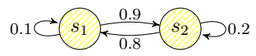
Markov Chain: 2−tuple $(\mathbb{S}, \mathbf{T})$

$\mathbb{S} = \{s_1, s_2\}$,$\mathbf{T} = \mathbf{T}(s)$



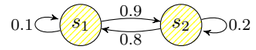
Transition Model: $\pi(s'|s)$, for discrete states are transition matrix

$$\mathbf{T} = [\pi(s'|s)] = \begin{array}{c} \\ s_1 \\ s_2 \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} 0.1 & 0.9 \\ 0.8 & 0.2 \end{bmatrix} \end{array}$$

Sensor Model: States are completely observable
i.e. $p(o_1|s_1) = 1$, $p(o_2|s_2) = 1$

Hidden Markov Model: 4−tuple $(\mathbb{S}, \mathbf{\Omega}, \mathbf{T}, \mathbb{O})$

$\mathbb{S} = \{s_1, s_2\}$, $\mathbf{\Omega} = \{o_1, o_2\}$, $\mathbf{T} = \mathbf{T}(s)$, $\mathbb{O} = \mathbb{O}(o|s')$



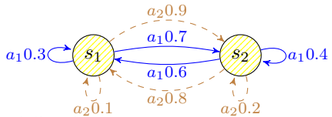
Transition Model: $\pi(s'|s)$, for discrete states are transition matrix

$$\mathbf{T} = [\pi(s'|s)] = \begin{array}{c} \\ s_1 \\ s_2 \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} 0.1 & 0.9 \\ 0.8 & 0.2 \end{bmatrix} \end{array}$$

Sensor Model: $\mathbb{O} = \mathbb{O}(o|s)$
We are unsure which state we are in
e.g. $p(o_1|s_1) = 0.75$, $p(o_2|s_2) = 0.75$

Markov Decision Process: 4−tuple $(\mathbb{S}, \mathbb{A}, \mathbf{T}, \mathbf{R})$

$\mathbb{S} = \{s_1, s_2\}$, $\mathbb{A} = \{a_1, a_2\}$, $\mathbf{T} = \mathbf{T}(s, a)$, $\mathbf{R} = \mathbf{R}(s, a)$



Transition Model: $\pi(s'|s, a)$, for discrete states are transition matrix

$$\mathbf{T} = [\pi(s'|s, a)] = \begin{array}{ccc} & & \\ s_1 & a_1 & \\ & a_2 & \\ s_2 & a_1 & \\ & a_2 & \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} a_1 & 0.7 \\ 0.1 & 0.9 \\ 0.6 & 0.4 \\ 0.8 & 0.2 \end{bmatrix} \end{array}$$

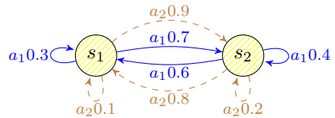
Reward Model $r(s, a)$ or $r(s, a, s')$

$$\mathbf{R} = [r(s, a, s')] = \begin{array}{ccc} & & \\ s_1 & a_1 & \\ & a_2 & \\ s_2 & a_1 & \\ & a_2 & \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} r_{111} & r_{112} \\ r_{121} & r_{122} \\ r_{211} & r_{212} \\ r_{221} & r_{222} \end{bmatrix} \end{array}$$

Sensor Model. States are completely observable
i.e. $p(o_1|s_1) = 1$, $p(o_2|s_2) = 1$

Partially Observalbe Markov Decision Process: 6-tuple $(\mathbb{S}, \mathbf{\Omega}, \mathbb{A}, \mathbf{T}, \mathbf{R}, \mathbb{O})$

$\mathbb{S} = \{s_1, s_2\}$,$\mathbf{\Omega} = \{o_1, o_2\}$,$\mathbb{A} = \{a_1, a_2\}$, $\mathbf{T} = \mathbf{T}(s, a)$, $\mathbf{R} = \mathbf{R}(s, a)$,$\mathbb{O} = \mathbb{O}(o|s')$



Transition Model: $\pi(s'|s, a)$, for discrete states are transition matrix

$$\mathbf{T} = [\pi(s'|s, a)] = \begin{array}{ccc} & & \\ s_1 & a_1 & \\ & a_2 & \\ s_2 & a_1 & \\ & a_2 & \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} 0.3 & 0.7 \\ 0.1 & 0.9 \\ 0.6 & 0.4 \\ 0.8 & 0.2 \end{bmatrix} \end{array}$$

Reward Model $r(s, a)$ or $r(s, a, s')$

$$\mathbf{R} = [r(s, a, s')] = \begin{array}{ccc} & & \\ s_1 & a_1 & \\ & a_2 & \\ s_2 & a_1 & \\ & a_2 & \end{array} \begin{array}{c} \begin{array}{cc} s_1 & s_2 \end{array} \\ \begin{bmatrix} r_{111} & r_{112} \\ r_{121} & r_{122} \\ r_{211} & r_{212} \\ r_{221} & r_{222} \end{bmatrix} \end{array}$$

Sensor model $\mathbb{O}(o|s')$ or $\mathbb{O}(o|s', a)$
We are unsure which state we are in
e.g. $p(o_1|s_1) = 0.75$, $p(o_2|s_2) = 0.75$