Bayesian Inference in Machine Learning:

Leveraging Bayes' Theorem for Intelligent Decision Making

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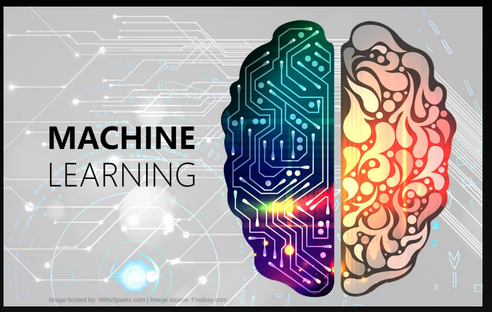
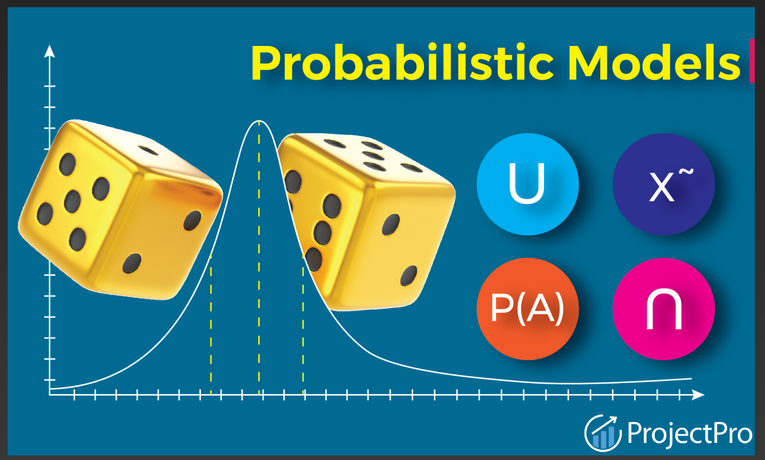


Overview of Machine Learning

- What is Machine Learning?
  - Subfield of Artificial Intelligence
  - Algorithms that enable computer systems to learn from data and make predictions or decision without being explicitly programmed
  - Models learn and improve from experience
  - Overtime tasks perform more accurately or efficiently (If the data used to train is good enough to train the algorithm)

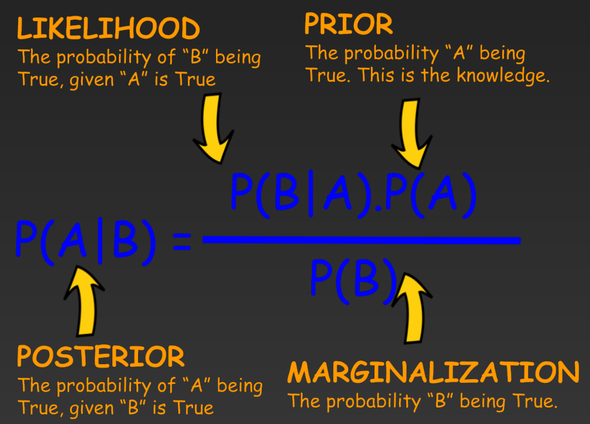
Role of Probabilistic Modeling

- Significant role in Machine Learning
  - Provides a framework to model uncertainty, make informed decisions, and handle complex real-world data.
- Quantifying uncertainty,
- Flexibility in handling complex data,
- Bayesian inference and learning,
- Decision making and uncertainty,
- Handling missing data, etc.



Bayes' Theorem

- Fundamental concept in probability theory
- Update beliefs or probabilities based on new evidence or observations
- Mathematical framework for reasoning under uncertainty
- Used in multiple fields:
  - Statistics, Machine Learning, Decision theory, etc.
- P(A|B) = (P(B|A)*P(A)) / P(B)



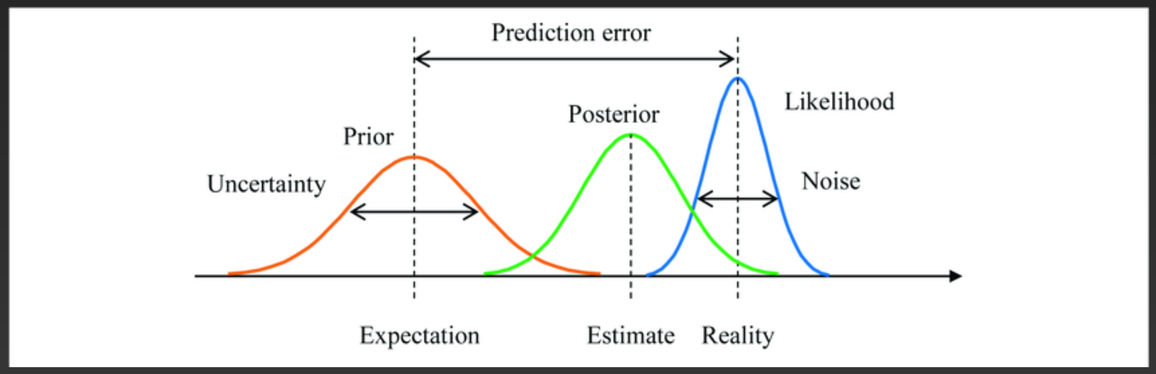
Bayes' Theorem for Machine Learning

- How is Bayes' theorem applied in Machine Learning?
- Updating of probabilities or beliefs based on new evidence.
- Enables models to adapt to changing conditions, incorporate prior knowledge, refine predictions.

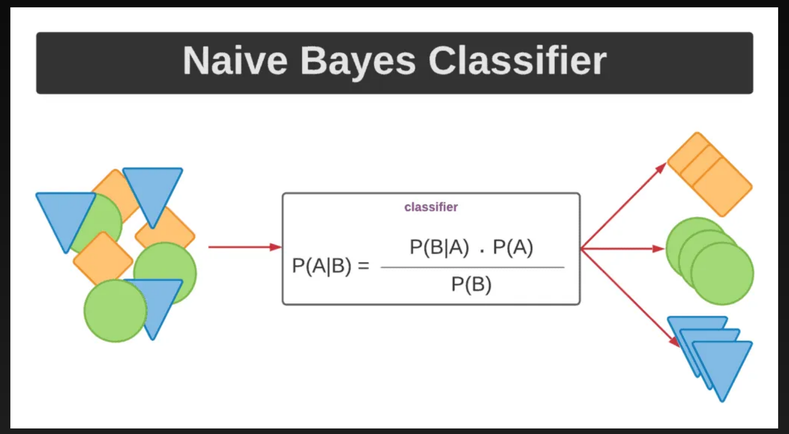
Bayesian Inference

Bayesian Inference:

- What is Bayesian Inference?
  - Powerful framework in M.L.
  - Allows us to update beliefs or probabilities based on observed data.
- How are prior beliefs updated using Bayes' Theorem to obtain posterior probabilities?
  - Likelihood
  - Bayes' Theorem
  - Posterior Probability
  - Iterative Process



Naive Bayes Classifier



- Popular M.L algorithm
- Probabilistic classifier
- Applies Bayes' Theorem
- Estimates probability of a class label given a set of features
- Assumes conditional independence among the features
- Mathematical expression:
- P(y|x1, x2, …, xn) = (P(y)*P(x1|y)*P(x2|y)*…*P(xn|y) / P(x1, x2, …, xn)

Real World Applications

- Spam e-mail filtering
- Medical diagnosis and risk prediction
- Fraud detection
- Recommender systems