# A probabilistic approach to ML

Bayesian approach: find $y$ that maximizes $\mathbb{P}(Y = y | \text{data}, X = x)$

This problem of Bayesian inference is hard to solve without additional hypothesis.

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## Naive Bayes classifiers

- Make a naive, counter-intuitive hypothesis of conditional independence of the feature variables;
- Compute each class' probability for a new example using this hypothesis and picks the most probable one;
- Are a simple, scalable, online method;
- Despite their simplicity, perform surprisingly well and are competitive in many applications.

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## Gaussian Processes

- Compute the most probable function that passes through the data points, given a priori information about how related two data points are (through a covariance kernel);
- Also provide a measure of prediction uncertainty in each point;
- Are computed offline and require an $N \times N$ matrix inversion for $N$ data points in the training set (computationnally costly);
- Careful engineering of covariance kernels can help incorporate priori knowledge into Gaussian Processes;
- Are suitable both for regression and classification.

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Note that Gaussian Processes are widely used in preliminary design phases, especially as surrogate models that replace physics computations.