Understanding Node Splitting in Decision Trees: Exploring GINI, Entropy, and Information Gain

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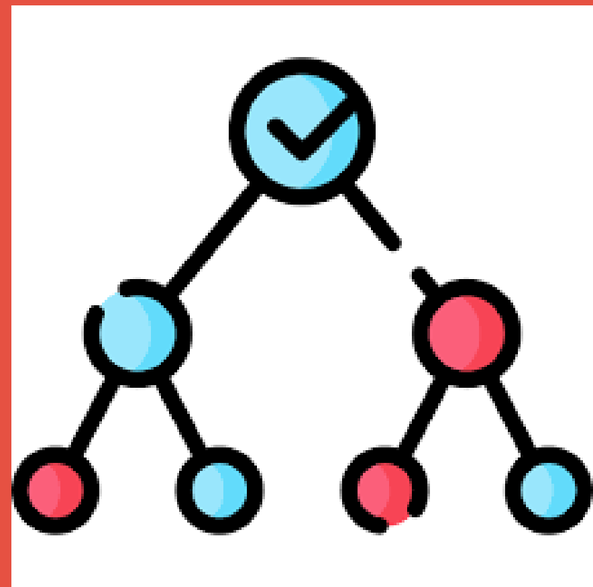
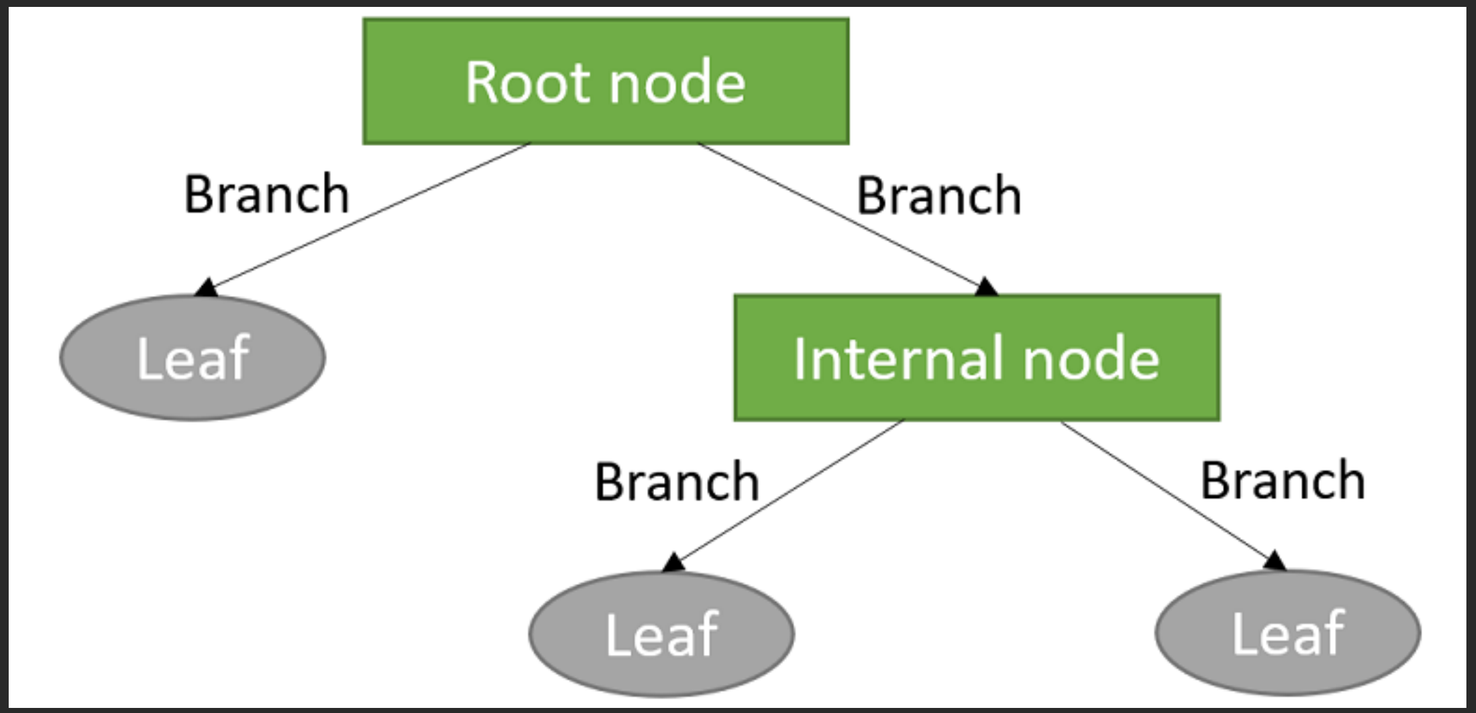
Decision Tree

- **A Visual Representation of Choices, Consequences, Probabilities, and Opportunities.**
- **A Way of Breaking Down Complicated Situations Down to Easier-to-Understand Scenarios.**
- **By applying**
  - **Logic**
  - **Likely Outcome**
  - **Quantitative decision**





Decision Tree Structure

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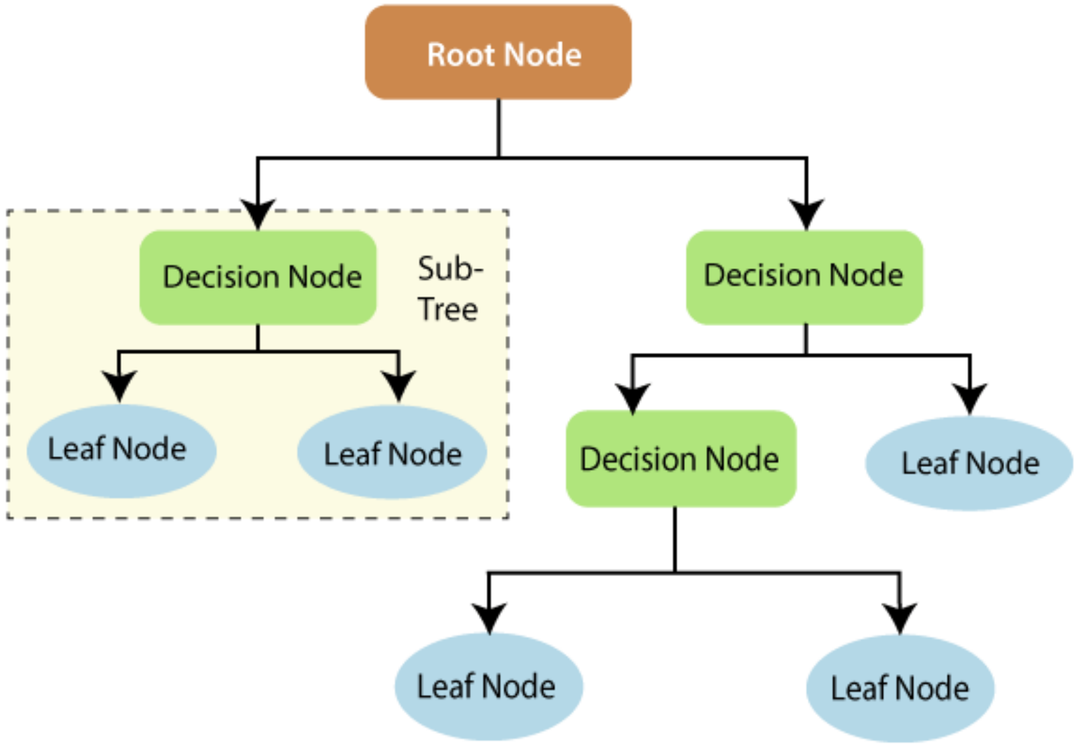

Node Splitting

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Importance of Node Splitting

- Effective dataset division
- Improved model performance
- Interpretability
- Segments dataset into homogeneous groups
- Captures complex decision boundaries
- Reduces bias and variance
- Enhances model interpretability

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Example of Decision Tree

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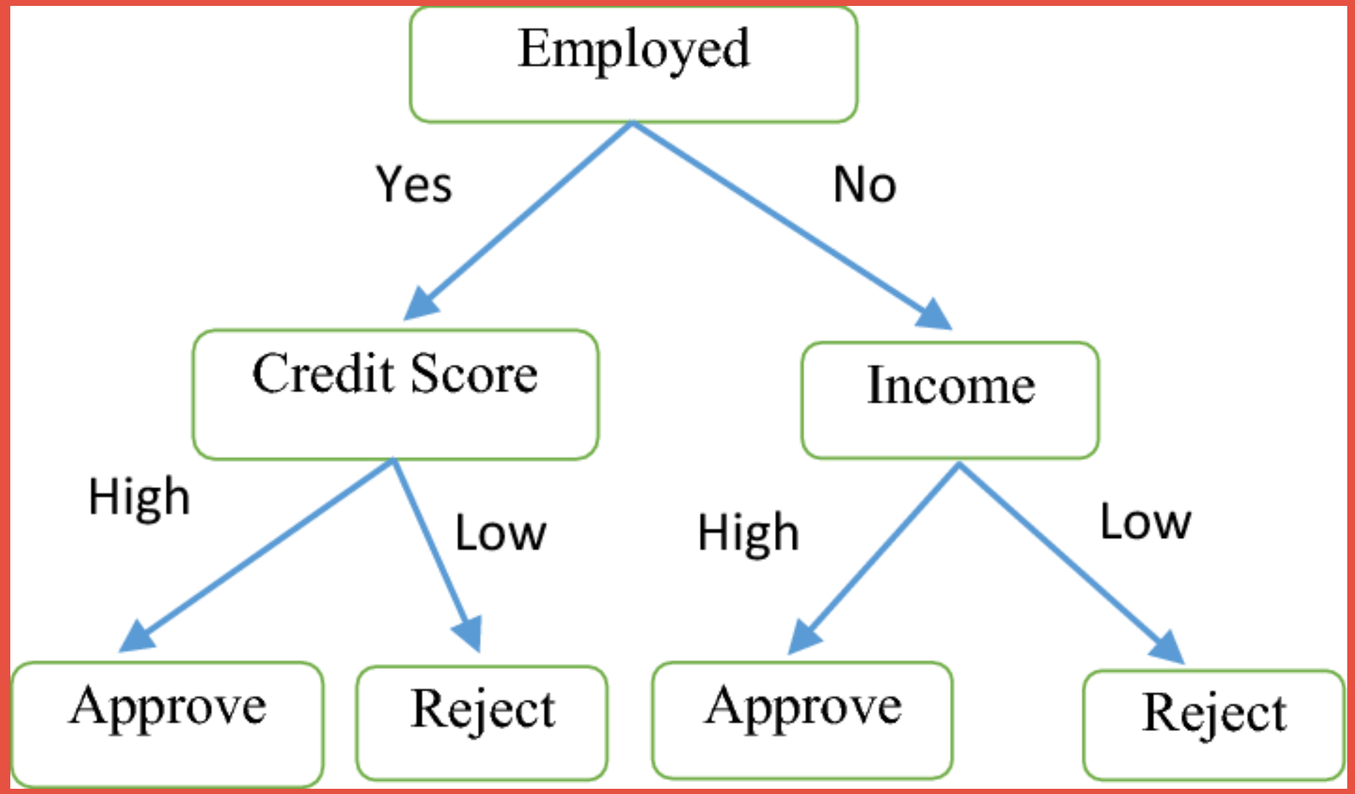
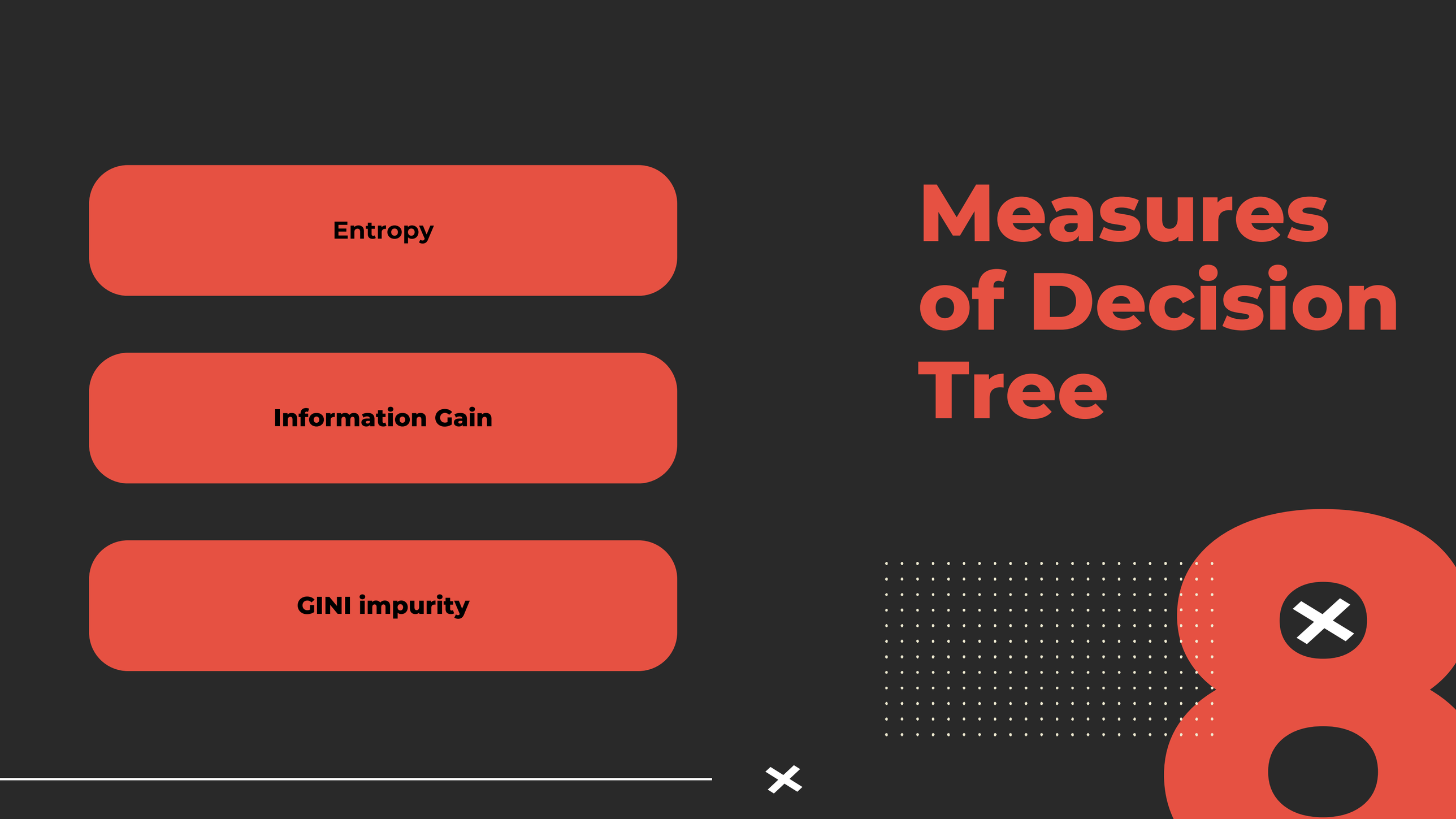


Measures of Decision Tree

Entropy

Information Gain

GINI impurity



What is Entropy?

Low Entropy

High Entropy

$$\text{Entropy} = \sum_{i=1}^{c} - p_i \log_2 p_i$$

c --> number of classes

p_i --> Probability of i^{th} class

Information Gain

$$\text{Information gain (T, F)} = \text{Entropy (T)} - \sum_{v \in F} \frac{|T_v|}{T} . \textit{Entropy}\,(T)$$

- Where T is target, F is the feature we're considering to split on, Tv is the subset of T for which Feature F has value v.

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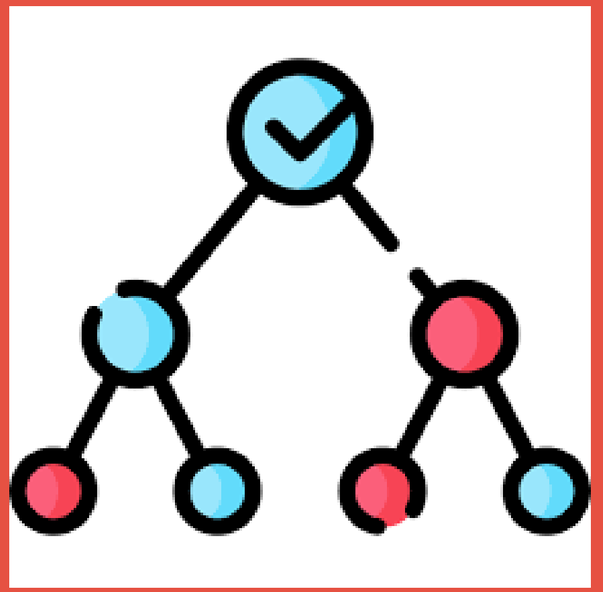
GINI Impurity

$$Gini = 1 - \sum_{i=1}^{C} (p_i)^2$$

Where pi is the probability of an item being classified to a particular class.



TUTORIAL

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Conclusion

- **Entropy** measures how mixed or uncertain our dataset's target variable is.
- **Information Gain** tells us how much a particular attribute helps in reducing the uncertainty about the target variable.
- **Gini Impurity** is another way to measure uncertainty in a dataset. It's similar to entropy but has a slightly different calculation.

- http://www.learnbymarketing.com/481/decision-tree-flavors-gini-info-gain/
- https://medium.com/analytics-steps/understanding-the-gini-index-and-information-gain-in-decision-trees-ab4720518ba8
- https://scikit-learn.org/stable/modules/generated/sklearn.tree.DecisionTreeClassifier.html
- https://towardsdatascience.com/understanding-decision-tree-classification-with-scikit-learn-2ddf272731bd
- https://www.shiksha.com/online-courses/articles/splitting-in-decision-tree/#:~:text=Splitting%20a%20single%20node%20into,concept%20that%20is%20diametrically%20opposite.
- https://gatesboltonanalytics.com/?page_id=282

References

THANK YOU!