# Notes on Bayesian Optimization

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## Introductory Notes

### Black-box Optimization

We have a function which has some optimum we are interested to know about. The problem is that we do not have a direct access to so we have no idea about how this function behaves in the search space. We write this as:

where is a black-box function for which the following is true:

* only the function value can be observed – that is, we can query at some input point ; this implies that we have no direct access to the function gradients
* the evaluation of is expensive – takes substantial amount of time and/or takes substantial computer resources
* the observation typically is noisy – it is corrupted by noise.

Black box,

*, noisy output*

input

## References

[1] [Practical Bayesian Optimization, Danel J. Lizotte, U of Alberta, PhD thesis, 2008](https://github.com/dimitarpg13/probabilistic_machine_learning/blob/main/articles/bayesian_optimization/PracticalBayesianOptimization_lizotte_phd_thesis_2008.pdf)

[2] [A Tutorial on Bayesian Optimization of Expensive Cost Functions, with Application to Active User Modeling and Hierarchical Reinforcement Learning, Eric Brochu, Vlad M. Cora and Nando Freitas, 2010](https://github.com/dimitarpg13/probabilistic_machine_learning/blob/main/articles/bayesian_optimization/A_Tutorial_on_Bayesian_Optimization_of_Expensive_Cost_Functions_Brochu_2010.pdf)

[3] [Taking the Human Out of the Loop: A Review of Bayesian Optimization, B. Shahriari et al, UBC, 2016](https://github.com/dimitarpg13/probabilistic_machine_learning/blob/main/articles/bayesian_optimization/Taking_the_Human_Out_of_the_Loop-A_Review_of_Bayesian_Optimization_Shahriari_UBC_2016.pdf)

[4] [Bayesian optimization and multi-armed bandits, Nando de Freitas, 2013, youtube lecture](https://www.youtube.com/watch?v=vz3D36VXefI)

[5] [Bayesian optimization, Matthew W. Hoffman, DeepMind, UAI 2018, youtube presentation](https://youtu.be/C5nqEHpdyoE?si=qOUBK1ZhG2ih)