.0000 m/s, Angle = 3.2000 radians and New Forward Force: 0.9996 N
At 4700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.05, Right:0.00
(4.7569, 2.0747) New Speed = 1.0000 m/s, Angle = 3.3000 radians and New Forward Force: 0.9996 N
At 4800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.05
(4.6571, 2.0689) New Speed = 1.0000 m/s, Angle = 3.2000 radians and New Forward Force: 0.9996 N
At 4900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.06, Right:0.00
(4.5583, 2.0531) New Speed = 1.0000 m/s, Angle = 3.3000 radians and New Forward Force: 0.9996 N
At 5000 ms: Weight of membership functions: Arrived=1.00, Close=0.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.00, Right:0.04
(4.5583, 2.0531) New Speed = -0.0000 m/s, Angle = 3.2000 radians and New Forward Force: 10.0002 N
Within 5ft of the goal (0, 0)

Example #3: Robot starts at (5, 20) and its goal is (-3, -4):

The purpose behind this example is to show that a robot can reach a location even if it is distant.

At 000 ms: (5.0000, 20.0000) Speed = 0.0000 m/s, Angle = 0.0000 radians and forward force: 0 N

At 100 ms: Weight of membership functions: Arrived=0.00, Close=0.94, Far=0.06, Stopped=1.00, Slow=0.00, Fast=0.00, Left:0.00, Right:1.00

(5.1990, 19.9800) New Speed = 2.0000 m/s, Angle = -0.1000 radians and New Forward Force: 20.0000 N

At 200 ms: Weight of membership functions: Arrived=0.00, Close=0.93, Far=0.07, Stopped=0.00, Slow=0.80, Fast=0.20, Left:0.00, Right:1.00

(5.3896, 19.9414) New Speed = 1.9448 m/s, Angle = -0.2000 radians and New Forward Force: 2.0473 N

At 300 ms: Weight of membership functions: Arrived=0.00, Close=0.93, Far=0.07, Stopped=0.00, Slow=0.81, Fast=0.19, Left:0.00, Right:1.00

(5.5719, 19.8850) New Speed = 1.9087 m/s, Angle = -0.3000 radians and New Forward Force: 1.9594 N

At 400 ms: Weight of membership functions: Arrived=0.00, Close=0.92, Far=0.08, Stopped=0.00, Slow=0.82, Fast=0.18, Left:0.00, Right:1.00

(5.7453, 19.8117) New Speed = 1.8816 m/s, Angle = -0.4000 radians and New Forward Force: 1.9135 N

At 500 ms: Weight of membership functions: Arrived=0.00, Close=0.93, Far=0.07, Stopped=0.00, Slow=0.82, Fast=0.18, Left:0.00, Right:1.00

(5.9081, 19.7227) New Speed = 1.8558 m/s, Angle = -0.5000 radians and New Forward Force: 1.8856 N

At 600 ms: Weight of membership functions: Arrived=0.00, Close=0.93, Far=0.07, Stopped=0.00, Slow=0.83, Fast=0.17, Left:0.00, Right:1.00
(6.0587, 19.6197) New Speed = 1.8249 m/s, Angle = -0.6000 radians and New Forward Force: 1.8653 N
At 700 ms: Weight of membership functions: Arrived=0.00, Close=0.94, Far=0.06, Stopped=0.00, Slow=0.84, Fast=0.16, Left:0.00, Right:1.00
(6.1952, 19.5048) New Speed = 1.7837 m/s, Angle = -0.7000 radians and New Forward Force: 1.8499 N
At 800 ms: Weight of membership functions: Arrived=0.00, Close=0.95, Far=0.05, Stopped=0.00, Slow=0.84, Fast=0.16, Left:0.00, Right:1.00
(6.3156, 19.3808) New Speed = 1.7281 m/s, Angle = -0.8000 radians and New Forward Force: 1.8411 N
At 900 ms: Weight of membership functions: Arrived=0.00, Close=0.97, Far=0.03, Stopped=0.00, Slow=0.85, Fast=0.15, Left:0.00, Right:1.00
(6.4184, 19.2512) New Speed = 1.6547 m/s, Angle = -0.9000 radians and New Forward Force: 1.8426 N
At 1000 ms: Weight of membership functions: Arrived=0.00, Close=0.98, Far=0.02, Stopped=0.00, Slow=0.87, Fast=0.13, Left:0.00, Right:1.00
(6.5028, 19.1198) New Speed = 1.5615 m/s, Angle = -1.0000 radians and New Forward Force: 1.8574 N
At 1100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.89, Fast=0.11, Left:0.00, Right:1.00
(6.5685, 18.9907) New Speed = 1.4492 m/s, Angle = -1.1000 radians and New Forward Force: 1.8768 N
At 1200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.91, Fast=0.09, Left:0.00, Right:1.00
(6.6178, 18.8640) New Speed = 1.3594 m/s, Angle = -1.2000 radians and New Forward Force: 1.6660 N
At 1300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.93, Fast=0.07, Left:0.00, Right:1.00
(6.6522, 18.7399) New Speed = 1.2875 m/s, Angle = -1.3000 radians and New Forward Force: 1.5051 N
At 1400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.94, Fast=0.06, Left:0.00, Right:0.97
(6.6731, 18.6187) New Speed = 1.2300 m/s, Angle = -1.4000 radians and New Forward Force: 1.3831 N
At 1500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.95, Fast=0.05, Left:0.00, Right:0.87
(6.6815, 18.5006) New Speed = 1.1840 m/s, Angle = -1.5000 radians and New Forward Force: 1.2910 N
At 1600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.96, Fast=0.04, Left:0.00, Right:0.78
(6.6782, 18.3859) New Speed = 1.1472 m/s, Angle = -1.6000 radians and New Forward Force: 1.2217 N
At 1700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.97, Fast=0.03, Left:0.00, Right:0.68
(6.6638, 18.2751) New Speed = 1.1178 m/s, Angle = -1.7000 radians and New Forward Force: 1.1696 N
At 1800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:0.02, Right:0.58
(6.6396, 18.1683) New Speed = 1.0942 m/s, Angle = -1.7934 radians and New Forward Force: 1.0588 N
At 1900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:0.11, Right:0.49
(6.6093, 18.0651) New Speed = 1.0754 m/s, Angle = -1.8559 radians and New Forward Force: 0.7039 N
At 2000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.98, Fast=0.02, Left:0.17, Right:0.43
(6.5753, 17.9647) New Speed = 1.0603 m/s, Angle = -1.8978 radians and New Forward Force: 0.4718 N
At 2100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:0.22, Right:0.38
(6.5389, 17.8665) New Speed = 1.0482 m/s, Angle = -1.9258 radians and New Forward Force: 0.3192 N
At 2200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:0.24, Right:0.36
(6.5009, 17.7698) New Speed = 1.0386 m/s, Angle = -1.9446 radians and New Forward Force: 0.2184 N
At 2300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:0.26, Right:0.34
(6.4621, 17.6743) New Speed = 1.0309 m/s, Angle = -1.9572 radians and New Forward Force: 0.1512 N
At 2400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=0.99, Fast=0.01, Left:0.27, Right:0.33
(6.4227, 17.5797) New Speed = 1.0247 m/s, Angle = -1.9656 radians and New Forward Force: 0.1063 N
At 2500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.28, Right:0.32
(6.3829, 17.4858) New Speed = 1.0198 m/s, Angle = -1.9712 radians and New Forward Force: 0.0759 N
At 2600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.29, Right:0.31
(6.3430, 17.3924) New Speed = 1.0158 m/s, Angle = -1.9750 radians and New Forward Force: 0.0551 N
At 2700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.29, Right:0.31
(6.3029, 17.2994) New Speed = 1.0126 m/s, Angle = -1.9775 radians and New Forward Force: 0.0407 N
At 2800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.29, Right:0.31
(6.2628, 17.2067) New Speed = 1.0101 m/s, Angle = -1.9792 radians and New Forward Force: 0.0305 N
At 2900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.2227, 17.1142) New Speed = 1.0081 m/s, Angle = -1.9803 radians and New Forward Force: 0.0232 N
At 3000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.1825, 17.0219) New Speed = 1.0065 m/s, Angle = -1.9811 radians and New Forward Force: 0.0179 N
At 3100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.1424, 16.9298) New Speed = 1.0052 m/s, Angle = -1.9816 radians and New Forward Force: 0.0139 N
At 3200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.1022, 16.8377) New Speed = 1.0041 m/s, Angle = -1.9819 radians and New Forward Force: 0.0109 N
At 3300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.0621, 16.7457) New Speed = 1.0033 m/s, Angle = -1.9822 radians and New Forward Force: 0.0086 N
At 3400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(6.0220, 16.6539) New Speed = 1.0027 m/s, Angle = -1.9823 radians and New Forward Force: 0.0068 N
At 3500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.9819, 16.5620) New Speed = 1.0021 m/s, Angle = -1.9824 radians and New Forward Force: 0.0054 N
At 3600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.9418, 16.4702) New Speed = 1.0017 m/s, Angle = -1.9825 radians and New Forward Force: 0.0043 N
At 3700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.9018, 16.3784) New Speed = 1.0014 m/s, Angle = -1.9825 radians and New Forward Force: 0.0034 N
At 3800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.8617, 16.2867) New Speed = 1.0011 m/s, Angle = -1.9826 radians and New Forward Force: 0.0027 N
At 3900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.8216, 16.1950) New Speed = 1.0009 m/s, Angle = -1.9826 radians and New Forward Force: 0.0022 N
At 4000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.7816, 16.1033) New Speed = 1.0007 m/s, Angle = -1.9826 radians and New Forward Force: 0.0017 N

At 4100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.7415, 16.0116) New Speed = 1.0006 m/s, Angle = -1.9826 radians and New Forward Force: 0.0014 N
At 4200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.7015, 15.9199) New Speed = 1.0004 m/s, Angle = -1.9826 radians and New Forward Force: 0.0011 N
At 4300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.6614, 15.8282) New Speed = 1.0004 m/s, Angle = -1.9826 radians and New Forward Force: 0.0009 N
At 4400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.6214, 15.7366) New Speed = 1.0003 m/s, Angle = -1.9826 radians and New Forward Force: 0.0007 N
At 4500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.5813, 15.6449) New Speed = 1.0002 m/s, Angle = -1.9826 radians and New Forward Force: 0.0006 N
At 4600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.5413, 15.5533) New Speed = 1.0002 m/s, Angle = -1.9826 radians and New Forward Force: 0.0005 N
At 4700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.5013, 15.4616) New Speed = 1.0001 m/s, Angle = -1.9826 radians and New Forward Force: 0.0004 N
At 4800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.4612, 15.3700) New Speed = 1.0001 m/s, Angle = -1.9826 radians and New Forward Force: 0.0003 N
At 4900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.4212, 15.2783) New Speed = 1.0001 m/s, Angle = -1.9826 radians and New Forward Force: 0.0002 N
At 5000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.3812, 15.1867) New Speed = 1.0001 m/s, Angle = -1.9826 radians and New Forward Force: 0.0002 N
At 5100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.3411, 15.0950) New Speed = 1.0001 m/s, Angle = -1.9826 radians and New Forward Force: 0.0001 N
At 5200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.3011, 15.0034) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0001 N
At 5300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.2611, 14.9117) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0001 N
At 5400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.2210, 14.8201) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0001 N
At 5500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.1810, 14.7285) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0001 N
At 5600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.1410, 14.6368) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 5700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.1010, 14.5452) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 5800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.0609, 14.4535) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 5900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(5.0209, 14.3619) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.9809, 14.2703) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.9408, 14.1786) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.9008, 14.0870) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.8608, 13.9953) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.8207, 13.9037) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.7807, 13.8121) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.7407, 13.7204) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.7007, 13.6288) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.6606, 13.5371) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 6900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.6206, 13.4455) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.5806, 13.3539) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.5405, 13.2622) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.5005, 13.1706) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.4605, 13.0790) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.4204, 12.9873) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.3804, 12.8957) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N

At 7600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.3404, 12.8040) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.3004, 12.7124) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.2603, 12.6208) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 7900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.2203, 12.5291) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.1803, 12.4375) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.1402, 12.3458) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.1002, 12.2542) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.0602, 12.1626) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(4.0202, 12.0709) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.9801, 11.9793) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.9401, 11.8877) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.9001, 11.7960) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.8600, 11.7044) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 8900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.8200, 11.6127) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.7800, 11.5211) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.7399, 11.4295) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.6999, 11.3378) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.6599, 11.2462) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.6199, 11.1545) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.5798, 11.0629) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.5398, 10.9713) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.4998, 10.8796) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.4597, 10.7880) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 9900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.4197, 10.6964) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.3797, 10.6047) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.3396, 10.5131) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.2996, 10.4214) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.2596, 10.3298) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.2196, 10.2382) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.1795, 10.1465) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.1395, 10.0549) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.0995, 9.9632) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.0594, 9.8716) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 10900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(3.0194, 9.7800) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.9794, 9.6883) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N

At 11100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.9393, 9.5967) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.8993, 9.5051) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.8593, 9.4134) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.8193, 9.3218) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.7792, 9.2301) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.7392, 9.1385) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.6992, 9.0469) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.6591, 8.9552) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 11900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.6191, 8.8636) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.5791, 8.7719) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.5390, 8.6803) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.4990, 8.5887) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.4590, 8.4970) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.4190, 8.4054) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.3789, 8.3138) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.3389, 8.2221) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.2989, 8.1305) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.2588, 8.0388) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 12900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.2188, 7.9472) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.1788, 7.8556) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.1388, 7.7639) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.0987, 7.6723) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.0587, 7.5806) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(2.0187, 7.4890) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.9786, 7.3974) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.9386, 7.3057) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.8986, 7.2141) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.8585, 7.1225) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 13900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.8185, 7.0308) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.7785, 6.9392) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.7385, 6.8475) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.6984, 6.7559) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.6584, 6.6643) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.6184, 6.5726) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.5783, 6.4810) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N

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At 14600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.5383, 6.3893) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.4983, 6.2977) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.4582, 6.2061) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 14900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.4182, 6.1144) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.3782, 6.0228) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.3382, 5.9312) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.2981, 5.8395) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.2581, 5.7479) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.2181, 5.6562) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.1780, 5.5646) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.1380, 5.4730) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.0980, 5.3813) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.0579, 5.2897) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 15900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(1.0179, 5.1980) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.9779, 5.1064) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.9379, 5.0148) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.8978, 4.9231) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.8578, 4.8315) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.8178, 4.7399) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.7777, 4.6482) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.7377, 4.5566) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.6977, 4.4649) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.6576, 4.3733) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 16900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.6176, 4.2817) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.5776, 4.1900) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.5376, 4.0984) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.4975, 4.0067) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.4575, 3.9151) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.4175, 3.8235) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.3774, 3.7318) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.3374, 3.6402) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.2974, 3.5486) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.2573, 3.4569) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 17900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.2173, 3.3653) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.1773, 3.2736) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
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At 18100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.1373, 3.1820) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.0972, 3.0904) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.0572, 2.9987) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(0.0172, 2.9071) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.0229, 2.8154) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.0629, 2.7238) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.1029, 2.6322) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.1429, 2.5405) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 18900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.1830, 2.4489) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.2230, 2.3573) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.2630, 2.2656) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.3031, 2.1740) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.3431, 2.0823) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.3831, 1.9907) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.4232, 1.8991) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.4632, 1.8074) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.5032, 1.7158) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.5432, 1.6241) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 19900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.5833, 1.5325) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.6233, 1.4409) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20100 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.6633, 1.3492) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20200 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.7034, 1.2576) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20300 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.7434, 1.1660) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20400 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.7834, 1.0743) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20500 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.8235, 0.9827) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20600 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.8635, 0.8910) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20700 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.9035, 0.7994) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20800 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.9435, 0.7078) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 20900 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-0.9836, 0.6161) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 21000 ms: Weight of membership functions: Arrived=0.00, Close=1.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-1.0236, 0.5245) New Speed = 1.0000 m/s, Angle = -1.9826 radians and New Forward Force: 0.0000 N
At 21100 ms: Weight of membership functions: Arrived=1.00, Close=0.00, Far=0.00, Stopped=0.00, Slow=1.00, Fast=0.00, Left:0.30, Right:0.30
(-1.0236, 0.5245) New Speed = 0.0000 m/s, Angle = -1.9826 radians and New Forward Force: 10.0000 N
Within 5ft of the goal (-3, -4)
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As shown in this example, the robot has no difficulty reaching its destination, regardless if a U-turn is required or long-distance travel.

Ethical issue:

The ethical issue I was concerned about before was that the robot should not go too fast, so all people near the robot can have time to move out of the way before they get hit. I addressed it by making sure when the robot is going "fast" that it will either slow down or maintain its speed but it will never speed up further. As seen in the test cases, this limits the robot's speed to 6m/s, which is equivalent to about 13mph. That is a speed of a normal biker, so people should not have a hard time getting out of its path.

There exist objects that are on the ground in the real world. So an ethical concern that should be addressed in the future is that the robot should not choose any path it deems convenient because it can run into such objects causing damage and receiving damage.