

Real-world examples of various types of Markov Chain models in Machine Learning

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- Markov Chains are powerful models that can capture sequential dependencies in data.
- They have a wide range of applications in various fields, including Machine Learning.
- In this presentation, we will explore some real-world examples of Markov Chain models in Machine Learning.



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Markov Decision Process

Markov Decision Process

To understand the Markov decision process, let's consider you're playing with a die.

- Each round, you can either **continue** or **quit**.
- If you **quit**, you receive \$5 and the game finishes.
- If you **continue**, you receive \$3 and roll a 6-faced die. If the die comes up as 1 or 2, the game ends. Otherwise, the game continues onto the next round.

The things to keep in mind here are the following:

- The **states**: Be in or out the game,
- The **actions**: Decide to quit or continue (move between the states)
- The **transition probability**: the probability to move between the states.
- The **rewards**: The gain of obtained while moving.



We can have the following figure

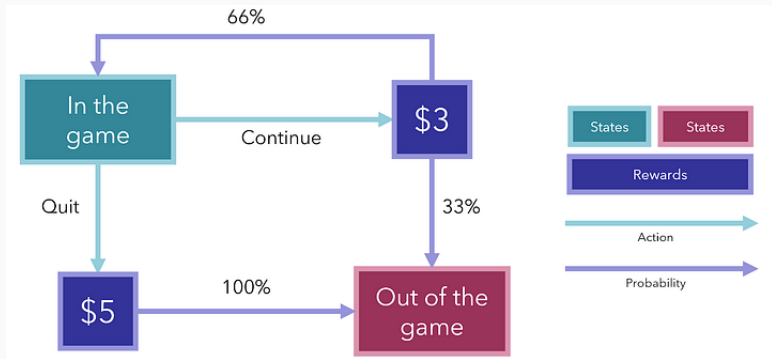


Figure 1: Transition diagram



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Markov Decision Process

Definition

A **Markov Decision Process** is a 4-tuple $(S, A_s, P_a, R_{s,a})$ where

- S is a set, the set of states,
- A is the set of actions (or A_s actions available from state A).
- P_a is the transition probability : prob. to move from one state to another after an action a .
- $R_{s,a}$ is the reward or penalty obtained after doing any move.

The goal of the decision-making is to maximize the reward by choosing the nicest actions.

Markov Decision Process: Applications

Markov Decision Process (MDP) is a type of Markov Chain model used in reinforcement learning.

Some real-world example of MDP are:

- robot navigation, where the agent has to navigate through an environment to reach a goal while avoiding obstacles.
- Automatic car control...



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Hidden Markov Model

Hidden Markov Model

- Hidden Markov Model (HMM) is a type of Markov Chain model widely used in speech recognition, image processing, and bioinformatics.
- HMM assumes that the observations are generated from a set of hidden states.
- A real-world example of HMM is speech recognition, where the hidden states are the phonemes and the observations are the audio signals.



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Reccurent Neural Network

Recurrent Neural Network

- Recurrent Neural Network (RNN) is a type of neural network that can capture sequential dependencies in data.
- RNN is a generalization of Markov Chain model that can capture long-term dependencies.
- A real-world example of RNN is natural language processing, where the model has to predict the next word in a sentence based on the previous words.



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Conclusion

- Markov Chain models are versatile and powerful tools for modeling sequential data.
- They have a wide range of applications in various fields, including Machine Learning.
- In this presentation, we explored some real-world examples of Markov Chain models in Machine Learning.



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