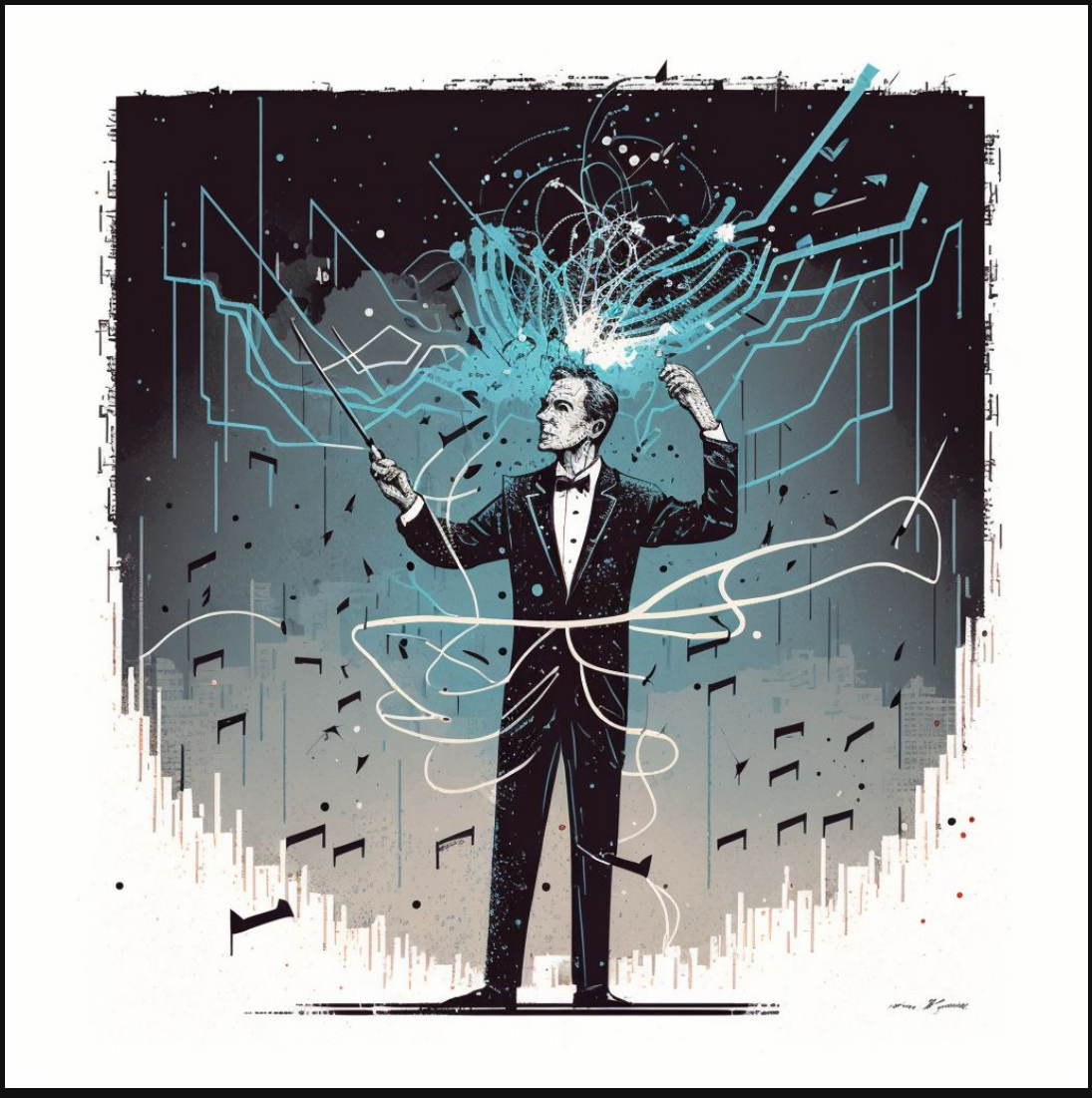
Bayesian Optimization
Tuning ML Models Like a Symphony Conductor



Sergej Stoppel
in/sergej-stoppel

Welcome to our adventure through the world of **Bayesian Optimization**

We'll be exploring how this global optimization technique can help **tune machine learning** models like a maestro conducting a symphony.

After this slideshow you should have a good overview of Bayesian Optimization for ML models, or you get your money back!

Sergej Stoppel
in/sergej-stoppel

So, you've created a marvelous machine learning model, but it's acting like a stubborn teenager.

The issue? **Hyperparameters**! They're the settings that need to be tweaked to make your model sing like an angel.

Sergej Stoppel
in/sergej-stoppel

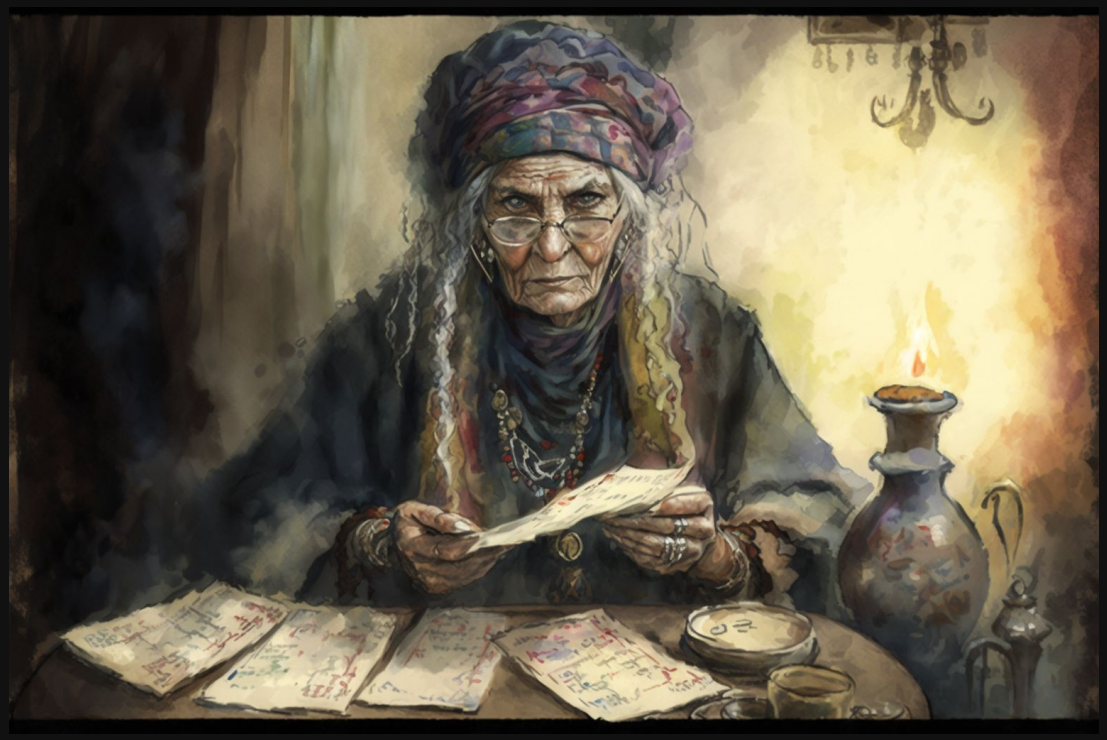
Enter Bayesian Optimization

Bayesian Optimization is like a wise sage that figures out the best combination of hyperparameters for your model.

It does this by building a probabilistic model of the function to optimize and weighing exploration and exploitation.

Sergej Stoppel
in/sergej-stoppel

Think of probabilistic models as fortune tellers. They predict what the future holds for your model's performance based on its past experiences.
It's like tarot cards, but with way more math involved... or a better analogy.



Sergej Stoppel
in/sergej-stoppel

One of the key ideas of Bayesian Optimization is to strike balance between using existing knowledge and seeking new information, these concepts are also known as **Exploration vs. Exploitation.**

Exploration is like searching for new ice cream flavors, while **exploitation** is sticking to your tried-and-true favorite. Bayesian Optimization balances these two approaches to find the best hyperparameters for your model.

Sergej Stoppel
in/sergej-stoppel

But how do we actually find these parameters? This is done with Gaussian Processes.

Gaussian Processes are the secret sauce of Bayesian Optimization. They're a family of probability distributions over functions, helping us to predict how a model will perform with different hyperparameters.

Sergej Stoppel
in/sergej-stoppel

They can be thought of as a collection of random variables, where any finite subset of those variables has a joint Gaussian distribution.

In the context of Bayesian Optimization, Gaussian Processes are used to model the underlying function that we want to optimize.

This allows the optimization process to make informed decisions based on the predicted function values and associated uncertainties.

Sergej Stoppel
in/sergej-stoppel

After modeling the model performance we need to decide how to tune it. This is done with the help of **acquisition functions**.

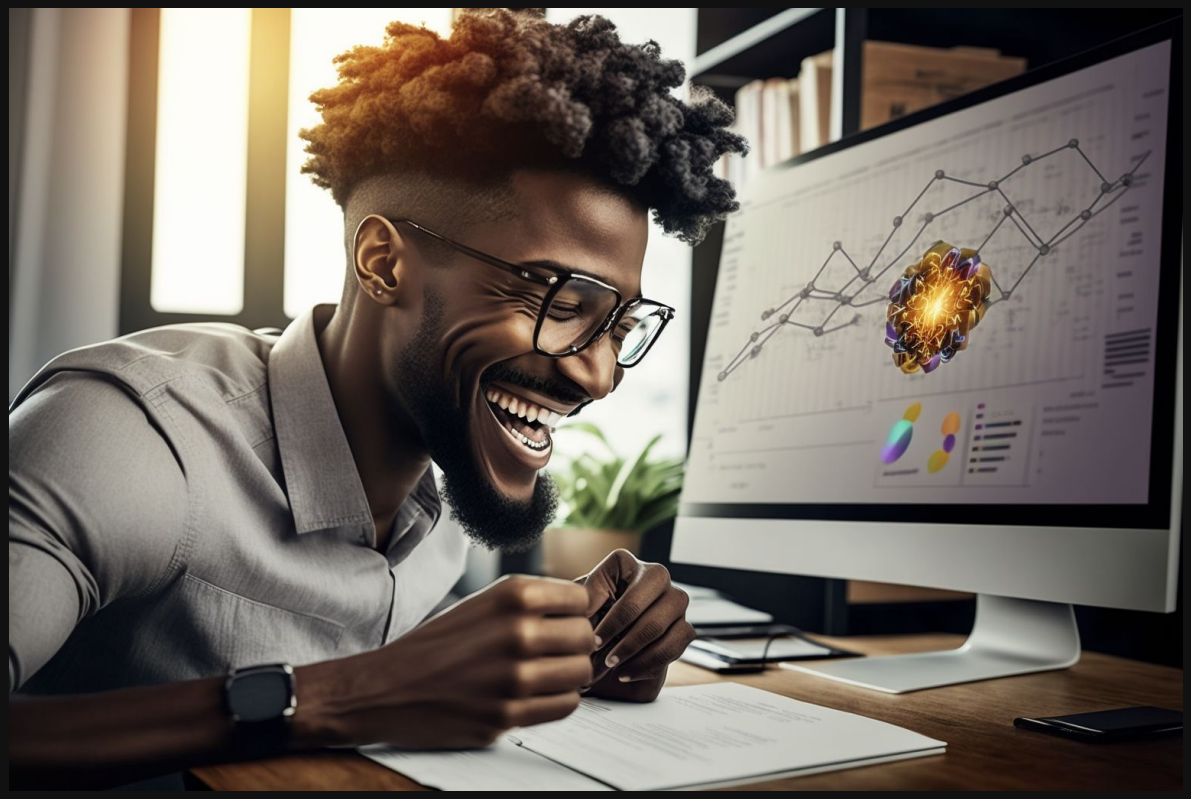
Acquisition functions are like your GPS in the world of Bayesian Optimization.

They help you decide which direction to go in your search for the optimal hyperparameters, based on the knowledge you've acquired so far.

Sergej Stoppel
in/sergej-stoppel

So why do we care?

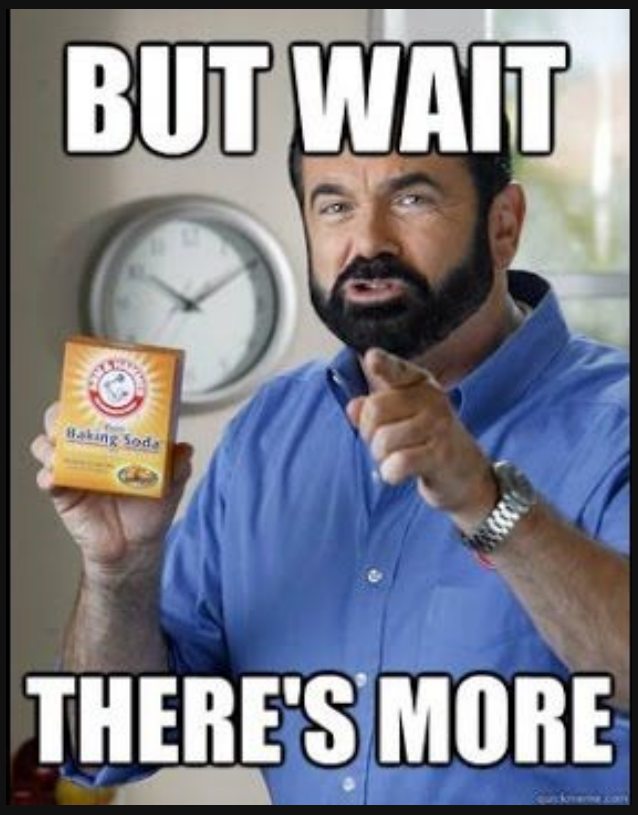
With Bayesian Optimization, you get a smart, efficient way to optimize your model. It requires fewer iterations, can handle noisy data, and might even save you from pulling your hair out.



Sergej Stoppel
in/sergej-stoppel

But Wait, There's More!

Bayesian Optimization isn't a one-trick pony. It can be applied to other optimization problems, like supply chain optimization, drug discovery, and even designing the perfect cupcake recipe.



Sergej Stoppel
in/sergej-stoppel

Keep Calm and Know the Limitations

While Bayesian Optimization has its perks, it's important to remember it's not a cure-all.

For high-dimensional problems, it can slow down, and it might have a tough time with discrete or categorical variables. Just like any method, it has its quirks, but that doesn't mean it's any less lovable.

Sergej Stoppel
in/sergej-stoppel

To overcome Bayesian Optimization's limitations, you can sprinkle in some pixie dust in the form of other techniques, like random search or grid search.

Or, and hold to your seats, just like you optimized the ML models, you can fine-tune Bayesian Optimization itself.

You can optimize the acquisition function or use parallelization to speed things up. Even optimizers need a little love!

Sergej Stoppel
in/sergej-stoppel

In conclusion, Bayesian Optimization is a potent method for tuning hyperparameters, finding balance between exploration and exploitation, and bringing harmony to your machine learning creations.

Now go forth and optimize your models, create world-changing algorithms, and maybe even bake those **perfect cupcakes**.

Happy optimizing!

Remember

1. Bayesian Optimization is a method to tune ML models
2. Gaussian Processes are used to predict how the model will perform under different parameters
3. Bayesian Optimization struggles with large dimensions or discrete data

Feel free to reach out or to connect with me for more weekly slideshows on visualization, data science and machine learning.

If you learned something new today, don't keep it to yourself. Share it with your loved ones, and even your not-so-loved ones...
I won't judge.

Sergej Stoppel
in/sergej-stoppel