

Problem Solving in AI



Decision Trees

Problem Solving


- In computer science, a **problem-solving** is a part of **artificial intelligence**
- It encompasses a number of techniques such as
 - algorithms,
 - heuristics to solve a **problem**.
- A **problem-solving** agent is a goal-driven agent and focuses on satisfying the goal.
- An important aspect of intelligence is goal-based **problem solving**.




Problem Solving

- In Machine Learning
 - Problem solving techniques plays a vital role.
 - Supervised Learning is performed for development of such skills.
 - Making decisions under given circumstances are widely required
 - One of the methods for doing this is by using the Decision Trees

Decision Trees

- **Decision tree** is one of the most popular machine learning algorithms used all along.
- Used widely for analysing the problem and taking decision. 
- A **decision tree** is a supervised learning technique that has a pre-defined target variable and is most often used in classification problems.


Decision Trees

- A decision tree is a series of nodes, a directional graph that starts at the base with a single node and extends to the many leaf nodes that represent the categories that the tree can classify. 
- Another way to think of a decision tree is as a flow chart, where the flow starts at the root node and ends with a decision made at the leaves.

Advantages of Decision Trees

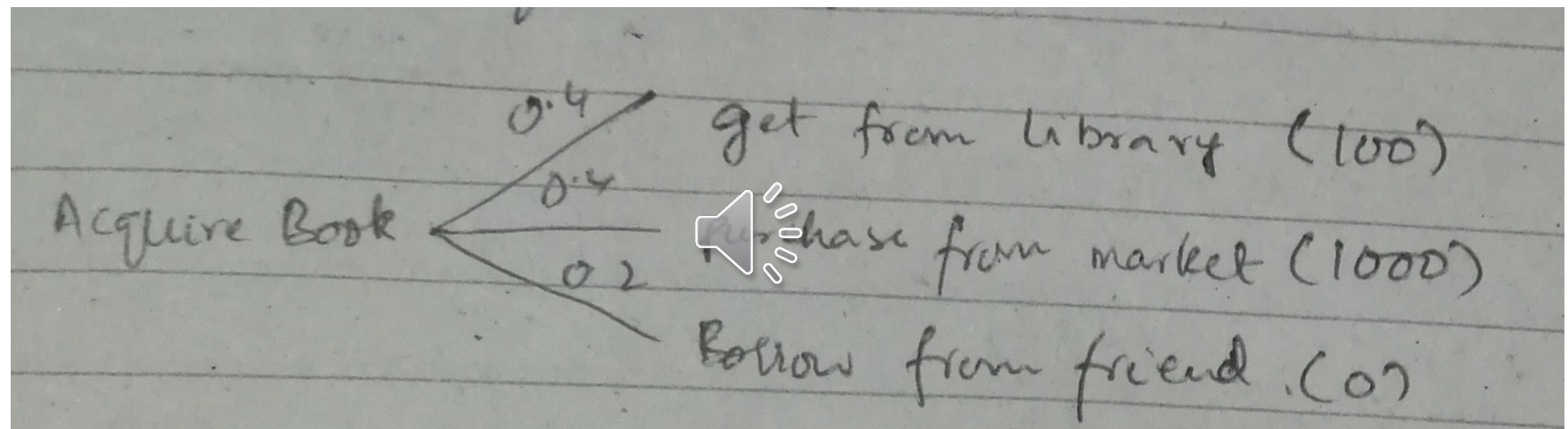
- Decision trees are a popular algorithm for several reasons:
 - Explanatory Power:
 - The output of decision trees is interpretable.
 - It can be understood by people without analytical or mathematical backgrounds.
 - It does not require any statistical knowledge to interpret them.
 - Exploratory data analysis:
 - Decision trees can enable analysts to identify significant variables.
 - Important relations between two or more variables, helping to surface the signal contained by many input variables.

Advantages of Decision Trees

- Minimal data cleaning:
 - Because decision trees are resilient to outliers and missing values, they require less data cleaning than some other algorithms.
- Any data type: 
 - Decision trees can make classifications based on both numerical and categorical variables.
- Non-parametric:
 - A decision tree is a non-parametric algorithm,
 - Does not require large number of coefficients, known as parameters to give the solution.

Example


- Acquire a Book



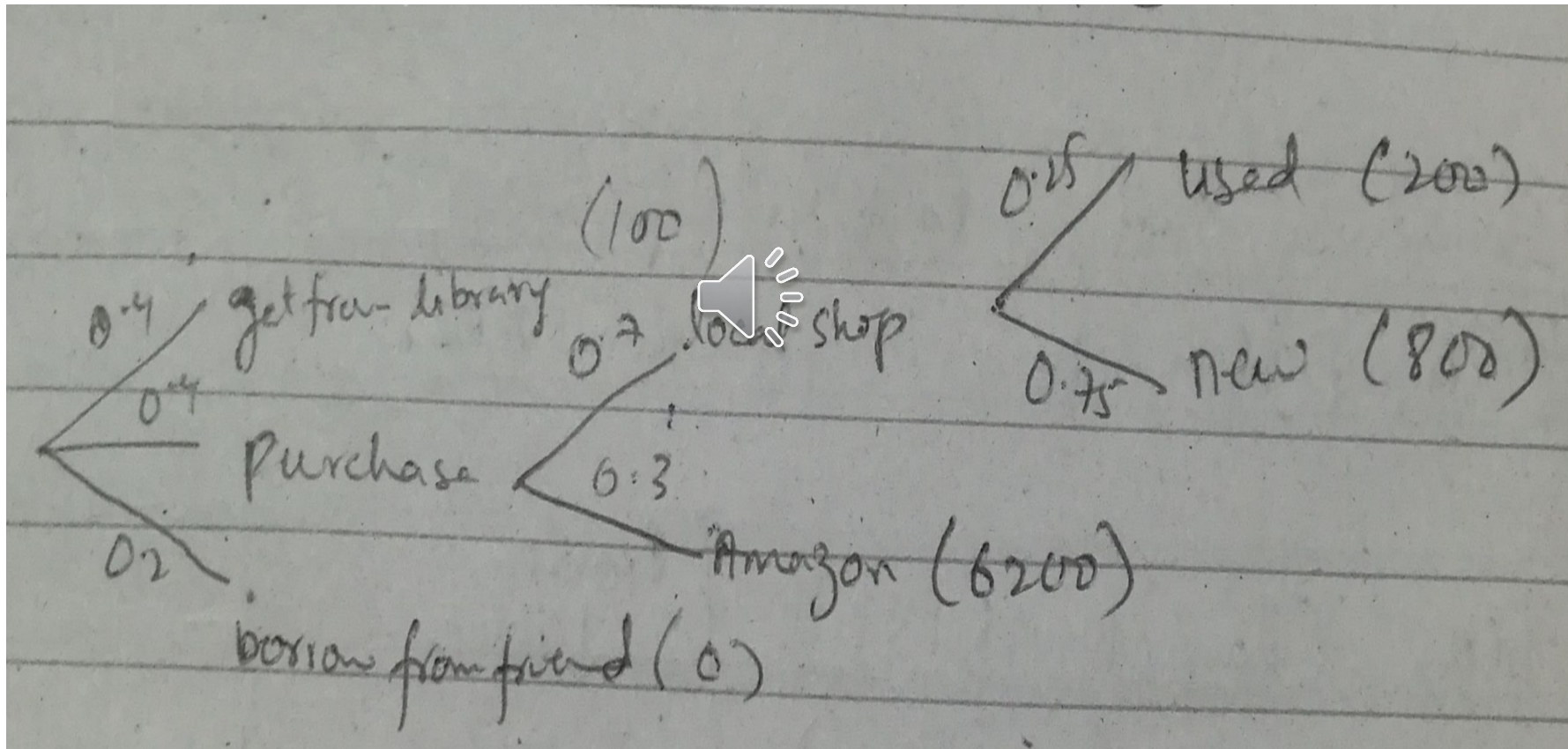
A handwritten decision tree on lined paper. The root node is 'Acquire Book'. It branches into three options: 'get from library (100)' with a probability of 0.4, 'Purchase from market (1000)' with a probability of 0.4, and 'Borrow from friend (0)' with a probability of 0.2. A small speaker icon is placed next to the 'Purchase from market' branch.

$$AB = 0.4 * 100 + 0.4 * 1000 + 0.2 * 0$$
$$= 440$$

Example

- Decision to be taken:
 - The Cost we get is Rs. 440/-
 - We have two choices
 - Get from the Library 
 - Borrow from a Friend

Example



Example

$$\begin{aligned}\text{Purchase} &= 0.3 * 6200 + [0.7 (0.25 * 200 + 0.75 * 800)] \\ &= 1860 + [0.7 (650)] \\ &= 1860 + 455 = 2315\end{aligned}$$

Analysis Cost - used to check the average cost & find the cost below that line.

$$\begin{aligned}AC &= 0.4 * 100 + 0.4 * 2315 + 0.2 * 0 \\ &= 40 + 926 = 966\end{aligned}$$

Example

- Decision for Acquiring a Book:
 - Since the Analysis Cost is Rs. 966/-
 - Choose the option which is \leq the cost
 - We now have several options
 - Get from the Library
 - Purchase from Local Market
 - Either Used or New
 - Borrow from a friend

Summary

- Decision Trees are efficient Problem solving techniques.
- Performs an in-depth analysis of the problem
- Provides us with all the possible solutions to acquire.
- Gives us an in-sight of the problem and enables us to take the best possible decision.