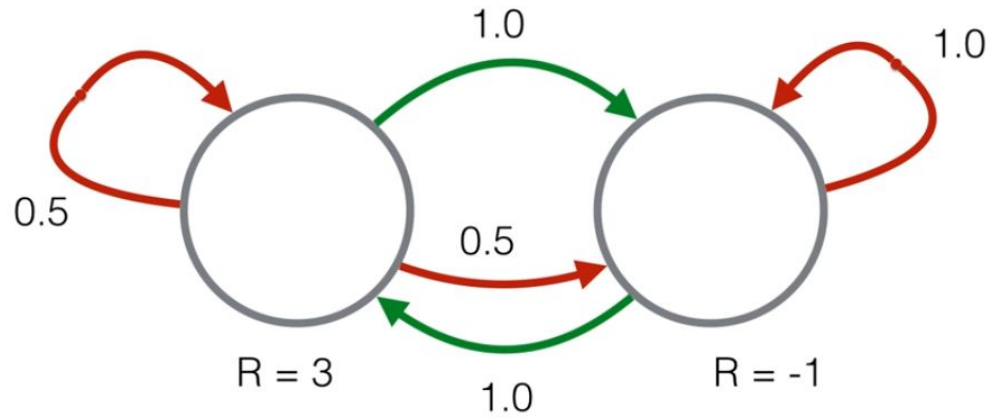


# Using Markov Decision Process for multi-agent Path Planning

Devon Webb

# Markov Decision Process (MPD)





# MPD used for Path Planning

-1	-1	-1	-100	-1	-1
-1	-1	-1	100	-1	-1
-1	-1	100	-1	-1	-1
-1	100	-1	-1	-1	-1
-1	-1	-100	-1	-100	-1
-1	-1	-1	-1	-1	-1

# MPD used for Path Planning

-1	-1	-1	-100	-1	-1
-1	-1	-1	100	-1	-1
-1	-1	100	-1	-1	-1
-1	100	-1	-1	-1	-1
-1	-1	-100	-1	-100	-1
-1 	-1	-1	-1	-1	-1

# MPD used for Path Planning

-1	-1	-1	-100	-1	-1
-1	-1	-1	100	-1	-1
-1	-1	100	-1	-1	-1
-1	100	-1	-1	-1	-1
-1  0.9	-1	-100	-1	-100	-1
-1   0.1	-1	-1	-1	-1	-1

# MPD used for Path Planning

-1	-1	-1	-100	-1	-1
-1	-1	-1	100	-1	-1
-1	-1	100	-1	-1	-1
-1	100	-1	-1	-1	-1 
-1	-1	-100	-1	-100	-1
-1 	-1	-1	-1	-1	-1 

# Bellman Equation

$$U_{i+1}(s) \leftarrow R(s) + \gamma \max_{a \in A(s)} \sum_{s'} P(s'|s, a) U_i(s')$$

$$U(s) = R(s) + \gamma \max_{a \in A(s)} \sum_{s'} P(s'|s, a) U(s')$$

# Utility Calculations

-1    -10.1	-1    -2.111	-1    -1.111	-100    -90	-1    -0.111	-1    -1.01
-1    -10.1	-1    -0.100	-1    9.00	100    100	-1    9.00	-1    -1.111
-1    -0.100	-1    9.00	100    100	-1    9.00	-1    -2.1	-1    -1.110
-1    9.000	100    100	-1    9.00	-1    -0.100	-1    -10.0	-1    -1.111 
-1    -0.100	-1    9.000	-100    -99	-1    -1.000	-100    -100.1	-1    -1.111
-1  -1.111	-1    -1.111	-1    -1.111	-1    -1.111	-1    -1.111	-1  -1.111



# Utility Calculations

-1    -10.1	-1    -2.111	-1    -1.111	-100    -90	-1    -0.111	-1    -1.01
-1    -10.1	-1    -0.100	-1    9.00	100    100	-1    9.00	-1    -1.111
-1    -0.100	-1    9.00	100    100	-1    9.00	-1    -2.1	-1    -1.110
-1    9.000	100    100	-1    9.00	-1    -0.100	-1    -10.0	-1    -1.111 
-1    -0.100	-1    9.000	-100    -99	-1    -1.000	-100    -100.1	-1    -1.111
-1    -1.111 	-1    -1.111	-1    -1.111	-1    -1.111	-1    -1.111	-1    -1.111 

Diagram illustrating a sequence of utility calculations across a 6x6 grid. The grid contains numerical values, with some values highlighted in blue (100, 100) and others in red. An airplane icon is present in the bottom-left cell (-1, -1.111). A path is indicated by arrows: one arrow points from the bottom-left cell to the cell above it (-1, 9.000), and another arrow points from that cell to the cell to its right (100, 100).

Demo