**IMPERIAL COLLEGE BUSINESS SCHOOL**

**Professional Certificate in Machine Learning and Artificial Intelligence**

**CAPSTONE PROJECT**

**Reflection on Capstone Project**

While the project achieved its primary goals, there are several areas where improvements I could have been made to enhance the performance and robustness of the optimization process those ideas listed below were not so clear in the beginning of the course however after a couple of months they are much feasible despite my limited time to focus on it.

**Areas for Improvement**

Exploration of Additional Optimization Techniques

While Random Search and Bayesian Optimization with UCB are powerful techniques, incorporating other advanced optimization methods could have provided a more comprehensive comparison and potentially better results. Techniques such as

Enhanced Hyperparameter Tuning.

For Bayesian Optimization, the choice of kernel and its hyperparameters in the Gaussian Process can significantly impact performance. More thorough hyperparameter tuning or even automated tuning using techniques like grid search or random search for hyperparameters could have resulted in better models.

Scalability and Computational Efficiency

Bayesian Optimization, while powerful, can become computationally expensive as the number of dimensions and data points increases. Implementing techniques to reduce computation time, such as sparse Gaussian Processes or using surrogate models, could have made the process more efficient.

Additionally, parallelizing the Random Search method could have saved significant time, especially when dealing with high amount of data.

Improved Visualization and Interpretation

Visualizing the optimization process and results can provide deeper insights into the performance of different methods. Improved visualizations, such as convergence plots, uncertainty visualizations from Gaussian Processes, and comparison plots across different methods, would have added value also.

Robustness and Generalization

Ensuring that the optimization techniques are robust across various types of functions is crucial. Testing the methods on a more diverse set of benchmark functions, including those with different characteristics (e.g., noisy, multi-modal, non-continuous), would have provided a better assessment of their generalization ability.

Conclusion

Reflecting on the capstone project, it is clear that while significant progress was made in optimizing the functions using Random Search and Bayesian Optimization with UCB, there are several avenues for improvement.

By exploring additional optimization techniques, enhancing hyperparameter tuning, improving scalability, adding better visualizations, ensuring robustness, and providing comprehensive documentation, the overall effectiveness and user experience of the project could have been substantially enhanced.