

# What Are Decision Tree Algorithms?

Why?	
<p>This lesson equips students with an understanding of decision-making processes in technology, fostering critical thinking and digital literacy skills essential for navigating an increasingly AI-driven world. By learning about algorithms and decision trees, students gain insights into how everyday technologies make decisions, enhancing their ability to think logically, solve problems, and comprehend the ethical implications of automated systems. This knowledge is crucial not only for potential future careers in technology but also for being informed, responsible digital citizens in a world where AI impacts many aspects of daily life.</p>	
Materials Needed	Time needed
<ul style="list-style-type: none"> <li>Simulation printout</li> </ul>	Approximately 30 - 45 minutes
Objectives	
<ul style="list-style-type: none"> <li>Students will be able to identify real-world applications of decision trees, particularly in automated decision-making systems.</li> <li>Students will be able to use decision trees to develop problem-solving strategies for given scenarios</li> <li>Students will be able to collaborate effectively in groups to simulate decision-making scenarios</li> <li>Students will be able to critically assess the effectiveness and limitations of decision trees in solving real-world problems.</li> </ul>	
Key Concepts & Vocabulary	
<ul style="list-style-type: none"> <li><b>Algorithm:</b> A step-by-step procedure for solving a problem or performing a task.</li> <li><b>Decision Tree:</b> A flowchart-like structure for making decisions based on sequential choices.</li> </ul>	
Lesson	
<ol style="list-style-type: none"> <li><b>Introduction:</b> Introduce the concept of using a decision tree for a simple task, such as deciding what to wear based on the weather.             <ol style="list-style-type: none"> <li>Wake up, and ask, do I need to go to school today? Yes or no?</li> <li>Figure out what the weather is expected to be like today. Will it be hot? Yes or no? Will it be raining? Yes or no?</li> <li>Determine whether you need specific clothes for gym class. Yes or no?</li> <li>What would the answers of these questions tell you about what to wear?</li> </ol> </li> <li><b>Basic Definition:</b> Explain that a decision tree is a way of making decisions or predictions based on certain information. It's like a series of yes/no questions leading to an answer.             <ol style="list-style-type: none"> <li>Create a basic version of the decision tree given as an example in step 1.</li> </ol> </li> </ol>	

Draw a starting point on the board, and then build a decision tree, with YES going one way and NO going the other way. (See end of plan for example.)

- b. Everyday Examples: Decision trees might be used in work or home scenarios, such as a physician deciding on a diagnosis, an emergency response, or meal planning.
3. **Read this description of AI use with decision trees:** Artificial intelligence uses decision trees in algorithms to analyze data much more quickly than humans could.
  - a. AI can take in huge amounts of information, like medical records, shopping trends, historical weather data, credit scores, delivery route maps, etc.
  - b. Another similar example is an automated phone customer service system, which asks you for responses on a sequence of questions to narrow down the possible outcomes.
4. **Simulation:** Students create a human decision tree to illustrate the process of AI determining outcomes. This simulation is about the topic of helping students determine how much risk they are comfortable with in their physical activities. This tree will help them figure out if they are OK with high-risk activities, or if a low-risk environment might be better for them.
  - a. See Simulation page at the end of the plan.
  - b. Ask for volunteers or select seven students to act as questioners. Each questioner gets a question and two paths (depending on whether they answer YES or NO) to send applicants.
    - i. Print out the Simulation page and cut it up so each Questioner knows the question and answer options to give classmates.
    - ii. Questioners must stick to the question on their papers to make sure classmates are directed down correct paths.
  - c. Students will walk up to Questioner #1. Questioner will ask the question, and student will respond. Then Questioner directs the student to the next step in the process.
    - i. Students get asked a series of questions.
    - ii. Students answer based on their own personal preferences.
    - iii. Questioners should indicate their Question number so students know where to go.
    - iv. Eventually, students will arrive at one of the three Outcomes. They should stay in that location until all students are complete.
  - d. After students are sorted into the three Outcomes, bring the class back together for discussion.

### Tips

- Consider making a large decision tree diagram on the board for the class to reference during and after the simulation.
  - Alternately, have the students create the decision tree diagram based on the activity.

### Discussion Questions

- What did you learn about how decision trees work in helping people make decisions?
- We want our decision tree algorithms to be correct, but we also want them to be efficient. Which one is more important?
- How did it feel to go through this simulation? Were you surprised by the outcome you reached?
- From the AI's perspective, if you were a Questioner, how did it feel to guide classmates based solely on their responses, without considering any personal factors?
- Imagine an AI decision tree for a more high-stakes situation, such as determining whether a person should get a bank loan. How comfortable do you feel with AI making this type of decision?
- Do you think this kind of decision-making process can be biased?
- What limitations did you notice in using a decision tree for complex decisions?
- How has this simulation changed your perspective on how automated systems make important decisions?

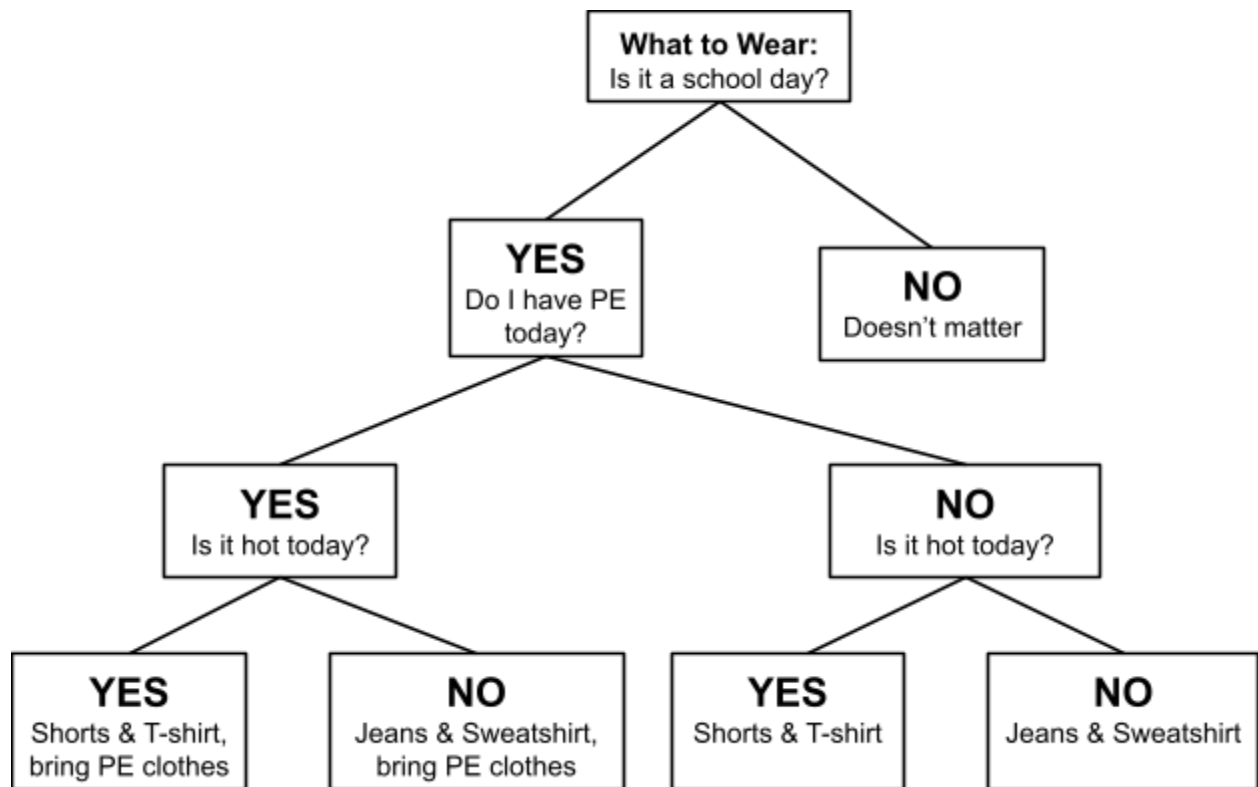
### Supplemental Activity Ideas

- **DIY Decision Tree:** Students create their own decision trees about a topic of their choice. Personal examples could include meal planning, grocery shopping, choosing a college major, or selecting a movie to watch. Societal examples could include healthcare decisions, emergency response situations, or delivery route planning.
- **Exploring Bias in AI:** Have students conduct research or discussions on how bias can enter into AI systems and its effects. Use specific examples like facial recognition software or loan approval algorithms.
- **Morse Code Binary Branching Tree:** Have students form a human decision tree, as shown in the [image](#) here. The students forming the tree should only have the letter. For the remaining students, give them a pattern (such as --●--). Have them start at the top of the tree, and go down the lines. When they finish their pattern, they know their letter.

### Sources to Learn More

- Tree-based learning algorithms explained - <https://medium.com/analytics-vidhya/tree-based-machine-learning-algorithms-explained-b50937d3cf8e>
- IBM's explanation of their use of decision trees - <https://www.ibm.com/topics/decision-trees>

## Decision Tree Example - What to Wear?



## Decision Tree Simulation - Physical Risk

**Question 1:** “Do you like a physical challenge?”

**Yes:** Go to Question 2

**No:** Go to Question 4

**Question 2:** “Are you comfortable with activities that involve heights / speed?”

**Yes:** Go to Question 3

**No:** Classify as “Medium Risk”

**Question 3:** “Do you have experience with safety training?”

**Yes:** Classify as “High Risk”

**No:** Classify as “Medium Risk”

**Question 4:** “Do you prefer activities that require strategic thinking?”

**Yes:** Go to Question 5

**No:** Go to Question 6”

**Question 5:** “Are you comfortable with competitive environments?”

**Yes:** Classify as “Medium Risk”

**No:** Classify as “Low Risk”

**Question 6:** “Do you value relaxation?”

**Yes:** Classify as “Low Risk”

**No:** Go to Question 7

**Question 7:** “Do you get energy from social environments?”

**Yes:** Classify as “Medium Risk”

**No:** Classify as “Low Risk”

High Risk	Medium Risk	Low Risk
Activities such as skydiving, hang gliding, BASE jumping, car racing	Activities such as soccer, gymnastics, skiing, backpacking	Activities such as walking, gardening, golf, swimming

An illustration of this decision tree is on the next page.

## Simulation Decision Tree

